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DOKUZ EYLÜL UNIVERSITY FACULTY OF SCIENCE

Artificial Intelligence Based Real Time Turkish Sign Language Recognition System

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Abstract

In this study, an artificial intelligence-based real-time Turkish Sign Language Recognition Application was developed, aiming to reduce communication barriers between Turkish Sign Language users and hearing-impaired individuals. The application has the ability to recognize Turkish Sign Language words in real time and is designed to improve the ability to understand certain phrases. In this way, a tool is presented that aims to help hearing-impaired individuals communicate more easily in their daily lives. The developed application is designed to include not only hearing-impaired individuals, but also non-hearing-impaired individuals. In this way, awareness of hearing-impaired individuals in the general society will be increased and the desire to learn sign language will be encouraged.

Sign language recognition is a challenging problem where signs are defined by simultaneous local and global articulations of multiple sources, namely hand shape and orientation, hand movements, body posture, and facial expressions [1]. Our application allows hearing-impaired individuals to communicate more effectively through text or voice conversion processes by detecting basic Turkish Sign Language words. In our study, a large and diverse data set was created for the training of the artificial intelligence model we developed. This dataset consists of thousands of images representing Turkish Sign Language signs. This comprehensive data set enables our model to recognize different signals with high accuracy.

Well-known major technology companies such as Google, Microsoft and Facebook have contributed to Augmented Reality (AR), Virtual Reality (VR) and Mixed Reality (MR) technology projects. This trend has expanded the application areas of hand signals and pose estimation. Additionally, some research has focused on controlling hand movements in the field of Human-Computer Interaction (HCI) [2].

In our application, accuracy is increased by using advanced deep learning models. These models are trained on a large Turkish Sign Language dataset and can recognize complex hand movements with high accuracy. Traditional sign language methods often use hand-designed features and Hidden Markov Models (HMMs) that model temporal information. However, creating reliable hand-engineered features is difficult and cannot accommodate large variations of signal words. To approach this problem, we propose a method based on LSTM, considering that Long Short-Term Memory (LSTM) can well model the contextual information of the temporal sequence [3]. Thanks to the real-time processing capacity, the sign language from the user is instantly recognized and a fast and effective communication is provided. The application is designed to be easily used by people who do not know sign language, with its user-friendly interface.

Our main findings show that the developed system can recognize Turkish Sign Language signals with high accuracy and process them in real time. In the tests, the performance of the system on different users and different Turkish Sign Language words was examined and successful results were obtained. This reveals the application's potential to be an effective communication tool for both hearing-impaired individuals and those who do not know sign language.

In conclusion, this study offers an important innovation in the field of artificial intelligence-based real-time Turkish Sign Language recognition applications and takes a big step towards overcoming communication barriers between Turkish Sign Language users and hearing-impaired individuals. It is expected that the developed system will be used by large masses, enable hearing-impaired individuals to participate more actively in social life and contribute to social integration. Additionally, the proliferation of such technologies can help hearing-impaired individuals have more equal opportunities in education, work and social life. This will contribute to increasing social awareness and improving the quality of life of hearing-impaired individuals.

Keywords: *Artificial Intelligence, Sign Language, Turkish Sign Language, Deep Learning)*

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DOKUZ EYLÜL UNIVERSITY FACULTY OF SCIENCE

Creating a Smart Decision Support System that Students Can Use in Their Dormitory Preferences and Developing a Mobile Application

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Abstract

Every year, tens of thousands of students struggle to find suitable housing options as they begin a new academic year. This project, which we prepared and designed for students who have just started or are continuing their university life, will enable students to make decisions with more comprehensive information about the dormitory they choose. In this respect, the project will be an important application designed to shape students' housing decisions and increase their experiences. Within the scope of this project, a decision support system will be developed that will facilitate the decision processes and include artificial intelligence components to meet the housing needs of students. In the project, a large dormitory database will be created by collecting all state, private and foundation dormitory data in the targeted province (in the case of Izmir). Dormitories can be analyzed according to their facilities and proximity to certain universities and districts. A model will be developed to calculate the best price-performance and transportation suggestions, taking student preferences into account. In the development of the model, parameters such as urban public transportation opportunities, transportation opportunities to certain important points of the city and universities, user preferences, etc. will be taken into account. Mobile and web interfaces and background applications will be developed to enter user preferences into the system and reflect the analysis results. This application will be able to make comprehensive and reliable analyzes and create optimal suggestions for students in line with dormitory options, and will facilitate the process of finding the most suitable dormitory for students.

From what we have researched, this will be the first such app on the market. We aim to develop this project, which we will first start in Izmir Province, further develop it with the data we collect and present it to all of Turkey. In the application developed within the scope of the project, the user will be able to extract information about dormitories based on certain personal preferences, compare dormitory facilities, ease of access to the university and certain important places of the city, and make price-performance analyses.

Within the scope of the project, data mining techniques will be used to analyze dormitory data [1,2]. Multi-Criteria Decision Making (MCDM) methods such as AHP, TOPSIS, PROMETHEE will be used to calculate the weights of the criteria taken into account in determining user preferences [3-6]. Location Valuation Index (LVI) will be used to analyze the proximity of dormitories to universities and location-based preference analysis [7,8]. Text mining and sentiment analysis methods will be used to analyze comments about dormitories [9].

The novelties of the project can be listed as follows:

Comprehensive database: All dormitory data in the targeted province will be collected and combined on a single platform. This comprehensive database will provide students with a wide range of dormitory options and make comparisons easier.

Personalized filtering: Every student's needs are different. Our application will allow users to filter and rank dormitories that suit their personal preferences based on budget, location, services and other preferences.

Real user comments: It will provide a platform where students can share their own experiences. User comments and ratings will provide other students with real and reliable information, helping them make more informed decisions.

Easy use and mobile access: A user-friendly interface will be offered, accessible through both the mobile application and the website. Students will be able to easily compare and choose dormitories from any device.

Keywords: *Decision support system, Artificial intelligence, Data mining, Mobile application, Web application.*

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DOKUZ EYLÜL UNIVERSITY FACULTY OF SCIENCE

Investigation of the Toxicity and Effect of β-Myrcene on Epithelial-Mesenchymal Transition in Breast Cancer and Control Cells

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Abstract

Cancer is a characterized by the uncontrolled cell proliferation. Cancer is the second leading cause of death worldwide, following heart diseases. In Turkey, cancer-related deaths are higher compared to the global average, and cancer cases are rapidly increasing worldwide. Breast cancer is the most common cancer in women[1]. Genetic and environmental factors play a role in the development of breast cancer. The increasing mortality due to breast cancer in women is largely attributed to its metastasis. The metastasis of cancer-initiating cells is related to the Epithelial-Mesenchymal Transition (EMT) process[2].

Plants have been used for medicinal purposes for thousands of years. Natural resources hold significant importance for both modern and traditional medicine, and many cancer drugs are derived from natural products[3,4]. Current treatments often lead to side effects. A better understanding of the molecular foundations of cancer cells can offer new therapeutic approaches. The plants have potential bioactive molecules. Medicinal plants and biomolecules hold a crucial place in cancer research.

Terpenes are compounds obtained from plant sources and have a high potential to provide health benefits. Studies have been shown that terpenes have anti-cancer effects such as regulating cell growth and inducing the differentiation of tumour cells[3,5]. β-Myrcene is a monoterpene compound found in the oils of aromatic plants and it is used as a flavoring agent in foods[6]. Despite its use in the production of cosmetics, household products, and food additives, β-Myrcene is listed as a possible carcinogen for humans according to data from the International Agency for Research on Cancer (IARC)[7]. The data on β-Myrcene appear scientifically contradictory and require further scientific studies.

