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PREFACE

Dear All,

This symposium is an interdisciplinary and multidisciplinary event and it is the first time organized by the Graduate School of Istanbul Technical University. Despite the first symposium, over 400 manuscripts had been loaded to the system and got chance to be in the program. In my opinion, a new tradition has been started in ITU. As known that Istanbul Technical University, which is approaching its 250th anniversary, is one of the oldest technical universities in the world and the first technical university in Turkey, is identified with its engineering and architectural education.

When we consider graduate education also, ITU is one of the leader universities in Turkey. In Graduate School of ITU we have 76 Departments, Programs; 98 Master, 24 Master (non-thesis) and 71 Doctorate programs, Totally 10443 students that doctorate 3566, master with thesis 6469 and non-thesis 408.

Organizing International Graduate Symposium has been started approximately 10 months before and it was really very hard for us to manage processes related with this event. One of the main problems is to connect and collect different disciplinaries at one symposium. However, one of the main advantages of this multidisciplinary approach is to understanding scientific approaches at different perspectives. I hope researches at different disciplinaries would understand to each other by high level scientific discussion and sharing experiences with information.

During this symposium firstly, I want to thank to Vice Dean of Graduate School, Dr. Ahmet Öztopal for his great effort and devotion to the IGRS'22 and hope this effort will continue in IGRS'23. Additionally, I want to thank to Vice Dean Dr. Burak Kulga, Dr. Burcu Yildiz Ataş and Dr. Abdussamet Subaşı for their support and efforts of organizing the IGRS'22.

I want to thank to keynote speakers Dr. İbrahim Dinçer, Dr. Zekai Şen, Dr. Yusuf Yağcı, Dr. Lisa Gilman and Dr. Fatmagül Berktay to accept our invitation. Also, I want to thank to our participants for their valuable contributions to the symposium. Additionally, I want to thank to chairs of each session to accept our invitation and I know that they would manage each session with their great efforts. Especially, I want to thank to research assistances of Graduate School of ITU; Aycan KIZILKAYA, Bayram ARSLANOĞLU, Berker PANDIR, Erdem ÇİÇEK, Gökhan GÜLER, Güncel Gürsel ARTIKOĞLU, Hande VURAL, Hatice Şeyma SELBESOĞLU, Melek AKIN, Merve AĞAOĞLU, Sena KAYNARKAYA and Sıla Burcu BAŞARIR

Thanks to all participants and my colloquies.

Best Regards,

Ahmet Duran ŞAHİN
Professor,
Dean of Graduate School
Istanbul Technical University

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CONTENTS

AERONAUTICS AND ASTRONAUTICS ENGINEERING

Non-Linear Time Domain System Identification of F-16 Aircraft

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ABSTRACT

The objective of this study is to retrieve the aerodynamic coefficients of an aircraft from given flight data. The time-domain methods are employed to retrieve non-linear aerodynamic models from flight carried out with a closed loop control system. Currently, system identification methods in the frequency domain are widely used. However, these methods are used to retrieve linear models that imitate the aircraft only around a specified trim condition. Moreover, special maneuvers that contain frequency rich data are required. On the other hand, given the rise of high-quality sensors, measurement noise has reduced substantially paving the way for time domain methods to be applicable. Additionally, flight data retrieved from most new aircraft involves a high-level autopilot system. Frequency domain methods generally give poor results since the controller suppresses low frequency excitation. As seen in this study, time domain methods can be applied to solve for non-linear models with flight data retrieved when the autopilot is on.

A complete 6-DOF simulation of the F-16 fighter aircraft is prepared in Simulink. Maneuvers are carried out with the help of an autopilot system and the flight data is recorded. To imitate a real-life scenario, measurement noise, calibration errors and delays are included. Next, time domain output error method is implemented using the appropriate non-linear state and response equations. Finally, the maximum likelihood cost function is minimized using the Gauss-Newton optimization method.

Major findings of the study include:

- When the measurement noise is low, time domain methods (especially output error method) perform quite well.
- It is possible to solve for a non-linear aerodynamic model using the time domain methods.
- Output error method results may be affected if the plant is unstable and works in a closed loop. It is shown that this can be fixed using artificial stabilization.

***Keywords*:** System Identification, Equation Error Method, Output Error Method, Simulation, Aircraft Dynamics.

Effects of Thermal Loading and Material Distribution on the Vibration Characteristics of Rotating Double Tapered Blades

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ABSTRACT

A main concern for helicopter is the vibration effect on helicopter blades during movement. The effect causes reduction in life of components, noise problem and so on. The rotor blade rotation is the major source of the vibration. This paper is aimed to examine effects of thermal loading and material distribution on the vibration characteristics of rotating double tapered blades. To evaluate vibration characteristic accurately, natural vibration frequencies are calculated. Finite element method provides an approximation of the meshed surface, which provides a good approximation for the first natural frequencies. The first three natural frequency values were taken into account to interpret the vibration characteristics. Material properties were constituted depending on modulus of elasticity, thermal expansion parameter, poisson's ratio and density. In the modelling of helicopter blades, Euler-Bernoulli Beam Theory was used. Finite Element Method (FEM) was applied on Euler-Bernoulli Beam Theory, so equations were obtained. While FEM is applying Euler Bernoulli Beam theory, centrifugal force, stiffness and mass matrices were used. The beam theory is stated that the planes, which are perpendicular to the beams neutral axis, maintain their perpendicularity after deformation. The reason of that is the neglection of shear stresses and their displacements during deformation. The computational mathematical software MATLAB has been used to carry out the numerical calculations to examine the free vibration behavior of rotating tapered functionally graded blades under effects of different material distribution and thermal loading. Consequently, the calculation results were compared with open literature. Consistent results were obtained and low deviation rates were observed clearly.

Keywords: Double Tapered Blades, Finite Element Method, Functionally Graded Material, MATLAB, Thermal Loading, Vibration Analysis.

Genetic Algorithm Based Aerodynamic Design Optimization of an Airfoil for Fixed Wing Reconnaissance UAV with XFOIL and MATLAB for Maximum Aerodynamic Efficiency

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ABSTRACT

In this paper, a genetic algorithm based airfoil design is utilized for a 1500-2000 kg class fixed wing reconnaissance MALE (Medium Altitude Long Endurance) type UAV (Unmanned Aerial Vehicle). Due to their mission descriptions, these UAV are generally designed to have long range and high loiter time. For these reasons, an aircraft to be designed for observation purposes must have high aerodynamic efficiency and high fuel load ratios (low empty mass) to maximize the range and loiter time. To achieve high aerodynamic efficiency, these aircraft have high wing span ratios, and their wings contain specially designed airfoils. These airfoils are generally designed to have high lift-drag ratios. On the other hand, due to long wing structures of high-span aircraft, the wings of such aircraft have high bending forces especially during maneuvers. Therefore, design of airfoils of such aircraft have a compromise between fitting the ideal lightweight inner skeleton for the wing and providing ideal aerodynamics. For these reasons, the wing profile located at the root of the wing is generally chosen to be thicker than the profile used at the tips of the same wing. To ease the design process, each airfoil is constructed from two Bezier curves that create top and bottom lines of airfoils. Control points of the Bezier curves are the input of the genetic algorithm program. From sets of control points, the airfoils are created. Then, the airfoils are analyzed in X Foil by the interface of the function made in MATLAB. Then the airfoils that pass the basic requirement are sorted by their maximum lift to drag ratios. The airfoils with higher maximum lift-to-drag ratios are selected for creating the next generation, and the cycle continues. When the maximum number of generations are achieved, the best airfoil of the last generation is selected as winner.

***Keywords*:** Genetic Algorithm, Bezier Curve, Panel Method, XFoil, MATLAB.

Investigation of the Effects of Wing Parameters on Aerodynamic Performance and Stability of a Glider using Response Surface Method

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ABSTRACT

During the design process of a glider, engineers simultaneously deal with different disciplines such as aerodynamic performance, stability, and structural strength. Since the gliders do not have any propulsion system, their lift-to-drag ratio is aimed to be maximized. Wing design parameters such as taper ratio, aspect ratio, sweep angle, and dihedral angle have critical importance on aerodynamic performance and stability of it. This research aims to illustrate the variation of the lift-to-drag ratio, the pitch moment coefficients, and the static margin with the wing design parameters performing response surface analyses. 25 different glider models having the same fuselage but different wing dimensions are modelled in DATCOM+ Pro software to determine the aerodynamic coefficients and the static margin values. Those results are used to construct 3 different response surfaces using the central full composite model in Minitab software. Graphical results of this work not only determine the most effective wing parameters (design variables) on response variables but also clarify whether the relationship between the design variables with the response variables is linear or not. Surface equations that are derived as a result of the analyses can also be used to perform a virtual optimization process that is quite beneficial for designers during the preliminary wing design phase.

***Keywords*:** Glider, Aerodynamic Performance, Stability, Response Surface Method.

Model-Based Design of a Satellite Attitude Control System Using 2 DoF Reaction Wheel Testbed

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ABSTRACT

Attitude determination and control system is one of the most critical subsystems of a spacecraft. It is possible to orient a spacecraft from one point of view to another one by using reaction wheels as an actuator instrument of the attitude control system. In this work, we follow a model-based design procedure for verification of control strategy using a reaction wheel testbed. Model-based design is a method to construct complex control systems that covers design, implementation, and testing procedures. It is a cost and time effective approach besides enables the verification of the control strategy prior to implementation to an embedded controller. We begin to design the reaction wheel actuated control system by using a model-in-the-loop procedure. We construct model-in-the loop system as controller, actuator and plant subsystems. We use set of differential equations in order to model the actuator and plant. We simulate the actuator as a permanent magnet DC motor. We use a reaction wheel taken from 2 degree-of-freedom attitude control testbed (manufactured in model-based design laboratory) and implement the inertia of it into the rotor inertia of the motor. Plant part consists of 1 degree-of-freedom spacecraft dynamics equations. We build a linear controller to compensate the error between input and output angle. Subsequent to verification of the satellite attitude control strategy in computer environment, we execute a processor-in-the loop simulation on a mass-spring-damper system. We use a microcontroller to implement a proportional control strategy and compare model-in-the loop besides the processor-in-the-loop results. We observed that an extra overshoot occurs in processor-in-the-loop simulation compared to model-in-the-loop one, which is interpreted to be arisen from synchronization errors and disturbances in microcontroller hardware.

***Keywords*:** Model-Based Design, Satellite Attitude Control, Reaction Wheel.

Miniature Electrical Propulsion System Design for Cube Satellites

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ABSTRACT

A cube satellite, or cubesat, is a small satellite made up from 10 x 10 x 10 cm sized cubes named units of U for short. Size of a cubesat can range from 1U to 27Us depending on the mission. They have been used for academic and educational purposes since 1999. With the advancements in processor and sensor technologies cubesats are now being used for commercial and scientific missions as well.

They are compact, affordable and easy to launch into space. Drawbacks of CubeSats are limited mass and power budgets for demanding missions. Therefore, till now very few CubeSats with propulsion systems have been launched into space.

Addition of a propulsion system to a cubesat can provide greater mission envelope, precision control for formation flying constellation and extended lifetime of the satellite. A viable propulsion system candidate is an RF ion thruster. RF ion thruster is a type of electric propulsion system. Electric propulsion systems provide greater specific impulse and provide an efficient propulsion capability compared to traditional chemical propulsion systems. However, thrust levels that are provided by electric propulsion are much less than chemical propulsion systems.

Generally, ion thrusters provide highest specific impulse among electric propulsion systems. This aspect of RF ion thrusters make it very appealing to be used in a cubesat where propellant use efficiency is paramount.

In this study an RF ion propulsion system is designed to be used in a cubesat. Theoretical calculations regarding the system is performed. The system is calculated to provide approximately 550 µN of maximum thrust and up to 3300s of specific impulse.

Developed laboratory model of the system consists of a discharge chamber made out of glass, an RF coil to create inductively coupled plasma, a pair of grids, named screen and accelerator grids, to create an electrostatic field that accelerates heavy ions of plasma and relevant structural support elements. In order to create an electrostatic field between grids, one grid is polarized positively and the other is either kept on ground potential or polarized negatively.

Ignition tests are performed at Bogazici University Space Technologies Laboratory (BUSTLab) using Argon propellant. System was put into a vacuum chamber. RF power between 35 to 65 Watts was provided to the RF coils to create a plasma within the discharge chamber. The accelerator and screen grids are polarized at -200V and +600V, respectively in order to accelerate the ions. During experiments accelerated ions are observed as beamlets leaving the thruster through grid apertures.

As future work ion beam current will be measured downstream from the thruster to measure actual thrust provided by the thruster.

***Keywords*:** Cubesats, Electric Propulsion, RF Ion Thruster.

A Study on the Development of Multifunctional Solar Panels for Nano and Micro Satellite

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ABSTRACT

Solar panels are one of the most important subsystems in satellite projects. Considering that solar energy is generally the only energy source after satellites are sent into space, the importance of solar panels can be better understood. The production cost of such a critical subsystem and dependence on foreign sources stand out as factors that slow down the development of satellite technologies. For this reason, a project started in ITU Space Systems Design and Test laboratory in order to gain this subsystem capability and to be this subsystem space-qualified. This article contains the outputs of the design, production, testing and evaluation studies carried out within the scope of this project. In this project, which started with a literature review, experience was gained by conducting solder integration trials with old solar cells after material supply. By examining the connection schemes and circuit protections of the ordered solar cells, an infrastructure was created for the design of printed circuit boards. In this way, a printed circuit board with magnetorquer on it was designed and produced to be used on a 1U cube satellite. Different methods have been tried in the integration of solar cells to solar panels such as soldering, bonding with silver epoxy, joining with cold-weld and bonding with Areldite-2014- 2 brand epoxy. All tests of the produced solar panels were carried out according to ECSS Standards. After the production process, the first tests were carried out known as Suction Test, in which the strength of the solar cells integrated into the solar panels were tested After this test, TVAC tests were carried out to test the compatibility of solar panels with space environmental conditions. After the TVAC tests, the solar panels were subjected to the suction test again and their structural strength was measured.

***Keywords*:** Solar Panel, Cubesat, Nanosat, Solar Cell.

Dynamic and Structural Analysis of Rocket Launch Systems

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ABSTRACT

This study aims to make dynamic and structural analyses of a selected model rocket launch systems developed. After search the open literature in hand, a mechanical model including a rocket launch system positioned on a moving vehicle was established. While creating the mechanical model of the system consisting of chassis, launcher, the launch pad, and rocket, and deformable elements with damped elastic support are used. The mathematical model of the system, which corresponds the physical model based on the movement of auto-crane and telescopic crane shafts, is obtained in terms of two second-order nonlinear and nonhomogeneous differential equations. These equations are derived by using Lagrangian mechanics which is based on mechanical energy balance of the system based on two generalized coordinates. The equations of motion were modelled with SIMULINK software; thus, the first analyses were performed and the impact of the launch on the whole system investigated. In the graphics resulting from the simulation, it has been observed that the deflection at the end of the launch pad is damped as it is expected. Later, the forces acting on the system were found by using the acceleration obtained from the equations of motion, therefore, stress analysis can be made of the system. By using the obtained values, recommendations can be made regarding the design of a rocket launcher system on a moving vehicle.

***Keywords*:** Rocket Launchers, Mathematical Model, Launch Pad, Lagrange Mechanics, Dynamic Analyses.

Artificial Neural Network Approach to Predict the Vibration Responses of Composite Sandwich Plate with a Honeycomb Core

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ABSTRACT

The composite materials and metal alloys have an expensive production and testing process. Development process needs so many specimens and that is a costly. The artificial neural network (ANN) is a system that predicts these test results without physical testing with a high accuracy. To obtain an efficient and a reliable system for predicting mechanical properties by using ANN, training has a vital importance for accuracy and a good training need a huge database. However, creating this database with experimental methods is expensive and needs a long time to obtain results. Instead of using experimental methods, a suitable dataset is created by using finite element analysis. Nevertheless to validate ANN results, there should be a data from experimental cases. In this case, beside of finite element analysis, experimental results are supplied from historical researches for validation of ANN.

In this study, multi-layer perceptron (MLP) architecture with back-propagation error algorithm is utilized in ANN. Multi-layer perceptron is a neural network which contains layers of neurons connected to each other by synapses with weights. Back-propagation error algorithm is chosen because of the high efficiency in multi-layer perceptron.

The aim of the study is to obtain an accurate prediction system which evaluates vibration responses on a composite sandwich plate. The investigation contains modelling of composite sandwich plate and finite element analysis of this plate for creating datasets. These datasets is used for ANN model in training part. After obtaining results from ANN, to understand accuracy of the system, available experimental data in open literature is used for validation.

***Keywords*:** Artificial Neural Network, Vibration Responses, Multi-layer Perceptron, Back-Propagation Algorithm, Finite Element Analysis, Composite Sandwich Structure.

ARCHITECTURE

Architect Perpignani and His Apartment Block in Pera: *Transformation of a Family House in Early Twentieth Century*

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ABSTRACT

In the second half of the nineteenth century, a grand development and change took place in Pera/Beyoğlu where multi-story apartment blocks were constructed on the site of individual one family houses. Perpignani Apartment block, a residential building from the beginning of the twentieth century, is a remarkable example of this change. The designers of the building are Antoine N. Perpignani and Marco G. Langas. Although the construction date of the building is 1904 as inscribed on the façade, archival documents prove the existence, on the same plot, of an older building belonging to the Perpignani family. This building was a smaller one family-house which was damaged by the great 1894 earthquake. Shortly after, it is reconstructed by A. Perpignani, the adjacent plot added and flats enlarged to serve for rental purposes. Perpignani, as the owner of the damaged house was a prominent Levantine architect-conservator of his time who had worked on various historic buildings. The architect re-used some existing walls of the former building with consolidation interventions where necessary. The new building, besides the re-used existing materials and architectural elements, included some novelties and new technologies. Being one of the very early examples of reinforced concrete in Istanbul, the stairs and the slabs were the design of Langas who was the dealer of the French Hennebique System. The eclectic design approach, reflecting the tendency of the period was also clearly shown on the ornamented street façade.

Perpignani Apartment block, currently a six-story block, has been documented in detail and archival research has been conducted to shed light on the history of the building. The results of the study show that important changes have been made by different users until today. Some conservation problems occurred due to these changes and some inappropriate new functions inserted to the flats. The article aims to present an early twentieth century residential building of Beyoğlu, with its architectural features, conservation problems and the architects who designed it.

***Keywords*:** Housing, Pera, Perpignani Apartment Block, Antoine N. Perpignani, Marco G. Langas, Hennebique Concrete System.

Sustainable Adaptive Reuse of Complex Buildings

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ABSTRACT

Sustainable adaptive reuse of cultural and architectural heritage is an important subject for architecture, interior architecture and urban design disciplines in many aspects. Adaptive re-use, as a sub-brunch of conservation, can revitalize existing building and sites without compromising the intrinsic values and contribute to their sustainable uses for shaping future and a good investment for present and future generations. The study focuses on the sustainable adaptive reuse of complex buildings and explores how complex buildings can be transformed for new uses and what strategies for reprogramming and revitalization can be used. Therefore, the aim of the study is to reveal sustainable adaptive reuse strategies for the reprogramming and revitalization of complex buildings. In the theoretical part of the study, adaptive reuse of complex buildings investigated in terms of interiors. Additionally, the eight examples, which contain different buildings in a complex, exemplified both Turkey and abroad. In the study, eight adaptive reuse strategies, which was defined by Graeme Brooker in his book titled "Adaptation Strategies for Interior Architecture and Design", used for analyzing the chosen examples through literature review and on site observation and the classification of the results. The study results reveal the importance of adaptive reuse strategies taking into account the intrinsic characteristics of the past and meeting the needs of today's and future users. It also reveals that the complex buildings have a great importance in the survival of the cultural heritage sites and have an attraction for encountering and using these structures for people. This study will provide benefits methodologically for sustainable adaptive reuse of existing interiors. Furthermore, the sustainable adaptive reuse of existing cultural heritage will also help and support future studies architecturally, aesthetically, symbolically, politically, and economically.

***Keywords*:** Adaptive Reuse, Complex Buildings, Cultural Heritage, Interiors, Sustainability.

Conservation Approaches for Urban and Heritage Values in Kurtuluş (Tatavla)

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ABSTRACT

Tatavla, currently called Kurtuluş, surrounded by Bomonti, Osmanbey, Nişantaşı, Harbiye, Elmadağ, Dolapdere, Beyoğlu, Kasımpaşa, Feriköy districts and historical cemeteries. It is also called "Little Athens" with its churches, tombs, schools, theaters, charity associations, sports clubs, bath, fairs, taverns, important professionals and 500-year carnival, which is famous even abroad, whose origins are based on the Venice and Rio carnival.

Tatavla, which dates back to the time of Suleiman the Magnificent, became an autonomous region where only Greek-Orthodox people are allowed to live in cosmopolitan Istanbul in which all nations lived together thanks to an edict in 1793. Therefore, Tatavla entered the 20th century after Pera as a district where the most people of Greek origin lived among other districts of Istanbul.

Tatavla had a low-rise wooden construction that developed in organic texture in the 19th century. Due to natural disasters, the district entered the first quarter of the 20th century with a new urban texture that developed with a regular and gridal system around Kurtuluş (Tatavla) Street, which is the main artery. This texture, most of which has survived to the present day, consists of masonry and multi-story apartments which were built with Neo-Classicism, Art-Nouveau movements and Art-Deco architectural style.

Kurtuluş (Tatavla) District has also reached the present day with interventions, annexes and unqualified constructions that have damaged historical urban tissue with the pressure of change and transformation. The district that reflects the urban, historical, social and cultural texture of the 19th and 20th century will be destroy by transformation if no regulations planned.

The construction of new buildings in place of historical buildings, the need for functions such as a social center, neighborhood library, student dormitory to support the development of the district, the existence of buildings that need to be restored in an idle state, the desire to continue the Tatavla Carnival in accordance with the traditions, and the implementation of the "Harita Tatavla" online project with conservation plan outputs in order to make all values visible as a result of the great sensitivity of civil society in the district reveal the importance of this conservation plan to protect whole tangible and intangible cultural heritage and supply all needs of the district mentioned above.

Therefore, urban conservation for Kurtuluş (Tatavla) District aims to rehabilitation with conservation principles, revival with continuous usage and transferring to the future by adapting to technology.

Keywords: 19th Century, 20th Century, Historical Urban Conservation, Greek Culture, Tangible and Intangible Cultural Heritage, Physical and Social Development.

A Multi-Layered Settlements and Conservation Problems in the Cappadocia Region: *The Case of Ürgüp-Akköy Village*

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ABSTRACT

The conservation problem of the multi-layered settlements in Turkey is one of the widely discussed issues within the scope of conservation planning approaches in Turkey. The lack of legal instruments to define and protect the multi-layered settlement structure along with the lack of planning approaches specialized for those features deepened the problems. Cappadocia defines wide geography and represents integrity and originality with its natural, cultural and archaeological values including the UNESCO World Heritage Site. With the combination of these different values, the region also has a very rich rural landscape character with its rural life practices. The main problem of the area is that there are no concrete legal documents that regulate the property relations in multi-layered settlements, so there are representation problems of the vernacular architecture in the region, hence, more holistic planning approaches should be applied to those settlements. Geographical Information Systems (GIS) is widely used to improve a database and represent the data at different levels. Besides that, photogrammetrical applications are highly used in heritage conservation projects both the building scale and site. The aim of the study is to improve conservation planning approaches by developing a system on GIS that works with multi-layered settlements on the Cappadocian scale and implementing underground map production to join the different levels of the heritage by laser scanning. With this study, a new model for the analysis, interpretation and management methods for the multi-layered settlements will be developed for the Cappadocian region in general by mainly focusing on Akköy village in Ürgüp. Furthermore, the rural characteristics of the area, especially, its vernacular architecture and monumental buildings will be analyzed and documented. As a result of this study, the characteristics of the settlement and the problems of the multi-layered settlements will be detected and more site-specific solutions will be presented.

***Keywords*:** Cappadocia, Rock-Cut Buildings, Multi-Layered Settlements, Rural Landscape, 3D Cadastral Mapping, GIS.

The Impact of Tourism in Historical Sites of Turkey

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ABSTRACT

Tourism makes great contributions to the economies of countries and affects societies with its various dimensions. With the realization of the economic benefits of the tourism sector, the countries that want to get the highest share from it, have tried to develop tourism and increase the number of tourists.

Despite the economic difficulties encountered in the preservation of historical sites, tourism can be one of the most important tools in the preservation of cultural heritage with its economic gains. On the other hand, the rapid and unplanned development of tourism in a historical site causes the loss of natural and cultural heritage.

The growth in the tourism sector in Turkey, which started in the 1960s, entered a breaking point in the 1980s as a result of government policies, and caused the development of intense tourism in a narrow coastal band. These coastal sites with different qualities such as urban, archaeological and natural sites have begun to lose their integrity by losing their original values due to effects such as rapid urbanization as a result of tourism.

In this study, which is based on the doctoral thesis prepared in the department of restoration, it is aimed to discuss the importance of the balance between preservation and tourism through the study areas selected from Turkey and to point out the importance of maintaining this balance especially in the historical sites where tourism is developing rapidly.

Since the study focuses on the impact of tourism in historical sites, the cultural, social and economic change that the study areas have undergone under the influence of tourism has been examined as a method.

Although the work carried out was prepared in the field of restoration, it will have a great contribution that spreads widely to the other fields of architecture such as design and other disciplines such as tourism and environmental protection.

***Keywords*:** Preservation, Tourism, Historical Site.

Biobased Filament Production for 3D Printing of Bacterial Cellulose-based Composites

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ABSTRACT

3D printing with biobased materials was investigated through the case study of bacterial cellulose, as a promising substitute for petroleum-based materials. In order to minimize the negative repercussions of the Anthropocene. Bacterial cellulose has a robust nano-fibril structure that enables interfacial bonding for adhesion to plant cellulose-based structures, and it has the ability to develop on the surfaces of a specified form in relation to its inherent, but controlled bio-intelligence, according to previous investigations in the literature. This study investigates bacterial cellulose-based composites through a process involving three specific, yet interconnected, phases: 1. 3D modeling; 2. Printable biobased composite formulation; 3. 3D printing. The results have demonstrated that the bonding of bacterial cellulose with plant-based cellulose fibers of jute yarns significantly increased the tensile strength, whereas pure bacterial cellulose losts its tensile strength when the moisture content was removed, which leaves it sensitive to compression pressures and even its own weight. Since the final forms were produced from a biobased substance, the biodegradation process also enables us to elaborate on the fourth dimension: Time, through which the research findings could further establish a bio-upcycling process of wastes towards biosynthesis of valuable products. Furthermore, the development of a bacterial cellulose-based filament reveals a practically feasible next step in the development of multi-resolution interpretations on the growth of habitable living structures that could augment the interplay between nature and architecture in sustainable and revolutionary ways.

***Keywords*:** Bacterial Cellulose, Biocomposite, Digital Fabrication, 3D Printing.

Improvement Insulation Aspects of Glass Reinforced Concrete (GRC) Panels by Using Phase Change Materials

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ABSTRACT

New fabrication techniques and modern improvements in the field of building construction have led to reduced build time and cost for residential and commercial buildings. However, these technologies further resulted in lightweight structures and construction materials with low thermal mass, and attention has been increased to indoor thermal comfort due to degraded thermal storage potential.

This lack of thermal mass combined with dynamic thermal excitations (climate-and internal load-based) results in an inability to decrease dynamic thermal loads, leading to large diurnal indoor air temperature fluctuations and heat conductivity increases, accompanied by increased space-conditioning energy consumption.

Because of the latent heat storage features of Phase change materials, they can store energy and regulate temperature by heat conductivity decreases in the system and play the role of a barrier or insulator.

Due to the most energy losses occur from building envelops especially facades and according to the current mentioned aspects, this project was developed to provide comfortable conditions for indoor areas. The current research was carried out with the support and cooperation of industry and academics. For experiments, phase change material (PCM) was added to glass-reinforced concrete (GRC) facade panels. Knowing that in different climates, facades are designed with special and different specifications, the common point of all is to provide comfortable conditions for residents.

Based on the information obtained from the experiments, the expected efficiency in decreasing the thermal conductivity coefficient was realized by using phase change material in GRC mortar. The increase in efficiency was proportional to the use of PCM at a higher rate in the main mortar. However, regarding the amount of PCM used, as the use of PCM increases, the density and compressive strength of the composite material decreases. Therefore, the PCM ratio should be determined by considering the physical properties and thermal conductivity value expected from the composite material.

Keywords: Heat Conductivity, Energy Storage, Concrete Panels, Phase Change Material (PCM), Glass Reinforced Concrete (GRC).

Linguistic Representation and Architectural Terminology: *A study based on the examination of the Arkitekt Journal*

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ABSTRACT

Language, a communication tool that changes and develops with people, is an ancient phenomenon that evolves over time. This process can be traced largely in the field of architecture. It can be said that there is a cycle in which the development of architectural terminology is fed on language and then architectural terminology itself contributes to language by giving back to it. Decoding the historical path of this cycle is one of the main motivations of the work. The paper explores the intersection of body and architecture through a linguistic frame and aims at questioning or revealing the richness of language through architecture by tracing the body analogies in architectural theory and practice. Exposing the extent to which architectural practice makes use of language offers a new perspective on the representations of architecture since body and language appear as leading terms that often participate separately in discussions of architectural theory. This study focuses on the projection of the areas of these main notions' intersection and the relationships between words and architectural concepts. In the scope of the research, how language is discussed with auxiliary theories is handled both historically and relationally. As a part of the research, the expressions that are borrowed from human life, especially the human body, are gathered to generate a vocabulary. This vocabulary contains anthropic words that are also in the everyday jargon of architectural production and theory. The research aims to provide an insight into the language-architecture relationship through a narrowed vocabulary and to produce a new perspective of the architectural representation. To find the words that are borrowed from the body, the journal Arkitekt, a science and art publication, has been used as a historical base. This reading is essential for the identification of the words that started to infiltrate the architectural theory after the Republic. By following the chronology of the architectural history literature through Arkitekt, clues about the words first emergence are also revealed.

***Keywords*:** Linguistics, Architectural Terminology, Body Analogies, Translation.

Exploring the New Materiality at the Intersection of the Vernacular Tectonics - Contemporary Architecture - *Examples from the Aegean Region*

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ABSTRACT

This paper presents a critical evaluation of new materiality in the context of vernacular architectonics within the framework of the concept of belonging to the place, and provides an understanding of the relationship between the contemporary structures and local construction methods through the concepts of critical regionalism which is defined as aspects that give a sense of belonging, cultural identity, conformity with place and environment (Anderson & Al-Bader, 2006). Therefore, regionalism is a set of strategies applied by optional shaping of solutions, methods, designs and criteria that respond to local conditions and needs defined by Tzonis, Lefaivre and Frampton. In this study, the transition in-between the vernacular tectonics and contemporary buildings are analyzed to clarify the construction methods and local relations. The research design employs a multiple case-study method that is further structured for architectural research in the context and includes a thorough literature survey for vernacular architecture and critical regionalism in order to lay the foundation for such arguments about the subject matter. Case study buildings are selected from the Turkish Riviera particularly Aegean region. The selected buildings are studied in detail according to their architectonic content including materiality, structural systems, vernacular references, spatial layout, landscape integration and holistic design approach. The results provide a comprehensive insight to the knowledge of the modern design and construction approaches with a strong reference to the vernacular genetics of the place.

***Keywords*:** Vernacular Tectonics, Genetics of The Place, New Materiality, Aegean Contemporary Architecture.

References

Anderson, R., & Al-Bader, J. (2006). Recent Kuwaiti architecture: Regionalism vs. globalization. Journal of Architectural and Planning Research.

Frampton K., (1983) Towards a Critical Regionalism. Six Points for an Architecture of Resistance.

Tzonis, A. and Lefaivre, L. (2003). Critical Regionalism. Architecture and Identity in a Globalized World.

Honestly Visible, Visibly Honest: *Problematizing Pugin's Technologies of Architectural Authenticity*

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ABSTRACT

From his self-published "Contrasts" to "Present State of Ecclestical Architecture in England", Augustus Pugin's discussion on structural honesty of Gothic Architecture is influential and rather has a well-established place in histories of modern architecture. Pugin narrated, etched and thoroughly illustrated a conception of European Gothic that expressed the plain structural essence of building. For Pugin, this expression was in perfect accordance with the Catholic virtue of honesty; and the "decayed" state of 19th century architecture was simply a result of larger political problems England had to endure since the reign of Edward VIII.

As this particular moral theme, honest expression of an essence, although secularized, had been an integral part of legitimating arguments for modern architecture in the early 20th century, Pugin's account is remarked by numerous critical histories that dealt with the concept of truth in architecture. Pugin's conception of an architecture that is true to its own self in essence hits the same notes that call of authenticity hits. Authenticity, simply meaning being true to one's own self, was a concept that was increasingly gaining moral weight beginning from the 18th century and onwards. Pugin, as many other theorists of the 19th century, dreamt of a return to a golden age, a primordial state in which the practice of architecture was not corrupted by the societal desire to appear as something other than itself.

This study aims to revisit Pugin's illustrated writings from a media-theoretical perspective. As Friedrich Kittler's media analysis suggests, how a given culture selects, stores and transmits relevant information is a crucial part of knowledge-production. Thus the study problematizes Pugin's conception of honest expression as a visual phenomenon. Pugin, using representation techniques via various media technologies, transforms the ancient virtue of honesty to something that can be textually and visually represented and contrasted with other phenomena. The study attempts to provide novel critical knowledge on how, even the moral concepts, became an integral component of larger media systems.

***Keywords*:** Authenticity, Media, Augustus Pugin, Honest Expression, Morality.

Architecture for Nobody

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ABSTRACT

The search for the ideal body was brought to life by the Vitruvian Man, who subjected the body to certain proportions, and was redefined by modernism and The Modulor's standardization. The standardized ideal body and the products designed for it, as well as the rules governing the design of these products, have all had an impact on the field of architecture. Architecture has come to life with the understanding that a 'appropriate' composition must be produced within this set of standardized rules and proportions from the second half of the twentieth century until this time. Architectural space, shaped by window openings, floor heights, stair heights, and so on in specific proportions, aims to allow the body to perform specific movements and actions within the space. And this process requires the necessity of having a 'ideal' body. The body (non-ideal body/other body) that is unable to perform the spatial practices dictated by space within the set of rules is excluded and marginalized as the "other".

In this context, the research focuses on the alienation of space, which is standardized over the ideal body, to bodies that are unable to realize these spatial experiences. It searches ways to extend the potentials of the standard space established on the ideal body and tries to rethink on it taking the "architecture for nobody" approach in consideration. It reveals this approach as a tactic that establishes space through "otherness" and tends to disrupt the familiar architectural practice taking the discussion on hand in a theoretical framework defined by the concepts of Human Space by Bollnow and Architectural Body by Arakawa & Gins. It focuses on spatial practices that have the potential to be architecture for nobody and investigates selected spatial practices through the lens of the concept of otherness.

By doing so, the study intends to raise awareness about what kinds of alternative perspectives can be developed on an architectural practice that dictates, excludes, and establishes otherness, as well as to look for ways to make it more inclusive.

***Keywords*:** Standardization, Otherness, Body and Space.

Rescaling the (Lost) Bodies in Architectural Space: *Alice in Wonderland Syndrome*

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ABSTRACT

This paper focuses on atypical forms of spatial perception. Starting from this, "scale" in architecture is aimed to reconsider through "Alice in Wonderland Syndrome" which is a rare neurological disorder that causes perceptual distortion of space, time, and body form/proportions. Alice in Wonderland Syndrome (AIWS) provides unexpected scale transitions in spatial experience and establishes unique scalar relationships with the surroundings. In this way, it is intended to question the understanding of architectural space shaped by norms and standards via unpredictable perceptual experiences in the "designed" space. Despite the long history of the human body-oriented ideal design notion and the limited "body" with generalized and reductionist proportions, the non-constant role of the "subject" of architecture is emphasized.

The symptoms of AIWS are listed as distortions of bodily sensation, visual distortions, time distortions, distorted feelings of reality, and illusory feelings of levitation (Blom, 2020, p.39). Benefit by these symptoms as strategies for different kinds of measurement, it is believed that the parameters of "scale" which is an important tool in spatial design can be changed. Within the scope of this research, National Reinsurance Headquarters which has scale transitions has been re-experienced in two stages. At first, the routes with dramatic scale transitions in the building are chosen and diagrammatized to demonstrate the body's position and feeling in this route. Second, the routes with more stable scale transitions in the building are chosen and diagrammatized again. In addition, the building is re-experienced empathically just as looking through a cylindrical lens in a twisted, warped, contorted manner like people with AIWS to speculate about changing of scale transition and spatial perception. Within the framework of this research, the non-ideal bodies in mind with AIWS are considered as lost bodies in architectural space. It is believed that these hidden bodies become visible in the place via scale transitions. The body is in dialogue with constantly changing grounds and ceilings in the gaps with different dimensions in this building. So, the body forgets its actual dimension and becomes free by eliminating its linear boundaries and establishing more relationships with space.

During the design process, architects have several tools for reducing the scale difference between their bodies belonging to the real world's scale and the model's scale, which is called as "Gulliver Gap" in architectural theory. As a result, it is believed that such dynamic bodily perception creating/reducing a "Gulliver Gap" can be used as an alternative experimental tool in spatial research. Thus, new spatial understandings can be discovered.

***Keywords*:** Spatial Reality, Scale, Measurement, Representation, Alice in Wonderland Syndrome.

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Reference

Blom, J. D. (2020). Alice in Wonderland Syndrome. NY: Springer.

An Assessment on the Corridor in Unit Housing Planning

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ABSTRACT

Corridor, which is the French word *"cours"*, which means *"flow, course, route, going, process"* in the origin of the word, is defined as a "narrow, long passage" in the common opinion. This study intends to bring forward the corridors, which is one of the fundamental elements of architecture in architectural practice, into question on today's concepts and discussion axis through local examples. The study is concerned with the situation of the corridor which is usually a dim space of one meter in width in Turkish architectural practice, transformed into a commodity within the circulation discussions in housing production and defined over square meters and the experience of spatiality established in the housing through the corridor. From this point of view, research and studies will be carried out on the theoretical plane and examples to identify the issues that are discussed and not discussed in unit housing planning in current architectural practice in Turkey and to include critical approaches to reach more diversified units housing planning and living spaces. Within the scope of the study, the potential of the corridor, which establishes purposeful connections, is explored through the housing units. The research is embodied by employing the multiple case study method, which examines the corridor in the housing unit through the plan drawings as its emphasis on the horizontal aspects and its abstract constructs. The discussion, enlarged by the resulting findings, is a spontaneous and concrete answer to why it is important to discuss the corridor space in the housing unit.

***Keywords*:** Corridor, Circulation, Housing Unit, Turkey Architecture.

The Taxonomy of Computational Precedent Analysis Tools

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ABSTRACT

In the early stages of architectural design, the designer makes use of precedent analysis in order to master the project and they can use design memory to find several solutions for their own design problems. Precedent analysis is used to see responses to similar design problems and to examine different approaches that are applied by another designer to the same problem. Approaching the design problem by analyzing previously designed projects will provide an important information pool for the designer and may become a guide. Also, displaying the current studies in a computer-aided approach will save time, and will enable designers to reach relevant solutions. However, the current studies in this field are limited. Within the scope of this study, a new perspective is provided to the existing computational precedent analysis tools due to the importance of precedent analysis in architectural design. This paper aims to review existing computational analysis tools designed after 1990, to see the current situation of these tools. By searching 3 different databases with related keywords; 99 studies are reached and 27 of them are found suitable for the scope of this research by examining all the results. A comprehensive review of 27 computational precedent analysis tools is conducted. Existing tools are classified in general headings and their analysis criteria are discussed in detail. These different approaches are discussed with their advantages and disadvantages. The current situation in the literature-evaluated, and deficiencies are determined within the framework of today's possibilities in terms of computation and information technologies. In the light of this information, possible future studies are discussed.

***Keywords*:** Precedent Analysis Tool, Precedent Based Design, Case Based Design.

Expansive Immersive Environments: *A Comparative Study between Architecture and Digital Games*

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ABSTRACT

Creating mediums that respond to the anticipated movements of users and thereby increase interaction potential via these spaces is the common purpose of both architecture and games. Those two phenomena have always influenced each other and evolved after the close design approach. As a result, the interaction between these two actions has shaped the built environment. Along with the modern era, the praxis of architecture in a western way has evolved to concentrate on result-oriented, close-ended, singular designs. Nonetheless, in the praxis of the game, the emphasis has always been on the players and their interactions with others. In the digital era, one could assume that reconnecting these two praxes would generate creative insights into space and the body. By examining digital games and architecture in the context of shared experiences, the study aims to question the possibility of comparative research between contemporary architecture and digital games through the agential structure. Research suggests that re-examining digital games with a spatial point of view has the potential to look at those practices from an outsider's perspective. Both games and buildings, as creators of immersive environments that expand based on the player's participation, share characteristics in narration/functionality and actual/interpretive dichotomies within the contexts of exploration and psychological reflection, respectively. This study is an attempt to illustrate that thinking through a comparative study in the context of actual mechanical, actual fictional, interpretive mechanical, and interpretive fictional situations between architecture and digital games. It tries to demonstrate situations of spatial agency through readings on building-game dualities such as Modern Architecture-Action Games, Postmodern Architecture-Narrative Games. The research methodology in this study is logical argumentation, which is applied to the architecture literature using ludic concepts. Finally, as an alternative approach to the spatial, ludic spaces, which are ephemeral environments that mediate cognitive senses and where bodies have appropriated the space, have been proposed. Within that perspective, bodies may feel more responsible for their environments, and the tendency toward status-quo design methodologies based on form-narrative hybridization could be overcome in one respect.

***Keywords*:** Architectural Theory, Digital Games, Game Concept, Architectural Design, Design-User Interaction, Ludic Spaces.

"A New Form of Architectural Media": *The Discourse of ANY, 1993-2000*

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ABSTRACT

An editorial manifesto titled 'Dear Reader' was published in the first issue of ANY, 'No. 0: Writing in Architecture' in May/June 1993. In this text, the periodical's editor Cynthia Davidson argued that ANY is "a new form of architectural media" that refer the periodical's form, format, and content. The last issue of the following eight years of publication that is titled 'No. 27: Being and Nothingness,' was published in 2000. "Planned ending" of the periodical was explained with "everything is connected to everything" statement, which points out the links between the discussions within the architectural media, carried by the editorial text titled 'Dear Reader,' written by Davidson.

This study analyzes ANY's editorial policies starting from 1993 and ending in 2000, the period when it was published. During these eight years, ANY's editors conceived the magazine as a "new form of architectural media." One important aspect of this "new form" was the use of the tabloid format and its appearance as a visually rich newspaper of architectural history, theory, and criticism. During the magazine's active years, the editorial board included well-known architects like Greg Lynn, Rem Koolhaas, and Tadao Ando together with authors like John Rajchman, Sanford Kwinter, and Robert E. Somol known for their work in theory. The scope of this "new form", however, was much broader than that: The post-1968 architectural media from Oppositions: Journal for Ideas and Criticism in Architecture (1973-1984), which symbolizes critical architectural theory, to PRAXIS: a journal of writing + building (1999-2019), that symbolizes the post-critical arguments and the end of critical architectural theory, signalizes a historical transformation. In that transformation, referring to Davidson's argument, everything was connected to everything in terms of the themes, the authors, the ideas, and the ongoing discussions. Within the continuity in the post-1968 architectural media, ANY was carrying the signs of the transformation from critical architectural theory to the post-critical arguments. Editorial policies included the representatives of both positions, critical theorists and practice-oriented authors, in the periodical, consolidating the periodical's betweenness.

By analyzing the dialogues between editorial texts written by Davidson, issue editors, and editorial board members, and debates on which these dialogues are based, I aim to clarify the complex position that ANY Magazine occupies within the wider territory of post-1968 architectural media.

***Keywords*:** Post-1968 Architectural Media, Critical History and Theory, Post-Critic, Continuity, Transformation, Betweenness.

Building Product Selection in the Context of Life Cycle Assessment (LCA) with Digital Design Tools: *The Case of One Click LCA*

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ABSTRACT

The building meets the needs of its users through the features of the building products that made up with. Technological and economic developments resulting from industrialization have led to changes in user needs. Building product decisions made in the past in line with experience and tradition; It has become a challenging process for the user due to reasons such as new production techniques, the emergence of many construction products of different quality and quantity. Since each building product has different environmental effects, choosing the right product is becoming increasingly important in terms of sustainability. A wrong product decision harms the environment and human health.

Building products are directly or indirectly in interaction with environment during a cycle that includes processes like; raw materials extraction, production, application, usage and end of the lifetime, recycle or disposal. Life Cycle Assessment (LCA) is a method to present the environmental impacts of buildings and building products in these circular processes. In this context, environmentally friendly building product selections can be made based on LCA.

A variety of methodologies and tools have been developed to optimize LCA-based product selection, helping designers make objective decisions about product selection. Design and product selection based on LCA, which are carried out with traditional tools, are made with digital design tools with the developing technologies today.

Digital design tools; based on traditional understandings of design, they can help the designer to create different ideas. They provide an environment and opportunity for the design action that cannot be done with traditional methods or can produce solutions in a short time. With the help of digital design tools, it has become possible to develop new and free virtual forms, easily integrate and simulate technical issues such as LCA into the design. One Click LCA, developed by Bionova, is one of these digital tools that can be used in building product selection in the context of LCA.

The aim of the study is to introduce digital design tools that can be used in LCA-based product selection in environmentally friendly building design, to show an understandable and practical way. The study will examine the LCA-based product selection in One Click LCA, which can be integrated into digital design tools. This examination is important in terms of making environmentally friendly designs, increasing the knowledge and awareness of designers/decision makers on sustainability, and contributing to the economy with the correct use of resources.

***Keywords*:** Building Product Selection, Life Cycle Assessment, LCA, Digital Design Tools, LCA-Based Building Product Selection, One Click LCA.

Function of Illusions in Architecture: *The Case of Design's Ability to Predict*

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ABSTRACT

In architecture, designs rarely unfold as expected. This is so obvious that it hardly requires mentioning. Considering, however, the fact that architect's engagement with buildings relies heavily on design's ability to predict, this naive observation suddenly presents itself as a significant obstacle. Or at least it should. But despite the obvious evidence to the contrary, the belief in an uninterrupted flow from design to building is maintained.

The primary aim of this paper is to explore some of the implications of this situation in which the belief in design's ability to predict and knowledge that reveals this to be an illusion coexist. As a base for this exploration, philosopher and cultural theorist Robert Pfaller's discussions about this type of illusions provide us here with a suitable framework. Some aspects of his arguments have important implications for us. Firstly, it turns out that the common assumption that illusions could be dispelled through better knowledge isn't true in every case. Especially those illusions that produce pleasure not only aren't affected, but on the contrary are strengthened by that knowledge. This seems to indicate that the pleasure an architect derives from their work to a certain extent may depend on their ability to somehow maintain an illusion of this kind. Secondly, culture has a tendency towards pushing these pleasure producing illusions out. This seems to be mirrored in architecture by the rising number of discussions about authorship which to a large extent depends on the illusion in question. And if the first point is valid, then these discussions might end up having the unintended consequence of diminishing the pleasure gained from work.

Put together, the resulting picture shows that in certain cases where better knowledge is present and acknowledged, illusions, far from being harmful, might become assets, and the criticism directed at them might turn out to be the obstacle instead.

Keywords: Illusions, Pleasure (Architect), Authorship, Architectural Design.

Essayistic Reading of Place: *Architectural Essay Film*

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ABSTRACT

Interdisciplinary intersections have the potential to open up a creative space to produce new meanings and associations. Suggesting an interdisciplinary model in architectural design research can provide an environment to produce complex research forms that are both self-reflective and propositional. In this context, representations methods can be diversified through various disciplines' conceptual logic and their intervals.

This study aims to research an inclusive reading practice about place by using the coexistence of different disciplines. It uses the architectural essay film, which is defined as a sub-genre of essay films, as a method. Essay film is a critical, original and hybrid genre that has come to the fore in recent years in cinema studies. It incorporates each of the disciplines such as literature, cinema, and photography. In the essay film, the boundaries between these disciplines are quite vague and intertwined. The essay film serves as a lens to understand and feel the place in its multiple aspects. It tries to open up contemporary discussions in place-reading by using different tactics. In this study, it is aimed to investigate the potentials of visual, auditory, and sensory representation of place, time, and landscape in the context of essayistic thinking.

The research questions can be grasped by the following questions. What kind of pattern can be found in the reading of place in architectural essay films? How are place and publicity represented in architectural essay films? Is it possible to form a basis for an alternative place-reading method? Is it possible to map these findings? What happens when we combine essayistic thinking with architecture? In order to search for answers, it is planned to map the patterns of time and place in architectural essay films. Determining the tools of the essay film by mapping the tactics constitutes the methodology of the study.

***Keywords*:** Interdisciplinarity, Architectural Representation, Essay Film, Essayistic Idea, Place-Reading.

Avant-Garde Readings in Everyday Life

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ABSTRACT

The scope of the work consists of evaluating a daily event, occupation or attitude within the ideology of avant-garde. The purpose of doing this is to demonstrate that the avant-garde' ongoing effort since the 20th century continues its aim today. "Through the commercial mechanisms that control cultural activity, avant-garde tendencies are cut off from the constituencies that might support them, constituencies that are always limited by the entirety of social conditions.'' (Debord, 1967)

The idea that the avant-garde is in a delimited relationship with the society and exists in a separate group has been dominant. Eventually, the work will be associated with everyday life rather than an avant-garde art environment dedicated to capital. In this respect; art will be evaluated through examples where it can be defined without being bounded by certain institutional frameworks. The examples can be considered as the situations where avant-garde(art) may exist in life without the boundaries it establishes with society.

Scanning to be carried out in this framework; is the discovery of various tactical ways that art follows in order to exist in its sensible shared form. Examples will be in a common denominator that responds to creative solutions to political, social or individual problems. Those can be read as a strategy to find a solution against the ideologies dominated by the neoliberal economy. In this context, art, life, politics and their relations with each other will be discussed within the framework of different situations of everyday life. It is aimed to present an inference that the avant-garde continues in daily occupations, attitudes and actions; socially or individually.

***Keywords*:** Avant-Garde (Art), Everyday Life, Social Movements, Individual Pursuits.

Community-Making: *Pop Imagination and Transformative Ballroom*

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ABSTRACT

This paper investigates how a group of queer performers in Istanbul created a robust community out of a recurrent nighttime entertainment event. I have been embedded in the community around the event series *Dudakların Cengi* for an ethnographic fieldwork. I have conducted participant observations, in-depth-interviews, and requested written narratives from the participants. Findings from the qualitative analysis of the social phenomena as narrated by the participants and fieldnotes show a multitude of relations between people and how they make sense of the community and the event.

People who perform at these events initially come together around a need for a platform for self-expression that is inclusive and accessible. They share a common pop imagery driven by an idea of fame, inspiration and shimmering art that creates a self-referencing world of meaning-making. Mainstream drag shows are secluded to either an expensive and socially intimidating club scene that is unaffordable to many, or to a competition show format that leaves many out. These clubs and competitions promote a standardized mode of show that is repetitive, provide exposure to only those performers who satisfy certain norms, and pit performers against each other. Whereas the community around Dudakların Cengi reformulates these in a non- competitive environment, employs an amateur aesthetics, and prioritizes engagement in modes of solidarity. The community's alternative positioning increases in-group socialization. This shifts the performers' attention from audience-pleasing towards community-building.

The unique mode of socialization constitute a local variation in Istanbul to the concept of ballroom that enables and transforms its participants. This reinforces the function of such ballroom organizing away from the sole domain of entertainment and work opportunity, and towards a mode of community-making that revolves around transformative imaginations.

***Keywords*:** Ethnography, Community, Queer, Performance Art, Ballroom, Imagination.

"Reception Days" as a Domestic Practices in the 1980s: *Objects, Stages, Signs*

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ABSTRACT

The 1980s, when the meaning and image of the house irreversibly changed, is positioned as a critical threshold within the scope of the study. Using the 1980s period as a tool to comprehend both the symbolic values attributed to the home and spatial organizations together with social processes becomes meaningful as it has the potential to develop a critical view of today's domestic life.

In the 1980s, as a result of the decrease in public space activities, interior spaces came to the fore. The popular media, whose sphere of influence has expanded considerably, has formed the basis for the visibility of home life. In this context, the home whose meaning has changed has become a showcase where consumption habits can be read and a stage where social conflicts can be analyzed. Within the scope of the study, among the issues that brought the concept of home to the agenda as spatial quality, an indicator tool, or a metaphorical ground, those that were most discussed in the 1980s media are examined. Then, the socially constructed house phenomenon and " *performing* " and "*watching*" as prominent concepts of the period, are examined through the ritual "Reception Day" (*Kabul Günü*) event in those years.

The method of the study was shaped around grounded theory and content analysis was technically applied. In this context, a comprehensive survey of the 1980s media was made and the newspapers, magazines, and movies of the period were reviewed. Selected movie footage, news clippings, and advertisement images were read by correlating each other. The concepts filtered from these sources shaped the content and fiction of the study and fed the discussions directly. The function of the house as a representation tool and ground makes it possible to decipher the system of signs and social meanings it contains.

The study aims to analyze the construction of new arrangements and interpretations of space together with social conflicts. It emphasizes the effect of the concepts highlighted by the public discourse in the home space and reveals the multi-layered structure of the parameters that make the home into existence.

***Keywords*:** "Reception Day", The 1980s, Domestic Practice, Home, Performing, Watching.

Pursuit of Incompleteness in Architecture: *Events*

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ABSTRACT

The body is the interface that man communicates through with the outside world. It is the body itself that experiences, perceives, and gives meaning to the space. The body, which exists in the space following the direction of the space, also creates the space. Every time, the space is re-defined as a result of the diversity of each body. The routines which the physicality of the space dictates to the movements are destroyed when the body becomes a founder.

The making-breaking structure of the space becomes visible with instant production. These loose and blurry formations are produced by the dialogue between the body and space. These points, which we can describe as in-between spaces, occur with spontaneous movements of the body called events. Because of the dynamic form of events, the space is incomplete and constantly reproduced.

This study aims to problematize incompleteness in architecture through the concept of events. The difference between this approach and the existing literature is that the potential of the in-between spaces that appear through events is made visible and categorized.

Performing arts, which make the movements visible, are a good example of examining the incompleteness based on this body-oriented process. Performance builds in-between spaces by increasing the awareness of the body. The fluid characteristic of the performance involves the body in the space and drags it into a process of discovery: deconstruction, production and continuity. For these reasons, the performance space was regarded as a research laboratory. The in-between spaces, in which the body becomes the main actor and rituals are constantly broken down and rebuilt, have been used to discuss incompleteness in the space. In this study, incompleteness will be discussed in a theoretical framework through in-betweenness and events. The "unfinished" will be mapped in selected performance spaces. It is aimed to raise awareness that incompleteness of spaces can be discovered by participating bodies.

***Keywords*:** Incompleteness, Event, Body, Movement, In-between Space, Spatial Routine.

An Investigation of Design Strategies in Collaboration of Architect and Computational Environment in the Context of Creativity

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ABSTRACT

In the second digital age, the computational environment is evolving to become the tool for thinking together. This paves the way for discussions of new ways of thinking and creativity related to the design environment. This paper joins these discussions by researching the changing design strategies in collaboration with the architect and the computational environment. This work presents an evaluation of the main motivations and design strategies of architectural design offices in adopting collaboration with the computational environment in the design process. Eight offices have been selected as working areas. Collaboration motivations and design strategies of these offices with the computational environment have been researched through the text and visual documents in the publications about their completed projects. This research demonstrates that offices collaborate with the computational environment from the early concept stage with the motivations to rationalize and justify design, reveal unexpected exploratory representations, calculate the complex designs, topological research, and research digital tectonics, and interact with representations in augmented reality environments. The paper stands out that with these motivations, the design processes of the offices that cooperate with the computational environment, "design on the master model", "prototyping and testing", "research with pseudo randomness and generative algorithms", "designing their own tool", "topological research", "building life cycle and user analysis", "digital tectonic research: file-to-factory design", "digital tectonic research: computational materials research" and "digital tectonic research: co-bot production" strategies come to the fore. Depending on these strategies, this paper argues that the reflexive dialogues established between the architect and the computational environment have the potential to create an environment for human-computer co-creativity and emphasizes the creative potentials of this collaboration.

***Keywords*:** Human-Computer Co-Creativity, Computational Environment, Reflexive Dialog, Collaboration, Computational Design.

(Re)-Thinking of Architectural Form with the New Materialism

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ABSTRACT

As a result of the reorganization of worldwide social relations under the influence of industrialization, the theoretical paradigms of philosophical, artistic, political, and social discourse have undergone remarkable transformations. Within the scope of transformations, New Materialism (NM), which emerged as a thesis against thought systems that establish the relationship between subject and object on a subject-centered basis, has found its place in the literature. The main criticism of NM against current understandings is that the subject is in the position of perceiving, consuming, and acting; the object is stuck in passive, measurable, volume-defining definitions and the subject-object relationship flows are established on linear causality and obtain fixed results. NM constructs a constantly moving/transforming relationship world in which all human and non-human actors are in the agency/active position. It is considered valuable for research in this direction to investigate the potential of the dynamically self-created architectural form understanding, which is the product of all actors. The aim of the study is to problematize by emphasizing the effects of the changing structures and positions of the causality that accompanies the subject, object, and process, on the architectural form. Within the scope of the study, the concept sets revealed by NM will be examined and these concepts will be evaluated and mapped comparatively in terms of the relationship flows between them, the way they form the form, and the information they reveal in the formation process. In the mapping created, traces of the form/formation processes that are tried to be redefined with these concepts will be sought on existing spatial practices. It is thought that the study is valuable in that it enriches/stretches the discussions on the form in the context of changing roles at the subject-object intersection and thus opens the possibilities and constraints of the form to discussion.

***Keywords*:** New Materialism, Architectural Form/Formation, Subject, Object Autonomy, Regenerative Process.

Thinking of the Concept of Spatiality as a Metaphor to Render Order by

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ABSTRACT

This study focuses on investigating the potentials of conceiving the concept of spatiality as run as the subsidiary subject of kind of a metaphorical apparatus being operated by the order giver qua a medium in order that rendering either internal social order or international state of balance. It is searched how the space can be interpreted as a devised discourse through which the knowledge is generated and transferred, the 'truth' is recursively produced and so could have had the regime of order and the status quo constituted prevail. The notion of space either intentionally wo/man made or occasionally natural dealt with is to be comprehended both as concrete physical spaces and as imaginative landscapes. The phenomenon of metaphor is to be interpreted as a way of producing discourses by means of which the paradigms of power relations can be set and hence the social conduct could be managed in order to ensure the conditions of 'governmentality'. The aim is, whilst taking the very ambivalent nature of the concepts dealt with constantly into account, to call a debate on the conception enunciated so far into being and to hover around the context via bringing some examples forth in support of deliberately contemplating the possibilities to construct the hypothesis.

***Keywords*:** Space, Governmentality, Truth, Reality, Discourse.

Eisenman's Late Concept Based on Contradiction: *Lateness*

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ABSTRACT

It is possible to state the relationship which Eisenman established between resistance and architecture with his desire for the possibility of presenting an architecture that resists the metaphysical project. Metaphysics was built on the basis of presence and has described itself with dualities by creating a hierarchy between concepts like the center, the natural, the whole, and their oppositions (Küçükalp, 2008). Unlike Derrida, who argues that the relationship between architecture and metaphysical project is inseparable because of the presence problem of architecture, Eisenman believes that there is a possibility of an architecture that succeeds in breaking from the dialectical relations of the metaphysical project (2007). Lateness is a concept which is defined originally by Theador Adorno as coming from Beethoven's Late Work. "*Adorno finds in Beethoven's late work a return to classical conventions after a long period of rejecting them almost entirely, and yet this classical recapitulation does not follow formulaic classical structures*" (Eisenman, 2020, p.7). While Eisenman adopts the concept of lateness for architecture, he focuses on the 'conventions', which are forms that belong to past styles, and they are the parts that will create a late architectural whole (2020, p.7). It can be stated that, for Eisenman, the late architectural whole, which does not exist through displacing the old, which has hybridity and complexity, can create an opportunity to succeed in the metaphysics of presence since it promises more than just a dialectical relationship between old and new. In this article, I argue that although Eisenman is trying to overcome the dialectical relations of the metaphysical project, he continues to produce the separateness between dualities since he focuses on either the material presence of architecture or the centrality of language (signifier, signified), not their, in the words of Karen Barad, entanglements. For Barad, the universe is the on-going intra-actions of material-discursive practices. Neither material nor discursive practices are superior to one another (2007). Eisenman, especially in his own project, Residenze Carlo Erba, which he described as an example of lateness, skips that these conventions/forms taken from past periods are material-discursive entanglements in their own times, so it should not be possible to be critical while taking the forms without criticizing their material-discursive entanglements. As a result, the article claims that his attempts to create a late architectural whole today from past conventions contradicts his old critical discourses, since he took the forms materially by forgetting that they are material-discursive entanglements.

***Keywords*:** Resistance, Metaphysic of Presence, Displacement, Disturbance, Lateness, Material-Discursive Entanglements.

References

Küçükalp, K. (2008). Batı Metafiziğin Dekonstrüksiyonuna Yönelik İki Yaklaşım: Heidegger ve Derrida. Uludağ Üniversitesi, Sosyal Bilimler Enstitüsü, Bursa.

Eisenman, P., & Iturbe, E. (2020). Lateness. Princeton: Princeton University Press.

Barad, K. M. (2007). Meeting the universe halfway: Quantum Physics and the entanglement of matter and meaning. Duke University Press.

Erecting the Captivity of Own

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ABSTRACT

'Open-Flexible Spaces' design strategy has been extending it' ground at ways of making architecture. It is associated with increasing productivity and efficiency. The openness comes in the same package with the flexibility, and it brings the visibility into consideration.

A disciplinary society defined as an organism generated by different 'environments of enclosure' (Deleuze G., 1992). After the Second World War, the formation of the 'institutions' -the enclosed environments operating the organism- has got in a crisis. The organization starts to change and leads the structure into a new mechanism: societies of control! The individual, now, has to be existing/surviving in all the enclosed environments at the same time, interminably. The system is established on the gaze of being a team. The ultimate goal of the orderer is to turn the every single individual constituting the society into one of the tools of monitoring those let the control mechanism be set and run. A new characteristic of be(com)ing an individual: monitoring while being monitored. In the era of control, following the pattern "open-flexible spaces" in ways of making architecture when designing co-working/studying spaces would lend 'the orderer' a helping hand at ensuring the complete control over the individuals by dispensing the duty of surveillance homogenously up to them. By designing so, 'it' would be provided with being able to have every single one being surveyed by the being surveyed ones. Do we wish for this?

The purpose is to criticise the underlying motivations of seizing on the design norm 'open-flexible spaces' while designing the co-working/studying spaces of the day and the future; to set a debate on if it is for good, or it is the way to concept of control making itself emerged in the field of architecture: the mechanism of complete control over the individuals by the increased visibility. Or, these two are an inseparable dual having a relation of goal and strategy!

The study is to be supported by an on-site case study planned to be held with the employees of a company working at the office campus designed by 'the idea' and also with the students experienced the 'translucent' classrooms settled on the galleries of Taşkışla, the building in which ITU Faculty of Architecture is settled.

***Keywords*:** Control, Surveillance, Enclosure, Monitoring, Visibility, Open-Flexible Spaces.

The Poetics of Techne

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ABSTRACT

Artists often explore ideas of space and place in their work, while architects use buildings and landscapes as their canvas. Both offer various perspectives on the representation of phenomena, offering some quite explicit similarities regarding their creative approaches and the way they see things. This interdisciplinary approach offers a variety of complementary ways of thinking at the intersection of architectural design, art and philosophy. Philosophy of art proposes ways of thinking that question the essence and meaning of artistic creations and question ethical and aesthetic principles, just as the philosophy of architecture does. In this context, where knowledge is also a representation, the partnership of art and architecture is based on the semantic structure established in the relationship between the signifier and the signified, and the representation methods of this relationship.

An ancient Greek word, techne, which has the connotations of knowing, making, revealing, creating, is a very remarkable concept for investigating the representation, meaning and design planes that are desired to be unravelled in the study. The aim of the study is to decipher these possible intellectual routes on this foundation that exist in all kinds of art and architectural creation processes. In this study, it is intended to carry out this speculative search in two ways, subject-based and object-based: The first is to make semantic analysis in which the perspectives of individuals who are architects, artists and thinkers are framed; the second is to try to discover the relations and codes between the signifier and the signified by analyzing art and architectural creations and performances. Thus, the research may open the door to new possibilities for making sense of the complex and chaotic creative processes of architectural design.

***Keywords*:** Architectural Design, Art, Semantics, Techne.

Queering Space through Body-Space-Time Relationship

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ABSTRACT

The reciprocal relationship between body and space is discussed in Elizabeth Grosz's theory through her conception of the ways in which body and space establish each other. Grosz's understanding of body and space as incomplete and mutually defined entities engenders discussions around the body (both human and nonhuman) which is thrown into a place that excludes it. While conventional conceptualizations of body and space as autonomous entities exclude many others in architecture, Grosz's reconceptualization of body and space as entangled promises to discuss space in its inclusivity. Contrary to binary understandings of body and space (or material-immaterial, space-time, etc.) this entangled understanding conceptualizes bodies (both spatial and living bodies) in their vulnerability which makes it impossible for them to stand and act separately in autonomous ways. The term *vulnerable* is discussed in a positive manner as referred by feminist-posthuman theorists as the condition to build relationship with the other. In the paper, Grosz's theory about the ways of reconsidering space in relation to body and time is discussed along with the design process of the project Passage 56 by atelier d'architecture autogérée (aaa - studio for self managed architecture) that uses similar references with Grosz such as Luce Irigaray's concept of sexual difference and Gilles Deleuze's relational concepts of difference and becoming. Reconsideration of space as a becoming – always passing from one state to another, requires an understanding of it in constant change due to the relations it builds with different scales. It is argued that discussing Grosz's theory through building relationships with an architectural practice is crucial in order to discuss many questions that emerge from these relationships that theory or practice may not be able to address separately. Through transitions between Grosz's theory and the project Passage 56, several strategies are discussed, criticized, and proposed while several questions are revealed. In this regard, the ways of *queering space* which means to consider space in its multiplicity and heterogeneity were discussed by focusing on microscale relationships, invisibles, and differences in design process.

***Keywords*:** Bodyspace, Becoming, Heterogeneity, Inclusive Architecture, Spatial Agency.

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Examination of the Relationship between Spatial Attributes and Age-Friendliness of an Urban Space: *Dunya Baris Park Case*

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ABSTRACT

In today's world, the acceleration of transportation and communication processes through technological developments significantly affects the activities of daily life. Within that period, indirect communication forms and meeting platforms are on the march. However, the pandemic process has clarified that indirect communication forms can only be supportive and cannot completely replace direct meetings in which both physical and social interaction can be established. Even though the flow of life is getting faster, people move at an average walking speed of 5 km/h and are on the lookout for experience. All in all, urban spaces are still the most important platforms that set the stage for social life.

Herein, the necessity of focusing on the physical and socio-spatial qualities of the urban space and its components remains up-to-date. The interaction of various user groups with the physical and social layers of urban space differs. Accordingly, these are essential to criticize the idea of designing for the "average person" (healthy, young, male one) and to create spaces for everyone: young or old, fit or frail.

In this context, this study focuses on the notion of "design for all" and the interaction of the elderly user group with urban space. The main purpose is to analyze the effects of spatial attributes on the age-friendliness of an urban open space. The proportion of elderly people in the world population is on the increase. This user group has significantly encountered social isolation during the pandemic. Herein, it is important to establish and analyze urban spaces that can enable elderly users to remain physically, mentally, and socially active. Examination of the theoretical data through the case study constitutes the methodology of this study. Within the scope of the case study that was carried out in the Dunya Baris Park informal personal interview, systematic and natural observation techniques were used. The findings of the study contribute to understand how urban spaces can be more inclusive for different user groups through the parameters of familiarity, distinctiveness, and comfort.

***Keywords*:** Urban Space, Spatial Attributes, Age-Friendliness, Design for All.

Analysis of Turkish Participants's Speeches at International Congresses of Aesthetic (ICA)

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ABSTRACT

Aesthetics, which is the research area of the relationship between subject and object, is one of the main interdisciplinary study areas of design practices through meaning, interpretation and evaluation actions. In the world literature of aesthetic research; it is emphasized that it is handled in the light of the concepts and understandings of the West. Although the history of aesthetic studies goes back to old times, the congresses of the International Aesthetics Association (IAA), which is based on a scientific basis, is an interdisciplinary aesthetic archive. These congresses, which started in 1913 and held every 3-4 years after the Second World War, bring together various speakers from all over the world. Turkish speakers attended the congress for the first time in 1964 and the number of speakers has increased in the last 10 years.

Since the 2000s, the aesthetic understanding in congresses has turned its face away from the West. At this point, it is important to question how aesthetic researchers in Turkey contribute to the field of aesthetics and what discourses they produce from within Turkey. The main subject of this study is to question the studies of speakers from Turkey at IAA congresses in the field of aesthetics. The texts of speakers from various disciplines (painter, art historian, architect, philosopher) were analyzed.

***Keywords*:** Aesthetic Congress, Turkish Participant, Turkish Aesthetic, International Aesthetic.

Narrative-City: *Reading Post-modern Urban Character through Metaphors and Analogies*

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ABSTRACT

The city is a sum of different syntactic and semantic layers and relationships composed together in time. With its unique character, the city manifests itself as a complex structure. The postmodern city is more than a clear composition of parts built around a center and certain hierarchies; it is an endless formation that does not have a beginning, an end, and a center, expanding in different dimensions syntactically and semantically. Every definition made to understand the city creates a new code that expands its borders. It seems almost impossible to make a single definition of the city. Therefore, discussing a number of metaphors and analogies addressing the post-modern city will be beneficial in terms of understanding the complex physical structure of the city and revealing the narrative character in it. Metaphors and analogies help to create an extension of meaning and new ways of reading/understanding the existent conditions for future studies in urban and architectural disciplines. This paper aims to read and understand the post-modern city through metaphors and analogies put forward in post-modern urban and philosophical literature to unfold alternative meanings and hidden/untold urban characteristics in a conceptual dimension.

In this paper, specific urban metaphors and analogies such as "scrambled egg", "ladder", "enunciation", "text", "language" and so on from post-modern urban and philosophical literature are considered as trajectories for reading the urban conditions. The paper focuses on the dynamics creating the post-modern urban character firstly, then tries to understand the relationship between the metaphors/analogies and the city conceptually, and lastly scrutinizes prominent metaphors and analogies used by urban/architectural theorists. The paper concludes with a discussion of the potential and alternative reading methods of the city through linguistic codes. The city emerges as a "narrative" which is a fragmental, relational, multifaceted, and multi-layered structure to be unfolded and read.

***Keywords*:** Narrative-City, Postmodern City, Reading the City, Urban Analogies, Urban Metaphors.

Soil Loss by Urbanization and its Transformation Potentials

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ABSTRACT

Soil is the source of almost everything; nutrients, minerals, raw materials…It has an essential role in defining matter from antiquity to Anthropocene. In this study, which describes matter as transformable, and considers this transformation a process consisting of sequences, the soil change over time has been examined. Especially, the rapid changes in Anthropocene have affected architecture and the soil is covered with concrete. With intense urbanization and industrialization, soil that has been displaced in the city is described as 'lost' in this research. In this context, the aim of the study is to seek the transformation potentials of the soil that is lost with urbanization. Since the process of transforming excavation soil is versatile, the study is carried out with a transdisciplinary approach. It is planned to present this collective work through a biennial that includes the archive and the end products. In the process, data mining systems are used to make projections for the future, and a trans-material approach was adopted in order to explore different potentials. Adding different materials to soil taken from the metropolitan construction sites creates an archive with the prototypes. Within the scope of the Taşkışla Biennial plan, innovative ideas are put forward to transform the waste excavation soil into sustainable products on the construction site. To this end, the importance of this study is twofold. First, it reveals the importance of reusing the excavation soil, considered waste, and discusses possible solutions.

***Keywords*:** Matter, Transformation, Urbanization, Soil Loss, Transdisciplinary, Trans-Material.

Examining Eco-Gamification Method for the Development of Smart Urban Settlements

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ABSTRACT

The 21st century faces increasing urbanization accompanied by the need to consider new city strategies. As one of these quests, smart city strategies are based on the principles of sustainable development and provide a smart way to implement these principles. Today's smart city model incorporates the human factor and aims to ensure sustainable development through smart people and technological capabilities. Information and communication technologies stand vital as they support the communities to become smart ones that are capable of developing smart practices to cope with the environmental problems. Ecogamification is one of the prominent technology-based applications. This study aims to investigate the effectiveness of eco-gamification method in developing smart urban environments. And; it will be questioned how much it is considered in the discipline of Landscape Architecture. In this study, the eco-gamification method is studied as a tool. And; since it is a comprehensive study topic, various case studies were examined to understand the eco-gamification concept through these cases. Within the scope of this study, gamified smart city applications in different countries were compared. Following to worldwide case study investigations, this manuscript represents a specific concern for the comparison of Europe and Turkey. Thus, 7 Examples from Europe were selected that exist in the major cities of different countries. Selected case studies were analyzed and compared with each other quantitatively to develop strategic plan proposals for the future, which stands as a result of this study. This study interrogates the gamification concept related with landscape architecture. As landscape architecture is multiscale and multi-disciplinary profession; the findings of this research have a potential to guide professionals from various disciplines. Furthermore, this study is not only benefits of Turkey but also for the other countries up to develop their smart city strategies.

