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## ABSTRACTS BOOKLET

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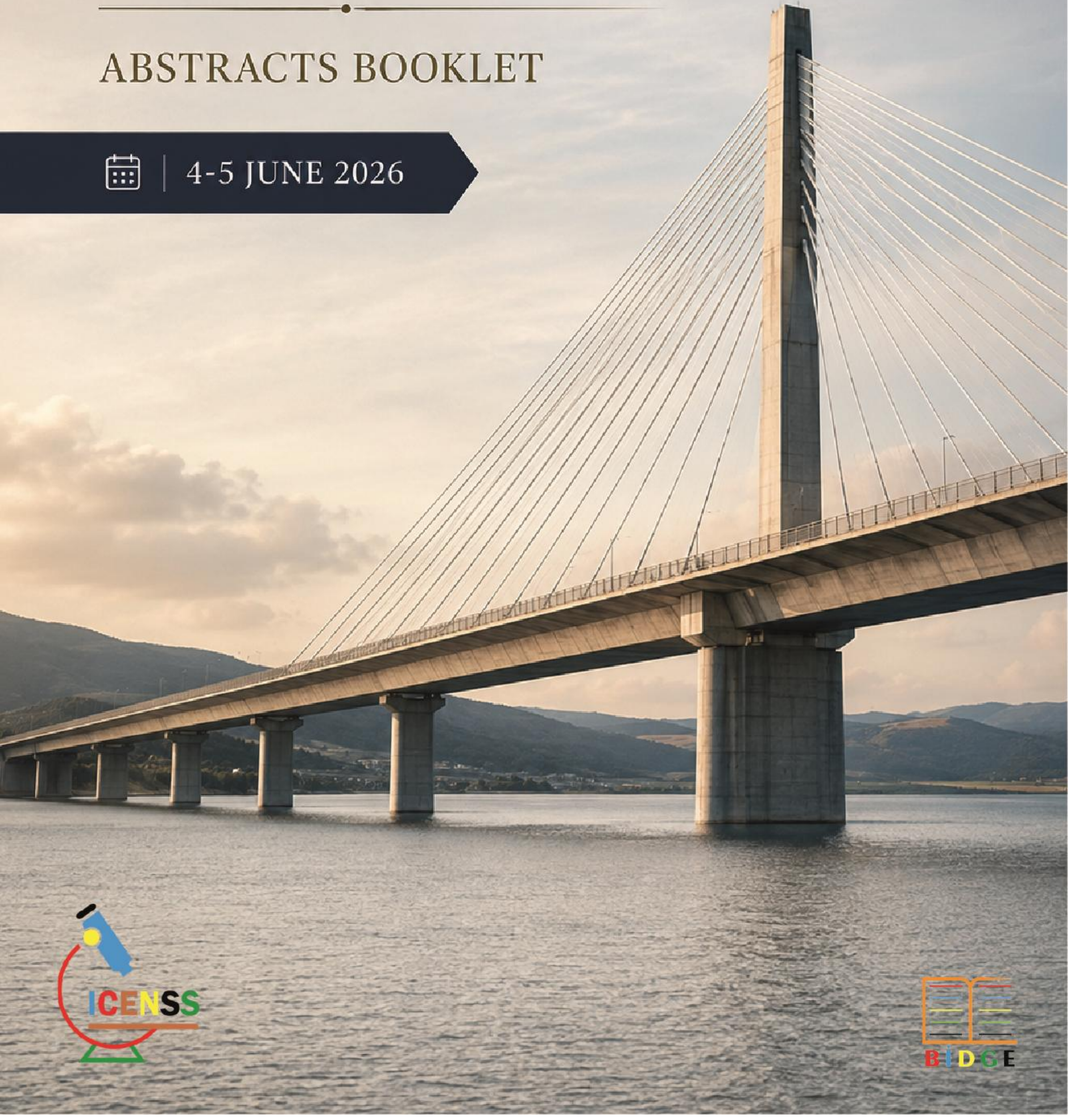

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# ABSTRACTS

# Prediction of Crack Parameters Using Natural Frequency Data and Polynomial Regression

*Kubilay Hoşaf*[1]
*Cihan Demir*[2]
*Mustafa Rahimi*[3]

## Abstract

Structural damages such as cracks significantly affect the dynamic behavior of beam structures by reducing structural stiffness. These stiffness changes directly alter the natural frequencies of the system and can therefore be utilized for structural damage identification. In this study, an integrated experimental, finite element, and machine learning-based approach was developed to estimate crack location and crack depth using natural frequency data obtained from cracked beam structures.
Experimental beam specimens were manufactured from CK45 structural steel. Artificial cracks were introduced using wire electrical discharge machining in order to obtain controlled crack geometries. Experimental vibration measurements and finite element analyses were performed to obtain natural frequency data. The first three natural frequencies (W1, W2, and W3) were used as input parameters in machine learning models, while crack location and crack depth were selected as output parameters.
Polynomial Regression was implemented in the MATLAB environment to model the nonlinear relationship between frequency variations and crack parameters. Linear Regression was also applied for comparison purposes. In order to improve model reliability and generalization capability, 5-Fold Cross Validation was employed during the training and testing stages. Model performances were evaluated using Mean Squared Error (MSE) and coefficient of determination ($R^2$) metrics.
The obtained results demonstrated that Polynomial Regression significantly improved prediction performance compared to Linear Regression. In addition, the experimental and finite element analysis results showed good agreement with the theoretical calculations. The study demonstrated that natural frequency-based approaches and machine learning techniques can be effectively used for crack detection and structural health monitoring applications.
**Keywords**: Crack Detection, Natural Frequency, Finite Element Analysis, Structural Health Monitoring, Machine Learning, Polynomial Regression, Modal Analysis

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# Optimization of HVAC Systems According to User Profiles & Investigation of Effects on Thermal Comfort

*Osman SÜMER*[1]
*Simge TAŞLICA*[2]