Overall, the project aims to determine β-Myrcene effect on cytotoxicity, migration, and EMT-related gene expression profiles in breast cancer and breast epithelial cells.

Keywords: *Breast Cancer, β-Myrcene, Cytotoxicity, Epithelial-Mesenchymal Transition*

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DOKUZ EYLÜL UNIVERSITY FACULTY OF SCIENCE

Isolation of Halophilic Bacteria from Wastewater of Leather Factories in Corlu, Tekirdag

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Abstract

In Turkey, leather processing activities are carried out in various enterprises located in cities such as Uşak, Istanbul (Tuzla), Bolu (Gerede), Tekirdağ (Çorlu), İzmir (Menemen), Bursa, Isparta (Yalvaç), Manisa (Kula, Salihli), Denizli, Balıkesir (Gönen), Çanakkale (Ezine), Hatay, Niğde (Bor) and Aydın (Karacasu) (1). Çorlu Leather Industrial Zone, which has an important share in leather production in our country and ranks among the top five, processes approximately 50,000 tons of leather annually. In order to protect and preserve the raw leather, which is the raw material source of the leather industry, salt is used at a rate of 30-50% of the weight of the leather and approximately 50 to 100 kg of water is used for the processing of 1 kg of leather (2-3). The control of these wastes in leather industry enterprises is of great importance and although it has been emphasized in recent years, it is known that waste management cannot be carried out in a healthy way in many factories. Therefore, the aim of this project proposal is to perform bacterial isolations from samples collected from the wastewater of Çorlu Leather Industry, to test the salt resistance of possible halophilic isolates in different concentrations of saline media and to identify the bacteria with halophilic properties by molecular methods. Although there are studies in the literature on the isolation of halophilic bacteria in the leather industry (4-6), especially from salted animal hides, there is no study on the detection of halophilic isolates from the areas where factory effluents are mixed, especially in Çorlu Leather Industrial Zone. For this reason, it is considered that the project topic is unique and when the project work is completed, it will contribute both to the literature and to the training of a undergraduate researcher by preparing a undergraduate thesis. In addition, if the study is successfully carried out, the detection, diagnosis and cultivation of halophilic isolates from the areas where leather industry industrial wastes are mixed with industrial wastes will be carried out and studies on the use of these isolates in different fields of biotechnology will be pioneered due to their biological potential.

Keywords: *Leather processing, Waste water, Halophiles, bacteria.*

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DOKUZ EYLÜL UNIVERSITY FACULTY OF SCIENCE

Effect of Halophilic Bacteria on Tomato Plant Growth

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Abstract

Today, it is predicted that the world's population and agricultural production will not grow in tandem, making malnutrition one of the biggest problems facing living beings in the future. For this reason, strategies are being developed to increase the yield of agricultural products and ensure their sustainability. In particular, the use of methods that do not have negative effects on the environment and human health, reduce the use of chemical fertilizers and pesticides in agriculture, improve the soil, which plays an important role in the development of agricultural products, promote plant growth and increase crop yields are being promoted. For this purpose, one of the most preferred applications in recent years is the use of Plant Growth Promoting Bacteria (PGPB). PGPBs can protect plants against various biotic and abiotic stresses by triggering their resistance mechanisms and at the same time provide solutions for eliminating unfavorable conditions in the soil, which is the plant's habitat (1-3).

One of the biggest problems facing farmers today due to climate change is soil salinity. Salinity is one of the major factors limiting the growth of most crops in arid and semi-arid regions (4, 5). However, since it is believed that the effects of salt stress on crops can be reduced by using some salt-tolerant bacteria isolated from saline environments and promoting plant growth, the effects of halophilic bacteria on the growth of tomato plants under saline conditions will be investigated in this study. Although there are studies on increasing the yield of tomato plants with PGPR (Plant Growth Promoting Rhizobacteria) bacteria (6-12), there are no studies in the literature on the use of 4 different halophilic isolates (*Zhihengliuella salsuginis*, *Thalassobacillus devorans*, *Bacillus atrophaeus* and *Promicromonospora* sp.). In this sense, the subject of the project is considered unique.

When the project work is completed, both solutions will be developed for the development and yield of tomato plant, which has an important share in the agricultural production of our country economically and commercially, and will contribute to the training of a researcher at the undergraduate level by conducting an undergraduate thesis in this field. At the same time, it is envisaged that the isolates used in this preliminary study can be used to carry out different studies on the elimination of salt stress in different plants, studying their mechanisms and thus contributing to the economic/commercial cultivation of plants.

Keywords: *Halophilic bacteria, tomato, PGPR.*

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DOKUZ EYLÜL UNIVERSITY FACULTY OF SCIENCE

Determination of Biofilm Formation Levels of Different Escherichia coli Isolates Under Various Conditions

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Abstract

Bacteria are microorganisms that constantly communicate with their environment and with each other. Under conditions that threaten their survival, such as changes in pH, dehydration, and the use of antibiotics or disinfectants, bacteria communicate to form biofilm structures. While the biofilm structure contains 97% water, the remaining 3% of the matrix consists of extracellular polymeric substances (EPS), nucleic acids, lipids, phospholipids, and proteins. The proportions of these elements in the biofilm structure vary from one bacterium to another. Through the extracellular polymeric matrix they produce and live within, microorganisms adhere strongly to surfaces and become difficult to remove. This biofilm structure, which is formed by bacteria that cause infection-based diseases, a significant issue today, protects the microorganisms from damage and provides them with resistance. Additionally, it can lead to severe organ damage and even death within the body. Bacteria that adhere to biomaterials form biofilms, leading to chronic infections. Preventing the biofilm formation of *E. coli* bacteria, which cause community and hospital-acquired infections, is crucial for taking measures against these public health-threatening diseases. In this study, the biofilm formation levels of a total of 14 different *Escherichia coli* isolates, including 11 clinical isolates (CI), 1 standard isolate (ST), 1 food isolate (FI), and 1 multidrug-resistant isolate (MDR), will be examined and compared under various conditions.

Keywords: *Microorganism, Biofilm, Escherichia coli, Drug Resistance*

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DOKUZ EYLÜL UNIVERSITY FACULTY OF SCIENCE

Determination of Antimicrobial Effects of Halophilic Bacteria

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Abstract

Bacteria isolated from extreme environments have gained importance in biotechnological applications in recent years due to the evolution of their molecular components and the stability of their macromolecules with respect to their growth and physiological conditions. It is known that some bacteria isolated from hypersaline environments with high salt content, known as extreme environments, show genetic adaptation to extreme solar radiation, ionic strength and desiccation to survive, making them promising candidates for drug discovery (1). Nowadays, various strategies are applied to produce new antimicrobial agents from halophiles and they are used in many industrial fields such as paint, oil and waste water treatment, food, medicine, cosmetics, textiles, pharmaceuticals and agriculture due to the production of many bioactive metabolites with pharmaceutical potential (2). In particular, halophilic bacteria compete with other microorganisms in their environment with the various metabolites and exopolysaccharides (extracellular lytic enzymes, secondary metabolites, siderophores and antibiotics they produce) and therefore exhibit antagonistic activities. In this context, the aim of this project is to determine the antagonistic effects of some halophilic bacteria previously isolated and whose PGP properties have been determined and which show siderophore properties (3-6). For this purpose, the antagonistic activity of halophilic isolates in our culture collection against plant pathogens will be tested, their antimicrobial activity against clinical pathogens will be determined, taking into account their broad-spectrum potential, and the susceptibilities of these isolates to the antibiotics ofloxacin, azithromycin and streptomycin will be determined. This will determine the antimicrobial activity of antibiotic resistant and PGP isolates against both plant and clinical pathogens. Although there are separate studies in the literature determining the activity of halophilic bacterial isolates against plant pathogens and clinical pathogens, the original value of the project will be that the isolates to be used are different and the antimicrobial effects of the isolates to be tested against different pathogens will be revealed due to their biotechnological potential. At the same time, when the project work is completed, it will contribute both to the literature and to the training of a researcher at the undergraduate level through the preparation of an undergraduate thesis. In addition, according to the results of this study, which is considered as a preliminary study, it will provide an opportunity for new project studies in which the metabolites produced by effective isolates will be determined and their mechanisms will be studied in terms of being a source of raw material for the pharmaceutical sector in an economic / commercial sense.