***Keywords*:** Smart City, Smart Citizen, Sustainable Development, Eco-Gamification, Landscape Architecture.

Examining the Factors Affecting Free Zone Performance in Turkey between 2008 - 2018

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ABSTRACT

Countries have developed export-oriented policies with the thought that the key to economic growth is foreign trade. Therefore, countries have seen free zones as an essential application tool to get a larger share of foreign trade. Free zones can be defined basically as areas within the political borders of a country but outside of various foreign trade restrictions. They have broader incentives, advantages, and exemptions are provided in terms of industrial and commercial activities, which are considered outside the customs zone in terms of foreign trade, tax, and customs legislation. The adoption of the free market economy in Turkey with the January 24 decisions has increased the importance of free zones for the country's economy. So, the Free Zones Law was enacted in 1985. Today, there are eighteen free zones in Turkey. This study investigates the effect of the criteria determined depending on the establishment purposes of free zones in Turkey on the economic performance of free zones. The trade volume of free zones between 2008 – 2018 in Turkey for performance measurement data is used. The establishment purposes of free zones are matched with the independent variables collected in three groups: population, human capital, and technological innovation. Panel data analysis was used in the study. According to the result, population density, migration rate, number of high school graduates, and the number of R&D centers are statistically significant. Among the variables with a significant relationship, a negative relationship was found between population density and trade volume of free zones, while a positive relationship was found between migration rate, number of high school graduates, and the number of R&D centers. A young population, insured employees, university, master's and doctorate graduates, patent applications, and the number of the university from independent variables on the trade volume of free zones are not statistically significant.

***Keywords*:** Free Zones, Annual Trade Volume of Free Zones, Turkey, Panel Data Analysis.

The Position of Free Zones in the New Economic Order of the Age of Globalization: *An Evaluation of Practices in the World and Turkey*

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ABSTRACT

It is seen that the era of globalization that we live in brings many new benefits to individual and social life, and the effects of this process, which carries all kinds of interaction and accessibility to the highest levels, are reflected in the field of economy as well as in all other fields. With the establishment of transnational relations, it is seen that trade walls have been demolished, intense competition relations have been established, and free-market policies have been adopted in the economy. This facilitation of access to cross-border areas has triggered the formation of certain groups and regions that dominate the world market, and at the same time has given foreign trade an unprecedented momentum. Therefore, this observed mobility has necessitated the search for new systems, especially for underdeveloped and developing countries. It is seen that Free Zones are one of the systems that are expected to be an intermediary in this new market order. Although they have a deep-rooted history, these regions, which became widespread in the last period of the twenty-first century, were expected not only to be instrumental in adapting to the national economy but also to provide socio-economic development in the regions where they were established. In other words, the mission of providing national and local development has been assigned to these regions. This mission and its increasing popularity are also reflected in academic studies. It is seen that many studies investigating successful/unsuccessful examples, socio-spatial effects of these examples, and reaching different findings have been completed. Within the scope of this study, the worldwide accepted definitions, differentiated types, and purposes of free zones, which are the new economic exponent of the globalizing world, are examined. Their changing functions from the past to the present, and how successful they are in the vision they have today are discussed, and it is tried to evaluate the free zones in Turkey with the inferences made from successful free zone applications in the world.

***Keywords*:** Foreign Trade, Regional Development, Free Zones.

The Effective Use of Daylight in Double Skin Facade Buildings

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ABSTRACT

The use of daylight in buildings is longstanding as the architecture is. That makes it one of the key matter in building design today. Artificial lighting systems can provide visual comfort as well, in cases where daylight isn't sufficient. However, their use increases electrical energy consumption. So, it isn't possible to save energy using only daylight. When the amount of daylight is sufficient, photosensors reduces the usage of artificial lights or makes the system turn off, or daylight redirecting systems can be mounted in fenestration to get the daylight penetration indoors more efficiently. Daylight not only contributes to energy savings, but also has positive effects on user comfort and health. Sunlight provides the synthesis of some hormones and vitamins in the human body, regulates the biological clock and creates positive effects on human psychology. Daylight increases work performance of office users and the amount of success of students. However, excessive amount of daylight causes glare and undesirably affects the user comfort and health. It is necessary to get benefit of it in sufficient amount and homogeneously. Double skin façade (DSF) systems which are principally assembled to save energy by reducing heat losses in buildings can additionally allow daylight penetration efficiently, reduce glare, and maintains the even distribution of daylight in the interior when compared to traditional façade systems. This facade system provides a high level of light transmission but the penetration of daylight above the required level is prevented with the use of sun shading systems in the cavity of DSF. While the thermal performance of DSFs has been mostly examined in literature, the effective use of daylight in DSF buildings is discussed in terms of the concepts of daylight and daylighting, technical issues of DSFs and recent studies about evaluations of daylight in DSF buildings, in this study.

***Keywords*:** Double Skin Facades, Daylight, Energy Efficiency, Building Envelope, Health.

Total Construction Duration Calculation of TOKI Housing Projects: *A Case Study*

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ABSTRACT

In modern project management principles, accurate estimations for construction duration are significant to successfully complete projects on time. However, in accordance with literature review and Supreme Court decisions, it was determined that considerable number of housing projects were delayed in Turkey. TOKI (Housing Development Administration of Republic of Turkey), as an authorized public entity, has been major client to build housing projects in Turkey. Therefore, it was decided to study the construction delays for TOKI housing projects in this case study. The objective of this study was to reveal the difference between calculated construction durations by TOKI's own calculation method and durations indicated in official construction contracts between TOKI as client and awarded contractors. This research was adopted as a case study methodology involving semi-structured interviews with TOKI personnel. The datasheet showing detailed project information about 2800 completed TOKI projects was obtained. Interviews also showed that TOKI has been using three factors, namely number of houses, drawing type, and non-working days to calculate total construction duration. Findings of the study showed that calculated construction durations by TOKI were way higher than of those indicated within official construction contracts. Study revealed that TOKI was significantly shortened the calculated durations while transferring to contract durations officially which ultimately resulted in considerable number of housing projects delayed.

***Keywords*:** Project Management, Planning in Construction, Construction Duration, TOKI, Case Study.

A Proposed Model for Estimation of Ideal Construction Duration In Housing Projects

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ABSTRACT

Recent project management related research on construction duration modelling have received a considerable attention among academicians all over the world. There are various factors affecting construction duration such as number of flats, drawing type, priority of project and complexity, financial risks, location, and climatic factors. Estimation models for construction duration with these factors have been used by previous researches to produce more reliable and effective project durations. Despite strong potential of construction duration models, only a few studies applied these models in tender phase and less in housing projects. Moreover, research related to construction duration in Turkey showed that there were considerable delays occurred in housing projects. For this reason, it was decided to investigate the factors affecting construction duration only for housing projects to propose a novel model to achieve "Ideal Construction Duration". Data on housing projects was obtained from Housing Development Administration of Republic of Turkey (TOKI) which has been major client to build housing projects in Turkey. Statistical data analysis was performed by multiple regression analysis, CHAID and CART. Findings of the study have shown that several factors were significantly affected the Ideal Construction Duration for each statistical method. The cut-offs and standard errors were calculated to test the validity all three statistical methods. Testing of model was conducted with regression formula and it is shown statistical significance in regression method. After testing of model, it was observed that the delays in housing projects were significantly decreased.

***Keywords*:** Project Management, Planning in Construction, Factors Affecting Construction Duration, Construction Duration Estimation, Regression Analysis, CHAID and CART Analysis.

Effect of Model Detail Level on Reverberation Time Prediction: *Example of Odeon Room Acoustics Software*

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ABSTRACT

Different techniques are used to evaluate the spaces in terms of room acoustics properties: field measurement, scale model, and computer modeling. Computer modeling of room acoustics has been a favorite tool in recent years because it gives fast results. The procedure like that a 3D geometric model is imported into the software program and material properties (absorption and scattering coefficient) and source-receiver points are defined and finally, the prediction algorithm is run. However, because of acoustic simulations of models of the same space at different levels of detail (LOD), several results can be obtained, which reduces the reliability of the studies. This research aims to analyze the relationship between the level of detail and reverberation time (RT) prediction using Odeon room acoustics software. Living space and the conference hall with 3 different detail levels, low, medium, and high, were examined in the research. For each room typology, calculation method (hybrid) and input data (weather, background noise, material properties, etc.) were kept constant so the only independent variable was LOD, and the dependent variable is reverberation time. Reverberation time was calculated for every LOD situation, and they were compared with each other in the scope of case type. When the living space and conference room reverberation time estimates are examined, it is seen that the reverberation time decreases with the increasing level of detail. As a result of statistical analysis, a negative but very high correlation was found between the reverberation time and the level of detail. While the RT results obtained from LOD 2-medium and LOD 3-high detail levels are close to each other, there is a 50% difference between them and the LOD 1-low case. This change is well above the 5% just noticeable differences (JND) described in the ISO 3382-1 (2009) standard. A recommendation can be done for researchers calibration of models should be done according to the results of field measurement or project examples in the literature.

***Keywords*:** Room Acoustics, Computer Modeling, Level of Detail, Reverberation Time, Odeon.

Bibliometric Analysis of Zero Energy and Building Retrofit Research: *A Review through Co-Authorship and Co-occurrence Analysis*

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ABSTRACT

Zero energy building (ZEB) is a promising solution for tackling global warming and reducing energy demand in the building sector. EPBD Recast, published by European Commission (EC) on 19 May 2010 states that all new buildings in the Member States should be nearly zero-energy buildings (nZEB) by the end of 2020. There are also suggestions for retrofitting existing building stock in an energy-efficient way.

In 2020, the Commission published the strategy called "A Renovation Wave for Europe- Greening our buildings, creating jobs, improving lives" to accelerate renovation in Europe. In accordance with this strategy, existing building stock must be improved to achieve nZEB target.

This paper intends to review the major research area, journals, emerging trends, relevant authors, and countries for zero energy and building retrofit studies. The research objectives are: to obtain knowledge about recent studies regarding zero energy and building retrofits (1). To find out influential researchers and journals related to the research area (2). To identify emerging topics related to ZEB (3). To identify/discuss knowledge gaps for future studies.

Bibliometric analysis method was selected for the quantitative evaluation. VOSviewer software was chosen as a tool and the analysis was performed by using Scopus database. Searching query was set as "zero energy" OR "NZEB" OR "zero energy hous" AND "retrofit" OR "renovation" OR "refurbishment". Scopus search was set to title/abstract/keywords to reach relevant publications including relevant terms in their title, abstracts or keywords. The analysis was conducted through 620 Scopus records. In the next step, screening process was carried out based on title and abstracts to strengthen relevancy. Articles in the fields of Chemistry, Business, Management and Accounting, Decision Sciences, Agricultural and Biological Science, Earth and Planetary Sciences were excluded. Further analysis was conducted through 136 documents. Co-authorship and co-occurrence (terms/keywords) relationships were evaluated.

***Keywords*:** Zero-Energy Building, Energy Retrofit, Renovation, Refurbishment, Bibliometric Analysis.

Indoor Air Quality in Residential Kitchens: *A Review*

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ABSTRACT

Constantly evolving life and working styles, along with the pandemic-related measures that impose people to stay at home, have added new functions to the houses, enabling them to be used more effectively and intensively. Because of this increased usage, the indoor air is getting more polluted in the houses. Thus, creating healthy spaces for the users emerged as an important need.

In kitchens, cooking activity produces indoor pollutants, such as various gases and particulates, along with heat and vapor. These pollutants spread to other spaces in the house via air circulation and significantly reduce the indoor air quality. Natural ventilation, which is one of the passive preventive methods, reduces the effects of polluted indoor air on user health, however, in order for it to be effective, building-related parameters such as building orientation, prevailing wind direction and speed, window size, location and opening type, etc. should be carefully analyzed in the early stages of architectural design. In cases where natural ventilation is not adequate, active (mechanical) systems should be incorporated.

This paper presents data collected from various scientific research publications, which examine in detail the; (i) properties of the pollutants released in the kitchens by cooking, (ii) the factors affecting their spread, and (iii) the effects of ventilation on indoor air quality. According to publication results, the smoke from cooking in the kitchens contains respirable size ultra-fine particles and various chemicals, which pose risk to human health. In addition, other factors, such as cooking temperature, type of food, type of fuel used, etc., have significant effects on pollutant concentrations in kitchens. In this paper, it is aimed to address and examine the conditions associated with the pollutants released in kitchens in order to develop effective solutions. By improving the kitchen air quality, it will be possible to design healthier and more comfortable indoor spaces.

***Keywords*:** Residential Kitchens, Indoor Air Quality, Indoor Air Pollutants, Ventilation.

Floor Plan Recognition Considering Visual and Topologic Spatial Relations Through Machine Learning

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ABSTRACT

Artificial intelligence and machine learning approach have the capacity to be an important collaboration model for architects by learning the complex relationships that architectural floor plans contain and embody. Various models have been proposed for floor plan recognition. The work presented by Huang & Zheng (2018) aimed to recognize space functions according to labelled spaces. The algorithm easily recognizes spaces with clear boundaries and distinctive furnishings, such as bedrooms, kitchens, and toilets, but has difficulty in distinguishing spaces whose boundaries meet in certain places, such as living rooms and corridors. Another example is the work of Zeng et al. (2019), on predicting the limiting elements and the function of the space. The network has difficulties in perceiving the inner and outer regions of some areas. In this regard, a novel method is proposed in this paper for recognizing floor plans in terms of topological and visual relationships required by the functions of the spaces (while private spaces require less visual and physical relationships, common spaces have higher visual relationship and physical accessibility) through machine learning. Machine learning models demonstrate an impressive ability to learn from a set of examples. Within the scope of the research, 20 single-storey and 25 two-storey residential plan sets selected from the leading architects of the 20th century were examined. Residential plans offer a wide range of activities and situations, which include spaces that interaction and common living spaces such as the living room and dining room, as well as spaces specific to the privacy of the individual such as the bedroom, dressing room, bathroom. In the proposed study, considering the visual relationship between the spaces as well as the topological relationship in the recognition processes, the vertical circulation and the spatial and visual relationship between the floors constitute the original contributions of the study to the literature. The visual perception of the surfaces of various qualities in the space, in a sense, is realized by making the surfaces visible. The visibility of the surfaces is revealed by the reflection and/or passing of the light from the surfaces. Therefore, three-dimensional view sphere analyses and grid-based natural lighting simulations were performed. Levenberg-Marquardt Back Propagation (LMBP) algorithm was used to identify the space function with RGB colour code labels in single and two-storey house plans. The data set consists of 415 spaces and 10 different labels. The average model success was calculated as 78%. Investigating whether computational processes can come to the point of learning the qualitative characteristics of space is particularly important in the context of an artificial intelligence program that supports design decisions.

Keywords: Floor Plan Recognition, Floor Plan Analysis, Machine Learning

References

Huang, W., & Zheng, H. (2018). Architectural drawings recognition and generation through machine learning, *Proceedings of the 38th Annual Conference of the Association for Computer Aided Design in Architecture*, Mexico City, Mexico, 18–20.

Zeng, Z., Li, X., Yu, Y. K., & Fu, C.-W. (2019). Deep Floor Plan Recognition Using a Multi-Task Network with Room-Boundary-Guided Attention, *Proceedings of the IEEE International Conference on Computer Vision*, 9096–9104.

Empty Space: *How Not to Fill?*

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ABSTRACT

The concept of emptiness, especially when considered in relation to space, encompasses a broad range of concepts. It can be seen in relation to a variety of terms including vacancy, void, absence, space, derelict, hollow, and so on. All of these terms are used to describe a physical or conceptual state of absence. Emptiness is a highly subjective phenomenon that depends on who is performing the observation and what the subject expects to find. Despite its negative connotation in regard to absence,emptiness is widely regarded in architectural theory as a potential of unexpected events. The state of emptiness that allows the event to occur, on the other hand, vanishes at the same time when the event occurs. If it is understood that emptiness is a potential for unexpected events in public space, the next question to consider is how to maintain the condition of emptiness?

To answer this question, it is necessary to define the empty space and then reveal the various types of relationships that have been established with the empty space. Because it is impossible to define emptyspace in a single word, it must be classified. The first classification can be made based on the absence of human or non-human actors in that space. The following would be in terms of scale, temporality anduse/activity. Interactions with 'empty space' will be discussed from two opposing perspectives: designer practices and bottom-up interventions.

The multi-layered structure of the empty space, which is classified based on the absence of various actors, will be mapped in terms of scale, use, and temporality, and superimposed with different types of interventions. It is hoped that by doing so, a type of interaction that does not fill the empty space will be revealed.

***Keywords*:** Empty Space, Urban Space, Mapping, Assemblage Thinking.

Effects of Nano Tio2 Application for Cementitious Materials: *A review*

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ABSTRACT

Concrete is the most widely used material in the world due to its versatility, durability, and sustainability. One of the most common problems associated with these structures is the water and moisture resulting from atmospheric conditions. The damages resulting from water and moisture can lead the concrete to abrasion, dissolution, and staining, thereby reducing the resistance of the building materials. Nowadays, the application of Nanoparticles on the surface of the cementitious building materials to improve their physical properties has received widespread attention from both the construction industry and researchers due to their interface of improving effect, filling effect, and surface effect.

This paper investigates two incorporating techniques of Nanoparticles with cementitious materials. These techniques are firstly integrating Nanoparticles into the concrete matrix and secondly using Nanoparticles as coating on the surface of the material.

Due to the considerable performance of Nano-TiO2 (NT) in the enhancement of the durability properties of concrete and mortar, it is the one attracting the attention of the researchers.

This paper reviews previous researches examining the effect of NT on the mechanical properties and durability performance of the concrete. With the help of a comprehensive literature review, the impact of TiO2 nanoparticles on the concrete's compressive strengths, flexural strengths, hydrophobicity, acid resistance, abrasion resistance, and accelerated-aging considering freezing-thawing, wetting-drying, and UV effects performance is discussed in this paper.

Furthermore, this paper presents the benefits and advantages of improving concrete properties by utilizing Nanomaterials. It is shown that, in general, the usage of TiO2 Nano-particles significantly improves the mechanical properties and durability of the concrete. In addition, this paper aims to provide an insight for the possible applications of NT in/on the concrete material in the construction industry.

Keywords: Concrete, Durability Performance, Hydrophobicity, Nano-TiO2.

ARCHITECTURAL DESIGN

Early Stage Architectural Design and Local Data Relationship In BIM

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ABSTRACT

Architecture, unlike other design disciplines, is a discipline that is directly related to space (Norberg, Schulz, 1980). The features of the place constitute a special character to spaces and show how architecture can respond to its environment by creating a meaning. (Ünal, Demir,2020). Architect can control the design process and outputs of design correctly by analyzing the relationship between the building and the place in the early stages architectural design process. Although BIM environments do not correspond the needs well enough in early stage of architectural design as a tool, when examined in its current situation, it can be stated that it has very powerful features such as easy metering, calculation, parametric design, productive design, design coordination and energy analysis. (Nalbant, Ofluoğlu, 2020). This research reviews the use of Building Information Modeling systems in the early-stage of architectural design process and aims to analyze the role of local data in BIM systems. The typology study of the software tools used in the BIM system and the fields in which these software tools contribute to BIM are expressed in the accompanying tables. The typology study focuses on software tools that are directly related to the architectural design process and examines the possibilities of these tools in depth with literature research and studies. The research examines the role of the early stage architectural design process in BIM systems and examines the use of local data in this stage. With this research, data-rich models are produced and accurate analyzes are made in the early stage architectural design process, while providing more accurate decision-making mechanisms for building performance and its relationship with the environment. It is expected that the local data concept being addressed in the early-stage architectural design process by BIM will positively affect the decision- making mechanisms throughout the life cycle of the building. Having the local data integrated into the BIM system in architectural design processes, the process can be reinterpreted and different site-specific alternatives can be produced. It is predicted that BIM will be a better digital design tool in the future with the concept of local data to be considered in the early stage architectural design process.

***Keywords*:** Building Information Modeling, Local Data, Early Stage Architectural Design.

Investigation of Building Fire Safety Measures in BIM Environment

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ABSTRACT

In parallel with the developments in building technology, the use of BIM has become widespread among stakeholders in design and construction industry. As with most design disciplines, BIM is becoming a more powerful tool in the field of fire safety. In this study, an office building modelled with Revit, which is one of the widely used BIM platforms, has been examined using CYPEFIRE Design and FINEFIRE software working in the BIM environment in the field of fire safety in Spain and the USA. The requirements of the office building regarding fire safety are regulated in accordance with the provisions of the Turkey's Regulation on Fire Protection and the relevant standards. Usability assessment was carried out on the parameters of learnability, efficiency, memorableness, errors and satisfaction in accordance with EN ISO 9241-11. As a result of the evaluations, CYPEFIRE Design software provided 13 (52%) and FINEFIRE software 10 (40%) compliance checks according to regulations and standards within the scope of the 25 fire safety measures expected to be provided by the building. According to the parameters of the discussed usability, CYPEFIRE Design software is at the forefront of evaluating efficiency and errors, while FINEFIRE software is at the forefront of evaluating learnability and memorableness. Both software is different from each other and provide advantages in certain titles. As a result, it is clear that the decisions to be taken in line with the data obtained with these software, which can analyze the impact of fire safety measures on the entire building, support more effective management of the fire safety design process. Based on its current situation, it is possible to say that BIM technology will become more widespread and more comprehensive in the field of fire safety in the near future.

***Keywords*:** Building Information Modeling (BIM), Fire Safety, Building Fire Safety Measures.

Proposal of an Interactive Virtual Education Environment that Increases the Knowledge of Structure in Architectural Design Education

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ABSTRACT

Today, the potentials of virtual reality technology, which has become effective with the development of science and technology, are evaluated in terms of education in many fields. In architectural education, these potentials are studied for design, history and technical courses. In this study, it is aimed to develop a virtual environment proposal that can contribute to structural education in the field of architecture by using the specified potentials. The reason for the study is to eliminate the educational deficiencies that arise from the student's inability to adequately reconcile the architectural structure knowledge, which he has learned passively and theoretically, with the design knowledge. Firstly, in the study, the use of virtual reality technology in education was justified, based on the constructivist education and cognitive development theories. Then, the curricula of structural education in architecture in national and international universities were examined, and the relationship between the student's structure education and learning in architecture was examined. In addition, previous studies on the structure education of virtual reality technology in architecture have been analyzed in detail. In this context, an infrastructure has been created for the virtual environment proposal to be developed by compiling the problems identified in the structure education in architecture. Virtual reality technology has been researched and its components have been emphasized in order to feed the phase of structuring and designing the virtual environment. Accordingly, with the use of virtual reality technology, it is possible to switch from a teacher-centered education to a student-centered education, the student can take an active role and the permanence of the learned information can be extended. In addition to these, it is foreseen that the proposed virtual environment will be a course support material. It is planned for the student to experience the application by interacting with the teacher and friends and with instant feedback through trial and error. The digital infrastructure required for this was determined, the interface was designed, and the working principles and flow of the application were determined and explained in detail. In future research, it is planned to apply the proposal to architectural students in structural knowledge courses and analyze the results.

Keywords: Cognitive Development Theory, Constructivist Education Theory, Design-Structure Interaction, Structure Education in Architecture, Virtual Reality.

Proposal to Renovate Existing University Campuses with Planning and Architecture According to 21st Century Learning Spaces: *Example of Gebze Technical University*

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ABSTRACT

Gebze Technical University campus and registered buildings are an area that shapes the agricultural policies, production and education of the Republic of Turkey in terms of agricultural history. This area was first used as Çayırova Technical Gardening School in 1943 as 4027 decares. Accordingly, GTU Campus is built on historical traces. As a research problem, it has been seen that GTU Campus should develop architectural, spatial and business-oriented change proposals in a way that can direct the innovations and education in the 21st century. This study aims spatial planning proposals regarding the transformation of Gebze Technical University Campus area into 21st century learning spaces and aims to develop an agricultural innovation center design proposal in the 'place' determined within the campus area.

The study was completed in ITU Architecture Non-Thesis Master's Program in 3 education periods, 2020-2021 Spring and Fall and 2021-2022 Spring semester. It was carried out by distance education method in the form of group work during the pandemic process. Masterplan design, spatial function proposals and operational proposals have been developed for the GTU Campus area of the first period of the MTZ Program. In the second semester, 'an agricultural innovation institution' building was designed at a selected 'location' within the campus area. The theoretical background of the building study design idea, the usage scenario, design strategies, the building function diagrams, the building details, the building materials have been studied according to the sustainability principles. The whole study was prepared and printed as a graduation thesis in the third semester of the program.

Preliminary researches were started by making readings on current websites that worked on architecture, planning and management on 21st century learning spaces and agricultural innovation in the world. More theoretical concept studies and academic e-book databases were used. Concept decided trees were used to generate design ideas, and architectural diagrams were used to show design ideas. With the clarification of the ideas, more precise models were prepared using architectural drawing and modeling programs.

In conclusion, 'It is aimed to design an innovation institute as an campus experience and continuous learning space.' The project (B)iobased, (A)gricultural, (S)ustainable, (I)nnovation, (C)ampus -BASIC- is proposed with its design principles based on the innovative agricultural bioeconomy vision. It is recommended that designers, engineers, entrepreneurs, government, local government and non-governmental organizations develop more studies to promote the agricultural characteristics and capacity of Gebze and GTU.

Keywords: Architectural Design, Distance Learning, 21st Century Learning Spaces, Agricultural Innovation Institution, Gebze Technical University Campus.

Translated Architecture Books: *The Positioning of Turkish Architecture Realm Towards International Paradigm Shifts on Architecture*

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ABSTRACT

Architecture, as a profession that depends on practice eminently and as a field that created a vast amount of theoretical knowledge should be taken on with these aspects comprehensively. On the other hand, not only academicians in the field but also practicing architects endeavor to generate and circulate their knowledge through the books they have written. The intellectual acts of writing and publishing (or written culture) play a dominant role in the production of knowledge in architecture. Although the ideas on architecture are significantly more transitionary and free-ranging than architects, there have been times that foreign architects were invited to construct government buildings and modernize architectural education with a contemporary approach, hence having a significant impact on the trajectory of the architecture field.

The purpose of the study is to unveil the manifold relationship in knowledge transfer in Turkey through translated architecture books. The inventory of these books was prepared including various meta-data such as author, translator publication date, and publisher, in order to accomplish extensive research. The content analysis method was applied to collected data and notable inclinations in the publications were extensively discussed with supporting documents such as architecture journals and architecture website news. When retrospectively examined, university presses have come into the prominence of architectural literature in the early years of the Turkish Republic, in the later years, architecture-specific publishing houses and private publishing houses have arrived on the scene in turn. Although the orientation of translated books and widely accepted architectural ideas of the time are mostly compatible, the irregularities and contrasts can be observed. These tensions mostly arise from the approach to international paradigm shifts in the Turkish architecture realm. The correlation between translated architecture books and the positioning of Turkish architecture towards foreign architects and global (or international) architectural movements are effectively traced and interpreted to understand the cultural background in Turkey with the help of substitutive architectural documents and supportive arguments.

***Keywords*:** Architecture Publication, Production of Knowledge, Translation Theory, Pedagogy, Intertwined History.

Migration as a Passage to the Future: *Traces of Bruno Taut and Margarete Schütte-Lihotzky in Turkey as Visionary Architects*

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ABSTRACT

This study conceptualizes migration as a movement that exceeds boundaries between places and times. The movement of people turns the borders into passages, transitions, and processes. Migration becomes a key that opens to other possible futures or a bridge that connects the past and the future. The uncertain and unpredictable nature of migration makes it a potential moment for social transformation. Thus, migration can be a visionary action for the possibility of another world and future. Migrants open the way for new experiences not only for themselves but also for others. The Turkish Republic, in its first decades, had become a safe place for avant-garde architects, artists, and urban planners to flee from the depressing political environment and regime pressures of that period in Europe. This paper focuses on exiled architects Bruno Taut and Margarete Schütte-Lihotzky. After Bruno Taut came to the Turkish Republic with the help of Martin Wagner, he helped Schütte-Lihotzky for coming as well. The enchaining character of migration shows that migrants were hopeful and felt responsible for the future. The idea of 'new beginnings' became the common ground of migrants and the atmosphere of the country. As Hannah Arendt argues, migrant individuals should involve themselves in the world by telling their personal/collective stories; exiled architects had involved themselves in the world through their designs and revealed the potential of transformation through the action of designing. In this context, migrant architects had the opportunity to continue modernist visions weakened in their countries' political environment.

***Keywords*:** Avant-Garde, Modernism, Visionary Architects, Migration.

ARCHITECTURAL HISTORY

Reading the Ottoman Perception of Archaeology and Historical Artifacts through the Archive: *The Case of Khorsabad Excavation (1843-1844)*

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ABSTRACT

Khorsabad being a significant Assyrian capital located around the city of Mosul hosted one of the premise archaeological excavations officially conducted in the Ottoman lands in the first half of the 19th century. This initial excavation in Khorsabad, which was the precursor to proceeding excavations carried out by other states until the 20th century, was led by Paul Emilé Botta on behalf of the French State between 1843 and 1844. It revealed important Assyrian ruins for the first time and marked the beginning of Mesopotamian archaeology. This study focuses on Botta's period to understand the attitude toward archaeology and archaeological finds through the Ottoman Archive. The found documents related to this subject represent a distinct example standing between the "blissful indifference" and "anguished concern", with Edhem Eldem's definition. In this context, the documents are discussed in terms of the perception of archaeology and historical artifacts regarding the mentioned period. The first section covers the reactions to the excavation as well as attempts to define and control archaeological activities. Moreover, the intense correlation between diplomacy and archaeology is reviewed with its aspects affecting Ottoman perception by examining both the French ambassador's letters and Ottoman documents. The second section, on the other hand, includes comments on the language of the documents and the word choice. As a matter of fact, the words used to describe the finds such as "figured stones" (*musavver taşlar*) and "things" (*şeyler*) are remarkable clues for understanding the adopted approach. Additionally, it covers Ottoman officials' timid stand on the conservation of the finds due to the lack of experience, and the Sublime Porte's obligations and hesitations for permitting them to be transported to France. Reminding the fact that this early and distinctive excavation was conducted before the official regulations regarding archaeology and museology, this section is also associated with the non-existing museum facilities and the awareness that is just beginning to emerge. In conclusion, this study aims to highlight the significant points noticed in the archival documents of an early excavation process to reveal the Ottoman approach. The results of this study hopefully create the opportunity to read Ottoman perception of archaeology and historical artifacts more tangibly over the case of Khorsabad.

***Keywords*:** Khorsabad, Excavation, Ottoman Archaeology, Perception of Historical Artifacts.

Tahsin Öz and the Years of World War II: *Exhibition Spaces and Doors of Topkapı Palace*

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ABSTRACT

One of the steps taken for Westernization in the 19th century in the Ottoman Empire was museum activities. During this period, the state aimed to create contemporary institutions that demonstrated its power to prove its participation in Western civilization through the museum institution. Museums established during the Ottoman period should be considered as a layer that forms the conceptual basis of the function of national museums in the Republic of Turkey. Topkapı Palace, which is the only example of classical Ottoman palaces that has been able to maintain architectural integrity to this day, has undergone many changes over nearly 400 years. In the early periods of the Republic, the program selected for museums aimed to emphasize national integrity by showing consistency with the national ideology of the period. Tahsin Öz was appointed to Topkapı Palace and became the director of the museum in 1928 and continued his duties until 1953. He was asked to restore The Topkapı Palace Museum according to its architectural features from the 15th and 16th centuries to reflect the history that supported the glorious history of the Ottoman Empire rather than the years of decline. In this context, the exhibition space and door restorations made in the Second and Third Courtyards during World War II will be discussed. When articles on restorations are considered, there is a widespread belief that the "Achieving Stylistic Unity" approach was effective in restorations between 1940 and 1951. This study aims to question if the restoration works that went through at Topkapı Palace during World War II, were carried out with this approach or not. Therefore, restoration works will be compared with the 16th-18th century visual data (paintings, engravings). The similarities and differences in the spatial arrangement are going to be revealed by comparing the photographs of the restorations with these data. Then how the restorations are handled in the press will be discussed through the articles of architects. In the light of this information, Tahsin Öz's restoration decisions are going to be read through the concepts of "Achieving Stylistic Unity" and Westernization.

***Keywords*:** Tahsin Öz, Topkapı Palace, Museumization, World War II Period, Restoration.

Fluxus Movement in Architecture: *Geroge Maciunas' Fluxus Cooperatives*

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ABSTRACT

The Fluxus movement was born in the world conjuncture where the social events in the 1960s and the search for new meaning and expression ways in art were experienced. It has turned into an international network of artists where American, European and Far Eastern artist come together to perform in various fields such as performance, poetry, literature, music and painting. George MAciunas (1931-1978), an architect, designer and city planner among these artists, is the person who gave the movement its name and also formed the essence of the movement. One of the most important aims of the Fluxus movement is to transform the world into a more equal and livable place through art.

In the 1960s, Maciunas found solutions to the economic difficulties experienced by many artists working in New York, with artists cooperatives that it established in 1966 on a similar principle to the Soviet kolkhozes. With his project called Fluxus Cooperatives, he repairs disused old factories in the lower part of Manhattan, known as SoHo (South of Houston), and underdeveloped factory district, and turns them into lofts for Fluxus artists.

Fluxus cooperatives have allowed artists not only find solutions to the housing problem, but also to live together, change the cultural structure of the region, produce and exhibit their works in their own loft apartments. It is remarkable in that it enables the influence of George Maciunas to continue today for various reasons such as vision of simple design based on collective ownership, being functional and expensive in terms of architecture, embodying the principles of equality. The aim of this article is to evaluate the possible impact of art as a social transformation tool on creating a more equal and more livable space by considering the architectural aspect of the Fluxus movement, which has not been mentioned much in previous academic studies. In the article, first of all, the manifesto and articles written by George Maciunas on Fluxhouse Cooperatives, project drawings, newspaper advertisements will be searched by searching the internet archives will be evaluated in an art historical context.

***Keywords*:** Fluxus, George Maciunas, Fluxhouse, Fluxhouse Cooperatives, SoHo.

In the Period of the Republic of Türkiye, Urban Change and Transformation of Üsküdar

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ABSTRACT

With the declaration of the Republic of Türkiye in 1923, İstanbul lost its capital status. The modernization of the city, in accordance with the Republican ideals, began with a range of legislation passed by the government and was conducted under the direction by French urban planner Henri Prost. Following the Second World War and the transition to the multi-party system, the redevelopment of İstanbul gained a new pace. The newly elected Democrat Party's attitude towards the liberal economy, the mechanization of agriculture, the migration from rural to urban areas and rapid urbanization were the important factors significantly affected the redevelopment works. Similar to other parts of İstanbul, Üsküdar was deeply influenced by the activities and actors of the modernization ideal adopted from the beginning by the new nation-state. This study, therefore, aims to deal with the change and transformation of the morphology of Üsküdar between 1923-1960. It focuses on the historic centre of Üsküdar inherited from the Ottoman Empire as well as the nearby districts such as Paşalimanı, Salacak, Nuh Kuyusu, Bağlarbaşı and Selamsız.

The modernization history of Üsküdar is investigated under two sub-headings. The first period is from the establishment of the Republic to the World War II and the second period is from the war to the end of the Democrat Party government in 1960. In line with qualitative research method, urban change and transformation experienced in Üsküdar are discussed through comparative aerial photographs, maps, plans and photographs as well as primary and secondary sources on this topic. Since the 1960s Üsküdar's modernization process has continued in parallel to the modernization of İstanbul, and the foundations of the change and transformation in the urban morphology of Üsküdar, as perceived today, can be found in the Republican era as discussed in this paper.

***Keywords*:** İstanbul, Üsküdar, Modernisation, Urban Change, Republic of Türkiye.

Temporary Structures and Daily Practices in Public Spaces After Modernity: *Case of Ephemerality in Üsküdar Pier Square*

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ABSTRACT

The purpose of the research is to reveal the relation between temporary structures and social sustainability and initiate a discussion about paradigm shift in architectural design approach towards humanitarian architecture in times of "liquid modernity". Within the conceptual framework of late modernity and social production of space, the study aims to introduce the continuity of temporary structures in urban squares based upon their contribution to daily practices.

Üsküdar Pier Square in İstanbul is chosen as the case study area of the research due to its temporal and public features. The Square has been an important and busy transportation hub over the centuries and enclosed by monumental buildings and temporary structures. Overlapping maps and aerial photos of the Square from 1930's until 2010's indicate that parcel boundaries and roads are permanent although demolition of buildings and urban regulations. Engravings, paintings and photographs point out the vivid social environment in the Square, based on mobility and economic activities. Investigations on the site shows that architectural forms of temporary structures in the Square are directly associated with social space that is produced by daily practices which are determined by consumption and commuting habits of citizens.

The research indicates spatial solutions for daily practices in a historical urban square and people's adaptation to technological developments and the implementations on urban scale. The findings emphasize the connection between present and historic facts of the temporary structure usage in the Square. The study uncovers the social impact potential of temporary structures on urban squares and urges upon the importance of establishing architectural design criteria for those structures with the collaboration of inhabitants, academics, urban and architectural designers, entrepreneurs, and municipalities. Additionally, the analyses point out that temporary structures are partially detached from building codes which gives the possibility of using different materials or construction techniques.

***Keywords*:** Temporary Structure, Late Modernity, Ephemerality, Social Sustainability, Public Space, Üsküdar.

The Spaces of Samsun Nation Schools (1928-1935)

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ABSTRACT

The alphabet reform, which is an extension of the nationalization and modernization policies of the republican revolution, was declared on 1 November 1928. The debates on abandoning the old alphabet, dating back to before the Republic, ended with the systematic and planned practices of the new Turkish state, and new letters were adopted. The practical implementation of the letter revolution was largely achieved through the establishment of the Nation Schools (NS). The research aims to investigate NS spaces to reveal how the existing building stock was utilized for this mobilization across the country to Samsun. Based on the Education System [Maarif] Nation Schools Activities Statistics, the study covers the years between 1928 and 1935.

The fact that NS can use "every place available on site but suitable for gathering" brings along a reciprocal adaptation process. The transformation of a wide range of building types, such as schools, mosques, coffeehouses, private houses, public and private institutions, into NS depends on the type of building and its current state. The photos and –oral and written- memoirs give clues about the environment of NS. On most of the photos; furniture, users, heating and lightning elements can be seen. Moreover, the memoirs describes the atmosphere in NS. These data were collected from periodicals, novels and academic publications. The regulations and guides were also a pathfinder. A catalogue of architectural components of NS was prepared to understand the general framework. Then, in general-to-specific modelling method, same process was applied for NS of Samsun but in more detail including the NS buildings used and the urban interrelations.

At the end of the study, it was determined that NS spaces were created in three different ways: temporary conversion, usage in shifts and reopening after rehabilitation. Each way has its own requirements and the spatial organization was done accordingly with the spirit of the era.

***Keywords*:** Samsun, Nation Schools, Spatial Organization.

ATMOSPHERIC SCIENCES

Lightning Analysis with WRF Regional Model: *Istanbul Case Study*

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ABSTRACT

In this study, thunderstorm events with a high number of lightning have been analyzed with Weather Research and Forecast Model. As known, lightning is one of the most sudden meteorological activities and so, it is hard to predict numerically. Thus, comparing numerical weather models results with observation data is the purpose of that study. Understanding atmospheric characteristics during lightning activities would be a good reference for upcoming lightning forecast algorithms. Hyperlocal lightning observations were used as input variables to determine convenient environments for lightning activities.

In this study, Gridded Global Forecast System (GFS) forecasts have been used as a meteorological database and this source was set for area of interest and upscaled to 3 km x 3 km grid size. In this study, the prepared domain has been used for two different time and case studies. Each case study was started nine hours before lightning became consistent. After that spin up time, Graupel Flux at the mixed region and Vertical Integrated Ice (VII) over the area of interest were estimated and considered with statistical analysis.

Here, the Lightning Forecast Algorithm (LFA) approach was applied for 26th September of 2017 and 27th May of 2018 case studies. It could be declared that the vertical integrated ice and graupel flux approach lets numerical lightning forecast for Istanbul. Firstly, these different cases have been analyzed separately and after that results of these events were combined. In consequence, it could be said that the lightning forecast algorithm is a convenient model for forecasting lightning over Istanbul with evaluated coefficients. Results documented that numerical models are capable of predicting lightning density over 0.7 correlation coefficient.

***Keywords*:** Lightning, Lightning Forecast, WRF, Thunderstorm Forecast.

Flood Prediction by Coupling WRF-ARW and HEC-HMS Models, Ergene Basin

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ABSTRACT

Flood is the most economically devastating weather phenomenon and natural hazard so, it is important to predict floods and take necessary precautions. In this study, flood runoff, occurring in the district of Pehlivanköy in the Kirklareli province of Ergene Basin on February 15, 2010, was tried to be predict. The purpose of this study is trying to predict flood runoff by coupling numerical meteorological and hydrological model and analyze the performances of these models in the flood prediction. Weather Research and Forecasting (WRF) model and HEC-HMS model were used together to evaluate the performance of these two models in flood prediction. Obtained precipitation values from WRF-ARW were used as input data for HEC-HMS model. Initial conditions for WRF-ARW model was obtained from the National Center for Environmental Prediction (NCEP), Global Final System Analysis (GFS-ANL) with grid scale of 0.5°. The HEC-HMS model was first calibrated with observed precipitation data and run to predict the observed runoff for Luleburgaz SGS and İnanlı SGS. Then HEC-HMS model was run again with precipitation data obtained from WRF-ARW to predict flow for case. Precipitation values was interpolated over the basin with Inverse Distance Method (IDW) which takes place in meteorological model component in HEC-HMS. As a result of the calibration, the model has followed a path consistent with the observation data for the Lüleburgaz station and predicted the highest discharge 288 m^3/s when observed value is 230 m^3/s on the same day. In process of running with WRF-ARW precipitation outputs (re-run), the model predicted the highest discharge for the station with less than 14 m^3/s with 1-day delay compared to the observed data. As a result, it is concluded that HEC-HMS is directly affected by precipitation so, prediction of precipitation should do carefully if WRF-ARW and HEC-HMS model are used together.

***Keywords*:** Flood, Climate Change, WRF-ARW, HEC-HMS, Extreme Weather.

Variability of Salinity and Temperature in Black Sea in Recent Years

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ABSTRACT

The amount of atmospheric carbon has increased rapidly since the beginning of the Industrial Era and causing change in the earth's climate in a significant way. . Climate change and its impacts gained much interest after 1970s and scientists has been researching climate change not only globally but also regionally. One of the most affected parts of the earth system is the oceans, showing drastic changes in the ocean parameters.

Black Sea as a closed sea, has unique features such as Rim Current and positive fresh water balance. Termohaline structure is another unique and complicated feature for Black Sea. Main reason for this is an exchange of waters via Bosphorus. Mediterranean water, which is relatively more saline and warmer, enters to the Black Sea from deep through Bosphorus. it is also one of the reasons for stratified structure of Black Sea. In this study, we aimed to investigate impacts of climate change on Black Sea water temperature from 1993 to 2019. During the investigation, both spatial and temporal distributions are used in different Black Sea water masses. In addition, sea surface and depth averaged temperature values are used monthly and seasonally.

Black Sea Physical Reanalysis system data (monthly, 1/27° × 1/36° km resolutions) from Copernicus Marine Services is used for the investigation of temperature of Black Sea over the period from 1993 to 2019. In addition, Argo Float measurement data is used for comparison of the reanalysis data over the period from 1993 to 2019. Pearson correlation-coefficient is used for measuring correlation between datasets. Mann-Kendal, Seasonal Mann-Kendal and linear regression methods are used for detecting trends.

The results indicate that the depth averaged seasonal temperatures are increasing at a rate of 0.038 °C/year and there are trends in mean, minimum and maximum temperatures annually. There seems to be no clear trend at deep part of Black Sea, whereas, Cold Intermediate Layer (0.012 °C/year), surface waters (0.096 °C/year) and coastal waters (0.096 °C/year) are showing increasing trends. Finally, depth averaged temperature trends range from 0.04 to 0.1 °C and sea surface temperature trends range from 0.06 to 0.1 °C annually.

***Keywords*:** Black Sea, Climate Change, Warming, Argo, Copernicus, Temperature.

Fog Analysis at Kars Harakani Airport Last Decade: *In 8-9-10 February 2013 Case Study*

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ABSTRACT

Fog is one of the meteorological events that most affect flight operations. Fog events can lead to serious consequences, such as an accident. Even if there is no accident, it causes important losses in terms of time and money because of diverting or canceling. Kars Harakani Airport (International Civil Aviation Organization [ICAO] code: LTCF, International Air Transport Association [IATA] code: KSY) is one of the airports located in the northeast of Turkey and where fog is experienced intensely. For this airport, a total of 1880 foggy observations, including 1311 foggy aviation routine weather reports (METAR) observations and 569 foggy selected aviation special weather reports (SPECI) observations, were examined in the 10-year time period, from 2011 to 2020. The data of the METAR and SPECI observations consists of the data obtained from the Turkish State Meteorological Service (TSMS) and Iowa Environmental Mesonet (IEM) database of Iowa State University. It has been determined that a total of 1320 hours and 29 minutes of fog existed within the examined period, and the fog continued uninterruptedly only for 32 hours of this examined period. The purpose of this study is to examine in detail the 32-hour fog event that started at Kars Harakani Airport on February 8, 2013, at 19:50 GMT, and continued uninterruptedly until February 10, 2013, at 03:50 GMT. Within the scope of this purpose the Meteosat Second Generation (MSG) fog low clouds satellite images, weather charts, Skew-T LogP diagrams, METAR, and SPECI observations were analyzed. In addition, in this study, by applying the fog classification procedure used for the New York City region in the article published by Tardif and Rasmussen in 2007, it was determined that the fog event in the specified time period was radiation fog according to the physical formation mechanism. During the examined period, moderate density fog events were dominant. Also, according to the temperature analysis made in the study, warm fog and ice fog were not detected, only cold fog was detected. Another analysis related to temperature is temperature dew point spread (TDS) analysis. According to this analysis, observations were determined at TDS value of 1 °C with a rate of 55.88%.

***Keywords*:** Kars Harakani Airport, Fog, Fog Analysis, Radiation Fog.

Investigation of the Effect of the Covid-19 Epidemic on Air Pollution from Aircraft Emissions; Istanbul Airport Example

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ABSTRACT

The effects of emissions from aircraft and airports attract national and international attention. In general, the impact of aircraft emissions is studied on a global scale depending on climate change. At the local scale, air quality is handled directly or indirectly due to many health problems. For this reason, the impact of airports on their environment should be examined and determined. There are 56 airports open to civil air transportation in Turkey. Among these airports, Istanbul Airport (IST) ranks first when looking at the number of aircraft that land and take off annually. While the flight traffic of Istanbul Airport had an increasing trend in the period before the Covid-19 epidemic, it decreased because of the restrictions and restrictions applied all over the world due to the epidemic. Especially in April, May and June 2020, when the epidemic emerged and its effects were seen for the first time, with the effect of uncertainties, air traffic decreased significantly by 99 percent compared to the values in 2019. According to the statistics published by the State Airports Authority (DHMI), in the summer of 2021, the values before the epidemic could only be reached in terms of aircraft traffic, with the effect of increasing tourist transport. Within the scope of this study, the effect of the decrease in air traffic caused by the Covid-19 epidemic on air pollution and thus air quality was determined. Emission values for nitrogen oxide, carbon monoxide and sulphur oxide parameters were calculated by using emission factors determined by aircraft types and published by the International Civil Aviation Organization (ICAO). When the pre-epidemic and post-epidemic values were compared, the calculations made; It shows that reductions of up to 90 percent have occurred in the scale of the determined parameters.

Keywords: Air Quality, Emissions, Climate, Aircraft, Airport, Covid-19.

Development of a Satellite-Based Precipitation Algorithm for Turkey by using AMSU-B and MHS Data

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ABSTRACT

Precipitation plays a crucial role in the hydrologic cycle as it serves as the primary driving force. It acts as the main input for hydrometeorological models. Rainfall is a complex atmospheric process, which depends upon many weather-related features. Therefore, accurate rainfall prediction is more complicated today due to climate variations.

Measurement data from both ground-based and space-based observing systems are utilized to quantify precipitation. Gaining an understanding of the characteristics of measurement data is crucial in assessing its reliability and accounting for uncertainties. Satellites are capable of tracking the temporal and spatial changes that are characteristic of precipitation. Operational satellites provide periodic measurements of atmospheric parameters, thus providing data on a global scale. Precipitation information is obtained from infrared and visible channels of geostationary satellites (GEO) and passive microwave (PMW) channels of low-earth orbit satellites (LEO). PMW data is directly related to the physical processes of cloud and precipitation but has a poor temporal and spatial resolution. Methods developed with passive microwave data are sensitive to the concentration of precipitation-related ice particles or water drops.

This study has been carried out to analyze the performance of the 183-WSL algorithm in Turkey. The algorithm runs with five channel data obtained from AMSU-B and MHS radiometers are 89, 150, 181, 184, and 186 Ghz channels. According to the study, three different flood cases have been selected. The rain rates and type of precipitation of the events have been obtained. Heavy rainfall occurred in Ağrı province on May 28, 2007. The rain rate has been calculated between about 2 to 5 mm/h, and the type of rain is stratiform. In the flood disaster that occurred on May 8, 2001, in Hatay, it has been determined that the rain rate is 5 mm/h and the precipitation type is stratiform. The rain that occurred on August 22, 2020, in Giresun, has taken twelve hours. The rain rate has been calculated at about 15 mm/h, and the precipitation type has been determined as convective.

In order to eliminate the false precipitation areas, it will be considered to add a snow mask and digital elevation map in the model. Additionally, the accuracy of the model will be tested using ground station data.

Keywords: AMSU-B, MHS, Passive Microwave, Precipitation Algorithm.

Potential Implication of Sea-Level Rise in Turkey and Its Vicinity

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ABSTRACT

As a consequence of climate change, sea-level rise has accelerated in recent decades. Latterly, sea-level rise and its potential implications have been a hot topic in Turkey with the increase in extreme events such as flooding and erosion. However, there are a few studies about sea-level rise and its impacts on the Turkish coasts. Turkey has the 17th longest shoreline with 8333 km in the world, and there are 28 coastal cities located around the shorelines. The contribution of the coastal region to the Turkish Gross National Product (GNP) is approximately 65% of the total. These cities cover about %28,5 of Turkish surface area, yet two-thirds of the population lives in coastal cities. Especially the Marmara region has a higher population density than other regions located in Turkey. Low-lying coastal areas are highly vulnerable to sea-level rise. High population density has led to significantly increasing anthropogenic stress and will likely induce and increase the impacts of sea-level rise in the region. This study presents primarily the change in sea-level rise in the Turkish seas and its vicinity at varying times over the last several decades based on hourly sea-level tide gauge data from PSMSL (Permanent Service for Mean Sea Level). The mean rate of sea-level rise over the Black Sea; 5,31 mm/yr in 1874-2018, the Marmara; 8,79 mm/yr in 1984-2009, the Aegean Sea; 0,844 mm/yr in 1969-2019, and the Mediterranean Sea; 0,8455mm/yr in 1923-2019 are estimated. Within the framework of these results, the socio-economic impacts of sea-level rise in the low-lying areas are discussed in this study.

***Keywords*:** Climate Change, Sea-Level Rise, Vulnerability, Turkish Coasts, Socio-Economic Impact.

BIOTECHNOLOGY, MOLECULAR BIOLOGY AND GENETICS

Recombinant Production and Characterization of Chitinase from *Pseudomonas mandelii* KGI_MA19

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ABSTRACT

Chitinases, enzymes used to remove chitin waste, enable chitooligomers to be used in agriculture, food, pharmaceutical industry, and medicine. Among them, cold-adapted chitinases can easily bind to their substrates with low activation energy, due to their adaptation to low temperatures and flexibility of their protein structures. The discovery of chitinase enzymes with new features, which can provide high efficiency by reducing energy consumption, is needed in the industry recently. The aim of the study is to produce and characterize the chitinase enzyme of the *Pseudomonas mandelii* KGI_MA19 strain isolated from the Antarctic. It is a psychrotolerant bacterium whose full genome was analyzed using next-generation sequencing by our group previously.

Within the scope of the study, genomic DNA isolation of the *P. mandelii* KGI_MA19 strain was done, and primers unique to the strain's chitinase gene sequence were generated using bioinformatics tools such as Primer-BLAST and OligoAnalyzer. The gene sequence of chitinase was amplified by PCR (Polymerase Chain Reaction) method with the help of the designed primers and then it was cloned into the pET-28a (+) expression vector. Sanger sequencing confirmed that the chitinase gene was cloned successfully. The recombinantly produced chitinase enzyme was purified using affinity chromatography approach via HisTrap™ column without any contaminant protein. Characterization of the purified enzyme is still in progress.

***Keywords*:** *Pseudomonas Mandelii*, Extremozyme, Recombinant Production, Chitinase.

Biopolymer Production Via Enzymatic Polymerization Method for Medical Use

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ABSTRACT

In this study, it was aimed to synthesize poly(ω-pentadecalactone-co-δ-valerolactone) for biomedical applications via enzymatic ring opening polymerization with high molecular weight, efficiency, and favorable physical properties. For the first time in literature, this copolymer is obtained by the catalysis of Candida antarctica lipase B (CALB) immobilized onto rice husk ash (RHA), which has been shown to be highly efficient for both polymerization and copolymerization of various lactones in previous studies. Copolymerization reactions were carried out at 80 °C for various reaction periods and monomer ratios. Molecular weights, monomer conversions, and monomer ratios of the samples were determined via Proton Nuclear Magnetic Resonance Spectroscopy (1H-NMR). Molecular structure was characterized by the use of both 1H-NMR and Fourier Transform Infrared Spectroscopy (FTIR). Also, thermal properties were investigated via Differential Scanning Calorimetry (DSC) and Thermal Gravimetric Analysis (TGA). After determination of highest molecular-weighted copolymer sample, copolymer was blended with gelatin in a suitable solvent system with a previously determined ratio. Prepared copolymer/gelatin blend was electrospun in order to obtain nanofibrous membranes and surface morphology was characterized via Scanning Electron Microscopy (SEM). Consequently, enzymatically synthesized poly(ω-pentadecalactone-co-δ-valerolactone) copolymers are suggested to be applied in biomedical applications such as, drug delivery and tissue engineering by participating in electrospun blends.

Keywords: Enzymatic Polymerization, Candida Antarctica Lipase B, Rice Husk ash, ω-Pentadecalactone, δ-Valerolactone, Electrospinning.

Biochemical Characterization of Truncated Amylopullulanase from *Thermoanaerobacter brockii brockii*

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ABSTRACT

Together with increasing environmental pollution caused by industrial production to supply growing human population needs have forced the industrial production stages to be shortened and carried out with high efficiency and eco-friendly. One of the most important step in ensuring these transformations is the usage of enzymes in industrial applications. Day by day the integration of enzymes into the industrial field is increasing which leads to the formation of an ever-expanding global enzyme market. The enzyme class-leading this enzyme market is the carbohydrases, which are commonly involved in starch hydrolysis processes and play an active role in detergent, textile and especially food and beverage industries.

In this study, *T. brockii brockii* thermostable amylopullulanase enzyme (TbbApu) which is the member of carbohydrase class was studied. Six C-term and N-term truncated variants which are TbbApuΔSH3, TbbApuΔCBM20, TbbApuΔX25-1-SH3, TbbApuΔX25-2-SH3, TbbApuΔX25-1-CBM20 and TbbApuΔX25-2-CBM20 of TbbApu were constructed. So the effects of X25 domain at the N-terminus of the enzyme and CBM20 and SH3 domain at the C-terminus on the substrate binding, activity and stability of the enzyme were elucidated. The gene sequences of six variants of TbbApu were obtained by PCR (Polymerase chain reaction) method with the help of the designed primers and the genes were cloned into the pET-28 a (+) expression vector. The expressed variants were purified at high purity using immobilized metal ion affinity and ion-exchange chromatography methods and the resulting variants were partially characterized.

***Keywords*:** Amylopullulanase, X25 Domain, CBM20 Domain.

Genome Wide Identification of Stable Intronic Sequence RNAs under Apoptotic Conditions in HeLa Cells

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ABSTRACT

Until recently, intronic transcripts were neglected since they were thought to be degraded rapidly. However, studies in *Xenopus* and *Drosophila* reported some stably expressed intronic sequences differentially expressed in early development. They are called stable intronic sequence RNAs (sisRNAs). They may be generated directly from undegraded spliced-out introns after pre-mRNA splicing or by transcription from their own intronic promoters. sisRNAs transcribed from their intronic promoter may have 5' cap and polyA tail. The molecular function of sisRNAs is unknown. At present, the extent of sisRNA expression in human is unknown as there is no genome-wide study documenting sisRNAs transcribed from their intronic promoters in human. Thus, we aimed to identify differentially expressed (DE) sisRNA transcripts in HeLa cells under apoptotic conditions. To this extent, HeLa cells were treated with cisplatin, a chemotherapeutic drug that induces the intrinsic apoptotic pathway. Then, deep sequencing of total RNA, polyA + and polyA eliminated fractions was performed with control and cisplatin-treated RNAs. The reads were analyzed by a *de novo* assembly method, De-kupl algorithm (a reference genome independent method) to identify DE intronic transcripts. The intronic reads identified through De-kupl analyses (both in total RNA and polyA+, not in polyA eliminated fraction) have been screened visually in Integrated Genome Viewer, and the ones with polyadenylation signal near their 3' ends and clear limits have been selected as candidates. Consequently, we have identified 48 sisRNA candidates. Transcription units of candidate sisRNAs were confirmed by 5' and 3' RACE experiments. This study reveals that human introns may harbour a novel class of noncoding RNAs, sisRNAs, with an intronic promoter that adds another layer of gene regulation in human.

***Keywords*:** sisRNA, Intronic Promoter, Apoptosis, Noncoding RNA.

The Genome-wide Investigation of lncRNA-chromatin Interaction in HeLa cells

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ABSTRACT

Long non-coding RNAs (lncRNAs) are transcripts longer than 200 nucleotides in length. Although they were considered non-functional by products of transcription in the past, a new function of these molecules is emerging each day. Perhaps, one of the most intriguing lncRNA functions is their nuclear function in coordinating various nuclear processes. Weak splicing signals, polyA signals within the molecules and specific sequences such as Alu repeats can cause lncRNAs to localize in the nucleus. Interestingly, a fraction of nuclear lncRNAs modulate chromatin dynamics in the nucleus. They can either directly interact with DNA or chromatin structure, or function via protein localization. These interactions can lead to changes in chromatin folding under various cellular conditions. iMARGI is a recently developed method employed to investigate such interactions in a genome-wide manner. Crosslinked lncRNA-DNA molecules are ligated inside the nucleus to probe lncRNA; chromatin interactions. In this study, we prepared a library of lncRNA-chromatin hybrids from adenocarcinoma, HeLa cells. Cloning of certain fragments showed combined DNA-RNA sequences. This approach can be applied to other cancer cell lines. Gaining insight into the lncRNA function in chromatin dynamics can increase our understanding on chromatin folding and gene expression, facilitating a better understanding of cancer molecular biology.

***Keywords*:** lncRNAs, Chromatin Regulation, lncRNA-Chromatin Interaction, iMARGI.

A CRISPR/cas9 Vector Construction for Engineering of Bacilysin Biosynthetic Operon in *B. subtilis* PY79

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ABSTRACT

Bacillus species produce a wide range of secondary metabolites with antimetabolic and pharmacological activities. The dipeptide antibiotic bacilysin, one of these important metabolites, is synthesized nonribosomally and excreted by certain strains of *Bacillus subtilis*. The *bac*ABCDEF operon is responsible for the biosynthesis of bacilysin and there is no clear strong ribosome binding site (RBS) surrounding the upstream of the *bac* operon (RBS). Sequence similarity of this location to the 3' end of 16S rRNA is particularly significant since the 16S rRNA pairs with the Shine-Dalgarno (SD) sequence on the mRNA, and thereby it directly affects translation efficiency. Conclusively, in this study, it is aimed to engineer the RBS of the *bac* operon and turn it into strong RBS to improve the bacilysin biosynthesis in *B. subtilis* PY79. For this, a CRISPR/cas9 bac operon RBS editing vector was constructed by using the plasmid pJOE9958.1. Firstly, a 932 bp homology template containing the strong ribosomal binding site (5'-GCTTAAGGAGGACAAACTC- 3') was generated by employing an overlap extension PCR strategy. For this, the 313 bp upstream region from *bacA* start codon was amplified via the first PCR reaction, and its 615 bp open reading frame was amplified via the second PCR reaction. Subsequently, the first and the second PCR products were aligned together and amplified via the third PCR reaction, resulting a 932 bp homology template extending with SfiI cutting sites. It was then ligated into Sfi1 cutting site of pJOE9958.1 to construct pJOE9958.1 .*bacA*strongRBS. A 20 nt sgRNAs for targeting of *bacA* RBS site was designed with the CRISPR-Cas9 online prediction tool CCTop. This sequence was synthesized into two complementary oligonucleotides and inserted between the *Bsa*I sites of pJOE8999.bacAstrongRBS and the resulting plasmid described as pJOE9958.1.*bacA*strongRBS.sgRNA. This final CRISPR/cas9 vector can be effectively used for editing the RBS region of the *bac* operon to improve the bacilysin biosynthesis in *B. subtilis* PY79.

***Keywords*:** Bacilysin Biosynthesis, *bac*ABCDEF, CRISPR/cas9, Ribosome Binding Site.

Controlled Release of Tetracycline Hydrochloride from Silica Based Polycaprolactone Nanohybrides

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ABSTRACT

In this study, it was aimed to make microparticles by using water-soluble drug tetracycline hydrochloride which is an antibiotic used to treat a wide variety of infectionsand polymer Polycaprolactone for biomedical applications via water-oil-water (W/O/W) double emulsion solvent evaporation method. Rice husk ash (RHA) silanized with 3-Glycidoxypropyltrimethoxysilane was used as support material to immobilize Candida antarctica lipase B. The developed biocatalyst was then utilized in the ring opening polymerization (ROP) of epsilon-caprolactone and in situ development of Polycaprolactone/Silica nanohybride. Polymerization reactions carried out at 40°C 48 hour sand after48 hours polymerization, precipitate out in methanol and synthesized nanohybride polymers. After synthesized nanohybride polymers, prepared microparticles by using nanohybrid polymers which synthesized earlier and drug tetracycline hydrochloride via double emulsion solvent evaporation method. Tetracycline hydrochloride is solved in distilled water, and Polycaprolactoneis solved in chloroform. Prepared first phase Water in Oil by dispersion of polymer solution and drug solution within each other. Then added Water in Oil suspension in Poly-vinyl alcohol which is being water phase of this method. Synthesized Polycaprolactone/Silica nanohybrids was used for the controlled delivery and release of tetracycline hydrochloride (TCH) antibiotic. Varied amounts of tetracycline hydrochloride including PCL/Silica nanohybrid/PVA (1:10, v:v) binary polymer blend was microparticules. We used various PVA concentrations and drug amounts to find best proportions for encapsulation efficiency. Afterwards, in vitro drug release studies were carried out and followed by a sustained release through 27days.

***Keywords*:** Candida Antarctica Lipase B, Rice Husk Ash, Epsilon-caprolactone, Tetracycline Hydrochloride, Electrospinning, Emulsion Solvent Evaporation, Microparticles.

Stress Resistance Analysis of Yeast Strains with Mitotic Exit-Related Gene Deletions

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ABSTRACT

The yeast *Saccharomyces cerevisiae* is a commonly model organism to study the complex eukaryotic processes, including cell division. Yeast cell cycle is controlled by activity of cyclin-dependent kinases (Cdk). The expression and degradation of cyclins regulate Cdk activity to maintain the order and timing of the cell cycle events.

Mitotic exit requires inactivation of mitotic cyclin-Cdk complexes (M-Cdk) and dephosphorylation M-Cdk targets. Mitotic exit in yeast is achieved by a phosphatase named Cdc14. Cdc14 dephosphorylates Cdh1 subunit of the E3-Ubiquitin ligase Anaphase-Promoting-Complex to promote ubiquitin dependent proteolysis of M-cyclins. In addition, Cdc14 dephosphorylates the transcription factor Swi5 to promote transcription of the M-Cdk inhibitor Sic1. Cdc14 also dephosphorylates Sic1 to stabilize it. Thus, Cdc14 is the key protein for mitotic exit in budding yeast. Fourteen Early Anaphase Release pathway (FEAR) and Mitotic Exit Network (MEN) activate Cdc14 through its release from nucleolus. FEAR-released Cdc14 contributes to chromosome segregation, spindle stabilization and disassembly. Spo12 is an essential protein for FEAR. MEN-released Cdc14 mediates mitotic exit. MEN is driven by the GTPase Tem1. The Spindle Position Checkpoint (SPOC) inhibits MEN upon spindle mispositioning. When SPOC is active, Bfa1-Bub2 GAP complex inhibits Tem1 to block mitotic exit. Bfa1-Bub2 activation relies on kinase Kin4 and phosphatase Glc7.

This study aims to investigate the effects of stress factors such as rapamycin, chromium, aluminum, nickel, manganese and H_2O_2 on various S. cerevisiae strains with deletions in certain mitotic exit-related genes. The deletion strains including *bfa1Δ, spo12Δ, kin4Δ and Gal1-GLC7-GFP* and their control strains were subjected to stress resistance tests by spot assay. Cells were grown on YPD broth and spotted on YPD agar plates including each stress factor. Stress resistance levels of each deletion strain was determined in comparison with their control strains, and the results were evaluated, based on a detailed literature survey.

***Keywords*:** *Saccharomyces cerevisiae*, Mitotic Exit, Stress Resistance.

First Report of the Open Reading Frame (ORF) and Indel Polymorphisms of the Prion Protein Gene (PRNP) in Eswatini Indigenous Cattle Breed Bos Indicus and Bos Taurus Africanus

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ABSTRACT

Bovine spongiform encephalopathy (BSE) is one of the numerous lethal neurodegenerative illnesses caused by infectious prion proteins known as transmissible spongiform encephalopathies (TSEs). Genetic variations correlated with susceptibility or resistance to BSE for bovine strains from Eswatini Nguni cattle have not been reported thus far, although these native cattle are consumed as meat and health food. Therefore, this study aimed to look at prion protein variation in Eswatini native domestic livestock. Such knowledge may be used to create strategies for regional control of animal genetic capital, such as the survival and long-term use of the Nguni breed in Eswatini. To describe the bovine *PRNP* polymorphisms of Nguni animals, we explored the prion protein gene in both the coding region (open reading frame) and non-coding region (promoter indel polymorphism), computationally assessed the effect of variants on prion protein stability, investigated the genotype and allele frequencies of *PRNP* polymorphisms, and compared these polymorphisms with those previously reported for BSE-affected animals in this work. In the coding region of the *PRNP* gene, we discovered and assessed mutations and polymorphisms. Three synonymous polymorphisms were found, of which two were identified as novel polymorphisms, the third position of codon 78 G→A, the third position of codon 113 C→T a novel polymorphism, and the third position of codon 226 T→C a novel polymorphism. Furthermore, in the non-coding region of the *PRNP* gene in bovines, we explored the insertion/deletion (indel), such as indels of 12-base pairs (bp) in intron 1 and 23-base pair (bp) in the promoter region of the bovine *PRNP* gene. The results of the Nguni breed had a greater incidence of deletion alleles for both the 12-bp and 23-bp as opposed to insertion. Due to the comparatively high frequency of deletion genotypes and alleles of 12 and 23-bp indel polymorphisms, the susceptibility to BSE is significant for Nguni cattle.

Keywords: Bovine Spongiform Encephalopathy, Prion Protein Gene, Polymorphism, Eswatini Nguni Cattle.

Genetic Stability Analysis of Boron Stress-Resistant *Saccharomyces cerevisiae*

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ABSTRACT

Evolutionary engineering, which is an inverse metabolic engineering approach, is a powerful strategy to obtain industrially important, desired microbial phenotypes. Evolutionary engineering consists of systematically repeated random mutation and selection cycles to obtain desired phenotypes, followed by physiological and omic-level (genomic, transcriptomic, proteomic, etc.) analyses of the desired phenotypes. Prior to these detailed analyses and characterization of the evolved strains, however, it is crucial to verify that the evolved strains are genetically stable.

Boron is an essential micronutrient for plants and it is beneficial for animals as an ultra-trace element. The main function of boron in the cell is the formation of boric acid and low concentrations of borate anion which both can react with various sugars, glycoproteins, glycolipids and phosphoinositides to form complexes. However, high boron concentration has a toxic effect on microorganisms, as boron can bind to molecules such as ATP, NADH, RNA and inhibit metabolic functions. The exact molecular mechanisms of boron stress response and resistance in the yeast *Saccharomyces cerevisiae* are yet to be understood, based on the analysis of boron stress-resistant *S. cerevisiae* strains.

The purpose of this study was to determine the genetic stability of a boron stress-resistant *S. cerevisiae* strain previously obtained by evolutionary engineering. For this purpose, the evolved yeast strain was cultivated in non-selective (boron-free) YMM medium by passaging 10 consecutive times. Boron stress-resistance of culture passages were determined by plating culture samples in boron-containing YMM agar, using spot assay technique. The genetic stability results were evaluated based on the boron stress-resistance levels of each culture passage.

Keywords: Evolutionary Engineering, Stress Resistance, Boron, Yeast, *Saccharomyces cerevisiae*, Genetic Stability.

CHEMISTRY, CHEMICAL ENGINEERING, METALLURGICAL AND MATERIALS ENGINEERING

Evaluation of Kinetic Models Via Computational Optimization Techniques for Direct Syngas-to-Olefins Process

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ABSTRACT

In this study, the kinetics of Fischer-Tropsch (FT)-to-olefins were investigated on activated carbon-supported FeCuK catalysts. The kinetic experiments were performed in the fixed-bed reactor under reaction conditions without external diffusion limitations. Two different numerical methods have been made with the models that are considered to best describe the kinetic data. The two models proposed by A.N. Fernandes and Y.N. Wang were chosen. The differential equations were presented in the derivative form of conversion and the Euler method was applied. Alternatively, the ode45 function in MATLAB R2021a which uses the Runge-Kutta method was employed. Kinetic parameters, namely activation energy and specific reaction rate constants have been calculated. Calculated kinetic parameters were validated experimentally. Comparing the two methods solutions applied to the kinetic model, the ode45 function approach gave better accuracy. When the two kinetic models were compared with two different methods, calculated kinetic parameters were achieved with fewer errors in the Fernandes model with the ode45 function. For instance, hydrogen conversion measured in the validation experiments could be calculated with an error of 2-8% by the applied kinetic model. On the other hand, while the error calculated in CO conversion is 4-7% at high gas hourly space velocity (GHSV) values, CO conversion can be calculated with higher error values of up to 30% at low GHSV values. For hydrocarbon products, on the other hand, ethylene can be calculated with an average error value of 30%, while propylene can be calculated with a much less error value of 0.5 – 13%. Calculated activation energies for the reactions giving methane, paraffin, and olefin were 108.7 kJ/mol, 107.7 kJ/mol, and 91.5 kJ/mol, respectively. However, Fernandes's model neglects olefin re-adsorption, unlike Wang's model, so Wang's model seems more appropriate to estimate paraffin products. All in all, as per calculations on experimental analysis, both models need improvement in terms of product distribution.

***Keywords*:** Kinetics, Fischer-Tropsch, Advanced Optimization, Multi-objective Generic Algorithm.

Derivation of Carbon Adsorbents from UiO-67 Metal Organic Framework to Removal of Indole from Liquid Fuels

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ABSTRACT

Fossil fuels contain pollutants such as sulfur and nitrogen compounds. There are various methods available to remove these polluting components from fuels. Adsorption, desulphurization and denitrogenation can be examples for these methods. In the adsorption, various adsorbents are studied in the literature. Among these adsorbents, metal organic frameworks are a new class of materials. They are unique materials with the pores they contain.

In this study, UiO-67 was synthesized which has not been used in the removal of nitrogeneous component indole. Then, the synthesized UiO-67 was heated under nitrogen cover in a muffle furnace at 400, 600 °C, for 2 and 6 hours. Adsorbents with zirconium metal array on carbon were derived. Removal of indole was investigated with these adsorbents by adsorption. Also, the effect of heating temperature and heating times on adsorption was observed. Adsorption amount, kinetic and isotherm was studied with this carbon adsorbents and UiO-67. At the end of the study, it is aimed to contribute the prevention of environmental pollution caused by the emission of indole.

According to the experimental studies, UiO-67-400°C-6h adsorbent has the highest adsorption capacity and adsorption yield. Adsorption efficiency is calculated as 57.46% at 1 mg adsorbent amount for UiO-67-400°C-6h.

It has been observed that carbon adsorbents, which are derived by heated at 400° UiO-67-400°C-6h and 600° UiO-67-600°-6h (43.99%), have higher adsorption efficiency than UiO-67 (11.04%) at 1 mg adsorbent amount. Also, all adsorbents and UiO-67 are coherent with pseudo first and second order kinetic models. Carbon adsorbents are coherent with Freundlich and Dubinin-Raduschkevich isotherm models.

Keywords: UiO-67, Carbon Adsorbents, Indole, Fuels.

Synthesis of Porous Boron Carbon Nitride ($B_xC_yN_z$) and Usage in Wastewater Treatment

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ABSTRACT

Water pollution is a worrying reality all over the world mainly due to rapid industrial growth. Industrial wastewaters contain toxic heavy metals. In this context, there is an ever-growing interest for new adsorbent materials to be used to remove heavy metals from wastewaters. Recently various boron compounds have been proposed as adsorbents for heavy metals. One of the most worrisome of the heavy metals that cause water pollution is Pb^{2+}. Considering the importance of initiatives to produce high value-added boron products for Turkey's prosperity and future, in this study, porous boron carbon nitrides ($B_xC_yN_z$) were successfully prepared and tested for Pb^{2+} adsorption performances.