**Abstract**

This study presents a user-centric optimization of automotive HVAC (Heating, Ventilation, and Air Conditioning) systems, focusing on thermal comfort, energy efficiency, and environmental impact. User expectations were classified through the KANO methodology, generating profiles representing diverse operational scenarios. Corresponding heating (heat-up) and cooling (cool-down) strategies were defined for each profile. The performance of the optimized HVAC system was evaluated using Computational Fluid Dynamics (CFD) simulations.
Simulation results demonstrate that, during cooling scenarios, the system maintains cabin conditions within the "comfortable" thermal zone, while in heating scenarios, it achieves the "warm but comfortable" range. Surface temperature analysis across key driver body regions (head, chest, right arm, left arm) shows deviations from target thermal comfort values ranging from 3.9% to 21%, indicating improved zone-specific regulation. Compared with conventional HVAC strategies, the optimized approach maintains cabin temperatures closer to user-preferred comfort ranges and reduces response time for achieving desired thermal states.
The findings confirm that integrating user profiles into HVAC control enables adaptive, region-specific temperature management, enhancing occupant comfort while reducing energy consumption. This approach supports environmental sustainability by minimizing HVAC-related emissions and demonstrates the potential of intelligent, personalized climate control systems in next-generation vehicles. Overall, the study highlights the critical role of user behavior modeling, scenario-specific optimization, and CFD-based validation in developing energy-efficient, comfort-oriented automotive HVAC solutions.
**Keywords:** HVAC, Optimization, CFD, Thermal Comfort, Energy Saving, KANO Method

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# Design of a Multi-Functional Ramp Bracket for Integrated Interior Trim Mounting and Curtain Airbag Guidance

*Berkay ORCAN*[1]
*Orhun BOSTAN*[2]

## Abstract

Automotive interior trim components not only fulfill aesthetic and comfort requirements but also play a critical role in ensuring the safe and controlled deployment of curtain airbag systems. In conventional designs, ramp brackets responsible for guiding airbag deployment and trim support brackets used for mounting interior components to the vehicle body are designed and manufactured separately. This approach increases part count, labor costs, and assembly complexity. In this study, a multi-functional bracket design is proposed, integrating both airbag guidance and trim mounting functions into a single component. The design is optimized by incorporating surfaces that effectively control the deployment direction of the curtain airbag along with robust interfaces for secure trim attachment. As a result, the number of parts and fasteners is reduced, labor costs are minimized, and assembly processes are simplified. In addition, tolerance management is improved, packaging efficiency is enhanced, and the overall manufacturing process is streamlined. In practical application, the proposed multi-functional bracket ensures the mechanical stability of interior trim components while supporting the safe deployment of curtain airbag systems. The design provides functional integration in automotive interior and safety systems, delivering significant benefits in terms of manufacturing efficiency and cost reduction. This approach also facilitates engineering validation during the design phase, reducing overall development time. The single-component solution minimizes assembly errors while improving system reliability and enabling more stable results in mass production. Additionally, it provides faster adaptation to different vehicle programs, increasing flexibility in product development processes.
**Keywords:** Curtain airbag, Ramp bracket, Trim support, Interior trim assembly, Multi-functional bracket

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# Architectural Implications of Multi Energy Platform Strategies for L5e Category Vehicles

*Şaban KOÇ*[1]
*Özer ÖZDEMİR*[2]

**Abstract**

L5e three wheeled vehicles are becoming increasingly relevant for urban passenger transport and small scale freight mobility because they combine compact dimensions, practical usability, and architectural efficiency. Under Regulation (EU) No 168/2013, the L5e category covers both passenger oriented and commercial tricycles, which makes it a suitable basis for shared platform development across different use cases. At the same time, the growing visibility of electric light vehicles in urban mobility and the continuing importance of two and three wheeled vehicles in many developing markets have increased the need for platform strategies that can accommodate more than one propulsion architecture. This study investigates the geometric effects of managing battery electric vehicle and internal combustion engine derivatives on a common L5e platform. The analysis compares passenger and cargo oriented vehicle layouts and focuses on the interaction between rear propulsion package, energy storage location, rear axle architecture, wheelbase definition, ground clearance, cargo floor height, and passenger package efficiency. The findings show that the main challenge is not simply integrating different propulsion systems into one structure, but allocating limited vehicle volume among propulsion, energy storage, occupant package, cargo function, and clearance requirements. BEV derivatives can provide a more compact rear propulsion package, but battery placement creates strong constraints in occupant and cargo related zones. ICE derivatives require a larger and more sensitive rear module because of engine size, supporting systems, driveline arrangement, and service needs, while CNG based variants intensify competition for the same protected package areas. The study concludes that common platform feasibility in L5e vehicles must be addressed as an early geometry driven architecture problem, and that successful commonality depends on defining controlled common and derivative specific package zones from the concept stage.

**Keywords:** L5e, three wheeled vehicle,

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# Experimental Comparison Of Block Load Fatigue Testing And Road Time History Fatigue Testing for A Vehicle Rear Suspension

*Mustafa BOZ*[1]

**Abstract**

Fatigue durability evaluation is a critical part of automotive suspension development, as suspension components are continuously subjected to complex loading conditions generated by road irregularities and vehicle dynamics. In order to reproduce these service loads under laboratory conditions, different fatigue testing approaches are commonly used in the automotive industry. Among these methods, block fatigue loading and road load time history testing are widely applied for durability validation of suspension components.

This study presents an experimental comparison of block fatigue loading and spindle-coupled time history fatigue testing for a rear torsion beam suspension system. Road load data were collected from durability tests performed on statistically developed proving ground tracks representing typical road conditions such as potholes, rough asphalt, and cobblestone surfaces. During the measurement phase, the vehicle was instrumented with wheel force transducers, accelerometers, and displacement sensors in order to capture the dynamic loads acting on the suspension system.

A virtual vehicle dynamics model was used to generate mission load cases from the measured road inputs. These loads were then simplified into sequential single-axis block loading programs applied in longitudinal, lateral, and vertical directions. In parallel, spindle-coupled time history fatigue tests were conducted using a wheel force transducer interface and a drive file development process to reproduce the measured load signals.

The fatigue load spectrum were evaluated using level crossing and damage accumulation analysis, and the results were compared with the physical fatigue test outcomes. The study aims to assess the correlation between simplified block fatigue loading and realistic time history loading in terms of fatigue damage representation and structural failure behavior of rear suspension components.