Keywords: *Halophilic bacteria, PGPB, Antagonistic activity, Pathogen*

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DOKUZ EYLÜL UNIVERSITY FACULTY OF SCIENCE

Determination of Antimicrobial, Antioxidant Activity and Biochemical Content of Plantago lanceolata Plant with Ethnobotanical Importance

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Abstract

Plants have been in the most important place for life from the beginning of the world until today. Nature still maintains its importance in many areas such as shelter and nutrition. Plantago lanceolata, which belongs to the Plantaginaceae family, is known as the most common genus of this species. It is among the perennial plants that can be widely found in our country. It is used under the names of 'Nerve grass, Nerve grass' among the people. It is known that it is mostly used for healing wounds and infectious diseases in our country. Disc diffusion method will be used to determine the antimicrobial effect of ethanol extract of P. lanceolata against 53 strains. According to the results obtained, MIC test will be applied to find the minimum effective concentration. Minimum Bactericidal Concentration (MBC) test will be performed to determine whether the lowest concentration found as a result of the MIC test will be bactericidal or bacteriostatic. DPPH scavenging method will be applied in the antioxidant activity test to determine the antioxidant properties. GC-MS test will be performed to determine the biochemical content of P. lanceolata plant.

Keywords: *Plantago lanceolata, Antimicrobial, Antioxidant, Biochemical Content.*

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DOKUZ EYLÜL UNIVERSITY FACULTY OF SCIENCE

Investigation of metamagnetic anomalies in magnetic disorder lines

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Abstract

In Condensed Matter Physics, the magnetic properties of strongly interacting disordered systems cannot be directly deduced from the behavior of pure and homogeneous systems. Disordered systems can be considered prototypical examples of many systems with rough free energy forms. From the theorists' point of view, disordered systems are considered relatively difficult to solve for non-perturbative reasons. It is known that computer simulations play a very important role in this field, producing highly reliable numerical results. A common feature in complex systems containing large numbers of degrees of freedom is the incredibly slow dynamic evolution of the system. This situation makes studies in this field difficult both theoretically and experimentally. Systems involving disorder or complexity generally require the collaboration of three different scientific disciplines: Condensed Matter Physics, Statistical Physics and Computer Science. Therefore, new developments in this field affect all three research areas. The topic proposed in the project proposal coherently combines basic concepts and modern techniques from the above-mentioned areas. It is hoped that the creation of a new simulation scheme for magnets containing disorder effects will be of great value to a significant number of scientists working in this field. If a typical ferromagnet kept below the Curie temperature is driven by an oscillating external magnetic field, interesting results emerge as a result of the competition between the period of the external magnetic field and the relaxation time of the system. These are: dynamic phase transitions and hysteresis events, and they have similar points to thermodynamic phase transitions. Apart from this, another important phenomenon that has a completely different physics and has no counterpart in thermodynamic phase transitions is metamagnetic anomaly behavior. This anomaly behavior was first demonstrated in experimental studies of pure, flawless thin film systems that do not contain disorder effects, and has been confirmed several times by subsequent theoretical studies. It is planned to examine for the first time in this project the metamagnetic anomaly behavior that may occur in chain-type magnetic defect lines planned to be created in a homogeneous system under the influence of a time-dependent external magnetic field. The important points planned to be developed for this purpose are summarized below: (i) new Monte Carlo simulation techniques, (ii) advanced statistical analysis methods and (iii) special computer platforms required for large simulations. With these steps, the main aim is to understand the disorder effects on various 2D kinetic spin-1/2 Ising magnets driven by a time-dependent oscillating external field. In particular, it will be examined for the first time whether the metamagnetic anomaly behavior, which has no equivalent in thermodynamic phase transitions and only occurs near the non-equilibrium phase transition point, has a universal structure according to the changing disorder parameters created on the defect lines.

Keywords: *Magnetic disorder line, Monte Carlo simulation, Metamagnetic anomaly, Dynamic phase transitions.*

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DOKUZ EYLÜL UNIVERSITY FACULTY OF SCIENCE

Nanoparticles in the treatment of Magnetic Hyperthermia: particle size effect

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Abstract

Magnetic hyperthermia is an important phenomenon that is used especially in cancer treatment and is based on creating temperature changes at certain values in certain areas of the body. Planning an effective treatment is possible by creating a temperature change at the desired value, and this is possible by obtaining the specific absorption rate at the desired value. At this stage, it is of great importance to determine the specific absorption rates of various magnetic materials theoretically. With the increasing use of magnetic nanoparticles in magnetic hyperthermia treatment in recent years, specific absorption rate calculations of magnetic nanoparticles have found a wide place in the theoretical magnetism literature. In this study proposal, the change of specific absorption rates of SPION magnetic particles according to particle size will be obtained and a nanoparticle proposal of size with ideal magnetic hyperthermia properties will be developed.

Keywords: *magnetic hyperthermia, magnetic nanoparticle, specific absorption rate*

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DOKUZ EYLÜL UNIVERSITY FACULTY OF SCIENCE

Pair-material magnetic nanoparticles in data storage: hysteresis properties

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Abstract

The rapid development in data science and ever-growing application areas have made it necessary to store larger amounts of data in smaller materials. This necessity has manifested itself in the theoretical magnetism literature in the form of increasing studies on determining the magnetic properties of magnetic nanoparticles. Calculation of hysteresis losses, which is the basic quantity in data storage, constitutes the main axis of this study. Since the use of traditional materials in the field of data storage is limited to a certain limit, as a result of the search for alternative materials such as pair materials, the study proposal proposes to create pair-material nanoparticles by combining different percentages of Ni, Fe, Co and Py, determining hysteresis losses and obtaining the ideal material - percentage combination is aimed.

Keywords: *pair material magnetic nanoparticle, magnetic hysteresis, hysteresis loop field*

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DOKUZ EYLÜL UNIVERSITY FACULTY OF SCIENCE

Geometric Phase diagrams of spin-1 Blume Capel Model with crystal field disorder

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Abstract

Investigation of the effect of disorder on various kinds of condensed matter orderings remains an open field of inquiry . Random field effects on magnetic systems have been systematically studied, not only for their theoretical interests but also for their experimental realization implications. To the best of our knowledge, the spin-1 Blume-Capel model with quenched diluted single ion anisotropy has not been studied by the means of Riemannian geometry. With this aim a method combining statistical equilibrium theory and Riemannian metric geometry will be used to investigate the properties of thermodynamic curvature or Ricci scalar (R) for the isotropic and anisotropic spin-1 Blume-Capel (BC) model with random crystal field. In this study crystal field chosen to be randomly diluted by a probability (1-p). It has been shown that BC model with randomly diluted crystal field exhibit three distinct phase diagrams depending on the value of p.

In the present project, we are planning to extend the Ruppeiner's geometrical treatment of thermodynamics to the BC model with with quenched diluted single ion anisotropy. This extension is interesting due to fact that R for the present spin system is negative on the F side of continuous phase transition line with a divergence to $-\infty$ near the zero temperature, but it diverges to $+\infty$ below the critical temperature. Conversely, $R > 0$ on the paramagnetic (P) side. The vanishing curvature line ($R = 0$) which separates the $R > 0$ and $R < 0$ phase regimes will be determined in the phase diagram, and the results will be analyzed in comparison with the other curvature calculations.