Preparation was performed by direct thermolysis under air atmosphere. Boric acid and melamine were used as starting materials. 3-factor 2-level full factorial design was used. The investigated variables are the molar ratio of melamine to boric acid (3:1, 3:3, and 3:5), the time (2, 3, and 4 hours), and the temperature (500°C, 550°C, and 600°C) of the thermolysis. XRD, SEM, FTIR, and BET measurements were used for the characterization of the prepared samples. To compare the Pb^{2+} absorption capacities of the synthesized $B_xC_yN_z$ samples, measurements were conducted by equilibrating 50 ppm Pb^{2+} solution and adsorbent in an adsorbent content of 0.4 $g{\cdot}L^{-1}$. Adsorption isotherms were obtained by using the sample providing the best adsorption capacity. The solutions with initial concentrations in the range of 25-250 ppm were used. The Pb^{2+} concentrations in the solutions were determined by ICP. The best performance with the maximum adsorption capacity of 362 mg Pb^{2+}/g adsorbent was obtained with the sample prepared using Boric acid: Melamine molar ratio 3:5, thermolysis temperature, and time of 500 °C and 4 hours, respectively. The Langmuir isotherm was found to be appropriate to describe the ion exchange equilibrium.

***Keywords*:** Boron Carbon Nitride, Thermolysis, Lead, Adsorption, Wastewater Treatment.

Characterization Studies of W-1 wt% Ni Matrix Composites Reinforced with CeB_6 Particulates by Powder Metallurgy Methods

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ABSTRACT

This study reports the effect of milling type on the microstructural, physical and mechanical properties of the W-1 wt% Ni-x wt% CeB_6 (x=1, 2, 5, 10) composites. Powder blends having the composition of W-1 wt% Ni were milled at room temperature for 6 h using a Spex 8000D Mixer/Mill rotated at 800 rpm. Then, CeB_6 powders were produced from CeO_2, B_2O_3 and Mg starting materials by mechanochemical synthesis. W-1 wt% Ni powders were reinforced with CeB_6 by using 6 h mechanical alloying. Also, powders were compacted in a hydraulic press under a uniaxial pressure of 480 MPa for 1 min and subsequently cold isostatic pressing was employed. Green bodies were sintered at 1400 °C for 1 h under Ar/H_2 gas atmosphere. Also, powders were sintered with using spark plasma sintering at 1400 °C for 1 min. Phase and microstructural characterizations of the milled powders and sintered samples were performed using X-ray diffractometer (XRD), TOPAS software, pycnometer, scanning electron microscope/energy dispersive spectrometer (SEM/ EDS) and particle size analyzer (PSA). Archimedes' density, Vickers microhardness measurements and sliding wear tests were also conducted on the sintered samples. Spark plasma sintered and pressureless sintered samples were compared with each other. Pressureless sintered W-1 wt% Ni-2 wt% CeB_6 sample had the highest hardness (6.796 ± 0.08 GPa) and lowest wear volume loss (0.992×10^{-4} mm^3) among the all pressureless sintered composites. Besides, spark plasma sintered W-1 wt% Ni-10 wt% CeB_6 sample exhibited the highest hardness (20.76 ± 0.39 GPa) and lowest wear volume loss (0.21×10^{-4} mm^3) among the all spark plasma sintered composites.

Keywords: Sintering, Mechanochemical Synthesis, W-Ni Matrix Composites, Characterization, Mechanical Alloying.

Fabrication of Enhanced Core-Shell Co-ZIF-67@MO_x (M = Zn, Mn and K) Nanocomposites via Intermediate Pyrolysis and Plasma Treatment for Fischer Tropsch Synthesis

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ABSTRACT

Shortage of crude oil and environmental pollution problems oblige humanity for the research on alternative processes of producing value added chemicals. To overcome this situation, Fischer Tropsch Synthesis (FTS), which produces valuable chemicals and clean liquid hydrocarbons by transforming the syngas (CO and H2) derived from coal biomass such as carbon-containing wastes, is one of the best alternatives. In FTS, catalysts have crucial impact on activity and selectivity that is why catalyst design has a vital role. Agglomeration problem, stability, deactivation rate; surface area, activity and, selectivity are the significant properties of catalyst. Zeolitic imidazolate frameworks (ZIFs) which are subclass of Metal-Organic Frameworks (MOFs), have crystalline structure, extremely high surface area and tunable pore aperture as well ZIFs consist of transition-metal cations. At ZIF-67, cobalt is the transition metal that has high FT activity, high selectivity to paraffins and low water-gas shift activity. In this work, it is aimed to develop novel core–shell-structured Co-ZIF-67@MOx (M = Zn, Mn and K) nanocomposites via intermediate pyrolysis and plasma treatment. Metal-organic Frameworks (MOF) structure of Co-ZIF-67 enhance catalytic surface area, selectivity and activity. Moreover, with pyrolysis highly dispersed metal-embedded graphitized catalysts could be produced while preventing agglomeration of Co3O4 particle, thus, active nanoparticles for FTS can be achieved. Furthermore, dispersion degree of cobalt active metal sites would be also well preserved via calcination process. As an originality of this research, it is believed that modification of surface properties and crystalline structure of catalyst would be adjusted with plasma treatment to improve stability and activity of the catalyst. Co-ZIF-67s was subjected to plasma technique prior to the corresponding pyrolysis and calcination steps which is applied for the first time in this field. In this regard, ZIF-67 were synthesized and then 12 catalysts were produced as follows: 6 of them were pyrolyzed between 400-900°C without any plasma treatment, rest of the samples were pyrolyzed between 400-900°C after plasma treatment later on pyrolysis 12 samples were calcined. In the manner of selectivity and activity, the prepared Co-ZIF-67 catalysts were evaluated for their FTS performance under the conditions of 230°C, 15 bar, H2/CO = 2, and GHSV of900 mL.g-1h-1. As a result, CO conversion -C5+selectivity of pyrolyzed catalysts at 400°C, 500°C, 600°C, 700°C,800°C, 900°Care obtained as follows:10.5-14%, 24.5-22%, 25.5-23.2%, 12-21%, 6.6-22.4%, 4.9-31.2%. This study provides better understanding on the effect of plasma treatment.

***Keywords*:** Metal Organic Framework Mediated Synthesis (MOFMS), Plasma, Fisher Tropsch Synthesis, Pyrolysis.

Examination of Phosphorus (V) Oxychloride Solutions as Alternative Phase Change Materials in Cold Storage for Tropical Fruits

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ABSTRACT

Cold chain management (CMC), one type of supply chain management, is of great importance, especially for temperature-sensitive and perishable foods. Tropical fruits could be listed in the class of perishable foods, and their storage life highly depends on the temperature. Thus, the temperature of tropical fruits should be reduced as soon as possible after harvest and should be kept under a certain value depending on their type. Therefore, cold storage is the main issue under consideration for keeping the quality of these fruits. Even though the cold storage systems provide the required temperature values, they are responsible for a huge amount of energy consumption, and also their performance has been underwhelming during power failure. Phase change materials (PCMs) integration into these systems is one of the most preferred techniques to eliminate these problems. Thus, in this study, a cooling system was operated for 11 ℃ differential value due to the storage temperature of tropical fruits (5-13 ^{o}C) with PCM solutions. Phosphorus(V) oxychloride ($POCl_3$) solutions with low concentrations (0-2 wt.%) were prepared as PCMs because of their suitable phase change temperature. The results showed that the running time percentage was significantly reduced with PCM integration, and the minimum running time percentage (11.1%) was achieved with 1.65 wt.% $POCl_3$ solution. The advantage of PCM integration was also investigated for the power failure period. The reaching of cabin air temperature to the ambient temperature of 18 ^{o}C was maximized with 1.65 wt.% $POCl_3$ solution. It took approximately 5.0 times more hours than that of the case without PCM. All results deduced that even though it needs to be more careful during the usage of the $POCl_3$ solutions, the $POCl_3$ solutions with low concentration might be preferred as an alternative PCM not only for the storage life prolongation of tropical fruits but also for extending the compressor's lifespan.

***Keywords*:** Cold Storage, Tropical Fruits, Phase Change Material, Phosphorus(V) Oxychloride, Energy Consumption, Power Failure.

Enhancing the Performance of Freezers with Phase Change Materials

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ABSTRACT

Freezers are widely used refrigeration systems due to their providing required temperature for preserving temperature-sensitive and perishable food. Even though the air temperature of freezers is theoretically monitored at -18 °C with the thermostats, the temperature fluctuations can occur during storage and transportation. Hence, the system temperature is reported over the recommended temperature. The main concern with this temperature fluctuation is the quality loss of frozen products, besides huge energy consumption to achieve the required temperature values. These systems are widely operated with phase change materials (PCMs) to keep temperature value at a required value with less energy consumption. PCMs, undergo a phase change, which allows for the storage or release of latent heat. Therefore, the temperature could be controlled more easily than that of the case without PCM. There are lots of parameters that should be under consideration during PCM integration to the refrigeration systems, such as PCM type, location, *etc*. The objective of this study was the investigation the effect of various PCMs integration on the performance of a cooling system simulating a freezer operating over the recommended temperature. Sodium chloride (NaCl) solutions were selected as PCM due to their appropriate phase change temperature. These eutectic solutions were prepared with borax and carboxymethyl cellulose (CMC) as nucleating and thickening agents, respectively. The effect of different concentrations of NaCl (16 and 4 wt.%), borax (0-2 wt.%), and CMC (1 and 1.5 wt.%) was examined for a cooling system operating between -5 to -13 °C. All results reveal that the performance of the freezer highly depends on the concentrations of both NaCl and the agents. The best PCM candidate was determined as the solution of 4 wt.% NaCl -1 wt.% CMC-1 wt.% borax. The results showed a 26% reduction in the running time percentage for this PCM compared to the case without PCM. The cabin air temperature change was also recorded during a power failure. The reaching of cabin air temperature to the ambient temperature of 18 °C took 3 times more hours than that of the case without PCM. According to the evaluations, integrating the appropriate NaCl solution together with the agents as PCM into a freezer provides an advantage in terms of energy consumption as well as allowing the temperature to be kept at required levels for long time periods during power failure. In sum, the suitable NaCl-Borax-CMC solution might be suggested as an alternative PCM for freezers.

***Keywords*:** Freezer, Energy Consumption, Phase Change Material, Power Failure.

Investigation of the Activation Routes and Nitrogen Doping on Carbon Residues from High Temperature Pyrolysis of Lignocellulosic Wastes

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ABSTRACT

Hydrogen is considered a green energy carrier when its production depends on renewables and sustainable sources. However, there exists some challenges on hydrogen production such as high cost, storage and transportation. In order to reduce the cost, integrated process designs are needed for value-added byproducts. In this regard, the production of functional carbon materials such as biochar, activated carbon and carbon black have great importance. Activated carbon, thanks to its high surface area and improved porosity, has an exceptional adsorbent performance, especially for CO2 capture. In this study, the aim is to produce syngas rich in hydrogen and to receive activated carbon as byproduct by using lignocellulosic wastes. High temperature pyrolysis of apricot kernel, hazelnut and walnut shells were executed at 800°C under nitrogen atmosphere. Chemical and physical activation were applied in order for the carbon residue left upon pyrolysis to improve its CO2 capture capacity. To bring the carbon residue to commercial grade activated carbon quality, four different activation routes were investigated: impregnation with KOH 1:1 (w/w) before pyrolysis, chemical activation with KOH 1:1 (w/w) after pyrolysis, physical activation with steam (20 g/h), and activation with KOH 1:1 (w/w) under CO2 atmosphere (0.5 l/min). The best sample in terms of their physicochemical properties such as surface area, surface functional groups etc. was chosen for further chemical modification, namely nitrogen doping and its CO2 capture feature before and after doping was examined. Activation procedures were applied successfully and H/C and O/C data plotted on the van Krevelen diagram. Catalytic effect of activation performed with KOH before pyrolysis was observed evidenced by an increase in hydrogen share in syngas from 19.91-23.12% without activation to 33.58-39.43% with activation. Finally, the surface area of steam activated carbon from walnut shells was measured as 507 m^2/g.

***Keywords*:** Hydrogen Production, High Temperature Pyrolysis, Activated Carbon, Carbon Dioxide Capture.

Photocatalytic Activity of Hydroxyapatite/Graphene Oxide Composite for Degradation of Ciprofloxacin in Aqueous Solution

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ABSTRACT

Water pollution is a global problem and has reached a critical point nowadays. Pharmaceutical pollutants, which are one of the causes of water pollution, are water pollutants whose health and environmental effects should be taken into account. Ciprofloxacin (CIP) is one of the most commonly detected antibiotics in water resources due to its widespread use. Considering the long-term persistence of CIP in the environment and its negative effects on microbial communities in the ecosystem, it is necessary to remove it from wastewater.

Hydroxyapatite (HAp), ($Ca_{10}(PO_4)_6(OH)_2$), is a biomaterial that is frequently used in studies in the field of water pollution removal due to its important properties such as high adsorption capacity, acid-base adjustability, ion exchange capacity, and thermal stability. Graphene Oxide (GO) is a preferred material for applications in environmental remediation. GO consists of several functional groups such as hydroxyl, carboxyl, and epoxy groups, which provide adsorbing sites for pollutants in water. GO stands out among carbon-based adsorbent materials in terms of low cost, easy processing, environmental friendliness, and biocompatibility.

In this study, composites were synthesized by using HAp and GO materials for the removal of CIP from wastewater. The synthesized HAp/GO composite was successfully characterized using FTIR. In order to determine the most suitable removal conditions, the initial drug concentration, weight of GO in the composite structure, ambient pH, and agitation speed were determined as parameters. Samples were prepared as 50 mg composite and 50 mL drug solution. Experiments were designed and carried out with the Minitab program using "Box-Behnken", which is one of the experimental design methods. In addition, the experimental results obtained were also evaluated in this way. Among the samples, the HAp/ GO composite consisting of 150 mg GO has the best photocatalytic performance. 94.7% of ciprofloxacin was degraded in the condition of ambient pH 7, initial CIP concentration 10 ppm, the HAp/GO composite prepared with 150 mg of GO, and shaker speed 125 rpm. As a result of the study, it was observed that GO addition increased the photodegradation capacity of HAp, and HAp/GO has a potential as a photocatalyst for CIP degradation. The effect of the amount of composite on the efficiency was investigated by adding 25, 50, 75, and 100 mg of the HAp/GO composite under the experimental conditions with the highest efficiency. In experiments with 75, and 100 mg HAp/150GO composite added, 100% yield was obtained.

***Keywords*:** Ciprofloxacin, Graphene Oxide, Hydroxyapatite, Photocatalytic Degradation.

The Production of H. Perforatum Oil Incorporated Antibacterial Thermoplastic Polyuretahane (TPU) Nanofibre Mat

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ABSTRACT

In this study, a novel wound dressing was engineered by combining thermoplastic polyurethane (TPU), fish skin gelatin (FSG) and H. Perforatum Oil (H.P. Oil) by the emulsion electrospinning technique. Scanning Electron Microscopy (SEM), Attenuated Total Reflectance / Fourier transform infrared spectroscopy (ATR-FTIR), Thermogravimetric Analysis (TGA), water contact angle (WCA), water vapour transmission rates (WVTRs) and the fluding handling capacities and pH measurements were performed on the obtained TPU mats. The average fibre diameters of 5%(E-1), 8%(E-2), 10%(E-3), and 12%(E-4) H.P.Oil containing defect-free nanofiber mats were calculated between 410±158 nm- 514 ± 136 nm which were suitable to mimic the native Extracellular Matrix (ECM) with these diameters. ATR-FTIR analysis showed the interactions between TPU and FSG. In addition, the characteristic absorbance peak at 1744 cm-1 confirmed the presence of carbonyl groups (C=O) belonging to the ester bonds of the H.P.Oil, which is an indication of the incorporation of H.P.Oil into the produced TPU mat. TGA results also confirmed the interactions between the components of the nanocomposite fibre and agreed with FTIR. Increasing the WCA from 83.24 ± 2.91o in the oil-free control(C-1) sample to 100.67±7.00o in the presence of H.P. Oil can promote healing without irritating the wound site by increasing hydrophobicity and facilitating protein adsorption. The moisture-controlling performance of the produced mats was evaluated by performing WVTRs and fluid handling capacity tests. As the WVTRs of TPU mats containing 8%(E-2), 10%(E-3), and 12%(E-4) H.P. Oil in the first 3 days were determined between 1789 ± 117 g.m-2.day-1-1883 ± 140 g.m-2.day-1. At the end of the first weeks, WVTR values reached a balance at the levels at the range of and 992 ± 145 g.m-2.day-1 - 1258 ± 74 g.m-2.day-1. Meanwhile, the fluid handling capacities of the same samples varied between 8.2±0.9 g.g-1 - 10.4±0.6 g.g-1. The moisture-controlling performance of the produced TPU nanofiber mats were found suitable to absorb the exudate and transmit water vapour for moderate to high exudating wounds. The slightly alkaline pH value (7.31) of the C-1 sample decreased to a slightly acidic pH (to 6.62) with the inclusion of H.P. Oil in the nanofiber mats, which improves the healing process.

In conclusion, the produced H.P. Oil encapsulated TPU nanofibre mats indicate a promising dressing candidate for wound dressing application.

Keywords: Wound Dressing, Emulsion Electrospinning, Thermoplastic Polyurethane, Fish Skin Gelatin, H. Perforatum Oil, St. John's Wort Oil.

Rethinking the Design of a Hybrid Extraction-Distillation Process for Purification of Biobutanol from ABE Fermentation Broth

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ABSTRACT

As a result of the rapid growth of the world population and shortage of fossil fuels, there is a high demand for fuel resulting in environmental concerns about fossil fuel usage. Thus, alternative energy sources play an important role instead of conventional fuels. One of the promising alternatives is biofuels, and among alternative biofuels, biobutanol comes forward with its higher fuel value and lower volatility compared with bioethanol.

In several studies, acetone-butanol-ethanol (ABE) fermentation is used for biobutanol production. However, because of the butanol toxicity to microorganisms, a dilute fermentation broth is obtained with a very low concentration. In addition, there are homogeneous (ethanol water) and heterogeneous (butanol-water) azeotropes in the fermentation broth making the purification of biobutanol a challenging work.

Several process configurations have been studied in the literature to separate the components of ABE fermentation broth. One of the studied configurations is the hybrid extractor-distillation process, where it is claimed that all the water can be removed from the raffinate of extraction with the help of a solvent agent called hexyl acetate. Thus, the extract includes only the ABE mixture and hexyl acetate, and they can be easily separated using conventional distillation columns since there is no more azeotrope in the process.

However, the recent studies conducted by us show that although most of the water is removed from the raffinate of extraction, there is still a significant amount of water leaving the extractor in the extract phase along with ABE mixture and hexyl acetate. Thus, there are still azeotropes in the process, and separation of this mixture only with a conventional distillation column is impossible.

This study aims to propose a new process configuration including extraction and distillation stages to purify biobutanol from the fermentation broth. In this novel configuration, the extract phase of the extractor is fed into an extractive distillation process to separate the remaining water from the ABE mixture by using hexyl acetate as the entrainer. The distillate of the extractive column consists of water and entrainer which are separated using a decanter. The bottoms of this column are sent to a recovery column to remove the entrainer from the bottoms and recycle back to the upstream units. The distillate stream including ABE mixture is then sent to a conventional distillation column sequence to purify butanol, acetone, and ethanol.

The simulations are conducted using Aspen Plus. The proposed process configuration is optimized by minimizing the total annual cost (TAC) where grid search is used as the optimization algorithm. For consistency, feed properties, thermodynamic model, and binary interaction parameters are taken from studies published in the literature.

***Keywords*:** Biobutanol, ABE Fermentation, Aspen Plus, Azeotropic Distillation, Extractive Distillation, Process Design.

Texture and Microstructural Evolution of AISI 4140 Steel During Tube Spinning Process

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ABSTRACT

Tube spinning is an efficient bulk metal forming process used to produce high precision, thin- walled, conical and multi-contoured and seamless tubes and cups with improved mechanical properties. Tube spinning has been an important constituent of the aerospace, automotive and nuclear industry for over six decades, due to its promising process features and applicability to form an extensive range of materials. Understanding the deformation mechanism of tube spinning is challenging due to relatively complex forming forces and varying process parameters. Although a large number of researches has been published in the literature, investigating the deformation mechanism of tube spinning at the micro level is limited. This study aims to provide an insight into the deformation mechanism of backward tube spinning, focusing on microstructural and crystallographic texture evolution of AISI 4140 low-alloy and medium-carbon steel, and comparing trials with varying process parameters in terms of reduction in thickness, feed ratio, staggered spinning and number of passes. Metallographic analysis was conducted by optical microscope (OM). Considering optical microscope analysis, tube spinning resulted in directed and relatively uniform microstructure with reduced and homogeneous grain size distribution. By X-ray diffraction (XRD) analysis, an important step was taken to understand approximately the texture evolution during tube spinning. The texture evolution of the body-centered cubic (BCC) crystal structure was observed with an increase of reduction in thickness. To understand the relationship between process parameters and hardness variation, the hardness variation of each trial was determined through wall-thickness by the Vickers hardness test. Hardness variation was non-homogeneous, varying from tube outer diameter to tube inner diameter.

***Keywords*:** Tube Spinning, Flow Forming, Deformation Mechanics, Texture Evolution, Microstructural Analysis.

Fatigue Behaviour of Micro-Arc Oxidation Coatings

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ABSTRACT

Nowadays, one of the global concerns is excessive fuel consumption and CO2 emission. One of the approaches is to reduce the weight of vehicles in the automotive industry to reduce emissions. Therefore, the use of lightweight metallic alloys as a substitute for steel and cast iron is highly demanded; however, they possess low wear resistance and are prone to corrosion under harsh service conditions.

Micro-arc oxidation (MAO) process, is one of the attractive techniques for light metallic alloys to generate hard, thick, and well-adhered oxide-based coatings for protection against wear- and corrosion- related failures. Among several commercially used surface modification techniques such as hard anodizing, physical vapor deposition, chemical vapor deposition, and electroplating, the MAO process has various advantages; its cost-effectiveness, ability to coat the complex geometries and the internal surfaces. In the open literature, the wear and corrosion resistance of MAO coatings are vastly investigated. However, fatigue behavior and microstructure-fatigue relation of MAO coatings were rarely studied and discussed.

Therefore, in the present study, MAO coatings were deposited on 6082 aluminum alloy after the substrates were ground with the grits of P400, P800, P1200 and P2500 silicon carbide papers. A basic electrolyte was prepared using sodium aluminum oxide (NaAlO2, Alfa Aesar) and potassium hydroxide (KOH, Aldrich). After the MAO treatment, fabricated samples were cleaned ultrasonically in ethanol, distilled water and dried at room temperature. After microstructural characterization, fatigue tests were deployed by a rotating bending fatigue tester for untreated and MAO'ed samples.

Keywords: Micro-Arc Oxidation, Light Metallic Alloys, Microstructure, Fatigue Behavior.

Synthesis of EMT Zeolite and Its Coatings in Different Ionic Forms

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ABSTRACT

EMT zeolites have favorable properties for adsorption and catalysis. These highly metastable materials are generally synthesized by using expensive organic templates which are not environmental friendly. Such facts prevent the common use of EMT zeolites in commercial applications. The presence of organic templates makes the preparation of zeolite coatings difficult, too. Consequently, there is not much research in literature on the preparation of coatings of EMT type zeolites.

In this study, firstly, EMT-type zeolite was synthesized by using an organic template from a known reaction mixture with molar composition of 2.2 Na_2O:Al_2O_3: 10SiO_2: 140H_2O: 0.87(18-crown-6) and then ion exchange was applied with different ions such as Li, Mg, Ca, Ce, In and Sr. The water desorption capacities of EMT zeolite in original Na and other ionic forms were determined by thermogravimetry (TG). The ion exchange capacities of the samples were optimized by varying the experimental conditions (i.e. time, molarity, temperature). In the second step, coatings were prepared on stainless steel substrates by using conventional synthesis. Various reaction mixture compositions not containing templates, as well as different synthesis times and temperatures were employed, especially in order to obtain reaction mixtures that were clearer to the eye, which may provide coatings of relatively high quality. After obtaining relatively high crystallinity and thickness for the coatings, ion exchanges were performed by using the most favorable two ions. The materials obtained were characterized by thermogravimetry (TG), X-ray diffraction (XRD) and field emission gun scanning electron microscopy (FEGSEM).

Crystalline EMT coatings with relatively high thickness could be obtained at 65 °C after 24h of synthesis from a molar composition of 23.43Na_2O: Al_2O_3: 15SiO_2: 375H_2O. Results from the TG analysis showed significant enhancement of water capacities for EMT zeolite after being exchanged by various ions. The coatings could remain stable after the ion exchanges.

***Keywords*:** EMT, Zeolite, Coating, Ion Exchange, Water Capacity.

Development of Bio-based Wood Adhesive

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ABSTRACT

The wood-based panel industry has an important place in order to ensure the industrial production of products such as particleboard and fiberboard, which are frequently used in daily life such as flooring, furniture, etc. One of the most important inputs used in board production is thermoset resins that act as binders. Generally, urea-formaldehyde, melamine-formaldehyde, and melamine urea formaldehyde-based resins are frequently used due to their reactivity and cost advantages. Because, these resins are not sustainable and formaldehyde emissions are becoming more limiting day by day for the industry, there is a great trend toward bio-based sources. In this context, a bio-based resin formulation was developed by using cornstarch and Mimosa tannin as an alternative to formaldehyde-based resins in the study. The main reason for choosing cornstarch and Mimosa tannin as raw materials is the compatibility of their chemical structures. The solids and gel times of the synthesized resins were determined. In addition, laboratory-scale board production was carried out in order to determine the performance of the developed resin formulations. The mechanical and physical properties of the produced boards as well as the formaldehyde contents were measured. The obtained results showed that the developed resin formulations are promising for particleboard production suitable for interior applications.

***Keywords*:** Wood Adhesive, Cornstarch, Mimosa Tannin.

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Synthesis of Caffeic Acid Grafted Poly(lactide)-*b*-Poly(hydroxyethylmetacrylate) Polymer

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ABSTRACT

With increasing environmental awareness and ecological risks, bio-based and bio-derived materials have gained attention. Poly(lactide) (PLA) is a bio-derived polymer that can easily be obtained from renewable resources, can be recycled and shows comparable physical properties to conventional petroleum plastics. Caffeic acid is a phenolic compound which has potential anti-oxidant, anti-inflammatory, and antineoplastic activities. In this study, we aimed to prepare an antimicrobial, PLA based partially degradable caffeic acid functionalized film that has potential to be used in active food packaging.

We report a synthetic route for functionalization of poly(lactide)-*b*-poly(2-hydroxyethyl methacrylate) copolymer with caffeic acid. First, we synthesized a dual initiator, namely 2-bromo-*N*-(5-hydroxypentyl)2-methylpropanamide (BNMP) (yield = %58), bearing ATRP initiator and ring opening polymerization initiator. Firstly, ring opening polymerization of lactide was achieved via hydroxyl group of BNMP using tin(II) 2-ethylhexanoate ($Sn(Oct)_2$) as catalyst (M_n = 9800 g/mol). Secondly, 2-hydroxyethyl methacrylate (HEMA) was polymerized through atom transfer radical polymerization (ATRP) using poly(lactide) macroinitiator yielding poly(lactide)-*b*-poly(HEMA). Eventually, the block copolymer was functionalized by an esterification reaction between caffeic acid and hydroxyl groups of poly(HEMA) segment. Polymers were characterized by size exclusion chromatography (SEC), NMR spectroscopy, ultraviolet spectroscopy (UV) and infrared spectroscopy (IR). Caffeic acid-functionalized block copolymer will be investigated in terms of antimicrobial activity against gram-positive (*S. aureus.) and gram-negative (E.Coli)* bacteria.

***Keywords*:** Poly(lactide), HEMA, Caffeic Acid, ATRP, Antimicrobial.

Light-Activated Heterogeneous Catalyst: *As an Alternative and Effective Tool for CuAAC Click Chemistry*

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ABSTRACT

Light is an indispensable energy source and can be used in photochemical processes as a traceless and environmentally benign driving force for chemical reactions. Using light sources to activate the reaction instead of thermally driven systems has also provided economic benefits due to the fewer energy requirements. One of the reactions where light can be used is "click reactions". Since the discovery of the Huisgen 1,3-dipolar cycloaddition reaction of azides and alkynes, it has become a prominent tool in synthetic chemistry. The addition of copper complex to this process has provided adaptability from a small scale to a macromolecular aspect due to its ease of application, efficiency to produce the targeted products with very high yields, and little or no by-products under a variety of conditions. Recently, near-infrared (NIR) light has begun to find a place in modern synthetic chemistry, especially in click chemistry. Copper-catalyzed azide-alkyne cycloaddition (CuAAC) reaction is an excellent example of a click reaction and has since attracted great attention from researchers in many fields such as organic chemistry, drug discovery, bio-conjugation, and polymer science. Photoinduced CuAAC reactions are based on the photochemical formation of the active form by the reduction of copper (II) to copper (I) species through the photochemical processes. The aid of a heterogeneous photocatalyst allows the click reaction to take place at a longer wavelength. Recently, we explored the potential application of semiconductor graphitic carbon nitride (mpg-C3N4) in conjunction with an up-conversion glasses combination to activate the copper. In this study, photocatalytic activation of mpg-CN was achieved by using Tm3+ and Yb3+ ion-doped glass which absorbs the laser irradiation at 975 nm and is capable of emitting blue light at 475 nm. The efficiency of the dual system has been investigated ranging from small molecule synthesis to macromolecular scale which includes modification strategies.

***Keywords*:** CuAAC, Click Chemistry, Graphitic Carbon Nitride.

Synthesis and Characterization of a Novel Aza-BODIPY Derivative

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ABSTRACT

Aza-BODIPYs, boron complexes of aza-dipyrromethenes, are the structural analogues of BODIPY dyes with a nitrogen atom at the C8 position of the BODIPY core [1]. Aza-BODIPYs have absorption and emission above 650 nm in the visible region. These notable bathochromic shifts for the absorption and emission relative to those of BODIPYs can be attributed to the presence of nitrogen atom that decreases the HOMO-LUMO energy gap [2]. In addition to their strong absorption and emission in therapeutic window, aza-BODIPYs have outstanding properties which are essential for an ideal photosensitizer for photodynamic therapy (PDT) [1,3]. The main drawbacks of aza-BODIPY that limits their usage in biomedical applications is their poor solubility in water caused by the aggregation because of the presence of aromatic rings and the highly planar structure of the aza-BODIPY core [4]. One of the strategies tried for improving the water solubility of aza-BODIPYS includes the synthesis of polymers containing aza-BODIPY moieties in the main chain or the side chain [5]. Herein, an aza-BODIPY derivative carrying hydroxyl groups at the para position of the distal phenyl groups was synthesized, and subsequently hydroxyl-containing aza-BODIPY was converted to a polymerizable acrylate monomer. Copolymerization of this novel monomer with acrylamide resulted in a water soluble fluorescent polymer. The polymer was characterized by using UV–Vis, fluorescence, FT-IR and 1H-NMR spectroscopies. Photophysical and photochemical properties including fluorescence quantum yield and singlet oxygen quantum yield were measured in order to determine its effectiveness as a photosensitizer for PDT. Acknowledgement: This project was financed by ITU BAP (Project No: TYL-2022-43422) and TUBITAK (Project No: 119N594).

***Keywords*:** Aza-BODIPY, Polymer, Polyacrylamide, Singlet oxygen, Photodynamic Therapy (PDT).

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References

[1] Loudet, A. and K. Burgess, BODIPY Dyes and Their Derivatives: Syntheses and Spectroscopic Properties. *Chemical Reviews*, 2007. 107(11): p. 4891-4932.
[2] Yamane, H., et al., Synthesis of furan-substituted aza-BODIPYs having near-infrared emission. *Tetrahedron Letters*, 2017. 58(30): p. 2989-2992.
[3] D'Alessandro, S. and R. Priefer, Non-porphyrin dyes used as photosensitizers in photodynamic therapy. *Journal of Drug Delivery Science and Technology*, 2020. 60: p. 101979.
[4] Pliquett, J., Dubois, A., Racoeur, C., Mabrouk, N., Amor, S., Lescure, R., ... & Goze, C. (2019). A promising family of fluorescent water-soluble aza-BODIPY dyes for in vivo molecular imaging. *Bioconjugate Chemistry*, 30(4), 1061-1066.
[5] Yoshii, R., Yamane, H., Nagai, A., Tanaka, K., Taka, H., Kita, H., & Chujo, Y. (2014). πConjugated polymers composed of BODIPY or aza-BODIPY derivatives exhibiting high electron mobility and low threshold voltage in electron-only devices. *Macromolecules*, 47(7), 2316-2323.

Sulfonated Polysulfone Membranes

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ABSTRACT

Polysulfone is a high-performance thermoplastic with significant properties such as, thermally and oxidatively stable at higher temperatures, good mechanical properties, high glass transition temperatures, high strength, and stiffness at high temperatures, continuously use, perfect resistance to acids and bases. Polysulfone offers good film forming properties as well. Recently researchers are benefitted from the film forming properties of polysulfones. Due to ease of manufacturing of reproducible membranes having controlled pore sizes polysulfone polymers finds places in membrane technology such as hemodialysis, water purification, gas separation and fuel cells.

The present work examines, a new composite membrane based on a sulfonated polyethersulfone (SPES) was fabricated. Until today, all studies were carried out with commercial polsulfones. In this study, the target was to synthesize polysulfones, polyethersulfones and their sulfonated versions, and then to fabricate membranes by them. We have also developed a sulfonated polyether ether ketone for membrane technology such as fuel cells. All polysulfones which are characterized by Fourier transform infrared (FTIR), nuclear magnetic resonance (NMR), differential scanning calorimetry (DSC) and gel permeation chromatography (GPC). We had two kind of NMR analysis for these polysulfones as 1H NMR and 13C NMR to characterize polysulfone backbone. Polysulfones glass transition (Tg) are determined by differential scanning calorimetry (DSC). Characteristics of membranes were investigated by measuring the contact angle, pore sizes, and using scanning electron microscopy (SEM) images.

***Keywords*:** Polysulfone, Sulfonated Polyethersulfone, Membrane.

Effect of Cryogenic Conditions on the Properties of Synthetic and Biological Cryogels

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ABSTRACT

Cryogelation is a gelation technique in which the polymerization and cross-linking reactions occur below the freezing temperature of the reaction system. Although different types of cryogels have been studied for many years, it is still unclear how the cryogelation conditions affect the properties of the resulting cryogels. The main aim of this study was to find a correlation between the cryogelation conditions and the pore volume of the cryogels. For this purpose, a series of cryogels were prepared and their pore volumes were compared with the simulation results of the cryogelation conditions conducted in differential scanning calorimetry (DSC).

The cryogels were prepared using acrylamide (AAm), N, N-dimethylacrylamide (DMAA), acrylic acid sodium salt (AAc-Na), methacrylic acid sodium salt (MAAc-Na) and 2-acrylamido-2-methyl-1-propanesulfonic acid sodium salt (AMPS-Na) as the synthetic monomers and silk fibroin (SF) and deoxyribonucleic acid (DNA) as the biological polymers. All cryogels were synthesized in the presence of a suitable cross-linker and initiator system at -18°C, and they were characterized after freeze-drying. The total pore volume of cryogels were measured by immersing freeze-dried cryogels in an excess of acetone which is a poor solvent for the cryogels and hence, only fill the pores. On the other hand, simulation experiments were conducted via DSC by freezing aqueous monomer or polymer solutions without an initiator system at -18°C, and then heating from -18°C to 10°C with a scanning rate of 1°C/min. From the melting enthalpy of frozen water in the solutions, the mass fraction of unfrozen water and ice volume were calculated.

We observed a direct correlation between the ice volume calculated from DSC measurements and the actual pore volume of the cryogels. For instance, the ice volume of DMAA, AAm, SF, DNA, AMPS-Na, AAc-Na and MAAc-Na solutions were calculated as 17.9±0.2, 16.5±0.3, 14.4±0.2, 13.0±0.2, 13.1±0.3, 12.0±0.1 and 11.8±0.1 mL/g, respectively, while the total pore volume of the corresponding cryogels were 14.1±0.5, 15.5±0.3, 10.4±0.4, 12.4±0.4, 10.6±0.4, 6.7±0.1 and 10.5±0.2 mL/g, respectively. It is seen that all cryogels exhibit a slightly less pore volume than the estimated ice volume from DSC. This difference is attributed to the shrinkage of the pores in the cryogels during freeze-drying. In concluding, DSC measurements conducted on the reaction solutions are a mean to predict the pore volume of the cryogels.

Keywords: Cryogels, Cryogelation, Macropores, Pore Volume, Differential Scanning Calorimetry.

AMPS-Based H-Bonded Superabsorbent Hydrogels

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ABSTRACT

2-Acrylamido-2-methylpropane sulfonic acid (AMPS) is a well-known monomer to obtain superabsorbent hydrogels used in baby diapers, agriculture, and biomedical fields like tissue engineering, wound dressing, drug delivery systems. However, poly(AMPS) (PAMPS) hydrogels usually exhibit weak mechanical properties because of their chemically crosslinked structure limiting their application areas. H-bonding is an effective method for preparing dynamic structured hydrogels exhibiting properties like self-healing, self-recovery behavior without breaking under stress. Multiple H-bonds can easily form between H-bonding acceptor and donor functional sites of suitable polymer chains by yielding extraordinary mechanical strength. In our previous studies, we have shown that the UV polymerization method can be used in the synthesis of hydrogels that are only combined with physical crosslinks [1]. In addition, the same study showed that by choosing N,N-dimethylacrylamide (DMAA) as a comonomer of AMPS, the complementary H-bonds required to create self-healing and shape-recovery properties can also be created. In the present study, alternative comonomers namely methacrylic acid (MAAc) and acrylic acid (AAc) were also used in the preparation of AMPS-based hydrogels. Moreover, terpolymer hydrogels based on AMPS, MAAc, and DMAA were also synthesized at various compositions. We found that the terpolymer hydrogels formed at a MAAc:DMAA mol ratio of 4:1 shows a Young's modulus of 26.1±1.5 MPa which is 63-fold higher than the modulus of AMPS/DMAA hydrogel. Further studies revealed formation of cooperative H-bonds between MAAc and DMAA segments leading to a phase separation of the highly H-bonded regions. The terpolymer hydrogels prepared under various conditions were characterized in detail by FTIR and elemental analyzes as well as by rheological and mechanical tests.

***Keywords*:** Hydrogel, Complementer H-Bonds, Superabsorbent, Terpolymer.

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Reference

[1] Su, E., Yurtsever, M., Okay, O. (2019). A Self-Healing and Highly Stretchable Strong Polyelectrolyte Hydrogel via Cooperative Hydrogen Bonding as Superabsorbent Polymer. Macromolecules, 52, 9, 3257-3267.

Visible Light Induced Radical Coupling Polymerizations of α,α-Dibromo-p-xylene and 1,4-dibromo-2,3-butanedione to Obtain Poly (phenylene ethylene) and Polyketone

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ABSTRACT

The interest in applying photochemical alternatives over conventional methods is rapidly growing since the advantages of the photochemical approaches are being understood by industry and academy. Light induced techniques increase the spatio-temporal control over the reaction media and require lower energy and chemicals to synthesize. Such advantages are crucial to developing more sustainable methods that are in line with green chemistry. Also, visible light induced systems have advantages over ultraviolet (UV) light induced polymerizations as UV light is more energetic and dangerous to operate. To be able to initiate a reaction in visible light a chemical substance is required to absorb the light and undergo a chemical reaction to yield the product. Manganesecarbonyl is well known for its high quantum efficiency in visible light region, and capability of abstracting halogens from alkylhalides which can yield relatively stable radicals after its homolytic decomposition after absorbing light. Polycondensates, namely, polyurethanes, polyesters and polyamides were previously synthesized by our research group using manganesecarbonyl chemistry by radical coupling reactions. In this presentation, we report a visible light induced radical coupling polymerization system to obtain poly (phenylene ethylene) and polyketones using manganesecarbonyl as photoinitiator. The resulting polymers were characterized using various spectrometric and chromatographic methods.

***Keywords*:** Visible Light, Radical Coupling, Polymerization.

A Novel Visible Light Induced Approach for Depolymerization of Poly(Methyl Methacrylate)

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ABSTRACT

Photochemistry has received great attention in recent years as it offers eco-friendly conditions and spatio-temporal control over the reaction media. Lower requirements of chemicals and energy makes photoinduced systems desirable as we are moving towards a more sustainable world. Several photoinitiated polymerization systems have been developed to be used in variety of applications including radical, chain, step-growth, cationic, anionic and controlled polymerizations to yield different types of polymers including polyacrylates, polystyrene derivatives, polycondensates and so on. However, combining photochemistry with depolymerization is a novel technique that has not been investigated yet. In this work, a novel approach of degradation of polymers at ambient temperature by using dimanganesedecacarbonyl (Mn_2CO_{10}) as a photoinitiator has been contextualized. As the modal polymer for the depolymerization using visible light, polymethylmethacrylate (PMMA) derivatives with low polydispersity (*Đ*) has been synthesized via atom transfer radical polymerization (ATRP) technique. Thus, obtained PMMA was characterized and depolymerization was monitored by using spectroscopic and chromatographic methods. The results indicate that the ambient temperature is sufficient enough for the depolymerization process, unlike conventional methods which require high temperature conditions. Additionally, control experiments showed that depolymerization is depending on the supply of the light as the reaction is ceased when the light is off and vice versa. This new strategy could be adapted to macroscales and easily controlled with light. Thus, it would be expected in the near future applications on recycling to contribute to the environment.

***Keywords*:** Visible Light, Depolymerization, Polyacrylate.

Synthesis of Phthalocyanine-Bodipy Hybrid Molecule

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ABSTRACT

The use of phthalocyanine (Pc) and BODIPY compounds in the fields of biology and pharmacology has increased considerably in recent years. In particular, promising studies have emerged on subjects such as antibacterial, antioxidant, chemical sensor, enzyme inhibition, cytotoxic/phototoxic, anticancer and PDT. The thermal stability, photophysical and photochemical properties of BODIPY and Pc cores are remarkable. In addition, it is very important that the chromophoric core of these structures can provide many properties, thanks to their proneness to chemical reactions [1]. Studies about compounds containing these two structures with rich properties on the same molecule are very limited. The aim of the present study is to introduce a new hibrit molecule to the literature containing both BODIPY and Pc units. In addition, the presence of pentafluorophenyl groups in this hybrid molecule can improve the physical and chemical properties of this structure [2-4]. Therefore, this new structure shows all the advantages of two different unique groups and could be a good candidate in many application areas.

In this study, the synthesis of a new zinc phthalocyanine hybrid compound conjugated with BODIPY carrying pentafluorophenyl group, which is a candidate for use in biological applications, and its characterization using UV-Vis, FTIR, NMR and mass spectroscopic techniques are planned. For this purpose, 2,9,16,23-tetrakis-(propynyloxy)phthalocyaninatozinc(II) derivative was reacted with 4-azido(tetrafluorophenyl)-BODIPY molecule under "click-chemistry" conditions to give phthalocyanine-BODIPY conjugates linked by 1,2,3-triazole units. This new hybrid molecule, with its extended physical and chemical properties, appeals to biological applications such as antibacterial, antioxidant, enzyme inhibition, cytotoxic/phototoxic anticancer and photodynamic therapy (PDT).

***Keywords*:** Phthalocyanine, BODIPY, Photodynamic Therapy, Singlet Oxygen, Fluorescence.

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References

[1] R.I.S Staden, I.R. Comnea-Stancu, H. Yanık, M. Göksel, A. Alexandru, M. Durmuş, Anal. Bioanal. Chem. 409 (2017) 6195–6203. Doi: 10.1007/s00216-017-0560-y

[2] H.R.A. Golf, H.U. Reissig, A. Wiehe, Org. Lett. 17 (2015) 982–985. Doi:10.1021/acs.orglett.5b00082

[3] M. Özçeşmeci, Ö.B. Ecevit, S. Serdar, E. Hamuryudan, Dyes Pigm. 96 (2013) 52–58. Doi: 10.1016/j.dyepig.2012.06.018

[4] A. Koca, M. Özçeşmeci, E. Hamuryudan, Electroanalysis 22 (2010) 1623–1633. Doi: 10.1002/elan.200900545

Development and Characterization of ZnCdSSe and CdSSeTe Quaternary Alloyed Quantum Dots

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ABSTRACT

Quantum confinement effect gain remarkable and tunable optical properties to quantum dots, which provides several opportunities on outstanding and wide potential of application area. Although cadmium-based quantum dots have two important key parameters such as high photoluminescence and high photostability to contribute its broad application in bio-imagining and display technology, regulatory authorities limit its usage because of its high elemental toxicity. To ensure and expand cadmium-based quantum dots usage in next generation technologies, we investigate possibilities of decreasing cadmium concentration by preserving and improving its current beneficial optical properties with expanding its absorption and emission wavelength range by red shifting. Therefore, we designed two strategies, which are adding Zn to lower Cd amount and Te to broad wavelength range of ternary alloyed CdSSe quantum dots by obtaining ZnCdSSe and CdSSeTe quaternary alloyed system via previously studied and published two phase synthesis method by Caner Ünlü et al. 2013. Our findings showed that Cd amount could be decreased with half of its original CdSSe ternary system by adding Zn with Zn/Cd (1:1) ratio, which lead red shift on UV and PL spectrum while XRD results demonstrated preserved crystal structure. However, when optimal Zn/Cd (1:1) ratio exceeded by adding more Zn, crystal structure deteriorated. Furthermore, second adding Te strategy gave greater red shift on UV and PL results and doubling amount of Te showed any unfavorable effects on crystal structure. As a result, ZnCdSSe and CdSSeTe quaternary alloyed system allowed us to lower cadmium concentration and enlarge achievable wavelength range.

***Keywords*:** Quaternary Alloyed Quantum Dots, ZnCdSSe Quantum Dots, CdSSeTe Quantum Dots.

Effect of Calcium Lignosulfonate in Urea Formaldehyde Resins for Particleboards

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ABSTRACT

The wood based panel industry mainly use urea formaldehyde resins however, they have an important disadvantage known as formaldehyde emission. Decreasing formaldehyde emission without compromising mechanical properties is an important challenge for panels.

In this present work, three steps urea-formaldehyde (UF) resin has been modified with calcium lignosulfonate (LS) that is obtained from sulfite pulping processes wherein cellulose is extracted from wood in the pulp industry. Synthesized UF-LS resin was compared with blank UF by means of FTIR, DSC, ^{13}C NMR, SEM and SEM-EDAX. To evaluate the calcium lignosulfonate effect, these resins have been employed as adhesives for particleboard pressing. The particleboards glued with UF and UF-LS that fulfilled the European standards and met P2 classification according to EN 312. In situ addition of LS was highly improved internal bond property. On the other hand, LS decreased slightly from the modulus of elasticity.

The formaldehyde content of particleboards have been determined with perforator method; UF and UF-LS exhibited E1 emission according to EN 12460-5. UF-LS exhibited lower formaldehyde content than blank one and it is worth to mention that the particleboards that pressed with UF-LS supplies F** and CARB I specifications via approaches to different formaldehyde test methods. Therefore, *in situ* usage of LS is highly recommended for UF resins for particleboard pressing.

***Keywords*:** Urea Formaldehyde, Wood Adhesive, Lignosulfonate, Low Formaldehyde Emission, Particleboard.

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Photoinitiated Cationic Ring-Opening Polymerization of Octamethylcyclotetrasiloxane

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ABSTRACT

Photoinduced polymerization techniques have been investigated vastly in recent years as their advantages have been realized by both industry and academy. Advantages offer greener improvements over conventional polymerization methods such as higher reaction rates and lower consumption of chemicals. Photoinduced techniques have been adapted to several polymerization techniques to yield a wide range of polymers. However, implementation in siloxane derivatives was investigated scarcely. Octamethylcyclotetrasiloxane (D4) is the most important monomer for the synthesis of poly(dimethylsiloxane) (PDMS) and various siloxane copolymers. Due to the high biocompatibility of PDMS, it is used in a wide range of products, including automotive applications, cooking, baking, and apparel such as undergarments, sportswear, footwear, electronics, medical devices, and implants. Ring-opening polymerization (ROP) of D4 can be triggered by both basic or acidic catalysts. Thus, their action may proceed by an anionic or cationic mechanism, depending on the initiator. Cationic ring-opening polymerization of cyclosiloxanes has been known for many years, particularly when initiated by strong protic acids such as sulfuric, sulfonic, and perchloric acid. In this study, cationic ROP of D4 initiated by diphenyl iodonium hexafluorophosphate (DPI) has been studied. As known, DPI is a photoinitiator and an oxidizer that can absorb the light around 360 nm and is able to generate acids to initiate the polymerization of siloxanes. Also, both one component (direct) and two component (indirect) initiating modes were investigated. Polymers were characterized by several chromatographic and spectroscopic methods. In addition, the use of DPI, an environmentally friendly initiator, will make a significant contribution to the industrial use of polysiloxanes.

***Keywords*:** Octamethylcyclotetrasiloxane, Polydimethylsiloxane, Photopolymerization.

Development of Imprinted Fluorescent Hydrogels Containing Quantum Dots for Phthalate Analysis

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ABSTRACT

Phthalates are widely used as plasticizers or polymer additives in many products to increase flexibility, extensibility and durability. Because phthalates are not chemically bound to plastics or polymers, they penetrate from plastic food packaging materials, personal care products, and children's toys into human tissues, food, or a variety of environmental media such as water and soil. Possible risks of phthalates to human health include endocrine disruption, reproductive mutation and carcinogenic effects.

The molecular imprint technique is based on the formation of ligand-selective sites on synthetic polymers. After complexes are formed with this technique, the imprinted target material is separated and a void specific to this target is formed in the cross-linked polymer matrix. Hydrogels are cross-linked hydrophilic polymers that respond to stimuli in water by swelling or shrinking. It is affected by many environmental parameters such as gel volume, solvent composition, ionic strength, pH and temperature.

In this study, Mn-doped ZnS quantum dots (QDs) were synthesized and then modified with 3-(trimethoxysilyl)propyl methacrylate to obtain vinyl substituted QDs (V-QDs). Then, V-QDs covered by fluorescent/temperature-sensitive molecularly imprinted hydrogels were prepared using dibutyl phthalate (DBP) as a template molecule, acrylamide as a functional monomer, N-isopropylacrylamide as a temperature sensitive monomer, vinyl carbazole as a fluorescent monomer and N,N'-methylenebisacylamide as a crosslinking agent. The nanocomposite hydrogels with ratiometric fluorescence property were characterized by transmission electron microscope (TEM), scanning electron microscope (SEM), Fourier transform infrared spectroscopy (FT-IR), dynamic light scattering (DLS) and fluorescence spectroscopy. The imprinted nanocomposite hydrogel shows dual emission bands centered at 350 nm and 594 nm, respectively. The change in fluorescence ratio of sensor depending on concentrations of DBP was evaluated as a function of pH and temperature of environment. In addition, optical stability and the response time of sensor were also elucidated.

***Keywords*:** Phthalate Determination, Quantum Dots, Ratiometric Fluorescence, Imprinted Hydrogels.

Preparation and Characterization of Chitosan Based $ZnFe_2O_4$ Nanocomposite Material for Imatinib Release

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ABSTRACT

In the current pharmaceutical technology, it has been gained a huge importance to design carriers for targeted delivery of antitumor drugs and prolonged release in tumor cells. Among many carrier, hydrogel polysaccharide nanoparticles (NPs) have been increasingly interested recently. Chitosan (CS) is a natural polymer which known as biocompatible, biodegradable, and bacteriostatic. It is also cost-effective and exhibits a high absorption potential. Application of chitosan include films, hydrogels, fibers, micro/nanocapcules, and micro/nanoparticles. Since the magnetic separability plays an important role in expanding the medical applications, magnetic nanoparticles have been recently used in drug carrier systems. The main objective of this research was to develop chitosan-modified magnetic nanoparticles for drug delivery. $ZnFe_2O_4$, which is a paramagnetic and antibacterial nanometal oxide was used in this study. The ionic gelation technique was implemented to prepare the nanoparticles. The prepared nanoparticles was loaded with Imatinib, which is the active ingredient of the drugs used in the first-line treatments of chronic myeloid leukemia (CML) and gastrointestinal stromal tumors (GIST) as a tyrosine kinase inhibitor also known as "Gleevec". The Imatinib-loaded $ZnFe_2O_4$-CS NPs were then used to investigate the drug entrapment efficiency and *in vitro* drug release. The entrapment efficiency was found to be 77.8%. The CS NPs prepared without $ZnFe_2O_4$ was also investigated for drug entrapment. However, its efficiency was significantly lower (36%) than that of $ZnFe_2O_4$ included CS NPs. For the characterization of the carrier, $ZnFe_2O_4$-CS NPs, the particle size, zeta potential, X-ray diffraction pattern, and transmission electron microscope analysis was performed. This work could be helpful to the cancer researches which is on the overcoming the side effects of conventional chemotherapy.

Keywords: Polysaccharide, Chitosan, Zinc Ferric Oxide, Nanoparticle, Drug Release.

Preparation Pyrene Bearing Asymmetric Block Copolymer for Sensing Applications as a Fluorescent Chemosensor

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ABSTRACT

Herein, a pyrene based fluorescence chemosensor was designed with vicinal diol pendant groups for sensing application of various targeted analyte such as cobalt or boric acid via aggregation induced emission. In this protocol, first hydrophilic poly(oligo (ethyleneglycol) methacrylate) (POEGMA) macro-CTA was synthesized via RAFT polymerization. Then, poly(oligo (ethyleneglycol) methacrylate)-block-poly(glycidylmethacrylate)-co-poly(4-(1-pyrenyl)-styrene)(POEGMA-b-PGMA-co-PPySt) block copolymer was prepared via chain extension of POEGMA by RAFT polymerization technique with different DPn of PGMA and PPySt segments. Then, epoxy units of the PGMA segment were opened in two ways to obtain many vicinal diol groups either by reaction with Trizma base or basic aqueous medium. Resulting asymmetric hydroxyl functional block copolymer expected to exhibit chelating units towards to cobalt or boric acid from the hydroxyl and/or seconder amine units. By this way, the polymer loss the hydrophilicity from this complexation with the targeted analyte which forces to make agglomeration. This agglomeration triggered the formation of excimer emission via π-π interaction of the pyrene units. This novel approach simply provides selective detection of cobalt or boric acid detection in aqueous medium. Most of the agglomeration induced emission studies carried out by solvent manipulation, in our case the agglomeration induced by the complexation of targeted analyte. The demonstrated route has novelty on different analytes by simply changing the chelating units of asymmetric block copolymers. The critical point of the material is balancing the hydrophilic and hydrophobic ratio of the block copolymer to get the agglomeration after the complexation of the analyte. Overall, a simple sensing method was represented with this pyrene and vicinal diol bearing asymmetric block copolymer.

Keywords: Asymmetric Block Copolymer, RAFT Polymerization, Fluorescence Chemosensor, Aggregation Induced Emission.

Encapsulation of Drug into Biopolymeric Matrices Based on Modified Xanthan Gum and Chitosan Microparticles

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ABSTRACT

Chitosan is receiving a lot of interest in the encapsulation of bioactive compounds due to its biocompatibility, low toxicity and biodegradability. Positive surface charge of chitosan makes it suitable for drug delivery and clinical applications. Crosslinking of chitosan can be delivered by both ionic and covalent crosslinkers. However, due to their toxicity, most chemical cross-linkers described in the literature, such as formaldehyde, glutaraldehyde, glyoxal, and epichlorohydrin, can cause problems in clinical usage.

Xanthan gum (XG) is a negatively charged natural polymer used in drug delivery, tissue engineering and cosmetic applications. Due to its negative surface charge XG can interact positively charged chitosan and forms polyelectrolyte complexs which are widely used in encapsulation or entrapment of natural active molecules such as essential oils.

The aim of this study is to develop and optimize a safe encapsulation system for drug delivery in human body. Trans-cinnamaldehyde is an natural active molecule extracted from cinnamon oil which is known its antibacterial and antifungal activity. Encapsulation of trans-cinnamaldehyde with natural polymers and optimizing release rate of active molecules of system at different pHs can be used controlling human pathogens in gastrointestinal track without causing toxic effects.

In this work, xanthan gum was modified by sodium periodate oxidation and dialdehyde xanthan gum (DXG) was obtained to be used as a safe alternative crosslinker for chitosan. Sodium periodate oxidation is effective method for introducing dialdehyde groups into polymer backbone since modified xanthan gum can react amine grups by Schiff base reaction and forms imine bonds with amine groups on chitosan. Covalent crosslinking allows chitosan to release less active molecules in acidic pH such as gastric fluid and release more active molecules at neutral pH such as intestinal fluid where it intended to use.

Microparticles were synthesized by changing the concentrations of DXG while keeping the concentration of chitosan constant and optimized in terms of size, encapsulation efficiency and loading capacity. Obtained microparticles were characterized by FT-IR, SEM and DLS measurements. Release studies of trans-cinnamaldehyde loaded microparticles were investigated as a function of pH values in buffer solutions.

***Keywords*:** Modified Xanthan Gum, Encapsulation, Trans-Cinnamaldehyde, Drug Delivery.

Synthesis and Characterization Studies of Refractory High Entropy ($WNbMoVAl_x$ (x= 0 – 1.0)) Alloys

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ABSTRACT

This study comprises on the production, sintering and characterization of the refractory high entropy (WNbMoVAlx (x= 0 – 1.0)) alloys. First of all, WNbMoV alloys were synthesized via high energy ball milling (HEBM) in a Spex 8000D Mixer/Miller as a base composition at different milling durations (2h, 4h, 6h and 8h). After that, aluminum powders were added to the milled base alloy in varying in amounts between 0.25 and 1.00 mol % with increments of 0.25 mol %. This composition was mechanically alloyed for 2h-4h-6h-8h to obtain high entropy phase. These mechanically alloyed powders were cold pressed, cold isostatic pressed (CIP) and debinded followed by presureless sintering in a dilatometer at 1650 ^{0}C for 2 hours. Characterization studies were carried out using X-ray diffractometry (XRD), particle size analysis and scanning electron microscopy/energy dispersive spectrometry (SEM/EDS) techniques. In addition, density measurements were made using the pycnometer for powder characterization and Archimedes principle for sintered sample characterization. Abrasion tests and micro-hardness measurements were performed as the mechanical characterization studies. As a result of the characterization investigations, 6 h mechanical alloyed and sintered sample in the base alloy, single-phase structure, and high hardness values can be obtained and based on these results 6 h is chosen as the optimum milling duration. Secondly, when 1 mol % Al is added to the 6 h milled base alloy sintered for 2 hours at 1650 ^{0}C, a high hardness value of 10.48 GPa and high relative density of 91.15 % was achieved, making it the optimum composition.

Keywords: Mechanical Alloying, Presureless Sintering, Characterization, Refractory High Entropy Alloy.

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Effect of Chain Branching with Multifunctional Epoxides on Rheological and Thermal Behaviors of Polylactide

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ABSTRACT

Polylactide (PLA) is a polyester based bioplastic, which has comparable properties to those of commonly used petroleum-based commodity polymers. However, PLA has low melt strength, slow crystallization kinetics and undergoes thermal degradation during processing. The use of chain extenders (CE) could overcome these problems by reacting with the available carboxyl end groups which introduces chain extension and branching. In this study, amorphous PLA (aPLA) and semicrystalline PLA (scPLA) with two different epoxide-based oligomeric chain extenders known as Joncryl ADR 4468 (high functionality) and Joncryl ADR 4400 (low functionality) were processed using an internal melt mixer. The samples were analyzed with small amplitude oscillatory shear (SAOS) rheological tests and differential scanning calorimetry (DSC). Rheological experiments revealed that both Joncryl 4468 and 4400 increased the melt viscosity and thermal stability of PLAs when compared with unmodified counterparts. The use of Joncryl 4468 resulted in higher improvements in melt properties of both PLAs since higher functionality enabled more branching and chain entanglement. On the other hand, melt properties of aPLA enhanced further with both CEs when compared to those of scPLA. This could be resulted from the higher optical isomer content of aPLA which reduces the chain mobility and increases the effect of chain entanglement. DSC analysis showed that the scPLA-based samples exhibited enthalpy relaxation and cold crystallization during first heating and subsequent melt crystallization behaviors at slow cooling rate (2 ºC/min). It was found that chain extender addition shifted melt crystallization temperature (T_c) to lower temperatures and also decreased the peak intensity that implied chain extension of PLA made chain ordering more difficult. This effect was more pronounced for the Joncryl 4468. It was obtained that the aPLA-based samples did not showed cold crystallization and chain extender addition did not influence the glass transition temperature (T_g) of aPLA.

Keywords: Polylactide, Biopolymers, Joncryl Chain Extender, Rheology, Differential Scanning Calorimetry.

Development of Sustainable Rigid Polyurethane Foams (R-PUFs) using Environmentally Friendly Blowing Agent Systems

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ABSTRACT

The energy-saving products come to the fore increasingly each day with the growth in environmental awareness and the importance of energy consumption. Refrigerators, as continuously operating household devices, are one of the most energy-consuming appliances. In this regard, to control the energy consumption of such devices, strict energy regulations are on the agenda. Therefore, the enhancement of thermal insulation performance becomes more essential. For refrigerators, insulation is mainly provided with rigid polyurethane foams (R-PUFs) and conventionally, they are blown with pentane systems. By developing Hydrofluoroolefin, HFO-1233zd (HFO), blown R-PUFs, having a more sustainable foam system could be possible due to their zero Ozone Depleting and low Global Warming Potential as well as better insulation capability. In this study, the effect of HFO blowing agent amounts on thermal conductivity of R-PUFs was investigated. Accordingly, it is found that 0.25 moles of HFO per hundred parts of polyol provide the best thermal insulation performance. In comparison to CP systems, HFO-blown R-PUFs can provide a reduced thermal conductivity value that is more than 10% lower. By considering this amount, to observe the effect of HFO/CP blend systems on R-PUFs, samples with different blowing agent ratios were prepared and their effect on the thermal conductivity and morphology were analyzed. According to the analysis results, it has been found that by using HFO-based blowing agent systems, it is possible to develop R-PUFs with improved thermal insulation performance. Moreover, considering the resultant thermal conductivity values, different blend systems could help to optimize the thermal insulating performance of refrigerators with different energy classes.

Keywords: Rigid Polyurethane Foams, Refrigerator Insulation, Energy Efficiency, Sustainable Polyurethane Foams.

Development of Nanostructured Functional Interlayer for High- Performance Li-S Batteries

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ABSTRACT

As the need for energy storage escalating, lithium-ion batteries with the theoretical energy density of 250 $Whkg^{-1}$ will no longer be sufficient. Recently, so many studies in literature can be found focusing on the development of batteries with high energy density and better electrochemical performance. Lithium-Sulphur (Li-S) battery systems have high theoretical capacity of 1675 $mAhg^{-1}$ and energy density of 2600 $Whkg^{-1}$. However, Li-S battery systems could not yet find commercial application due to, among others, the shuttle effect, transferring of lithium polysulphides in liquid electrolyte between anode and cathode during charge/discharge cycles.

In this study, we focused on eliminating the shuttle effect with a functional intermediate layer of TiO_2 nanoparticles on the separator, on which polysulphides are expected to be immobilized. TiO_2 is known to have low electrical and ionic conductivity causing a decrease in the electrochemical performance of the battery. To alleviate this problem, TiO_2 nanoparticles were doped with Ag by sol-gel synthesis. Cyclic voltammetry (C-V) and galvanostatic charge/discharge tests were performed to study the efficiency of Ag doping of TiO_2 nanoparticles on the kinetics of chemical reactions and the electrochemical performance of the Li-S battery. Results indicated that the shuttle effect was effectively alleviated using these modified separators. 1% Ag doping gives best results with initial specific capacity of 1506 mAhg-1 and 483 $mAhg^{-1}$ after 100 cycles at 0.3 C. This study revealed that Ag doping of TiO_2 nanoparticles, which is then coated on the separator, is a simple and efficient way to impede the shuttle effect.

***Keywords*:** Lithium Sulphur Battery, Ag Doped TiO_2, Shuttle Effect, Functionally Modified Separator.

Boriding of Ti20Nb Alloy Produced by Powder Metallurgy for Tribological Applications

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ABSTRACT

Titanium and its alloys are mostly preferred over stainless steel and CrCo alloys in dental and orthopaedic implant applications due to their low density, low modulus of elasticity, high corrosion resistance and superior biocompatibility. Yet, the insufficient tribological properties of titanium alloys limit their wide range of use. Boriding is widely used to overcome such drawbacks as low surface hardness, high coefficient of friction and low wear resistance. In the present study, a Ti20Nb alloy was produced by the powder metallurgy technique and then, paste boriding was applied to the fabricated samples to generate a hard, wear-resistant and well-adhered boride layer.

A powder mixture containing 80% Ti-20% Nb was compressed in a uniaxial die at 370 MPa pressure. Afterwards, samples were sintered under an argon atmosphere at 1400 °C for 1 hour. The boriding process was carried out at 1100 °C for 8 hours by sealing the samples in glass tubes. After the boriding process, samples were ultrasonically cleaned. The fabricated samples were characterized using a scanning electron microscope, X-ray diffractometer, Vickers microhardness tester and ball-on-disk wear tester.

Microstructural investigations showed that fabricated Ti20Nb alloy was composed of alpha + beta phases. Cross-sectional SEM surveys revealed that the coating consisted of continuous TiB_2 and whiskery TiB layers and the average thickness of the layers was measured as approximately 9 and 34 µm, respectively. The average hardnesses of the as-produced sample and boride were determined as 400 and 4537 $HV_{0.1}$, respectively. After boriding, the wear resistance drastically increased when compared to the as-sintered samples.

***Keywords*:** Ti-Nb Alloys, Powder Metallurgy, Boriding, Wear Resistance.

Development of Microfluidic Organ-on-a-Chip Platform for Three Dimensional Cell Culture

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ABSTRACT

Living cells in a living tissue are three-dimensional systems and have strong environmental relationships. In addition to vital needs such as food, air and hormones, they are constantly exposed to some physiological and mechanical effects. Cell cultures and living tissues taken by biopsy cannot freely access this environmental interaction in the laboratory environment. Environments that mimic the living tissue environment can be created for cell cultures by means of microfluidic systems. These microsystems can mimic mechanical factors such as breathing and peristaltic movements. These microsystems, called organ-on-a-chip, make an important contribution to the survival of the tissue taken from a living thing or the cell culture in the laboratory environment as a three-dimensional system, and subsequently to the realization of experiments with these cells. In organ-on-a-chip systems, there are methods that allow the viability of cells/tissues/organs to be followed simultaneously and the their interaction.

In this study, a microfluidic platform for kidney-on-chip applications was designed and implemented by considering the cell environment in living tissue. Living cells were attached to the membrane placed inside the microfluidic system and their vital activities were analyzed with the help of electrodes placed on the lower and upper surfaces of the microfluidic system. Commercially available polycarbonate(PC) membranes were used in the PDMS microchannel system. Titanium(200nm)/Aluminium(50-100nm) electrodes deposited by Physical Vapor Deposition (PVD) method on a glass substrate were used as microelectrodes.

3-(4,5-dimethylthiazol2-yl)-2,5-diphenyltetrazolium-bromide (MTT) tests, which examine the vital activities of cells for kidney-on-chip systems, were performed. Cell viability on PC membranes was measured at time intervals. TEER (Trans Ephitelial Electrical Resistance) measurements were carried out under conditions where there is no continuous flow (static) and a continuous flow (dynamic) on the cells. Longer cell viabilities were obtained in dynamic conditions indicating the formation of tight connective tissues between cells, and the good level of cell differentiation. Early experimental results were collected for a period of 6 hours after conformal cell formation on PC membrane. MTT and TEER test results appear to be in agreement and indicate cell differentiation under dynamic conditions. Experimental studies will be repeated for 12, 24 and 48-hour periods and further analysis will be performed.

Keywords: Organ-on-a-Chip, Microfluidic Systems, PDMS, TEER, MTT, Microelectrode.

Design and Fabrication of Micromixers for Efficient Antigen-Antibody Binding

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ABSTRACT

Microfluidic systems have attracted significant attention in the past few years in biomedical analysis due to their economical and analytical advantages. Traditional immunosensors rely on the diffusion coefficients of reactants, leading to slow reactions. The flexible design of microfluidic systems eases the integration of micromixers that facilitate chemical and biological reactions inside the microchannel by disturbing the laminar flow in microfluidic systems with small Reynolds numbers. These miniaturised systems offer high specific area, increasing contact medium between fluids leading to fast reaction rates. Additionally, the design and geometry of micromixers can be modified in order to achieve uniform mixing either through split and recombine structures or by chaotic convection.

In this work, different micromixer geometries were designed and fabricated to investigate their enhancing effect on antigen-antibody binding. The Polydimethylsiloxane (PDMS) microchannels were fabricated using standard microfabrication techniques, then bonded on glass substrates by oxygen plasma bonding. The antigen-antibody binding efficiency was investigated by feeding functionalized magnetic beads and target protein from different inlets and allowing them to be passively mixed inside the microchannel in order to form Ag-Ab-MBs complexes. These complexes are then collected in a sample container from the output for electrochemical sensing. Electrochemical impedance data was collected using microelectrode and correlated for mixing efficiency.

Early results indicate that the incorporation of micromixers in microfluidic systems for immunosensing facilitates antigen-antibody binding by agitation of the flow, encouraging homogeneous mixing and reducing assay time. In addition, the incorporation of magnetic beads allows the fabricated systems to be reused with different analytes. These findings are important for developing future diagnostics for diseases that require rapid and accurate results.

***Keywords*:** Microfluidics, Biosensor, Micromixer, Immunoassay, Electrochemical detection, Magnetic Beads.

Improvement of Micro-Arc Oxidation Coating Formed on 7075 Al Alloy for Reducing the Coefficient of Friction

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ABSTRACT

Aluminium (Al) and its alloys attract great attention in a wide range of applications for aerospace and automotive industries owing to their high specific strength-to-weight ratio, excellent formability and good corrosion resistance. However, they possess some drawbacks such as low hardness, insufficient wear resistance, and high and unstable coefficient of friction (COF). In order to overcome these limitations, various surface modification techniques have been developed. In this aim, the micro-arc oxidation (MAO) process has been an attractive alternative via its numerous advantages.

The present study mainly focused on reducing the COF of MAO coatings fabricated on 7075 Al alloy. Within this scope, the cold spray technique (CS) was applied prior to the MAO process on 7075 Al substrates. Afterwards, the MAO process was conducted in an electrolyte containing $NaAlO_2$, Na_3PO_4 and KOH. Structural features of fabricated MAO coatings were characterized by an X-ray diffractometer (XRD) and a scanning electron microscope (SEM). For evaluating the tribological performance of the MAO coatings, wear tests were conducted at the room temperature sliding against the Al_2O_3 ball at the reciprocating sliding configuration. Hereby, the specific wear rates and COF values of the samples were compared for samples directly MAO'ed and MAO'ed on CS'ed layer on 7075 Al alloy.

***Keywords*:** 7075 Al Alloy, Micro-Arc Oxidation, Wear Resistance, Coefficient of Friction.

Effects of Mechanical Alloying on WMoNbVCr Alloy Produced by Arc Melting

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ABSTRACT

Design and production of WMoNbVCr refractory high entropy alloy (RHEA) has been carried out by mechanical alloying (MA) of elemental powders followed by densification using vacuum arc melting. The composition of the alloy is unique and has not been studied or reported in the realm of HEA before. The elemental powders have been subsequently mechanical alloyed for up to 8 hours. The MA'd powders were consolidated using uniaxial press under 390MPa pressure. The consolidated green bodies were made into ingots using vacuum arc melting. The microstructural evolution of the bulk HEAs ingots were subsequently investigated. Phase analyses were carried out using an X-ray diffractometery (XRD), Scanning Electron Microscopy /Energy Dispersive spectrometery (SEM/ EDS), EVA diffraction software, TOPAS software and Particle Size Analysis (PSA) techniques. During the MA process, single body-centered cubic (BCC) structured solid solution was formed. Effect of MA contributed to a maximum of 12% increase in microhardness compared to that of the as blended melted powders. A highest hardness value of 7.84 ± 0.458 GPa was achieved after 6 hours of mechanical alloying. A relative density values between 97-99% were obtained for arc melted ingots with a maximum density value of 10.67 g/cm^3 for 6h mechanically alloyed and arc melted RHEA. This RHEA in the as cast condition exhibited a typical dendritic structure with larger dendritic grains at the center and a finer dendritic structure close to the surface. Sliding wear tests revealed that the lowest volume loss achieved was 0.43x10^{-3} mm^3 after 6 hours MA in contrary to that of the ingot arc melted from as blended powders which exhibited the highest volume loss of 3.89x10^{-3} mm^3.

***Keywords*:** Refractory High Entropy Alloys, Arc Melting, Mechanical Alloying, Alloy Design.

Industrial Scale Sustainable Nanocomposite Production by Melt Mixing Technique

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ABSTRACT

Scientists are in search of new biopolymers as alternatives for petroleum-based polymers due to environmental concerns. Polylactic acid (PLA) is a biopolymer that is produced from renewable feedstock and has high performance with biodegradable and sustainable nature. This is while PLA suffers from brittleness, poor processability, and impact strength. The development of PLA composites and blends are possible ways to overcome such drawbacks. Cellulose nanocrystals (CNCs) are good alternative nanoparticles to improve some of these drawbacks compared to other reinforcements for not only providing good mechanical and physical properties but also being low density, biobased and biodegradable filler. Unfortunately, the production of nanocomposites on a large scale with good CNCs dispersion is still a challenge. This study is aimed to develop sustainable polymer nanocomposites by direct melt-mixing on an industrial scale through two approaches that are with and without masterbatch preparation. For this purpose, the PLA was reinforced with CNC (1, 2, and 4% (w/w)) in an industrial-scale co-rotating twin-screw extruder. Polyethylene glycol (PEG) was used as an agent that could enhance the interfacial interaction between PLA and CNC to promote dispersion and acts as a plasticizer to improve the brittleness of PLA. PEG concentration was kept constant at 10%(w/w) throughout all formulations. Fabricated nanocomposites were characterized by differential scanning calorimetry (DSC), thermogravimetric analysis (TGA), X-ray diffraction (XRD), rheological analysis, and tensile test. Results show that the addition of CNC could improve the tensile modulus and strength of PLA. Moreover, the addition of PEG to PLA leads to a decrease in initial thermal decomposition temperature while the addition of CNC resulted in an improvement. Furthermore, PLA crystallinity increased due to the nucleating effect of CNC.