**Keywords:**Rear suspension durability, Torsion beam suspension, Block fatigue testing, Time history fatigue, Vehicle durability testing, Road load data

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# 700 Bar Type IV Composite Hydrogen Tanks: Structural Optimization of Boss–Liner Interface Sealing

*Başak TEKİN ERBAĞ*[1]
*Hayriye Göksu ARALIK* [2]

**Abstract**

Hydrogen energy has emerged as a critical alternative energy technology for heavy-duty and long-distance transportation sectors such as heavy-duty vehicles, railway transport, maritime applications, and logistics, due to its high energy density, short refueling time, and low emissions advantages. For these applications, Type IV composite hydrogen tanks with high-pressure resistance are utilized to enable safe and lightweight hydrogen storage. Type IV tank structures consist of a thermoplastic liner providing hydrogen barrier properties, metallic boss components controlling gas inlet and outlet, load-bearing carbon fiber reinforced composite layers, and epoxy resin systems.
In this study, leakage issues observed in 700 bar Type IV composite hydrogen tanks developed for transportation applications were investigated. Hydrostatic pressure and burst tests revealed that leakage occurred particularly in the dome regions at the interface between the metallic boss and the thermoplastic liner. Analytical evaluations indicated that the root causes of this problem were insufficient adhesion between the thermoplastic liner and the metallic surface, as well as interfacial stresses arising from differences in thermal expansion coefficients (CTE) of the two materials.
To eliminate the identified sealing issues and improve interfacial integrity, two different structural optimization approaches were evaluated. In the first approach, mechanical sandblasting, surface activation, PE-based primer/coating application, and controlled thermal curing processes were applied to the metal boss surface in order to enhance chemical and micromechanical bonding strength. In the second approach, macro-mechanical interlocking was targeted through geometric optimization. In this context, hole and channel structures were designed on the boss surface, allowing the molten thermoplastic liner material to penetrate these features during the rotomolding process, thereby forming a mechanical anchoring effect at the interface region.
As a result of the implemented hybrid optimization approaches, improved boss–liner connection performance, reduced leakage issues in the dome region, and enhanced safety performance of the tank under high-pressure conditions were achieved. This study is expected to contribute to the localization and reliability improvement of 700 bar Type IV composite hydrogen tanks, which are critical components in the heavy transportation and mobility ecosystem.
**Keywords**: Hydrogen storage tank, Type IV composite tank, boss–liner adhesion, thermal expansion mismatch, filament winding, high-pressure vessels, heavy-duty transportation.

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# Investigation of the Effects of Different Infill Density and Infill Pattern on Mechanical Properties in Additive Manufacturing

*Recep YILDIZ1*

**Abstract**

In the determination of the mechanical performance of parts produced using fused deposition modeling (FDM) technology, a type of additive manufacturing, critical parameters such as infill density and infill patterns were examined through a systematic analysis based on the literature. Current academic studies have been compiled to reveal the effects of filler parameters on tensile, yield, compressive strength, and modulus of elasticity. Within a filler density range of 10% to 100%, optimum filling patterns were determined based on mechanical properties. The findings show that the Concentric fill pattern exhibits the highest tensile and yield strength values due to its layer continuity. In performance analyses under compressive force, it was determined that the Grid fill pattern, especially at fill densities between 40% and 80%, is the geometry that best preserves structural integrity and is most resistant to maximum load. It has been observed that the modulus of elasticity varies with different filler densities and filler patterns, and no single filler geometry establishes a dominant advantage. In the FDM method, selecting optimized filler patterns and filler densities according to the direction and type of force the part will be subjected to is critical for achieving the goals of part lifespan, raw material savings, and product lightness. This study serves as a comprehensive guide for selecting the optimum filler pattern for parts manufactured according to the targeted filler ratio. The main outcome of this study is to provide an academic roadmap for designers and engineers that accelerates optimization processes, saves time, and directly contributes to these optimization processes.

**Keywords:** Additive manufacturing, Infill density, Infill pattern, Fused deposition modeling, 3D printing, Mechanical properties

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# Scenario-Based Mathematical Modeling and Multi-Controller Design for a Nano Quadcopter

*Alperen KÖSE*[1]
*Hakan ÜLKER*[2]

## Abstract

Nano quadcopters have become important research platforms for autonomous flight control applications due to their lightweight structure, agile maneuverability, and highly nonlinear dynamics. This study presents a comprehensive multi-scenario modeling and design framework for the flight controller of the Crazyflie 2.1 nano quadcopter. The flight envelope was compartmentalized into four operational flight scenarios: hovering, rising, straightforward flight, and coordinated maneuvering (level turn). A 6-degrees-of-freedom nonlinear mathematical model incorporating 12 coupled ordinary differential equations, including translational and rotational motion dynamics and aerodynamic and gyroscopic effects, was implemented in MATLAB/Simulink. For each flight scenario, the trim conditions were obtained. The linearized state-space models were then derived around the corresponding trim points and converted to lower-order transfer functions to simplify controller design. The proposed control structures were designed for each flight scenario through the 4-motor pulse-width modulation control signals subject to physical motor constraints in the range of 10000–60000. In the rising scenario, the body-frame vertical velocity was controlled to achieve a constant climbing velocity of 30 m/s using a PD controller. For the hovering scenario, the altitude output was regulated at a constant value of 5 m using a PD controller. In the straightforward flight scenario, conventional PD-based approaches provided insufficient stability performance; a phase-lead compensator was designed to improve stability and tracking capability. For the maneuvering stage, a PD controller was designed to track a constant yaw rate of 0.087266 rad/s during a coordinated turn at a steady altitude of 3 m. PD controller parameters were determined using the second Ziegler–Nichols and pole placement tuning methods. The closed-loop simulations confirm stable reference tracking across all scenarios, and the results indicate that the designed controllers maintain satisfactory performance not only at the exact trim points but also at neighboring operating conditions, providing a robust foundation for future real-time nano quadcopter applications.

**Keywords:** Nano Quadcopter, Scenario-Based Flight Control, PD Controller, Phase-Lead Compensator, MATLAB/Simulink

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# Design and Functional Evaluation of Vehicle Fender Components

*Cihangir Gündüz*

**Abstract**

Fenders are critical components in vehicles, positioned around the front and rear wheel areas to provide coverage and isolation. Their primary function is to prevent external elements such as stones, water, and debris from entering sensitive internal parts like the engine compartment and vehicle body. Beyond their main positioning, fenders interact with multiple surrounding components including the hood, bumper, doors, headlights, side panels, attached plastic parts, and the underbody structure. Therefore, their design requires careful consideration of these interfaces to ensure proper fit, functionality, and durability. Design changes in adjacent components can significantly influence fender geometry and performance, making the design process highly interdependent. Additionally, fenders can be produced using different material types such as metal, plastic, and composite materials, each offering specific advantages in terms of weight, cost, strength, and manufacturability. This study highlights the importance of fender design in terms of vehicle aesthetics, structural integrity, and safety, while emphasizing the need for an integrated design approach considering multi-component interactions.
**Keywords:** Fender, automotive body, design integration, material selection, vehicle safety

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# Objective Prediction of Driver Annoyance Using Multi-Domain Vehicle Performance Indicators

*Kürşat ÇOBAN*[1]

**Abstract**

Horse-pulling carriages have been used by humans for thousands of years to move items and people. Vehicles took over this job in the late 19th century and have continued to evolve non-stop. At the beginning, this evolution was on the mechanical side then include comfort and safety.