The Project is organized as follows: A Ruppeiner metric will be introduced on the two-dimensional phase space of dipolar and quadrupolar order parameters. An expression will be derived for R and its variation as a function of reduced temperature and reduced cyrstal field (d) for various values of p, particularly its behaviors near the first-order and second-order phase transitions and critical/tricritical/multicritical points will be examined numerically. It is expected for R to tend towards plus infinity while approaching the second-order phase transition and tricritical point. These results are expected to fit well with those in the mean-field Ising model in the lowest order approximation and quantum lattice model with multi-well potentials as well as Blume-Emery-Grifitths model. Finally, geometric phase diagrams, including critical/multicritical topology, will be presented for spin-1 Blume-Capel (BC) model with random crystal field.

Keywods: Geometric phase diagrams, Ricci scalar, Riemanniann geometry, Ruppeiner metric, Thermodynamic curvature

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DOKUZ EYLÜL UNIVERSITY FACULTY OF SCIENCE

A Scale Development Study for the Comparison of Distance Education and Face-to-Face Education for University Students in Academic, Social and Economic Perspectives

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Abstract

Due to the two states of emergency following the Covid 19 epidemic and the earthquakes whose epicenter was Kahramanmaraş on 06.02.2023, universities have turned from face-to-face education to distance education twice. University students have encountered a different university life by getting used to a new academic, social and economic order after the transition from face-to-face education to distance education. While some students may argue that distance education is more advantageous economically because they live with their families, some students may argue that face-to-face education is more advantageous in terms of negative effects on social life.

The aim of this study is to develop a valid and reliable scale to measure the attitudes of undergraduate program students towards distance education and face-to-face education in terms of social, academic and economic life, with the target sample being Dokuz Eylül University Faculty of Science students, and to make statistical inferences about the results. The aim of the scale to be developed is to measure students' attitudes not only in terms of education, but also in social and economic aspects, and to determine which education system they prefer according to independent and demographic variables. The aim of the valid and reliable scale to be developed at the end of the project is to give universities an idea in terms of education and social life in case of a possible transition to distance education and to determine the expectations of their students.

The main objectives of the study are listed below:

- To compare face-to-face and distance education methods from a pedagogical and sociological perspective and to determine the strengths and weaknesses of both approaches.
- Quantitatively measure the effects of both types of education on student achievement.
- To compare student motivation, participation and participation in classes in both types of education.
- To identify the factors affecting students' participation in class and to analyze these factors.
- To provide suggestions to improve the learning experience of both types of education by collecting student feedback.
- Create a scale or rating system to measure the effects of both types of training, based on survey results.
- To make this scale available to educators and students and to support data collection processes.
- To identify the challenges and obstacles encountered in distance education.
- To offer suggestions to overcome these difficulties and make distance education more effective.
- To investigate university students' approaches to face-to-face and distance education models in terms of social and economic life.

As a face-to-face and distance education evaluation, a draft scale will be created in line with the verbal and written feedback received from the students and a face-to-face meeting will be held with 4 (four) experts, at least two of whom will be statisticians. As a result of comments and suggestions, the draft scale will be rearranged in terms of spelling rules and semantics. The factor structure of the scale will be investigated by applying explanatory factor analysis (EFA) to the scale obtained after expert opinions. While the final scale is being obtained, items with weak loading values and items that are included in more than one factor will be removed from the draft scale. After the relevant items are removed, explanatory factor analysis (EFA) will be applied to the scale again to obtain the final structure. Confirmatory factor analysis (CFA) will be applied to test the compatibility of the items with the factors. The stability of the scale will be analyzed by the test-retest method, and the discrimination indexes will be analyzed by the upper-lower groups method. In order to measure the internal consistency of the items, scale reliability will be determined with Cronbach's alpha coefficient.

Keywords: *Scale Development, Distance Education, Face-to-Face Education, Validity and Reliability*

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DOKUZ EYLÜL UNIVERSITY FACULTY OF SCIENCE

Predicting Employee Churn in the Call Center Using Data Mining and Evaluating the Factors of Preventing Employee Churn

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Abstract

Companies strive to retain their employees in order to achieve sustainable growth and gain a competitive advantage. This is because losing trained employees can lead to significant time and financial losses for businesses. Therefore, predicting employee turnover in advance is of critical importance for understanding the reasons for resignation.The reasons for employees leaving their jobs can generally be evaluated as positive factors (such as better offers, career development) and negative factors (conflicts, lack of appreciation, low payment). Additionally, factors such as age, gender, education level, years of service, tenure, performance, salary, etc., are taken into account to determine whether employees will leave their jobs in companies. In this study, data from call center employees of a global company operating in customer experience, business processes, and outsourcing worldwide were obtained. Machine learning methods such as Regression Tree, Random Forest, Logistic Regression, Classification Trees, Bagging, Random Forest, K-nearest Neighbors (KNN), and XGBoost were used to predict employee turnover. The best method, determined by performance metrics with 97.73% accuracy and 97.21% sensitivity, was Random Forest. Furthermore, through explainability analysis, it was determined that the key variables affecting employee turnover were hourly wage, work schedule, tenure, and absenteeism. Additionally, specific characteristics influencing an employee's propensity to leave their job were identified.

Keywords: *Employee Churn Analysis, Supervised Learning Algorithms, Explainability Analysis*

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DOKUZ EYLÜL UNIVERSITY FACULTY OF SCIENCE

Dynamic Cornering Fatigue Test and Reliability Prediction of Aluminum Alloy Passenger Car Wheel

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Abstract

Statistical reliability analysis is used to measure the reliability of components or systems. This analysis plays an important role in assessing the reliability of components, identifying potential problems at an early stage, detecting problems at the design stage in product development, and meeting customer expectations in terms of reliability and durability. The reliability of wheel production plays a critical role in the safety, performance, durability and cost-effectiveness of the car. In this study, it is aimed to examine the reliability parameters of non-heat treated aluminum alloy passenger car wheels at different moment/stress levels. In the research, dynamic cornering fatigue test and accelerated life test data of passenger vehicle wheels performed for 3 different stress levels within the CMS R&D center were used. Estimates of reliability parameters for the wheels were made using test data performed at stress levels of 125, 140 and 165 MPa. Minitab, Reliasoft Weibull++ and ALTA software were used to analyze the data.

Keywords: *Reliability analysis; Accelerated life test, Inverse Power Law model; Weibull distribution*

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DOKUZ EYLÜL UNIVERSITY FACULTY OF SCIENCE

Preparation of Magnetic Nanoparticle Modified MMT Biochar Composites as Microwave Absorbing Material and Investigation of Surface Properties by Applying to Fabric Surface

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Abstract

Microwave is a type of electromagnetic radiation and includes electromagnetic waves in the region of the electromagnetic spectrum. Microwave energy can be reflected, transmitted, absorbed and through its interaction with the molecular and electronic structure of the material in which it is absorbed, it generates heat in the material and can convert the incoming electromagnetic waves into thermal energy. This results in energy consumption. Microwave frequencies are used in radar systems to detect and locate objects. Radar absorbing materials (RAM) absorb energy by absorbing radar waves rather than reflecting them, thus reducing or completely obscuring the radar signature of objects. RAM is often used on platforms such as military aircraft, ships, vehicles and other military equipment, which can be covered with such materials to reduce radar signatures. In the design of radar absorber structures, instead of single-layer or single-type absorber materials, the design of composite absorber structures consisting of multi-layer structures with the lowest possible thickness, the widest possible operating bandwidth and the lowest possible reflection properties has recently become the focus of interest in many studies. In this study, BC/MMT@Fe3O4 composites were formed by synthesizing magnetite (Fe3O4) in situ in a homogeneous mixture of montmorillonite (MMT)/biocoal (BC) homogeneous mixture (between clay layers and between biochar pores) with natural and sustainable properties of the radiation absorbing properties of ferromagnetic nanoparticles known in the literature as RAM, which have effective electromagnetic (EM) wave absorber function in the frequency range of 18-40 GHz. The BC/MMT@Fe3O4 composites function as broadband multilayer RAM.
The BC/MMT@Fe3O4 composite material was applied to the cotton fabric surface with 4 different methods at different concentrations and the characterization and functional properties of the cotton fabric surface were determined.