***Keywords*:** Sustainable Nanocomposite, Large-scale Production, Extrusion, Polylactide, Cellulose Nanocrystal.

Surface Modified Cellulose Nanocrystal Incorporated Nanocomposite

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ABSTRACT

The majority of petroleum-based polymers cause non-degradable wastes in the environment. To solve this problem, studies on biodegradable polymers gain importance. Polylactic acid (PLA) is a good example of a biodegradable polymer. It has a potential in biomedical and commodity applications such as packaging. However, it has also some drawbacks such as slow crystallization kinetics and low melt strength. Cellulose nanocrystal (CNC) can be a good alternative as a filler in biopolymer matrices due to its superior properties such as high mechanical strength, high surface area and low density, as well as behaving like nucleating agents. However, the hydrophilic nature of CNC results in agglomeration in hydrophobic polymer matrices, which eliminates the effects of CNC on polymers. In the literature PLA/CNC nanocomposites produced by using solution casting whereas, this method is not eco-friendly due to using solvents. To solve this problem, CNC surface should be modified and, in this study, citric acid (CA) and ascorbic acid (AA) was chosen to modify CNC. After the modification step, PLA/CNC specimens were produced by melt mixing method. In rheological analysis, complex viscosity and storage modulus were investigated and dramatic changes were obtained.

***Keywords*:** Polylactic Acid, Biodegradable, Cellulose Nanocrystal, Surface Modification.

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Iron oxide@rGO Nanocomposites: *Solvothermal Synthesis, Characterization and Performance Tests for Electrochemical Energy Storage*

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ABSTRACT

Due to their relatively high theoretical capacity, environmental friendliness, and low cost, iron oxides have been extensively investigated for electrochemical energy storage applications. However, the poor rate capability and short cycling life of iron oxide anodes are the main obstacles to their use. Thus, nanocomposites of iron oxides with graphene derivatives have attracted much attention because of graphene's superior electrical and chemical properties, as well as its large surface area.

In this study, Fe_3O_4@rGO nanocomposites were synthesized by the solvothermal method. Two solutions consisting of 0.01 g GO with 5 ml of distilled water and 0.07 g ferrocene ($C_{10}H_{10}Fe$) with 5 ml of acetone were prepared and sonicated for 10 minutes. Subsequently mixing two solutions, hydrogen peroxide (0.35 ml, 30%) was slowly added, and the solution was vigorously stirred for 30 minutes. Then the solution was exposed to 196°C for 26 hours in a Teflon-lined stainless-steel autoclave and then allowed to cool naturally to room temperature. The powders were precipitated by magnetic separation and washed with acetone. Then the obtained powders were dried at 60°C overnight before powders were calcined at 500°C in an Argon atmosphere for 2 hours to improve the crystallinity and remove the organic species. Finally, the test electrode was prepared by casting slurry consisting of the as-prepared powder, carbon black and Polyvinylidene fluoride (PVDF) in a weight ratio of 80:10:10 on a copper foil, followed by drying overnight at vacuum. CR2032 coin cells were assembled in the glove box.

The X-ray diffractometer (XRD), scanning electron microscope (SEM), Raman spectrometer, and galvanostatic cell cycling were used to characterize the synthesized nanocomposite. The electrode shows a stable and reversible capacity of 552 mAh/g after 100 cycles at the current density of 100 mA/g which is significantly higher than the theoretical capacity of commercial graphite anodes (372 mAh/g).

***Keywords*:** Energy Storage, Iron Oxide Anode Materials, Graphene Derivatives, Li-ion Batteries, Solvothermal Synthesis.

Effect of Polylactide Molecular Weight on Chain Branching with Multifunctional Epoxides

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ABSTRACT

Biobased and biodegradable polylactide (PLA), one of the most well-developed commercial bioplastics, has the potential to be used as a replacement for the commonly used petroleum-derived plastics. However, there is still a need to improve the deficient properties of PLA. Chemical modification with epoxide-based oligomeric chain extender (CE) Joncryl has been shown to promisingly improve the rheological and thermal properties of PLA. Thus, the motivation of this study is to investigate the effect of molecular weight of PLA on its reactivity with Joncryl CE. Three different PLAs having low, medium, and high molecular weights (L-PLA, M-PLA, and H-PLA, respectively) with two different CEs, Joncryl ADR4468 (high functionality, HF) and Joncryl ADR4400 (low functionality, LF), were processed using an internal melt mixer. The samples were analyzed with small amplitude oscillatory shear (SAOS) rheological tests, differential scanning calorimetry (DSC), and Fourier-transform infrared spectroscopy (FTIR). It was found that the HF CE more significantly improved the rheological properties of all PLA grades. On the other hand, Joncryl reactivity increased in PLAs with higher molecular weight. This was because the carboxyl groups within long molecular chains of PLA seem to be more reactive with Joncryl than hydroxyl end groups of PLA samples with short molecules. The results were also confirmed by FTIR analysis.

***Keywords*:** Polylactide, Joncryl Chain Extender, Rheological Properties.

Synthesis and Characterization of Copper Nanowire for Lithium-Sulphur Battery Application

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ABSTRACT

Copper nanowire (Cu NW) is one of the most promising materials to use in novel electronic technologies, having wide range applications in sensor technology, rechargeable battery and microfluidics technology. Cu NW has high surface area to volume ratio and high electronic conductivity due to short electronic pathway at nanoscale. In this study, we have synthesized Cu NWs by hydrothermal synthesis method. This method has several advantages such as synthesising in short period of time at low temperatures and low-cost of production. The main difference between other hydrothermal synthesis method and our synthesis is Cu NW synthesis time was reduced. We first worked on the Cu NW synthesis in short period, therefore, we could analyze the consequences of effect of different concentration agents to Cu NW properties. Effects of different number of agents in Cu NW synthesis were studied and Cu NWs were characterized with different characterization techniques such as SEM (Scanning Electron Microscope). In this synthesis, we used HDA (hexadecyl amine), $CuCl_2$ (copper chloride), glucose and DI (distilled water). We used to glucose as a reducing Cu2+ ions in the aqueous solution of $CuCl_2$ as a precursor at 120 °C in the presence of HDA. In order to analyse of agent concentration, we mainly focussed on two parameters: concentration of HDA and $CuCl_2$. The results showed that Cu NWs were synthesized with average diameter of 60-160 nm and > 40 µm in length. Cu NWs will be used in separator coatings for Lithium-Sulphur batteries to evaluate their inherent capabilities for lithium polysulfides entrapment for future studies.

***Keywords*:** Copper Nanowire, Nanowire Synthesis, Hydrothermal Method.

Induced Crystalline Fiber-Like Structure as Reinforcement in PLA Products Through Applied Shear in Injection Molding

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ABSTRACT

Polylactic acid (PLA) is a biopolymer produced from edible resources, which is considered an alternative to commodity and engineering applications. However, PLA suffers from high brittleness, low melt resistance, and slow crystallization, hampering processing and applicability. Although various methods have been applied to improve these drawbacks, the biodegradability and natural advantages of PLA should be preserved while also reducing the end-product cost. Therefore, self-reinforced PLA composites (SR-PLAs) have been introduced to provide high strength and stiffness without traditional reinforcements. This study aims to determine the manufacturability, mechanical and thermal properties of SR-PLA composites prepared through injection molding. Initially, blends containing an amorphous polylactide (aPLA) with three different semicrystalline PLA (cPLA) grades with different crystallizability were separately injection molded below the melting temperature of the cPLAs. The differential scanning calorimetry (DSC) analysis showed an absence of a cold crystallization peak, indicating that the pre-process isothermal heat treatment induced complete crystallization of cPLAs. The melt crystallization temperature shifted to higher temperatures, and the peak intensity increased when cPLA3 with the highest crystallinity and the melting temperature were used. The tensile test results revealed that the tensile strength and modulus values of the aPLA/cPLA samples were significantly greater than those of the neat aPLA. Moreover, this reinforcing effect became even more prominent when cPLA3 was used. These enhancements were due to preserved cPLAs crystallites, and the induced fiber-like structure obtained through the inherent high shear rate of the injection molding process. However, no significant improvement was observed for the impact strength values. Therefore, blends containing aPLA/cPLAs and poly (butylene adipate-co-terephthalate) (PBAT) were separately injection molded to improve the low toughness of SR-PLA composites. While a slight reduction in mechanical properties was observed, the toughness of aPLA/cPLAs was enhanced with increasing PBAT content.

***Keywords*:** Polylactide, Self-reinforcement, PBAT, Injection Molding.

Synthesis and Characterization of High Entropy $(HfTiZrMnTa)B_2$ Ceramics

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ABSTRACT

In this investigation, high entropy $(HfTiZrMnTa)B_2$ ceramics were produced through high-energy ball milling (HEBM) and spark plasma sintering (SPS) method. Firstly, each metal boride was synthesized from relevant metal oxide, magnesium and boron oxide powder blends by mechanochemical synthesis (MCS) and subsequently leaching was applied on the MCS'd powders to remove unwanted phases. During the MCS process, different parameters (milling time, reactant amount) were employed to achieve optimal composition of pure boride phases with less unwanted by-product. Afterwards, each metal borides were mechanically alloyed in a Spex 8000D Mixer/Mill for 6 h to obtain a hybrid composition. The alloyed powders were sintered using two different processes. SPS method was used for sintering at 2000°C at 30 MPa. Linn furnace and dilatometer were used for the cold pressed/cold isostatic pressed samples to sinter them at 1650°C. Characterization studies were conducted by using an X-ray diffractometer (XRD) and scanning electron microscope/energy dispersive spectrometer (SEM/EDS). Also, density measurement by using Archimedes' method and hardness measurement using Vickers method were carried out on the sintered samples. A high entropy phase with high hardness was obtained by SPS system based on the characterization results.

Keywords: Mechanochemical Alloying, Spark Plasma Sintering, High Entropy, Characterization.

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Mechanochemical Synthesis and Characterization of an Equimolar HfMoNbVW Refractory High Entropy Alloy

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ABSTRACT

In the present investigation, mechanical alloying was employed as the synthesis method. Powder blends of an equimolar HfMoNbVW alloy from pure elemental powders of Mo, Nb, V, W and Hf was produced via mechanical alloying then pressureless sintered. The blends were high energy ball milled in a Spex 8000D Mixer/Mill at 1200 rpm with 10:1 ball-powder ratio for 2,4,6 and 8 hours. After that, milled powders were cold isostatically pressed at 390MPa and debinded in a tube furnace at 420°C. Sintering was carried out in a Linn T^M furnace at 1650°C for 2h. Characterization of the milled powders and selected sintered samples were performed by using X-ray diffractometry (XRD), scanning electron microscopy/energy dispersion spectroscopy (SEM/EDS), pycnometer density and microhardness measurements. The crystal sizes of milled powders were calculated by Rietveld analysis method and the smallest value was found as 4.9nm. In density calculations, the optimum relative density result was calculated as 97% for milled powders. Based on the results, 6 hours of mechanical alloying was chosen as the optimum milling time. After that, the 6 hour mechanically alloyed equimolar HfMoNbVW alloy was pressureless sintered. Microhardness result of 6 hours mechanical alloyed HfMoNbVW is 9.503 ± 0.71 GPa (Vickers Hardness).

Keywords: Refractory High Entropy Alloy, Mechanical Alloying, Sintering, Characterization.

Characterization of Biodegradable Zn-Cu-Mn Alloys

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ABSTRACT

Zinc alloys, which have been studied extensively in recent years for use as biodegradable implants and show superior properties, have become the focus of attention. Although zinc is aninteresting element in terms of biodegradability and biocompatibility, it is not within the desiredvalue ranges in mechanical implant application. Therefore, alloying should be done by choosingsuitable alloying elements and the mechanical values of zinc should be increased. In this study, the effect of varying proportions of manganese (Mn) on the originally produced biodegradableZn-1Cu-xMn (x≤ 1 wt%) casting alloy was investigated. This alloy is the development of biodegradable Zn-based mesh implants instead of the titanium mesh membrane used in the grafting operation for jawbone expansion. In the use of titanium mesh implants, the fact that the patient requires two operations, expensive and imported requires the development of alternative materials. Our project will be the basis for the development of mesh implants that will remain in the body during the treatment and will be degraded and absorbed.

The aim of the project is the characterization of the Zn-Cu-xMn casting alloy on mechanical properties, degradation rate and antibacterial behavior. Studies will be carried out to ensure thatthe titanium membrane, which is currently used as a dental implant, can provide its properties.We can list the tests carried out as: producing of the alloy as casting, microstructure examinationunder optical microscope, xrd analysis, tensile test, hardness measurement, determination of degradation rate by immersion test in artificial urine and simulated body fluid, and antibacterialtests using E.coli and S.aureus bacteria. .

In the event that all the targets set forth in the project are achieved, the developed implant material can be used in jawbone expansion operations without requiring a second operation. Since it is economical compared to titanium, it will not be an economic burden to the patients.

***Keywords*:** Biodegradation, Implant, Antibacteriality, Biocompatibility.

CIVIL ENGINEERING

Incrementally Launched Bridge Design

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ABSTRACT

The incremental launching method (ILM), which has many applications around the world, is a bridge construction method that has also been used in Turkey. In this construction method, the precast yard is located behind one of the abutments, where one segment of the superstructure is constructed each time. Each segment is prestressed to the previous part of the structure and after hardening the bridge is launched forward with special equipment. Deck spans generally range from 40m to 60m, and continuous decks with total bridge lengths of 700m to 800m can be constructed. The most significant financial advantages of this method are the reduction in material, the reduction in construction time, the reduction in the number of bearings, and the reduction in the number of expansion joints.

In this study, the basic steps of the analysis and design of an incrementally launched bridge are explained on a sample bridge. The sample bridge model consists of two 35m long side spans and three 55m long main spans, and the total length of the bridge is 235m. The bridge is straight in plan and elevation and also consists of a 12m wide prestressed concrete (PSC) box girder section. For the incremental launching method, the internal forces that occur during the launching of the bridge were taken into account at 1 m intervals by using an internationally verified bridge design software, and superstructure checks were carried out for the launching and the post-construction stages. Post-tensioned tendons were modelled in two groups as launching tendons and service tendons and also included in the calculations.

***Keywords*:** Incremental Launching Method, Post-Tensioned Bridge, Staged Bridge Design.

The Multiple Plastic Hinge Practice for Columns In the Nonlinear Performance Evaluation of RC Buildings

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ABSTRACT

Turkey is located on the active seismic zones and the devastating earthquakes shown the importance of the earthquake resistant design of buildings. The casualty and the collapses of many buildings in Izmir because of October 30, 2020 Samos Earthquake has displayed once more that structural performance of the existing building stock should be evaluated quickly. Depending on results of the structural evaluation, it would be possible to strengthen some of these buildings by using various methods.

Different analyses procedures are existing in the literature to evaluate the structural performance. The nonlinear methods are straightforward to reach the real structural behavior. Nonlinear pushover analysis and nonlinear time history analysis are two vital methods defined in Turkish Building Earthquake Code-2018.

The site observations and document readings of the collapsed İzmir Buildings displayed that the axial stress is relatively high on lower story columns as well as the shear capacity is critical for the ductile behavior. Thus, firstly a literature survey has been made on the nonlinear shear behavior of reinforced concrete columns. The multiple plastic hinge descriptions are made for bending moments, shear and axial forces for columns by ignoring the possible interaction between them.

The multiple plastic hinge definitions for columns have been exemplified for simple structures to assess the solution performance of the structural analysis package. The procedure of multiple hinge definition has been applied in the performance evaluation of a totally collapsed apartment building in İzmir. The possible reason of the collapse has been searched by using the results obtained from the numerical analyses.

***Keywords*:** Pushover Analysis, Time-History Analysis, Performance Evaluation, Axial and Shear Plastic Hinges, Multiple Hinge Definition.

The Perceived Importance of Trend Topics in Construction Management by Graduate Students

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ABSTRACT

Promoting the use of digital technologies is important for the future of construction, one of the most traditional and resistant to change industries. The construction industry is criticized for not being a digitalized industry, especially in developing countries. To increase the efficiency of the sector, digital transformation is needed. Engineering and architectural education content needs to be updated for digital transformation to be widespread. Within the scope of the digitalization of the construction industry, new concepts such as BIM, immersive technologies, digital twins, artificial intelligence, the Internet of Things, etc. are frequently mentioned as trends, hot topics, or special topics in the literature. However, graduate-level students of civil engineering and architecture are not familiar with these new concepts and lack experience at an advanced level in Turkey. The aim of this study is (1) to analyze the level of awareness and application of trend topics in the construction industry among civil engineering and architecture graduate students through surveys and interviews and (2) to make suggestions that will guide the content of graduate education in Turkey. Making these suggestions increases the efficiency in the work areas of the graduate students in the construction sector and saves time. As a result of the study, it has been determined that IT-based courses are inadequate at the graduate level, and this has a considerable effect on the employment of graduate students in the sector. For future studies, if the course content is updated, the research could be repeated with new graduates taking courses focusing on trending topics in construction.

***Keywords*:** Construction, Graduate-Level, Trend Topics, Survey.

Fragility Curves for Buildings Retrofitted with Different Methods

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ABSTRACT

One of the important issues in Istanbul are the expected damages of old buildings during earthquakes due to the lake of proper earthquake engineering design and supervision. There are two ways to deal with such buildings, either to demolish them or to retrofit them. In case of retrofitting, the target performance of the building must be obtained under certain earthquake level and to ensure the life safety of residents during severe earthquakes. Fragility Curves is a well-known method to investigate the buildings performance under different earthquake levels. Fragility curves show the probability of different levels of damages that can occur in a structure due a certain event (which will be earthquake in this study). Two of Istanbul's schools located in Kadikoy district will be chosen in this study. The reason of selection is that Kadikoy has a high level of earthquake risk, and the age of these buildings was also a criterion. To examine the time of construction effects on the earthquake performance, two building with different construction dates are selected that first buildings was built in 1957 and the second was built in 1991. Two buildings will be modeled and analyzed to obtain the current state of earthquake performance.

Fragility Curves will then be obtained for different earthquake risk levels. Three retrofitting methods will be applied to improve performance: Concrete jacket, CFRP and shear wall addition. The methods will be compared in terms of increasing the capacity and ductility of the structural systems of the buildings. The fragility curves of the reinforced buildings will be compared and the differences between these curves will be analyzed and optimized.

***Keywords*:** Fragility Curve, Target Performance, Retrofitting, Earthquake Performance, Concrete Jacket, CFRP, Shear Wall.

Out-of-Plane Shake Table Tests on Solid and Double-Leaf Masonry Walls

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ABSTRACT

In this study series of dynamic shake table experiment, performed as a part of SafeGo Project and conducted at the laboratory of Hanze University of Applied Sciences (Groningen, Netherlands) are presented. The tests were conducted with increasing intensity of ground shaking, where double-leaf and solid unreinforced masonry (URM) walls were tested in their out-of-plane direction. The construction methods tested are the ones used in traditional Dutch houses, specifically in Groningen, North Netherlands, where small magnitude shallow induced earthquakes threaten masonry building stock. The solid walls tested represent the pre-second world war structures, and the cavity walls represent the newer structures, which constitute more than 2/3rd of the residential buildings in the area.

In this study, experimental results of solid and double-leaf URM walls subjected to out-of-plane loading are presented. The findings show that, although cracks open and close, leaving almost no trace of damage, the overall stiffness of the walls decrease significantly, elongating the fundamental period in the out-of-plane direction. Modelling of the walls with beam elements and sero-length members is also presented in this study, showing a satisfactory agreement with the experimental results.

***Keywords*:** Shake Table Tests, One-Way Bending, Unreinforced Masonry, Cavity Walls.

Effects of Fine Content on Mechanical Behavior of a Rock Quarry Residue

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ABSTRACT

Rock quarries supply crucial materials such as boulders and gravel to support shore protection, local infrastructure, municipal projects and other public works. The produced quarry residuals may be propounded for beneficial use alternatives as clean materials compared to other mining operations. In this study, the rock quarry residue stored in a tailing pond is examined to illustrate the effect of varying fine content (FC) on the use as soil-based material for geotechnical projects. Grain size distribution analyses of the samples recovered from the tailing pond pipeline present that the FC of residue were varying in between 25% and 49%. Consistency limits tests were performed on the soil samples with high fine content (HFC) and low fine content (LFC), which were non-plastic, and they were classified as silty sand (SM). The compressibility of the samples tested under standard compaction effort were increased by FC that the maximum dry unit weight, $\gamma_{d\,max}$ and optimum water contents, w_{opt} were 20.5 kN/m^3 and 10.7% at HFC and 18.7 kN/m^3 and 10% at LFC, respectively. The soaked samples, compacted under standard compaction effort, showed no swelling potential before California bearing ratio test, and lower soaked CBR values were observed as 9.1% at HFC which was 15.5% at LFC. Direct shear tests of the compacted samples show that cohesion value, c was negligible and internal friction angle φ, was 38° for HFC, while c= 0 kN/m^2 and φ =41° for LFC. Permeability test results show a decrease with FC that the permeability coefficient, k values of HFC and LFC were 2.2x10^{-6} m/s and 5x10^{-6} m/s, respectively. Therefore, the compacted residue has a potential to be used as fill material, but low to medium CBR values should be increased by a proper improvement technique to achieve the requirements of road construction projects as subgrade material.

Keywords: Beneficial Use, Rock Quarry Residue, Compaction, Fine Content, Permeability, Shear Strength.

Rapid Damage Detection from Post-Earthquake City Surveillance Camera Images Using Machine Learning Algorithms (*Case Study: 1999 Marmara Earthquake*)

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ABSTRACT

Earthquake have always been one of the feared natural disasters, as there have been many earthquakes that have caused a large number of casualties throughout history. In order to reduce the number of casualties caused by earthquakes, quick post-earthquake damage detection and correct reaction are as important as the taken pre-earthquake precautions. Therefore, the issue of rapid damage assessment after the earthquake has attracted attention in recent years and innumerable studies have been carried out on rapid damage detection, especially using the post- earthquake satellite images. In this study, it is aimed to automatically and quickly perform post- earthquake damage detection by using local image sources such as city surveillance cameras with the different machine learning models to be created. Darıca, one of the districts affected by the 17 August 1999 Marmara Earthquake, was chosen as a case study. In the training and testing of the machine learning models, pre and post-earthquake images taken from city surveillance cameras in Darıca will be used. The success of the model in detecting damaged buildings will be measured by comparing model predictions with the actual results.

***Keywords*:** Post-Earthquake, Damage, Machine Learning, Local Images.

The Effect of Coarse Aggregate Concentration on the Bond Stress vs. Slip Relation Between Low-Strength Concrete and Reinforcing Steel

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ABSTRACT

In construction, reinforced concrete is the most widely used load-bearing system due to its durability, strength, ductility, and fire resistance. But despite the development in the field of concrete and the use of moderate and high-performance concrete, in most existing residential buildings, poor performance concrete still exists. Also, the concrete in existing structures may have different concentrations of coarse aggregates. Hence, the study of the bond strength of reinforced concrete is of crucial importance, especially for countries located in active seismic zones. But, in the literature, the studies on bond strength between low-strength concrete and reinforcement are limited. For this purpose, in this study, pre-peak stress-strain properties and the bond strength and bond-slip behavior between the steel reinforcement and low-strength concrete with varying coarse aggregate concentrations were aimed. To this end, 4 different concrete mixtures with 1.2 water/cement ratio and 4 different coarse aggregate concentrations (60%, 40%, 20% and 0%) was used. 150x150x150mm cube samples in which the plain and ribbed reinforcement were embedded and 100x200mm cylinder samples were prepared. Once removed from the mold, the samples were placed in curing pools until the test day (28th day). Compressive strength and splitting tensile strength tests were performed on cylindrical specimens with a load-controlled compression device. Elastic modulus, discontinuity, and critical stress limits were determined with the help of a displacement-controlled compression device. Finally, pull-out tests were performed to determine the bond strength and bond-slip behavior between the concrete and plain/ribbed reinforcement. Based on the results, bond strength and bond-slip behavior between the reinforcement and low-strength concrete were compared with the models available in the literature and structural codes.

***Keywords*:** Low-Strength Concrete, Coarse Aggregate Concentration, Compressive Strength, Splitting Tensile Strength, Bond Strength, Bond-Slip Behavior.

Performance Verification of Transparent and Flexible Material for Manufacturing an Enhanced Transparent Impermeable Laminar Soil Container

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ABSTRACT

Laboratory tests on soil material is always challenging. Since, the performance of the soil during the test is supposed to resemble the free field conditions, the test setup preparation procedure is important. Normally, the laboratory tests are performed on the shaking table (1G) or on the centrifuge (NG). The tests are performed using soil containers which is used to transfer the dynamic applied motion to the soil material and test structure in it. Depending on the type of the soil container the performance of the soil material changes. In order to get the closest results to the free field conditions, based on the studies, the best performing container is a laminar soil container. Besides, the type of material for the laminas and moving mechanism of the laminar soil containers, affects the performance results. So, in order to achieve more resembling results to free field conditions, the moving mechanism of the laminas itself, and the required material to be used for manufacturing the laminas and moving mechanism of the container, must be verified. In this study, the available materials for manufacturing an enhanced transparent impermeable laminar soil container are verified by laboratory tests. These tests, are performed on the Plexiglas and a flexible sealant produced by Sika Company. The procedure which is used aims to verify the attaching strength between the surface of the Plexiglas and flexible sealant. Also, the strength of the laminas during the lateral loading in cases of only one single beam and also three attached beams together are verified. The selected material for the purpose of the manufacturing the enhanced transparent impermeable laminar soil container represents satisfying results and proper deformation potential during the lateral loading of the lamina frames.

***Keywords*:** Plexiglas, Flexible Sealant, Transparent, Impermeable, Laminar Container.

The Use of Digital Twin Technology for Facility Management in an Infrastructure Project: *A Case Study of Istanbul Airport*

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ABSTRACT

With recent developments in technology, digital transformation strategy has become widely applied in many fields such as industry, automation and construction. Digital twin technology, one of the digital transformation applications, is used to create a copy of the physical product in a virtual environment with various sensors and simulations. During the life cycle, product management and data flow can be performed more easily using digital twin technology. In parallel with the developments in digital technologies and data collection methods, digital twin technology is used in the design, construction, and facility management stages of the construction industry. In this study, the sensor and model data collected in the main terminal building of Istanbul Airport were examined in detail and the advantages of using the produced digital twin in facility management were investigated. The maintenance and repair data used in the facility management were analyzed and the method of obtaining the relevant data was examined. Possible simulations that can be created with the data collected in the main terminal building have been evaluated. In addition, the contribution of the centrality of the terminal building automation system to facility management has been discussed. Moreover, identifying challenges related to maintenance and repair in facility management, how to take action and solve problems using digital twin technology were discussed. Furthermore, digital twin facility management and traditional facility management differences were compared in detail. As a result, the superiority of facility management performed by applying digital twin technology during lifecycle over the traditional method has been revealed.

***Keywords*:** Digital Twin, Facility Management, Building Automation, Digital Transformation.

Behavior of Hexagonal Shaped Arglass Composite Specimens under Compressive and Tensile Loads

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ABSTRACT

In order to reinforce the walls, the application (experimental) and literature research on the use of cement-reinforced composite elements was started. The aim is to obtain information about how the wall element with hexagonal shaped Ar-Glass composite elements will work. For this purpose the parameters of the materials used in composite elements were investigated from the literature. Similar studies have been investigated in order to increase the ductility and strength of the system and to investigate how the load transmission between hexagons will be.

New generation textile-reinforced cement-based composite (TRCC) products are superior to other cement-based composites because of their high tensile and bending strength, fast, cheap and easier production capability, and also because they are lighter.

Some factors play an important role in increasing the strength of these composites, one of them is the reinforced textile ratio in the composite and the other is the adherence between the cement-based binder and textile yarns that constitute the composite matrix part.

The fact that textile-reinforced cement-based composite materials play a major role in the formation of structural and non-load-bearing structural systems reveals that new systems and production techniques should be developed.

There are different techniques for the production of cement-based composite materials, but it is aimed to produce these materials faster, easier, in desired shapes and sizes and at lower costs.

Since the production technique of cement-based composite materials in different cross-sections with high strength is not available today, a machine that applies the PPR (Pull-Pour-roll) production method specific to Istanbul Technical University (Composite Structures Laboratory) was designed in order to produce TRCC composite elements in an economical, fast and practical way and all of the composite elements were produced with this machine.

Thanks to this machine, it is possible to quickly and economically adjust the material section thickness in the desired dimensions, the textile ratio and the amount of mortar used, and produce accordingly.

In this study hexagonal shaped textile-reinforced cement-based composite specimens were produced. The specimens are produced by wrapping 4 or 6 layers of textile material.

Axial monotonic compressive, axial monotonic tensile and diagonal monotonic tensile tests were applied on 4 and 6 layered hexagonal shaped specimens.

The amounts of maximum elastic load and vertical displacement at maximum elastic load, ultimate load and vertical displacement at ultimate load, failure load and the vertical displacement at failure load for each of 4 and 6 layered hexagonal shaped specimens obtained by these tests.

Keywords: Hexagonal Shaped Composite Specimen, Ar-Glass, TRCC, PPR.

Compressive Strength Prediction of Eco-Friendly Concrete Incorporating Nano-Silica using Machine Learning

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ABSTRACT

The growing concern about global climate change and its adverse impacts on societies put severe pressure on the construction industry as one of the largest producers of greenhouse gases. Concrete is the essential material in civil engineering. It has a substantial impact on the environment as cement, whose production involves a large amount of CO_2, is its main ingredient. Enhancing the mechanical and durability properties of concrete structures can reduce their impact on the environment. Incorporating a small amount of nanoparticles in concrete can modify the nano-structure of cementitious materials and thus procure high durability. This study proposes an Artificial Neural Network (ANN) model to predict the compressive strength of concrete partially substituting ground granulated blast-furnace slag (GGBS), silica fume (SF), Fly Ash (FA), and Nano Silica (NS) at different ages. The concrete compressive strength is a highly nonlinear function of age and ingredients. The compressive strength of concretes obtained by experimental tests will be used to develop the model. The specimen age, contents of NS, FA, Course and fine aggregates, and W/B were considered as inputs variables and compressive strength as output for developing the ANN model. It is anticipated that the predicted results would establish the accuracy and high prediction ability of the proposed model.

***Keywords*:** Machine Learning, Concrete Compressive Strength, Nano-Silica, High-Strength Concrete.

Comparing UK and Turkish Perspectives on Office Leasing Criteria with AHP Method

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ABSTRACT

Today, the employed population spends most of their time in office buildings. Therefore, which office building to choose is a challenging issue in terms of employee productivity and customer satisfaction. Companies that provide physical office leasing services evaluate the offices in their portfolio according to predetermined criteria that follow customer demands. There are no common determined criteria for leasing an office for both developed and developing countries. Also, the importance of these criteria is not examined. This study aims to provide Multi-Criteria-Decision Making (MCDM) approach to improve the decision-making processes of office leasing organizations in developing countries by using Analytic Hierarchy Process (AHP). In this approach, office leasing criteria have been determined in the literature, and the common criteria for England and Turkey have been selected through focus group meetings. In total, 5 main criteria were established: rent, location, leasable area size, letter of guarantee amount, and office characteristics. Six sub-criteria were also established. The importance weights of the chosen criteria were then evaluated using six expert interviews. The study's findings analyzed the relative importance levels of office leasing criteria in industrialized and developing countries. This study will be a guide for developing countries in the office leasing approach and can be customized after determining the in-company criteria. In future studies, case studies can be evaluated for the comparison of various alternatives in line with these criteria and the selection of the most advantageous alternative. In addition, comparisons can be made with different multi-criteria decision-making approaches such as TOPSIS, COPRAS, etc.

***Keywords*:** Analytic Hierarchy Process, Developing Countries, Multi-Criteria-Decision-Making, Office Leasing.

COMPUTER ENGINEERING

Pair Redundancy Approach for Train Control and Management Software

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ABSTRACT

In constantly developing rail transportation systems, electronic units are increasingly having safety critical functions. The electronic units used in these systems affect the availability and reliability of the system. The most effective and recommended way to increase availability is to use redundancy. In redundancy, the redundant unit takes over the function of the failed unit from where it left off. The tighter the synchronization between units, the more accurate takeover occurs. In this study, the Checkpoint Synchronization Redundancy (CSR) method developed for tighter synchronization in low-bandwidth Train Control and Management System (TCMS) is explained. There are three roles in CSR, namely "active", "passive" and "not ready". While "active" unit manages TCMS, the "passive" unit monitors the TCMS and in case of "active" unit failure, it switches to the "active" role by loading the last checkpoint. If the unit is in the initialization phase or has failed, it is in the "not ready" role and remains in this role until the error is recovered. TCMS has periodic tasks due to the work it has to do. The process from the beginning to the end of the TCMS period is called the CSR cycle. At the end of each CSR cycle, the units create a checkpoint containing local data. The hashes of the checkpoints, created at the end of each TCMS cycle, are compared. If there is a mismatch, the active unit's data is synchronized to the passive unit. CSR is designed independent of communication protocol and can be used with diversity programming. In this study the use of CSR in two-unit redundancy, which is a low-cost redundancy method, is discussed. We evaluate implementation of CSR on an Arm Cortex-A7 processor which demonstrates a reasonable performance cost for TCMS.

Keywords: Redundancy, Pair Redundancy, N-Version Programming, TCMS, Train Control and Management System.

Signal Feature Learning and Generation for Wearable Sensor Signals

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ABSTRACT

The sensor-based Human Activity Recognition (HAR) problem has emerged as an area of great interest in the academic world in recent years. In order to classify human activities, it is necessary to extract features from the signals obtained from wearable sensors. Time and frequency domain feature extraction techniques are among the common methods to be used for sensor signal feature extraction. The human activity classification accuracy can be adversely affected by the selected set of features obtained from time and frequency techniques. Energy based probabilistic generative models can remedy this problem by extracting features automatically from signals directly. Restricted Boltzmann Machine (RBM) as a generative model is an energy-based probabilistic graphical model that factorizes the probability distribution of a random variable over a binary probability distribution. As an extension of RBM, the Conditional Restricted Boltzmann Machine (CRBM) is a generative model that can learn the temporal dependencies in time series signals and use it in classification. The performance of signal generation and feature learning capability are compared for four generative models RBM, CRBM, GAN (Generative Adversarial Networks), WGAN-GP (Wasserstein GAN-Gradient Penalty), and one predictive model LSTM (Long Short Term Memory). An offline dataset which includes six human activities is used for the training and testing of the models. For the comparison purpose, we outline a performance criterion framework for signal generation accuracy performance for aforementioned models. The framework employs three similarity metrics to compare the models' signal generation accuracy performances. The results reveal that CRBM model can produce signals closest to the true signal with a significantly higher success rate compared to other generative and predictive models. Statistical analysis of the findings is given and it is shown that the findings are supported significantly.

Keywords: Statistical Feature Learning, Generative Models, Sensor Signal, Human Activity Recognition.

Predictability Analysis of Classification Performance with respect to Hyperparameter Variation in DNNs

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ABSTRACT

Hyper-parameter assignment has a significant role in performance of the deep neural networks. This is an open problem because choosing the correct neural network parameters and structure is a serious challenge and generally it requires many different experiments. Besides, hyper-parameter optimization needs priori information about characteristics of the data. As a first step of all these problems, in our paper, we propose a novel entropy-based approach. We simply use two different artificial deep neural networks. First neural network is used for a specified and changeable subtask, and it is trained many times with different parameters. For the first neural network tasks, we choose various classification and regression problems and different artificial neural network types. The second network is the main and predictive network, and it uses structural entropy change values based on the weight histograms of the first network as the input data. Additionally, for the output data of the second network, we take the performance rates of the first network models. By doing this, we aim to predict the performance of the first network with the second network before the test data is seen and using the first network's topological information.

In this method, network weights are taken from each epoch during the training of the first network and their histogram entropy values are calculated. Besides, we can use only some parts of this data for the second network. Around 10% of the original data can be enough for the performance prediction. Additionally, we can take these parts from different places of the total data. Using this method, we observed that we can estimate the performance of the first network with a success rate of over 80% in some experiments.

In the continuation of this study, we can adapt the hyper-parameters during training to increase the performance using the predicted performance rate. For instance, if we take the entropy values only from one of the initial 10% epochs of the training and see the predicted performance of this model is insufficient, we can change the parameters automatically for the remaining of the training. In that case, development of this study is feasible for also the hyper-parameter optimization problem.

***Keywords*:** Entropy, Predictability, Performance Prediction, Hyper-parameter Optimization.

Finding the Relationship between Social Media Ratings and Traditional TV Rating using Data Mining Methods

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ABSTRACT

The rating indicates how many times a program has been viewed and often determines whether a program can continue to be featured on TV. Today, apart from traditional methods, ratings can be calculated from various platforms such as Twitter and the web. In this study, it has been tried to determine whether there is a relationship between traditional TV rating measurements, Twitter ratings and views on the web. Additionally, ratings are tried to be reproduced through alternative data sources by data mining methods. Easily accessible TV series from Turkey are chosen as the sample set includingÇukur, DirilişErtuğrul, MucizeDoktor and Hercai. The relevant data is collected manually from different platforms (Twitter, YouTube, Facebook, and web). Multiple Linear Regression and Support Vector Machine for Regression (SMOReg) algorithms are used in our study. Attributes that make up the dataset are Twitter rating, Twitter number of unique users, number of views on the web, TV rating, and TV share rate. Double, triple and quadruple correlations between these features are examined separately. A model is created in which Twitter rating, Twitter number of unique users, web views and TV share attributes are input variables and TV rating is the output variable. The correlation value is calculated as 0.89. Furthermore, an application is implemented to estimate the rating based on the aforementioned ML methods. As a result of the evaluation made with the training and test data using k-fold cross validation method, the mean absolute error value of the results produced from the program is found as 0.9528. It is seen that the application is promising to estimate TV ratings.

***Keywords*:** Data Mining, Rating, Social Media, Television.

Effect of Semi-Supervised Self-Data Annotation on Video Object Detection Performance

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ABSTRACT

As deep learning architectures replace conventional machine learning approaches, accessing annotated data is important now more than ever. Training performance can be inadequate if the data has low quality, even if the algorithm is robust. Some features are developed to overcome data-related problems. However, these features have an adverse effect on algorithm complexity and processing cost. Data annotation process consists of several steps that are both time and money consuming. Further, errors due to human factors should be considered such as misclassifying or bad labelling. In this study, the effect of semi-supervised data annotation on video object detection is analyzed by using the Soft Teacher algorithm. Soft Teacher is a Swin-Transformer backboned semi-supervised learning method which has a major advantage on overcoming limited data. There are two types of models; the Student model and the Teacher model. The Teacher model performs pseudo-labeling on weak augmented unlabeled images and the Student model is trained on both labelled and strong augmented unlabeled images while updating the Teacher model. The Soft Teacher model is trained with warehouse data that consists of 4 labels named as pedestrian top, pedestrian side, truck top and truck back. First, the trained model annotates the same data and then, some of the state-of-the-art algorithms are trained with model annotated data. The new trained model cannot detect exact boundaries of boxes, which can lead to loss of features, although the algorithm is good at detecting objects. Results suggest that semi-supervised data annotation degrades the detection performance in expense of huge amounts of training time savings.

***Keywords*:** Data Annotation, Semi-supervised Learning, Video Object Detection.

A Comparative Study to Forecast Vehicle Prices in Automotive Industry using Machine Learning Techniques

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ABSTRACT

Precise estimations in marketing is important in terms of getting results with higher financial returns and making more accurate strategic decisions. Estimations made only by expert opinion can be incorrect or insufficient and cause great financial damage to companies. In this study, a solution to this problem is presented to forecast vehicle prices in the automotive industry by using popular machine learning techniques. In recent years, machine learning techniques have been used in the literature for price estimation of computer, electronic products and online product sales, mainly fashion products, retail/market products. In this study, performances of Decision Tree, Random Forest, Support Vector, Artificial Neural Networks regression techniques on an automotive sales dataset are evaluated and compared using Root Mean Square and Mean Absolute Percentage Error metrics. In experiments, a sales dataset of 6019 samples with 13 features (serial number, new price, name, location, year, kilometers driven, fuel type, transmission, owner type, mileage, engine, power, seats, price) was used, and a three-stage pre-processing was applied. In the first stage, blank data were removed; in the second stage, text expressions in numerical properties were extracted; and in the last stage, categorical values were converted into numerical data by Label, One Hot, Binary and Frequency coding techniques. In all analyses, K-Fold Cross Validation method was used in the estimation of price prediction error. As a result of the experiments, the best coding and the best estimation method on this data set were revealed comparatively. The results have presented some interesting points which makes this study a potential choice for relevant applications.

***Keywords*:** Vehicle Price Prediction, Machine Learning, Pre-processing, Cross Validation.

Designing an Early Detection of Postpartum Hemorrage by Artificial Intelligence Methods

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ABSTRACT

The Creating innovation in health care disciplines, health promotion and care services is only possible with interdisciplinary studies and innovation. Reducing maternal mortality rates, which is an indicator of the welfare level of countries, and which does fall on the agenda of all international organizations, is one of the main issues that should be addressed within the scope of innovation in health. Postpartum hemorrage (PPH), which is one of the main preventable causes of maternal deaths, is determined by subjective methods with midwife observations in general medical protocols and is not measured with an objective and quantitative measurement tool.

In this study, an objective and qualitative method that analyses with artificial intelligence methods, was proposed to help detect PPH. An electrical device was prepared to detect the amount of bleeding and measurements were made with a computer-assisted obstetrics simulator in Karabuk University laboratories. In the setup, data were obtained according to the amount change of four different liquid types, which are tap water, isotonic solution (0.9%), urine and blood fluids. According to the measurement results, it has been determined that due to the low viscosity of the blood and its coagulation, its diffusion is not as fast as other fluids, so it can be separated according to the fluids that may come out of the other body. In addition, a predictable classification has been determined in the values of the data obtained as the number of liquid changes according to the same measurements.

***Keywords*:** Artificial Intelligence, Measurement Methods, Postpartum Hemorrage, Sensors.

Neural Language Modelling Approaches for Post-OCR Text Processing

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ABSTRACT

Optical Character Recognition (OCR) is the process of recognizing text in a digital image. OCR is a common practice for transferring old papers and historical books to electronic text to maintain them and make them available around the world. Currently, OCR systems obtain good results with 20th-century documents, however, the accurate recognition of historical documents is still challenging because of their vocabulary and complex page layout. Our aim is to minimize the errors in the historical documents after the OCR processing on the dataset presented in the International Conference on Document Analysis and Recognition (ICDAR) 2019 OCR Post Error Detection and Correction competition. The competition dataset comes from multilingual projects and the corpus includes 22M OCRed characters along with the corresponding Gold Standard (GS). There are two main tasks for eliminating the post-OCR text errors in this competition: error detection and error correction. We employed the post-OCR text process with the following steps: detecting the erroneous words in the text with an error detection model, replacing the erroneous words with the "<mask>" keyword to give as input our error correction model, and selecting the best candidate from error correction model and replace with it. The best method for error detection and correction tasks in the 2019 competition is a pretrained BERT and character-level machine translation model respectively. Our proposed model is based on pretrained XLM-RoBERTa since the model is multilingual and some Latin monologues are found in the English dataset. We achieved an 86% of F1-score on the English dataset with tokenizing and fine-tuning on the pretrained "xlm-roberta-base" model and the winner of the competition was 67% with the BERT model. On the other hand, Virk et.al. proposes a Support Vector Machines with n-gram representations of the words and they achieved the best F1 score with % an 83 score on ICDAR 2019 English data set so far.

For the error correction task, we applied two models: "xlm-roberta-base" and the state of art self-supervised learning proposed by the Meta AI team: Data2Vec. We chose Data2Vec because it is based on a self-distillation setup using a standard Transformer architecture and proposes state-of-the-art (SOTA) results for language, image, and speech. We obtained an 11.6% improvement percentage on the English dataset and the improvement result of the winner of the competition was 11%. This is the best result comparable to the best-performing approaches on English datasets of the competition on post-OCR text correction in ICDAR 2019.

***Keywords*:** Post-Ocr Text Processing, Data2Vec, Error Detection, Error Correction, Neural Language Model.

EARTHQUAKE ENGINEERING, DISASTER MANAGEMENT

Review of Viscoelastic Coupling Dampers (VCDs) for Seismic Performance of Reinforced Concrete High-Rise Buildings

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ABSTRACT

The carrier systems of high-rise buildings generally have a core formed by the shear wall arms around the stairs, elevators and technical areas, and the coupling beams connecting these shear wall arms. In high-rise shear wall systems with coupling beams, coupling beams can be subjected to large non-linear deformations under seismic loading. Generally, non-linear strains are concentrated in these elements. Therefore, the performance of tall buildings with this type of structural system under seismic loads generally depends on the performance of the coupling beams. In order to increase the performance of the coupling beams under lateral loads, the detail commonly used in practice is the diagonal reinforcement configuration in the reinforced concrete deep coupling beams. The difficult and time-consuming fabrication of conventional reinforced concrete coupling beams (CCB) brings up the improvement of the design and performance of coupling beams in high-rise structural systems. Significant damage to the CCB may occur under seismic loading and urgent rehabilitation may be required. In many studies, the design of more flexible energy absorbing coupling beams has been investigated instead of reinforced concrete rigid coupling beams. Viscoelastic Coupling Damper (VCD) for high-rise buildings was developed at the University of Toronto to replace CCBs. In this study, Viscoelastic Coupling Damper (VCD) developed at the University of Toronto was used instead of reinforced concrete coupling beams. The first model is a high ductility shear wall system, in which 46-story reinforced concrete shear wall arms are combined with deep coupling beams, located in an area with high seismicity. In the second model, VCDs were used instead of the deep reinforced concrete coupling beams in the first model. In order to compare the performance of these two systems and to optimize the location and number of VCDs, earthquake records were selected and analyzed in the non-linear time history. The analysis results of high-rise buildings with two different systems were compared and examined.

***Keywords*:** High-Rise Structural Systems, Reinforced Concrete Coupling Beam, Viscoelastic Coupling Damper.

Vertical Load Effect on Seismic Base Isolation Systems

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ABSTRACT

Earthquake is one of the most important threats for all structures from past to present. The concept of seismic isolation has emerged to reduce these effects and ensure building reliability. In recent years, the number of base isolated buildings, especially in hospital buildings, has increased considerably in Turkey. Since the main idea of this systems is to ensure that the building can continue to service after a major earthquake, it is extremely necessary to use base isolation system in hospital buildings. In this research, a sample hospital building designed with a lead rubber bearings (LRB), which is one of the most preferred seismic isolation units, is examined. As the main purpose, the efficiency of including not only horizontal components but also vertical component of the earthquake is investigated. The parameters taken as basis for the efficiency evaluation are the interstory drift ratios, story accelerations, base shear and moment forces, and vertical forces on the isolators. These parameter results are tackled as they are the main parameters required for the structure and isolator design. These parameters are examined at three different cases respectively, analyses are done with static vertical load, dynamic vertical load and without any vertical load. The time history nonlinear analyzes that direct integration and fast nonlinear analysis method are performed with ground motion record, which are selected and scaled using the seismicity of Bolu. According to the results of this study, there is no identifiable difference between these two methods, which are used as nonlinear analysis methods in time history. There are notable differences in the variation of the distribution of vertical forces on the isolator units. Highest to lowest axial loads are obtained respectively from dynamic, static analysis and analysis without vertical ground motion.

***Keywords*:** Seismic Isolation, Lead Rubber Bearing, Non-linear Analysis.

The Effect of SH Waves on the Structure that is Located Edge of the Steep Slope

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ABSTRACT

The goal of this study is to determine the effects of multiple scattering, diffraction and reflections from the foundation and the free surfaces of the half space and steep slope on the structure responses in the case of anti-plane motion. In the model, the structure located at a certain distance from a steep slope is considered by exposure to earthquake waves. The structure has a semi circular foundation located on the half space. The structure which is excited by the plane SH waves with any angle of incident rests on isotropic, homogeneous and elastic half-space in the edge of the steep slope. In the analysis, dynamic soil structure interaction is taken into account. During the analytical solution of the dynamic interaction of the structure, Newton second Law, wave expansion method, image method and Graf's Addition Theorem are used to obtain the response of the structure respectively. In the solution model, the image method is derived to satisfy the free surface boundary conditions of the steep slope. In the image method, the reflections and scattering from the steep slope is represented by the reflections and scattering of the imaginary structure. All the physical and mechanical properties of the imaginary structure are the same as the structure in the model. As a result of the study, numerical results obtained with various parameters are interpreted. The numerical show that foundation impedance and the relative displacements of the structure are significantly affected by edge of the steep slope. Finally, the results are compared with the studies in the literature. Results show that when distance of the structure to the steep slope is increased, displacement amplitude of structure is approach studies in the literature. In that case displacement amplitude is not effected by incident angles of the wave.

***Keywords*:** Soil-Structure Interaction, SH Wave, Image Method, Graf's Addition Theorem, Wave Function Expansion Method.

Decision Making Process in Disaster Management Cycle Phases

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ABSTRACT

Decision-making process in the disaster management cycle has very significant role in making versatile and effective actions at any level of management for people including disaster managers. People may face any emergency situations or any types of disaster in an unprecedented scale and psychological extent so that corresponding decisions on disaster management should be taken at the highest possible reliable level. Thus, it is very crucial to make right decisions before/during/aftermath the disasters in order to minimize any risks which have capacity to transform any level of hazards related to life, economy and infrastructure.

This study's main idea is to scrutinize appropriate decision-making methods which can be useful in compatibility between two systems of thinking, called "System 1" and "System 2", otherwise they are computing to each other to induce unconditioned risk management. The study is based on a general literature review in disaster management and a new hypothetical decision-making model for every phase of disaster management will be proposed. The model is composed of two main different parameters of critical level and number of decisions relative impact of the time. The model is formulated and named as "Density of Decisions". It may be possible that in future studies, various parameters e.g. "Decision Quality" which are related to the field can be added in formula. Thus, decision-making process in disaster management can attain accurate results with a measurable perspective since the level of management difficulty is linked to the density of decisions model. Also, disaster managers who aim to be entitled to the disaster management will be able to evaluate the effectiveness in their opinions by using the hypothetical model. Integrating two modes of thinking into our model will surely enhance disaster managers point of view in decision-making process while they have to make multiple decisions under uncertainties in struggling severe situations.

Keywords: Decision Support Systems, Disaster Management, Systems of Thinking.

ECONOMICS

The Effect of Lecture Time on Student Outcome, Cross-Country Study with TIMSS Data

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ABSTRACT

Human capital is one of the key elements of economic development. Upon the importance of human capital, there are some detailed assessments that enable researchers to measure subject specific knowledge and abilities over countries. From this perspective, the International Association for the Evaluation of Educational Achievement (IEA) conducts highly detailed large-scale assessments on 8th and 4th grade students, named TIMSS and PIRLS, over the nations. While some countries' students and schools have high scores, the rests' obviously fall behind. The score variation in between countries and within countries has different and reasonable explanations. Our study's purpose is to enlighten one of the possible reasons for score variation and proposing some reformative policy advice based on empirical outcomes. Our study's importance comes from being unique in the literature that investigates the relationship between lecture time, student specific school behaviors and achievement scores on country basis by using TIMSS 2019 data. This study specifically analyzes 8thgrade students' mathematics and science achievement scores as plausible values and contextual outcomes gathered from student surveys over 10 countries, then investigates the causal relationship between lecture time, student specific school behaviors and student achievement score. The study's method is firstly presenting the current literature and detailing the data, then, using unique OLS regressions with the rich control variable setandeconometrical research tools. Our study points out that a positive relationship between lecture time and student achievement score exists. However, this relationship seems stronger in Mathematics when compared to the Science. Besides, by taking the basis of huge data from TIMSS achievement results and contextual surveys; student background-based variables' effects, on student achievement score are also presented.

Keywords: TIMSS, OLS, Education Economics, Lecture Time, Student Achievement.

A Dutch Disease Approach into the Premature Deindustrialization

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ABSTRACT

We explore the main causes and consequences of the premature deindustrialization phenomena. We argue that local currency overvaluations mainly associated with a surge in capital inflows into the emerging market economies following the deregulation of their capital accounts severely hurt the output share of manufacturing industry. Applying the second generation estimators allowing for cross-section dependency (Augmented Mean Group and Common Correlated Effects Mean Group), we run a panel data regression model based on a sample of 39 developing countries in Latin America, Sub-Saharan Africa, East Asia, North America, and Europe from 1960 to 2017. The baseline model is augmented with an overvaluation index adjusted for the Balassa-Samuelson effect. We find that an overvaluation of 50 percent which corresponds approximately to one and half standard deviations is associated with a contraction of manufacturing output share as high as 1,25 percent over the five year period. We show that the baseline regression results are robust to different data sets, alternative real exchange rate/deindustrialization measurements, and dynamic model specifications. Moreover, the evidence suggests that the link between real exchange misalignments and deindustrialization can be nonlinear so the manufacturing competencies which have been eroded by local currency overvaluations in real terms cannot simply be brought back during the undervaluation periods. Hence, the need for a comprehensive industrial policy along with a firm use of capital controls and macroprudential measures given a robust institutional framework comes out as the main policy implication of our results, and they are duly discussed in light of recent developments in the literature.

***Keywords*:** Premature Deindustrialization, Dutch Disease, Structural Change, AMG, CCEMG, Panel System GMM.

Nonlinear Time Series Analysis of the Effects of Energy Price Shocks on Agricultural Commodities

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ABSTRACT

The world is facing an energy crisis currently and rising energy prices which affects many products, sectors, financial instruments, and the economy as a whole. Likewise triggered by climate change, drought and, uncertainty stemming from the war between Ukraine and Russia, the price of agricultural commodities reached unprecedented levels with the rising energy prices. Due to the usage of energy by agricultural machinery, vehicles and facilities in the agricultural production process, the cost of farming increases, resulting in higher agricultural commodity prices.

Therefore, in this study, we examine the short-term and long-term effects of price shocks of different energy sources (coal, oil, natural gas, uranium, nuclear energy and heating oil) on main agricultural commodities (wheat, sugar, cotton, rice etc.). For this purpose, we develop a hybrid model that considers both different investment horizons and holding periods and the asymmetry effect of shocks. More precisely we combine time and frequency dimensions and then analyze the effects of shocks through the nonparametric cumulative measure of dependence method developed by Escanciano and Hualde (2019) and the impulse-response estimation by local projections (LPs) methodology introduced by Adämmer (2019). Therefore, different from the previous studies which consider only time dimension we also take into account frequency dimension of the data. In fact, Wavelet transformation technique allows us to combine both time and frequency domain. Once the original series are decomposed into seven frequencies, the effects of energy shocks are examined over the whole time period.

Notice that Adämmer (2019)'s method is one of the non-linear tail dependency techniques, and it permits the effects of price shocks that reach a certain threshold value. Since the threshold value can be determined completely externally, the method is very flexible and suitable for the purpose of the study. In addition, using Escanciano and Hualde (2019)'s method, we are able to measure persistence of shocks and systematic risk. To our knowledge, this hybrid method will be applied for the first time in this study.

Our study covers the monthly period of 01/2000-02/2022 for both agricultural commodities and energy sources. The result show that there are spillovers between energy and agricultural markets.

Keywords: Energy Price Shock, Agricultural Commodity, Nonlinear Tail Dependence, Wavelet Transformation.

Rationing for Islamic Inheritance Disputes

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ABSTRACT

The bankruptcy or rationing problem in microeconomics deals with the allocation of a resource among a group of agents. Although the primary concern in the literature is to allocate the liquidation value of a bankrupt company to its creditors, the applications of the problem are not limited to the bankruptcy only. Adapting the bankruptcy problem to inheritance law disputes is a common practice. The source of these practices is the inheritance problems and solutions given in the Babylonian Talmud, one of the most central texts of Judaism. In the literature, these problems are modelled as bankruptcy problems, and the solutions taken from the same text are defined as the bankruptcy problem rules. Additionally, some other rules that are not in line with Judaism like the proportional rule and game-theoretical solutions are also applied to the same problems.

Although Islam is rich in terms of inheritance law disputes, which can be modelled as a bankruptcy problem, it contains, none of these disputes are examined in the bankruptcy problem literature. The main sources of Islamic law contain many detailed rules which are obligatory regarding inheritance. However, these rules are not comprehensive enough to make provisions for all possible inheritance law disputes, therefore lacunae emerge. This situation has revealed controversial applications, which originated from the decisions of early jurists, between Hanafi and Shia schools of Islam when solving inheritance law disputes which can be modelled as bankruptcy problems.

The aim of the study is to model the generic inheritance problem in the Islamic law literature as a bankruptcy problem, to identify the well-known applications as allocation rules using the axiomatic approach, and to compare the solutions, provided by these allocation rules, with the solutions of bankruptcy problem rules.

***Keywords*:** Bankruptcy Problem, Claims Problem, Lacunae, Islamic Inheritance.

The Impact of Macroeconomic Factors on the Stock Returns of BRIC Companies During Covid-19 Pandemic

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ABSTRACT

Macroeconomic variables are known to have an effect on business performance. Therefore, establishing the relationship between macroeconomic variables and corporate financial performance is a primary objective of the pertinent literature. Data collected from financial statements is the main source of financial performance for a publicly traded company. However, financial statements are published quarterly, and the data shown in these are lagged. On the other hand, stock returns are used as an indirect indicator in the literature. This indicator contains information regarding financial performance, news about the company, and insider information at a scale. Moreover, stock returns are highly frequent as the stocks of publicly owned companies are open to continuous trading during the trading hours. The recent pandemic COVID-19 has cast a shadow over the global economy, particularly the financial sector. The disease's rapid spread has had a significant impact, resulting in a slew of health and financial problems and nearly bringing the economy to a halt during the recession. This study examines Turkey's financial development during the COVID-19 pandemic. The long-term and short-term effects of the virus have been analyzed by employing the energy prices, stock returns, and global economic policy uncertainty. The QARDL model, the Wald test, and the Granger causality test have been used to examine daily data from various sources. In two ways, the QARDL approach outperforms the linear approach. First, the method allows for location-based asymmetry, as the dependent variable's location can affect the coefficients within the conditional distribution. Second, the approach compares the long-run equilibrium effects of defined variables' overall quantiles to their short-run aspects. The study aims to suggest policy recommendations to assist investors, the government, and others in making more informed choices about the Turkish economy

Keywords: Covid-19 Pandemic, Stock Returns, Turkey, QARDL.

Net Neutrality in Oligopolistic Models of Content Provision and Internet Service Provision Markets

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ABSTRACT

Importance of telecommunications in all societies and all industries is growing tremendously. From entertainment to online shopping, we rely on the telecommunication networks to provide us the means. Behind the scenes there is a complex mesh of advanced technology with an evolving market interaction of Content Providers (CPs) and Internet Service Providers (ISPs) racing to profit from the end-users (EUs). National Telecommunications Regulatory Authorities (NTRA) in each country regulate the market to maximize the total welfare.

Net Neutrality (NN) prevents ISPs asking for termination fees from CPs to give them access to the EUs. Latest academic articles have focused on the successive monopoly or successive oligopoly models in vertically related markets to explain the dynamics of the CP, ISP and end- user interaction. In these models, upstream is the CP (e.g., Netflix, BluTV), downstream is the ISP (e.g., Comcast, TTNet) and CP and ISP are assumed to be perfect complements. Therefore, the termination fee that CP pays to the ISP becomes irrelevant, hence does not impact the prices to the end-user or the total welfare. This result is not consistent with what we observe in the industry, like the case between South Korea Broadband and Netflix. Indeed, there is mounting pressure from ISPs to allow these payments, which means these fees are not irrelevant.

My imperfect complementarity model releases the constraint that the quantity of CP demanded, and the quantity ISP demanded to be equal, and I show that introducing a non-zero termination fee can indeed increase social welfare. Therefore, we recommend NTRAs to consider termination fee as a leverage to maximize the social welfare within each country. Furthermore, I show that the need for net neutrality depends on the level of complementarity and the own price effects of ISP and CP relative to each other.

Keywords: Net Neutrality, ISP, CP, Termination Fee.

The Relationship Between Device Diversity and Disparities in Online Engagement

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ABSTRACT

Internet access is only possible with necessary tools and technologies which enable connectivity. Demographic and socioeconomic differences in society lead to an uneven distribution of resources, which in turn, leads to unequal opportunities for internet experience. Different types of devices that can be connected to the internet offer additional advantages so that one can diversify their internet experience by using various devices (van Deursen and van Dijk, 2019). Therefore, individuals must have the appropriate devices to engage in various online activities which is considered a requisite for meaningful connectivity, a new measure for internet access. By using TurkStat (2020) "Information and Communication Technology Usage Survey on Households and Individuals" survey data, in this paper we investigate the distribution of device ownership, reflecting the device diversity among the Turkish population and further examine whether the type of device used to go online affect individuals' internet experience. Finally, we analyze whether this result is related to individuals' demographic and/or socioeconomic background. Based on the data used and by employing logistic regressions, we find that device diversity affects the level of online engagement. The vast majority of the population is reliant on smartphones and thus constrained by what smartphones offer them. The uniformity of device preferences in Turkey reveals the lack of multimodality of internet use such that lower device diversity implies limited number of online activities which limits the potential benefits of the internet. Finally, we point out that those who cannot fully benefit from what internet actually offers them are underprivileged social groups which can be considered an indication of digital divide in Turkey.

Keywords: Device Access, Device Diversity, Internet Use, Online Engagement, Digital Divide, Turkey.

Evaluation of Factors Affecting the Performance of Large-Scale Private Banks in Turkey

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ABSTRACT

This study aims to evaluate the competition and performance indicators between the six largest banks in terms of asset size among non-publicly owned (domestic and foreign private banks) banks operating in the Turkish Banking Sector (TBS). As of December 2021, the asset size of those six banks accounts for 73.2% of the total size of total 43 private banks of TBS.

It is planned to consider return on equity (RoE) and return on assets (RoA) ratios as key performance indicators (KPI) in our study. On the other hand, while these KPI's have been directly considered as success criteria in many studies in the literature, it is also planned to evaluate the risk/return balance. When considering the RoE criterion, the Capital Adequacy Ratio (CAR) will also be considered to evaluate the risk level that the institution faces and the actual return.

In this study, the period between 2006 and 2021 with quarterly data has taken into consideration. For all banks, unconsolidated financial statements have been used. During the base period, these banks increased their loan sizes from 12 to 25 times, respectively. Moreover, trends are measured in terms of market share within these six banks, where the dynamics of economic activity and the business size are similar, rather than the growth rates and amounts of each bank. Moreover, publicly available financial statements, annual reports, investor and earnings presentations, integrated and sustainability reports have been used to determine active customer numbers.

Early findings suggest that, level of demand deposits and growth rate of active customers have a key role in bank performance.

***Keywords*:** Active Customers, Bank Performance, RoA, RoE.

Capital Inflows to Emerging Economies

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ABSTRACT

Capital flows are an essential source of financing for emerging economies. High capital flows may help increase investments and economic growth by relaxing credit constraints and decreasing interest rates. However, a decrease in capital flows may reverse the trend; credits get reduced and an economic slowdown set about. Against this backdrop, this study aims to analyze capital flow dynamics in emerging economies. Specifically, we investigate the conditions that secure high and stable capital flows to emerging economies.

Due to financial globalization, capital inflows to emerging economies are affected by a wide range of domestic and global factors; and the effects of these factors depend on various definitions to quantify the amount of capital flows. For the analysis, we draw quarterly capital flow data from the International Monetary Fund's International Financial Statistics database for the 2005Q1-2020Q4 period. We construct capital flow data as a binary variable in order to define long-lasting surge episodes of capital flows. To specify the determinants of these episodes, we employ a set of domestic and global variables which represent country-specific and common factors, such as economic growth, domestic inflation rate, the difference between domestic and world interest rates, and country-specific and global risk factors. By utilizing the complementary logarithmic framework and dividing capital flows into subcomponents, we find that countries with higher levels of country-specific risk and debt-to-GDP ratios are less likely to experience long-lasting surge episodes in the "portfolio and other investments", while maintaining high domestic economic growth and low inflation volatility seem to be crucial factors for the course of "foreign direct investment".

***Keywords*:** Capital Inflows, Emerging Economies, International Finance.

Unpaid Domestic Care Work for the Family in Kazakhstan

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ABSTRACT

Gender inequality in unpaid work is embedded in discriminatory social norms. In most cultures, breadwinning is considered men's business, whereas caregiving and domestic work is commonly seen as women's responsibility. Measuring the unpaid work is important, because the gender gap in unpaid care work is an essential indicator of gender inequality. Time and effort spent on doing household chores vary depending on urban or rural location, availability of social infrastructure, household characteristics, etc. Poor estimation of unpaid care work may cause inaccurate assumptions about the public measures in social protection, labor market, and limit the effectiveness of government spending in a variety of socio-economic areas.

This paper examines unpaid domestic care work for children and other dependent family members in Kazakhstan. The main objectives are to determine the status of domestic work and care services, and to identify if there is a need to expand the care services provision (institutionalization of care services), in order to reach a higher female labor force participation. We analyze gender-segregated primary data obtained from the National Statistics Agency of Kazakhstan. The Time Use Survey was conducted in 2018 with a sample of 32,301 respondents (family members in the 11,904 households). The analysis illustrates how time spent on care and household chores are affected by the factors such as gender, marital status, age, level of education of respondents, and the presence of children under age of 12 in the household. Time use data indicate that there are substantial gender imbalances in paid and unpaid work: women perform a higher number of hours of total paid and unpaid work. In Kazakhstan, women spend significantly less time on paid work, and more than two times more on unpaid work than men do. In total, when paid and unpaid work are combined, women work more than men do.

***Keywords*:** Unpaid Care Work, Domestic Work, Household, Kazakhstan.

ELECTRICAL AND ELECTRONICS ENGINEERING

Design of Decentralized Microgrid Based on Renewable Energy and Electric Vehicle Charging Station: *A Case Study of Karabuk University*

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ABSTRACT

The world's increasing energy demand, the limited availability of fossil fuels, and environmental pollution are significant issues in the world. The incorporation of distributed energy resources (DER) into electric power systems (EPS) and the use of electric vehicles (EVs) due to low pollution has increased in recent decades. The single entity including DERs, energy storage devices, point of common coupling, power electronic devices (inverter, controller, static switch), and flexible loads which can operate either in an island or grid-connected mode is referred to as Microgrid. In this paper, a networked multi-microgrid (MMG) is designed with decentralized control of renewable energy and an EV charging system for the campus of Karabuk University. According to the technical and environmental conditions, the utilizing of PV panels and batteries are more effectively in the Karabuk region to generate electricity for decentralized MGs networks. In this study, DC and AC charging stations have been investigated by the multi-attribute decision-making (MADM) method with Expert Choice software. The priority of using charging stations for 24 hours a day has been calculated by MADM technique, Analytical Hierarchical Process (AHP), based on EV specifications. The proposed method shows that the DC charging station has the priority of EV charging with 51.4%, and the use of the AC charging station is 48.6%. Moreover, the Newton-Raphael method calculations performed with MATLAB software show that the proposed method not only has the ability to supply the energy needed for EVs 24 hours a day without putting pressure on the main grid but also has the ability to decrease power losses.

***Keywords*:** Multi-Microgrid, Electric Vehicles, Distributed Energy Resources, Multiple Attribute Decision Making, Electric Power Systems, Analytical Hierarchical Process.

Voltage Dips Analysis in a Doubly-fed Induction Generator Based Wind Turbine Using Active Crowbar Protection

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ABSTRACT

Recently, doubly-fed induction generator (DFIG) has been frequently used in wind turbines (WTs) compared to other forms of induction generators. However, one of the disadvantages of the DFIG is that they are sensitive to grid disturbances. Normally, the rotor side of the DFIG is connected to the grid through the converter. Thus, when a grid fault happens the converter is damaged. The crowbar protection device has been used to solve this issue. This protection, on the other hand, maybe ineffective in a big power system because of the overvoltage and inflow current that happens during symmetrical and asymmetrical events. Thus, we have programmed improved crowbar protection to be suddenly activated when the voltage dip occurs and return it under normal operation condition. During the dip, all the energy at the crowbar resistance is burned. Accordingly, in order to make this event progress much faster, we have lowered the resistance which, for instance, makes the peak of the crowbar current and torque become bigger depending by the demand of the grid code. Therefore, the crowbar resistance should be carefully chosen to protect the converter. This paper analyses the behaviour of a grid-connected DFIG during symmetrical and asymmetrical voltage dips. Moreover, symmetrical and asymmetrical fault has been compared in terms of their performances. The entire system has been validated using MATLAB/Simulink environment for different scenarios. The results are obtained from the parameters of a 2 MW, 690 V DFIG based three-blade WT. Detailed simulation result is presented and discussed in the result section.

***Keywords*:** Wind Turbine, DFIG, Symmetrical, Asymmetrical, Crowbar Protection.

Influence of the High Voltage Underground Cable Systems Design Parameters on Electrical Performances by Finite Element Method

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ABSTRACT

High voltage underground cables are commonly used because they do not cause visual pollution and provide a reliable operating condition for electrical distribution systems. However, the electrical performance of high voltage underground cable systems varies depending on their installation and operating characteristics. Current distribution, screen currents, screen voltages, and losses on conductors in cable systems vary according to the following parameters: number of parallel circuits, the distance between phases, and the distance between parallel circuits, formation, phase sequence, bonding system, harmonic distortion level and loading level of other cables. Those parameters have a crucial effect, especially on parallel cable systems used in the same cable gallery due to the increasing electrical power requirement. This study aims to examine the electrical performance of cable systems with two parallel circuits in flat and trefoil formation, solidly and single-point bonded in different phase sequences for different twelve cases. The influence of cable system design parameters should be evaluated during the design phase due to efficiency, safety, and sustainability performance. In this context, cable systems created according to different design parameters were modeled using the finite element method, and analyses were carried out. Within the scope of the analysis, the current distribution of the conductors, the screen currents, the screen voltages, and losses were calculated. According to the analysis results, the highest screen current in the flat formation is three times the trefoil formation for the solidly bonded and balanced current case. Similarly, for the single-point bonded case, the highest screen voltage in the flat formation is three times the trefoil formation. In this context, when analyzed parameters are evaluated, it is seen that the trefoil formation is superior in many aspects. In addition, different design cases were evaluated in this study.

***Keywords*:** High Voltage Underground Cables, Current Distribution in The Conductor, Screen Currents, Cable Losses, Finite Element Method.

Simulation and Analysis of a Grid Connected Photovoltaic System using PVsyst Software

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ABSTRACT

Solar energy occupies an important place today and its use is becoming widespread. An important part of solar energy systems are grid-connected systems. In this study, as an example of grid-connected photovoltaic system, the grid-connected system with 700 kW AC installed power in Denizli has been taken as reference. First, the three-dimensional model of the system, which has already been created with the help of the SketchUp program, has been uploaded to the PVsyst software. Then, the system structure was created by entering the characteristics of the equipment (inverters, AC and DC cables) used in the system into the PVsyst software. With the help of PVsyst software, the meteorological information of the region to be established was taken and the simulation was made considering the shading status of the system and other environmental factors in real time for a year, and daily, monthly or annual production amounts and many other output data were obtained. AC and DC losses are also included in the simulation and it is aimed to get more realistic outputs. Simulation and analysis of such systems is important in terms of drawing a suitable path by seeing the scenarios that a system to be installed will face before it is installed, observing the system behaviours and how the system will work in different ambient and temperature conditions. The monthly and annual production data of the system can be observed with the remote monitoring system. The simulation outputs were compared with the actual values, and the simulation results and the actual values were largely similar.

Keywords: Photovoltaic Systems, PVsyst, Grid Connected Systems.

Assessment of Electrical and Photometric Measurements of Driver on Board LED Floodlights under Different Grid Conditions

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ABSTRACT

The demand for DOB (Driver on Board) LED (Light Emitting Diode) luminaires and the usage rates are increasing with the rapid development of DOB technology. DOB technology has been a cost-effective solution for low powered inner lighting luminaires and recently started to be used in higher powered luminaires such as floodlights as well. The efficiency of floodlights has increased considerably with the switching from metal halide and high-pressure sodium lamps to LED. With the use of DOB technology, there has been a great advantage in costs as well as efficiency increase. However, concerns have been raised regarding efficiency stability and durability of DOB LED luminaires at high powers. In this study, a sample set was created by obtaining DOB LED floodlights from 3 different manufacturers and an LED floodlight with external driver each with a power of 200W to analyze the performance and durability of high-power DOB floodlights by performing electrical and photometric measurements under different grid conditions. 4 scenarios were considered to analyze the effect of mains fluctuations on DOB floodlights thus measurements were repeated under 4 different input voltages depending on these scenarios. Electrical safety and hi-pot tests are also performed according to Low Voltage Directive (LVD). The results showed that the samples did not provide declaration values of various properties. LED DOB floodlights within the sample set are critically affected by fluctuations in mains voltage. The tests revealed that decrease in voltage caused %56 power loss and over 8500lm decrease in total luminous flux. However, with the use of DOB technology, the cost of LED floodlights decreased significantly and it was concluded that DOB technology will have much greater importance and rate of use in LED lighting with minor physical improvements on the luminaire body and the electronic design.