Over the past decades, vehicle development has achieved substantial improvements in noise, vibration and harshness refinement (NVH), significantly reducing steady acoustic discomfort inside of the vehicle cabin. Simultaneously, the widespread integration of Advanced Driver Assistance Systems (ADAS) has increased the frequency of auditory and visual alerts during typical daily driving conditions. While NVH annoyance is well-modelled through psychoacoustic metrics, and ADAS performance is evaluated using safety-oriented indicators, no unified framework currently quantifies total driving annoyance across mechanical and digital domains.

This study proposes a Dual-Domain Annoyance Index (DAI) for integrating continuous NVH exposure and event-based ADAS alerts into a single objective metric. The model combines weighted psychoacoustic parameters with occurrence frequency, severity, and a false-positive-based alert weighting system. It also incorporates an interruptive salience coefficient to reflect the difference in perception between steady and transient stimuli.

Scenario based simulations comparing the profiles of legacy and modern vehicles demonstrate that increases in alert density can offset substantial reductions in cabin sound pressure level. The proposed framework allows for cross-vehicle benchmarking and provides OEMs with a practical tool for evaluating road tests and calibrating systems.

**Keywords:** Dual-Domain Annoyance Index; Vehicle NVH; ADAS Alert; Psychoacoustic Modelling; Driver Perceived Comfort

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# Bell Type Industrial Furnace Retort Cooling: An Experimental and Numerical Study

*Alper KELEŞOĞLU*[1]

## Abstract

Bell-type industrial furnaces are widely used in heat treatment processes due to their batch production capability, uniform temperature distribution, and operational flexibility. This study examines at the effect of cooling air flow rate on the cooling performance of a bell-type industrial furnace retort by comparing cooling time, pressure loss, and temperature homogeneity between upper and lower zones. Experimental data and numerical simulations done for the flow rate conditions (1000-2000 m³/h) were compared for cooling from 625°C to 150°C with minimum cooling ramp as 120°C/min. The findings show that raising the volumetric air flow rate greatly reduces cooling time in both zones thanks to improved convective heat transfer. However, this improvement comes with a significant rise in pressure loss, indicating a larger energy need for airflow generation. Despite the increased cooling rates, there was a persistent temperature differential between zones 1 and 2 where they are located longwise of the retort, indicating that increasing flow rate alone is insufficient to achieve thermal homogeneity. The experimental condition showed a lower temperature gradient, emphasizing the relevance of optimal operating parameters and flow distribution. As a result, the data demonstrate a key trade-off between cooling efficiency, energy consumption, and temperature uniformity, underlining the importance of balancing all three aspects for optimal system performance.
**Keywords:** Industrial furnace, Cooling, Bell type, Retort

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# Artificial Neural Network Based Winglet Optimization of the Onera M6 Wing

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## Abstract

Aerodynamic efficiency is a key performance indicator in aircraft design. In finite wings, wingtip vortices increase induced drag and reduce the lift-to-drag ratio (CL/CD). Winglets are passive design elements used to regulate wingtip flow and improve efficiency. This study investigates the effect of winglet geometry on the ONERA M6 wing using a CFD and Artificial Neural Network-based approach. The geometry was defined by five variables: cant angle, taper ratio, sweep angle, toe angle, and twist angle. A Box–Behnken design of experiments was used to sample the design space. CFD analyses were performed using a three-dimensional, compressible, steady RANS approach with the Spalart–Allmaras turbulence model. The numerical method was validated against ONERA M6 experimental data, and the validated solver settings were applied to all configurations. Using the CFD results, an Artificial Neural Network model was developed to predict the lift coefficient (CL) and drag coefficient (CD) separately; CL/CD was then calculated from these predictions. The trained model was used to scan the design space and identify high-efficiency candidate configurations. The ANN-based search identified a candidate configuration with a cant angle of 65.5°, taper ratio of 0.20, sweep angle of 11°, toe angle of −2.75°, and twist angle of −2°, which was validated using an additional CFD analysis. The results showed an approximately 12% improvement in CL/CD compared with the reference wing. The findings indicate that efficiency is governed not by a single parameter, but by the combined geometric influence of the winglet variables. The combined use of CFD and ANN enabled a systematic evaluation of the design space.

**Keywords:** Winglet Geometry, Computational Fluid Dynamics, Artificial Neural Network, Parametric Analysis, Aerodynamic Efficiency, ONERA M6 Wing

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# A Study on the Design and Evaluation of Shielding Structures for High-Voltage Component Protection in Electric Vehicle Frontal Crashes

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**Abstract**

The rapid increase in the number of vehicles on the road has raised concerns regarding traffic safety, particularly regarding frontal impact. Electric vehicles (EVs) introduce new safety challenges due to the presence of high-voltage battery systems and power electronics. In severe frontal impacts, structural deformation may threaten the integrity of the battery pack, high-voltage cables, and related components, potentially leading to short circuits, or loss of isolation. To address these risks, several passive and active safety measures are employed.

One approach to improving crash safety in EVs involves reinforcing the battery casing and high-voltage cable conduits using high-strength materials or multi-layer protective structures. These reinforcements help the system withstand impact forces and prevent critical component damage. Additionally, protective shields and energy-absorbing structures can be integrated to redirect or attenuate crash loads before they reach the high voltage cables. These components distribute energy more effectively throughout the vehicle's architecture.

The shielding structures, particularly those integrated into complex architectures with numerous components such as engine assemblies, may exhibit various design vulnerabilities. Insufficient bolted connection interfaces or localized regions with inadequate structural strength can negatively influence overall performance. Therefore, effectively managing deformation, folding behavior, and force distribution during impact events through appropriate engineering methodologies is of critical importance. This study examines the collision behavior of a shielding structure that fails to provide adequate connection strength despite its intended function of protecting electrical socket interfaces and evaluates various improvement strategies and solution approaches within the framework of load path management.

Through these measures, the overall crashworthiness of electric vehicles can be improved, mitigating the risk of electrical hazards. Enhancing the protection of high-voltage components contributes to safer EV operation and increases consumer confidence in electric mobility systems.