Keywords: *Radar-absorption; Cotton-Fabric; Composite*

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DOKUZ EYLÜL UNIVERSITY FACULTY OF SCIENCE

Growth Differentiation Factor 9

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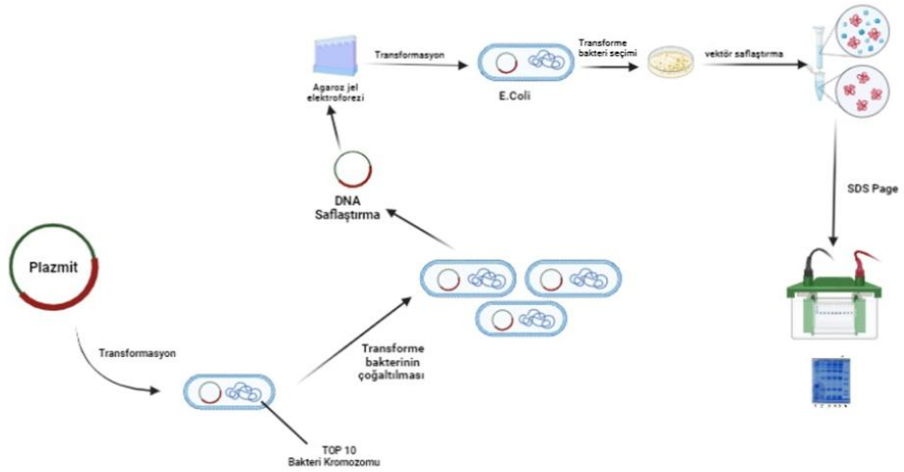
Abstract

Growth factors are important in the regulation of various cellular processes. These growth factors are essential for normal physiological processes and dysregulation of their activity can contribute to a variety of diseases, including cancer and developmental disorders.The key role of GDF9 in female fertility highlights the need for any variation of this gene or protein to lead to devastating effects on the reproductive system and consequently be associated with infertility.Recombinant proteins in E. coli are obtained as a class of soluble or insoluble proteins. Protein secretion in culture media offers several advantages over intracellular production, such as easier detection and purification. Cloning of the GDF-9 protein with the pET-28 vector will be performed. For the production of recombinant proteins in culture media, it is very important to optimize the medium composition and to ensure protein production outside the cell. In recombinant production, E. coli is being studied due to its fast growth and low reproduction cost. Our project includes experimental studies of protein activity and characterization to enable the production of recombinant GDF-9 protein. Within the scope of these studies, it is aimed to verify protein production and determine high efficiency.



Keywords: *E. Coli, GDF-9, Recombinant proteins, Infertility*

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DOKUZ EYLÜL UNIVERSITY FACULTY OF SCIENCE

Recombinant PDGF-A Production

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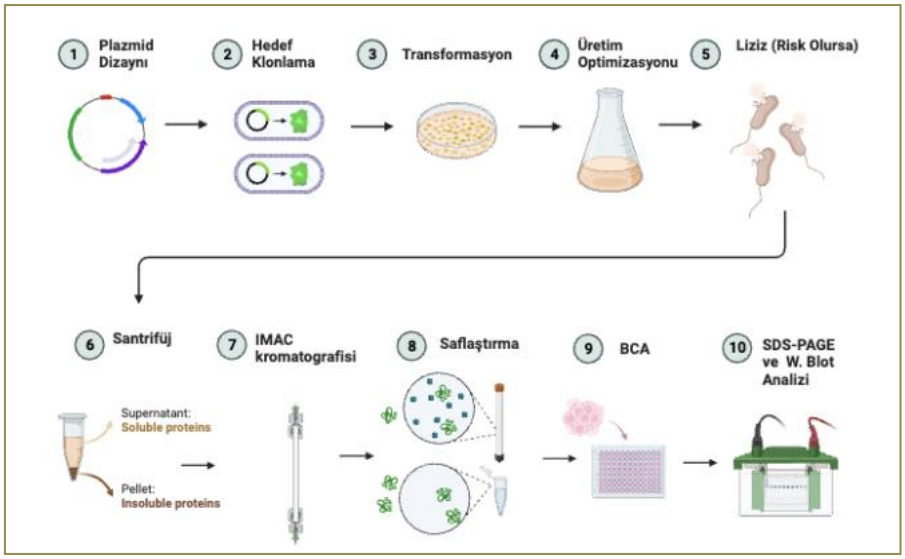
Abstract

Growth factors are known as biologically active molecules that are secreted and affect the growth of cells. It also appears to have an effect on specific cell surface receptors that send growth signals to other different intracellular components and ultimately cause altered gene expression. Finally, growth factors are among the molecules that trigger different cellular processes, including cell proliferation, differentiation and multicellular morphogenesis during development and tissue healing. Platelet-derived growth factor (PDGF) isoforms are a polypeptide mediator involved in the stimulation of replication, survival, and migration of mesenchymal cells at the time of the pathogenesis of fibrotic disorders. PDGF; It is a drug target in wound healing, accelerating the healing process of diabetic wounds, healing heart tissues and correcting cardiovascular diseases. In Escherichia coli, recombinant proteins can be produced as solvent or insoluble protein aggregates. Protein secretion; It can be detected more simply in culture media than in intracellular production and can provide various benefits, including purification. In the project, cloning of the PDGF-A protein will be carried out with the pET-28a vector. It is important to optimize the medium composition in order to achieve high yield production of recombinant proteins in culture media. The main reasons why recombinant DNA technology is preferred include optimizing culture conditions and increasing protein synthesis or cell proliferation. The main reason for choosing E.coli is that it provides benefits such as low cost and fast production. In the project; It is aimed to realize the production of recombinant PDGF under suitable conditions, to produce an innovative and high-yield protein, and to use the existing technological potential.