***Keywords*:** Driver on Board, LED Floodlight, Electrical and Photometric Measurements.

Detection and Diagnosis of DC Faults at Module Level in Photovoltaic Systems

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ABSTRACT

Unexpected failures in photovoltaic (PV) systems; can cause serious power losses, temporary or permanent damage, risk of fire, and potentially fatal accidents. Monitoring PV systems and signaling in case of failures, enabling early action is important to achieve an optimized sustainable efficiency. Fault classification appears as a preliminary process in determining the fault location. In this study, unknown parameters were extracted by applying the Newton-Raphson Method to the single diode model of a 10 Wp PV module using the datasheet provided by the PV module manufacturer. Series resistance (Rs) and parallel resistance (Rsh), determined by parameter extraction technique, were applied in Simulink software to model the PV module. Using Matlab/Simulink software, both 140 Wp (14x10Wp) PV system simulations were made, and various fault situations were created in the simulation study, and fault classification was made according to possible real situations. This study presents a methodology for fault detection by evaluating the effects of faults on the dc side of the PV system on the I-V curve. Normal operating condition, partial shading; temporary partial shadow, permanent partial shadow, short circuit fault; the number of PV cells shorted (nd), and the number of PV modules shorted (np), aging failure; annual deterioration rate of the PV module (x) and the remaining useful life of the PV module (M), open circuit fault; The number of open circuit parallel arms in the string consisting of series and/or parallel arms and all string open circuit situations were evaluated. It seems that the faults specified in the simulation studies on the PV system are correctly classified.

Keywords: Parameter Extraction, Newton-Raphson Method, Matlab/Simulink, PV Faults, Fault Detection Algorithm.

5G Ultra-Wideband Slot-Loaded Microstrip Patch Antenna for Brain Tumor Detection

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ABSTRACT

In this study, an ultra-wideband slot loaded implant microstrip patch antenna powered by biocompatible 5G mobile communication technology was designed for use in the detection of brain tumors. The disadvantages of narrowband and low gain of microstrip antennas have been eliminated by the proposed design. The antenna can be easily used in biomedical applications that require wideband. The proposed design has a unique geometry, in which the bandwidth is increased by opening the slots. A slotted rectangular patch geometry was preferred as the antenna shape. 2 different slots have been opened. The antenna is designed to be electrically small in size so that it can be easily implanted. The dimensions of the proposed design are 17 mm×19.5 mm. In this design, RO3203 material with a thickness of 1.5 mm was used as the substrate. The antenna is coated with PF-4 (foam) material to be biocompatible. The proposed antenna operates in the frequency band 3.57 GHz. The parameters of the antenna such as return loss, radiation pattern, gain were analysed in the simulation environment. The return loss of the designed antenna was obtained as -33.36 dB, the bandwidth was obtained as 2632,6 MHz, and the gain was obtained as 2.12 dBi. Antenna design and analysis was carried out in CST simulation environment. Detection of cancerous cells takes a long time. It is desirable that the monitoring of cancerous tissue cells of sick individuals be continuous and rapid. To achieve an effective result in a short time the 5G frequency band has been preferred. Thus, the desired results will be achieved in a very short time with the large bandwidth in the 5G frequency band. At the same time, the fact that the antenna is implantable and works on broadband gives a great advantage to speed.

***Keywords*:** 5G, Microstrip Antenna, Slot-loaded Antenna, Ultra-Wideband Antenna, Brain Tumor Detection.

Design and Analysis of Circuit Board Prototyping Devices with Step, Servo and Hub Motor Based 3-Axis Numerical Controlled Central Processing Unit (CNC)

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ABSTRACT

Prototyping has a multiplier factor importance on an industrial R&D division. Prototyping reduces time and cost domain dramatically. The aim of this research is to design a multiple condition operator device by analysing fused deposition modelling devices, computerized numerical control devices, electrical motor types and software.

The effect of the multiple domains has indispensable roles on the criticization of physical design. System must provide drilling, engraving, machining and material adding options as a proof of concepts. Design methodology has 3 bases.

Firstly, a chassis has been designed by comparing FDM, SLA, and MJF 3D printing methodologies with a focus on the alteration of the chassis in CNC machine technologies. After spindle concept, hybrid machine is combined with Cartesian 3D Printer and Milling CNC Machine according to the maximum weight and 3 axes usability criteria.

Second base is to obtain and procure its components with full consideration of backlash, precision, obligatory drilling and engraving its torque analysis. In this base, microcontroller, motor driver and linear bearing tools should be compared and be selected according to the needs of the chassis, prior to the analyses of the results. Drilling process's minimum raising torque and minimum lowering torque with a 10-kilogram load for copper were calculated as 2,74N/cm and 0.50N/cm, respectively. In addition, feed force was measured as 2.9N/cm under the same conditions. With the calculations mentioned above, multiplication of feeding force and lowering force was 3,4N/cm. This value elucidates for drilling PCB for a 0.2mm layer with a spindle speed of 20.000 rotation/min.

Servo Motor's close loop system has advantage of no-step missing under high loads. Design parameters eliminates high load bearing negativity. Hub motor has harder concept; it needs special controller design that supports the field-oriented control system. On the other hand, step motor design allows a dynamic torque of 80% by holding maximum torque. Also, maximum torque characteristic changes with reference voltage of step motor driver, which in return matches with Nema 17 standard motors. Step, Servo and Hub Motor types were compared in the light of in this study and step motor was chosen due to its relatively cost and maintain advantage.

As the final base, among Klipper, Marlin 2 and open-source software, a modified Klipper software was re-written for configuration. Frequency stabilization and resonance cancellation with ADXL345 sensor as well as the half million micro step advantage OF STM32F103 microcontroller with built in Web interface features were two main influential factors for the selection and re-coding of the Klipper software.

***Keywords*:** CNC, Hub Motor, Servo Motor, Step Motor, Klipper, Hybrid Systems, FDM.

Designing Microstrip Patch Antenna at 3.6 GHz by Using Redfox Optimization Algorithm for the Parameters

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ABSTRACT

In this study, a cost-effective compact microstrip antenna designed and optimized at the frequency of 3.6 GHz and 200 MHz bandwidth for 5G wireless communication systems. Due to the ease of fabrication, rectangular patch geometry and embedded microstrip line feeding were preferred for Impedance matching. FR4 substrate was used thanks to its reasonable price and easy accessibility in the design. By using the Transmission Line Model (TLM), selected antenna parameters, which are return Loss (S_{11}), center frequency and Bandwidth, were optimized for the antenna geometry by the Red Fox Optimization Algorithm (RFO). CST Studio Suite program was used for antenna design and electromagnetic analysis. Antenna parameters were modelled in MATLAB and the optimized values were estimated. Then the fitness function based on the analysis results were designed with a graphical approach. So, S_{11} parameters, center frequency and Bandwidth values were successfully optimized. Regarding the results, the proposed antenna is promising for using in many industrial applications that require miniature antennas such as the internet of things, unmanned aerial vehicles, autonomous vehicles and swarm drone applications.

***Keywords*:** 5G, Antenna Design, Artificial Intelligence, CST, MATLAB, Redfox Optimization Algorithm.

Cancerous Lesion Segmentation for Early Detection of Breast Cancer by using CNN

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ABSTRACT

This study presents a segmentation method by using the convolutional neural network (CNN) approach for detecting cancerous lesions in mammograms. To that aim, a subset of 1319 mass images from the Curated Breast Imaging Subset of DDSM (CBIS-DDSM) dataset, which is publicly available, is used in this study. Mammogram images are pre-processed first by using conventional techniques such as background removal, histogram equalization, padding to make images square-sized, etc. To perform segmentation, the popular U-Net + VGG16 architecture is used. In order to provide the most accurate segmentation, average and standard deviation of performance metrics including accuracy, sensitivity, specificity, IoU, and Dice are calculated pixel-wise for different threshold values. Based on the performance metric calculations, the optimal threshold value of 155 is selected to achieve the best segmentation.

***Keywords*:** Breast Cancer, CBIS-DDSM, CNN, Early Diagnosis, Lesion Segmentation.

Leaf Disease Detection with PSO Algorithm using CNN Model

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ABSTRACT

In recent years, with the acceleration of studies in the field of artificial intelligence, in its simplest definition, is the general name of systems that try to imitate a certain part of human intelligence, the interest in image processing-based pattern recognition and classification has increased. And image processing technology provides various conveniences by offering innovative solutions in many fields such as medicine, agriculture, security systems, space sciences, industrial systems and defence industry. In agriculture, which is one of these areas, applications in which artificial intelligence is adapted to the processes of tillage, planting, irrigation and crop care are becoming more and more common. These applications support product quality and food safety by offering the opportunity to increase efficiency and sustainability, especially in agricultural production. By the way, the plants seriously reduce the yield in agriculture because of some diseases. And some methods can be used for the detection of diseases to prevent production losses.

In this study, we proposed a solution for detecting plant diseases earlier, by developing artificial intelligence and image processing algorithm, aiming to reduce crop loss and improve productivity in agriculture. We used the leaf images dataset, which were obtained from the PlantVillage dataset. The number of data was increased by applying the data augmentation process, and then the optimization process was carried out with the Particle Swarm Optimisation (PSO) algorithm and then the images were tested with the developed CNN model. The implementation was made in Python using Anaconda 2020.11, Spyder 5 development environments. The developed Convolutional Neural Network (CNN) model detects plant diseases with an accuracy rate of 84%.

***Keywords*:** CNN Model, Deep Learning, Image Processing, Leaf Disease Detection, PSO Algorithm.

Optimization of the Hybrid Renewable Energy System using Homer Pro: *Case Study Al-Fallujah/Iraq*

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ABSTRACT

In the last decades, the attention to alternative energy resources has increased by means of low cost, environmentally friendly, and sustainable to reduce relying on traditional energy resources. Iraq's power system generation depends on fossil fuels that significantly affects the environment. In addition, generated electricity doesn't meet the consumer needs. There is a significant gap between generation and energy demand, interruptions, and the daily shortages of electricity, especially in the summer period. Obsolete power plants and distribution networks still in operation in most regions of Iraq. The rehabilitation of these stations and grids is considered very expensive and needs working hands and huge budgets. In 2019, about 23% of Iraq's electricity was generated by natural gas imported from Iran, and Iraq imported about 5% of its electricity from Iran. At the same time, Iraq has tremendous renewable energy sources potential to generate electricity. In this paper, the optimization of a hybrid renewable energy system is conducted for a residential complex in Fallujah, Iraq. Techno-economic analysis of the hybrid system carried out by the HOMER program using initial data of loads, solar global horizontal irradiance, and wind speed potential. The simulation results show that an effective hybrid system consists of 410 kW solar panel, 50 batteries (each battery provides 16.8kWh, 51.2V, and 328Ah, 25 kW diesel generator, 185 kW inverter with a net present cost of 939984 US $, and a cost of energy of 0.0448 US $/kW. Operating cost 24289 US $ per year, initial capital cost 625982 US$, and 31.6 %renewable fraction.

***Keywords*:** Iraq's Power Systems, Renewable Energy, Hybrid System, HOMER Software.

Performance Change in Relation to the Shading State and Thermoelectric Effect of the Photovoltaic Panel

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ABSTRACT

Since fossil-based resources meet the intensive energy needs, the ecological balance has been damaged and global and local disasters have also occurred. For this reason, instead of using non-renewable energy sources such as coal and nuclear energy, it is necessary to turn to energy sources such as renewable solar, geothermal, biomass. Of these, solar energy meets our energy needs in our daily lives at higher rates by increasing the usage areas day by day with its suitability for innovation and cost. The heat energy generated on the surface of the photovoltaic panels reduces the efficiency of the panels. In addition, with the increase in temperature, the efficient working time of photovoltaic panels decreases. In this study, the photovoltaic panel in the ghosting state and the photovoltaic panel cooled with the help of a thermoelectric cooler were examined by reducing the temperature on the surface and changing its performance. Thanks to the thermoelectric module connected to the back surface of the photovoltaic module, the temperature of the photovoltaic module surface can be reduced below this level and cooled. As a result, the performance of the panel in the ghosting state and the panel that is not in the ghosting state was observed and it was also tried to increase the efficiency of the photovoltaic module by preventing the increase in temperature.

***Keywords*:** Renewable Energy, Photovoltaic System, Thermoelectric, Performance Analysis, Efficiency.

Analysis and Enhancement of Distribution Network by Sharing Renewable Energy

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ABSTRACT

Iraq's electricity generation in general depends on fossil fuels – natural gas and oil which accounts about 97%. According to the International Energy Agency natural gas using in electricity generation increased from 20482 GWh in 2015 to 53039 GWh in 2019. With an annual population increase of more than 1 million people, the electricity demand for Iraq is expected to increase double between now and 2030. There is a significant gap in distribution network system of Iraq, including interruptions, the daily shortages of electricity. Iraq has enormous potential of domestic renewable energy resources and can a significantly increase the share of renewable energy resources in the electricity production. The penetration of renewable energy to distribution network systems with its advantages has also drawbacks. Renewable energies exhibit power fluctuation, high nonlinearities, changing dynamics, and uncertainties. Therefore, it is required to provide a stable operation and reliability of the power system while integration of renewable energy into the distribution network of the utility grid. In the paper, a study of a low voltage distribution network operation using renewable energy is considered for 11 kV feeder with 3.5 MW load of Bagdad city. ETAP software is applied to analyse a distribution network including such parameters as load flow, drop voltage, power losses, harmonic analysis and active power. The distribution network analysis process is executed to evaluate the state and operation of the existing system under different load operating conditions. The simulation results in ETAP show that using PV energy can reduce overload and power losses in a distribution network.

***Keywords*:** Distribution Network, Renewable Energy, ETAP, Load Flow.

Development and Analysis of Prediction Models for an AI-Based Energy Management System for Microgrids

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ABSTRACT

Microgrids are structures consisting of renewable energy sources, energy storage units and local loads, which can operate simultaneously connected to the power grid when needed, or can operate independently and autonomously from the grid for economic and structural reasons. This autonomous operation feature of microgrids necessitates a strong energy management system infrastructure. Today, microgrids are sized using classical installation methods and controlled with expert system-based management systems. This type of management both limits the efficiency that can be obtained at the time of operation of the microgrid and has difficulty in following new trends in energy storage technologies. The idea that current energy storage technologies are used effectively in the system and that today's artificial intelligence technology forms the basis of the energy management system of microgrids constitute the importance of the study. An artificial intelligence (AI)-based energy management system should be able to predict the power generation of the solar power plant and the power generation of the wind turbines in the microgrid. In addition, it should be able to predict the dynamic price data and the load level to be requested from the microgrid. Accordingly, the system needs prediction models with high accuracy. In this study, solar power generation and wind power generation in a microgrid are forecasted by ensemble learning and other machine learning algorithms. While live price and load demand data are forecasted by deep learning algorithms, the performances of these prediction models are examined and compared. The suitability of all these prediction models for an AI-based energy management system has been investigated and analysed.

Keywords: Microgrid, Machine Learning, Deep Learning, LSTM, Energy Management System.

Low Power Quantized YOLO for Face Detection on FPGA

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ABSTRACT

With the latest advances in embedded systems, artificial intelligence applications on edge devices have increased. In older systems, data was being collected from the edge devices and decision making was applied on the servers. Therefore, low network speed or network problems were limiting the system performance. However, smarter applications can be developed and run on modern embedded systems. System-on-Chip (SoC) architectures which contain CPU and FPGA (Field Programmable Gate Array) in a single chip together offer low power consumption while running Convolutional Neural Networks (CNNs). In this paper, we modified, trained and deployed TinyYolov3 architecture for face detection by using Brevitas and FINN framework on PYNQ-Z2 board which is a low-end cheap development board having Xilinx Zynq 7020 SoC. With Brevitas which provides quantized version of convolution, fully-connected and activation layers of a CNN in Pytorch, we created modified version of TinyYolov3 with various integer bit precisions for weights (W) and activations (A) such as 2W4A, 3W5A, 4W2A, 4W4A, 6W4A and 8W3A. Then, we trained it in a quantized form with WiderFace dataset. To reduce power consumption and get higher speed, we optimized the logical resource allocation and used on-chip memory of the FPGA to store the weights and activations. Additionally, we changed the last layer's activation function Sigmoid to rescaled HardTanh. To run the trained backbone CNN on the FPGA, we synthesized it with Vitis HLS and Vivado by using FINN-HLS library which contains layer definitions of the created model in C++. Besides, we utilized CPU of the SoC for preprocessing, postprocessing and TCP/IP streaming of the results in a multithreading approach to increase throughput. As a result, with the 4W4A bit precision, we observed 18 Frames Per Second (FPS) throughput, 2.4 Watt total power consumption on PYNQ-Z2, 70% utilization of the resources of the FPGA and 3% Mean Average Precision (mAP) drop on the accuracy compared to nonquantized version of the model.

Keywords: FPGA, System-on-Chip, Quantized Convolutional Neural Network, TinyYolov3, Face Detection.

The Effect of Virtual Impedance on Inverter's Control Topologies ın Islanded Microgrid

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ABSTRACT

There are a lot of new works related to Microgrid in the last decades. The single power entity includes distributed energy resources (DERs), energy storage devices, point of common coupling, power electronic devices (inverter, controller, static switch), and flexible loads is referred to as Microgrid (MG). The Microgrid is a key component of a new concept – Smart Grid. Microgrids can operate either in an island or grid-connected mode. While designing Microgrid control it is necessary to achieve stability for each unit in addition to the stability for the Microgrid entire in various conditions of load and system. Penetration of DER to a distribution network causes impacts on the stability of power systems. Due to the variety of energy sources high-reliability inverters and converters are required to provide regulated power to customers and facilitate microgrid integration. Microgrids use inverters to create a connection between distributed generation units and loads/grid. The modelling, control design, and stability analysis for two various inverter topologies are considered in this paper. Furthermore, the differences in the type of output impedance (inductor/resistor) of parallel inverters can affect the accuracy of power-sharing and thus destabilize the system. The parallel inverters offer the system redundancy besides the high reliability needed for a flexible Microgrid structure. The paper studies this phenomenon by utilizing the Bode Plot technique. The controller based on virtual impedance is proposed to enhance the stability of the system. The results of the simulation are implemented in MATLAB/Simulink to verify the validity of the theoretical analysis, and the efficiency of the proposed controllers.

***Keywords*:** Microgrid, Distribution Energy Resources, Inverters, Droop Control, Virtual Impedance.

ELECTRONICS AND COMMUNICATION ENGINEERING

Extending the Instruction Set Of RISC-V Processor for ASCON Algorithm

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ABSTRACT

Lightweight cryptography (LWC) is an important research area at a time when constrained devices are on the rise. The well-known asymmetric and symmetric cryptography algorithms such as AES and RSA are not suitable for these devices. So, the lightweight cryptography field has emerged. Speed and memory usage are the most important attributes of LWC algorithms. ASCON lightweight cryptography algorithm is one of the finalist algorithms in the standardization process of the NIST and CEASER competition. In this study, the instruction set architecture of Ibex core, a RV32IMC processor has been extended for the ASCON algorithm. The algorithm has been run on the processor and observed the execution time, size of instruction memory, the average energy consumption and the area coverage. The code has been profiled on the SPIKE RISC-V ISA simulator and the most frequent operations have been chosen. The chosen operations have been designed with Verilog HDL, the modules instantiated at the processor and the same measurements are done with the custom instructions. Thus, the execution time of the algorithm is decreased by 30.2%, the memory size is decreased by 2.3%, the energy consumption while running the algorithm is decreased by 41.84%, and the number of look-up tables and flip-flops in the modified processor are increased by 18.2% and 1.94% respectively.

***Keywords*:** Lightweight Cryptography, Custom Instruction, RISC-V, Open-Source Hardware, Instruction Set Extension.

Novel Design of Transducer for Bone Conduction Use

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ABSTRACT

Hearing losses are worldwide acknowledged health problems affecting overall life quality of suffering patients. Fortunately, distressed patients can be assisted with early diagnosis and proper treatment. Different types of hearing aids were developed to rehabilitate and treat people suffering from hearing traumas. One such type of hearing aid is the bone conduction (BC) hearing aid, which is helpful for indicated patients. BC has been used for many decades in hearing aids, and there are now several implantable versions. These hearing aids transmit the sound through the skull bones to the inner part of the ear bypassing the outer and middle parts. BC hearing aids are essentially designed with a transducer principle that includes a motor unit used for BC. This motor unit transforms electrical signals into mechanical vibrations. The main objective of this project is to build a magnetostrictive transducer to be used for auditory BC.

Magnetostrictive material options were reviewed to replace piezo-electric ceramics frequently used in BC hearing implants. According to literature review, the ferromagnetic alloys Terfenol D, Galfenol, and Metglas 2714A® were identified as possible transducer materials. The ANSYS® Mechanical environment was chosen for simulation and testing. After material evaluation, Metglas 2714A® Magnetic alloy and Terfenol D were deemed less suitable for this application because of size and robustness requirements. Hence, we decided to proceed with Galfenol for initial tests in ANSYS® Mechanical. Mechanical dimensions were simulated and optimized with regards to size and resonance frequency, similar to existing bone conduction transducers. We found out that 0.5-millimeter thickness, 20 mm length, and 4.8 mm width were appropriate to use in our transducer design in modal analysis of ANSYS® Mechanical. The results of magnetic field density and force output of our transducer model were presented are simulated in ANSYS® Maxwell.

Keywords: Bone Conduction, Bone Conduction Hearing Aid, Galfenol, Vibration.

A Broadband and High Gain 28GHz Microstrip Antenna Design for Millimeter-Wave 5G Communication Systems

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ABSTRACT

The mutual purpose of evolvements in wireless communication technologies and improvement actions coordinated in the direction of these developments is to receive data obtained from communication systems efficiently and properly. Therefore, antenna design plays a key role in the 5G communication module. Antenna structures used in Fifth Generation (5G) technologies should essentially include a wideband operation region and high gain in order to meet design requirements. Various configurations using patch geometries can be obtained in order to obtain broadband and acceptable high gain in planar antenna structures for 5G technologies.

Antennas used in 5G communication systems should be compact, light, and designed that can be integrated into reserved space for the antenna in interested devices. Microstrip antennas are often preferred in 5G technologies due to their low cost, compact size, and ease of fabrication and several techniques can be applied to remedy their low gain and narrow operation bandwidth properties of them. The patch technique is frequently used in microstrip antenna designs. In this study, the design properties of the proposed microstrip antenna are taken into account for new-generation wireless communication systems. A microstrip antenna design with compact size, operating N257 (26500 – 29500 MHz) frequency band, gain above 3dB, having broadband operation ability is proposed intended for Fifth Generation (5G) communication technologies. After that, antenna geometries are modified using the patch technique to obtain a high gain and desired operation bandwidth of the designed antenna. To meet design requirements, the top and bottom of the proposed microstrip antenna are trying to be changed by patches with various proper geometrical shapes.

***Keywords*:** 28 GHz Antenna, 5G Antennas, Fifth-Generation Communication Antennas, Microstrip Antenna, Patch Antenna.

Design of an Embedded Fault Diagnostic System

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ABSTRACT

Detection of errors has become even more important to correct the errors, ensure maximum efficiency, and provide optimized and sustainable systems. Accordingly, fault diagnostic systems that are designed specifically for the purpose of detecting and recording the error conditions on the software, hardware or equipment etc. have become widespread in different fields. The primary purpose of this study is to design a microprocessor-based embedded Fault Diagnostic System (FDS), which operates in conformity or integrated into main units such as control, automation, power units to be used in numerous fields. This system is fundamentally a logger system that continuously records wave-forms measured by external sensors, creates "Error Messages" in case of special conditions determined as an error, and stores error messages even in case of a power cut.

For this purpose, conceptual and detailed system designs are built in the light of researches on system architectures, memory structures, protocols etc. Then, components such as memory units, super capacitors, real-time clock/calendar were selected according to researches, and a PCB was designed in Altium Design Tool. Afterwards, software architecture was built based on the system-level scenario, and divided into sub-functions directly responsible for diagnostic tasks such as different type of SPI-based writing, reading, erasing, detection, MRAM – EEPROM communication. After these sub-functions are verified one by one, the main software was designed with C language as well.

As the final step, accuracy and performance tests were performed on real hardware by generating dummy traffics and simulating the real operation scenarios. Results were analyzed by using two different verification methods. Because the microprocessor-based system has a fixed architecture and limited number of I/Os could be used for SPI, real-time recording cannot be executed during the error transfer. So, running time of the error transfer process is as important as the data accuracy, and performance tests were also performed. As the result of the tests, the FDS has been verified and validated successfully. No corruption between the source and destination, no bad data or missing packets were observed in tests.

***Keywords*:** Fault, Diagnostic, Embedded, Microprocessor, SPI.

Investigation of Microstructure Movement under Flow by using Image Processing and Deep Learning

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ABSTRACT

The viscosity of chemical and biological fluids is an essential material property which must be accurately measured in many industrial and biological applications. Different methods have been developed to measure viscosity.

In micropillar-based microfluidic viscometer method, a relationship between viscosity and flow induced micropillar displacement is used. Specifically, calibration curves (viscosity vs. micropillar tip displacement) are generated using solutions with known viscosities before doing general viscosity measurements. This is performed by filming experiments with glycerol/water solutions having viscosities varying from 2 to 100 cP at fixed flow (shear) rates. Then, the experiment is repeated with a sample fluid of which viscosity one wants to measure. For this purpose, an image processing software, ImageJ, is used to measure the displacement of pillars in captured experiment videos with the sample fluid. Finally, the measured displacements are mapped to the calibration curves to calculate the viscosity of the sample fluid. This method provides accurate results. However, the downside is that the displacement calculation via ImageJ takes some time and requires human effort. Therefore, in this study, we employed two different image processing algorithms that provide much quicker results. These are Lucas-Kanade (KLT), which is used in classical video processing, and FlowNet2 neural network model.

KLT algorithm is a widely used differential method for optical flow estimation. To get displacement of pillars, we used the KLT to track four corners of the pillar tip. Then, by taking the average of these four corner displacements, we calculated the final displacement data. Flownet2, on the other hand, is a convolutional neural network (CNN) used to interpret visual images in deep learning. FlowNet2 has features such as huge displacement mastery and accurate estimation of extremely fine details in optical flow field. We used the FlowNet2 model, which was pre-trained on the THINGS dataset. We took the first frame of video as the first entry of the model and upcoming frames as the second entry to get displacement data.

For calculating the accuracy of the methods, we used ImageJ data as a reference to calculate the accuracy of the proposed methods for 10 videos. KLT and FlowNet2 provided an average accuracy of 93% and 92% respectively with respect to ImageJ. By employing these methods, we eliminated the need for human assistance resulting in significant time savings. With KLT we achieved real time calculation, and with FlowNet2 we decreased the processing time about 6 times compared to ImageJ.

***Keywords*:** Viscosity, Micropillar, KLT, FlowNet2.

ENERGY,
NUCLEAR RESEARCHES

Evaluating the Thermal Performance and Carbon Emission of an Aluminum Curtain Wall of a Residential Building

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ABSTRACT

In recent years, with the rapid increase of the world population, energy consumption has reached very high levels throughout the world. As many sectors have a share in this energy consumption, the amount of energy consumed by buildings is undeniable. Many strategies are followed to reduce buildings' energy consumption, such as good envelope insulation. Correspondingly, aluminium curtain wall systems could be a good alternative structurally as well their energy performance could be improved with the insulation integration.

The purpose of this study is to improve the thermal performance of a residential building by replacing the exterior wall with an aluminium curtain wall, located in Turkey's Istanbul Kağıthane district. For this, simulation models have been created to analyse the energy consumption differences as a result of the insulation improvement of the building. Energy simulation software e-Quest was utilized as a tool for analysing the energy performance of buildings.

The first modelled as sheathing (U=0,554 W/m^{2}K), which is the external wall insulation of the existing building, and the energy consumption was found to be 140.55 kWh/m^2. Furthermore, the exterior of the building was changed with an aluminium curtain wall system (South, East, West facade U=0.468 W/m^{2}K, North facade U=0,423 W/m^{2}K) and window changes with better thermal performance. Also, sun shadings were placed in front of the windows for summer comfort. According to this model, the energy consumption in the building was determined as 103.77 kWh/m^2.

In addition to these, the LCA analyses of the building models were performed and the results were analysed to find the reduction in carbon emission. The values of the base building and the building with aluminium curtain wall system were found to be 444 kg CO_2e/m^2 and 522 kg CO_2e/m^2. The result shows that insulating elements play a major role in carbon emission.

As a result of the exterior insulation of the building with aluminium curtain walls, improvement in thermal performance was determined by a significant decrease in the operational energy consumed by the building. In addition to improving the operational energy values of the building, sustainability with environmental impacts of the building insulation has been evaluated. However, the increase in CO_2 emissions due to the material differences in the facades brought a different perspective to the increase in thermal performance.

***Keywords*:** Thermal Efficiency, Aluminium Curtain Wall, LCA, E-Quest Modelling.

Comparative Evaluations Between a Traditional and Passive House in terms of Energy Efficiency and Global Warming Potential

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ABSTRACT

Energy efficiency in buildings will become a more important subject with the increasing energy demand in the world. Especially during the COVID 19 pandemic period, spending more time indoors resulted in a significant increase in energy consumption. Thus, buildings' energy efficiency has great importance both in energy saving and in reducing global warming potential.

For those concerns, a passive house has been considered, defined as a construction concept that is energy efficient, ecological, and comfortable at the same time. As a case study, the energy performance of a traditional house in Edirne is analyzed to compare with the passive house criteria and the TS 825 standard. Furthermore, applied passive house strategies have been evaluated in terms of energy consumption and their effect on the environment. Detailed energy models have been developed by utilizing e-Quest software. Outcomes have been represented in terms of the energy consumption and global warming potential of the applied strategies.

Results represent that in the TS 825 house 40%, and in the passive house 71% savings compared to the traditional house in the primary energy demand. In addition, the global warming potential of the houses has been compared, in TS 825 house 23%, and the passive house 54% savings have been achieved. Therefore, the passive house is remarked as a more energy-efficient and environmentally friendly option compared to others.

***Keywords*:** Passive House, Energy Efficiency, Global Warming Potential, Building Energy Consumption.

Spatial Analysis of the Renewable Energy Potential in Antarctica Research Stations

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ABSTRACT

The field of renewable energy comes to the fore day by day with the growing world population, limited energy resources, carbon emission and climate change crisis. Renewable energy facilities established at some stations in Antarctica, an important center of scientific research, are an indicator of this awareness. The Antarctic continent is a region where scientific research is carried out under difficult conditions and it is very difficult to integrate renewable energy sources due to climatic conditions. The use of renewable energy resources in the Antarctic continent is very important in terms of the future of the continent and being a guide to the world. Although fossil fuels are mostly used in research stations, the demand and studies for renewable energy sources are increasing. In the Antarctic continent, there are examples of the Princess Elisabeth research station, whose source is 100% renewable energy, and stations close to the polar center, which cannot use renewable energy sources with adverse climatic conditions. Renewable energy potential is evaluated according to regional and seasonal conditions.

This study evaluates the renewable energy potential and awareness in Antarctica. The study includes a specific review of 20 research stations selected to cover East and West Antarctica. Seasonal solar and wind energy data were created by taking the average values of the 40-year reanalysis data obtained from the Modern Era Retrospective-Analysis for Research and Applications (MERRA-2) assimilation model for research and applications. The results give us information about the direction of polar energy demand, carbon emissions and its future of the Antarctic continent by investigating the current energy status of some stations.

The study is supported by The Scientific and Technological Research Council of Turkey (TÜBİTAK). Project Number: 118Y322.

***Keywords*:** Antarctica, Research Station, Renewable Energy, Wind Energy, Solar Energy.

Determination of the Deuterium-Tritium(D-T) Neutron Generator's Average Neutron Energy and Neutron Flux by Multi-foil Activation Analysis

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ABSTRACT

In this study, the neutron flux and average neutron energy had been determined experimentally for the D-T neutron generator (Thermo-Fisher TM MP320) that is in ITU TRIGA Mark II Reactor which is performed for the first time for this generator. To determine the average neutron energy, multi-foil analysis had been used. Multifoil analysis is a method that is based on activating the foils with neutrons and counting the gamma rays that are emitted from the foils. Foils' cross-section with neutron and gamma-ray intensity must be high to determine. Nb and Zr foils had been chosen to determine the average neutron energy and Al foil was used to determine the neutron flux. Neutron activation analysis had been performed on each foil. Foils are irradiated for 3 hours together on the generator's target plane. HPGe detectors are used to count the foils. An Ortec HPGe detector was used for counting Al by locating the foil to the center of the detector, Canberra HPGe detector was used for counting Nb and Zr by locating the foils to the center of the detector. For both detectors' efficiency and energy calibration Ba-133, Co-60, Cs-137, Eu-152 and Am-241 foils were used as sources. Nb and Zr foil counted for 172825 seconds, Al foil counted for 95675 seconds in detectors. For average neutron energy calculation Nb-93(n, **γ**) Nb-92m and Zr-90(n, **γ**) Zr-89 reactions were used and for neutron flux calculation Al-27(n, **α**) Na-24 reaction was used. Neutron generator set at its maximum yields (70 kV-90 mA) while irradiation. The average neutron energy was found as 14,20 MeV and neutron flux was found as 819.558 n/cm^2.

***Keywords*:** Neutron Activation, Multifoil Analysis, HPGe Detector, Gamma-Ray.

Monte Carlo Estimation of Spent Fuel Gamma Spectrum and Dose from Measurement System

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ABSTRACT

The knowledge of the burnup of fuel elements in the reactor core is important for in-core fuel management. The experimental measurement requires the removal of fuel elements from the core in a cask and placement of them in a measurement system. Radiation protection must be accomplished at all times. This study aims to determine fuel burnup and radiation dose during experimental determination by using Monte Carlo simulations for the Istanbul Technical University TRIGA Mark II research reactor. The source generator module of the MCNP Monte Carlo code was used to generate gamma source energy distribution. It was observed that the assumptions of aging of isotopes affect the final dose estimation and gamma counts therefore a different time scale for aging was investigated. In addition, the gamma spectrum of selected TRIGA fuel elements and dose rate around the measurement cask was extracted from measurement cask simulations. Cesium-137 radioisotope peak at 662 keV has the highest count in a spent fuel element and is generally used for fuel burnup calculations was clearly visualized with MCNP tallies. The models developed in this study can replace experimental needs related to fuel element characterization, as a result, the radiation dose received by the reactor staff can be reduced.

***Keywords*:** Burnup, Radiation Protection, MCNP, TRIGA.

ENVIROMENTAL ENGINEERING

High-temperature Pyrolysis of Sewage Sludge and Polypropylene Mixtures: *Investigation of its Synergistic Effect on the Pyrolysis Yield and Product Distribution*

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ABSTRACT

Waste management is a global concern and there is an increasing trend to get the wastes into the circular economy. Besides, waste abatement requires to handle different feedstocks in one pot. In this sense, waste utilization as mixtures rather than bonding to one kind renders the process versatile. Since wastes react to the process conditions inherently depending on their physicochemical structures, it is imperative to understand the mutual effects of their different types under identical process conditions for the estimation and optimization of the outputs. In globally changing waste management perspective, waste sludges are being more treated as feedstocks for sustainable fuels and chemicals production. On the other side, increasing demand for personal protective equipment left the huge piles of polypropylene (PP)-based polymeric wastes behind during Covid-19 pandemic. Sewage sludge (SS) and plastics are two different wastes presenting a great potential for further utilization. In this study, an understanding will be developed about the pyrolysis of SS and PP mixtures, whose individual thermal behaviours differ significantly. For doing this, high-temperature pyrolysis in the ranges of 750-850 °C in a batch type reactor was applied for the mixtures of SS and PP prepared in different ratios. The effects of temperature and pyrolysis vapour residence time as a measure of swept by nitrogen flow were examined. At a first glance, it was noticed that higher syngas yields were obtained at the expense of biochar and bio-oil with increasing temperature. While syngas yields were recorded to be 44.55% and 75.8% for sewage sludge and PP, respectively at 850 °C and 1 l/min of nitrogen flow, it was 62% for their equal mixtures. Preliminary results indicated that overall yield of mixture was slightly improved compared to the theoretical value based on the ratios of SS and PP.

***Keywords*:** Co-Pyrolysis, High-Temperature Pyrolysis, Polypropylene, Sewage Sludge, Syngas.

Investigation the Catalytic Effects of Natural Minerals for Sewage Sludge under Different Gasification Atmospheres

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ABSTRACT

Sewage sludge is a mud-like residue resulting from wastewater treatment. With the rapid growth of urbanization and industrialization, its annual production rate increases tremendously. Sewage sludge contains heavy metals and pathogens such as viruses and bacteria and creates significant environmental problems during disposal. So, there is an urgent need to find environmentally friendly and cost effective sustainable solutions. Thermochemical treatment routes such as combustion, pyrolysis and gasification appear promising in terms of energy and material recovery. Gasification has some advantages over the other two techniques, e.g. syngas, a mixture of CO and H_2, forms upon gasification and can be further converted to fuels and chemical. The byproduct, fly ash may find use as cementitious materials. On the other side, the presence of alkaline-soluble P bonds in the bottom ash makes the chemical extraction of phosphorous compounds simple, although toxic heavy metals in the content of bottom ash limits its use. Sewage sludge gasification in the presence of some catalytic materials might lead to different gasification efficiencies and product profiles. Pyrolytic volatiles (tars) can be catalytically converted into H_2, CO_2 or CO, thereby increasing the overall efficiency of the process and syngas quality. In this context, the aim of this study was to investigate the catalytic effect of some minerals, namely dolomite, olivine and limonite for different gasification agents. To simulate the gasification conditions, experiments were conducted in a fixed bed tubular reactor by flowing carbondioxide, air, steam and air–steam mixtures over sewage sludge in mixture with mineral in mention. In preliminary results, H_2 share of syngas was increased by the use of catalyst besides the use of water vapor as gasification agent. This increase was ascribed to the occurance of water gas shift and steam reforming reactions.

***Keywords*:** Energy, Sewage Sludge, Gasification, Catalyst.

Effects of Operational Conditions on Phosphorus Recovery as Vivianite

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ABSTRACT

Phosphorus recovery is a vital issue for the world because of the uneven distribution of phosphorus resources and decreasing amount of current phosphorus resources. Studies continue on more efficient and economical phosphorus recovery techniques from wastewaters and sludges. Existing tried-and-tested practices have limitations in terms of efficiency and applicability.

Recovery of phosphate as struvite ($NH_4MgPO_4.H2O$) is a recommended method. However, with this process, phosphate recovery remains as low as 10-40% of the influent amount and this method is possible in facilities with advanced biological phosphorus treatment. In many wastewater treatment plants, phosphorus removal is provided by the addition of chemicals (such as iron or aluminum salts) along with advanced biological phosphorus treatment to meet stringent discharge standards. The presence of these metals reduces the efficiency of obtaining struvite. Therefore, more economical and efficient phosphate recovery techniques are needed. If iron and phosphate are present and relatively less sulfide concentrations are present, vivianite ($Fe_3(PO_4)_2{\cdot}8H_2O$), an iron phosphate mineral, is formed in anaerobic conditions. Recovery of phosphorus as vivianite is a current issue worldwide and studies are ongoing. Vivianite is a valuable mineral used in some industrial facilities and agricultural activities. Therefore, recovery of P from wastewater based on vivianite formation not only contributes to the sustainable use of phosphorus, but also provides potential economic opportunities.

In this study, it was aimed to determine the recovery potential of phosphorus as vivianite and to evaluate the effects of operational conditions on phosphorus recovery. For this purpose, lab-scale semi-batch completely mixed crystallizer reactor was used. The reactor with a volume of 1 liter was stirred with a magnetic stirrer. Synthetic wastewater containing Na_2HPO_4 was used and $FeCl_2$ was added as Fe source. In experimental studies, the effects of parameters such as pH, Fe:P ratio, Fe feeding rate, and P concentration for vivianite crystallization were investigated. Within the scope of the paper, detailed information about these studies will be given and the results will be discussed. As a result of all experimental studies, P removal efficiencies of up to 50-70% has been achieved by vivianite crystallization.

***Keywords*:** Phosphorus, Wastewater, Vivianite.

Impact of Co-treatment of Food Waste and Municipal Wastewater in the Performance of Aerobic Granular Sludge System

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ABSTRACT

One of the main goals of wastewater treatment plants (WWTPs) in terms of sustainability is to achieve a neutral/positive energy balance without compromising discharge standards. Aerobic granular sludge (AGS) technology promises high treatment performance with low energy and footprint requirement. AGS process is aimed to form granules that include both autotrophic and heterotrophic microorganisms in order to remove chemical oxygen demand (COD), nitrogen and phosphorus in a single granule. The purpose of this study was to investigate the effect of co-treatment of municipal wastewater and food waste (FW) on the treatment efficiency, settling behaviour of the granules, and granule morphology. Two stages were applied in this study. At Stage 1, raw wastewater from a full-scale municipal wastewater treatment plant with a daily capacity of 600000 m^3/day was fed to the AGS reactor, whereas a mixture of wastewater and FW was fed to the reactor at Stage 2. The AGS reactor in this study was operated as sequencing batch reactor (SBR) mode. Six cycles per day were applied in SBR mode. Duration of each cycle was 240 min including 3 min of feeding, 30 min of settling, 120 min of aeration, 65 min of anaerobic, 2 min of idle and 20 min of decanting. High COD (>80%) removal efficiencies were achieved at each stage. High total nitrogen (TN) and total phosphorus (TP) removal efficiencies were observed at Stage 2 compared to Stage 1. An environmental scanning electron microscopy (ESEM) combined with an energy dispersive X-ray (EDX) spectroscopy was conducted to examine the morphology of granules. A more uniform and compact structure of granules was observed at Stage 2 than Stage 1. Based on EDX results, aerobic granules obtained at each stage had higher percentage of carbon (C) and nitrogen, indicating higher organic content of granular sludge. This study highlights the positive impact of FW and municipal wastewater integration in AGS system based on treatment performance and granular morphology.

***Keywords*:** Aerobic Granular Sludge, Co-Treatment, Food Waste, Municipal Wastewater, Treatment Performance.

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Application of Reverse Osmosis for Industrial Water Reuse

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ABSTRACT

High water demand for domestic, agricultural, and industrial purposes are expected to be dramatically affected by water scarcity in the next decades. Moreover, untreated wastewater discharge or poor treatment has detrimental effects on the environment. Treated wastewater can be used as a resource to cope with water scarcity. There are several advanced treatment technologies to produce reclaimed water such as adsorption processes, advanced oxidation processes, electrocoagulation, and membrane processes. The purpose of this study was to investigate reverse osmosis (RO) filtration technology as an advanced treatment of municipal wastewater for industrial water reuse. The effluent of a laboratory-scale "biological treatment process + microfiltration process" configuration was used to feed the RO filtration system. A polyamide thin-film composite RO membrane (with 100-200 Da molecular weight cut-off) was selected for the operation. The RO set-up was operated at a transmembrane pressure of 15 bar and flux of 20 $L.m^{-2}.h^{-1}$. Outstanding total nitrogen (94%), total phosphorus (96%), and conductivity (95%) removal efficiencies were achieved. Furthermore, solids free effluent without coliforms was obtained. It was found that the effluent water quality met the United States Environmental Protection Agency (US EPA) requirements for industrial water reuse purposes. This study showed that the RO filtration can be used to obtain high effluent quality from municipal wastewater, which can reduce freshwater demand of industrial processes.

Keywords: Advanced Treatment, Industrial Water Reuse, Membrane Process, Municipal Wastewater, Reverse Osmosis.

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The Effects of Moss Amendments on DDE Accumulation in Zucchini Plants Growing in the Contaminated Soils

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ABSTRACT

p,p'-DDE (2,2-bis(chlorophenyl)-1,1-dichloroethylene) is one of the persistent organic pollutants(POPs). *p,p'*-DDT (2,2-bis(chlorophynly)-1,1,1-trichloroethane well-known pesticide may be converted into the by-products of *p,p'*-DDE and *p,p'*-DDD in soil due to abiotic or biotic reactions. Although DDT was banned in Turkey in 1985, DDT and its metabolites have still been measured in environmental samples. Therefore, remediation of soil contaminated with DDT is too difficult and requires expensive technologies.

Cucurbita pepo spp. *Pepo* can accumulate *p,p'*-DDE from the soil compared to other plant species. However, *p,p'*-DDE uptake mechanisms by *Cucurbita pepo* spp. *Pepo* has not been well understood yet and needed further research on it. This study evaluates the influence of mosses amendments on the phyto-accumulation potential of *p,p'*-DDE in zucchini plants. Golden Zucchini seeds were bought, and samples of moss were collected from Uludag, Bursa. Each pot was packed with 2 kg of DDE contaminated soils and the experiments were done in the following sets: pots having only Golden Zucchini (control plants set), pots covering only moss samples (control moss set), and Golden Zucchini planted on the pots covered by the moss. After 45 days of the growth period, plants were harvested. Plants compartments (root, shoot, and leaves), moss, xylem saps, and soil samples were extracted based on previously published methods and transferred into 2-mL GC vials after clean-up processes. *p,p'*-DDE content of the samples was measured by GC/µ-ECD. While the average *p,p'*-DDE concentration in control Zucchini plants was calculated as 3600 ng/g dry weight basis, *p,p'*-DDE content in the plants from moss amended pots was measured as 1600 ng/g. That an average *p,p'*-DDE concentration in control moss set was 160 ng/g dropped to ng/g in moss amended sets. The results showed that moss amendments decreased up to 50% of *p,p'*-DDE in zucchini plants.

***Keywords*:** p'p-DDE, Cucurbita Pepo spp. pepo, Mosses, Contaminated Soil.

FOOD ENGINEERING

Protein-phenolic Interaction as a Protein Modification Method for Chickpea Protein

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ABSTRACT

Since the supply of animal protein will be insufficient in the future, the call of scientists for the development of alternative protein sources is gaining more importance with every passing day. Although plant-based proteins are significant alternative protein sources in this regard, their functional properties are not always as good as animal-based proteins. For this reason, different modification methods including chemical, physical and enzymatic approaches are applied to improve their functional properties. Likewise, interaction of proteins with phenolic compounds is also considered as a protein modification method due to its effect on the structure and functionality. In this study, it was aimed to investigate the changes in the functional properties of chickpea proteins as a result of their interactions with spent coffee phenolic compounds. With this purpose, spent coffee phenolics which were prepared in varying concentrations interacted with chickpea protein at two different pH values (7.0 and 9.0). Afterwards, functional properties of chickpea protein including solubility, foaming and emulsifying properties were analyzed. Also, additional analyses to determine the changes on the structural properties including zeta potential and fluorescence spectroscopy were carried out. Our results showed that with the interaction of phenolic extract, the functional properties of chickpea protein were improved. The most significant effect was observed on foaming capacity for every tested conditions. However, different results obtained for other parameters were found to be dependent on the interaction condition. Consequently, interaction with spent coffee phenolics might be considered as a promising modification method to boost the functional properties of chickpea protein isolates.

***Keywords*:** Chickpea Protein, Modification, Protein-Phenolic Interaction, Functionality.

Effects of Packaging Materials with Different Barrier Properties on the Quality and Shelf Life of Powdered Foods

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ABSTRACT

Packaging materials used in food products, influence the preservation of quality and shelf life of food, environmental effects, and economical value of the process. Therefore, this study investigated the changes in different quality parameters of commercial powdered foods packaged with three different materials having different gas permeabilities. The powdered foods were selected as 'Kıtırlı Domates Çorbası', 'Köfte Harcı' and 'Çıtır Pane Harcı'. The food products were obtained from a commercial processing line packaged with different multilayered materials named Package-1, Package-2, and Package-3. O2 transmission rate (OTR) of materials were found significantly different from each other at 1.31, 17.07, and 4.79 cm3/m2.day respectively. Water vapor transmission rates (WVTR) of the packages were determined as 2.29, 1.45, and 1.81g/m2.day respectively with no significant difference. The samples were kept in three storage temperatures: -15°C (as control) and room temperature (25°C) for 12 months and 35°C (accelerated conditions) for 10 months. Every 2 months, quality analyses were done by headspace gas composition of the packages, clumping, color, moisture, water activity, oxidation by thiobarbituric acid reactive substances (TBARS), and sensory analyses. For each food product, Package-1 and Package-3 headspace O2 contents decreased while CO2 increased. The changes in the gas composition occurred less in all Package-2 samples and all 'Çıtır Pane Harcı' packages. Storage temperature and time resulted in color degradation in 'Kıtırlı Domates Çorbası', yet the packaging material had no impact. There were no significant color changes in other samples by any parameter. Regardless of the packaging material, the moisture content decreased and TBARS value increased due to high storage temperature and time. The color degradation in 'Kıtırlı Domates Çorbası' were clearly noticed during sensorial analyses as well. However, any other changes in sensorial quality in the means of color, odor, taste, and overall acceptability were not observed in other samples. In conclusion, the packaging materials with OTR in the range of 1.31-17.07 cm3/m2.day did not affect quality of the food products significantly during the 12-month storage.

***Keywords*:** Powdered Food, Packaging Materials, Quality, Barrier Properties.

Effects of Packaging Materials with Different Gas Permeabilities on the Quality and Shelf Life of Commercial Powdered Soup Mixes

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ABSTRACT

Selection of correct packaging materials for food products is important for product shelf life as well as management of packaging cost. The purpose of this study is to compare the performance of three packaging materials with different gas permeabilities on maintenance of various quality attributes of two commercial powdered soup mixes: 'Ezogelin' and 'Tavuklu Tel Şehriye'. The products were packaged with 3 different packaging materials under the same production line in a commercial company. The packaging materials were all multi-layered namely: package-1, package-2, and package-3. The products were stored at -15°C (serve as fresh control) and 25°C (commercial condition) for 12 months, and at 35°C (accelerated condition) for 10 months. Package head-space gas composition, color, moisture, thiobarbituric acid reactive substances (TBARS) and sensory analysis were carried out every two months. The O_2 transmission rate (OTR) of the tested packaging materials at 23°C were significantly different and determined as 1.31, 17,07, and 4.79 cm^3/m^2.day for package-1, package-2 and package-3, respectively. The water vapor transmission rates of these materials were similar and measured as 2.29, 1.45 and 1.81 g/m^2.day, respectively. O_2 level decreased and CO_2 level increased in the head space of package-1 and package-3 during the storage but no change was observed in package-2. The 'Ezogelin' samples preserved their color better in package-1. In accelerated conditions at 35°C, colour of the 'Tavuklu Tel Şehriye' samples in package-3 darkened more than the samples in other packages. The moisture content, TBARS value, and sensory qualities of both samples were not significantly affected by the packaging materials during 12-month storage. In conclusion, use of packaging materials with different OTR from 1.3 to 17.1 cm^3/m^2.day resulted in similar quality of the products during 12-month storage. Thus, their selection can be based on their cost. However, if a shelf-life more than 12-month is desired further investigations are required to assess the performance of these packaging materials on maintenance of the quality

***Keywords*:** Powdered Soup Mix, Packaging, Oxygen Permeability, Quality.

Optimization of Aquafaba Production by Response Surface Methodology and Application in Plant-Based Mayonnaise

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ABSTRACT

Aquafaba is the liquid left over after the chickpeas are cooked. Aquafaba, which is used as an egg replacer in vegan products, is a valuable product that has become popular in recent years. The components that pass into the water during the boiling process provide foaming and emulsion-forming capabilities. The composition and functionality of aquafaba are affected by variables such as cooking time, pH, and solid-liquid ratio during boiling. The purpose of this research was to investigate the effects of pH, time, and solid-liquid ratio on various characteristics of aquafaba and to optimize aquafaba production using response surface methodology. Aquafaba produced with the optimized conditions can be potentially applied in plant-based mayonnaise.

Response surface methodology was used for the design of experiments. The Brix, pH, foaming capacity, stability and emulsion activity index values were measured in 15 aquafaba samples produced according to the experimental design. The Brix values of the samples obtained ranged from 1.12 to 2.22, with initial pH values varying from 5.96 to 6.14. The foaming properties of the samples at pH 4.0 yielded significantly higher foam value and stability compared to the other samples. The highest foam volume and foam stability were observed in samples adjusted to pH 4.0. While the foam volume varied between 58.5% and 74.5%, the foam stability varied between 4.6-83.8%. The foam volume was affected by the pH*time interaction ($p<0.05$). The emulsion activity index varied between 96.8 and 99.1%. The emulsion activity index was affected by the solid-liquid ratio ($p<0.05$). In conclusion, aquafaba characteristics changed depending on pH, time, and solid-liquid ratio. Aquafaba with improved functional properties can be produced by adjusting these parameters.

A plant-based mayonnaise produced with aquafaba was compared to commercially available regular and vegan mayonnaise. Analysis of pH, Brix, acidity and consistency of mayonnaise samples were performed. In addition, the product was evaluated by 21 panelists in a sensory test. The acidity and consistency values of the product produced with aquafaba were observed to be lower compared to control due to differences in formulation. It is possible to obtain products with the desired properties by making the necessary improvements.

***Keywords*:** Aquafaba, Response Surface Methodology, Plant-Based Mayonnaise.

Phenolic Content and Antioxidant Acitiviy of Lamas Lemon Peel by Ultrasound-Assisted Extraction

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ABSTRACT

As citrus peels are increasingly used as valuable by-products because of their potential health promoting effects like antioxidant, antihypertensive, anti-diabetic, anti-inflammatory, antibiotic, anti-hypercholesterolemic, anti-ulcer, and anti-allergenic, it is important to provide a more detailed view on their bioactive compounds and how to recover them. Lemon peels which constituted about 50 to 60% of the total fruit mass, contain phenolic compounds such as phenolic acids, flavanones, flavones and flavonols. The extraction of these polyphenolic components from lemon peel will not only help the food industry to supply a natural antioxidant to health-conscious consumers, but it will also allow the waste to be valorized. In this study, Lamas peel waste which is the most commonly used cultivar in juice industry was evaluated for it's potential of total phenolic, flavonoid content and antioxidant activity. Extraction was carried out from lemon peel powder by using ethanol-water (1:1 v/v) with and without ultrasound application. Ultrasound extraction was performed by using an ultrasonicator with working frequency of 24 kHz, output power of 400 W, amplitude of 50% and at room temperature for 15 minutes. When the extraction temperature was increased from 23 to 70°C, total phenolic content and flavonoid content of the extract increased with or without ultrasound application. Antioxidant activity of the extract measured by ABTS and CUPRAC methods enhanced when the temperature was increased from 23 to 70°C. Ultrasound application did not exhibit additional effect to heat treatment on the antioxidant activity of lemon peel powder. Effects of process parameters of ultrasound can be investigated for increasing its impact on extraction.

***Keywords*:** Lemon Waste, Ultrasound, Total Phenolics, Total Flavonoids, Antioxidant Activity.

Ultrasound Assisted Extraction for the Recovery of Phenolic Compounds from Plum (*Prunus domestica*) Peels

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ABSTRACT

Purple plum (Prunus domestica) peels contain significant amounts of phenolic compounds characterized with their high antioxidant activity. Previous studies proved the effectiveness of use of novel technologies like ultrasound assisted extraction (UAE) for the extraction of phenolic compounds from different natural sources. The aim of this study is the optimization of ultrasound assisted extraction of phenolic compounds from Turkish purple plum (Prunus domestica) peels using response surface methodology (RSM). A Box Behnken Design (BBD) was arranged and the effect of three independent variables with three levels which are ultrasonic power (10, 35 and 60%), ultrasonication time (0.5, 3 and 5.5 min) and liquid/solid ratio (30:1, 50:1 and 70:1) on the extracted amount of total phenolic compounds (TPC) and total antioxidant capacity (CUPRAC) of extracts was investigated. The three factors showed significant effects ($p<0.05$) on the response variables TPC and CUPRAC. The determination coefficients (R2) for TPC and CUPRAC were 97.35% and 98.51% respectively. The optimum extraction conditions were as follows: ultrasonic power, 40%; sonication time, 5.5 min and liquid/solid ratio, 70 mL/g. The experimental values of TPC (38.75 mg GAE/g dw) and CUPRAC (94.81 mg TAEC/g dw) measured under these optimum conditions were in strong agreement with the predicted values (38.04 mg GAE/g dw for TPC and 94.42 mg TEAC/g dw for CUPRAC). Comparing to CSE, UAE produced similar TPC, DPPH and FRAP values and higher CUPRAC and ABTS values and reduced the extraction time from 30 min to 5.5 min. The HPLC-DAD (diode array detector) analysis of the extract produced under the optimum UAE conditions resulted in the identification and quantification of 4 phenolic compounds which were catechin, rutin, cyanidin-3-galactoside and cyanidin-3-glucoside with the respective amounts of 3.38, 0.34, 5.24 and 0.78 mg/g dw. The obtained extracts may be added to functional foods or pharmaceutical products either in liquid form or after encapsulation.

Keywords: Optimization, Ultrasound Assisted Extraction, Antioxidant Phenolic Compounds, Purple Plum Peels, Response Surface Methodology.

Optimization of Microwave Assisted Extraction of Phenolic Compounds from Plum (*Prunus domestica*) Peels using Response Surface Methodology

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ABSTRACT

Purple plum (*Prunus domestica*) peels represent a valuable by-product generated after the industrial processing of plum fruits since they contain considerable amounts of phenolic compounds. The objective of this work is the optimization of microwave assisted extraction (MAE) of phenolic compounds from Turkish purple plum (*Prunus domestica*) peels using response surface methodology. A Box Behnken Design (BBD) was arranged and the effect of three independent variables namely microwave power (140-700 W), irradiation time (30-150 s) and liquid/solid ratio (30:1-70:1) on total phenolic compounds (TPC) and total antioxidant capacity (CUPRAC) of extracts was investigated. The three factors showed significant effects ($p<0.05$) on TPC and CUPRAC values. The determination coefficients (R^2) for TPC and CUPRAC were 99.07% and 99.64% respectively and the lack of fit wasn't significant ($p>0.05$) for both responses. The optimum extraction conditions were as follows: microwave power, 700 W; irradiation time, 135 s and liquid/solid ratio, 70 mL/g. Under these conditions, the experimental values of TPC (37.77 mg GAE/g dw) and CUPRAC (93.84 mg TEAC/g dw) were in strong agreement with the predicted ones (37.16 mg GAE/g dw for TPC and 93.66 mg TEAC/g dw for CUPRAC). Comparing to conventional solvent extraction (CSE), MAE gave similar TPC, CUPRAC, DPPH and FRAP values, higher ABTS value and reduced the extraction time from 30 min for CSE to 135 s. The HPLC-DAD (Diode Array Detector) analysis of the optimized MAE extract revealed the presence of catechin, rutin, cyanidin-3-galactoside and cyanidin-3-glucoside with amounts of 3.76, 0.34, 5.72 and 0.85 mg/g dw respectively. These molecules are famous for their potential functional properties and health benefits. The obtained results suggest the possibility of using the extract produced under MAE optimum conditions as a food additive or in pharmaceutical products.

***Keywords*:** Optimization, Microwave Assisted Extraction, Phenolic Compounds, Turkish Purple Plum Peels, Response Surface Methodology.

GEOLOGICAL ENGINEERING, GEOPHYSICAL ENGINEERING

General Characteristics of the Central Anatolian Fault Zone Between Kayseri and Sivas (Türkiye)

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ABSTRACT

The Central Anatolian Fault Zone (CAFZ) is an intra-plate sinistral shear system that is located between Sivas and Pozantı (Adana). It has a 380 km-length arc-shaped geometry with N60° - 80° E orientation in the eastern part and N20° -30° E in the southern part. A sharp releasing bend in the Kayseri area resulted in an extensional basin where an important active strato- volcano, Mt. Erciyes, is located. Five fault segments of the CAFZ between Kayseri city and Altınyayla (Sivas) are namely: Dökmetaş, Sarıoğlan, Bünyan faults up to the Kayseri Basin from east to west. Besides, Erciyes and Erkilet faults are located at the west of the study area, bounding the Kayseri Basin in the south and north, respectively. The first three of the above- mentioned fault segments are mainly controlled by pure sinistral movement, yet the later two segments have normal components as well. Previous studies suggest a slow block motion along the CAFZ between 0.5 mm and 3.3 mm; moreover, limited paleoseismological studies outside of the study area proposed interevent times of more than 4500 years. This study aims to investigate the paleoseismologic and morphotectonic characteristics of the CAFZ between Kayseri city and Altınyayla (Sivas). In this context, sinistrally offset drainage channels which are the most common morphological indicators along the fault zone are studied. The maximum offset of 2300±100 m is measured on Kışlaköy creek along the Dökmetaş. Additionally, terrestrial cosmogenic nuclide dating of an alluvial terrace is employed for the vertical and horizontal slip rate assessments. Overall, 3 trenches were dug on the Erkilet Fault Zone for paleoseismological investigations and 2 alluvial terraces were sampled for slip rate studies. Surveys associated with potential trench locations and alluvial terraces for the next stages of our studies are in progress to determine the seismic potential of the CAFZ. This work is supported by TÜBİTAK project no. 120Y230.

***Keywords*:** Central Anatolian Fault Zone, Paleoseismology, Morphotectonics, Tectonic Geomorphology, Active Tectonics, Cosmogenic Nuclides.

Physical and Mechanical Properties and Abrasivity of Dykes and Surrounding Rocks in İstanbul

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ABSTRACT

The aim of this study is to investigate the differences between dykes and it is surrounding rocks in Istanbul by means of strength, strain and abrasivity. It is well known that the differences between strength, strain and abrasivity characteristics of dykes and it is surrounding rocks are important geological features that can effect the wear of TBMs and other excavation tools thus the cutting performance. For this reason, studies were conducted on core samples from both dykes and it is surrounding rocks from Istanbul. Physical properties including unit volume weight (γ), effective porosity (nt) and P-wave velocity (Vp) of the samples were determined. Also, mechanical tests such as unconfined compressive strength (UCS), Brazilian tensile strength (BTS) and point load test were conducted. In addition, to determine the abrasivity difference between dykes and surrounding rocks, CERCHAR abrasivity test was conducted to determine the CERCHAR Abrasivity Index (CAI) values. Additionally, mineralogical and petrographic studies were conducted utilizing X-ray powder diffraction (XRD) analyses and thin sections respectively. Data obtained from micro textural studies reveal that, the studied dykes are commonly in lamprophyry, diabase and andesite compositions. According to the test results, UCS, Young`s modulus and CAI values are between 34-231MPa, 12-69GPa and 1.68- 3.34 respectively for dykes and 30-149MPa, 9-38GPa and 1-2.69 respectively for surrounding rocks. The findings of this study reveal the necessity of detailed geomechanical studies for the construction phases of the underground rock structures.

***Keywords*:** CERCHAR, Dykes, Mineralogy, Petrography, Istanbul.

Assessment of Suitability for Settlement of the Area Between Kumköy and Çiftalan (North of Istanbul) in terms of Engineering Geology

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ABSTRACT

The area between Kumköy and Çiftalan (İstanbul) was a coal mining site between 1908 – 1995 where original topography was modified by constructions, steep production slopes and uncontrolled artificial fills. Additionally, naturally deposited weak soil material and shallow groundwater level also exist in the region. Hence slope instability and bearing capacity problems were triggered. The research investigated the suitability for settlement of the region regarding physical and mechanical properties of geological units and artificial fills, natural and man-made slope geometries, soil classes, groundwater depths, liquefaction potential, SPT-N_{30} values and flood risks. The analyses utilizing the above-mentioned properties were carried out for shallow foundations and for buildings with one and two basements separately. Prior to above mentioned studies, the investigation initiated by updating the geological and landslide susceptibility map by field observations. The effect of geological features and groundwater on the landslides in the region was also investigated. The soil classes and liquefaction potential of the geological formations were determined with respect to Turkish Building Earthquake Code and engineering data in terms of SPT-N_{30} and groundwater levels.

The minimum and maximum risk assessment coefficients of seven settlement criteria (slope, mass movement activity, liquefaction potential, groundwater, soil class, SPT-N_{30} distribution and flood hazard) entered into QGIS to generate a multicriteria decision methodology. Settlement criteria were weighted overlaid in QGIS. Thus, suitable, slightly restricted, severely restricted and unsuitable settlement areas were determined with respect to the interval of assessment coefficients regarding multicriteria decision method. Consequently % 0.03 of the site was found suitable for settlement without any additional investigation, % 36.9 slightly restricted, % 55.2 severely restricted and % 7.9 unsuitable. Additional geo-engineering investigations and engineering precautions for slightly and severely restricted areas were recommended. Steep rock fall and toppling zones and flood areas were unsuitable for settlement.

***Keywords*:** Landslide, Multicriteria Decision Method, Suitability for Settlement, Weak Soil, Kumköy-Çiftalan (İstanbul).

Spatial and Temporal Assessment of Geological Risks in Agriculture Basins using Earth Science Data

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ABSTRACT

Soil is one of the most valuable natural resources and is the weathering product of the minerals that make up the rocks. The physical, chemical, mineralogical, biological and morphological properties of soils developed on different geological parent materials differ from each other.

The geology is a driving factor in the development of the soils to varying degrees. Geological elements of an area such as tectonic, lithological, mineralogical, geochemical, hydrogeological, etc., are effective elements in shaping the parent material of the soils. During the development of the soil, there are many processes in the form of transformations, displacement, accumulation, participation and losses, and these processes determine the characteristic features of the soil. In this case, the soil can be regarded as a natural entity capable of recording the natural and anthropogenic processes of its surroundings.

Soil is a critical component of global and national food security. As a result, all of its characteristics, such as geology, should be clearly described, as geology is one of the most principal factors that determine soil character. This is especially crucial in countries like Turkey, where agriculture plays a crucial role in the economy.

The agricultural basins in Turkey have been defined based on climatic, topographic, and pedologic characteristics, as in the case of the İznik Basin, which is in the Southern Marmara Agricultural Basin. The basin was chosen as the subject of the Ph.D. thesis, which used geoscience data to assess the consequences of geological diversity (tectonic, lithological, hydrological, etc.) on an agricultural territory. The Basin has lithological units from various geological periods (ranging from Quaternary alluvium to Paleozoic metamorphic units) that have been and continue to be subjected to active displacements due to the North Anatolian Fault. This Ph.D. study aims to create a different perspective with geoscience data on the effect of various lithology on agricultural productivity along with the temporal and spatial effects of geological factors/risks on agricultural basins.

A descriptive bibliometric analysis of data obtained from subject databases was performed in this presentation, which will include the findings of the Ph.D. In this study, it was considered how these data will respond not only to the geology-soil process but also to other issues such as soil pollution, which is one of the Green Deal's topics.

***Keywords*:** Agriculture and Geologic Interaction, Sustainable Agriculture and Earth Science, Pedogeological, Agro-Geology, Green Deal.

Using Moving Average Filtering as a Boundary Analysis Method

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ABSTRACT

Potential field anomalies, such as the data acquired with gravity or magnetic prospecting, are related with the positions of their source bodies; so much that it is possible to estimate the bodies' horizontal extent by using various analysis methods. Boundary analyses in geophysics are commonly used to detect structural heterogeneities within shallow crust, especially at fault mapping, natural resource extent researches and archaeological studies. There are various methods making use of derivatives on the potential field anomalies, since the changes within the anomalies are direct indicators of the structural heterogeneities. In this study, we implement a boundary analysis approach: Moving Average Differences (MAD). We firstly explain the theoretical background information which lead us to use simplest form of low pass filtering as a boundary analysis method and build up the algorithm. Next, the MAD method is applied on three synthetic gravity anomalies, which are forward modelled from three different block models simulating different geological situations and aiming to test different aspects of the MAD method. The key feature of the MAD method, the window size parameter and its relation with the source depths are discussed with examples. Finally, the MAD method's results are compared with the results of other popular boundary analysis methods. The results we present indicate that the MAD algorithm can be acknowledged as a boundary analysis method as it provides useful information about the horizontal extent of the buried bodies by using the amplitude changes within the gravity anomalies.

***Keywords*:** Gravity Prospecting, Magnetic Prospecting, Boundary Analysis, Shallow Structures, Earth's Crust.

Elimination of Sea-bottom Multiples in the Multichannel Seismic Reflection Data Collected in the Çınarcık Basin of the Sea of Marmara

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ABSTRACT

Sea-bottom multiples, which are the products of traveler signals between sea-bottom and sea- surface multiple times, are one of the troubler-noise in marine seismic reflection data. It is essential to eliminate multiples to bring to light the covered signals by these multiples. In the multichannel seismic reflection data collected in the Çınarcık Basin of the Sea of Marmara, multiples are one of the most problematic issues. Studies in the literature show that the interpretation of seismic sections has been done on the data having some multiples. Consequently, it may cause missing some essential structures. It is critical to understand the structures in the Sea of Marmara, which is the host of the Marmara Fault. This study aims to eliminate these multiples from the seismic reflection data in the Çınarcık Basin of the Sea of Marmara.

There are many mathematical approaches to performing the multiple elimination step of the data processing. One of them is F-K (frequency-wavenumber) filtering. It helps to distinguish the reflections having different dips. By flatting the sea-bottom multiples with the help of velocity analysis and normal move-out (NMO) correction, it becomes possible to see multiples around zero wave number. Filtering these areas gives successful results for suppression the most of the multiples. Two ways of F-K filtering, which are by using ZMULT and F-K modules, have been applied to the data. Another approach is predictive deconvolution, whose parameters are determined by using a correlation algorithm. In this work, a synthesis of these two approaches has been used. It provides us to reveal real reflections under multiples with flying colors. In conclusion, synthesizing the different approaches gives us better results than using only one approach.

Keywords: Seismic Reflection, Sea-Bottom Multiples, Çınarcık Basin, Sea of Marmara, Predictive Deconvolution, F-K Filtering.

Experiments on Modelling the Gravity Effect of Topography in Auvergne Test Area

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ABSTRACT

In geodesy and geophysics literature, the gravity effect of topography is intensively analysed and modelled using standard methods. Among these methods, the second method of Helmert condensation and residual terrain model reductions are mostly used in geoid determination in geodesy. Besides Bouguer reduction is the most suitable approach for using in the interpolation and gridding the gravity observations. In all these approaches, the gravity effect of topography is calculated using a digital terrain model at a specific resolution that provides a three-dimensional shape of the topographical mass between the Earth and reference surfaces. Hence, the topography is discretized into volume elements and the gravitational effect of each topographical element can be calculated. In this study, we designed and implemented experiments on calculating the residual terrain model (RTM) correction on gravity and geoid undulation components. These experiments include trials on the effect of computational parameters and digital terrain model resolutions on the computed values. In the computations, as different than the common practice, four regularization methods including polyhedron, prism, tesseroid, and point mass were used.

The computations were carried out using the terrain gravity field (TGF) Matlab software. In applications, residual terrain correction as a retrieving parameter of the terrain-generated high-frequency gravity field signal is employed in smoothing the terrestrial and airborne gravity observations for interpolation in the frame of remove-restore based process, spectral enhancement of gravity field parameters obtained in low-frequency from the global geopotential models (GGM) having a limited degree of spherical harmonic expansion, precise solution of height system unification problem, as well as for the gravity reduction in detecting the near-surface mass density anomalies, etc.

In numerical tests, the calculated residual gravitational effect of topography on gravity signal is validated using high-resolution global topography gravity models' data. The indirect effect of the RTM on the geoid undulations was used for enhancement of the GGM derived geoid undulation parameters and the enhanced geoid undulations were tested with GPS/levelling observations at the benchmarks. The numerical tests were carried out using Auvergne test data, and hence obtained results were interpreted considering the similar experiments published in the literature.

***Keywords*:** Gravitational Terrain Effect, Terrain Correction, Bouguer Reduction, Tesseroid, Polyhedron, Terrain Gravity Field Software.

HISTORY OF SCIENCE AND TECHNOLOGY

Nusret Hızır, One of the Leading Representatives of Scientific Philosophy in Turkey, and His Influence upon the Turkish Academy

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ABSTRACT

The aim of the present study is to explain the story of positivism in Turkey, which formed the backbone of the education revolution in 1940s right after the proclamation of the republic, based on Nusret Hızır's life. As it is known, positivism emerged in France and Auguste Comte is accepted as the founder of this movement. Positivism, which puts science at the center of thought and excludes metaphysics from philosophy, has lost its effectiveness and popularity in the course of time, but it was reviewed by a group of intellectuals in Vienna who came to call themselves the "Vienna Circle", just before the Second World War and presented as "logical positivism" to the academic life with some revisions. There was another anti-metaphysical school, the Berlin Group, founded by Hans Reichenbach and had similar ideas and acted in line with the Vienna Circle. After the German occupation of Austria, most of the members of the Vienna Circle had to immigrate to various countries of the world. Hans Reichenbach, one of the prominent figures among these intellectuals, preferred Turkey, which was experiencing the University Reform at the time. He founded philosophy as an academic discipline in Turkey in the post-Reformation period. In his time, he developed and implemented an education curriculum in accordance with the scientific philosophy at Istanbul University. Nusret Hızır was the first follower of Reichenbach's *école* in Turkey, though there were some other names. He first worked as an assistant at Istanbul University, then he worked at Ankara University, Faculty of Language, History-Geography. Although the influence of positivism has relatively weakened in Turkish universities presently, there are still followers of the scientific philosophy movement. In our study, the birth and current statues of this idea in Turkey will be examined.

***Keywords*:** Positivism, Scientific Philosophy, Vienna Circle, Hans Reichenbach, Nusret Hızır.

On the Comparison of Khayyam and Descartes: *Solutions of Cubic Equations*

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ABSTRACT

Ancient period natural philosophers benefited from geometry to obtain the solutions of their daily life regulations and problems. In different cultures and civilizations, the approaches, and methods in which these mental inferences are used, differ and vary according to each other. The primitive second-degree equations (quadratic equations) and their solutions, which appear on the written tablets of the Babylonian period, are shown in a verbal flow. Over time, these equations have been divided into categories and the conditions for providing these solutions are given depending on the coefficients of the equations in these categories.

Muḥammad ibn Mūsā al-Khwārizmī, (d. 850) established the foundations of algebra (al-jabr) with his mathematical studies and brought a different approach to the solutions of these second equations with the methods of reduction and analogy. Adding on to al-Khwārizmī's work, Omar Khayyam (d. 1131), another Persian medieval mathematician, laid the foundations of algebraic geometry with the solutions of the third-degree equations (cubic equations). So much so that, with the help of algebra, it is claimed that Khayyam founded the basis of Analytical Geometry before did René Descartes (d. 1650) by solving third-degree equations.