**Keywords:**Finite ElementAnalysis(FEA),Frontal Crash, Fuel Line Protection, Fuel Leakage, Collision

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# Investigation of the Effect of Boron Nitride Nanoparticle Addition to Diesel and Biodiesel/Diesel Fuel Mixtures on Engine Parameters

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**Abstract**

This study aims to investigate the effects of nanoparticle use on the performance and emissions of a diesel engine. In this context, the development of alternative fuel technologies and the improvement of existing fuels are of great importance today. To this end, boron nitride (bN) nanoparticles were mixed with conventional diesel fuel and biodiesel fuel (diesel and 20% canola oil) at a mass concentration of 1000 ppm using an ultrasonic method. Additionally, conventional pure diesel fuel without nanoparticles was used to obtain reference values. In the tests, a single-cylinder air-cooled diesel engine was used at constant speeds of 1800, 2400, and 3000 rpm and under variable engine loads of 3, 6, and 9 Nm. These test conditions were selected to examine the engine's behavior under different operating regimes. Upon evaluating the data obtained from the tests, an increase in the cetane number, calorific value, and viscosity of the diesel fuel was observed with the use of nanoparticles. It is believed that these changes directly affect combustion characteristics. When test fuels containing nanoparticles were used, improvements in engine performance and emissions were observed. In particular, the increase in combustion efficiency played a significant role in reducing emission levels. It was observed that the addition of canola oil and nanoparticles generally reduced specific fuel consumption. The test fuel with the lowest specific fuel consumption was DKBN (80% pure diesel + 20% canola oil + 1000 ppm boron nitride nanoparticles), which was produced by adding both canola oil and bN nanoparticles. In conclusion, when all results are evaluated together, the use of boron nitride (bN) nanoparticles in combination with diesel and biodiesel fuels offers both energy-efficient and environmentally beneficial outcomes. These findings suggest that alternative fuel blends may also provide economic advantages and establish an important foundation for future research.

**Keywords:** Diesel, Boron nitride, Nanoparticle, Biodiesel, Canola, Performance, Exhaust emissions

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# Three-Variable Dimensional Design Study in Mechanical Steering Gear Design

*MuratGÜNEY [1]*

**Abstract**

Steering systems play a critical role in vehicle handling performance and driving safety. In the design of mechanical steering gearboxes, parameters such as gear geometry, steering ratio, and torque transmission must be carefully selected. In this study, a three-variable dimensional design analysis was conducted for a rack-and-pinion type mechanical steering gearbox. Steering ratio, gear module, and gear face width were selected as the design variables. The objective was defined as reducing driver input torque while increasing system efficiency. In the proposed model, engineering constraints such as gear strength and contact stress were taken into account. As a result of the calculations, optimal design parameters were determined, and an improvement in system performance was anticipated.
**Keywords:** Steering system, rack and pinion, gear design, sizing

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# The Effect of the Thermoforming Process on Automotive Part Geometry and Design Processes

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**Abstract**

Thermoforming is a widely used forming method in the automotive industry for the production of large-surface thermoplastic parts. Due to its low tooling cost, short development time, and suitability for prototype manufacturing, it is especially preferred in automotive interior and exterior trim applications. This study investigates the effects of the thermoforming process on automotive part geometry and design processes. Within the scope of the study, the fundamental operating principle of the thermoforming process, production stages, and its application areas in the automotive industry are first examined. Subsequently, the materials used during the process, material selection criteria, and surface texture alternatives are evaluated. In addition, the effects of key design parameters such as draft angles, corner radii, draw depth, and material thickness distribution on part geometry are explained. Furthermore, common manufacturing defects encountered in vacuum thermoforming processes, including thinning, corner tearing, vacuum marks, and surface waviness, are analyzed in terms of their formation mechanisms and their effects on design. In the final section, injection molding and vacuum thermoforming methods are compared with respect to production capacity, tooling cost, dimensional accuracy, and design flexibility. This study aims to present the key design parameters that should be considered throughout the process by examining the effects of the thermoforming process on automotive part design from both manufacturing and design perspectives.

**Keywords:** Thermoforming Process, Vacuum Forming, Aesthetic Surface Design, Plastic Part Manufacturing, Low-Volume Production, Automotive Exterior Trim

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# Mechanical Design and Operational Characteristics of Secondary Safety Hook Mechanisms in Automotive Hood Latch Systems

*Göktuğ BAKAN* [1]

## Abstract

In automotive hood systems, secondary safety hook mechanisms play a crucial role in preventing accidental hood opening during vehicle operation. These mechanisms function as a fail-safe element that maintains partial hood engagement when the primary latch is released, thereby ensuring driver safety and compliance with automotive safety regulations. In addition to preventing sudden hood lift-off, the secondary latch allows controlled user intervention for full hood opening, contributing to both safety and ergonomics. This paper investigates the design and functional behavior of secondary safety hook mechanisms used in passenger vehicles. The study examines the operating principles, mechanical configurations, and integration of safety hooks within hood latch systems, including their interaction with primary latch components and release cables. Different design approaches are evaluated in terms of kinematic behavior, load transfer mechanisms, and tolerance management. Key design parameters such as engagement geometry, user actuation accessibility, packaging constraints, material selection, and durability requirements are analyzed in detail. Special attention is given to environmental influences such as corrosion, contamination (dust, ice, and debris), and temperature variations, which may affect mechanism reliability over time. The study also considers manufacturing and assembly constraints, including stamping tolerances and alignment sensitivities. Furthermore, regulatory requirements and industry standards related to hood retention systems are reviewed, and potential failure modes, such as incomplete engagement, wear-induced malfunctions, and cable or lever failures, are discussed through a failure mode and effects perspective. Design validation methods, including physical testing and simulation approaches, are also briefly addressed.The results provide an engineering perspective on the development of reliable hood secondary latch systems and highlight important considerations for improving safety, robustness, and functional performance. This work aims to support design engineers in optimizing secondary safety mechanisms under real-world operating conditions while meeting stringent safety requirements.
**Keywords:** Automotive Closure Systems, Hood System, Safety Hook Design, Packaging Constraints, Ergonomic Criterias

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# Investigation of Ride Height Reduction Effects on Roll Behaviour of Vehicles with Independent and Dependent Suspension Systems

*Berk Can KUL*[1]
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## Abstract

Ride height reduction is commonly used to improve vehicle handling by lowering the center of gravity. However, its effect on roll behaviour depends strongly on suspension architecture and roll center characteristics. This study investigates the influence of ride height reduction on the roll behaviour of vehicles equipped with rear independent and dependent suspension systems. A comparative analysis is conducted under multiple ride height conditions by evaluating roll center height, roll moment arm, and roll gradient.

The results show that lowering does not always improve roll performance. In independent suspension systems, ride height reduction may cause an unfavorable decrease in roll center height, increasing the roll moment arm and potentially worsening roll behaviour. In dependent suspension systems, the response differs due to the distinct geometric characteristics of the axle structure. The findings demonstrate that the effect of lowering is suspension-dependent and should be evaluated with careful consideration of suspension geometry and roll kinematics.