Keywords: *Recombinant DNA Technology, PDGF, E.coli, Recombinant Protein*

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DOKUZ EYLÜL UNIVERSITY FACULTY OF SCIENCE

Synthesis of New Oxazolone and Imidazolone Derivatives

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Abstract

The oxazole ring containing nitrogen and oxygen atoms is a highly important five-membered heterocyclic compound. It is easily modified by electron-withdrawing groups and reacts with nucleophilic or electrophilic reagents. This important structure of the oxazole compound allows its derivatives to exhibit a variety of biologically active properties, thus enabling wide potential applications (Zhang H.Z., et al., 2011). The anticancer, antibacterial, antimicrobacterial and antioxidant properties of oxazolone derivatives against tuberculosis as well as their antimicrobacterial and antioxidant properties have shown their positive effect in various biological and pharmacological applications (Canan et al., 2017). Oxazol-5-one, an oxazole derivative, is a cyclic anhydride of N-acyl amino acids, usually derived from α-amino acids. Oxazol-5-one has many applications in the dye, pigment, polymer and cosmetic industries. Some of its derivatives are potential candidates for pharmaceutical applications as they exhibit antibacterial, antiviral and antifungal effects. These derivatives are used in the synthesis of pesticides as active ingredients in agrochemicals as they have insecticidal or antifungal effects (Youssef et al., 2016). Many agricultural products, especially cereals and vegetables, are susceptible to the growth of fungi and other microorganisms during post-harvest storage. Oxazol-5-one and its derivatives are found in fungicides used during storage of such products. Fungicides help maintain the quality of products by preventing the growth of fungi during storage of agricultural products (Ali, T. E et al., 2018). Furthermore, oxazol-5-one-based insecticides are used to protect agricultural products from harmful insects. Oxazol-5-one can also be used to improve the effectiveness of fertilizers used in the cultivation of agricultural crops. In particular, these derivatives help fertilizers to be better absorbed and used by plants. In addition, piperonylic acid, one of the aromatic acid species present in the structure of some oxazolone derivatives, also has antioxidant capacity (Si, Yx et al., 2013). Piperonylic acid is synthesized by hydrolysis of a plant alkaloid called piperine. Piperine is an alkaloid found naturally in black pepper and other plants. Pepper is one of the most widely used spices in the world and has been used for medicinal purposes since ancient times. Recently, the piperine compound has been reported to exhibit anticancer, anti-inflammatory, antibacterial and antioxidant properties. Black pepper (Piper nigrum L.), one of the most popular spices, has insecticidal properties (Gbewonyo, W. S. K., & Candy, D. J., 1992). In vitro antioxidant activities of piperine and its derivatives were investigated and it was found that piperonylic acid (3,4-methylenedioxybenzoic acid) synthesized by alkaline hydrolysis of piperine had the highest antioxidant activity among these molecules (Zarai et al., 2013). Piperonylic acid is an aromatic acid with a benzoic acid group. Derivatives of this compound are significantly used especially in pesticides. Crop diseases caused by bacteria are considered the second largest disease in agriculture after fungal diseases and cause huge agricultural losses every year (Abdullahiab et al., 2020; Wang et al., 2022).
In this project, synthesis of oxazolone derivatives and imidazolone derivatives containing new piperonylic acid structure will be realized. These compounds, which we will synthesize in the light of many studies, will contribute to many fields, especially agricultural and pharmaceutical applications, and will support new studies to be carried out.

Keywords: *oxazolone, pharmacology, oxazol-5-one, piperonylic acid, pesticide*

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DOKUZ EYLÜL UNIVERSITY FACULTY OF SCIENCE

Synthesis of New Schiff Base Ligands and Metal Complexes

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Abstract

It was first synthesized in 1864 by the Nobel Prize-winning German chemist Hugo Schiff (Journal of Polytechnic, 2018;21(1):245-249). Schiff bases are compounds obtained from the condensation of aldehydes or ketones with primary amines. They are called "imine" or "azomethine" compounds because they contain C=N in their structure. Schiff bases are represented by the general formula R1R2C=NR3. R1R2 and/or R3 are alkyl or aryl substituents. Depending on the amounts and structures of aldehydes and ketones, it is possible to obtain a wide variety of Schiff bases. Schiff bases have many properties that vary according to the substituents attached to the imine group. The stability of the azomethine compound increases when there is an electronegative group attached to the nitrogen atom. Although Schiff bases are stable against alkalis, they are hydrolyzed especially in acidic media and split into the constituent amine and carbonyl compounds. If amines containing electronegative atoms with unpaired electrons on the nitrogen atom are used, the reaction is completed without hydrolysis and can therefore be isolated in high yields (Arzu G. Vd ,2017).Schiff bases (imines) have succeeded in becoming one of the compounds of interest due to their stability and ease of synthesis.

Schiff bases and metal complexes have a wide range of applications. Schiff bases are important compounds in various branches such as pharmacy, medicine, biological systems, cosmetics, agriculture, production of dyestuffs, plastics industry, aircraft industry, liquid crystal technology, electronics industry and analytical chemistry. In addition to their properties such as synthetic oxygen carrier, intermediate in enzymatic reactions, antitumor effect, their use in analytical chemistry as spectrophotometric reagents by giving selective and specific reactions against some metal ions is also important. Schiff bases are generally colored solids. By utilizing these properties, they can be used extensively in the dye industry. Apart from these, they can also be used as liquid crystals in electronic demonstration systems and as accelerators of polymer formation. Due to their precise melting points, they are used in the recognition of carbonyl compounds and in the quantification of metals due to their ability to give coordination compounds with metals. In addition, some Schiff bases can also be found in the composition of fungicides and insecticides (Oğuzhan B. 2016). Metal complexes of Schiff bases, whose use as ligands was first reported by Pfeiffer in 1933, have been studied with interest. Metal-imine complexes have been widely investigated due to their use as antitumor and herbicidal agents. They have been reported to have a protective effect on the hematopoietic system. They are recognized as antibacterial and antifungal agents as well as antiviral agents. They are also used in the treatment of diabetes and AIDS.
In addition to these, Schiff bases are used in many fields such as corrosion inhibitors, cation carriers, ion selective electrodes, paint industry. In this study, three new Schiff base compounds containing nitrogen, which can be made soluble in water thanks to this feature, suitable for green chemistry were synthesized and their structures were elucidated by spectrochemical methods and it was aimed to contribute to the literature (Journal of Polytechnic, 2018;21(1):245-249). Very small amounts of schiff base Ni(II) complexes were found in Jack-Bean urease enzyme and some hydrogenase enzymes (Özbülbül A., 2006). Schiff bases of aromatic amines are used in chemotherapy, as oxygen carriers in some chemical reactions, as antistatic agents in polymer technology and in the dyestuff industry due to the properties of some groups in their structure (Özbülbül A., 2006).

Keywords: *schiff base, pharmacology, metal(II) complexes, biological applications, solar cells, pesticides*

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DOKUZ EYLÜL UNIVERSITY FACULTY OF SCIENCE

Development of Ulva Lactuca based biopolymers and investigation of their use as wound healing hydrogels

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Abstract

Ulva lactuca, also known as sea lettuce, is one of the ecological problems that have recently increased in our country. Due to reasons such as visual pollution and odor, it is considered as intermediate waste collected by the state. However, the effect of body and face masks, which are cosmetic products produced using the rich content of Ulva lactuca, was examined. According to the results obtained, anti-aging, revitalizing, moisturizing and cleansing effects on the skin were detected in face and body masks produced with Ulva lactuca. Thanks to these effects, it is suitable for use in cosmetics. It is suitable for use not only for cosmetic purposes but also as a cleaning agent. Due to Covid-19, the importance given to cleaning has increased greatly and chemicals are generally used in the field of cleaning. Here, skin and natural materials were produced using completely natural products, and Ulva lactuca, which is seen as waste, was added to the soap content. The project proposes an alternative not only to eliminate the pollution problem by preventing the formation of algae, but also to process these plants, which are highly concentrated in proteins and polysaccharides that are vital for human health. For this purpose, an extraction plan of Ulvan, the main polysaccharide component of Ulva species, was developed. The extracted ulvan was analyzed for its antioxidant activity and hydrogels were prepared for use in separation membranes, drug delivery systems and antimicrobial coating materials. Since the algae remaining after extraction continued to show antioxidant activity, this waste material was converted into health care products (e.g. soap). In this way, applications were realized within the framework of the "zero waste" approach planned as the final result of the project. Depending on the wound condition and the patient's comorbidities, some wounds can become chronic and lead to dramatic complications such as amputation.