This paper will scrutinize, the emergence of equation solutions in the ancient period first. Afterwards, it will move on to the discussion of how equation solutions were handled in Islamic geography and to what point did it reach with the contributions of Omar Khayyam. And finally, the following questions will be answered: to what extent does Khayyam's work overlap with Descartes'? Did Descartes encounter Khayyam's works because of the Western movement to translate Arabic works into Latin from the 10th century? How would all these fit in, within the framework of the East-West scientific exchange posed by the late Fuat Sezgin, a well-known historian science?

***Keywords*:** Omar Khayyam, René Descartes, Analytical Geometry, Cubic equations.

Tuberculosis and Space in Turkish Literature: *Sanatorium as a Healthcare and Social Environment in Mahmut Yesâri's Yakacık Mektupları*

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ABSTRACT

The notion of epidemic diseases, which has come to the fore again with the Covid-19 pandemic, introduces the necessity of revealing the experiences of past epidemics in a holistic approach including scientific, medical, technological, social, and cultural dimensions in order to take lessons from the past and shape the future. Tuberculosis, which led to the death of more people than other infectious diseases throughout human history, continues to be one of the most contagious killers in the world at present. Having significant impacts on civilization, tuberculosis is one of the crucial epidemics that influenced the medical sciences, healthcare systems, demography, art, and literature. Placing people at the centre, literary works enable us to analyse the socio-cultural dimensions of the illness as well as the medical practice. In this context, the present study has been handled at the intersection of the history of medicine and literature in order to clarify human experience in the history of tuberculosis. The purpose of the research is to review the social history of tuberculosis in a sanatorium based on the literary narrative. To achieve this aim, Mahmut Yesâri's *Yakacık Mektupları* (1938) has been taken up to examine in terms of the patient's view. In the memoir narrative, the experiences of tuberculosis patients have been addressed from the perspective of the narrator who suffered from tuberculosis and was treated in Yakacık Sanatorium. Based on the literary work, the description and the meaning of the sanatorium, the space and time perception involved, treatment and the cure, the sanatorium rules and schedules, the depiction of the patients, psychology and feelings of the patients, dialogues between the patients, and the medical terms used in conversations have been analysed in the narrative. Some concepts regarding the medical and social environment of Yakacık Sanatorium have been demonstrated and the findings have been reflected in the study. Sanatoriums, which have served as curative spaces in the medical treatment of tuberculosis, were important healthcare institutions where the therapeutic environment transformed into a social environment for the patients. Yakacık Sanatorium is not only the spatial reflection of the treatment of tuberculosis but also has a social meaning and role for the patients in terms of the literary narrative.

Keywords: Tuberculosis, Sanatorium, Yakacık, Mahmut Yesâri, Medicine.

Why is David Bloor's Sociological Conception of Knowledge not Defendable?

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ABSTRACT

A long-standing debate between positivist and post-positivist philosophies has been on the nature of scientific knowledge, whether it is socially determined or logically necessary. In his Strong Program in the sociology of knowledge David Bloor, a vehement critic of positivism, claims that not only scientific theories but also religious beliefs, philosophical accounts, and common-sense intuitions could all be taken as the knowledge of a society and seen as purely socially constructed. Accordingly, what follows is an attempt to account for the role that the concept of knowledge plays in social sciences. In particular, the project raises a question about the alleged-realism of the program and asks whether the explanatory method of the program commits into, even a weak form of, idealism. The project starts with a criticism of David Bloor's sociology of knowledge, and it argues that although neither his sociological account of knowledge nor his explanatory method to explain knowledge by themselves depend on an erroneous understanding, the further aspect of his program called 'finitism' bring the program into radically relativist and weakly idealist grounds. In Bloor's sociology, science, religion, culture, and philosophy are all seen as knowledge productions, and the difference between their products is a purely social matter. According to him, for example, any belief has been formed with regard to social causes and there is no serious role that nature plays in such a process of formation. Yet, 'purely social' is an insufficient explanation in accounting for the differences in our knowledge because it reduces the difference to a matter of contingency, and it overlooks the potential impact natural facts could play. However, only through a context-based application of knowledge the sociological explanation could be secured from radical relativism and idealism.

***Keywords*:** Strong Program, Sociology of Knowledge, Radical Relativism, Idealism, Finitism.

Critique of Henri Rousseau's "The Sleeping Gypsy" (*La Bohémienne Endormie*)

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ABSTRACT

Henri Rousseau is one of the important representatives of naive painting, whose desire to exhibit his works, which were ridiculed for not being understood during his lifetime, could only be realized after his death. Naive painting is more than a trend, it is a style. The most distinctive feature of naive painting is its denial of the rules of perspective and its childlike expression. Henri Rousseau spent a significant part of his life as a tax collector at the gates of Paris without studying painting. Although Rousseau had never been outside of France or even Paris, he portrayed the colorful mysterious life of the exotic rainforests quite realistically in his large-scale paintings. His unwavering belief in his talents allowed the majority of his paintings to be displayed comfortably, almost every year, away from the constraints of salon exhibitions, the Hall of Independents, an alternative group by his paintings exhibited. His works were appreciated by the young painter of the period Pablo Picasso and the writer Alfred Jarry. Henry Rousseau's work "Sleeping Gypsy", painted in 1897, is considered a fantastic and mysterious painting by art critics even today.

Methodology: The study about the work consists of two parts. In the first part, the life of the artist and the general characteristics of the period he lived in were examined. In this sense; An overview of the 19th century art scene and the important artistic events of the period, the effects of the political, social, economic and social transformations in the society on the art of the period and the position of the artist in this context were discussed. Academic literature was used to reveal the understanding of the period, and personal comments were included in the interpretation of the work with the same context paper format.

Keywords: Henri Rousseau, Mystery, Sleeping Gypsy, Naive Painting, Expressionism.

History of Science and Technology Studies at Istanbul Technical University

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ABSTRACT

Istanbul Technical University, which started to provide engineering education under the name of Mühendishane-i Bahri-i Hümayun in 1773, is known to be important in terms of the history of science and technology, with the production, application, and use of science in education. In the last 250 years, numerous studies on the history of science and technology have been carried out within the university. Although these studies were limited to the individual studies and special interests of the faculty members of Istanbul Technical University for a long time, a very valuable accumulation was formed over the years that contributed greatly to the historical development of science and technology.

After collecting this knowledge, the project will examine the studies in a social context by making use of the experiences of the teachers who have worked in the field with the method of oral history. This project, which will fill the gap in the literature by recording this valuable memory of ITU, is intended to first collect all the work done until the Science and Technology History Master's Program was opened in 2017, then the experiences of the teachers who contributed to the development of this field will be recorded and the new perspective will be created for ITU's contributions to the history of science in our country and in the world.

Keywords: History of Science and Technology, Oral History, Istanbul Technical University.

HYDRAULICS AND WATER RESOURCES

Drought Analysis of Küçük Menderes Water Basin

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ABSTRACT

Drought causes damage to land cover, water resources and many other natural resources as a result of precipitation below normal levels. Therefore, drought sensitivity should be determined in the most accurate way in Küçük Menderes Basin, which is facing the risk of drought due to its location and economic, touristic, agricultural importance.

In this study, monthly total precipitation and monthly average temperature data for the last 30 years (1991-2020) were obtained from a total of 11 meteorological observation stations, 6 of which are located in the Küçük Menderes Water Basin, one of the 25 major water basins of Turkey, and 5 in its immediate vicinity. The aim of this study is to determine the drought sensitivity of Küçük Menderes Water Basin.

For this purpose, dry periods were determined by using the Standardized Precipitation Index (SPI) and Palmer Drought Severity Index (PDSI), which are widely used in the international literature, and the results obtained were analyzed as part of this study.

By using these two meteorological drought indices, drought time series were created and the severity and duration of droughts in the basin were determined. Comparative timelines were prepared and the common dry periods between the indices were determined. It was observed that the droughts determined by the results of the analysis are compatible with the historical dry periods. In this context, dry periods of various durations were determined for the Küçük Menderes Water Basin for the years 1992, 1993, 1994, 2001, 2007, 2008, 2017 and 2018. Spatial analyzes were performed by creating maps showing the percentage distribution of drought probability according to the above mentioned indices. According to both indices, it was determined that the driest districts within the water basin are Çeşme and Kuşadası.

***Keywords*:** Küçük Menderes Water Basin, Drought Analysis, Standardized Precipitation Index (SPI), Palmer Drought Severity Index (PDSI), Meteorological Drought.

The Effect of Different Potential Evapotranspiration Data on the Performance of Two Hydrologic Models for the Konya Closed Basin in Turkey

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ABSTRACT

Accurate streamflow predictions are important for appropriate planning and operation of the river basins. This requires efficient set-up of hydrologic models and preparing reliable model inputs with gauge and satellite based meteorological data. Hydrologic models are classified into lumped, semi-distributed and fully distributed models. Lumped hydrologic models generally need discharge, precipitation and potential evapotranspiration (PET) as input and several parameters. Snow-melt routine requires daily mean temperature too. In this study, our aim is to compare the effects of different PET equations and three different datasets on the calibration performance of the two hydrologic models in the Konya Closed Basin in the central Anatolian region of Turkey. We used mesoscale Hydrologic Model (mHM) i.e., a physically based fully distributed model and GR4J i.e., a lumped model. We observed streamflow from the gauge D16A141 on the river.

Potential evapotranspiration (PET) is not directly measured but predicted using empirical energy balance equations. Here, we used two PET equations Oudin-2005 and Hargreaves-Samani-1985, which are widely used in the hydrology literature. PET was calculated with daily mean temperature and latitude in Oudin-2005, whereas max-min-mean temperature and latitude are used in Hargreaves-Samani-1985. We also tested the effect of P and PET inputs from ERA5, EOBS and local meteorological stations on the streamflow performance of the model. Nash–Sutcliffe Efficiency (NSE) and Kling-Gupta Efficiency (KGE) are used to measure the hydrologic models' performance during calibration and validation. We used the OSTRICH optimization tool to calibrate the hydrologic models. Our results show that mHM performs better than GR4J with ERA5 data over the basin. Further, the Oudin-2005 PET equation was more successful than Hargreaves-Samani (1985) when used in the GR4J model. Finally, ERA5 inputs for the GR4J hydrologic model showed better results than those with other meteorological datasets.

***Keywords*:** Hydrologic Modeling, mHM, GR4J, Distributed Models, Lumped Models.

Developing Data Driven Models for the Estimation of Grate Inlet Hydraulic Efficiency

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ABSTRACT

The main purpose of the current research is to estimate the amount of discharge that captured from the grate inlets using machine learning (ML) techniques. To accomplish this aim, the relevant data that were acquired as a result of laboratory experiments conducted through multifarious scenarios comprised of different longitudinal and transverse slopes. In addition, this study considered six different grate inlet types varying in shape and size along with the aforementioned configurations. It is especially worth mentioning that 6.75 m long and 1.20 m wide platform was used for the simulations. Thus, a total of 1800 experimental data were obtained to be subjected to the ML implementation within the scope of this research. To train the ML models, we divided the entire dataset into two major parts, i.e., training (70%) and testing (30%), while in the training 5-fold cross-validation was performed to avoid overfitting which is the commonly encountered challenge in ML applications. This study considered regression implementation of the k-nearest neighbors algorithm (KNN) as the original dataset contains numerical values. In addition, the KNN model was hybridized with the two state-of-the-art mete-heuristic optimization algorithms, i.e., particle swarm algorithm (PSO) and genetic algorithm (GA), to carry out hyperparameter tuning of the KNN algorithm. During the optimization process, the parameter ranges were defined and a total of 1,000 candidates were scanned to reach optimum model configurations. Based on the results obtained, the KNN model optimized with the GA yielded more accurate results compared to the model optimized with the PSO. Accordingly, the Nash-Sutcliffe Efficiency index (NSE) values were attained as 0.8621 and 0.8176 for the GA-KNN and PSO-KNN, respectively, while the determination coefficient (R^2) values were obtained as 0.8629 and 0.8231 for the GA-KNN and PSO-KNN, respectively. The overall results illustrate that the adopted ML techniques can be performed in order to estimate the intercepted discharge through the grate inlets and the conclusions of this research are expected to make significant contributions to not only the body of knowledge but also the professionals and practitioners interested and/or work in this domain.

***Keywords*:** Grate Inlet, Machine Learning, Soft Computing, Efficiency, Hydraulics.

Calibration of a Distributed Hydrologic Model for Konya Closed Basin using Multi Gauge Discharge Data

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ABSTRACT

In order to use the fully distributed hydrologic model for understanding the behavior of a river, continuous streamflow data must be available together with meteorological data, and basin-specific morphological data such as land use land cover, leaf area index, flow accumulation, flow direction, aspect, slope and soil properties. Fully distributed hydrologic models use precipitation and potential evapotranspiration (PET) and average temperature as meteorological input to estimate snow melt and infiltration processes. In this study, our aim is to calibrate a distributed hydrologic model for Konya Closed Basin (KCB) to understand hydrological processes in the basin that are relevant for droughts and sink holes in the domain using 30 streamflow observation stations from State Water Works (DSI) which are active in the last 25 years. For that we used mesoscale Hydrologic Model (mHM) to simulate discharge and other fluxes in the basin. We followed a step-wise and recursive calibration started from 30 stations and opted the worst gauges at every step. We assume that very poor gauges can be misplaced on the flow accumulation map or water balance is affected by upscaling the spatial scale from L0 to L1. The worst model results for each observation station were found and these observation stations removed from the calibration. By repeating these steps, the total number of gauges was reduced from 30 to 10 stations, which gave the optimum results for the Konya closed basin. During calibration and validation, the hydrologic models' performance is measured using Nash–Sutcliffe Efficiency (NSE) and Kling–Gupta Efficiency (KGE). Our results show that the mHM model can be used to simulate discharges from ten gauges and hydrologic fluxes in the entire catchment. Further, the model reduced to 10 stations gave better results than 30 stations. This emphasizes the importance of the relationship between the station data and the basin rather than the importance of the number of stations. Simulated monthly groundwater recharge maps, soil moisture maps of KCB together with discharge hydrographs will be presented to indicate spatio-temporal trends in the basin.

Keywords: Hydrologic Modeling, mHM, Full Distributed Model, Calibration, NSE, KGE.

Hydrological Model Structure and Calibration Algorithm Effect on Discharge Simulation Performance

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ABSTRACT

This study was carried out with the purpose of evaluating the effect of model structure and calibration algorithm selection on discharge simulation. Hydrological modelling studies are performed to help decision makers on water resources management and enlighten people about future expectations with predictions on hydrological components of the Earth. The earlier people learn the dangers that they face, the more time they may have to take cautions to avoid or reduce hazardous results of disasters like flood or drought. In this study, Acısu Basin, which is upper side of one of the most important basins (Gediz) in Turkey, was modelled using three types of hydrological models and three different calibration algorithms. Lumped (GR4J), semi-distributed (SWAT+), and fully distributed (mHM) hydrological models were built with ERA5 reanalysis data. Then, each model was integrated with Parameter Estimation Tool (PEST) which is a model independent calibration tool including various algorithms. Levenberg Marquardt (L-M), Shuffled Complex Evolution (SCE), and Covariance Matrix Adoption Evolution Strategy (CMA-ES) were selected as calibration algorithms. Additionally, one-at-a time manual sensitivity analysis were applied to all models to determine the effective parameters and eliminate the unnecessary iterations. Based on the threshold value, 3 out of 4 parameters of GR4J, 11 out of 20 parameters of SWAT+, and 15 out of 111 parameters of mHM were defined as sensitive parameters and calibrated. 1000 iterations were performed for each algorithm and each model using observed data of the State Hydraulic Works (DSI). Calibration period was selected as years of 1991-2000 interval, and validation results were obtained for the period of 2002-2005. Results have shown that mHM and CMA-ES combination showed the best discharge simulation performance according to NSE values of each model-algorithm couple. mHM and CMA-ES combination has NSE value of 0,67 for calibration and 0,60 for validation period. Although statistically the model results were classified as acceptable, the pattern comparison of discharge value shows that all of the models miss the peak values in important amounts. This problem may be related to the interventions made in 2000-2001 years interval and possible to overcome by changing the calibration and validation periods, increasing the number of iterations or using the neutralised gauge data.

***Keywords*:** Hydrological Modelling, Calibration Algorithm, GR4J, SWAT+, mHM.

Identification of Dry Periods from Standardized Precipitation Index Time Series in Gediz River Basin

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ABSTRACT

The objective of this study is to determine the characteristics of meteorological dry periods in the Gediz River Basin, western Turkey and to examine their distribution across the basin. We introduced a methodology to eliminate the short and weak wet periods in between dry periods with the following assumptions on grouping the dry periods and omitting short intervening wet periods (IWP): (i) The length of the IWP should be shorter than the neighbour dry periods. (ii) The length of the IWP should be shorter than the k, time scale of SPI-k. (iii) The maximum SPI value in the IWP should be smaller than the absolute value of the minimum SPI in neighbour dry periods. (iv) The severity of the IWP should be smaller than the severity of the neighbor dry periods. (v) The maximum SPI value in an IWP should not exceed 0.5. This methodology was applied to the SPI1, 3, 6, and 12 time series of the monthly total precipitation time series of 10 meteorological stations in Gediz River Basin, and dry periods were determined. The average intensity and duration of dry periods in each SPI-k time series were calculated. Results show the characteristics and their distribution across the basin vary with different SPI-k time scales which emphasises the importance of the SPI time scale decision. The intensities weaken with the increasing time scales of SPI in general, although exceptions can be seen at some stations, as SPI3 show greater intensity than SPI1. Durations exhibit a more regular behaviour as average durations increase with larger SPI time scales for all stations. As the results are examined geographically, it is clear that those stations that show the greatest drought intensity for the SPI1 are able to compensate for the lack of precipitation in longer time scales. While the average intensity decreases with longer SPI scales, the central stations become the more intensely dry part of the basin although the durations vary between different SPI scales.

Keywords: Dry Periods, Gediz River Basin, Hydrology, Meteorological Drought, SPI.

INDUSTRIAL DESIGN

Designing Running: *An Activity Theory Approach to Running Experience of Amateur Runners in Turkey*

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ABSTRACT

In this study, we adopt activity theory as a theoretical lens to explore the running experience of amateur runners living in Turkey. Employing Leotiev's hierarchical activity structure and Engeström's notion of contradictions, we aim to understand running activity with its physiological, psychological and social dimensions. Thus, we used three methods: online survey, in-depth semi-structured interviews and conversations. First, we conducted an online survey with 90 amateur runners. Then, we conducted in-depth semi-structured interviews with 2 experienced runners, and also had conversations with 2 participants. Conducting thematic analysis on overall data, we found that participants see running not as one specific thing, but as a whole consisting of various elements through which they define themselves in different aspects. We also realized that this multi-element nature of running not only affects how participants engage with running, but also with the artifacts in that context. Therefore, first we defined these elements: health, actualization, psychotherapy, freedom, socializing and social status. Then, investigating how this multi-element nature affects the runner-artifact interaction, we defined two interaction types: presence of artifacts and absence of artifacts. After presenting our running activity model, we discuss how today's artifacts in running context, especially running-specific ones, are designed to provide runners mostly technical and mechanical benefits, seeing running mainly as a performative and biomechanical activity. Hence, we believe that designing artifacts providing a more holistic running experience together with its all dimensions has vital importance. Therefore, we determined three crucial points which can be helpful to consider in the design of running-related artifacts: recognizing non-professional runners, discovering the variety in running, and designing absence.

***Keywords*:** Activity Theory, Amateur Running, Design for Running, Design for Sport.

A Study on the Use of Color in Luxury Product Design and Consumer Preferences

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ABSTRACT

Color is one of the crucial design elements in luxury product design, just like in any other product's design. It is critical to understand how the color of the luxury product is perceived by the consumer and how their preference shapes towards it. This paper explores the application of color in luxury products as a design element and searches for a methodology to reveal the effects of consumer's color preferences towards luxury products. Color may immediately trigger the consumer's emotional desires, which is one of the most essential visual domain aspects of luxury product design. Therefore, for this exploratory phase, emphasis is placed on the behavioral responses of consumers to color as a visual domain in luxury products and how data can be gathered on such phenomena. Because the focus is on consumers' behavioral responses to color as a visual domain in luxury products, an interview was constructed based on the findings. Situated on the findings of theoretical studies both on color and luxury domain, a set of semi-structured questions are formulated and how the outcomes will be analyzed are discussed in the paper. Generating a scale that measures the tendency of decision–making towards color as a visual domain in luxury products as consumers, will be the objective of the research once data is collected via the research methodology designed. Such a scale has the potential to enable the design process to be more precise in its means of color placement on the luxury product according to consumer preferences, as well as the marketing strategies can be more targeted in terms of the luxury product's color.

***Keywords*:** Color, Visual Domain, Perceived Value, Consumer Preferences, Luxury Product Experience.

Using Morphological Chart for Analysing Existing Designs

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ABSTRACT

Morphological charts are used as a design method to find as many solutions as possible to sub-functions of a structural problem. This method is mainly used by industrial design engineers. By reversing it, this design method can be used as an analysis tool to analyze already existing designs and examine their sub-functions and the created solutions. In this research, a collective morphological chart of 319 undergraduate level design students' designs is built. These students are enrolled in different departments in the Faculty of Architecture in Istanbul Technical University. These departments are: Industrial design, Architecture, Interior Architecture, Landscape Architecture and Urban and Regional Planning. This is a discontinued project, therefore, data used in this research, that is gathered from the archive, is important.

In order to construct this morphological chart, students' designs are gathered from the design presentation boards and these designs are deconstructed into their sub-functions. For every sub-function, different solutions are created; these solutions are added to the morphological chart. With more different solutions, this chart expands more.

A collective morphological chart, constructed using the students' designs as data, helps us understand the design vocabulary of the design student in the beginning of their journey. This research can also help us understand the similarities and differences in these students' design vocabularies and preferences while solving a structural problem. This research would also lead to further research in design methods, by introducing a new use of a current idea generation method.

***Keywords*:** Morphological Chart, Design Methods, Design Education.

Exploring Athletes' Experiences of Health, Injury and Recovery: *A Case Study of American Football Players in Turkey*

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ABSTRACT

This study explores American football athletes' experiences with health services in Turkey and how they impact on their recovery strategies. As one of the contact based sports with high injury risks, American Football is widely played in Turkey and athletes experience a variety of related health issues. Understanding and analyzing the nature of this sport is important for confirming the prominent aspects through gaining insight about the American football community in Turkey and their social interactions. Hence, health issues and health facilities as well as the health services are the key factors for athletes' well-being.

This paper mainly focuses on the "subjective well-being" of athletes through the lens of design. It aims to explore potential improvements in health services and in the subjective well- being of American Football athletes. The scope of this research is limited to university sports teams in Turkey and the data collection is conducted by utilizing unobtrusive methods, observations and survey. To understand sportive activities and their experiences of recovery processes due to injuries incurred, first sport archives were researched. The archive consists of popular media web pages' articles and social media posts. Second, the participant group was selected and initial observations were conducted. Third, a survey was conducted with American Football players and coaches.

The outcomes of the research demonstrates that athletes who play American Football in Turkey need improvements in health services particularly in their interactions with physiotherapists, paramedics, and health institutions.

***Keywords*:** American Football, Service Design, Health Service, Well-being, Injury.

Cognitive Process of Design Students in terms of Decision-Making about Usage Scenarios

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ABSTRACT

Decision-making is one of the most important steps in designing as it is a basic cognitive process. One of the main definitions of design implies that it is to create action sequences with the goal of altering existing conditions into desirable ones. Decision-making involves choosing an option or a course of action from a set of alternatives based on certain criteria. In this study, the main focus is inspecting the cognitive process of sophomore design students while designing a product by using only cardboard as a material in a studio class to map the way and patterns of decision making. The cognitive process is examined with respect to design students' decisions in terms of usage scenarios. Novice designers, in this case, sophomore students, are preferred since they may have less gut feeling and take less intuitive steps as done by expert designers, as the literature suggested. Semi-structured interviews were conducted with 5 students to create an understanding of their decision-making processes. Results were categorized under elements that create focus shifts, fixations, or aimless moves. Focus-shifts are the parts of the cognitive process that triggers decision-making whereas fixations immobilize the design process towards development. Besides, aimless moves are the cognitive parts that take the time of the designer but have little to no effect on the design. All of these aspects create major parts of cognitive processes and their correlation to decision strategies may vary. Revealing decision strategies of students that also partly define their design strategies in the process of designing opens ways to handle the design studio classes with higher performance.

***Keywords*:** Design Process, Cognition, Decision-Making, Design Education.

Exploring Metaphorical and Literal Contents Through Cultural Probes

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ABSTRACT

User-centred design focuses on users and user experiences to guide the design process. Various methods are adopted to design research to understand the user experience. This paper applies one of these methods, cultural probes, and focuses particularly on narratives that are rich in metaphors to develop a deeper understanding of how users experience the new way of working, i.e., working from home. Along with the cultural probes data, user narratives significantly inspire and inform the design process. These narratives usually include metaphors, as they are an integral part of how users experience and make sense of their world. Previous research around metaphors in design studies has focused on metaphorical thinking in the design process and how designers produce metaphors and apply them to their designs. Metaphors play a crucial role in the design activity since they are a part of the design thinking process, and powerful instruments for designers to convey meanings to users through their designs. By taking design as a form of communication between designer and user, it is critical to understand metaphors as an integral part of this dialog. This paper argues that metaphors make up an important part of user data and help to understand users and their experiences better. In this research user narratives with literal and metaphorical contents are collected through cultural probes. The probe kits include two types of tasks by asking for literal and metaphorical answers. The tasks aim to get an understanding of four main categories: objects, environment, work, and leisure. Gathered data are analysed through content analysis to make sense of the users' working from home experience. Finally, the study explores how literal and metaphorical data differ in the way they could inspire design.

***Keywords*:** Metaphor, User-Centered Design, User Experience, Cultural Probes, Working from Home.

A Study on Mobile Applications: *Telephone Usage Habits at Home During Covid-19 in Turkey*

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ABSTRACT

This article introduces Covi-19 pandemic mobile phone behaviors and morals compared to before the pandemic especially in home habitat. With this report, I made semi-structured interviews with 8 users are concentrated into people mobile phone applications, usages, communications between user and application, daily routines, habits and also Superapps. Also, with a survey, I combined two different complementary research which are Quantitative research and Qualitative Research to merge the all point of view: Superapps, user focused mobile behaviors, and Pandemic morals at home. This article was applied different interviews and supported with survey and it led to improvements to the initial concept, as well as justified decisions for further Superapp Researches.

Keywords: Quantitative Research, Qualitative Research, Semi-structured interview, Covid-19.

Probing the Cultural Probes: *A Study on Introducing User Research to Design Students*

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ABSTRACT

This study investigates novice design students' first experience of conducting a cultural probe kits study, mainly focusing on the relevance of the prepared cultural probe kits to the research theme and research questions. In this direction, a two-dimensional analysis is performed by handling two main constituents of the probe kits: tasks and tools. Applying qualitative content analysis, findings are interpreted in terms of these four categories and their sub-categories: kit components, the equipment delivered within the probe kit, types of the tasks included in the taskbook and activities included in the tasks, and prominent task features. The study reveals the important points of designing a cultural probe kit and provides insights about how the method should be introduced. Based on these, various criteria and instructions for introducing the method to novice design students, guiding the design of probe kits, and accordingly improving application of the method are presented.

***Keywords*:** Cultural Probe Kits, User Research, User-centered Design, Design Education.

MANAGEMENT ENGINEERING, INDUSTRIAL ENGINEERING

Financial Time Series Forecasting: A Machine Learning Approach

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ABSTRACT

Time-series forecasting is one of the critical areas in different financial markets. The emergence of cryptocurrencies as financial assets requires precise forecasting because of the high volatility in price movements. Many subfields of mathematics, finance, and computer science intend to develop a method to address this problem. Machine learning methods have been widely used for time series forecasting in recent years. Different machine learning algorithms can lead to different results when sufficient historical data is in hand. Using multiple methods is advantageous to develop more efficient models for financial time series forecasting. This study aims to find a better model for forecasting cryptocurrency prices using historical data. Based on the literature, seemingly on a not-too-large dataset, the XGboost and Random Forrest algorithms perform pretty well. However, models such as LightGBM and Catboost have been under a wider attention span in recent years. The performance of these models was reviewed on historical data, and the best-performing models were combined to make the most optimum forecasting. This study focuses on XRP, which is among the top cryptocurrencies by market capitalization, to find the most optimal forecasting. Findings support the idea that XRP follows the random walk theory. Since it is vital to forecast a couple of days before, high volatility and movement correlation in the cryptocurrency market causes errors in the mentioned models when they are applied individually to the cryptocurrency time series. In contrast, the combined model can make forecasting in an acceptable time window that gives enough time for further decisions in the market.

***Keywords*:** Financial Time Series, Forecasting, Cryptocurrency, Machine Learning.

TFEEC: *Turkish Financial Event Extraction Corpus*

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ABSTRACT

The economy and money play a vital role in our daily lives and keeping up to date with the latest news are essential for making financial decisions accurately. The task of events extraction has been investigated for a long time in order to be informed about these news and to enable automatic extraction of events from the news. However, to the best of our knowledge, no study has been conducted in the domain of Turkish financial and economic text mining. To fill this gap, we have created an ontology of 25 event types and 104 subtypes, and using this ontology we present a well-defined and high-quality company-specific event corpus of Turkish economic and financial news. Using our dataset, we conduct a preliminary evaluation of the event extraction model, to serve as a baseline for further work.

Most approaches in the domain of event extraction from natural language text rely on machine learning and require large amounts of labeled data for model training. However, building a training corpus with manually annotated events is a very time-consuming and intensive process. To solve this problem, we tried active learning and weak supervision methods to reduce human effort and automatically produce more labeled data without degrading machine learning performance.

Experiments on our dataset show that both methods are useful. Furthermore, when we combined the manually annotated dataset with the automatically labeled dataset and used it in model training, we demonstrate that the performance increased by %2,91 for event classification, %13,76 for argument classification. The public dataset can be accessed at https://github.com/kadirsinas/TFEEC.

***Keywords*:** Event Extraction, Semi-Supervised, Weak Supervision, Active Learning, Corpus Generation.

A Literature Review: *Links Between the Digitalization and the Labor Productivity in the Construction Industry*

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ABSTRACT

Digital technologies are on the prior agenda of the construction industry since they provide opportunities for improving the process and project management systems and activities that deal with significant productivity, quality and sustainability performance deficiencies due to being labor-intensive and highly waste creator. Construction operations are being transformed via digital applications operated at the site and during the project development via data modelling, such as building information modelling related attempts, wearable technologies, optimization algorithms, machine learning techniques, deep learning techniques, simulation and action recognition techniques. Previous literature explored various dimensions of digitalization in construction industry, such as the digitalization cases and applications, their impact on project success, business performance, competitiveness, occupational safety and health and sustainability in construction. However, the thematic literature reviews and bibliometric analysis studies are still rare on this topic, particularly on the linkages between the digitalization and the labor productivity in the construction industry context.

This study aims to explore the relationships between the concepts of labor-productivity and digital transformation in the construction with a bibliometric analysis on the Scopus database as a source of publications in this context. By a Prisma Flow approach, we retrieved and analyzed publication data using bibliometric software tools. Study presents the quantitative analysis of the publications by keyword co-occurrence, publications, authors and geographies, expanded to bibliometric analysis by co-occurrence, co-citation analyses and concept clustering.

The study findings revealed that the publications linking digitalization and labor productivity in construction industry are still very limited (n=52). Conceptual clusters show linkages between the digitalization and construction management, design, occupational health and safety concepts & accident prevention, sustainable development in relation with the labor productivity. Collaboration and integration are the keywords occurred much, hence is important for projects. In further research, qualitative studies can help to provide further insights about the linkages between labor productivity and digitalization in construction industry.

Keywords: Digitalization, Digital Transformation, Bibliometric Analysis, Labor Productivity, Construction Industry.

Prediction of Credit Card Default with Different Machine Learning Techniques

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ABSTRACT

Predicting the credit default has been a hot topic since the introduction of first model by Fair Isaac Corporation USA (FICO) in 1958. Predicting the default and default probabilities is crucial for risk management, capital adequacy, solvency, asset quality and profitability of banks. Credit risk modelling is based on predicting the borrowers' probability of default and different machine learning techniques are used by the financial institutions within that context. Credit card products, with their flexible and revolving characteristics, have social and financial impacts on both the consumers and financial services providers. Turkey has shown a great improvement in credit card industry in terms of credit card number and the transaction volume. This paper analyzes credit card data from a large commercial Turkish bank that contains around 39.000 clients with fifteen features. The aim of this study is to find the model that displays the highest accuracy in predicting default probability of a credit card portfolio. Prediction accuracy is measured using nine classifier data mining methods: Logistic Regression, Linear Discriminant Analysis, Quadratic Discriminant Analysis, Naïve Bayes, Decision Trees, Random Forest, Bagging and Support Vector Machine and Neural Network. The ownership of relatively new aspects of credit cards including the use of contactless cards and virtual cards and the cardholders crypto asset investment habits have also been used as predictors, which have not been used in similar previous studies. This study also aims to test the explanatory power of those variables on credit card defaults. The prediction accuracy of these models has been compared and suggestions for future studies have been displayed.

Keywords: Credit Card Default, Credit Risk Modelling, Probability of Default, Machine Learning, Supervised Learning.

Small Area Mobility Forecasting Around Groceries and Pharmacy Locations in Turkey using Google Mobility Data

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ABSTRACT

A substantial number of spatial studies have been undertaken on the effect of consumer mobility on retail activity. However, in the wake of Covid19 pandemic, studies on activity around retail placesincreased significantly. Most of these studies used retailers' IoT or transactional data to monitor consumer activity. Innovative open data sources published by leading internet companies provide an excellent tool for measuring this activity. As previous studies on consumer behaviour have shown a lack of adequate data on assessing people's mobility, we used the Google Mobility data that Google has been offering from the first days of the global pandemic. The data reports the density of users who have activated location sharing services on their mobile devices around areas like retail and entertainment, food retail and pharmacy, parks, transport stations, workplaces, and residential areas. In addition, we estimated a population density forecasting model for grocery and pharmacy locations using historical data. We conducted this study for 211 administration districts (ilçe) in Turkey, with complete time-series data for the 2020 –2022. The districts we studied translate to Local administrative units class in Nomenclature of Territorial Units for Statistics classification of EU. We employed both time series methods like ARIMA, ARMA, Exponential Smoothing and machine learning methods embedded in Prophet package in Python. The findings indicated that we could forecast 15 days of mobility with a 20.2% error rate on average.

***Keywords*:** Forecasting, Google Mobility, Retail, Spatial Analysis.

Prioritization of Factors Affecting Sustainability of Distance Education in Higher Education Institutions

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ABSTRACT

Providing better distance education quality is one of the most important concerns of universities. Along with the education quality, sustainability of education is also quite important for higher education institutions. In recent times, sustainability in distance education has become more important for higher education institutions due to the current COVID-19 pandemic. In this perspective, the purpose of this study is to investigate the factors affecting the sustainability of distance education in higher education institutions. Another aim of the study is to understand the interdependence between the factors using single valued neutrosophic sets. Single valued neutrosophic sets are preferred due to their efficiency and flexibility for explaining indeterminate judgments of decision-makers. In this study, the factors affecting the sustainability of distance education are identified by a literature review and by expert opinions. Subjective judgments of academic staff are collected as single valued neutrosophic numbers using the Delphi technique. Then, the initial and the final reachability matrices are obtained respectively. The factors and the interrelationship between the factors are presented in a graphical form using nodes and links. Finally, the factors affecting distance education for sustainability are ranked using a multi-criteria decision making technique. This study provides a comprehensive view of the distance education factors and attempts to establish the multidirectional interplay between factors facilitating sustainability in higher education institutions using neutrosophic sets. In addition, this study assists in understanding important distance education factors that can facilitate sustainability from the perspective of academic staff, who are internal stakeholders of higher education institutions.

Keywords: Distance Education, Higher Education, Multi-criteria Decision Making, Neutrosophic Set, Sustainability.

Engineer Competencies in the Industry 4.0 Environment

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ABSTRACT

The 4th Industrial Revolution, (I4.0), has already begun to change the world. The way we work, communicate, organization structure, job descriptions, business strategies, our role as a customer has already started to change.

This research analyses the competency needs of the workforce, specifically engineer competencies in the I4.0 environment keeping the following questions in mind: "How organizations adapt themselves to I4.0 environment? How organizations will be able to cope with the challenges posed by the I4.0 environment?"

When the studies on this subject are examined, it seems that there are some important shortcomings. Therefore, it is necessary to conduct research with a new perspective. The main shortcomings are as follows: different tasks require different competencies however, most of the studies are not specific to any profession, but for all employees. Secondly the competencies required for I4.0 are not determined based on principles specific to I4.0. In this study, a model has been developed in which these shortcomings have been eliminated. AHP (Analytical Hierarchy Process) model has been established as it is suitable for this problem structure. AHP is a structured technique for organizing and analyzing complex decisions by pairwise comparison approach which has two main components: criteria and alternatives. In this study, alternatives (competencies) to be selected based on criteria (principles). The principles that companies should take as a basis to be successful in the I4.0 environment; security, reliability, interoperability, and sustainability are adapted from a study on this subject. 118 studies from literature were examined to determine competencies which are suggested by researchers and top 9 competencies were used in the AHP model. Pairwise comparison matrices were prepared by establishing the AHP tree structure. A total of 24 experts participated in the evaluations. At the first step of the pairwise comparisons, the principles were compared in terms of their contribution to the success of a company in the I4.0 environment. Then, the importance of each competency relative to other competencies was evaluated for each principle.

By doing this, the importance of each competency for engineers in the I4.0 environment was determined. The order of importance obtained from the AHP model was different from the frequency order in the literature however in both, the first place belonged to digital competency.

***Keywords*:** Industry 4.0, Engineer Competencies, Competency.

MARITIME,
MARINE ENGINEERING

Analysis of Dynamic Positioning Incidents' Types per Year (2004-2021)

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ABSTRACT

Marine accidents have been always important for the industry since its lessons learnt are usually the reason of newly establishing rules or regulations. Particularly, DP (Dynamic Positioning) accidents have more critical consequences since the nature of offshore operations such as oil and gas industry, deep water drilling, gas exploration, etc.

Dynamic Positioning is a system that enable vessels to control their positions and heading automatically by means of active thrust according to IMCA (International Maritime Contractors' Association). By means of DP system, vessels installed with DP system can keep their positions in a required position as reliable as possible and as close as to other offshore structures, platforms, vessels or desired position. Due to the sensitivity of works such as drilling, diving or anchor handling operations, the system is required to be continuously monitored by competent dynamic positioning operator, shortened as DPO or DP operator.

This paper highlights the several main causes of DP incidents. A total of 1349 DP incidents reports from 2004 to 2021 which are collected from IMCA (International Marine Contractors Association) have been investigated, filtered and classified. Furthermore, these incidents cause groups have been analyzed to identify related hazards, its factors and sub factors which have resulted DP incidents.

While half of incidents cause loss of redundancy in which DP vessels have lost their redundancy, in another words their back-up system, the rest of the incidents cause a loss of position of the respected vessel. The major dominating cause which resulted DP incidents has been found related with thrusters and propulsion failure. The second significant cause has been identified as human factor and third greatest cause has been found as computer in the last 18 years period.

The results of this paper are considered to be helpful for the prevention of future DP incidents and building new methods or modules of trainings which are related to DP incidents.

***Keywords*:** Dynamic Positioning Incidents, DP vessels, Maritime Accidents, IMCA, Offshore.

An Extreme Value Analysis of Significant Wave Heights for the Turkish Coastline

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ABSTRACT

The purpose of this study is to carry out an extreme value analysis for significant wave heights along the Turkish offshore area. The return level of ocean waves obtained from the study is a determinative parameter for the design of coastal and offshore structure. 45 representative locations along the Turkish coastline are selected to carry out the analysis covering the Black Sea, Aegean, and the Mediterranean. This also ensures depicting a spatial distribution of extreme waves along the coastline. The recent ERA5 dataset is used from the European Centre for Medium-Range Weather Forecasts (ECMWF). The temporal length of the data is 41 years between 1979 and 2020 which enables the applications of both Annual Maxima (AM) and Peak Over Threshold (POT) based statistical distributions. The extraction of the extreme series benefited from AMD and POT methods. Statistical models of Generalized Extreme Value (GEV) and Generalized Pareto Distribution (GPD) are used respectively for the two extreme series selection methods to predict the return levels of wave height up to 100 years period. The comparisons are made between the AM and POT based methods through the quantile comparisons and return level variations. The results showed that, for the considered locations, the average 100-year return level are 5.6 m and 5.4 m, with a maximum of 7.6 m and 6.8 m for GEV and GPD models respectively, both located in the Black Sea near Sinop.

***Keywords*:** Extreme Value Analysis, Extreme Value Distributions, Extreme Sea Waves, Mediterranean, Black Sea.

Examining the Scientific Background of Mental Health Problems Faced Among Seafarers

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ABSTRACT

Maritime trade has a share of 80-90% in the transport of international trade and employs over 1 million seafarers. The maritime profession is distinguished from other occupational groups by factors such as the difficulty of sea conditions, hierarchical and shift work order, intense work tempo, the workplace being home at the same time, staying at sea for months, and the limitation of social life. Because of these factors, seafarers suffer from many psychological factors such as stress, depression, fatigue, burnout, and hopelessness in their living and working conditions on board. However, many seafarers hide their mental state for fear of being fired or stigmatized. In order to solve the mental health problems of seafarers, we purposed to determine the main psychological factors that affect seafarers and to examine their causes. In this direction, we aimed to determine the reflection of this problem in the literature. This reflection is important in determining the psychological factors that seafarers suffer more from. Of course, although the aim in a broad perspective is to produce solutions to all problems, this study contributes to the literature with its bibliometric analysis in terms of determining the primary problematic psychological factors for seafarers to seek solutions. Bibliometric analysis is a research method that allows detailed analysis of academic studies. Bibliographic data includes descriptive statistical data about publications on the relevant subject. We gathered bibliometric data from the Web of Science (WoS) and Scopus databases. This study examines the academic papers on maritime psychology between 1966-2022. 266 relevant publications were identified with a deep database review. We analyzed the data collected with the Bibliometrix tool in R software. Using the bibliographic coupling method, we identified research clusters of psychological problems faced among seafarers. We presented a detailed analysis of these clusters and future research issues.

Keywords: Seafarer, Maritime, Psychological Factors, Mental Health.

Root Cause Evaluation of Pilot Embarkation Accidents: *The Case Analysis of M/V Saluzi Accident*

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ABSTRACT

The root cause analysis of maritime accidents allows us to handle and understand the underlying causes correctly and determine practical corrective/preventive actions. Steps taken with this perspective will help reduce the number of accidents and create a safer working environment. Accidents experienced by maritime pilots have an essential place in maritime transport, which has many risks due to its unique structure. It is noteworthy that there is not enough study in the literature on the analysis of the accidents experienced by maritime pilots during the embarkation/disembarkation process. In this study, the accident on the M/V Saluzi, which is an actual event, was examined to better understand the root causes of the accidents that occurred during pilot embarkation and suggest appropriate corrective/ preventive measures. The SHARE Technique taxonomy was used to determine the root causes. The accident was evaluated by thirteen maritime pilots based on the accident investigation report published by the relevant maritime safety research unit. Findings were examined under two main headings: human-related and job-related factors. The outputs of the study showed that the root causes fell under these sub-headings: Human characteristics, Human behavior, Physical/physiological capacity-stress, Psychological capacity-stress, Insufficient knowledge, skills, training, Communication problems, Inadequate team culture, Safety-related factors, Deficiencies in shipbuilding, design, and equipment, System-related factors, Environmental factors, Third-party related factors, and Commercial pressure. According to the results obtained, suggestions were made about the safety barriers that should be created. It has been evaluated that the use of root cause analysis to systematically examine the accidents experienced by the maritime pilots plays a vital role in learning lessons from the accidents and preventing their recurrence, thus increasing safety at sea.

***Keywords*:** Maritime Transportation, Maritime Pilot, Embarkation Accident, Root Cause Analysis.

Assessment of Cold Ironing as Mitigation Tool of Emissions in Port: A Container Port Case Study

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ABSTRACT

Maritime transportation is considered the most efficient transport mode in economic and environmental terms. However, its impact on air pollution and global warming cannot be ignored. Especially ports located close to cities threaten public health with emissions from ships. The significance of the issue is understood better day by day by the authorities. The IMO has adopted mandatory measures to reduce emissions from international maritime transportation for ships. Despite efforts by the IMO to reduce ship-borne emissions, studies about the effects of air pollution caused by ships in port areas are insufficient. This study evaluated the effect of using shore power instead of an auxiliary engine on emission reduction. We examined 529 ships that visited the container port in Izmit Bay. We used two bottom-up methods, EPA and Entec, for emission estimation of the ships. For cold ironing, we used the emission factors of the Turkish national grid. As a result of this study, when cold ironing was applied instead of the auxiliary engine, the emission reduction rates of CO_2, NOx, PM, and SO2 were 21.02%, 91.64%, 58.67% and 2.42% respectively. The results obtained from the analysis showed that the application of cold ironing has environmental advantages for port areas.

***Keywords*:** Entec, EPA, Cold Ironing, Ship-borne Emissions, Emission Reduction.

Emission Reduction Potential of Hybrid Propulsion: *A Case Ferry from Istanbul*

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ABSTRACT

The International Maritime Organization, the ruler of the maritime industry, aims to reduce ship-sourced emissions to cope with the greenhouse gas and pollutant emissions which are not only one of the main drivers of global warming but also have very serious harmful effects on human health, especially in cities with ports. In line with this objective, evolutions on ship propulsion systems are the key points to enhancing the total efficiency by decreasing fuel consumption and emissions. In addition to the conventional marine diesel engine-powered systems, hybrid power and propulsion topologies attract the attention of the maritime industry. Today, the majority of the marine hybrid systems use a diesel engine-battery combination which is very efficient, especially during maneuvering. Hybrid power systems are particularly advantageous thanks to their ability to reach higher efficiency in the case of partial loads. However, the ultimate zero-emission goal is impossible with this configuration due to the use of fossil fuel for marine diesel engines. On the other hand, it seems like the best option during the transition to green shipping. In this study, the operational data of a ferry operating between Kadıköy – Eminönü, the two ports of Istanbul, is gathered and analyzed. The fuel consumption and emission profile have been extracted according to the load changes and power demand of the propulsion system during berthing, cruising, and maneuvering. Respecting the possible hybridization methods and their equipment characteristics, approximate fuel-saving and emission reduction potential has been estimated. It is shown that hybrid drive systems are an important option to reduce fuel consumption and greenhouse gas emissions, especially for ships with short sea trials and high load transitions.

***Keywords*:** Hybrid Propulsion, Emission Reduction, Energy Efficiency, Ship Emissions, Sea Transportation.

MATERIALS SCIENCE AND ENGINEERING, NANOSCIENCE AND NANOENGINEERING

MgO/ZnO/rGO Nanocomposite Based Electrochemical Enzymatic Glucose Biosensors

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ABSTRACT

Biosensors are devices comprises of a biological component and a physicochemical component. Biological one is used for detection of an analyte, the physicochemical one to produce a measurable signal. Glucose biosensors are the most widely used and commercialized ones in the electrochemical enzyme biosensor class. Nowadays, intensive studies in the field of glucose biosensors are focused on the development of the features such as sensitive measurement capability due to increase in diabetes disease. To provide accurate measurements for human health, enhancement of the biosensor sensitivity is needed. Various material combinations are studied for this purpose. In comparison to other materials, reduced graphene oxide (rGO) stands out for increased conductivity and metal oxides for providing enzyme immobilization thanks to high isoelectric point values.

In the scope of this project; MgO/ZnO/rGO nanocomposite will be produced in different morphologies by changing pH, temperature and process time values by hydrothermal synthesis method. Obtained particles are characterized and coated on an electrode surface. Electrochemical characterization analyses will be performed (CV, impedance and chronoamperometry) and the improvement in the measurement sensitivity of the glucose biosensor will be examined.

The originality of this project; is using combination of magnesium oxide (MgO: 9.8-12) and zinc oxide (ZnO: 9.5) which have the highest isoelectric point among the other metal oxides and rGO as conductive agent for the development of high sensitivity glucose biosensor. In this study, the observation of the increase in the measurement sensitivity of the glucose biosensor produced with the electrode material to be modified in different morphological structures of the MgO/ZnO/rGO nanocomposite is aimed.

Keywords: Biosensor, MgO/ZnO/rGO Nanocomposite, Hydrothermal Production Method.

Liquid Crystalline Mesophase Gel Electrolytes for High-Performance Supercapacitor Design

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ABSTRACT

All-solid-state high-performance supercapacitors have been widely developed but they own unavoidable low ionic conductivity of the solid-state electrolyte's. Therefore, all-solid-state have been developed for the supercapacitors composed of two electrodes with hydrogel electrolytes in between and they provide excellent attributes of fast charge/discharge, high energy density, and long cycle stability. In this sense, phosphoric acid ($H_3PO_4.H_2O$, PA) is one of the best proton conducting materials used as a supercapacitor electrolyte. Moreover, in order to avoid the liquid leakage problem, the electrolyte has been confined in a liquid crystal (LC) gel matrix cause it is known that PA can form LC mesophase with non-ionic surfactant as given in Figure below showing the diffraction pattern of a bicontinuous cubic mesophase with a lattice parameter of d = 3,9 nm. [1] PA and non-ionic surfactant (NI) (lauryl ether, $C_{12}H_{25}(OCH_2CH_2)_{10}OH$, C12E10) are used to form LC gels at a mole ratio in the range of 60 to 100 and proved to offer high specific capacity, Cg, at around 1128 F/g under the test conditions of 0.1 A/g in combination with the reduced graphene oxide symmetric electrode. The mesophase of the LC gel at each PA concentration was comprehensively analyzed with FTIR, polarized optical microscope, and XRD techniques to confirm that the mesostructure is the reason for high specific capacitance. The electrochemical performance was tested with cyclic voltammetry, galvanostatic charge/discharge and electrochemical impedence spectroscopy.

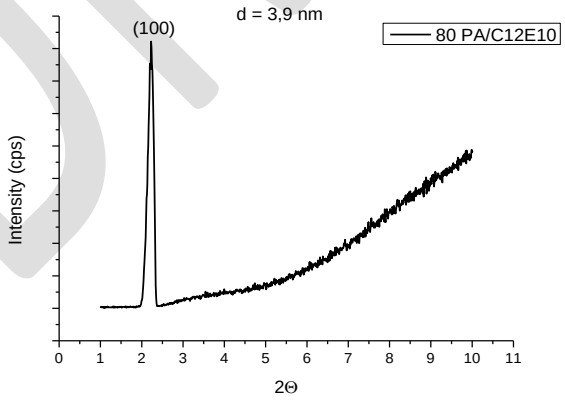

Figure XRD pattern of PA-NI LC gels at PA to NI mole ratio of 80

***Keywords*:** Supercapacitor, Liquid Crystal Gel, Phosphoric Acid.

References

[1] E. Tunkara, C. Albayrak, E. O. Polat, C. Kocabas, and O. Dag, ACS Nano 2014, 8, 11007.

Graphene Oxide Synthesise for Polyamide Thin Film Composite Reverse Osmosis Membrane

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ABSTRACT

Water is the most significant requirement in order to sustain life. At the present time, the World faces water scarcity on account of global warming, an extremely growing population, and industrialization. There are different solutions to handle water scarcity. Desalination is one of them because of its commercial and feasibility properties. Membranes are used for desalination systems to purify water. For membrane systems, three challenges stand out: energy consumption, membrane fouling, and chlorination. Our purpose is that Graphene Oxide Nanoparticles integrate into the Polyamide Thin Film Composite Reverse Osmosis Membrane in order to improve the hydrophilic, membrane fouling, and other properties of the membrane.

Graphene Oxide is a highlighted material in consequence of the stunning mechanic and hydrophilic properties of GO. Integrated graphene Oxide Sheets into the membrane can improve water filtering and lifetime. In this project, Improve Tour's method was used to synthesize GO sheets. Synthesized GO was characterized by 5 different characterization methods: SEM, micro-Raman, XPS, XRD, and FTIR. Sem analyses were performed to measure Graphene Oxide sheet size and our graphene oxide sheet size ranged from 200nm to 1000 nm. In order to further demonstrate the presentation of oxygen-containing functional groups, XPS analysis of GO is conducted. The results are shown that obtained GO was exposed to adequate oxidation.XRD pattern of graphene oxide gives about crystal structure. FTIR and micro-Raman indicate useful GO synthesized.

***Keywords*:** Graphene oxide, Reverse Osmosis, Polyamide Thin Film Composite.

Design and Simulation of Micromixers for Efficient Antigen-Antibody Binding

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ABSTRACT

Microfluidic systems have been utilized for various applications such as drug delivery, clinical diagnostics, biomedical engineering etc. They offer substantial advantages including low reagent consumption, fast analysis and high sensitivity of detection. Fluid flow in microchannel is laminar and dominated by molecular diffusion due to small Reynolds numbers of the fluids resulting in insufficient mixing. Enhanced mixing is required in most applications dealing with biological samples. To improve mixing, generally active or passive micromixers are used. Active micromixers require external energy sources such as dielectrophoresis, electrokinetic disturbance which make the fabrication complicated while passive micromixers do not require any external energy sources. For this reason, passive micromixers are preferred due to their ease of fabrication and simple operation.

In this study, in order to enhance mixing, passive micromixers with varying geometries have been designed and fluid flow pattern has been simulated using COMSOL Multiphysics software. Antigens and antibody modified magnetic beads were fed through two different inlets with varying channel geometries. The inlet channel geometry for the magnetic beads is expected to result in the formation of vorticities and disturbance of the fluid flow, causing the dispersion and rotation of the magnetic beads, which will help increasing the binding efficiency of antigens onto the surface of antibody modified magnetic beads. Moreover, the proposed micromixer geometries will cause the hydrodynamic interactions between antigens and antibody modified magnetic beads when they flow through the channel which enhances mixing. According to COMSOL simulation results, serpentine and convergence-divergence type micromixers resulted in good mixing of different fluids. To verify simulation results experimentally, some of the designed microfluidic systems giving best simulation results were fabricated and tested.

***Keywords*:** Microfluidics, Passive Micromixer, Simulation, Antigen-Antibody Binding.

Synthesis of Graphene Encapsulated Iron Oxide Nanoparticles Using Solvothermal Method and Cytotoxicity test

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ABSTRACT

Magnetic nanoparticles have been developed for various biomedical applications such as drug delivery, hyperthermia, disease detection and imaging. Carbon based encapsulations on magnetic nanoparticles improve biocompatibility and stability, reduce agglomerations and provide surfaces for drug carrying. Therefore, the solvothermal method, sol-gel method, combustion synthesis, plasma and chemical vapor deposition (CVD) are some of the methods that used for obtaining graphene coated nanoparticles. In the present study, Fe3O4@C core–shell nanostructures were prepared via a one-pot solvothermal method. In this process, the GO (0.01 g) was dissolved in 5 ml of distilled water. Then 0.07 g Ferrocene (C10H10Fe) was dissolved in 5 ml acetone. After 10 min sonication, 5 ml GO which is dissolved in distilled water was added at room temperature. Then, hydrogen peroxide (0.35 ml, 30%) was slowly introduced into the solution, which then was stirred for 30 min. After that, the solution was transferred to a Teflon lined stainless steel autoclave and then heated to 196°C for 26 h. Then the autoclave was cooled down to room temperature. The powders were precipitated by centrifugation and washed with acetone three times. Then, the obtained powders were dried at 60°C overnight. Finally, the resulting samples were calcined at 500°C in an Argon atmosphere for 2 h to improve the crystallinity and remove the organic species. Then the Fe3O4@C nanoparticles were coated with graphene under CH4 gas flow in the CVD system (900-1000°C) for 1 h. Synthesized Fe3O4@Graphene nanoparticles powders were characterized using an X-Ray diffractometer (XRD), scanning electron microscope (SEM), Raman spectrometer and particle size analysis. Then, cytotoxicity of Fe3O4@Graphene nanoparticles in MCF-7 (human breast adenocarcinoma cell line) was determined by using MTT assay for 72 h. According to the results, no significant toxicity was observed in MCF-7 cells treated with up to 500 µg/µl nanoparticles. On contrary, nanoparticle treated cells demonstrated higher cell viability compared to control cells.

Keywords: Magnetic Nanoparticles, Graphene Encapsulation, Solvothermal Synthesis, Cytotoxicity.

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High Performance Thermoplastic Composites with Advanced Manufacturing Technique

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ABSTRACT

The developments in the technology have made it necessary to change performance requirements expected from the material. Aerospace is one of the fields that requires strong, lightweight, resistant and flexible materials. To answer the high performance requirements studies on composite materials have significantly increased during the last decades'. Carbon fiber reinforced polymer matrix composites are one of the most commonly used materials on critical parts of design. Thermoplastic matrix resin has several advantages over thermoset resins, for being recyclable, lighter, durable and easy to storage. In this study, unidirectional carbon fiber reinforced thermoplastic matrix (CFR-UD PEKK) composite panels consisting of 11 plies are laid down with automated fiber placement robot with $[[0°/90°]_2 0°]/\underline{90}°]s$ orientation to address a typical design approach. The panels are laid down with different lay-up speeds with average of 100 mm/sec and 400 mm/sec. Also, the effect of the post consolidation is investigated by post consolidating one of two set of the identical panels in autoclave, others left as in-situ. The objective is to investigate the trend of approaching post consolidated performance level without any further need of post consolidation by changing the process parameters. Differential scanning calorimetry (DSC), microscope, gas piknometer and dynamic mechanical analysis (DMA) tests are conducted to evaluate the crystallinity, defect formation, void content, and mechanical performance of the panels. Results has shown that there is no significant effect of lay up speed on crystallinity, whereas post consolidation has a strong influence on both degree of crystallinity and thermo-mechanical properties. Post consolidated panels have 25000 MPa of storage modulus while in-situ panels have 15000 MPa. The results are also elaborated with the void content which is relatively decreases with the post consolidation treatment.

***Keywords*:** Composite Materials, Thermoplastics, Automated Fiber Placement.

Synthesis, Characterization and Supercapacitor Application of Polyaniline Doped with Different Acids

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ABSTRACT

Supercapacitors, one of the energy storage systems, are widely used because of their inspiring properties like excellent cycle life, high-power density, and rapid charge-discharge process. In this study, PANI-based conductive polymers to be used as electrode material in supercapacitors were synthesized via chemical oxidative polymerization using different acid dopants (HCl, HNO3, H2SO4, H3PO4, HClO4). The chemical structure of conducting polymers has been confirmed by Fourier-transform Infrared (FTIR) spectroscopy, X-ray diffraction (XRD), scanning electron microscopy (SEM), and thermogravimetric analysis (TGA). The electrochemical properties have been investigated by cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS). The PANI/H2SO4 electrode, obtained by chemical oxidative polymerization using sulfuric acid, provided a specific capacitance of 1180 F/g at a current density of 0.1 A/g. FTIR analysis of conductive polymers, synthesized to be used as electrode material in supercapacitors, was shown in Figure 1. The polymer shows the absorption bands at 1560, 1485, 1300, 1240, 795, and 505 cm−1 related to characteristics of PANI. The absorption peaks around 1500 and 1600 cm−1 appeared due to amine and imine units in the chemical structure of polymers. The absorbance at 1560 cm−1 proves the existence of quinoid rings (Q) caused by the N=Q=N stretching vibration. The presence of the bands at 1485 cm−1 is due to the stretching mode of N-B-N (B means benzenoid ring) in PANI. C-N-C stretching vibration shows the peak appeared at 1300 cm−1.

***Keywords*:** Supercapacitor, Energy Storage, Conductive Polymer, PANI.

The Effects of Different Surface Treatments Applied on Polypropylene on Paint Test Performances

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ABSTRACT

Polypropylene (PP) is heavily used to manufacture bumpers in the automotive industry because of its lightness, its resistance to both air agents, and impact performance. It is formed by long saturated hydrocarbon chains that contribute to its chemical inactivity and prevent the anchoring of paints. This is the cause of the black color of the bumpers. However, to meet the aesthetic requirements of the automotive market, polypropylene has become more suitable for painting. A standard plastic painting process consists of five steps: (1) cleaning to remove grease and dust from surfaces; (2) surface treatment to increase surface energy; (3) primer application to reinforce adhesion of the basecoat; (4) base coat application to give the color on the bumper surfaces; (5) clear coat application to ensure the continuity of brightness and durability of the surface.

In this study, surface treatment was applied to PP by plasma or flame application methods and the effect of paint test performance was compared to investigate the necessity of primer in applied surface treatments. Plasma and flame were applied at various distances. Wettability was investigated by measuring the contact angle. The roughness parameters and surface morphology were analyzed by an optical 3D measurement system. Adhesion resistance (Cross Cut), water resistance, humidity resistance, thermic cycle resistance, impact and gravel impact tests, which are paint test performances, were applied on PP plates on which different surface treatments and primer applicated/no primer applicated paint were applied. While all test results of the paint on the PP surface with no surface treatment and no primer application were negative, the paint with primer application only failed on the humidity test. However, it has finally been achieved that, once the plasma and flame treatments were applied at a certain distance, the need for primer application could be eliminated. Therefore, this study showed that it is possible to remove the primer application from a standard painting process with the appropriate surface treatment and its parameters.

***Keywords*:** Polypropylene, Plasma, Flame Application, Paint, Adhesion.

Dewatering of Goksu River Dredging Sludge with Geotextiles

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ABSTRACT

Geosynthetic materials provide economical and advantageous solutions for slope stability problems, highways and landfills. In addition to these, geosynthetics are widely used in the dewatering of sludge with high water content in the world, but it is a method that attracts increasing attention by researchers in our country (Turkey). In this study, it was aimed to dewater the dredging sludge with high water content and high compressibility, taken from the Goksu River in Istanbul province, by using the filtration feature of geotextiles, effectively, quickly and environmentally friendly, using anionic polyacrylamides. Jar Test was performed with 5 different polyacrylamides (A1, A2, A3, A4, A5) to find the most suitable polyacrylamide (in terms of flocculation and precipitation rate) for the sludge sample containing 5% solids, and it was found that the most suitable one was A5 polyacrylamide. Then, Jar test was performed to determine the most appropriate dose of polyacrylamide, and as a result, the best performing dose was determined to be 15 ppm. Rapid Dewatering Test (RDT) was performed both without polyacrylamide and with A5 polyacrylamide in 5 different dosages, and the amount of filtrate, the amount of solids in the filtrate and the water content of the filter cake were checked to test the compatibility of geotextiles and flocs using the polyacrylamide formed. In addition, the weight of the permeate amount was recorded dynamically during RDT and the effect of polymer dose on the dewatering rate was observed. It was observed that the water content of the sludge cakes decreased as the dosage of polyacrylamide used increased. As a result of this study, it was determined that the dewatering method with geotextile and polyacrylamide is a suitable method for the Goksu River dredging sludge.

***Keywords*:** Dredged Sludge, Dewatering, Geotextile, Polyacrylamide, Jar Test, Filter Test.

MATHEMATICS, MATHEMATICS ENGINEERING

A Topology on S-Spectrum of a Module

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ABSTRACT

Prime ideals/submodules and their generalizations play a significant role in Commutative Algebra and Algebraic Geometry. These structures help to characterize some rings and modules and also they have many applications in some branches of mathematics like Topology and Graph Theory.

Let R be a commutative ring with identity and S be a multiplicatively subset of R, M be an R- module and P be a proper submodule of M with $(P: M) \cap S = \emptyset$. Then P is said to be an S- prime submodule if there exists a fixed $s \in S$ such that $am \in P$ for some $a \in R$, $m \in M$ implies that either $sa \in (P: M)$ or $sm \in P$. The set of all S-prime submodules of M is denoted by $Spec_S(M)$. We define the sets $V_s(K) = \{P \in Spec_S(M): s(K: M) \subseteq (P: M), \exists s \in S\}$ and $V^*(K) = \{P \in Spec(M): sK \subseteq P, \exists s \in S\}$. The former set satisfies all the axioms to be a closed set in a topological space. Then we construct a topology by using this type of closed sets and the topology which is called S-Zariski topology and this topology is a generalization of classical Zariski topology. The latter set may not lead to a topology; however, in some special structures we can construct a topology by using this set and this topology is called quasi S-Zariski topology. In this study, we investigate many properties of S-Zariski topology on a module and introduce the topology of some special modules such as multiplication modules. Moreover, we construct some continuous maps and give the relations between these maps.

***Keywords*:** S-Prime Submodules, S-Maximal Submodules, Zariski Topology.

A Review on Bezier Curves Applications in CAGD

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ABSTRACT

In our age, due to the rapid development of computer and production technology and the tendency of technology to use computers in line with this development, and computer-aided design taking an active role in this field, studies in industry, social and scientific fields have led to the acceleration of studies in the field of computer-aided geometric design (CAGD). Graphical curves and surfaces are hot topics in many different research and application fields, especially due to the rapid advancement of computer-aided design (CAD) and gaming technology. Two of the most popular representations for this area are Bezier and B-spline curves and surfaces. As a result of the studies and new representation researches in this field, Bezier curves are indispensable for geometric modeling and computer graphics and are related to computer aided geometric design due to their aesthetic shapes. These curves were developed by P. Bezier, a French engineer working for Renault, in 1960 to define car body surfaces with curves that can be controlled by changing them with a small number of parameters. Various techniques and methodologies have been proposed over the years, such as curve fitting, curve processing, curve blending and merging, to better address and enhance the use of Bezier curves in every possible application in the CAD field, such as image extraction, modelling, profile approximation coating and flattening. Since Bezier curves have the control polygon containing the curve and desired changes can be made on the control polygon in the curve (for example, weighted control points, node vectors, changing the degree of the curve, etc.), these techniques have also found their applications in manufacturing. Toolpath optimization, profile design, reverse engineering, etc. Various approaches have been used to manipulate the Bezier curve in Computer Aided Design for manufacturing purposes. This research examines the properties of Bezier curves and Berstein fundamental functions, and presents a brief historical perspective on Bezier curves and the current state of their use and applications in Computer Aided Geometric Design (CAGD).

***Keywords*:** Bezier Curves, Bernstein Polynomials, Computer Aided Geometric Design (CAGD).

On the Shape Operator of Hypersurfaces in Minkowski 4-Space

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ABSTRACT

The shape operator is one of the most important extrinsic objects of a hypersurface M of a pseudo-Euclidean space which determines how the tangent plane and its normal move in all directions. Note that the shape operator S of the hypersurface M is defined by the Weingarten formula

$$SX = -\tilde{\nabla}_X N.$$

It is well-known that S is a self adjoint endomorphism in TM. Therefore, it is diagonalizable when M is Riemannian. The eigenvalues and eigenvectors of S are called the principal curvatures and principal directions, respectively. In this case, M is said to be isoparametric if all of its principal curvatures are constant.

On the other hand, when M is Lorentzian there is special cases where S is non-diagonalizable and S can be reduced to one of four canonical forms. The eigenvalues and generalized eigenvectors of S are called the principal curvatures and principal directions of the hypersurface M. Therefore, by extending the previous definition, one may call a hypersurface is as isoparametric if the minimal polynomial of is shape operator is constant. Note that when M is an isoparametric hypersurface with non-diagonalizable shape operator, one of its principal directions is a null vector field.

In this work, we consider families of isoparametric hypersurfaces constructed in (Magid, 1985) with non-diagonalizable shape operator. For each family of hypersurfaces that we study, we construct special pseudo-orthonormal frame fields of its tangent bundle including the principal direction(s) of the hypersurfaces. Note that if M is an n-dimensional Lorentzian manifold, then a frame field $\{e_1, e_2, \dots, e_n\}$ of its tangent bundle is said to be a pseudo-orthonormal if

$$\langle e_1, e_2\rangle = -1, \quad \langle e_i, e_j\rangle = \delta_{ij}, \quad \langle e_1, e_1\rangle = \langle e_2, e_2\rangle = \langle e_1, e_i\rangle = \langle e_2, e_j\rangle = 0$$

when $i, j \geq 3$.

***Keywords*:** Minkowski Space, Shape Operator, Isoparametric Hypersurfaces.

Lie Symmetries and Exact Solutions of the Benney–Roskes/Zakharov–Rubenchik System*

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ABSTRACT

This study is on the (2+1)-dimensional Benney-Roskes (BR) system of partial differential equations which was derived in the context of gravitational water waves. BR system is equivalent to the Zakharov-Rubenchik (ZR) system, which describes the interaction of low frequency acoustic type oscillations and spectrally narrow small amplitude high frequency wave packets. BR system includes the well-known Davey-Stewartson (DS) system in the limiting case. Although the first appearance of the BR system dates back to a few decades, it is seen that the research on qualitative and numerical analysis on the system finds place in the recent literature. As this literature lacks the results on Lie symmetries and solitary type analytic solutions of the system, it has been this work's main purpose to fulfill this gap.

In this work we take a two-fold approach in analyzing the BR/ZR system. First, we investigate its Lie symmetry algebra, which turns out to be an infinite-dimensional algebra. We find that the symmetry algebra is as not rich as the symmetry algebra of the DS system, which is one of the integrable equations in (2+1) dimensions. Second, we employ the traveling wave ansatz, which converts the nonlinear PDEs into nonlinear ordinary differential equations to obtain exact solutions to the BR/ZR system. Consequently, we find several exact solutions in the form of a line-soliton solution, hyperbolic solutions, and periodic solutions of elliptic and trigonometric type. We also obtain a lump-type stationary solution.

The results on the Lie algebra of the BR/ZR system provides a comparison with the symmetry algebra of the integrable DS system. The recent literature includes analytical solutions in (1+1)-dimensional BR/ZR system and some numerical efforts for the development of initial solitary wave profiles in (2+1) dimensions; however, there is no result on analytical solitary type solutions in (2+1) dimensions, which is the most important achievement of the current work.

***Keywords*:** Benney-Roskes System, Zakharov-Rubenchik System, Symmetry Algebra, Exact Solution, Davey-Stewartson System.

MECHANICAL ENGINEERING, MECHATRONICS ENGINEERING

Numerical Investigation of Hub Ratio Effects on the Performance of Hubless Rim-Driven Propeller

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ABSTRACT

The shaft and gearbox used in the conventional marine propeller design can cause various undesired occurrences such as efficiency losses, excessive fuel consumption and mechanical vibrations. Alternative propeller designs are needed to avoid such undesirable phenomena and to minimize the effects of these problems. Therefore; hubless Rim-Driven Propeller (RDP) was proposed and has been rapidly used as an alternative propeller design in marine transportation. The hubless RDP is basically driven by the outer rim connected to the electrical motor without any hub and shaft interaction. However, since the hubless RDP is a new design, its hydrodynamics effects need to be investigated and understood with Computational Fluid Dynamics (CFD) analyses and its performance must be tested for various propeller geometries. In this study, five different hub ratios of 0.05, 0.1, 0.15, 0.167, 0.25 on the hubless RDP design were examined with parametric changes in the geometric design to reveal their effects on the hydrodynamic performance of the propeller. Reynolds Averaged Navier-Stokes equations (RANS) along with turbulence transport equations were numerically solved by the finite-volume based flow solver Simcenter STAR-CCM+ using Multiple Reference Frame (MRF) approach. The CFD results have been processed in terms of non-dimensional numbers such as thrust coefficient (K_T), torque coefficient (K_Q) and efficiency (η) at a constant advance ratio (J) for 450 rpm and 1.3125 m/s freestream velocity. It was observed that at a certain rotational speed, with increasing hub, K_T, K_Q and η decreased. Accordingly, one can suggest optimum designs for the hubless rim driven propeller based on the propeller size, blade configuration, duct model and performance criteria.

Keywords: Computational Fluid Dynamics, Rim Driven Propeller, Hubless, Hub Ratio.

Reduction of Engine Torsional Vibrations Via Hydrodynamic Dampers

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ABSTRACT

Torsional vibrations limit the performance, increase noise and reduce the fatigue life of internal combustion engines. Harmful effets of these vibrations on engines can be inevitable if they are not damped properly. In order to suppress the undesired torsional vibrations, hydrodynamic vibration dampers are used particularly in heavy-duty engines. In this study, viability of a special type of hydrodynamic vibration damper consisting of leaf springs, fluid chambers, intermediate inertia masses with additional parts, and pressurized oil supply has been examined. In this type of damper, leaf springs provide the flexibility whereas viscous flow between the fluid chambers through the connecting channels generate the required damping action during operation.

Stiffness coefficient which is the first characteristic parameter of the current vibration damper is determined by using finite element method and a test system is designed to validate the calculated results. The other parameter, the damping coefficient, is calculated by using two different methods: control oriented method and reduced equivalent dash-pot system as a function of design parameters. Also, a bench test system is used in order to find the damping coefficient of the vibration damper using the logarithmic decrement method.

A detailed crank train model of a heavy-duty engine is created by using AVL EXCITE program to investigate the effect of hydrodynamic damper characteristics on engine vibrations. In this model, angular displacement and resulting stress values in different parts of the engine's crank shaft can be studied. The obtained simulated results revealed that the current hydrodynamic damper effectively reduces the torsional vibrations. Finally, seven different damper design cases are generated by altering the current stiffness and damping coefficients, and optimum stiffness and damping coefficients are proposed where torsional vibrations can be further reduced compared to existing hydrodynamic damper.

***Keywords*:** Hydrodynamic Damper, Torsional Vibrations, Vibration Damper, Vibration Reduction.

Chaotic Vibrations in Rotating Elastic Beams

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ABSTRACT

Nonlinear vibrations of a rotating Euler-Bernoulli beam are considered. Geometrical and dynamical nonlinearities are taken into account up to third degree terms. The related nonlinear integro-partial differential equation is approximated by a finite set of nonlinear ordinary differential equations through Galerkin's method. Single and two degree-of-freedom models are taken into consideration. The system is shown to exhibit chaotic vibrations under certain combinations of system parameters, as a result of both harmonic external excitation and a harmonic fluctuation in the angular velocity. Various criteria, such as Poincaré mappings, Lyapunov exponent calculations are applied and their results crosschecked to identify the onset of chaotic vibrations. Chaos charts are worked-out on a parameter plane corresponding to a selected pair of system parameters.