**Keywords:** Ride Height, Roll Behaviour, Roll Center Height, Independent Suspension, Dependent Suspension, Roll Gradient

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# Trial Production of Steel-Aluminum Wheels and the Effect of Vibration on Vehicle Comfort in Prototype Vehicles

*Barış ULUÇAY* [1]
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## Abstract

The wheel and tire assembly is one of the most critical systems affecting vehicle ride comfort, handling, and perceived safety. In this study, vibration issues observed within specific speed ranges on light commercial vehicles platform were investigated by analyzing the effects of wheel rims, hubs, tires, and fastening components on balance and vibration performance along the activation of protype product on development phases. Comparative evaluations were conducted between steel wheels manufactured in global plant and localized products produced with using transferred molds, as well as different aluminum wheel brands used on the same vehicle. Test results showed that even when the general production process is similar, variations in tooling, center bore tolerances, and process control parameters can significantly affect vehicle vibration behavior. Based on the findings, improvements in manufacturing processes, tooling revisions, and the addition of new control criteria that were proposed in order to prevent quality issues and improve customer satisfaction.
**Keywords**: Wheel vibration, wheel rim manufacturing, vehicle dynamics, NVH, wheel balancing, steel wheel, aluminum wheel, process control, tolerance analysis, quality, ride comfort, wheel localization, tire and wheel system, vehicle vibration performance.

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# Overview of Vehicle Occupants Architectural Performance

*Muhammed Ali VURAL*[1]

**Abstract**

The architectural performance evaluations of vehicle occupants are based on human-machine compatibility studies. Studies in this field have been conducted to enable humans to use machines more efficiently. They aim to increase this efficiency through parameters such as standardizing human-machine processes, correct work share and an ideal work rhythm. With the development of vehicle technology, studies on the vehicle occupants architectural performance have been carried out using information obtained from human-machine compatibility. The architectural performance of occupants has been evaluated by considering parameters such as interior roominess, external visibility, and ingress/engress values.

In addition to the information found in the literature, the dimensions of the vehicle's trunk are also a parameter that can affect the occupant's comfort. To demonstrate the impact of this parameter on the occupant's comfort, this study was conducted considering different trunk carpet heights. The height of the trunk carpet affects the user's comfort, and this parameter was correlated with the user's back and elbow angles.

When evaluating the vehicle occupants architectural performance, parameters such as roominess, visibility, ingress/egress, trunk dimensions, etc., need to be considered. The aim is to evaluate the relationship between the vehicle as a whole and its occupants. This study provides an overview of vehicle occupants architectural performance.

**Keywords:** Vehicle Architecture, Roominess, Visibility, Ingress/Egress, Trunk

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# Changes in Bumper Design with Electric Vehicles

*Gorkem OZTAS*
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**Abstract**

The transition to electric vehicles (EVs) has necessitated a fundamental redesign of vehicle exterior components, particularly bumper systems. This study examines how EV-specific structural requirements, such as aerodynamic efficiency and the integration of new technological components, drive these design changes. Key factors including modified grille structures, pedestrian safety acoustic systems, and the strategic placement of charging ports are discussed. The paper concludes by demonstrating how bumpers have evolved from simple protective parts into multifunctional modules in the era of electric mobility.

**Keywords:**Electric Vehicles (EV), Bumper Design, Aerodynamic Efficiency, Functional Integration, Pedestrian Safety (AVAS), Charging Port Placement, Automotive Exterior Trim

# The Impact of Drag Area ( ) on Cabin Wind Noise at 140 km/h: A Comparative Analysis across Diverse Vehicle Segments

*Muhammed Taha SIRMA*[1]

## Abstract

In modern automotive engineering, aerodynamic efficiency is traditionally quantified by the drag coefficient ($C_d$). However, as vehicle speeds reach the aeroacoustic threshold, typically above 100 km/h, the sound pressure level (SPL) within the cabin is increasingly influenced by the overall aerodynamic loading associated with vehicle geometry. This study investigates the correlation between drag area ($C_d \times A$) and interior wind noise characteristics at a cruising speed of 140 km/h. To provide a comprehensive analysis, six distinct vehicle geometries were selected for comparison: an A-segment city car, a B-segment sedan, a C-segment SUV, a D-segment sedan, an M-segment medium commercial vehicle, and an N-segment heavy commercial vehicle.

The methodology utilizes a full taping approach to isolate shape-induced noise from leakage noise. All body shutlines, door seals, and external cavities were sealed with acoustic tape, ensuring that the measured noise reflects only the pressure fluctuations generated by the global vehicle geometry. Measurements were conducted at a steady-state speed of 140 km/h with high-precision microphones positioned at the driver's ear level to record the cabin acoustic signature.

The findings demonstrate a strong linear correlation between drag area and interior SPL. The results show that drag area provides a more meaningful explanation of high-speed cabin acoustic comfort than drag coefficient alone. For instance, despite having a competitive drag coefficient, the N-segment heavy commercial vehicle exhibits significantly higher noise levels due to its large frontal area and the resulting increase in aerodynamic excitation. Conversely, the streamlined geometry of the D-segment sedan provides the most favorable acoustic signature. This study concludes that drag area ($C_d \times A$) is a more reliable predictor of high-speed aeroacoustic performance than drag coefficient alone and therefore can provide useful guidance during the early design phases of development.

**Keywords:** Aeroacoustics, Wind Noise, Drag Area, Vehicle Aerodynamics, NVH

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# Defects and Process Challenges in Resistance Spot Welding of Automotive BIW Structures

*Elif KOCAOĞLU*[1]

## Abstract

Resistance Spot Welding (RSW) is a joining method based on clamping two or more sheet metals between copper electrodes under mechanical pressure and generating a localized weld at the interface through resistance heat produced by the electrical current passing through the sheets. Due to its short cycle time and strong compatibility with automated production systems, resistance spot welding is widely preferred in automotive Body-in-White (BIW) sheet metal assemblies. The presence of thousands of spot welds in a typical vehicle body clearly demonstrates the critical role of this method in automotive manufacturing processes. However, the complex geometries of automotive body structures, together with variations in sheet thickness and material combinations, make it difficult to maintain consistent weld quality in resistance spot welding applications. These factors may lead to various weld defects and process-related challenges during production. This study presents a general evaluation of the most common weld defects encountered in resistance spot welding applications in automotive body structures, along with their root causes and the process-related challenges observed during production. By highlighting the limitations of resistance spot welding applications, this study aims to raise awareness of weld defects encountered in automotive body manufacturing and to provide a general engineering perspective on the subject.