Keywords: *Ulva Lactuca, biopolymer, antioxidant, wound healing*

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DOKUZ EYLÜL UNIVERSITY FACULTY OF SCIENCE

Exploring the Benefits of the Antioxidant Astaxanthin in Cataract Prevention

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Abstract

Cataract is one of the most common causes of blindness in the world. The two main causes of cataracts are opacification of the lens of the eye. The biggest reasons for the dulling of the lens of the eye over time are increased pollution due to the development of the chemical industry and the sun's rays [1,2]

Solutions to cataracts have been sought for many years. Eye drops, light therapies and herbal treatments have been tried in the search for solutions. However, not enough evidence has been collected to prevent and cure cataracts. Therefore, surgical interventions have been used. However, since cataract patients are at an advanced age, surgery do not want to choose too much because of the risk of recurrence.

Previous studies have shown that astaxanthin has 10 times more antioxidant capacity than beta-carotene, crosses the blood brain barrier in animal studies, is stored in the retina in mammals and protects receptors from sunlight in mice [1]. An important study in this field was reported by Ayşegül Çört from Akdeniz University, Institute of Health Sciences, Department of Biochemistry in her master's thesis titled "The Effect of Caratenoid on Retinal Structure and Function in an Experimental Glaucoma Model" [3]. Animal experiments have shown that astaxanthin can cross the blood-brain barrier and is stored in the retina of mammals similar to lutein. When damaged by sunlight, the retinal photoreceptors of astaxanthin-fed rats were less damaged than those of non-astaxanthin-fed rats, not damaged and recovered faster. Thus, it was concluded that astaxanthin accumulation in the eye may exert a stronger protective effect against sunlight and oxidation of retinal tissues and that astaxanthin has the potential to protect eye health. However, cataracts have not been studied, but sunlight is known to cause cataracts.

Therefore, by exploiting the effects of biopolymeric systems, we can use biopolymers from natural sources to prepare formulations that can contribute to delay, cure and/or prevent disease. Biopolymers such as hyaluronic acid, alginic acid, chitosan are biocompatible, biologically their degradability, non-toxicity and unique chemical properties such as bioactivity, film/capsule forming ability are preferred for use in pharmaceutical formulations due to their properties.

Preparation of biopolymeric systems (formulated as nanoparticles, solutions or hydrogels) based on natural polymers (hyaluronic acid, alginic acid, chitosan) containing Astaxanthin as an antioxidant agent, physical and chemical characterization of the obtained matrices and formulating them in the most efficient way and cataracts It is aimed to obtain the final product for treatment.

Keywords: *Astaxanthin, cataract, biopolymer, antioxidant*

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DOKUZ EYLÜL UNIVERSITY FACULTY OF SCIENCE

Commuting graphs of some metacyclic groups

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Abstract

Let G be a group and X be a subset of G. The commuting graph of G on X is a graph whose vertex set is X and whose vertices x and y are adjacent if and only if x≠y and xy=yx. It is denoted by C(G,X). When G is a commutative group, C(G,X) is a complete graph on X. When G is not commutative, the graph C(G,X) is studied intensely for different X's . These graphs were first studied by Brauer and Fawler [6] with X=G\{1}. The case where X is G\Z(G) has been studied in [7,10,16]. The commuting graph C(G,X) when G is a symmetric group and X is the conjugate class of elements with constant order is investigated in [2,3,4,5,8,9,12,13]. In addition, cases where G is a dihedral type group have been studied recently in [1,10,14,15]. As a general case of this type, an undergraduate paper [10] was published in 2018, showing that when G is a splitting metacyclic group and X=Z(G), the corresponding commuting graph is the disjoint union of complete graphs. The graph theoretic properties of these graphs such as the number of connected components, diameter, number of cliques, maximum/minimum degree, and chromatic number are also investigated.

In [10], as a result of an undergraduate research project, Gonzalez completely found the structure of the graph C(G,X) for 2 types of metacyclic groups with X=Z(G). Using this structure, the graph theoretic properties of the corresponding graphs can be easily found. In this project, we plan to study C(G,X) with X={elements of G of order p}, where p=prime for metacyclic groups and C(G,X) with X=Z(G) for non-splitting metacaycylic groups as a generalization of [10].

Keywords: *Commuting graphs of groups, Metacyclic group, Semi-direct product*

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DOKUZ EYLÜL UNIVERSITY FACULTY OF SCIENCE

A Geometric Approach to Bezier Surfaces Using I. and II. Fundamential Form

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Abstract

Approximating continuous functions with polynomials is one of the problems that Karl Weierstrass worked on [1]. The classical Weierstrass theorem shows the existence of a polynomial sequence that smoothly converges to a continuous function defined on a given closed interval. Bernstein used Bernstein polynomials as an alternative to Weierstrass's approach [2].

Bezier, who later worked in the automobile industry, defined Bezier curves, named after him, in 1960, using Bernstein polynomial bases and points on the curve (control points) [3]. A simpler algorithm structure for defining Bezier curves was introduced by Paul de Casteljou, named after him (Casteljou algorithm) [4].

Bezier surfaces given as tensor multiplication with two parameters constitute our subject of study. The bases of this surface patch structure correspond to parametric curves in classical differential geometry [6,7,8,9]. The tensor product is written as the sum of the multiplication of two base structures with their control points, each forming a separate Bezier curve. These curves are the parameter curves of the surface. Thus, in differential geometry I and II. The E, F, G, L, M, N elements used in the basic forms can be found in these two Bezier curve families [5].

In this study, we will obtain the basic elements E, F, G, L, M, N again, based on the differential geometry perspective. We will find surface normal curvature, principal curvatures, Gaussian curvature, mean curvature, geodic curvature and some of their properties.

The main goal of our study is; In [5], Bezier surfaces were calculated using the minimal area Dirichlet approach, and in [10] the minimal surface calculation was found with E, F, G, L, M, N elements by setting the mean curvature equal to 0. In our study, we will calculate not only the average curvature but also the fundamental curvatures of the surface.

Keywords: *Differential Geometry, Bezier surfaces, Principal curvatures, Gaussian curvature Minimal surface*

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DOKUZ EYLÜL UNIVERSITY FACULTY OF SCIENCE

Creating a Content-Rich Website to Present Basic Undergraduate Mathematics Topics with Geogebra Application

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Abstract

We will create a website that undergraduate students and instructors of the mathematics department can use in basic undergraduate courses. We will do this with the GeoGebra application, which is a popular application. We are considering adopting three basic methods such as creating visual materials for use in undergraduate courses, including information on how to use GeoGebra tools more effectively, and presenting educational materials. We will offer different learning resources to students by creating easily accessible free content, primarily covering topics in undergraduate mathematics courses, with detailed, effective and clear explanations created with the GeoGebra application. We will offer visual and interactive mathematics experiences to students by using the easy-to-understand interface and powerful infrastructure of the GeoGebra application. We will make mathematical concepts more understandable. We will make our website a popular learning tool with the contributions of our users. We will make our website a resource that facilitates and supports learning in mathematics education. These methods will be very valuable in developing mathematics students' mathematical abilities and improving their learning experiences.

Keywords: *Geogebra, Website, Mathematics*

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DOKUZ EYLÜL UNIVERSITY FACULTY OF SCIENCE

An Application on Advanced Option Pricing Models and Green Stocks

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Abstract

In this project, the valuation of financial options and the importance of green stocks in this context will be examined, focusing on advanced option pricing models. Option pricing models are used in the process of determining the value of option contracts and are generally developed to address uncertainties in financial markets. Advanced analysis of these models allows us to understand the complexity of pricing options and evaluate possible future movements of financial asset prices. The project will also examine the impact of green stocks on option pricing and the role of sustainability-oriented investments in financial markets will be discussed. This study aims to go one step further to understand the intersections between finance and sustainability and to explore how interest in green stocks is shaped in the context of option pricing.