***Keywords*:** Nonlinear Vibrations, Rotating Beam, Rotor-Blade Systems, Chaos, Fluctuating Angular Velocity.

Determination of Flow Characteristics and Optimal Geometric Parameters of Microchannels for Electronic Chip Cooling Applications

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ABSTRACT

Electronic chips are core of modern electronics. These chips consist of integrated circuits in which number of transistors are increased each year, which in return increases heat dissipation proportionally. This increase in heat dissipation has two major drawbacks, which are shortened operational life and degraded performance. There exists exponentially decaying relation between the transistor`s operational life and operational temperature. Such a relationship is also valid for the performance of the transistor. The motivation of this study is to increase the operational life and performance of integrated circuits by reducing the thermal resistance of overall structure.

The reference configuration consists of a power amplifier chip, a thermal interface material, and a microchannel heat sink. Thermal resistance analogy is, from the surface of a power amplifier chip to the base of a microchannel, constructed in MATLAB environment. The analogy is validated with the works in the literature, which investigate similar heat dissipation mechanisms. After the validation, the method is applied to the reference configuration. For a single channel of a microchannel, modified Darcy equation is also solved both analytically and numerically to analyze the impact of aspect ratio on flow profile.

Effects of flow rate and aspect ratio on thermal resistance are investigated. The results suggest that, increasing flow rate of the working fluid reduces the thermal resistance of the overall system, however it increases the pressure drop more significantly. Increase in aspect ratio seems to decrease the thermal resistance, yet there exists saturating tradeoff between manufacturability and benefit of increasing aspect ratio for simulated values of fin height. Considering these findings and reference structure, optimum value for channel height is found to be 1.5 mm for given channel width of 0.4 mm. After fixing the channel geometry, manufacturability, and compactness of the end product (i.e., space needed for a pump) should be taken into account to decide on flow rate. Additionally, the solution of the modified Darcy equation suggests that, as the aspect ratio of the microchannels increase, the homogeneity of the velocity profile increases which helps to increase heat transfer rate.

***Keywords*:** Microchannels, Power Amplifiers, Optimization, Thermal Interface Materials.

Specialized Injection Mold with Pneumatic Configurations for Experimental Investigation of Adhesive Bond Strength Between Polymers

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ABSTRACT

Two-component injection molding can be defined as a material combination process of different polymers in plastic part production. There are many advantages of this manufacturing method for engineering thermoplastics and thermoplastic elastomers. For engineering thermoplastics, the main advantages are reinforcement of the parts to replace metals and cosmetic appearance improvement by multi-color production. Besides, thermoplastic elastomers provide soft-touch and impact damper features for improved functionalities of the assembled parts. However, weak interfacial adhesion of the polymers limits wide range of applications. This study focuses on a comprehensive understanding of the injection molding process parameters that influence the adhesive bond strength between various polymer types. To understand the bond strength, two-component injection molded tensile test specimens were designed. The design of the new injection mold has been made, which has a moving feature that separates two injected melts. A pneumatic actuator is embedded in the mold, controls the separator. Therefore, overmolding and multi-injection molding of the tensile specimen becomes applicable in a single mold with a pneumatic separator. Multi-injection molding process parameters are examined, and the delay in the second injection controlling mechanism is unique in that regard. The delay and the pneumatic separator establish a fully controlled solid-melt interface. Finally, experimental data were analyzed; and solid-melt interface versus injection and mold parameters are investigated, and correlation functions are developed.

***Keywords*:** Adhesion, Bond Strength, Polymers, 2K Injection Molding.

Numerical Investigation of Boundary Layer Bleed Effects on Supersonic Air Intake Performance

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ABSTRACT

Air intake which is a vital component of the propulsion system plays an important role in determining inlet boundary conditions as well as the stability and efficiency. In this study, parametric Computational Fluid Dynamics (CFD) simulations have been performed to reveal the effects of bleed configurations and throttle opening rate used in supersonic air intakes for ramjet propulsion system. ANSYS Fluent 18.2 flow solver was used with the k-omega SST turbulence model to solve three dimensional, steady-state compressible air flows at three different free-stream conditions i.e. Ma=2.6, 3 and 3.5 with and without bleed effects. The aim of steady-state CFD analyses was to discover mass flow recovery, total pressure recovery along with Mach sensitivity at the outlet section of the supersonic air intake. Validation of the numerical model was done with the data available in the literature after mesh independency tests. To correctly capture oblique shocks occurring at the entrance and inside of the air intake, refined elements were preferred in the vicinity of shock waves. The application of boundary layer bleeding was found to greatly alter the performance characteristics of the design in terms of mass flow rate and total pressure recovery. It was observed that using boundary layer bleed, significantly changes the total pressure recovery and mass flow recovery attributes at 3 and 3.5 Mach flight condition. However, boundary layer bleed usage didn't noticeably affect air intake characteristics at 2.6 Mach flight condition. It was seen that the usage of boundary layer bleed also affects the buzz phenomenon especially at higher throttling rates, which is the state of shock formation before the flow enters the air intake.

***Keywords*:** Computational Fluid Dynamics, Supersonic Air Intake, Boundary Layer Bleed, Total Pressure Recovery, Mass Flow Recovery.

Effect of Torsional Axle Elasticity on Hunting Instability of a Railway Wheelset

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ABSTRACT

This paper investigates the effect of torsional elasticity of the axle on hunting instability behavior of a railway wheelset. As it is known, the wheels on a rigid-axle wheelset are assumed to rotate at the same angular velocity. In this study, the axle of the wheelset is assumed to have a certain torsional elasticity, thus the wheels are considered to rotate relative to each other, thus the wheels are allowed to rotate at different angular velocities. Consequently, a simplified mathematical model of a single wheelset is developed with certain degrees of freedom, which are namely the longitudinal displacement of the wheelset, lateral displacement of the wheelset, angular displacement of the wheelset about the vertical axis, angular displacement of the right wheel and angular displacement of the left wheel. First of all, the governing equations are obtained and these equations are solved with two different wheel/rail contact modeling approaches. In the first approach, the contact forces at wheel/rail contact interfaces are calculated by using Kalker's linear theory. Due to the nature of this approach, the governing equations are solved numerically. In the second approach, the contact forces are calculated with a simplified approach where a constant adhesion coefficient is defined at the wheel/rail interface. Due to the torsional elasticity of the axle, the governing equations become nonlinear and solved numerically as well. The results of both numerical approaches are compared in time domain. Second, the effect of wheelset axle elasticity on hunting instability is investigated. Also, the relationships between the critical speed of the wheelset and other system parameters such as rolling radius, conicity etc. are investigated.

***Keywords*:** Hunting Instability, Railway Wheelset, Critical Speed, Wheel/Rail Contact Modelling.

Modeling the Effect of Control Functions on Ti-6Al-4V Melt Pool Dimensions for Electron Beam Powder Bed Fusion Process

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ABSTRACT

The electron beam melting (EBM) process enables production of parts that are support-free or need minimum support compared to laser powder bed fusion (L-PBF) processes due to low thermo-mechanical deformations of the additively manufactured parts. Although the EBM machine vendor provides optimized default parameters for Ti-6Al-4V, detailed knowledge of the process is still required for successful, unique and challenging prints. Finite element analysis is a common methodology utilized to understand many AM process physical mechanisms. As the outputs of the process, the melt pool geometry including its width and depth, are critical validation parameters for modeling the process. Depending on the geometry, the EBM control algorithms change the beam speed and power in each scan line, which is hard to capture during the part build. We conducted an experiment in which scan speed and scan power could be measured. The effect of scan lengths ranging from 5 to 76 mm on the melt pool geometries was investigated. In addition, the effect of the thickness function was studied by scanning the lines as an overhang part. For various scan lengths, it is demonstrated that the width of the melt pools scanned without the thickness function is between 567 μm and 978 μm. When the thickness function is enabled, the beam scans the lines faster, and the melt pool widths decrease to 356 μm – 604 μm due to the lower energy density. The melt pool geometries are estimated with an error of between 8% and 20% using the thermal FEA model developed in this study for EBM process.

***Keywords*:** Additive Manufacturing, Electron Beam Powder Bed Fusion, Melt Pool Modelling, Single Bead Experiments.

Linerless Hybrid Structured Composite Pressure Vessel Development

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ABSTRACT

Linerless/Type-V composite pressure vessels, which are frequently used in space applications, have an important place in launch vehicles in a weight aspect. Today's technology allows the production of these vessels from composite materials and provides weight savings. For linerless composite vessels, the composite case should provide strength to the vessel, additionally should behave as a permeation barrier under pressure and environmental loads. This paper presents, a hybrid structured linerless composite pressure vessel development methodology. The study includes multiscale scale finite element method, fabrication methodology of the vessel, and proof of concept with hydrotest. Composite case is composed of glass and carbon layers. The glass layer stands as a non-permeable barrier and the carbon layer provides strength to the structure. Micromechanical strategy with Representative Volume Elements (RVE) has been utilized to understand stress/strain distributions on composite structure, as well as the relationship between constituent properties and large scale (effective) properties of composite materials. The multi-scale finite element provides true stress levels on constituents by combining the calculated unit microscopic stress field of a unit cell under unit strain loading, produced by applying the periodic boundary conditions to RVE, with the macroscopic strains determined by traditional finite element analysis. The paper also explains the fabrication methodology for Type-V vessels based on liquefiable paraffin mandrel and filament winding method. The paraffin-based mandrel is used with a room temperature curing epoxy system and liquefaction process is completed in autoclave with post-curing. The hydro leakage tests proved the structural integrity and non-permeable capability of the designed linerless pressure vessel for liquids.

***Keywords*:** Linerless Composite Pressure Vessel, RVE, Type-V, Multi-scale, Filament Winding.

Chatter Suppression by Sinusoidal Spindle Speed Variation in Simultaneous Turning Process of Flexible Workpiece

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ABSTRACT

Vibrations from chatter are one of the main effects that limit material removal rate in turning operations. One of the most common passive methods for the elimination of chatter is modelling the turning process and obtaining the stability map and selecting the optimal process parameters using the stability map. Also, in the literature, sinusoidal spindle speed variation (SSSV) which is one of the active methods proposed to further increase the stabile depth of cut and so possible material removal rate, has been proposed. In this paper, stability lobe of a parallel turning process model obtained and the process parameters were selected near the marginal region to investigate the effects of the SSV method on these process parameters. For modelling the turning process, the flexible workpiece model is recommended for cases where the work piece is thin enough to have a much lower natural frequency than the tool holder. In this model, the dynamic properties change due to the continuous material removal and the position of the tool in the cutting process. The workpiece modelled analytically as an Euler beam. X axis of the workpiece and the cutting tools considered as rigid. The end of the workpiece clamped on the spindle and the other end is simply supported with tailstock. Stable depth of cut is calculated by solving the eigenvalue problem of each element of cutting tool with nose radius. Experiments were conducted to provide the model and observe the effect of SSV. The evaluated results show that with SSV noise is suppressed and the surface roughness is reduced from 3,594 µm to 0.725 µm.

***Keywords*:** Chatter, Turning, SSV, Simultaneous, Surface Roughness, Flexible Workpiece.

Optimum Energy Management Strategy of a Hybrid Electrical Vehicle Based on Efficient Power Distribution and Battery Discharge Capacity

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ABSTRACT

In a hybrid electric vehicle (HEV), the efficient power distribution between prime movers, the internal combustion engine, and the electric motor plays a significant role in its energy management strategy to reduce the overall fuel consumption and CO_2 emissions. This study uses AVL Cruise Software to analyze the overall fuel consumption of a light-duty commercial vehicle (LCV) in P2 and P4 configurations. The simulated results show that the fuel consumption can be improved by 17.7% using the P2 configuration and 15.6% in the P4 design compared to the base vehicle having a conventional powertrain. This study also reveals that a particular internal combustion engine, electric motor power ratio, and maximum permissible battery power discharge capacity are required for a specific velocity range to improve fuel economy further. It is shown that an additional 5.1% improvement in the vehicle's overall fuel consumption can be achieved in a sustainable charge WLTC test. By incorporating the online traffic data via V2V, V2I, and GPS communication into the energy management strategy, the future vehicle velocity profile is generated, instructing the driver on an eco-driving procedure. The fluctuating velocity at the prediction horizon is smoothened using Savitzky–Golay filter, requiring the driver to maintain a constant driving velocity. The result showed a potential 6.1% improvement in fuel efficiency when an optimum P2 configuration is used.

***Keywords*:** Hybrid Vehicle, Energy Management, Intelligent Driving, Power Distribution.

Comparison for Analysis and Aerodynamic Designs of Backward Curved and Straight Radial Compressors

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ABSTRACT

Considering the limited oil reserves and the environmental effects of combustion emissions, there have been significant technological developments in internal combustion engines in the last century. One of the most important of these technological developments is the use of turbocharging systems in internal combustion engines. The turbocharger system is basically a simple system consisting of a compressor, turbine, shaft and body. However, a significant knowledge is required in its design and production for the efficient operation of the system. Due to the advantages of internal combustion engines used in road transport, radial compressor and turbine designs are mostly preferred. It is expected that this study will make an important contribution to both the literature and the production of radial compressors in our country. Analysis and improvement studies of radial compressors, which are designed typical, will be carried out with Computable Fluid Dynamics (CFD) methods. The numerical model is based on the conservation principles of mass, momentum and energy. In the designs made, besides the basic characteristics, parameters that will affect the compressor efficiency such as surge limit and choke limit have been carefully examined. Compressor designs, it is formed with impeller and blade designs. In this study, two radial compressor designs were made, with different blade geometries and the same impeller geometries. The blade geometries of radial compressors were designed as straight and backward curved to estimate the operational and aerodynamic characteristics of the compressor. Radial compressors were created by making dimensional calculations in ANSYS blade design module and Solidworks CAD commercial software. After the design, flow analyses were made with ANSYS CFX commercial software. Comparisons were made between the backward curved blade compressor and the straight blade compressor with 3 different operating conditions. According to the data obtained, although the straight blade compressor was ahead in terms of performance at the beginning, it was observed that the backward curved blade compressor was more efficient at increasing rotational velocities.

***Keywords*:** Radial Compressor, Aerodynamic Design, Impeller and Blade Design, CFD Analysis.

Monitoring Natural Rubber Fatigue Properties due to Degree of Dispersion of Carbon Black Variation

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ABSTRACT

Rubber with reinforced carbon black is a commonly known composite to improve the rubber mechanical properties. However, mixing ratio and degrees of dispersion are critical parameters that can disrupt the part properties if not optimized. This study aims to investigate the fatigue properties of vulcanized natural rubber reinforced with carbon black with different degrees of dispersion. Tensile and fatigue properties of rubber are sensitive to different degrees of dispersion of carbon black defined by ASTM D2663. Test samples at different dispersions are prepared to mix with the miniature internal mixer for 4 different mixing time from 120 seconds to 600 seconds. Dispersion degrees were measured by MonTech Disper Tester 3000 Plus according to ASTM D7723. Pure shear specimen with a crack at the side of each sample was used to run the fatigue characterization experiments Crack growth was observed at room temperature under 5 Hz cyclic loading between 25% and 75% strain by subjecting the shear sample to a fatigue loading. Images were collected with a Sony HDR-CX115E camera, and they were analyzed using Fiji.

***Keywords*:** Rubber Fatigue, Carbon Black, Degree of Dispersion, Pure Shear Sample, Cyclic Loading, Crack Propagation.

Comparing Different Hybrid Strategies for a Vehicle

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ABSTRACT

Our world is moving steadily toward a low-carbon economy by fighting climate change. In line with European Union decisions aimed at keeping Global warming below 2°C, it aims to reduce greenhouse gas emissions by up to 2030 compared to 1990. The European Union's carbon emissions affect the transportation sector with a 24% ratio after energy production. 94% of this is land transportation. to achieve the 2030 objective, it is essential to reduce greenhouse gas emissions of existing vehicles. Therefore, electric vehicles are considered to be one of the most important options for the automotive industry to achieve these goals. However, the lack of long road performance of fully electric vehicles and long battery charging times prevents the automotive industry from achieving these goals. For this reason, hybrid electric vehicles provide a significant advantage by combining both the urban advantages of electric vehicles and the long-haul advantages of traditional petroleum derivative fuels. In this study, the different engine-battery in different driving cycles of hybrid electric vehicles is intended to produce low fuel consumption in hybrid electric vehicles by comparing different regenerative braking strategies.

To find the most efficient operating range of hybrid electric vehicles, from the FASTSim simulation program developed by NREL, different drive cycles will use various battery capacity and regenerative braking strategies as the most appropriate strategy, comparing the various combination to a vehicle model in a realistic manner. In this study, the 2016 Mazda CX-5 was used as a glider and its 2.5 SkyActiv-G engine as an internal combustion engine. Various combinations are used such as conventional layout, hybrid electric vehicle, and plug-in hybrid vehicle. 11 kW, 0.6 kWh Li-Ion battery pack, and 10 kW electric motor are used to begin analysis from mild-hybrid/hybrid combination. Analysis showed that even though the mass of the vehicle has increased, the economy of the vehicle has improved by more efficient components from 7.4lt/100km to 1.7-2lt/100km.

***Keywords*:** Modelling, Hybrid Electric Vehicle (HEV), Simulation, Regenerative Braking, Emissions, Driving Cycle.

Nose Profile Optimization of High Speed Rockets by CFD Method

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ABSTRACT

Rockets need to have a wide variety of features depending on the tasks to be used. One of the leading features of these is that it can operate when the Mach number is above 1, which is called the supersonic and hypersonic speed regime. Aerodynamic properties such as friction force, lift force and thermal stresses of vehicles gain serious importance depending on the angle of attack and altitude distance studied, especially in cases where the flow rate exceeds Mach 3 and above. In addition, since it is difficult to experimentally test and verify the vehicles designed due to these conditions, it is necessary to perform the relevant calculations and simulations using the computational fluid dynamics (CFD) method for most of these tests. At this point, experimental studies will be used for the validation of the models. In this study, models were prepared on 2 different CFD solvers by using the geometry that was introduced to the literature as HB-1 test and verification geometry and experimental tests were made at different attack angles and altitudes at high speeds.

These models were verified, and different rocket nose profiles were applied to existing HB-1 geometry to improve aerodynamic properties. The model we built on Ansys Fluent was analyzed using Density-Based solver, k-omega SST turbulence model, High Speed Numerics (HSN) method and implicit solver.

Similar conditions were created using the open source codec OpenFoam using other than HSN and the two solvers were compared among themselves. In the models, maximum error was calculated as 10% when comparing the results obtained with the solutions taken from Ansys Fluent, up to Mach 10 and depending on the different angle of attack and altitude values, according to experimental data.

In the results obtained through OpenFoam, similar ratio was achieved in solutions with Mach number up to 7, and in scenarios where it was above 7, values were not included in the scope of the study because it exceeded this ratio. It has also been observed that nose profile used with increasing speeds and angles of attack is very effective on aerodynamic and aerothermal properties.

Among the seven nose profiles studied, the "long-elliptical" aerodynamics was obtained as the most optimal nose profile in terms of aerothermal angles and maneuverability.

***Keywords*:** CFD, High Speed Numerics, Hypersonic Flow, Rocket Optimization.

Modal Analysis of Air Tube Bracket through Experimental and Numerical Approaches

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ABSTRACT

A new pneumatic air tube bracket is designed to avoid coinciding modal frequencies of the bracket and the excitation frequency transmitted through the vehicle's chassis because some modal frequencies of the old bracket coincide with the excitation frequency from the vehicle. Therefore, bracket noise occurs because the dynamic behaviour of the old bracket has changed and resonance is observed due to the instability of the old bracket. The modal frequencies values of the old bracket are shifted to higher values with the newly designed bracket. Thus, the modal frequencies of the system move away from the excitation frequency. This study investigates the modal properties of old and new air tube brackets with experiments and the associated finite element model. Firstly, experimental modal analysis is performed on old and new air tube brackets to identify mode frequencies and corresponding mode shapes. Secondly, the mechanical properties of the brackets are defined to develop finite element models of the brackets and the models are updated by experimental data from the modal testing. Finally, the results of experimental modal analysis and finite element model results are compared in terms of the modal frequencies for the old and the new bracket. It is observed that a good correlation between experimental and numerical results as the maximum prediction error is less than 5%. Thus, the developed finite element model can be used to estimate the modal behaviours of the brackets.

***Keywords*:** Experimental Modal Analysis, Heavy Duty Commercial Vehicle, Finite Element Analysis, Pneumatic Air Tank Bracket.

Retrieving and Classifying Emergency Situations for Smart Home Applications

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ABSTRACT

One of the uses of Bluetooth, which is a wireless communication technology, is to communicate with smart devices in order to increase the functionality of not very advanced electronic devices and to carry data that appeals to the user. Bluetooth has also paved the way for devices without internet access to access the internet at a much lower cost by communicating wirelessly with devices with internet access. Data transferred to the Internet can be stored and used for any purpose. However, while doing this, user data must be kept encrypted by law and should not be shared with third parties.

In this study, it has been investigated how user data can be shared with authorized institutions for emergencies. A mesh network was created using the Cypress BT-Mesh kit. Each of the 4 development boards is programmed to simulate a smart home device. Cypress's SDK was used during programming. The RSA (Rivest-Shamir-Adleman) algorithm is used to send user data encrypted to authorized institutions in case of emergency. Thus, both the confidentiality was not violated and the emergency situation was reported to the authorized institutions and the user.

In this study, the scenario of notifying the fire department in case of fire and informing the police in case of a thief is simulated. In the simulation, it is shown how user data can be sent in an encrypted way. When the functioning of the network and the transmission of data are examined, it is concluded that the RSA algorithm provides a high-security solution for smart home applications. Thus, it has also been proven that a recovery notification use-case can be added to a smart home system without violating privacy.

***Keywords*:** Bluetooth Mesh Network, Smart Home, Cyber Security, Emergency Notification.

MINING ENGINEERING, PETROLEUM AND NATURAL GAS ENGINEERING

Artificial Neural Network Tool Development for Flue Gas Sequestration in Depleted Shale Oil Reservoirs

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ABSTRACT

The widespread use of oil and natural gas as an energy source has become a cause of disquiet due to its negative effects on the environment, particularly greenhouse gas (carbon dioxide, carbon monoxide, nitrous oxide, hydrogen sulfide) emissions. Sequestration is one of the promising methods to decrease the rate of greenhouse gases in the atmosphere. In this study, an artificial neural network tool was developed that predicts sequestration of flue gas in order to reduce the carbon dioxide emission in the atmosphere. The tool can also predict the production performances of hydraulically fractured shale oil wells. In order to create the reservoir model, double porosity – double permeability phenomenon between matrix and fracture and Langmuir adsorption isotherm formulation were considered. In order to increase productivity and injectivity, the stimulated reservoir volume approach is used to model shale oil production. 10,000 different set of reservoir characteristics and operational parameters, which are taken from literature, were generated as input parameters and these models are simulated with an in- house commercial simulator. In the construction of the neural-network based data-driven driven tool, the reservoir datasets were split into 80% training, 10% validation, 10% test sets. 39 input parameters and 75 output parameters were used, which include compositional shale oil (methane, ethane, propane, butane) production performance curves, well bottomhole injection pressures and compositional flue gas (carbon dioxide and nitrogen gas) injection stopping times. The tool can predict these output parameters with an average error of less than 5% in a fraction of a second with less computational power.

***Keywords*:** Shale Oil Reservoirs, Flue Gas Sequestration, Artificial Neural Networks, Performance Forecasting.

Prediction of Blast–Induced Ground Vibrations by Scaled Distance Equation and Gaussian Process Regression

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ABSTRACT

The aim of this study is the prediction of blast vibrations in an Istanbul Region aggregate quarry. Blast-induced vibrations were measured in the field. Special blast seismographs were used to monitor ground vibrations. The seismographs measure both particle velocity and frequency. The measurement location and instantaneous explosive charge were also measured in each blast. All the blast design parameters were recorded. Gaussian Process Regression (GPR) method and classical scaled distance equation were applied to develop prediction models. Sixty-nine training data and 26 test data were used to construct the forecasting models. The GPR model was created by the Regression Learner application of Matlab software. In the modelling stage, GPR model was trained by using 5 different kernel functions: squared exponential, exponential, rational quadratic, matern 5/2 and matern 3/2. Spacing to burden ratio (S/B), bench height to burden ratio (H/B) and scaled distance (SD) were chosen as input parameters. The predicted output is the peak particle velocity (ppv). The scaled distance equation was developed by univariate regression. Seven error criteria were applied to determine capability of the developed models. Absolute error metrics, percentage errors metrics and correlation coefficients were calculated for each model: As a result, it has been revealed that the GPR model, which is a machine learning method, is more successful than the classical scaled distance equation. The GPR model predicts particle velocity with a mean absolute error lower than 1.5 millimeter per second. In addition, twenty-one cases were forecasted with a mean error lower than 2 mm/s. The GPR model is not complex and suitable for practical applications.

Keywords: Gaussian Process Regression, Ground Vibration, Aggregate Quarry, Rock Blasting.

A Computer Application for Calculating Rock Mass Rating

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ABSTRACT

Rock Mass Rating (RMR) is well-known and one of the most used rock classification system during the day. Since the year it was published, it had attracted researchers and engineers so much. From that time and on, it has been used in many projects and scientific studies. Although many updates were made after it was first published in 1973, it achieved its most widely used version with its 1989 update. The RMR system is based on a simple survey of the rock's conditions on a table, and the ranges given for the conditions in the table are quite wide. In this study, MATLAB functions is developed for each effective parameter in the calculation of RMR, and singular values corresponding to each parameter in defined intervals is obtained. A computer application that is coded for the simple RMR calculation based on the MATLAB functions, makes the necessary adjustments to the simple RMR value, reaches the final RMR, and gives the support system with the excavation method recommended for the determined rock class. This computer application called "RMRCalc" is designed using the MATLAB graphical user interface.

Keywords: Rock Mass Rating, Computer Application, RMRCalc.

MUSICOLOGY,

An Approach Proposal in the Teaching of Central Anatolian "Türkü"s

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ABSTRACT

The concept of "ağız" forms the character of "türkü"s (folk song) in terms of their singing features. It is thought that this concept is a form of performance shaped according to regions, communities and tribes, personal styles, and the type of "uzun hava" to be sung. It cannot be expected that "türkü"s, which are products of oral culture, will remain unchanged in parallel with the change of people affected by each changing life condition in social life. The change at this point; It is provided with the interpretation element formed by the addition of the reproductions of the transmitters and receivers, by preserving the "pattern melodies" formed due to the "ağız" characteristics in the main structure. Oral culture products can thus continue their existence by catching the norms of the day in terms of time and space. It is known that the performing institutions, which were shaped in parallel with the compilation process of folk songs after the establishment of the Republic, gave education as a school in the years they were founded. These institutions transformed the traditional transfer process of folk songs into a new form and provided the training of professional urban performers. Turkey's first Turkish Music conservatory was established by the second generation actors trained by the first generation actors from the mentioned institutions, and thus this transfer process was carried to the academies. Since the second generation actors interacted with many source people in this period, they did not only use musical notes while teaching the "türkü"s, but also experienced and shared the living process of the "türkü"s. However, these actors have withdrawn from the transfer process over time. For this reason, the first period compilation notes used in the teaching of "türkü"s, in which the "ağız" elements were not expressed in detail, became almost the only source. There is a need for new teaching approaches that include both local and contemporary, preserving their originality, and also covering the change in time, in the transfer of the "ağız" characteristics of "türkü"s.

In the paper, the predicted teaching approach was tested on three volunteer subjects selected from conservatory students who participated in the study online, had basic music knowledge, did not work on voice training before. Because of our personal acculturation with the Central Anatolian region, a song selected for each subject from this region's repertoire was studied with the suggested teaching approach. Thus, it was aimed to gain the "ağız" features including local and contemporary to the subjects. Since our research includes both a qualitative and quantitative research process, it is a descriptive and experimental research and was conducted with a mixed research model. In the research, a single group pretest-posttest experimental design was used. The data obtained from the experiment process were evaluated by a jury, who are experts in the field, according to the ten-item performance scale developed by us. The percentage change ratios of these data between the two tests were shared and determinations were made in the subject-specific manner. The validity of the education and training approach proposed in the paper has been proven with the positive change ratios of the subjects according to the performance scale. The effectiveness of the teaching approach proposed in the paper has been proven with the positive change ratios of the subjects according to the performance scale.

***Keywords*:** Turkish Folk Song, Central Anatolian "Ağız", "Hançere", Educational Approach, Taxonomy.

Compositional Strategies to Create Experiences of Imaginary Spaces through Headphone Listening

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ABSTRACT

The study aims to find effective compositional strategies to create experiences of imaginary spaces through headphone listening that can be used as a descriptive tool during composing. The compositional strategies are, to provide strong detail and continuity of experience, discussed under the framework, structured as four interrelated elements: composing the narrative, environment, motion, and space.

There is no doubt that electroacoustic music has the potential to stimulate the mind of the listener to imagine spaces. There are imaginary spaces in the listener's mind that evoke and change with listening to the compositions. My main goal, in its simplest form, is to develop a spatial experience that is guided only by hearing, like virtual reality (VR) but only for the ears. This study is an example of headphone use in electroacoustic spatial music with the aim of creating more accessible and affordable immersive listening experiences.

So, is it possible to direct each listener's spatial imagination at a significant level? Do the differences in spatial thinking ability and spatial vocabulary extent of the listener influence their experience? To answer these questions, I developed a methodology consisting of a theoretical foundation (descriptive tool), a practical implementation (composition), and observation of the user experiences through qualitative surveys (listening experiment). I used the composition as a tool for evaluating the user experience regarding the effectiveness of the strategies. I conducted controlled listening experiments with different listening groups that are combinations of people trained in spatial and/or sound design. The subjects reported their spatial impressions of the experience by answering yes or no, scaling, and commentary questions.

Both the impression scores and the comments reveal that, to a considerable extent, listening to the composition created by the descriptive tool provides strong spatial impressions and delivers immersive listening experiences. All in all, I summarize the accuracy of my research method, measuring the perceptibility of abstract work.

***Keywords*:** Imaginary Space, Perception of Space, Sound Art, Aural Architecture, Virtual Space Design, Electroacoustic Music.

A Web-Based International Archive and Media Platform Proposal, Specific to Maqam Music, Regarding the Future of Academic Studies

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ABSTRACT

In this study, following the birth and historical processes of the phenomenon of musicology as a science, the media as a communication element and the institutionalization of the academy, the stages it has gone through until today are examined, in line with sample models from various academic media applications that are currently used, within the scope of makam music. A web-based archive and media platform proposal is presented, which can cover all studies under the roof of systematic musicology in the field, which aims to contribute to the field by serving all levels of interest, primarily academicians and professional researchers, with contemporary components and potential for the future.

In this context, in the text, a general definition is made by including the development of the musicology phenomenon, which constitutes the main axis of the study, from the historical process to the present, and this phenomenon, which is considered as the first of the four basic building blocks of the content by the author, is introduced in order to present a comprehensive perspective. For the same purpose, it is aimed to draw attention to the symbiosis relationship between the media as a communication element by emphasizing the importance of the evolution and information sharing from antiquity to the present. Following a briefing on the historical process within the scope of these two titles, three different basic phases in which the phenomenon of "university", which we can define as the institutionalized state of academic effort, has been classified from its formation to the present, and the basic components that form the general framework of the third generation concept, are explained and one of the contemporary academic media applications that are actively used today. By giving information about various examples, the elements that are positioned as the four basic building blocks of the content are completed and it is aimed to create a comprehensive perspective on the author's perspective.

Finally, in line with this information presented, we aim to contribute to the field by facilitating access to accurate, quality and refined information for academics and professional researchers, as well as academicians and professional researchers, who have the potential to operate at an international level, in particular on maqam music, which is the subject of the author's doctoral thesis and constitutes the main field of study. A web-based archive and media platform design proposal is made with the aim of introducing the main functions and components of this design, which is the subject of the study, and the conclusion is reached.

***Keywords*:** Musicology, Media, MaqamLib, Maqam Music, Open Science.

Teaching Experiences of Music Teachers in 2019-2021 Global Pandemic Conditions

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ABSTRACT

I prepared this study in order to observe and evaluate the online music lessons organized in some high schools affiliated to the Ministry of National Education under the global epidemic conditions of 2020-2021. Since I am also a high school music teacher, I am responsible for the process controls of the high school teachers in my branch, how they adapted their secondary education curricula to distance education and which educational methods and techniques they used during the education period. In short, I prepared it to learn the experiences of music teachers in these conditions.

In the study, I used the case study and unstructured observation method, which is one of the qualitative research methods. With the speaking style interview technique, I shaped the questions that I had prepared beforehand, according to the flow of speech. I have developed the data I have accumulated through the literature review with the secondary (passive) research method on the general network (internet). I made the interviews online that I could not hold in the field due to epidemic measures. I requested sample recordings from the teachers for the courses they taught using the distance education method, and analyzed these recordings and translated them into writing.

My findings were revealed by six music teachers. Four of the teachers partially comply with the curriculum. The other two teachers teach guitar playing by touching the curriculum from time to time in their lessons. The implementation of the education and training process, which the global epidemic fits into the homes, by high school music teachers and the positive and negative effects it brings have been the findings of my study.

***Keywords*:** Online Music Education, Distance Education, High School Music Lesson, Curriculum, Music Teachers, Education in The Global Epidemic, Covid-19.

Cosmogony of the 15th Century Ottoman Music Theory as a Multi-Cultural Heritage

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ABSTRACT

Although marginally depending on the translation of works composed up to several centuries before their initial penning, the tractates of the fifteenth century Ottoman music theory-known as edvar- also contain information coherent with the knowledge of their era. Certain authors absent themselves from challenging the prevailing set of information fed into their work from both their translations and the common way of knowing which was dominant at the time they were penned; thus, encouraging the production of a certain didactic turn of expression with a considerable amount of dogmatism woven in their fabric based on their prevailing cosmogony.

The cosmogony/music relation prevalent among edvar tractates will be presented as a unified unit and identified as the building blocks of a vast system of associations. The six edvar tractates upon which the presentation will be built are as follows; *El-Matlâ* by Seydî, *Risale-i Edvar* by Yusuf bin Nizameddin Kırşehrî, *Risale Min İlmi'l-Edvar* by Ahmedoğlu Şükrullah, *Risale-i Musikî* by Kadızâde Tirevî, *Kitabü-l Edvar* by Hızır bin Abdullah, and lastly *Muradnâme* by Bedr-i Dilşâd. Textual passages from the edvar tractates carrying implications about the way of the perception of the universe and the literary language of the scholars will be presented. The passages will be analysed over a foundation of several theories and concepts - namely episteme, functionalism and hermetic- thus, the texts will be interpreted through the filter of a sociologically enforced vantage point. Exo-musical manuscripts will also be sampled in order to point out the similarities between several schools of thought.

The intention of this presentation is to position the edvar tractates as an outcome of a cumulative labour of multi-cultural geo-historical scene by the aforementioned interpretations and intertextual comparisons. Thusly the works of the fifteenth century edvar authors will be defined and re-evaluated as one of humanity's joint intellectual heritage.

***Keywords*:** Ottoman Empire, 15th Century, Edvar (Theory tractate), Cosmogony, Episteme, Music.

Analysis of the Art Songs of Ferit Hilmi Atrek in Terms of Prosody and Vocal Technique

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ABSTRACT

The presence of Western art song in Turkey can be traced back to the Ottoman State before the establishment of the Turkish Republic in 1923. After the establishment of the republic, there was an intense attempt to integrate the genres and norms of Western classical music into the musical culture of the country. Consequently, many musicians were given governmental scholarships to study in European music schools. Ferit Hilmi Atrek was one of them.

Learning the art of composing primarily from Cemal Reşid Rey, Atrek composed several art songs. In fact, he can be considered among the outstanding composers of his generation with such a high number of art songs. However, he has been a rarely mentioned composer. His works are rarely performed as well.

The aim of this study is to bring forward this early republican Turkish composer and to analyze his art songs in terms of prosody and technical difficulty in terms of vocal performance. To realize this purpose, a scorebook including his art songs is taken into consideration under the rules of prosody and the vocal features of the soprano voice. As a consequence, some of Atrek's art songs are observed to be prosodically correct and vocally friendly whereas some of them are observed to have certain issues related to prosody and vocal difficulty. It is hoped that these findings will shed light on composing for the soprano voice and the works of Ferit Hilmi Atrek will find a place both in recital repertoire and the curricula of the conservatories in Turkey.

***Keywords*:** Early Republican Turkish Composers, Turkish Art Song, Ferit Hilmi Atrek, Soprano Voice, Performability of Vocal Works.

Toward a Definition of the Blues Restricted Generativeness and Inconclusiveness as Defining Elements of a Musical Style

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ABSTRACT

The paper's main aim is to establish a definition of the *blues* based on purely musical considerations. The author draws on Lerdahl and Jackendoff's generative theory of tonal music to uncover the processes underlying the production of works of *blues* music. By doing so, the author establishes a definition of the *blues* as a tonal musical style which consciously evades the directional movement of harmony in tonal music through melodic *stasis,* which results in a blurring of tonal *conclusiveness.* Since the static nature of melody in blues is in stark contrast to the chord structure underlying it, only limited *generativeness* in the sense of Lerdahl and Jackendoff may be assumed. It seems that *blues* is best defined by this lack of *conclusiveness* and thorough *generativeness,* making the two traits the main defining elements of the style.

***Keywords*:** Blues, Generative Theory of Tonal Music, Blues Theory, Definition of Blues.

A Struggle for Legitimacy: *Kemal İlerici and His Harmonic System*

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ABSTRACT

Today, when Dörtlü Armoni (Quartal Harmony) is mentioned in Turkey, the first name that comes to mind, at least for those who have heard of this concept before, is Kemal İlerici (1910-1986), the founder of this system. For this reason, this system, which essentially aims to provide the Turkish classical music a polyphonic design, is sometimes referred to as İlerici Armonisi (İlerici Harmony). Composers of a generation, such as Muammer Sun, Burhan Önder, and Melik Ertuğrul Bayraktarkatal, who had a chance to become his student by meeting with İlerici and learned this system from him, have benefited from this harmonic system in their compositions and some are still making use of it. For this reason, this system introduced by İlerici, is important in terms of Turkish music history. Although there have been various studies on the life and harmonic system of İlerici, there is no in-depth research that will shed light on for which need this system was created by İlerici or on the underlying social conditions. Therefore, in this study, the social conditions that shaped the Harmonic system will be focused on by examining the letters written by İlerici to various figures of the period, which are both in my personal archive and in the archive of M. Ertuğrul Bayraktarkatal. In this context, it will be revealed that the binary oppositions, which are understood to be at the center of İlerici's philosophy of life and which are frequently encountered in the discourses of his letters, are the reflections of a struggle that he had been through along his life. Furthermore, the main starting point of his most important work, the Harmonic system, is based on those binary oppositions as well. Thus, the unknowns about the life of İlerici will be revealed and what happened in the music modernization process of the Republican period will be discussed from a different perspective.

***Keywords*:** Kemal İlerici, Quartal Harmony, Modernization, Turkish Classical Music.

The Function and Influence of the Phenomenon of Music as a Meaning of Social Interaction

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ABSTRACT

In order to resolve disputes/conflicts that prevent societies from living in trust and peace, areas of discussion and ways of communication should always be open. In this way, it will also be easier to understand our differences due to culture or ideology. Realizing himself/herself and his/her environment, the individual will volunteer to create new forms that will make life possible together. Although predetermined forms and habits play an important role in the formation of social order, they resist the production of new forms. Unfortunately, this situation not only prevents individuals from thinking different, but also makes life together more difficult. If it is a social order created by harmonious individuals, it will mainly be possible with an artistic interaction. According to Georg Simmel, "Interaction between individuals is the starting point of all social formations". (Simmel, 2017). Accordingly, the communication path created by using language to interact in the social environment is realized by making sense of the sounds arranged in music. During the musical activity of two or more musicians face-to-face, a mutual mental experience is achieved, which is included in the "flow of thoughts of the other". In this way, the individuals who share the "moment" act in harmony by creating a "we-relationship". The aim of the study that we will evaluate in this way will be to show that musicians who share music together use music as a meaning of communication and that a "we-relationship" is created by sharing the musical flow. In addition, music is a way of creativity that leads to imagine a new view of world. A utopia for people to solve coflicts. In order to reinforce this statement, "The West-Eastern Divan Orchestra" and "Turkey-Greece Friendship Concerts" will be among the examples to be used in the study.

Keywords: Interaction, Communication, Utopia, Musical Sharing.

3D Sound Practices in Turkey 2021-2022

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ABSTRACT

Thanks to the development of 3D sound recording methods such as ambisonics and stereophonic 3D, ease of access to 3D sound by binaural audio through headphones, and the standardization of 3D playback systems such as Dolby Atmos & Auro 3D, the way we experience audio nowadays closely resembles the way we naturally experience sound. Developments such as the announcement for the support for Dolby Atmos format by Apple Music in 2021, increase in the sales of soundbar & home theatre systems in recent years, and standard offering of 3D sound through VR by binaural audio have increased the demand for 3D sound recording and 3D sound production. Therefore, it has become highly important to research and develop this new frontier of sound experience. Accordingly, the purpose of this study is to discuss 3D sound production by mentioning several 3D sound recording sessions and 3D sound projects from Turkey that took place in 2021-2022.

In this study, firstly, the recording sessions and projects are mentioned and concisely described. The sessions and projects that are mentioned in this study include ambisonics recordings of a sound installation, ambisonics recording of a quartet, ambisonics recording of an orchestra, stereophonic 3D recording of a duo, stereophonic 3D recording of a quartet, and the design and creation process of a 3D studio. Secondly, the purposes of these projects are pointed out. Moreover, technical details of these sessions such as microphone choice & placement, recording equipment, and production stages such as mixing are explained. Finally, technical challenges and future improvements are indicated.

***Keywords*:** 3D Sound, 3D Recording, Ambisonics, Binaural.

Rethinking Stardom in Popular Music: *The Case of Yıldız Tilbe*

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ABSTRACT

The concept of celebrity can be defined as the state of being known, recognized and visible by everyone. A celebrity can be a hero or a star. However, stardom as a social phenomenon is a systematized form of the concept of celebrity. Stars are the ones who gain the attention and admiration of the society with their unique features in the fields such as theatre, cinema, music and sports. In this research, celebrity studies and the literature on stardom in popular music will be reviewed and re-interpreted through the case of Yıldız Tilbe. The paper discusses Yıldız Tilbe's process of becoming a star as singer-songwriter, the transformation of her almost 30 years of musical career and especially her anti-star image through the media. The relationship between the fluidity in her musical identity and the transformation in the popular music industry in Turkey is debated. The research is conducted with online and offline ethnography providing a qualitative approach through discourse analysis and interpretative phenomenological analysis. Ultimately the paper aims to contribute to popular music studies of Turkey and musicological debates more broadly.

***Keywords*:** Celebrity, Stardom, Popular Music, Yıldız Tilbe.

The Effect of 'The Intelligent Choir' Philosophy and Vocal Painting on Choral Communication

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ABSTRACT

The philosophy of 'The Intelligent Choir' was put forward by professor Jim Daus Hjernøe, a faculty member of the Royal Danish Academy of Music. This philosophy, was developed in order to ensure that responsibilities and the creative process are shared between the choir conductor and the chorists. Vocal Painting (VOPA) is a choral study method developed in 2016, which is included in the idea of 'The Intelligent Choir'. It is a sign language, which consists of seventy-five signs, for the purpose of creating improvised music along with body language. During the performance, the leader directs the choir members using these signs. VOPA provides the opportunity for conductors, chorists and soloists to improvise music during the performance and create new arrangements. That is a fact that the language used by an individual is a guide in perceiving the world, making sense of life and shaping it. In this context, creating a musical performance with VOPA can change the structure of mind, communication and give a new perspective to the participants. It also affects the nature of creativity in musical performance of the choir. This ethnographic research is based on a fieldwork conducted to focus on the musical practices of 'Chromas' from Turkey, the first choir that apply VOPA method in their performances. The effect of the philosophy of 'The Intelligent Choir' and VOPA on choral communication is discussed in this paper.

Keywords: Choir, Conductor, Communication, Vocal Painting, The Intelligent Choir.

An Empirical Study on Generating Musical Materials from Images

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ABSTRACT

This study aims to obtain musical materials to be used in the music composition process by converting paintings and/or any kind of image file into sound material. An effort has been made to create a tool that follows an easy and methodical way to obtain musical material (melodic and/or harmonic) in the music composition process. Since the study had a narrow focus, only one research question was considered sufficient. Is it possible to find musical materials that can be used in the composition process after converting the image into sound with the program developed for the study?

For the study, a program that has been developed (and is still under development) in the Python programming language was used. The conversion of the image into sound was done by processing the data in the pixels of the image using three different methods, thus creating new data. The color information obtained from the pixels in the image was mainly used within the RGB color model. A chart named "The Color of Sound"(Melendez & Goss, 2016), created by Nicholas Melendez and Clint Goss to map colors with sounds, was used to map RGB color values to notes that are in the twelve-tone equal temperament system. The MIDI format has been chosen for the playback of the image data that has been processed. All processed data has been arranged to work with MIDI messages. The version of the program used in this study has three main parts. The first part is rounding the RGB values obtained from the image to the RGB values from the "The Color of Sound" chart. And converts them to the corresponding MIDI note values. For the octave distribution of the notes, a color spectrum from black to white was created. A mapping was made between this spectrum and the piano sound range. The color data obtained from the black and white version of the original image was processed with this mapping, and the previously obtained notes were distributed into octaves. The last part is the process of obtaining loudness (velocity in MIDI) data from color values. Velocity data was obtained by converting RGB color values obtained from the original image to the HSV (hue, saturation, value) color model and the saturation value of these colors. After MIDI file creation, the results were analyzed using a MIDI editing program, and the musical materials found were displayed with notation.

***Keywords*:** Music Composition, MIDI, Image Processing, Music.

"Meşk Tune", A Multi-Functional Tuner App, Prelude to Eastern Music Education Technologies

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ABSTRACT

Eastern music has a deep tradition-based theory that makes it very hard to learn from a distance or online. Nevertheless, there is a considerable number of people who are interested to learn authentic music all around the world.

"Meşk" project aims to develop a digital interactive music education tool to teach traditional music, especially eastern music starting from Turkish Makam Music. This multi-discipline project was developed to overcome the barriers via using sophisticated audio processing algorithms with user-friendly software interfaces and gamification techniques. The project was funded by The Scientific and Technological Research Council of Turkey (TÜBİTAK) within the technological entrepreneurship program (1512) and the first prototype was developed. The project was selected to be a finalist in İTÜ Arı Teknokent's Big Bang Start-up Challenge in 2019 and the prototype was examined with real users. Meşk's first product, a mobile application, Meşk Tune, is developed after the prototype and published. It is a world music tuner that includes eastern and western temperaments with an accurate and straightforward mobile interface. Its historical tuning module lets musicians fine-tune their instruments according to master's frequency presets (Such as Aşık Veysel, Hacı Taşan, etc). It also consists of a bağlama tuner and a chromatic tuner.

In this proceeding paper, the prototyping phases of the project and its current progress are shown and discussed. The future development plan and research possibilities are evaluated.

***Keywords*:** Tuner, Music Education Technologies, Meşk, Computational Musicology, Turkish Makam Music, Microtonal Music.

NAVAL ARCHITECTURE AND MARINE ENGINEERING

Performance Prediction of a Generic Submarine Undergoing Accelerating and Stopping Manoeuvers by Closed-Form Solutions and CFD

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ABSTRACT

Acceleration and the stopping characteristics are among the primary metrics of maneuvering performance of underwater vehicles (UWV's). Required time for reaching a predefined speed and/or maximum non-dimensionalized -with the overall length of the vehicle- distance required for stopping generally appears in technical specifications.

These requirements can easily be validated by utilizing experimental or numerical methods. However, these methods necessitate the existence of detailed geometry of the underwater vehicle which is not possible at the early stages of the design. The requirements regarding with the accelerating and maneuvering performance of an UVW must be satisfied from the very early stages of the design where the numerical and experimental methods cannot be used. This brings the necessity of relying solely on the closed-form solution methods based on semi-empirical data at the beginning of the UVW design.

This study is aiming to predict accelerating and stopping performance of a fully-appended generic submarine with closed-form (analytical) solutions and comparing the results with the ones obtained from numerical analyses. Resistance and added mass coefficients are calculated via a semi-empirical and computational fluid dynamics (CFD) methods. More than one method is used for semi-empirical calculations. Numerical resistance calculations performed by using Reynolds averaged Navier-Stokes (RANS) approach. For added mass calculations, unsteady RANS (URANS) based transient analysis method proposed by Javanmard (2020) is utilized. Results are then validated against available experimental and numerical data in literature and used in 1-DOF maneuvering analysis of fully appended DARPA Suboff submarine.

Results of the analyses demonstrate that, acceleration and stopping performance of UWV's can be predicted with a reasonable accuracy by closed-form solution methods (based on semi- empirical data) at early design stages only using the main dimensions of the UVW.

***Keywords*:** DARPA Suboff, Maneuvering, Acceleration, Stopping, CFD.

Reduction of the Sail Root Vortex of the DARPA Suboff Submarine

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ABSTRACT

Submarines have been the navy's indispensable strength in terms of military power since their inception, and it is critical for strategic reasons to keep up with developing technology. Although the hull form of submarines is designed with a hydrodynamic form, the need for appendages causes the incoming flow to deteriorate. This produces vortex and affects important factors such as noise increase, amount of energy consumed, maneuverability and stealth of the submarine.

In this study, it is aimed to reduce the formation of sail root vortex caused by the presence of sail by providing a leading edge fillet between the hull-sail junction. The Star CCM+ program is used to perform numerical calculations on the Darpa Suboff AFF-8 submarine and the results are confirmed by comparing the experiment results with the analysis results at 6 different velocities. In order to reduce the sail root vortex, leading edge fillets are designed with the straight, parabola, ellipse, and circle equation forms. The analysis is performed using the k-epsilon turbulence model at a speed of 3.051 m/s and a zero-degree angle of attack. Analysis is then carried out by varying the lengths and heights of the elliptical form fillet, which is the structure that produces the least vortex. The results of this study showed that the sail root vortex created by the flow separation from the sail-hull junction can be reduced with the optimum leading edge form and drag force can be dropped by 3.4 percent when compared to the results of the AFF-8 model without fillet.

***Keywords*:** K-Epsilon, Leading Edge Fillet, Numerical Simulation, Sail, Sail Root Vortex, Submarine.

Shock Tube Optimization for Blast Experiments

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ABSTRACT

The behaviour of structures under a variety of loads is a major field of mechanics so far. However, indications for blast conditions could be unpredictable as a result of the process based on blast response that happens in milliseconds. Therefore, the blast response of structures is analysed experimentally and numerically. The shock tube experiment is one of the significant methods in this field.

Blast conditions depend on the pressure-driven into the shock tube. Shock is provided in a tube at high pressure on a short time scale. There are two main sections in the tube which have low pressure and high pressure separately divided by a membrane that fails at a certain amount of pressure applied.

The system intends to be poised as a result of mass flow which occurs between sections after the failure of the membrane. According to Bernoulli Equation, the pressure difference transforms into flow celerity. Compressed gas intends to move toward the free end of the shock tube and discharges at high speed. The material that would be used for the experiment to apply is set up to the shock tube's free end, the material would be stroked by a shock. By the affections of this method, blast conditions are simulated experimentally by a shock tube.

Using with Arbitrary Lagrangian-Eulerian Method which uses Eularian and Smooth Particle Hydrodynamics (SPH), the shock tube system configurations are simulated. The configurations of the shock tube system for blast experiments are purposed optimizing according to simulations. This article deals with configurations of shock tube systems for blast experiments. Consequently, as a result of blast experiments, materials' behaviour against blast would be predictable. Materials' predictable behaviour provides stronger constructions design parameters against blast.

***Keywords*:** Shock Tube, Smooth Particle Hydrodynamics, Blast, Shock Pressure.

A Review Study on EEXI and Green Shipping

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ABSTRACT

As the maritime industry and trade grows on a global scale, the number of ships and voyages are in increase. Activities of ships and the fuel they use have an impact on the environment. The International Maritime Organization, national and international authorities have imposed a limit on ship-sourced emissions for the sake of a cleaner future and sustainability. Such constraints in favor of nature will become more stringent soon and emission-free, green fueled, smart design ships with low operating costs will come to the fore. Existing ships, on the other hand, should be able to comply with EEXI requirements by going through various conversions, modifications or by running their machines at a low level and several measures that can be taken like this. This paper's purpose is to provide reader a useful overview of abovementioned issues, shed a light on environmentalist approaches gaining popularity, and increase awareness.

***Keywords*:** EEXI, Emissions, Decarbonization, Energy Efficiency, Waste Heat Recovery.

Failure and Fracture Behaviour of 3D printed Short Carbon Fiber Reinforced/PET Polymeric Composites

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ABSTRACT

Short carbon fiber (SCF) reinforced/polymer composites enable the adaptation of 3D-printing technology to structural applications where high specific strength and stiffness is demanded. With the adaptation of conventional polymer processing to demands posed by 3D printing technology, novel composite filaments that can meet these demands have recently been commercially available. From composite's engineering perspective, the common approach here is to tailor the filament properties by varying the type of polymer, type of inclusions, polymer/inclusion interface and inclusion volume fraction. However, neither mechanical data provided from the suppliers nor the tests performed on the filaments may not be representative when the mechanical response of a printed part is of concern.

Originating from this point, this work focuses on the mechanical response of 3D printed Polyethylene Terephthalate (PET) with 15 wt.% SCF filaments onto dog-bone test standards per described in ASTM D638. Mechanical property tailoring for such filaments have been investigated as a function of printing angles. Three initial printing angles were chosen as (0)12, (90)12 and (+45/-45)3s. Samples with 3mm thickness are 3D-printed in 12 different layers (0.25mm each). Angle notation here is intentionally written as it is for laminated composites, rather than fiber direction, in this work, they represent the printing direction of melt polymeric composite being 0 parallel to loading direction.

Tensile tests performed on (0)12, (90)12 are used to determine the elastic constants and strength parameters such as E1, E2, v12, σ1max and σ2max whereas (+45/-45)6s samples are tested for G12 and τ12. Tensile tests of (0/90/+45/-45)s and open hole (0/90)3s samples are performed in order to measure the capability of two conventional failure criteria valid for structural composites such as Tsai-Wu and Hashin. Fracture surfaces of selected samples from each test case will be examined under Scanning Electron Microscopy to discuss the roots of mechanical failure.

In the light of both experimental and theoretical analysis, capabilities of both failure theories are discussed.

***Keywords*:** Polymeric Composites, 3D-Printing, Material Design, Failure, Fractography.

Subsea Pipeline Accident Analysis and Design Against Falling Objects

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ABSTRACT

Failures in submarine pipelines cause oil spills in the water and may even cause explosions with great material and environmental damage. Serious environmental disasters and human deaths in the oil and gas industry have made pipeline integrity method a very important business in economic, social, environmental and many more ways. The safe and efficient operation of submarine pipelines minimizes damage to the environment and humans. In order to reduce risks and eliminate the causes of pipeline failures, pipelines must be safely and appropriately designed, constructed and managed according to international codes and standards. As a result of the risk analysis to be made, the damages to the operation of the pipeline will be predicted, so that the weak points and high-risk areas of the pipeline will be determined. Pipeline integrity management considers many factors that can damage the pipeline operation, such as corrosion, environmental effects, impacts (anchors, trawls, etc.), human error. Integrity management includes pipeline design and operation, leak detection, emergency management, occupational health and safety, etc. issues to be taken into account. In the offshore oil and gas industry, the use of integrity management has increased as a result of major accidents that are difficult to compensate for the environment and living things. Inspection, maintenance and repair of submarine systems are essential components within an overall integrity management system. Pipeline systems can be subject to many types of damage that can compromise integrity. In this study, pipeline threats are identified and classified as a result of the necessary risk assessment, and the design against objects that may fall into submarine pipelines is emphasized.

***Keywords*:** Subsea Pipeline, Risk Assessment, Integrity Management, Impact Effect.

PHYSICS,
PHYSICS ENGINEERING

Optical and Electrical Properties of MBE Grown CuNiO and MgNiO Alloys

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ABSTRACT

In this study, the morphological properties of CuNiO and MgNiO alloys were investigated using Energy Dispersive X-ray Spectroscopy and Atomic Force Microscopy. In addition, the optical properties of CuNiO and MgNiO alloys were investigated using absorption spectroscopy and photoconductivity. Then, in order to examine the electrical properties of CuNiO and MgNiO alloys, researches were carried out using current-voltage and AC Hall measurement systems. MgxNi1-xO (x= 0, 0.21, 0.67) and CuxNi1-xO (x= 0, 0.03, 0.06, 0.1, 0.24, 0.42) samples were grown on STO and MgO substrates by using a Molecular Beam Epitaxy (MBE) system. Energy band gap of CuNiO and MgNiO alloys due to different Cu and MgO concentrations, as a function of elemental concentrations were determined from the analysis of the absorption and photoconductivity measurements. While the incorporation of the Mg in host material of NiO cause 12.6 meV/Mg% of a blue-shift in the bandgap, the increment in the Cu concentration results in 8.3 meV/Cu% of red-shift. Up to a 2 order of decrement in the resistance of the film and a stepped like Hall voltage characteristics were observed with increase the Cu concentrations. Our results pave the way the for a new generation heterojunction photodetector for ultraviolet and visible range and a magnetic switching device.

***Keywords*:** Photodetector, Photoconductivity, Optoelectronics, Copper Nickel Oxide, Magnesium Nickel Oxide.

Gunn Oscillations in n-type InGaAs Epilayer Structures

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ABSTRACT

In this study, we have investigated Gunn oscillations in an InGaAs- based light emitter that originates from domain transition along the device. InGaAs epilayers were grown were grown by the Metal Organic Vapor Phase Epitaxy (MOVPE) with an alloy composition on %In =

0.53. To fabricate the Gunn light emitter, the samples was defined in a simple bar geometry with various channel lengths. High speed Current-Voltage (I-V) were performed to avoid ohmic heating (Joule heating) to define the threshold of negative differential resistance regime and observe Gunn oscillations at the onset of the NDR. Integrated Electroluminescence measurements were carried to determine the threshold the light emission and EL measurements were used to obtain spectrum of the emission at NDR threshold. Gunn oscillations are observed just above NDR threshold of the I-V curves at around 3 kV/cm for InGaAs-based Gunn devices at 300K. The amplitude and period of the Gunn oscillations are observed to be electric-field dependent. Electrical measurements were made at 20ns, 40ns and 60ns pulse width of applied voltage. From the beginning of the NDR, Gunn oscillations have observed with a frequency of approximately between 0,5 GHz and 1GHz depending on the electric field. IEL signal has been started at around 3kV/cm then drastically increased. The peak wavelength of EL is observed to be at 1600 nm.

***Keywords*:** Gunn Effect, Gunn Diode, Gunn Oscillations, NDR, Ingaas-Based Gunn Diode.

Computation of Thermal Conductivity in Nanofluids

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ABSTRACT

In the present work, molecular dynamics simulations are used to evaluate the thermal conductivity of a nanofluid with spherical metallic nanoparticles. For the fluid-fluid, fluid-nanoparticle, and nanoparticle-nanoparticle interactions the Lennard-Jones potential is used while for the interatomic interactions in the nanoparticles we used the quantum corrected Sutton-Chen (Q-SC) many body potential. The volume fraction of the nanoparticles is varied from 0.3% to 9%. We used two different reverse non-equilibrium molecular dynamics (rNEMD) methods to evaluate the thermal conductivity of the nanofluid. Namely, the velocity exchange method and dual thermostat method. In the velocity exchange method the total energy and linear momentum are conserved while for the dual thermostat method the total energy and linear momentum are not conserved. The difference between rNEMD methods and the traditional non-equilibrium (NEMD) methods is that a heat flux is imposed on the system and then the temperature gradient is measured. This has two main advantages, first of all the heat flux is not well defined for systems with many-body interactions, secondly when one imposes a temperature gradient by modifying the periodic boundaries, this results in surface effects. However, for the rNEMD simulations the heat flux is imposed by unphysical means, and one must be careful in the interpretation of the results. The velocity exchange method and dual thermostat method results show that for a volume fraction of 0.3% of nanoparticles the thermal conductivity slightly increased while for larger volume fractions the thermal conductivity decreases.

***Keywords*:** Nanofluid, Molecular Dynamics Simulation, Reverse Non-Equilibrium Method.

Radiation Damage of Plastic Scintillators with Silicon Photomultipliers Measured with Collision Data in the CMS Hadronic Calorimeter Experiment

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ABSTRACT

In high energy particle collisions, plastic scintillators are commonly used to detect secondary particles and measure their energy along with silicon photomultipliers to amplify the signal. These detectors deteriorate over time due to radiation they are exposed to and lose their capacity to detect particles efficiently. In the Compact Muon Experiment (CMS) experiment at CERN, hadronic calorimeter is equipped with passive absorbers, plastics scintillators and silicon photomultipliers. In 2018, in the data taking period, in Large Hadron Collider (LHC) two proton beams traveling at opposite directions and each of which has 6.5TeV average energy are collided and outgoing particles are detected at four different locations along the accelerating ring. In the CMS experiment, energy response obtained from plastic scintillators are monitored in hadronic endcap calorimeter throughout the year and signal drop is measured with collision data, a method also known as in-situ measurement. Energy response of the detector can be monitored with precision in cellular level in longitudinal and azimuthal directions. Signal drop is then compared to alternative methods such as the one that makes use of laser. These results give insights about the life time of plastic scintillators and their response to dose rate effects. They also provide prospects for future upgrades. The results are used to calibrate the energy values of the collision events for precision measurements and are an integral part of the experiment. We provide the full results of our analysis.

***Keywords*:** Radiation, Dose, Damage, SiPM, Scintillator.

Determination of the Order Parameter for 5CB Based Liquid Crystalline Materials from High Resolution Dielectric Anisotropy and Optical Birefringence Data

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ABSTRACT

Liquid crystals have been used in widespread applications including sensor technologies, displays, device manufacturing, etc. A liquid crystal is a type of known material that reacts simultaneously to heat, temperature, or voltage. In recent years there have been growing studies on the effect(inclusion) of several types of nano-structures on liquid crystalline materials. It has been shown that the addition of those types of structures into liquid crystals improves their physical properties such as birefringence, dielectric anisotropy, and some visco-elastic properties. It is quite well-known that any anisotropic physical quantity can be used as a measure of orientational order in the nematic liquid crystalline phase. In this work, we investigated the temperature behaviour of the order parameter of pentylcyanobiphenly (5CB) liquid crystal and 5CB-nanostructures. With this aim, we have extracted the temperature variation of the order parameter by using high-resolution optical birefringence and dielectric anisotropy data. In order to quantify our data, we have performed several fit functions, which are themselves consistent with the tricortical nature of the nematic-isotropic phase transition. The consistency of the results for both pure 5CB and 5CB doped nanostructures has also been discussed with literature.

Keywords**:** 5CB**,** Nematic Liquid Crystals, Order Parameter, Ferroelectric-Nanoparticle.

RESTORATION

Preserving Seyfi Arkan's Modern-Industrial Architecture: *Seyrantepe Automobile Industry Complex*

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ABSTRACT

Seyrantepe Automobile Industry Complex has been a modest piece of Istanbul's multi-layered cultural texture since 1959. Besides the widespread use of automobiles in the 1950s, the auto-repair workshops were scattered around Istanbul. With the initiatives of President Menderes, the first industrial site planned systematically in Istanbul was designed by the pioneering modernist architect Seyfi Arkan. This complex design with a typological approach carries the innovative spirit of the era and reflects the simple and rational aesthetic understanding of the international style. Today, the site has become under the threat of losing its authentic identity and its relationship with the city has weakened due to the area being stuck within the boundaries of a central business district in one of the busiest centers of Istanbul.

This master's thesis starts with documenting the site and proposing a sustainable conservation plan for the site to be preserved against the pressures of a constantly growing metropolis like Istanbul. In the documentation phase, the surveys conducted with laser scanning are being financed by BAP grant. The primary objective of the suggested proposal is to strengthen the relationship of the site with the city and its users, by setting an example of a 20th-century architectural heritage built with reinforced concrete, steel, and glass being adapted to sustainable conservation programs. This study focuses on documenting this unique modern industrial heritage, developing a sustainable future scenario for it, encouraging the adaptive re-use of the 20th-century architectural heritage as suggested by the Madrid-New Delhi Document, ensuring that this urban space of Istanbul's 20th-century layer is handled with a holistic conservation approach, and finally managing the inevitable change. It is within the scope of the project that the proposed conservation plan is transformed into a guide that can be easily adopted by future users.

***Keywords*:** Seyfi Arkan, Modern Heritage, Industrial Heritage, Automobile Industry, International Style in Architecture, Conservation.

Proposal for the Adaptive Reuse of the Gelidonya Lighthouse, Antalya, Turkey

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ABSTRACT

Lighthouses, that were once the most important navigational assistants, lost their active function especially as a result of changing naval technology and became desolated buildings of heritage values. This study aims to develop, in the context of a comprehensive conservation project, an adaptive reuse proposal for Gelidonya Lighthouse, built in 1936 in Antalya, southern Turkey.

The first steps of the research are; documentation of the current situation with traditional methods and laser scanning; determination of the different historical layers of the building with literature and archival research and analysis of samples in the conservation laboratory to reach proper intervention methods. As the lighthouse is located on the Ancient Lycian Way and attracts many visitors as part of a cultural route, to create a master plan that would incorporate the lighthouse and underline its meaning is among the aims of the restoration project. Because Gelidonya Lighthouse is a complex that includes a lighthouse tower and a tied house connected with a courtyard, defining a new function to welcome its guests and to help its survival is important. A focused literature review of international and national implementations of lighthouse preservation and reuse has a vital part in the preservation decisions.

With the potential of being on the list of the 10 most preferred long distanced hiking routes, and with the burden of its deserted state, the dilemma provides a unique tourism based conservation approach to the lighthouse. This project ensures the recognition of the lighthouse and the area as a whole and aims to turn the lighthouse into a center of attraction that can light up its visitors about its background and the region's history. In other words, a relatively young lighthouse describes its own history and hopes to lead to awareness for lighthouses and the new possibilities they can offer in contemporary culture.

***Keywords*:** Lighthouse, Gelidonya Lighthouse, Antalya, Lycian Way, Adaptive Reuse.

Conservation Approaches for Çana Han and Synagogue

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ABSTRACT

This research has been prepared based on the Conservation Project of Çana Han and Synagogue studied in the 2021-2022 fall semester Conservation Project I, in Istanbul Technical University at Restoration Master's Program, by a group of master's degree students consisting of Elif Özkazanç, Merve Eylül Zorlu, Merve Tuna, Mürüvvet Nazlı Güngen Tanuğur, Sedef Demir Üresin and Tuğçe Öztürk, in consultation with professors and research assistants of Restoration Program. The aim of this paper is to discuss the developed conservation approaches for Çana Han and Synagogue. Çana Han and Synagogue is located in the Balat district of Fatih, İstanbul and it can be named as a building complex since it contains different building units sitting on four different parcels (4, 5, 6, 33) on building block 2337. The traces of different construction methods, periods of interventions, and different functions can be clearly followed on these parcels. Even though all of the building units have historical value, the only parcel that is registered as cultural property is parcel 33 on building block 2337. In the past, the building complex has been used for accommodation, commerce, rabbinate, and workshops. Nowadays, many parts of the Çana Han and Synagogue have been left over and are not open to the public, except for commercial units in the southern part. Generally, Çana building complex has different levels of deterioration due to unqualified interventions, usage of different building materials, and changes in functions of spaces. Archival research and interviews were done to understand the historical background of the Çana building complex. According to the research and observations on site, it was decided to examine the periodical background of the complex in four periods. The earliest structure on the site of the Çana building complex was constructed as a khan in the 18th century. In the 19th and 20th centuries there have been additions and comprehensive restorations. According to findings about the early 20th century's data, a restitution project was prepared. Finally, a conservation proposal was developed considering contemporary approaches. Considering that there have been serious additions to the building complex over time, studying the conservation project of the Çana complex is valuable in terms of both documenting different architectural construction techniques and showing the transformation of Balat. Also, it is important to prevent inconvenient future interventions to the Çana building complex and to preserve cultural values of buildings on both registered and unregistered parcels. The proposal for restoration and reuse of the Çana building complex will ensure that this lost and endangered cultural heritage is transferred to the future with its architectural knowledge.

***Keywords*:** Çana, Synagogue, Khan, Conservation, ITU Restoration.

SCIENCE, TECHNOLOGY AND SOCIETY

Internet Development in Turkey in Comparison with USA, Netherlands and South Korea

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ABSTRACT

The internet has become an indispensable part of modern life in its development adventure of half a century, and it is used in different fields and for different purposes, such as, communication, sharing information, education, shopping, marketing, social communication, service sector, security, government services, and business services. The purposes of using the Internet can be grouped under four main headings: Information, marketing, service, and security.

What was the driving force and the goal of the Internet? Why was it so widely accepted and used by the people? After connecting four computers to each other for the first time in 1969, ARPANET was developed infrastructural and turned into the Internet, and it took the 1990s to reach homes, offices and people. The Internet did not originate primarily for the purpose of marketing, sales, the service industry, or the government to provide services to its citizens. Technologically, the service sector and online shopping became possible only in the 1990s, and its full spread could only be after the 2000s. Since the marketing-sales and service options have been eliminated from the purposes of using the Internet, two options remain. In this paper the internet will be examined from the perspective of information sharing and security. In this context, the first emergence of the internet and the motivation, purpose and development of the internet in the process in its first period will be examined through developed and developing country groups. By considering the USA and the Netherlands as developed countries, South Korea and Turkey will be evaluated as developing countries.

Keywords: Internet, Security, Information.

Characteristics of Energy Efficiency Networks (EEN) in Turkey; *A Comparative Analysis*

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ABSTRACT

Countries' energy visions are determined depending on the analysis of geopolitics and international conjunctures. One of the main reasons policymakers consider energy from a holistic perspective is the principle of energy efficiency. The fact that energy efficiency is an element of political advantage beyond a waste of resources has brought the strategic situation of these networks one step forward. This is also a tool for integrating energy efficiency networks into daily life. The increasing inclusion of energy efficiency networks in demand-side energy management causes these networks to bring new approaches to everyday life and power production systems. Therefore, the nature of the energy efficiency networks, how they are designed and managed, and the establishment of the link in the energy production part determine the characteristic features of that network. The primary purpose of this article, in which various types of energy efficiency networks in Turkey will be discussed, is to show which networks develop which characteristics for which systems and analyze the characteristic features while creating a new energy efficiency ecosystem. This analysis will be based on Actor-Network-Theory. The construction of energy efficiency networks as a system is due to the deterministic nature of energy science and technologies and the value of energy as a commodity. The determinism here aims to create a clustered network for the entire energy system toward the primary efficiency goal. Therefore, while focusing on the characteristics of energy efficiency networks, a qualified analysis will be presented on how these networks are used.

***Keywords*:** Energy Efficiency Network, Demand-Side Management, Actor-Network Theory, Turkey.

Ethics in Energy Efficiency Networks; *A Case from Turkey*

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ABSTRACT

This article deals with the ethical analysis of the laws and regulations that reveal the established strategies of the energy efficiency networks that have just begun to spread in Turkey, considering the market benefit rather than the public benefit. The Case in the article is not taken from a past event or a legal case. It is created on the companies in the Energy Efficiency Networks that are just starting to develop in Turkey and the holdings that founded those companies. The case in this article has been created without considering the effects of a past event, incident, or the consequences of a civil lawsuit. Firstly, I have created and analyzed the Case within the framework of developing energy efficiency networks. Therefore, theoretically, there is no similarity with the cases in other books. Secondly, I used qualified research methods and intensive descriptions while analyzing the case. Therefore, I have constructed and analyzed the three main problems concerning each other in the Case in question. In addition, I created an ethical review on the scale of concepts such as virtue, norm, and utility to understand the effects of the state's life force. Finally, this article also explains how a desire for energy efficiency has transformed from an innocent phenomenon into a state apparatus based on interests in other elements discovered over time.

***Keywords*:** Energy Efficiency Network, Energy Ethics, Norms, Virtue, Value.

AI Cinema: *A Brief History and Future Perspectives*

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ABSTRACT

The cinema has situated a settings of intersection among science, technology, society and art since its emergence. Application of new technologies on cinema from the black & white, silenced to color films era and then the usage of special effects with computer generated images, videos and virtual reality in order to create an illusion of reality for the audiences, makes cinema a crucial research asset for science, technology and society (STS) studies. This paper aims to examine how emerging artificial intelligence (AI) technologies transform the cinema in the areas of script-writing and moving pictures creation by presenting a brief recent history with case examples and an addition of future perspectives about the subject. Machine learning algorithms provide a new kind of cinema with the adjective of AI, which raises important aesthetic, philosophical and ethical questions. From the STS perspective, one of the core discourses which tells that society and technology are co-produced, strengthens the importance of those questions since cinema is a highly effective type of sociotechnical assemblage that shapes the content of mass and popular culture. The usage of AI in such artistic assemblages proposes new types of non-human vision which expand and bridge our knowledge spaces about nature, society and culture. In case the future of cinema is predominantly held by AI technologies, the role of non-human entities in creating human popular culture will acquire challenging dilemmas. Differing from human eye, AI's high computational power and its ability to analyze huge amounts of data also makes AI cinema a potential reservoir of knowledge production in future.