**Keywords:** Resistance Spot Welding (RSW), Automotive Body-in-White (BIW), Weld Defects, Process Challenges, Welding Quality Consistency

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# Applications of Roll Forming Technology in Automotive

*Çiğdem BILGE*

**Abstract**

Roll forming technology has become an important manufacturing method in the automotive industry due to its capability to provide high dimensional accuracy, continuous production, and the manufacturing of lightweight structural components. The increasing demand for lightweight vehicle design, enhanced crash safety requirements, and the widespread adoption of electric vehicle architectures have significantly increased the use of roll-formed components in modern automotive structures.

This study presents a literature-based review of the applications of roll forming technology in automotive manufacturing. In particular, the use of advanced high-strength steels (AHSS), the application of roll forming technology in electric vehicle battery pack frame structures, and comparisons with conventional sheet metal forming processes are discussed. Previous studies indicate that roll forming technology provides high dimensional accuracy, reduced production defects, and more efficient material utilization in the manufacturing of automotive structural components such as bumper beams, door reinforcements, seat rails, and battery frames. These findings demonstrate that roll forming technology is an important manufacturing method for next-generation automotive production and electric vehicle structural designs.

**Keywords:** Roll forming, Automotive manufacturing, Advanced high strength steel, Electric vehicle structures Battery frame, Lightweight automotive design

# Development of Side Arm-Damper Attachment Connections with Forming Optimization in Rear Twist Beam

*İbrahim İNAN*[1]
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*Zafer GÜLER*[4]

**Abstract**

This study focuses on the design and assembly process of side arm and damper attachment components, which are sub-parts of a rear twist beam suspension system. The side arm is made from 4 mm thick S420MC sheet steel, with a hole diameter of approximately 17 mm obtained through the stamping process. The damper attachment part is a cold-drawn sleeve with an outer diameter of 32 mm. These two components are joined via a press-in operation using upper and lower fixtures. During the press-in of the damper attachment inner sleeve, the sheet bends and a flange is formed. To reduce notch effects and improve surface quality, a subsequent machining operation is applied, and the resulting final hole diameter is considered a critical process parameter.

The final hole diameter directly affects press-in performance. Smaller diameters increase the risk of cracks due to elevated contact pressures, whereas larger diameters reduce the retention force because of spring back after assembly. Furthermore, the bottom radius influences stress concentration, thereby affecting fatigue and crash performance. Any cracks formed during press-in create a notch effect that further compromises fatigue strength. Therefore, optimizing both the hole diameter and radius is essential.

Within this study, key process parameters including final hole diameter, bottom radius, flange length, and fixture geometries were systematically investigated. Numerical analyses were performed using AutoForm, followed by experimental validation on three selected hole diameters using a Zwick testing machine. The results enabled determination of the optimal hole diameter and associated process parameters for robust and reliable assembly of rear twist beam component.

**Keywords:** Automotive Industry, Autoform Simulation, Chassis Parts, Durability, Finite Element Analysis, Process Development

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# Impact Analysis of Euro 7 Emission Regulations on Vehicle System Architecture & Integration

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**Abstract**

The number of motor vehicles and the associated environmental pollution continue to increase worldwide. In order to reduce the harmful effects of vehicle emissions on both the environment and human health, emission regulations introduced with Euro 1 in 1992 have gradually become more stringent through subsequent standards such as Euro 5 and Euro 6.

The Euro 7 regulation establishes a new framework for the type approval of road vehicle emissions within the European Union. Unlike previous regulations that mainly focused on tailpipe emissions, Euro 7 introduces a broader technical scope that includes brake particle emissions, tire wear emissions, stricter durability requirements, and lifetime emission monitoring. With the publication of Regulation (EU) 2024/1257 on 8 May 2024, Euro 7 brings light-duty and heavy-duty vehicles under a unified regulatory framework while emphasizing the on-board monitoring (OBM) concept to ensure vehicles remain environmentally compliant throughout their operational life. According to the European Commission, the regulation introduces new requirements covering exhaust emissions, brake emissions, and battery durability, while also requiring that emissions be monitored through onboard sensors over the vehicle lifecycle.

In this study, the impacts of Euro 7 requirements on vehicle architectural integration are investigated by analyzing the changes introduced in vehicle components and subsystems. The analysis focuses on subsystems that directly affect vehicle architecture under Euro 7, including engine control architecture, exhaust and aftertreatment layout, evaporative emission systems.

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# Transfer path-based assessment of underhood insulation layout for airborne engine noise reduction

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## Abstract

In modern vehicle development, airborne noise control is critical for achieving target NVH performance levels. Acoustic insulation components used in vehicles are designed to reduce airborne noise transfer and improve overall NVH performance. In this context, understanding the insulation distribution and its relation to noise transmission characteristics is essential for optimizing NVH performance. The insulator distribution of components is determined by considering both acoustic requirements and assembly constraints. Within this framework, the distribution of an underhood insulator used in a light commercial vehicle is investigated using a transfer path approach, focusing on the relationship between insulation layout and airborne noise transmission behavior under the hood. The study questions the effectiveness of conventional insulation design approaches, where design decisions are often driven by packaging constraints and empirical practices rather than actual noise transmission characteristics. For this purpose, the distribution of the insulation component is evaluated together with noise transmission behavior under idle operating conditions in a semi-anechoic environment. Different insulation configurations, including baseline and locally modified insulation layouts based on transmission path identification, are comparatively assessed. The findings indicate that insulation distribution should be defined based on transmission-driven criteria rather than uniform or experience-based approaches. This approach enables the quantitative evaluation of the relationship between insulation distribution and interior noise, and supports the development of more efficient and targeted acoustic package designs for vehicles.

**Keywords:** Underhood insulator distribution, transfer path approach, acoustic package, airborne engine noise, NVH

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# Investigation of the Use of Recycled Materials in Automotive Weatherstrip Products from an Environmental Sustainability Perspective

*Eyüp Kurtuluş*[1]

**Abstract**

The automotive industry is accelerating efforts to adopt sustainable materials in order to reduce carbon emissions and meet circular economy targets. Weatherstrips, used for sealing doors, windows, and vehicle bodies, are typically made from petroleum-based elastomers, primarily ethylene propylene diene monomer (EPDM) rubber. EPDM is widely preferred due to its excellent resistance to heat, ozone, and weathering.