Keywords: *Option Pricing, Option Pricing Models, Green Stocks, Finance*

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DOKUZ EYLÜL UNIVERSITY FACULTY OF SCIENCE

An Elementary Introduction to Eigenvalue Equations in Quantum Graphs

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Abstract

Recently, we come across importance of the quantum graphs in application of Mathematical Physics. Pauling used the graph concept to model the movement of quantum particles on networks. These models have very wide and important application areas: Anderson localization, carbon nanotubes, mesoscopic quantum and optical waveguides are one of them. For a very basic start, we investigate eigenvalue problems of Laplace operator with various boundary conditions on quantum graphs. A graph consists of a set of countable number of vertices V = {vi} and a set of edges E = {ei} connecting these vertices. Graphs where edges are considered as one-dimensional pieces connected by two vertices and a distance (metric) between two points on these pieces are called metric graphs: Γ(V, E). If in a metric graph a differential equation is given to be satisfied on each edge with vertex conditions, then we obtain a quantum graph. In its most general form, one of the basic building blocks that make up a graph is the situation where the degree of the central vertex, known as a star graph, is greater than two. Our aim is to study the eigenvalue problems of Laplace operators defined on a star graph with various boundary conditions. The eigenvalue problems of the Laplace operator defined by Dirichlet and/or Neumann vertex conditions on the basic building blocks of metric graphs such as star and tree graphs will be examined.

Keywords: *Quantum Graph, eigenvalue, boundary value problem, Dirichlet, Neumann.*

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DOKUZ EYLÜL UNIVERSITY FACULTY OF SCIENCE

Analysis of Darboux Motions Using Lie Groups

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Abstract

In classical kinematics, the properties of rigid body motions such as position, velocity, and acceleration are examined. In this study, Darboux and Mannheim motions will be specifically analyzed using the modern kinematic method of Lie groups and Lie algebra, as opposed to the classical method. Darboux and Mannheim motions are actively used in engineering for the design of constrained mechanisms. The geometric and kinematic properties of the motions, such as velocity axes, axodes, acceleration centers, twist points, the Bresse hyperbola, and invariants of the motion, will be obtained using screw theory and their relationships will be investigated. Since the study is an interdisciplinary and contemporary topic, it is expected to have a high impact value.

Keywords: *Darboux Motion, Mannheim motion, Lie grupları*

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DOKUZ EYLÜL UNIVERSITY FACULTY OF SCIENCE

Creating an Artificial Intelligence-Based Website that Generates Questions Related to Daily Life Aiming to Reduce the Workload of Mathematics Teachers

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Abstract

This research aims to ease the workload of teachers, who are the cornerstone of education, and improve the quality of education. Education is a critical element that shapes the future of society, but the workload of teachers is increasing day by day and negatively affects their personal lives. In this context, an artificial intelligence-based approach is recommended. The research addresses the difficulties of mathematics teachers in generating mathematical questions related to daily life.

Keywords: *Artificial Intelligence, Education, Mathematics*

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DOKUZ EYLÜL UNIVERSITY FACULTY OF SCIENCE

GEOMETRY OF TANGENT TRIANGLES SURROUNDING INFLATED TRIANGLES AND MINIMAL AREA CALCULATION

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Abstract

The Reuleaux Triangle is named after the German engineer Franz Reuleaux, who used mathematics and motion geometry in his engineering studies in the 19th century. This triangle, in short, is essentially a spherical triangle consisting of three circular arcs of equal radius with centers at each vertex of an equilateral triangle. One of the most important features of Reuleaux triangles is that they have a fixed width, just like a circle. The fact that a geometric object in the plane has a constant width means that the spacing of both parallel support lines is the same regardless of their direction. This feature makes the Reuleaux triangle a useful geometric object used for many purposes in fields such as architecture and engineering. Inflated triangles can be viewed as a generalization of Reuleaux triangles. This generalization is made for any acute-angled triangle by taking the arc centers as the points where the middle perpendiculars intersect the opposite side, instead of the corner points of the triangle. Bulging triangles do not have a fixed width except in special cases. However, when the width is examined relative to two parallel support lines, a periodic change is observed. This project will examine the geometry of tangent triangles surrounding bulging triangles. The main purpose of the project is to determine the conditions for having minimal area from these tangent triangles. The aim of the research is for those who will read its content to have information about bulging triangles and various geometric objects that can be obtained from them, as well as to see the calculation methods of some of the quantitative properties of these objects. In addition, it will contribute to the world of mathematics as an original study in terms of explaining it not only with words but also in practice and with the help of figures. The method of the project is entirely based on mathematical calculations. In order to clearly see the geometric properties of the desired triangle, computer programs such as Geogebra and Mathematica, which can perform geometry, algebra and analysis calculations, will be used and methods such as basic calculus techniques, basic and analytical features of Euclidean geometry and also the application of Lagrange multipliers theorem will be used.

Keywords: *Reuleaux triangle, bulging triangle, Lagrange multipliers*

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DOKUZ EYLÜL UNIVERSITY FACULTY OF SCIENCE

Geometric Examine Of Generalized Bezier Curves

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Abstract

q-Bézier curves are also called generalized Bézier curves because they are generalizations of Bézier curves. We know that Bézier curves are suitable and useful in many areas, and we even witness that they have a wide range of usage. We mentioned that some of these areas of use are fields such as architecture, engineering, computer, automotive, art, industrial design and design. In order to further expand these usage possibilities and usage areas, to ensure that they can be made with the desired features, to increase the effectiveness of the usage areas and to benefit more from the features of the curves such as twisting, local, arc properties and global properties, generalized Bézier curves, which are the generalized version of Bézier curves, are used, which are not included in the literature. Our main aim is to make geometric investigations. The geometric analysis of classical Bézier curves has been made and has taken its place in the literature. In this project, generalized Bézier curves (q-Bézier curves), which are generalizations of classical Bézier curves and give classical Bézier curves in special cases, will be examined in terms of differential geometry. First of all, the Frenet-Serret elements of q-Bézier curves will be found, and then the curvature properties of q-Bézier curves will be examined. Then, the importance of control points for curvature will be studied and how control points should be selected according to the desired curvature feature will be discussed. The necessary control point conditions for two q-Bézier curves to have a continuous unit tangent when combining them will be investigated. Sample curve drawings will be made for different control points and the obtained curves will be examined geometrically using the created formulas. The general aim is to investigate how to use generalized Bézier curves with the desired features and how to activate the usage areas suitable for the desired features and to carry out the geometric examination of generalized Bézier curves. We know that one of the best methods that can be used for local and global properties of curves, bending properties or curvature calculation is the Frenet-Serret Frame. It is aimed to create the Frenet-Serret Frame and formulas suitable for examining the geometry of Generalized Bézier curves, which will be used to examine the properties of the curves and expand their activity areas and to create curves with the desired properties. A Frenet-Serret Frame will be created for generalized Bézier curves and curvature calculations will be made. Curves have structures that we call control points, and these control points give us a great deal of information about what properties the curve has. It is known that changing, decreasing or increasing these control points of the curves will change the properties of the curve such as twist, local, spring properties and global properties, and also changes the geometric interpretation of the curve. For this reason, in order to create a curve with the desired properties, the control points must be carefully and carefully selected to have the desired properties. In the light of this information, creating the Frenet-Serret formulas and determining the control points that enable the curve to be according to the desired curvature properties after the curvature calculations are another goal to be achieved. As a result, curves with the desired local properties can be created and transformed into a generalized form with the help of control points and the Frenet-Serret Frame and formulas. When generalized Bézier curves are created, the geometric examination of these curves will be successfully carried out, and some features given only at the end points will be transformed into general ones.

Keywords: *Frenet-Serret Frame, Bezier Curves, Bernstein Polynomials, Generalized Bezier Curves (q-Bezier Curves)*

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