***Keywords*:** Artificial Intelligence, Cinema, STS.

Female Politicians and Role-model Effects: *Evidence from India*

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ABSTRACT

Despite being the largest democracy in the world, the political representation of women in India, is far below an equitable representation and literature points to such disparity as having potential to influence aspirations, stereotypes and gender norms. In this paper, I exploit a fuzzy regression design and employ two-stage least squares regression (2SLS) estimation, to study the impact of female politicians at the district level (second level of administration) on outcomes of bargaining power, gender norms and financial empowerment. I use micro-data from India's NFHS-4(2015-16) survey and combine it with aggregated state constituency election data in India from 2010 to 2014, to find the impact of having a female elected representative on aforementioned outcomes. I also provide robustness checks for various margins of victory/loss and use sharp RD design on sample of only those districts that had a single man vs woman election.

To the best of my knowledge, this paper is the first in the literature to quantify effects of competitively elected female politicians on bargaining power, financial empowerment and domestic violence attitudes (gender norms) in the context of a developing country using individual level survey. The paper contributes towards a growing field of literature related to the effects of female political leadership on women's empowerment. The findings are important as it demonstrates that greater gender representation in politics can have spillover effects on breaking stereotypes and gender-norms.

The results although mixed point to some interesting findings - female representation leads to improvements in bargaining power- specifically there is an increase in the ability to decide how to use own money and healthcare. There is no significant impact on women's financial empowerment and improvement in gender norms as tested by using variables related to domestic violence attitudes.

***Keywords*:** Female politicians, Elections, Gender.

SHIPBUILDING AND OCEAN ENGINEERING

Numerical Modeling of Wave Induced Scour Around a Monopile

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ABSTRACT

Offshore structures have always been a part of the oil and gas industry. Recently, these structures are built and designed by considering renewable energy technologies. Apart from the aim of the offshore structure, single piles have always been a special interest from an engineering point of view. When a structure built in marine environment, the presence of the structure causes various physical changes in the profile of the waves, currents, combined wave and currents around it. Besides wave and wind forces, flow pattern changes cause sediment transport around the structure leading scour. In terms of the stability of the structure, it is extremely essential to understand scour and backfill mechanisms that occur around it. Scour may cause a situation that will affect the stability of the structure, accelerate the fatigue of the material and even cause the collapse of the structure. Knowing scouring and backfilling processes makes us stay at an extremely safe point in terms of engineering and ensures that we have data for fatigue analysis of the structure during the design phase of the structure.

Within the scope of this study, wave induced scour around a single pile located in open sea is numerically examined. Considering scour around piles of different diameters, experimental data found in the literature are utilized. These experimental data are compared with the results of the analysis carried out in the package program used in this field. Equilibrium scour depths, nondimensional time scales are compared with the experimental data. In addition to a single pile, studies are also carried out with pile groups with various placements.

As it is expected, Keulegan–Carpenter number (KC) and Shields parameter (θ) play an active role together for predicting scour, plus the results obtained from the numerical model agrees well with the experimental data. Therefore, a preliminary approach for locating group of piles within an optimum distance is aimed in this study. For this, several cases are run and effect of distance within piles on scour are examined.

***Keywords*:** Keulegan–Carpenter Number, Shields Parameter, Regular Waves, Monopile, Scour Depth, Time Scale.

Numerical Modeling of Waves Acting on a Pile

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ABSTRACT

Wave and current effects are vital in the design of water structures. These structures are quite costly to build. For this reason, it is very important to evaluate unpredictable results. At this point, physical models provide a lot of convenience to designers and are of great importance in optimizing the design. But physical models require time and cost. It is possible to reduce this time and cost with the help of numerical models. In addition, the design processes of more complex structures can be easily managed with numerical models, but the numerical models must match the results of the physical model. This step is very important for the reliability of the studies. There are many commercial and open-source tools available for solving numerical models. One of them is REEF3D. In this study, it is aimed to show that physical model results can also be obtained through numerical models. As a first scenario, a pile subject to currents has been utilized and the velocity profiles at different points in the physical experiment have been compared. The experimental results for velocity profiles agrees well with the numerical ones. Secondly, a pile subject to waves has been considered. The wave forces exerted on the pile have been calculated and compared with the results obtained by Morison's Equation. The forces calculated were also in good agreement with the ones obtained by Morison's equation. Therefore, as a final step, it has been aimed to calculate force distribution over various pile diameters for different wave heights.

***Keywords*:** REEF3D, CFD, Morison Formula, Wave, Current.

A Temperature and Time Dependent Corrosion Wastage Model for Seawater Ballast Tank Structures of Ships

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ABSTRACT

For the prediction of corrosion wastage on ships, field tests are commonly used. Statistical approaches based on field tests provide an average corrosion prediction rather than an explanation of corrosion characteristics. Furthermore, the models that ignore effects of environmental factors on corrosion development are unrealistic. Establishing a model that includes environmental factors, based on the segmentation of field tests, will provide a more than average approach for risk of aging ship structures assessment. In this study, a mathematical model that estimates corrosion wastage as a function of time and the working environment temperature of ships established for the ballast tanks by using segmentation of field test results.

***Keywords*:** Corrosion, Ballast Tank Structures.

A Study on Minimum Drag of an AUV using Integrated Optimization Platform by Open Source Libraries

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ABSTRACT

The design and production of Autonomous Underwater Vehicles (AUV) for the commercial and military usage gained momentum in recent years. One of the most important design criteria of these vehicles is to present a form with low drag characteristics to increase the battery capacities and cruising speed. In this way, the endurance of the underwater vehicle will increase and the limitations that may arise in the mission descriptions will be prevented. In this study, an application that works in integration with (i)parametric form design, (ii)creation of an unstructured mesh to be utilized within Computational Fluid Dynamics (CFD) analysis, (iii)performing CFD analysis according to predetermined design criteria and (iv)optimization algorithms libraries have been developed by using multiple open source software. With this application, form derivation, analysis and evaluation processes are carried out automatically for parametric forms whose design space is predetermined. In order to test the suitability of the developed procedure within the scope of the application, the validation study of the underwater form generated with Myring curves, which is one of the forms with test results available in the literature, has been carried out. After validation, sensitivity analysis was executed to understand the effects of geometric parameters on the drag of the form. As a result of the sensitivity analysis, parameters with relatively small effect were not included in the optimization cycle. Finally, an optimization study using Genetic Algorithms was carried out to find the optimum form provided in the literature within the predefined design space without considering the displacement constraints.

Keywords: Autonomous Underwater Vehicle, Computational Fluid Dynamics, Genetic Algorithms, Open Source Libraries, Resistance, Shape Optimization.

Numerical Simulation of Wave Run-up Over a Sloping Bottom

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ABSTRACT

Pile supported structures have a wide range of use in the offshore industry. These structures are much expensive to build. Therefore, it is important to evaluate unpredictable results before implementation. At this point, physical models are very convenient for designers and help to optimize the design. However, these types of models have some difficulties in terms of time and cost. With the help of numerical models, this loss of time and cost can be reduced significantly. In addition, numerical models provide flexibility in the design process of complex structures, but it is important that the results of numerical models must be compatible with the results of physical models. In this study, it is aimed to model a pile on a sloping bottom subject to waves. In order to solve the numerical model created within the scope of this study, the open-source REEF3D tool is used. A mesh convergence study has been done for the numerical domain and the optimum mesh size has been calculated. Secondly, relevant experimental data for wave run-up is compared with the numerical model. For that purpose, the surface profile at a certain point of a wave propagating to a coast with a slope of 1:6 had been replicated numerically. As a result, it has been seen that the wave profile obtained from the numerical model agrees well with the wave profile obtained in the experimental study. Hence, as a final step, a pile has been placed on a sloping bottom and wave forces acting on it have been calculated for various wave heights and periods.

***Keywords*:** Wave Run-Up, Waves, Pile, REEF3D, Wave Force.

Conceptual Design of an Offshore Wind Farm in Turkish Waters

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ABSTRACT

Wind turbines are structures that convert the mechanical energy into the electrical energy obtained by using wind energy, which is a renewable resource. To choose the appropriate location is very significant feasibility process for installation of offshore wind turbines in Turkish waters. However, it has been examined that there is not any experience of offshore wind farm installation yet in Turkey. In 2018, not any application was made by local companies for the first offshore wind farm tender due to insufficient technical infrastructure and finance. For this reason, the tender was postponed to later. In this study, it is aimed to determine the optimum location and structure where maximum efficiency can be obtained with minimum cost. According to the parameters of wind speed, water depth, wave height, seabed substrate, national sea borders, military/restricted areas, shipping routes, submarine pipelines and cable lines, grid lines, marine life, tourism and civil aviation, 8 possible locations were determined. All parameters are shown on the same map by using the Global Mapper software. Accordingly, the Analytic Hierarchy Process has been made elimination for these locations to select most suitable locations with 3 criteria's values, which are available areas, potential wind speed and the distance to the grid connections. With the 10 years meteorological data, wind profile and classification were determined in selected locations for choosing appropriate wind turbine model. Micro-sitting of wind turbines has been made with selected models by using bathymetric data in Wasp software. The maximum depth has been taken as 20 meters since mono-pile foundation type is planned to be used. The estimated annual energy production of the wind farm was calculated by using Weibull probability density function. In addition, wind load, wave load, rotary load and gravitational load were calculated and analysed for harsh conditions in order to determining the structure of foundation and tower. As a result, minimum diameters and thicknesses of foundation and hub have been determined for minimum cost.

***Keywords*:** Potential of Wind, Offshore Wind Farm, Offshore Wind Energy, Conceptual Design.

STRUCTURAL ENGINEERING

Dynamic Response of RC Chimney under Seismic Excitations

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ABSTRACT

The goal of the study is to analyze tall and slender structures under seismic loads by ABAQUS software. For this purpose, the reinforced concrete (RC) chimney 240 m high is taken into account. In the recent earthquakes, many of them were badly damaged or collapsed completely. Therefore, it is required to analyze the dynamic response of these tall and slender structures under different seismic codes. In this work, the RC chimney is analyzed by both Eurocode 8 and Turkish seismic code 2018 using nonlinear dynamic time history for their elastic response spectra. The concrete damage plasticity model (CDP) is used to simulate the inelastic behavior of concrete, defining the behavior of concrete under cyclic or dynamic loads and showing the residual concrete damage. An isotropic hardening model is used to simulate the elastic-plastic behavior of steel. For the solution, the earthquake records were taken from PEER strong motion database and the selected ground motions are matched for the response spectrum following Eurocode 8 and Turkish seismic code 2018. Dynamic soil-structure interaction is neglected and the foundation of the model is assumed as a fixed base in the model. The nonlinear time-history analyses are performed using transient response analyses with the direct time integration method (implicit method). The modified Newton-Raphson iterative procedure is performed throughout the dynamic analyses. The results are discussed in terms of lateral displacement, vertical stress, and the total damage due to earthquakes. The results are compared to the selected codes. The findings of the study showed that the maximum stress was formed in the lower area of the chimney. At the top, the stress is significantly reduced. The lateral displacement increased linearly towards the top of the chimney and remained relatively constant in the circumference direction. The model has not been damaged by compression. Tension damage occurred in the upper part of the chimney in a particular area.

***Keywords*:** Seismic Analyses, RC Chimney, ABAQUS 3D Finite Element Model, Nonlinear Materials.

Investigation of the Performance of Seismic Base-Isolated Building Built on Weak Soil

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ABSTRACT

The general principle in seismic isolation is the separation of the superstructure and the foundation. In this design, it is aimed to increase the earthquake resistance of the structure or to reduce the earthquake forces transferred from the ground to the structure. This reduction is done by increasing the period of the building or by increasing the effective damping of the structure. Seismic isolation is generally not preferred on soft soils. In such soils, the ground dominance period is very long. Since isolators will increase the period of the building, the construction period and the ground dominant period may overlap and cause resonance. Structural damage depends on ground conditions as well as earthquake and structural characteristics. Earthquake waves change as they move from bedrock to the ground. This effect of the ground on seismic waves is called the soil amplification effect. Unlike hard soils, soil amplification in soft soils may increase base-shear force of buildings that have long periods. In this study, seismic isolated analyzes of a hospital building were carried out on different soil classes. First of all seismic isolation systems were classified and the regulations of the Turkish Building Earthquake Regulation regarding seismic isolated structures were explained. Then, isolators dimensioning was performed in line with these regulation and related controls. The time history analyzes of the building models were performed using the ETABS program for different input motions represents the weak soil layers with low shear wave velocities. Maximum story displacement, story drift ratio, story shear force, story accelerations, base shear force ratios and column capacities obtained as a result of the analysis of the building models were compared and it was investigated how the soil shear wave velocity affected the results.

***Keywords*:** Seismic Isolation, Soil Behavior, Earthquake Engineering.

Investigation of the Effect of Structure-Pile-Soil Interaction on the Earthquake Performance of a Multi-Story Reinforced Concrete Building

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ABSTRACT

Turkey is located in a region with high seismicity because of it is located on active fault lines. In the past earthquakes, great loss of life and property has been encountered. As a result of this situation, the importance of accurately predicting the behavior of structures under the effect of earthquake has come into prominence. How the earthquake ground motion defined in the bedrock will affect the structure is possible by investigating the soil-structure interaction. Seismic waves traveling through the soil layers changes. Due to this change in weak soils, the effects of earthquakes increase. As seen in the Izmir earthquake, the soil amplification is higher in regions where the soil predominant period and the building vibration periods are compatible. In soft soils, the predominant period of the soil coincides with the period of multi-story buildings. Multi-story buildings in these regions were exposed to higher earthquake forces and were damaged. For this reason, it is important to examine the soil-structure interaction in multi-story buildings to be built on weak soils. Due to population growth and city planning problems, multi-story buildings are being built as in Izmir. The use of deep foundations has become widespread due to the deep presence of the bearing soil layer. In the Hyogo-Ken Nanbu earthquake that occurred in Japan, high-rise buildings with pile foundation system on weak soil were not affected by the earthquake, while buildings with shallow foundations were severely damaged. Similar examples exist in earthquakes occurring around the world, as in the Mexico City earthquake. For this reason, it is important to examine the structure-pile-soil interaction in high rise buildings to be constructed in areas with high soil predominant periods such as the coastlines of Izmir. Within the scope of this thesis, the structure-pile-soil interaction, which has become an important issue with the spread of construction of multi-story buildings in Izmir, which was built on weak soils with high seismic activity due to population growth in settlements, interaction calculations (Method-II) given within the scope of Turkish Building Earthquake Code (TBEC-2018) were considered. The effect of the structure-pile-soil interaction on the earthquake performance of multi-story buildings was investigated by performing a performance-based design with integrated and discrete system solution. According to the results of the analysis, it is aimed that the results obtained by comparing the solution methods in the structure-pile-soil interaction analysis will contribute to the literature.

***Keywords*:** Earthquake, Structure-Pile-Soil Interaction, Method-II, Performance Based Design, TBEC 2018.

Impact of Differential Support Settlement on Seismic Capacity of a Substandard RC Frame with Plan Irregularity

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ABSTRACT

Differential support settlements of reinforced concrete (RC) structures have been found to be responsible for the damage or even collapse of structures. This work aims to assess the influence of support settlement on the change of internal load distribution and lateral resistance capacity of substandard RC frames. It focuses on analyzing the effects of change in the column stiffnesses in irregular RC moment resisting frames caused by support settlement. For this purpose, a 3-story substandard RC frame building is selected as the case study building. The 3D finite-element model of the building is developed using OpenSees software framework. The selected building had been pseudo-dynamically tested at ELSA in Ispra as a part of the EU project Seismic Performance Assessment and Rehabilitation (SPEAR). Various scenarios for support settlement are imposed on the model in addition to the baseline model (without any support settlement). The static analysis under gravity loads is performed first, and significant changes are observed in the internal load distribution. After that, the change in the distance between the center of mass (CM) and center of rigidity (CR) is determined. The findings indicate that the differential support settlement causes changes in the axial loads of columns. The effective cracked stiffness of each column depends on its axial load. As a result, the center of stiffness of the building shifts with the onset of differential settlement. This shift causes changes in the eccentricity of the structural system. Moreover, static pushover analysis in both X and Y directions is performed for a set of alternative settlement scenarios to see the impact of differential settlement on the seismic capacity of the building. Following the settlement, a drop of up to 25% is observed in the roof drift ratio at ultimate displacement capacity in +Y direction.

***Keywords*:** Differential Support Settlement, Plan Eccentricity, Substandard RC Frame.

TELECOMMUNICATION ENGINEERING, TRANSPORTATION ENGINEERING

Near Field Range Profile of Digital Phase Code Radar with Pseudo-Random Noise Sequence

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ABSTRACT

In this study, a radar system is designed in order to extract the near-range target range profiles of the targets. The transmitter waveform of the designed system is produced in a digital phase coded form This signal, which is converted to the intermediate-frequency band, is digitized with the help of Analog to Digital Converter (ADC). A pseudo-random noise sequence is generated using a feedback shift register and this sequence is used as the phase of the pulse signal. While producing this signal, phase modulation is provided with the help of a two-phase modulator. This generated signal is amplified to the RF(Radia Frequency) band before emitting from the antenna and passed through the power amplifier in the relevant frequency band. Thus, broadcasting in a non-deterministic form has been ensured. Thus, it is foreseen that this system will not cause interference problems with signals in the same band from the environment and will be robust to jamming signals.

The radar system is envisaged to be attached to the unmanned aerial vehicle and is positioned to illuminate stationary targets on the ground in the near area. In order to model target objects more accurately, a realistic object is used instead of scattering points. While modelling this realistic object, a rectangular prism is created in the computer simulation environment and this object is divided into small sub-parts. The radar cross-sectional area of each sub-piece is calculated using physical-optic methods, and each of the sub-pieces is considered as a separate scattering point. The range profiles of the radar obtained from different locations are revealed by using signal processing based on correlation methods. As a result, it is seen that consistent range profiles are obtained.

***Keywords*:** Phase-Coded Waveform, Digital Radar, Pseudo-Random Noise.

Microstrip BPF Design with Coupling Matrix Method

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ABSTRACT

This paper provides an overview of coupling matrix synthesis and design of a microstrip bandpass filter for the 5G n77 (3700 MHz) band based on the coupling matrix approach. 5G radio equipment strictly requires high filtering performance to prevent adjacent channel interference. Asymmetrical pseudo elliptic filter approximation with finite transmission zeros provides optimal in-band, out-band performance and sharp cut-offs at the passband edges. Microstrip technology may employ filter designs up to 100 GHz. Unlike waveguide and coaxial cavity filters, microstrip filters are cost-effective and provide ease of manufacture.

The coupling matrix is a compact tool representing a particular topology of the bandpass filters. It represents the filter prototypes without being required to extract reactive components' values in advance. The coupling matrix incorporates both inter-resonator coupling coefficients and frequency offsets in the vicinity of center resonances. The direct synthesis approach mostly ends up with physically unrealizable coupling matrices. Instead, a realizable coupling matrix is obtained through successive similarity transformations applied to the synthesized matrix. Similarity transformations may emerge singlet, triplet, and quadruplet topologies which comprise a finite number of prescribed transmission zero, either real or complex.

This paper begins with design specifications. To satisfy n77 specifications, 0.1 dB passband ripple and a decent amount of out-band rejection may be realized by a 4th order filter with one finite transmission zero. Next, resonator geometry is fixed as fulfilling the mid-band insertion loss level, -3 dB. The unloaded quality factor is calculated using EM simulation. Then, design curves for inter-resonator and IO couplings are interpolated. The required coupling matrix is synthesized by an online tool called Synmatrix. Synmatrix is a web-based synthesis tool capable of multi-topology filters based on analytical and optimization-related methods. Diagonal elements of the synthesized coupling matrix represent the frequency offset of each resonator section, while off-diagonals are direct and cross-couplings. Physical dimensions of the initial layout are derived using design curves. The port tuning technique is applied to the initial form of the filter layout to meet return loss criteria. The final filter with losses has -2dB midband insertion loss and pretty sharp band edges without compromising bandwidth requirement.

***Keywords*:** Microwave Filter Design, Bandpass Filters, Coupling Matrix, Pseudo Elliptic Filters, Microstrip Filters, Resonator Circuits.

Side-Channel Analysis to Neural Processing Unit Architectures

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ABSTRACT

With the popularity of AI, the value of data has risen dramatically to the point where it is referred to as "the new gold". And it has several facets: the value represented by the data, the collection of training data itself, the weights, and architectures of neural networks obtained after costly training. When the value rises, so does the difficulty of safeguarding. Our work is motivated by this challenge and particularly deals with the protection of the weights and architectures from being extracted out of the platforms. To this end, we take an adversary's perspective and analyze the vulnerabilities of Neural Processing Units (NPUs) against physical attacks. Side-channel analysis and its countermeasures have been studied intensively in cryptography. These types of studies have recently been applied to neural networks. Both attacks, and mitigations, have been demonstrated on a variety of platforms. This field is still nascent, with numerous avenues for promising research results. As opposed to approaching the problem from the top-down, by studying one platform, we approach the problem bottom-up. We analyzed the architectures of numerous AI edge devices and extracted the building blocks they have in common. We obtained real-world architectures of these building blocks from the Verilog implementation of the Nvidia Deep Learning Accelerator, wrapped them in an analytical framework and loaded them on an FPGA (Field Programmable Gate Array). Activation function layers were then used as a target for electromagnetic emission, power consumption, and timing analysis. To contribute to the field, we initiate the study of side-channel vulnerabilities on building blocks of accelerators, rather than on entire platforms to capture the wide range of available edge devices. We successfully analyze isolated building blocks in a low-noise environment. This assessment provides a solid foundation for a future move towards a real-world attack against actual NPUs.

***Keywords*:** Side-Channel, Physical Security, Neural Network, Edge Device, FPGA.

Fractal-Based Dual-Band Microstrip Patch Antenna for 5G Applications

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ABSTRACT

The fifth-generation (5G) of communication systems has already been rolled out in some countries worldwide. However, the development of smaller and more practical components is still in need. In this work, the design of a double ring dual-band microstrip patch antenna for 5G systems has been implemented by using the principle of fractal geometry so that the antenna's smaller propagating ring is a scaled copy of the bigger one, and the dimensions of each ring are set to fit its corresponding frequency band at its center frequency, the simulations have been implemented using CST microwave studio simulator. Because of its two self-similar propagating rings the proposed antenna covers two of the main 5G operating bands of 3.1-4.1 GHz and 6.1-8.1 GHz, with center frequencies of 3.5 GHz and 7 GHz, respectively. The designed antenna has an impact size of 27x16 mm2 which is considered smaller than the other antennas operating in the same bands. Furthermore, the width of the microstrip line feeding has been set to 1.9 mm and the thickness of the FR4 substrate is set to 1 mm to create a 50 ohm impedance matching. The antenna showed a good reflection coefficient (S11) of around -20 dB, wide bandwidth, a good radiation pattern for both bands, and a gain of 2.29 dBi and 2.51 dBi for the first and second bands, respectively, which indicates that the antenna is a good candidate for 5G applications. Finally, the effect of adding two symmetrical triangular cuts on the ground layer has been studied for different cut sizes as well as the changing of the scale factor of the smaller ring and the length of the ground layer.

***Keywords*:** 5G, Fractal Geometry, Microstrip Patch Antenna, Antenna Modelling.

Analysis of Traffic Injuries in Turkey

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ABSTRACT

According to World Health Organization (WHO), each year Road Traffic Injuries (RTIs) take more than 1.3 million people's lives all over the world. Although RTIs are one of the most influential causes of global deaths in all countries, the majority of these deaths originate in low- and middle-income countries. RTIs are a threat to public health and are estimated to be responsible for 2.0% of all deaths in Turkey. Since incidents resulting in injuries and deaths continue to pose a major problem, this study aimed to emphasize this issue by providing an overview of the RTIs in Turkey through a review of available operational data. Because of the Covid effect, the data for 2020 and 2021 were separately interpreted and datasets of accidents between 2009 and 2019 were analyzed in terms of common faults causing traffic accidents. Descriptive analysis of these datasets revealed that traffic accidents have increased in recent years and drivers' faults with 89% are the main reason behind most traffic injuries and deaths. Pedestrian faults follow the driver faults with a 9% ratio. The death number of drivers is nearly half of the total deaths. Also, a drastic increase in car ownership in recent years which might be a cause of the growing population and developing economy leads to more RTIs. Moreover, it was observed that the peak number of accidents, traffic deaths, and traffic injuries occurred on Mondays and Fridays. This study will provide information to decision-makers to take precautions against the traffic accidents caused by driver failure.

***Keywords*:** Traffic Accident, Road Traffic Injuries, Road Safety.

Effect of Socio-Demographic Characteristics on People's Perception of AVs

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ABSTRACT

Emerging Autonomous Vehicles (AVs) in transportation technologies has opened up unprecedented possibilities for travel in the future. Therefore, research on this new area has become one of the most popular topics in the literature. However, research on this field does not adequately exist in Turkey. This study aims to partially fill this knowledge gap through descriptive analysis of data gathered by web based survey from 120 participants in Istanbul. This paper provides an early look into the impact of socio-demographic characteristics on people's opinions on advantages and drawbacks of AVs in choosing one. Descriptive results revealed that approximately 85% of people in Istanbul think AVs will affect our lives in a positive way. People with higher education levels perceive that the advantages of AVs coming to the markets will overweight the disadvantages of it. However, most people are concerned about autonomous vehicles malfunctions under bad air conditions, which has the highest effect on their willingness to buy an AV. They are also worried about losing their driving skills because of using fully AV, which lead to the lowest effect on their purchase. Furthermore, among all the advantages of Avs, like probable decrease in car emissions or providing more productive time during a trip, their potential to decrease car crashes has the highest effect on people's willingness to buy an AV and after that having less stressed driving experience has the most effect. The outcomes of this study will help autonomous car companies to make better decisions toward autonomous car technology and make improvements accordingly.

Keywords: Autonomous Vehicles, Advantages and Disadvantages, Socio-Demographic.

TEXTILE ENGINEERING

Design of a Movable Hotplate System for the Measurement of Forced Heat Convection

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ABSTRACT

Clothing plays an important role in thermal regulation of the body by controlling the heat and moisture exchange between the body and the environment. Radiation, convection, conduction, and evaporation are the ways in which the body exchanges heat with the surrounding environment. Maintaining the human body temperature is crucial to ensure thermal comfort which is one of the most important parameters of textile materials. When the transfer of energy between the human body and the external atmosphere is balanced, thermal comfort is achieved. Thermal properties of textiles can be measured by different systems. However, these traditional heat transfer measuring systems work on horizontal position. On the other hand, both the geometric structure of the human body differs from area to area and also with the movement the position of the body changes. From this point of view, in this study, an experimental setup was constructed considering all these conditions. The experimental system has an ability to calculate natural convection at different angle positions, namely 0^0, 30^0, 60^0 and 90^0 degrees. Hence, the effect of change of angle on the natural convection performance of textiles could be evaluated. In addition, the system is also capable of calculating forced convection rates of textiles under different angular positions and at various air velocities (0.6 m/s and 1.5 m/s).

***Keywords*:** Forced Convection, Textiles, Heat Transfer, Measurement Method, Hotplate.

A Study to Increase Capacity and Develop Strategies for the Turkish Clothing Industry

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ABSTRACT

The textile sector has the 2nd highest share in the Turkish economy and it has strategic importance for Turkey. It is required that the companies should increase their capacity, develop new strategies and try to keep their places in the industry. In this project, it is aimed to develop strategies that will provide sectoral development for the clothing industry.

The scientific impact is that there is no comprehensive study including sector analysis for the clothing industry in the literature. The strategies to be developed in this study are very important for the sector. Economically, the strategies that will be developed in this project will help the companies to move their places to the better places in the global environment. Also the needs and the problems of the industry will be determined within this study.

In this study, first of all current situation analysis and the capacity analysis of the clothing industry is critical to analyse and understand the current situation of the sector. In this study, Istanbul apparel industry will be evaluated. Istanbul has a very important role regarding Turkish clothing industry, since 70.8% of all apparel exports are made by Istanbul clothing companies. Then classification of the product, machine, and workforce by using the sector-level capacity analyses will be made. Determination of the important strategies and evaluations based on specified criteria will be conducted using appropriate data collection and analyses tools. Determination of globalization strategies and industry success variables for the Turkish clothing industry will be the last stage for this study.

There will be an innovation by analysing the capacity, making a classification of companies and analysing the strategies based on up to date information considering clothing companies' capacity levels and requirements. The study also will be the basis for the new studies in the future.

***Keywords*:** Apparel Industry, Capacity Analysis, Strategic Planning, Capacity Planning, Strategy Development.

Characterization of Copper-Based Coating Developed for Functional Textiles

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ABSTRACT

Ionizing radiation is energy in the form of waves or particles that have the power to eject electrons from atoms. The main sources of ionizing radiation, which can cause negative effects on human health, are radiological and nuclear medical examinations, cancer treatments, X-rays and gamma rays used in industry, and nuclear accidents. It is possible to provide personal protection against ionizing radiation by using wearable, flexible shielding materials. In this study, the commercially available, lightweight woven fabrics were coated with copper powders in order to develop wearable shielding material. The coating pastes for the work were prepared by mixing waterborne polyurethane and copper (Cu) in powder form. The single sides of the 100% cotton fabrics were coated with the knife coating method, with the average fabric thicknesses of 0.299 -0.345 mm. In order to evaluate the particle size effect on the coating performance, 3 µm and 10 µm Cu powders were employed in the coating pastes. In addition, the coatings pastes were prepared by adding Cu powders at the weight ratios of 50%, 60%, and 70%. FT-IR analyses of the coated fabrics were carried out, and the comparative evaluations of the samples were made by taking SEM images of the coated surfaces. The results showed that, even at 70% Cu weight ratio, the uniform coating of the fabrics are obtained. Also, in the SEM images no gaps were observed between the coatings and the cotton fiber surfaces which can be interpreted as Cu powder containing coating provided strong adhesion on the fabric surface. Finally, it was seen that both 3 µm and 10 µm Cu powders are agglomerated in the coating.

***Keywords*:** Ionizing Radiation, Fabric Coating, Copper, Shielding Material.

Borage Oil and Hypericum Perforatum Oil Containing Nanofibers for Atopic Dermatitis Treatment

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ABSTRACT

Atopic dermatitis (AD) is a chronic, itchy, and inflammatory skin disease that causes skin dryness, rashes, and inflammation. The disease requires regular use of moisturizers and anti-inflammatory drugs. Due to the fact that synthetic drugs are harmful to both human health and the environment in long-term use, the essential oil is alternatively used in AD treatments. In this study, it was aimed to develop nanofiber wound dressings with the emulsion electrospinning method, containing Hypericum Perforatum Oil and Borage Oil, for the treatment of AD. In the study, Polycaprolactone (PCL) and Polyvinylpyrrolidone (PVP) were used as the polymers and nanofiber surfaces were obtained by adding 1%, 2%, and 3% (v/v) oil to the polymer solutions. Hypericum Perforatum Oil and Borage Oil were mixed in a 1:1 ratio by volume and PCL and PVP polymer solutions were prepared at the weight ratio of 10%. For emulsion electrospinning, surfactants were used as Kolliphor RH40 (3% v/v) for PVP solution and Triton X-100 (3% v/v) for PCL solution. FT-IR analyses of the nanofibers, Borage oil and Hypericum Perforatum oil, and surfactants were carried out. In addition, SEM images of PCL and PVP nanofibers with different oil contents and pristine PCL and PVP nanofiber structures were evaluated. Depending on the surfactant content and oil ratios added to the nanofiber structure, increments in nanofiber diameters and changes in surface characteristics were observed.

***Keywords*:** Atopic Dermatitis, Wound Dressing, Nanofiber, Essential Oil.

Polydimethylsiloxane Based Polymers and Their Applications in Textile Finishing and Improving Antibacterial Properties of Cotton Fabrics

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ABSTRACT

With the development of economy and improvement of people's living standard, the functional textiles have gradually been widely used in various industries and human life. Cotton fabrics are one of the most important natural polymer materials, which possess superior properties such as softness, comfortability, breathability, and biocompatibility. Thus, cotton fabrics have acquired wide applications in the realm of clothing, house furnishing, industrial and military applications. In recent years, multifunctional cotton fabrics have been greatly developed, cotton fabrics with waterproofing, UV blocking, antibacterial resistance and flame-retardant have been reported by many studies.

To date, polysiloxane has attracted considerable attention in the area of fundamental research and industrial applications due to its unique properties, such as high thermal stability, biological compatibility, hydrophobicity, low toxicity, etc. Silicone softeners can be applied to natural and synthetic fibers, as well as providing a softer, flexible, draping feature compared to other softeners. Moreover, it has advantages such as not adversely affecting its mechanical properties such as tear resistance and abrasion resistance.

In this study, the use of PDMS compounds in textile finishing applications and the antimicrobial properties of molecules trapped in the polymer network; It has been investigated whether the surface will migrate from the surface in washing and wiping processes and the properties it will bring to the surface.

Keywords: Polydimethylsiloxane, Silicone, Finishing, Water Repellent, Antimicrobial Properties.

Chlorodimethylsilane-Mediated Reductive Etherification Reaction for Postpolymerization Modification of Aldehyde Functional Polymers

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ABSTRACT

Postpolymerization modification (PPM) is a useful method to obtain desired functional polymers required for several applications. PPM is particularly useful when direct polymerization of functional monomers is not suitable due to the possibility of side reactions in the polymerization conditions that can lead to the loss of desired functionality. A good PPM technique should fulfil some requirements such as quantitative yields, easy to conduct under mild conditions and easy to purify.

Reductive etherification reaction (RER) which utilizes organosilane compounds, generally with acidic catalysts, can be used to synthesize ethers from aldehydes or ketones. Self-reduction of carbonyl compounds yield to symmetrical ethers while alcohols are used as nucleophiles to prepare unsymmetrical ethers. In this work, a polymer with pendant aldehyde group was synthesized via free radical polymerization of 4-formylphenylmethacrylate in the presence of 1,1'-azobis(cyclohexanecarbonitrile) (ABCN) as radical initiator. The synthesized polymer platform was then subjected to RER in the presence of chlorodimethylsilane (CDMS) which has both Lewis acid and reductive properties, and different alcohols with various functional groups in a nitromethane/dichloromethane solvent system. The reactions were performed at room temperature overnight to afford different alkoxy-functional polymers. Effect of different alcohols and mole equivalents of reactants on PPM were investigated. Resulting polymers were characterized by several spectroscopic methods such as ^{1}H and ^{13}C nuclear magnetic resonance (NMR) spectroscopies, Fourier transform infrared (FT-IR) spectroscopy, and gel permeation chromatography (GPC). It was found that modifications proceeded in high yields (90-100%).

***Keywords*:** Polymer Modification, Reductive Etherification Reaction, Free Radical Polymerizatio.

URBAN AND REGIONAL PLANNING

An Investigation on Spatial Quality and User Satisfaction of Bakırkoy Bazaar

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ABSTRACT

When the concept of quality, which expresses the well-being of a character or situation, is handled in an urban space, the space offers its users more enjoyable experiences, a livable environment and a higher quality of life.

The study aims to examine the spatial quality of the Bakırköy Bazaar which is an important sub-center of Istanbul and to reveal user satisfaction according to gender and age parameters. Bakırköy Bazaar serves not only its immediate surroundings but also a large area and population. Therefore, spatial quality and user satisfaction are very important. Moreover, revealing the spatial quality and user satisfaction of the bazaar will make important contributions to the renewal processes that it will go through in the future.

The method of the study was designed in two stages. Firstly, observations were made according to "quality measurement indicators". Secondly, a survey was conducted with 60 users. The participants were asked questions about access to the area, land use and variety of activities, physical and visual quality, social interaction, safety and psychological comfort, then their answers were evaluated and inferences were made about the satisfaction level of the place.

According to the findings, accessibility and walkability are high thanks to the diversity and integration of transportation modes and pedestrianized streets. The bazaar hosts different activities and encourages social interaction. The bazaar is open to people of all social classes and age groups. Users feel safe in the area. Users, especially women and the 20-39 age group, find the bazaar to be weak in terms of image and aesthetic quality. Obsolescence, defects and forms of street furniture and flooring, and visual disharmony created by shop signs are among the most frequently mentioned negative issues. Furthermore, users find the maintenance and cleaning of the area insufficient.

***Keywords*:** Spatial Quality, User Satisfaction, Bakırköy Bazaar.

Publicness Evaluation of Public Spaces: *Aydın City Square*

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ABSTRACT

Public spaces are important elements of cities have always been discussed from different perspectives as definition, functions, types and design from ancient Greek to the present. Until today, there are breaking points that change and transform public spaces such as the industrial revolution, information and communication technologies and the covid-19 pandemic. In addition, the mention of public spaces in the 2030 sustainable development goals shows the importance of public spaces. All of them cause various approaches and discussions about public spaces like quality, perception, users' perspective and publicness.

The aim of this study is to understand the publicness criteria of squares as public spaces. Firstly, public space, publicness and evaluation models, such as cobweb model, star model, tri-axial model, OMAI model and publicness evaluation model, are discussed based on literature review. Then, the case area is analyzed within the framework of star model that includes ownership, control, civility, physical configuration and animation indicators. The indicators except ownership are measured between 1 to 5 by using method of structured observation and are calculated through arithmetic mean to provide star diagram. The case area is Aydın City Square, which was designed as a prestige project, image and identity element for the city center after becoming the metropolitan municipality. The importance of area is about new designed and being the only square in central district, Efeler in Aydın.

The main finding shows Aydın City Square's publicness scores are ownership, physical configuration, control, civility and animation from high to low. Firstly, Aydın City Square's ownership is on local authority. The physical configuration is related with macro and micro design decisions and can be evaluated as successful. The area is controlled with cameras all the time or by polices sometimes. Civility includes maintenance and the area is tidy and clean in general. Lastly, the least score is animation that is related with activities because there are no activities in city square. The activities are organized only for special days or aims.

This study is important to understand the publicness criteria and their effects in city square case as public spaces. The study will guide decision-makers for city square design decisions in terms of publicness criteria.

***Keywords*:** Publicness, Publicness Evaluation Models, Star Model, Aydın City Square.

Unmanned Aerial Vehicles Based 3D City Modeling Data Collection, Processing and Analysis: *The Case of Yavuz Sinan Neighborhood*

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ABSTRACT

In recent decades, Unmanned Aerial Vehicles (UAVs) have shifted from being exclusively used for military purposes to playing a role in civilian applications, with small drones becoming available for purchase in markets. Simultaneously, 3D city models (3DCMs) have taken a significant place in various fields of research, especially after the rise of computer graphics and improved storage abilities. High number of publications and their Compound Annual Growth Rate (CAGR) were observed in both 3DCM and UAV research separately, while limited publications were found when searching for topics involving both 3DCM and UAV.

The main motivation behind this research is to integrate UAV technologies into 3D city modeling. Data, including aerial and oblique imagery, were collected in the Yavuz Sinan neighborhood, located in the historical peninsula of Fatih province in Istanbul. Multiple UAV flights were performed using the DJI Phantom 4 drone and its built-in high-resolution camera, with flight settings based on previous photogrammetry research. The imagery was processed using key-points matching techniques, and the resulting data were integrated into the 3D modeling platform as input.

Produced maps were recognized to have higher resolution and accuracy when compared with satellite imagery. The Digital Terrain Model (DTM) was produced from a high-density classified point cloud dataset, with all points classified as vegetation, buildings, or man-made features being removed to create the DTM. The resulting mesh model, relying on both high-resolution aerial and oblique imagery, provides textured building roofs, elevations, as well as vegetation and terrain information. However, the derived buildings' footprints had limitations due to the fact that the buildings are side-attached, leading to the manual editing of polygons to split them into separate buildings of different heights. The generated building masses were represented by least solid polygons, allowing for urban simulation.

Finally, in an attempt to examine the analysis ability of UAV-based 3DCM, a pedestrian wind comfort analysis was performed. The simulation relied on Computational Fluid Dynamics (CFD) for 32 wind directions, with wind data obtained from the nearest weather station. The Lawson wind comfort criterion was used to assess the pedestrian wind comfort at a height of 1.6 meters from the ground. The study concludes with recommendations for maximizing the power of integrating UAVs as data collection tools for 3DCM to overcome data limitations. Lastly, the study provides general guidance for the workflow, highlighting the sections that can benefit future research likely to follow the same approach.

***Keywords*:** Unmanned Aerial Vehicles, 3D City Models, Pedestrian Wind Comfort Analysis, Drone, Yavuz Sinan Neighbourhood.

Urban Agriculture Site Selection for Food Security: *Case of Beylikdüzü, İstanbul*

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ABSTRACT

The global climate crisis threatens the resilience of urban systems more than ever before. The food system, as one of the urban systems, is impacted by the climate crisis and contributes to global warming. This circumstance raises concerns about food security in cities and the possibility of a future food catastrophe. In this context, urban agriculture is a prominent implementation within the scope of the planning discipline in urban areas. Despite the fact that there are several researches on food security and urban agriculture in the literature, there are few studies on the local and spatial level in Turkey. This research examines urban agriculture site selection at the local level for a durable system, responsive to food security. In this context, İstanbul Beylikdüzü was chosen as the study area. Following the literature review, Vancouver, Ljubljana, Baltimore, and Austin examined at in order to develop a comprehensive approach to food security and urban agriculture at the local level. A two-stage multi-criteria decision- making approach was followed in the GIS environment in the selection of the area for urban agriculture in the district. The first stage involves identifying food priority areas by evaluating at land use, household income, and access to food sales locations. In the second stage, the area selection for urban agriculture is carried out by overlay analysis in GIS environment with food priority area, population density, urban land use and property data. According to the outcomes of analysis, the low-income population has weaker food access, while the areas with low food access are concentrated in the coastal areas of the district. Considering the land use and public property in the site selection procedure, it is determined that there is relatively prioritized potential urban agricultural zone in 20 ha. This study presents a local scale spatial approach to food security in urban agriculture. The findings of this paper will guide public authorities and civic initiatives to provide an analytical procedure for establishing urban agriculture and food security policies in subsequent planning works.

***Keywords*:** Food Security, Urban Agriculture, GIS, Multi Criteria Decision Making.

Generative Design as a Decision Support Tool: *Land Use Decisions in Göktürk, İstanbul*

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ABSTRACT

Due to the acceleration of massive migration from the village to the city, professionals have developed various theories in order to define this acceleration and fulfill immediately the basic needs of new comers within the cities. Today, many professionals accept that cities are considered as complex systems of different subsystems. Thus, the migration destructs rapidly the current system and creating a new one. In the cases, where uncontrolled development of cities occurs, a new, fast and sustainable plan production system became a must. Current plans with a long-term plan production process have difficulty in catching this speed, and the changes made afterwards create disconnections in the plans. Generative design, as an effective decision support tool, is flexible in nature and shorten the decision process which can be used during the application of current built environment change. Aim in this study is to apply generative design to show how the generative design can help to planner in decision making process by creating optimized solutions to different scenarios in short time. Göktürk neighborhood was selected as a case study due to its rapid and heterogenic growth which private sector dominated. Because spatial disconnections will impair the city's quality in the future, it is critical to control changes in the built area. In this study, the existing road texture and parcels in Göktürk were taken and alternatives were produced in a generative way in line with the parameters determined by the designer as area adequacy and accessibility distance according to MPYY (Turkish spatial plans building code). Grasshopper, visual programming interface, was used due to its easy coding interface for beginners and it can be applied easily in alternative creation. First of all, the adequacy and accessibility of urban green areas (MPYY based) in the current land use were calculated over the shortest walking distances by applying the A* search algorithm. Then, alternative green area selections were made, these alternatives were optimized in an evolutionary way with Galapagos component and the most suitable plots were determined. 491 results were presented to the decision maker within 3 minutes. Among these alternative decisions, 2 main optimized scenarios were selected. In the first scenario, more parcels were accessible in 250 m distance to green areas but area adequacy was low while second scenario provides more areal competence but less accessibility. As a result, generative design has produced many alternatives in a short time, in a way that can be changed, allowing the planner to easily choose among these alternatives according to priorities such as space adequacy, accessibility and amount of expropriation in the decision- making process.

***Keywords*:** Generative Design, Alternative Scenario, Göktürk, Optimization.

Agricultural Land Use Change within Growth Context: *Evidence from Turkey*

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ABSTRACT

In the current period, the sustainability and continuity of agricultural production gains great importance due to many reasons such as pandemic, climate change and food crisis risk. At this point, it has become a necessity to use agricultural lands in accordance with their purpose. As in many developing countries, a rapid change has been observed in agricultural lands in Turkey in recent years. According to current studies on this issue, the main reasons for this change are related with population growth and then investments and/or spatial requirements. However, although the basic reasons do not exist, it is possible to observe areas where agricultural land change or loss continues. Preventing the destruction of agricultural lands depends on the correct determination of these reasons. This study aims to reveal the driving forces of agricultural land use change in Turkey especially in regions where the population is declining. In accordance with our aim, the address-based census data from 2007 to 2018 and CORINE (Coordination of Information on the Environment) data of 2006, 2012 and 2018 were used to analyze the transformation of agricultural land. The study focuses on determining the main reasons of agricultural land loss, and discusses whether the agricultural land change in the provinces (NUTS 3 level) with decreasing population depends on the planning criteria and related planning process. The change of agricultural lands is evaluated through development approaches and the environmental plans. Therefore, the paper will discuss the agricultural land use changes via relation between urban growth and socio-economic development. It is expected that plans without taking into account population trends and estimating needs of the regions accurately, plays a big role in affecting agricultural land. Ensuring the sustainability of agricultural lands and other existing potentials depends on the specific plan decisions and development approaches suitable for the local characteristics of each province. In order to protect agricultural land it is needed to provide a holistic planning approach within the country level.

Keywords: Agricultural Land Use Change, Population, Growth, Planning, Turkey.

Evaluating Historical Urban Squares in terms of Visitor's Preferences

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ABSTRACT

Citizens use urban squares, which are one of the public spaces, on a daily basis and urban squares are the focal point of social activity. Transportation and accessibility to urban squares are critical in this context. The purpose of this study is to utilize and deliberate the relationship between the visitor's mode of transportation and the purpose of using the squares in accessing selected squares (Beyazıt, Çemberlitaş, Sultanahmet, Sirkeci, Eminönü) located in the Historical Peninsula of Istanbul. The reason why this study is carried out in the Historical Peninsula is based upon that the city is one of the most important public space where the activities of all local and foreign visitors are centered, its access foundation is strong, it offers a walkable environment and it is the main historical and touristic focal point of the city. The study, which focuses on the square visiting preferences of three different groups of visitors who arrive at the squares as pedestrians, by public transit, or by private automobile, is conducted face-to-face with 375 people using a survey consisting of closed-ended questions. As a consequence of the study, it has been determined that the squares in the Historical Peninsula of Istanbul are considerably accessible in terms of transportation modes. The purpose of individuals who come to the squares as pedestrians or by public transportation is to participate in many activities, but those who arrive by private automobile are determined to arrive at a different location as a transit point. It is observed that the vast majority of visitors who come to the square do not make a travel plan before they come to the urban squares. The current state of the squares, as well as what needs to be done to improve their visiting purposes, are also discussed in the study. A broad assessment is made as a result of all of this information.

***Keywords*:** Urban Squares, Public Space, Urban Transportation, Istanbul, Historical Peninsula.

Private Health Insurance as an Economic Measurement of Accessibility to Healthcare Service: *The Case of Bursa*

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ABSTRACT

Getting healthcare services is possible in various ways. In large urban areas, the accessibility of all users to these services is challenged due to overpopulation, travel time and costs, transportation opportunities, etc. The accessibility cannot be defined dependent solely on distance between users and service. Availability and affordability of the service are components of the accessibility concept. Furthermore, the factors that affect accessing can describe demand measurements of the service. For instance, spatial, demographic and economic characteristics of the users indicate both the accessibility to service and the demand of the users. In this study, the healthcare sector was determined as the subject of the research. Healthcare services in Turkey are provided by both the public and private sectors. Considering the sectoral differences, economic parameters are determinant in accessing health services. Prices of health care services, income level of patients, ability to pay and having health insurance are the limits of affordability. The general health insurance includes the services which are provided only from public universities and public hospitals in Turkey. It can be said that private health insurance ownership is the most determinant parameter to analyze user behavior. The study aims to demonstrate the relation between spatial distribution of the private healthcare facilities and population with private health insurance in Bursa. The locations, capacities, specialties of the facility, population and number of private (and supplementary) health insurance owners constitute the inputs of this research. The distribution of these insured people and these facilities are analyzed on the scale of the counties.

Keywords: Accessibility to Healthcare Service, Health Insurance, Bursa.

Examining the Sense of Place and Belonging Among Students in Weimar

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ABSTRACT

This paper investigates different ways of creating sense of place and belonging among a small group of students who moved to Weimar, Germany in November 2021. The group consisted of individuals who comes from different locations, nationalities and modes of living but located in the social context of Bauhaus University in Weimar. I have been a part of the group through my own experience. The starting point of this short-term ethnographic research is a search for diverse understandings of how one feels belonging to a place. On this topic, three questions led the research. (1) In what ways the sense of place and belonging is created by different individuals? (2) What are the common qualities of these experiences? (3) How can spatiality be used to further understand these conditions? The paper conceptualizes the relationship between individuals and place formed through a sense of belonging to understand how different community practices and spatialities are formed.

To gain a better understanding of the different modes of meaning-making I have conducted semi-structured interviews in addition to participant observations.

The insights show the participants' newly formed relations to the place and draw parallels among distinct experiences. A unique sense of place and belonging is formed as a result of social relations that are bound with certain spatialities and specific locations, both real and virtual.

***Keywords*:** Sense of Place, Belonging, Students, Socio-Spatial Relations.

Investigation of Land Use Change and Urban Sprawl Around Mersin City Hospital

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ABSTRACT

The goal of this study is to analyze the change in land cover and land use in the vicinity following the construction of the Mersin City Hospital project. The analysis is carried out using remotely sensed satellite imagery, which is a powerful tool for analyzing a wide range of research issues, including the monitoring of built-up areas, changes in land cover, and land use. In this study, cloudless composites of open access Landsat 8 OLI (Operational Land Imager) satellite images of 2015 (before the opening of the hospital), 2017 (the year of the opening), 2019 and 2021 (after the opening) were prepared and classified in the Google Earth Engine Platform using ground truth samples and the Random Forest classifier. The quantitative results of the employed image classification show that the artificial surfaces covering 21.41% of the district in 2015 increased to 32.75% in 2021. At the same time, the rate of agricultural lands decreased from 44.8% to 31.47%, the forest area increased from 5.9% to 15.8%, and the barren lands decreased from 27.8% to 19.97%. As a result, it can be said that such a mega-project makes a negative contribution to the sustainable use of land in Mersin City. Housing production is found to be accelerating towards the project site, and the development seems to be uncontrolled in the vicinity of the Mersin City Hospital without considering the balance of protection.

***Keywords*:** City Hospitals, Land Use, Google Earth Engine, Geographical Information Systems, Mersin.

An Overview of Urban Transformation of Fikirtepe: *Spatial Analyses on Land Values*

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ABSTRACT

Cities are dynamic structures that constantly renew themselves within the phenomenon of time and change according to current social, economic and political conditions. Cities in transition is a very attractive subject for both research and policy makers, due to recent available low cost spatio-temporal data. This study aims to aid policy makers to monitor and analyze transforming districts in urban areas, where spatial information science and methodologies are deployed. Furthermore, impact of transportation infrastructures within this transformation is analyzed. A framework is developed for this purpose and is applied in Fikirtepe, in İstanbul Metropolitan Area. Fikirtepe, is a prominent example of this change in terms of social, environmental and economic aspects. Furthermore, the Istanbul metrobus line, which was opened in 2006 and in 2009, passes through Fikirtepe that has changed and accelerated this transition. In order to implement the designed framework, street based land value data for 2002, 2009, 2014 and 2021 were used. Data is retrieved from the official open sources of Kadıköy Municipality, to which Fikirtepe neighborhood is affiliated. The value increases in the region were examined with thematic maps, and their proximity to the bus rapid transit route was determined via spatial analyses. The change generated by the urban transformation process was observed that has started in 2012 in the region. The texture change in the region was examined with satellite images. In this study, the change of Fikirtepe has been examined using GIS-based analyses, where geometrical and land value changes are the main input for detecting the transition. According to the analyze, the land value pattern of the study area is achieved, where the increase in land values are not linear as expected. The full spatial analyses will aid policy makers to conduct collaborative analyses to manage areas in transition.

***Keywords*:** GIS, Spatial Analyses, Urban Transformation, Metrobus.

Cooling Effect of Green Parks - Istanbul Example

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ABSTRACT

With the industrial revolution, the rapidly increasing population has led to unplanned urbanization which in turn effected the existing natural areas. As a result of increasing population, heating and cooling consumptions, the increase in vehicle use and covering of soil surfaces with materials such as asphalt in cities cause temperature differences in urban scale. Urban green spaces (UGS) have cooling effect in reducing the impact of urban heat islands, which are directly related to climate change. The aim of this study is to evaluate the cooling effect of green spaces on the microclimate of the Anatolian Side of Istanbul-Turkey. 2018 Landsat 8 OLI/TIRS satellite image data is examined to determine the relationship between the land surface temperature (LST) and the buffer distances of the parks. Impervious surface density data is used to define the impervious surfaces. In 2018, the temperature difference between built areas and natural areas is determined, and it is observed that the temperature difference between impervious surfaces and natural areas (pervious land) is 5.4°C. 65 urban green areas over 25,000 m² are selected for a clear assessment of the scale of LST, and the average temperature of these parks is 25.57°C. Of the 3 metrics (Cooling intensity (CI), Cooling Extent (CE), Cooling Lapse (CL)) used to determine the cooling effect, the average value of CI is 1.6°C and the maximum value is 7.8°C. When the CI value in Istanbul is analyzed spatially, it is seen that it generally increases in the green areas near the Bosphorus. As the size of the park area increases, the LST decreases. There is a strong correlation between the LST of the UGS and the Water Distance. This is an indication that in future, not only the growth of green spaces as an area, but also the use in and around it should be carefully planned. It is concluded that the ecological functioning of the green parks in the landscape structure should be better planned based on scientific findings. Therefore, this study forms an example to underline the importance of efficient cooling effects on designing green spaces with the aim of reducing the Urban Heat Island (UHI) values in hot and humid cities like Istanbul.

***Keywords*:** Land Surface Temperature, Urban Green Spaces, Urban Heat Island, Cooling Effect, Istanbul.

Cyripto Cities

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ABSTRACT

Countries or cities always face a problem and take different actions. Increasing economic growth and employment, promoting diversity and equality in society, providing access to public spaces/services, reducing economic inequalities, compete against climate change on a global scale, increasing democratic participation, ensuring public safety, and while doing all these, the orientation from rural to urban The biggest challenge of the cities, which have to manage the demographic transformations that arise as a result of this, is the issue of social, political, environmental and economic sustainability. The new urban approaches used in studies on this subject are spare city, Wifi city, sponge city, resilient city, 15-minute city, learning city, etc. is in the form. The common point of these approaches is to increase urban sustainability and urban resilience, living standards and quality in cities. However, the concept of smart city appears in almost every approach. Policies produced from the perspectives and satisfactions of citizens, community perspectives, and focus on neighborhood design are essential to support sustainability in smart cities. "Is it possible for us to design and simulate the future plans of cities based on the past and present state of cities and to involve the citizens in the process at this stage?" In this study, which set off with the question of, the crypto city vision will be tried to be revealed with a metaverse approach in which the citizen is included in the planning. Within the scope of the crypto city, approaches such as digital twin, internet of things, blockchain, machine learning and game theory will be used. According to the smart city approach, perhaps the most important difference that stands out in this technological approach is the ability to provide experience to the citizens and to be actively involved in the management of the city. The approach being developed within the scope of the study; Matching the virtual and physical worlds of cities will allow data analysis and monitoring systems to prevent city-related problems before they arise, develop new opportunities, and make plans for the future with simulations. It is thought that this process can be realized in a virtual city over the metaverse and healthier decisions can be made. For this reason, it is thought that it would be beneficial to go to a metaverse-based citizen-supported planning process in the solution of today's urban problems within the scope of the study.

Keywords: Smart City, Crypto City, Citizen Participation, Metaverse, Game Theory, Digital Twin, Blockchain.

MISCELLANEOUS

Performance Comparison of Delayed Resonator Feedbacks for Non-Collocated Vibration Suppression in Flexible Structures

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ABSTRACT

Vibration phenomenon forms the basis of the main problems encountered in mechanical structures. While unwanted vibrations affect the surface quality of the machined part in machining, it can affect the trajectory tracking of the end point in robots. In order to solve this vibration problem encountered in various industries, long-term studies have been carried out for years. When the literature is examined, these studies have been carried out in three different methods as passive, semi-active and active. In passive absorbers, a material with high damping feature is integrated into the structure, while in active absorbers a force is created to suppress the vibration. In this publication, theoretical studies have been carried out on the active damping of forced vibrations in continuous structures in anon-collocated position away from the vibration source. Within the scope of these studies, anon-collocated vibration suppression delayed resonator for a continuous structure, one end of which is fixed, and the other end is free beam structure. Beam structures are mathematically modelled using Euler's equations and stability maps are obtained based on these models. The effects of the feedback method used in the delayed resonator were also examined in the broadcast. According to the simulation results, large differences were found between the acceleration, velocity and position feedbacks for stable excitation frequency ranges of the delayed resonators. Considering these results, it has been observed that the velocity and acceleration feedbacks have a wider range of stable excitation frequencies than the position feedback, but the suppression performed by using position feedback at a same frequency value gives better results.

***Keywords*:** Delayed Resonator, Feedback, Vibration Suppression, Euler Beam, Flexible.

Compression of Image Super-Resolution Networks via Self-Distillation

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ABSTRACT

Single image super-resolution (SR) is an ill-posed problem which aims to reconstruct high-resolution image from a given low-resolution image. Convolutional neural networks (CNN) have helped SR to achieve good performance as in many tasks in computer vision. With the advances on hardware, recent CNN-based architectures are designed as deeper and deeper models which have high computational complexity and memory usage in order to obtain better results for image super-resolution task. However, high memory and computational cost prevent the deployment of SR networks in mobile devices with low budget. This issue has drawn the attention of researchers to model compression which resulted in various frameworks such as parameter pruning and quantization, low-rank factorization and knowledge distillation. Hence, in this study, we focus on compression of SR networks with repetitive blocks using knowledge distillation. Our experiments demonstrate that the reconstruction performance of SR models decreases by a small margin even if many blocks of the model are removed from the network contrary to the classification networks. With this point of view, we propose a self-distillation approach for EDSR, which is an SR model with repeating blocks, in order to compress the network while keeping its performance as high as possible. Moreover, we conduct comprehensive experiments to validate our approach, where we evaluate the compressed models with different compression ratios on five SR benchmark datasets which are Set5, Set14, B100, Urban100 and Manga109. Results show that our approach yields successful compression of EDSR model where it achieves multiple compression ratios with a single training stage.

***Keywords*:** Image Super-Resolution, Knowledge Distillation, Self-Distillation, Model Compression, Hint Distillation, Feature Matching.

Effects of Silicon Fertilization on Plants

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ABSTRACT

Silicon (Si) is the eighth most common element in nature and the second most common in the soil after oxygen. Silicon, which has no toxic effects on humans and the environment, is probably the only element that can increase resistance to multiple stresses. The essentiality of silicon for plant growth and the silicon content of plants has been one of the study subjects of researchers. Although silicon is abundant in nature, its biological functions have not been determined as well as those of other elements such as carbon, hydrogen, and oxygen. In the early 1900s, silicon was recognized as one of the 15 essential elements for plant life. As a result of the next studies carried out to determine whether silicon is an essential element in plant development, it has been stated that silicon is not an essential element for plant growth (except for certain algae and the Equisetaceae). But increasing evidence in the literature indicates that silicon is beneficial for plants under stress conditions. Silicon fertilization is used to provide benefits such as tolerance to salinity, high and low temperatures, bacterial and fungal diseases, ultraviolet rays, heavy metal toxicity, and wear and water use efficiency in fruit trees, vegetables, crops, and turfgrass. Silicon fertilization has the potential to reduce nutrient consumption in the soil. It is an alternative to the widespread use of phytosanitary and NPK fertilizers to sustain sustainable agriculture. By reviewing the available data in the literature, the beneficial role of silicon on plants is discussed in this review. The study presents perspectives on the use of silicon to ensure quality and sustainability in plant breeding.

***Keywords*:** Plant Growth, Stress, Fertilizer, Essentiality.

Biological Invasions under Climate Change: *A Hybrid Modeling Approach*

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ABSTRACT

Biological invasions are a major component of global environmental change. Increasing numbers of Invasive species which are introduced to new regions with anthropogenic dispersal due to globalization, cause severe economic losses and lead to irreversible ecological consequences such as biodiversity loss and species extinctions. Since prevention, eradication or mitigation efforts are cost and labor intensive, careful planning is crucially important and requires reliable predictions on the potential outcomes which include consideration of various factors affecting invasion process. In this respect the modeling methods constitute a valuable tool. In the recent decades, in accordance with the increased accessibility of environmental data and widespread availability of high performance computational devices, species distribution models (SDMs), especially correlative models involving machine learning algorithms, have been utilized for making invasion projections to determine the suitability of a region for an invader. However, in consideration with the crucial mechanisms such as dispersal and propagule pressure, suitability which is interpreted as risk is not always sufficient to project a biological invasion. In this study we developed a hybrid modeling framework which takes advantage of predictive capabilities and spatiotemporal transferability of SDMs with utilization of Agent Based Modeling to overcome aforementioned inherent limitations to simulate biological invasions under climate change.

The framework consists of a correlative component which involves an SDM to determine bioclimatic suitability based on climatic projections at population level and an agent based component to simulate the invasion processes at individual level via subprocedures with utilization of various static and annual environmental layers such as topography and accumulated growing degree days, respectively. The framework has been utilized to simulate a biological invasion involving a hypothetical species under RCP4.5 scenario for the 2020- 2050 period and the results were compared with the conventional SDM application to demonstrate the differences between the projections.

Keywords: Biological Invasions, Climate Change, Species Distribution Modeling, Agent Based Modeling, Hybrid Modeling.

Economic and Environmental Assessment of the Use of Coal and Improved Coal and Mixture of Various Biomass Types

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ABSTRACT

The monetary equivalents for the heat provided by the coal and its mixtures used in the pulverized coal injection as a substitute for the heat provided by the coke fed to the blast furnace are calculated below. It is known that 440 kg of coke is consumed for 1 ton of liquid metal in the Kardemir blast furnace. An average of 1200 tons of liquid metal is produced daily in this furnace. Accordingly, daily coke consumption is around 528 tons/day. On the other hand, when the powdered coal is burned, the pulverized coal injection energy input fed to this furnace daily is in the order of 3,618,000,000 kJ/day. In this study, daily cost calculation when Azdavay coal is used alone is presented. Daily cost calculation for other crude coal/biomass/advanced coal mixtures is presented. The environmental cost of different biomass and reclaimed coal blends is also an important issue. Here, the use of renewable biofuels instead of fossil fuels is important for sustainability. It is important to reduce the CO and CO_2 values released into the atmosphere as a result of combustion-related environmental impact. Accordingly, the ratio of CO at the exit in the mixture of raw coal and improved coal is 0.338%, and the amounts of CO and CO_2 leaving the combustion chamber are in the order of 27.6 g/s (994 kg/h) and 85.4 g/s (3074 kg/h). In this case, there is at least CO. On the other hand, the lowest CO_2 emission is in the carpentry sawdust mixture. Considering these values, it is seen that the coal obtained as a result of the improvement of the raw coal has lower CO emissions than the biomass.

***Keywords*:** Economical Assessment, Combustion-Related Environmental Impact, Pulverized Coal Injection.

A U-Net Based Structure for Segmentation of High-Resolution Wound Healing Assay Time-Series Images

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ABSTRACT

Wound healing assay is an efficient and popular tool for cell biologists to observe collective cell movements under various conditions. Phase-contrast microscopy is a technique that is used for the analysis of wound healing assays with minimal effect on the living cells. However since phase-contrast microscopy does not use any special dye or fluorescent labelling to highlight the cells, differentiating empty and cell regions in the recorded microscopy time-series images can be challenging. Correctly labelling the microscopy images is an important step of the wound healing assay analysis. Thus automated segmentation of the wound healing assay images is an important research area. Moreover, there are some requirements to be met by the automated segmentation methods such as high accuracy, robustness and low computational cost. U-Net is an accurate and popular convolutional neural network structure used for medical image segmentation. However, the computational footprint of the U-Net structure increases exponentially by the size of the data input. There exists some approaches to use U-Net models with limited resources such as down-sampling or tiling the input data. Nevertheless, reducing the input resolution hinders the accuracy of the results and tiling operation is not efficiently applicable for some data that have large atomic characteristics such as wound healing assay images. In this paper we have proposed a new, high-resolution and shallow U-Net based structure for accurate and low-cost segmentation of high-resolution wound healing assay time-series images.

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***Keywords*:** Image Segmentation, Neural Networks, Wound Healing Assay, Microscopy Imaging.

Use of Computer and Mobile Application Supported Maintenance and Repair Management Systems in the Data Center

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ABSTRACT

Maintaining technical activities such as breakdown, maintenance and control of equipment in Data Centers are the basic steps of providing uninterrupted service. Planning the maintenance times, keeping a record of the failure notifications, and controlling the areas such as server rooms with mobile applications and computer-aided systems will both save time and provide instantaneous delivery of work orders to the personnel. For these reasons, computer-based and mobile application-supported software are recommended in this article. With this maintenance management application, it will be ensured that the maintenance is done at the right time and the probability of failure of the equipment will be minimized. Thanks to this software, it is possible to take photos and videos, fill in control and maintenance forms within the scope of quality, stop a task, transfer a task, add notes to a task, and complete a task. More clearly, all of the maintenance and in site control operations could be conducted through the proposed algorithm easily.

***Keywords*:** Maintenance Management System, Work Order Management, Field Task Management, Fault-Maintenance Management, Site Control System.

Employment and Unemployment Experiences of Sports Faculty Graduate Women

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ABSTRACT

This study aims to analyze employment and unemployment experiences of sports faculty graduate women. Most of the literature on women in sports are written with a feminist theory perspective as part of gender studies. Here, macroeconomic parameters and labor theories are prioritized in the analysis of employment and unemployment experiences of women in the sports industry. Semi-structured interviews were conducted online via Zoom with 22 women from different backgrounds, cities, universities, and ages, lasting 30-35 minutes on average. A qualitative research method was used, and a content analysis was conducted on the transcribed interviews, which revealed the following themes: geographical advantages and disadvantages, education's role in employment and unemployment, gender's role in employment and unemployment, wage and social security issues in employment, unemployment processes and experiences, perception of favoritism/cronyism/nepotism, perception of the sector and the profession. Almost every participant underlined the fact that women in sports, if they tried and educated themselves well enough, under the equal employment opportunities, will be able to find a job. In addition, every one of them pointed out that favoritism is the main problem surrounding the sports sector whether finding jobs in the federations, sports clubs, or academia. Turkey's heteronormative and patriarchal culture affecting societal gender norms challenges women in sports with housework and childcare in addition to their mostly physical work in their jobs. Women are faced with limitations on finding a job in the public sector and with obstacles, especially in terms of wages, in the private sector. This causes women either to be unemployed for years or working in jobs for unlawful hours for low wages. This study draws attention to the structural changes in governments, municipalities, federations, sports clubs, and universities that are needed for women to have a transparent, equal, and prosperous future in sports.

***Keywords*:** Women Employment, Sports Faculty Graduates, Youth Unemployment.

Air Travel Demand in Covid-19 Pandemic

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ABSTRACT

This study aims to forecast an airline's demand during the pandemic period. Since the characteristics of passenger demand have changed a lot compared to the pre-pandemic period, the current forecasting models lost their predictive power. Because the existing models are fed by the reservation curve of the flights that depart in the same period last year. As the booking curve changed, the estimation results lead to low accuracy as well. Load factor should be accurately estimated both to maximize the airline's revenue and to determine effective pricing strategies. Daily flight data from a European airline was used to estimate flight load factors. With the start of flights as of July 2020, all operating scheduled flights of the airline have been estimated. It was fed from the data created by the resumption of the flights that stopped during the pandemic. In the model, the day of week dummy variables to remove seasonal effects, booking numbers, and supplied capacities are used. Popular machine learning models were tested and chosen the model with the highest accuracy. When the model results are examined, much more successful estimation results were obtained compared to the pre-pandemic model. While the old model's MAPE value was more than 10 points in the pandemic period, it has now decreased to less than 3 points. The most important part was using the one-week reservation slope that captures the evolution of reservation characteristics during the pandemic. In this way, the model was able to observe the reservation periods shifts. Accurate flight estimation is of vital importance to maximize revenue, as flight cancellations are common in the pandemic due to flight bans and lack of demand.

***Keywords*:** Airlines, Expected Load Factor, Pandemic.

Highly Sensitive QCM Humidity Sensors with Nanoclay/Graphene Oxide (GO) Composite-based Films

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ABSTRACT

Humidity measurement is used in various aspects from weather forecasts to food and human safety, agricultural processes to mineral processing facilities. Therefore, there has been a growing requirement and extensive research on designing humidity sensors that are rapid, cost-effective, and highly sensitive. Although various methods have been developed, the Quartz Crystal Microbalance (QCM) is a very promising candidate, as it has excellent sensitivity to changes in mass with a nanogram level of detection and, an extensive measuring range. In addition, QCM sensors are stable and reliable in mild operation conditions and can be developed with low-cost. However, the quality and the properties of sensors are highly dependent on the additional sensitive layer. Thus, an additional sensing layer on the surface of QCM electrodes is required to improve the sensor performance including selectivity, sensitivity, response/recovery time and stability.

In this study, the preparation and coating properties of Nanoclay/graphene oxide (GO) composite-based films were investigated. GO was obtained from graphite powder by using a modified Hummer's method. Natural sepiolite and halloysite nanoclays were selected for fibrous clay structure and unique surface chemistry. Raw clay minerals were purified by air-lifting method. Dried samples were dispersed in distilled water by using a high shear mixer for 3 minutes. To form homogeneous composite material, GO and nanoclay samples were mixed with a proper ratio and were stirred for 12 hours. Spin-coating method was used to obtain a functional surface on the QCM electrode and characterized by AFM and contact angle measurements. By comparing the absorption peaks at UV-vis spectrum and the specific bands at FT-IR spectrum of GO samples, the existence of oxygen functional groups in GO nanosheets was confirmed. In addition, the AFM images and FT-IR spectrums of Nanoclay/GO composites demonstrates homogeneous coating was achieved and nanoclay particles were trapped between GO sheets as a result of particle morphology, porous surfaces and surface ion active groups as well as hydrophilic interactions.

Keywords: QCM, Graphene Oxide, Nanoclay, Humidity Measurement, Eco-Friendly Solutions.

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Shaping the Physical World's Digital Twin Based on Place Identity Theory

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ABSTRACT

The digital game and metaverse industry are shifting their focus on translating real-world urban environments into virtual versions (Digital twins). Even though digital games' visual and technological qualities are progressively being improved, an absence of a solid methodology for the optimal translation of urban environments from real to virtual is a non-negotiable fact. Hence, a unified design methodology must follow certain rules to maintain the sense of place when a virtual version of a city is being reconstructed. According to Bartle (2020), these translations do not necessarily attempt to make a replica of the cities. However, knowing which physical world elements should be mapped as a digital twin within the metaverse are essential (El Saddik, 2018). In addition, digital twins, in reality are the places that architects and landscape architects designed (Van der Merwe, 2021), so they are the people who perceive virtual places differently from the programmers and UI designers (Blinded, 2018) hence, based on their knowledge, metaverses are the new territories for them to redesign the digital twins stylishly to enhance the sense of place.

This research proposes an efficient and unified design method for translating the cities into twiners without annihilating the sense of place in the process. Although each physical place contains various components, all the components do not help to shape the place identity. In this regard, the research aims to find a pattern for developing the physical worlds digital twin. This goal is first achieved by taking advantage of place identity theory and classifying the fundamental urban elements using the Overlay Design methodology. Secondly, a university campus was modeled in the Unreal engine to test this theory. Therefore, based on the classification results, the environment components were deleted one by one for each model. These modeled versions went under step-by-step modifications to detect their impact on participants sense of place perception. Through a quantitative experiment on 110 participants who will experience the place in different versions, a questionnaire will fill out at each stage of the experiments.

The research expects from the experiment's data to recognize the components' effect on place recognition. In addition, with a 40 percent minimized model, users perceive the same â€˜Sense of Placeâ€™ as the replica model. As a result, a pattern will be introduced for the architects and landscape architects to redesign the physical places for the digital twins in a stylized way. By following the design method proposed in this research, architects and landscape architects can efficiently translate urban environments to their virtual versions.

***Keywords*:** Digital twin, Metaverse, Virtual Landscape Design, Place Identity.

References:

El Saddik, A. (2018). Digital Twins: The Convergence of Multimedia Technologies. IEEE MultiMedia, 25(2), 87–92. doi:10.1109/mmul.2018.023121167

Bartle, r.a. (2020) ce317/ce817 lecture 1. In: [online]. 2020 p. Available from: https://www.youhaventlived.com/qblog/2021/qblog270321a.html.

Friedman, A. (2021). Sense of Place, Human Scale, and Vistas. In: Fundamentals of Sustainable Urban Design. Springer, Cham. https://doi.org/10.1007/978-3-030-60865-1_8

Van der Merwe, D. (2021). The Metaverse as Virtual Heterotopia. In 3rd world conference on research in social sciences.

Examining the Change in Building Construction Technologies with Examples

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ABSTRACT

The world population is increasing rapidly. This situation also increases the need for housing. The construction sector has been slow to meet the housing demand. Residential construction accounts for 38% of the total global construction, and 40% of the total energy consumed is consumed by buildings. High energy consumption of buildings increases carbon emissions. Studies show that carbon emission is the most important factor triggering climate change. The construction sector has been insufficient in reducing carbon emissions. The increase in the effects of climate change and the increase in the demand for housing necessitate solutions that can be built quickly and that emit less carbon. For this reason, in this study, the issue of cost and environmental improvement of the construction sector is discussed in terms of examples of buildings that emit less carbon with faster production.

***Keywords*:** Housing, Building Construction, Robotic Fabrication.