However, its reliance on fossil resources and the slow degradation of end-of-life waste present environmental challenges. As a result, integrating recycled and bio-based materials into elastomeric sealing systems has become a key research focus. Studies show that recycled elastomer waste can be reprocessed through devulcanization and incorporated into EPDM compounds, enabling up to 20% reclaimed rubber usage in industrial applications. Additionally, new EPDM composites using recycled carbon black, recycled plastics, and bio-based fillers are being developed to reduce fossil raw material consumption and lower carbon footprints.

Recent research also highlights the potential of cellulose-based bio-fillers and reclaimed elastomers in improving both sustainability and mechanical performance. These "green composite" materials are considered promising alternatives for automotive sealing profiles.

This study examines current elastomeric materials used in weatherstrips and evaluates both academic and industrial efforts on recycled material integration. The findings indicate that while the use of recycled materials is technically feasible, optimizing mechanical properties, processability, and long-term durability remains essential. Increasing recycled content while maintaining performance is therefore a key area for future development in sustainable automotive sealing systems.

**Keywords:**

[1] Unvan, Üniversite, Bölüm, Orcıd:

# Comparison of Frontal Impact Regulatory Requirements in EMEA and NAFTA

*Müzeyyen Nur KAPLAN*

**Abstract**

This paper presents a comparative review of frontal impact regulatory requirements in EMEA and NAFTA, focusing on differences in regulatory philosophy, test configurations, dummy selection, occupant condition coverage, airbag deployment strategies, injury assessment criteria, and related frontal safety requirements. In the NAFTA framework, frontal occupant protection is mainly governed by the Federal Motor Vehicle Safety Standards, particularly FMVSS 208, together with associated frontal-related requirements such as FMVSS 204, FMVSS 212, and FMVSS 219. One notable divergence is the NAFTA framework's explicit consideration of unbelted occupant protection under FMVSS 208, which involves broader occupant condition coverage, including small-stature occupants represented by the 5th percentile female dummy and out-of-position (OOP) cases. Meanwhile, the mandatory EMEA framework, primarily represented by UNECE Regulation No. 94 and UNECE Regulation No. 137, follows a more targeted frontal impact approach centered on belted occupant protection and restraint-system performance. The study compares the principal frontal test configurations, restraint-related considerations, and injury assessment criteria applied in the two regions, including differences in occupant coverage and frontal evaluation scope. It also considers how these differing regulatory approaches shape airbag-related design logic and frontal safety development priorities. Overall, the findings provide a structured basis for understanding how regional regulatory philosophies influence vehicle platform development, calibration complexity, and global compliance activities.
**Keywords:** Frontal impact regulation, FMVSS 208, UNECE R94, UNECE R137, occupant protection

# Comparison Study of Static Load Compensation CAE Analysis and Physical Test Results on Hood

*Kübra Nur Kulaoğlu*[1]
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**Abstract**

This study investigates the comparison between Static Load Compensation (SLC)CAE analyses and physical validation tests performed on hood. When the hood is latched in its design position, the combined effects of gravity, seals, bumpers, and gas struts introduce a measurable deformation on the hood structure. Excessive deflection can lead to poor hood-to-fender flushness, uneven gaps, and insufficient or excessive seal pressure. The SLC methodology quantifies this behavior by predicting the hem edge deflection under the combined static loads and ensuring that the designed fit-and-finish criteria are maintained. In addition to static sealing loads, aerodynamic forces at high vehicle speeds may cause upward displacement of the hood, potentially lifting it above the nominal design position and inducing permanent set or long-term deformation. Both SLC and aerodynamic-load cases are modeled as static events with the hood constrained in the design position. The CAE model includes the contributions of gravity, seal compression forces, bumper reactions, and gas strut opening forces, along with the hood's structural stiffness and boundary conditions. The numerical results were compared with physical measurements obtained from prototype vehicles, including force–displacement behavior, hem deflection profiles, and local deformation modes. Comparisons focused on deflection magnitude at the hood hem, the overall deformation shape, and the interaction effects with adjacent components such as fenders and the front fascia. Results indicate that the CAE predictions achieve a correlation within %10–%12 of the physical test results, with deviations primarily attributed to manufacturing variability, seal stiffness tolerances, and idealized constraints used in the simulation environment. This work demonstrates the capability of CAE-based SLC and aerodynamic load analysis to accurately predict hood deformation behavior in early design stages. Furthermore, the study identifies key factors influencing correlation quality and provides guidance for improving virtual validation methods to reduce prototype testing effort and enhance fit-and-finish robustness.

**Keywords:** Static Load Compensation, Hood, Fit and Finish, Seal, Correlation

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# Effect of a Lower Bumper Structural Element on Tibia Bending Moment in Pedestrian Collisions

*Zubeyir Ramazan Aktasgil*[1]
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## Abstract

Vehicle front-end design has increasingly emphasized pedestrian protection in recent years due to the evolution of regulatory requirements and consumer assessment programs. In vehicle pedestrian collisions, lower leg injuries particularly those involving the tibia and knee joint represent a significant proportion of overall injury risk and are closely associated with the design of the bumper system and the front lower structural architecture. Within this context, the Legform Impactor tests (a-PLI and Flex-PLI), utilized in Euro NCAP and UN Regulation No. 127 (Pedestrian Safety) protocols, evaluate lower leg injury risk through biomechanical metrics such as tibia bending moment, knee ligament elongation, and knee shear displacement. Among these parameters, the threshold defined for tibia bending moment is widely recognized as a key performance criterion in front-end structural design. Previous studies in the literature indicate that energy-absorbing components within the bumper system, the bumper beam, and the geometry of the lower support structures play a decisive role in lower leg injury mechanisms. The position of the bumper beam and the local stiffness distribution in the lower bumper region are identified as critical parameters that directly influence the rotational kinematics of the lower leg and the resulting bending moment distribution along the tibia during impact. Therefore, optimization of the lower bumper architecture is considered an effective design strategy for mitigating pedestrian lower leg injury risks. In this study, the influence of small-scale structural elements positioned in front of the pedestrian cross-member within the lower bumper region commonly referred to in the literature as “enablers,” “doghouses,” or “baffles”is investigated with respect to lower leg impact performance. Various design configurations were examined by modifying the position, geometry, and stiffness characteristics of these elements in order to evaluate their influence on impact load transfer mechanisms. Performance assessments were conducted through virtual simulations, and tibia bending moment distributions were analyzed under both homologation and consumer test scenarios. The results demonstrate that strategically positioned structural elements in the lower bumper region can modify the impact load path and effectively control the bending moment characteristics acting on the tibia. In particular, locally reinforced support regions created ahead of the pedestrian cross-member contribute to maintaining tibia bending moment values within target performance ranges while requiring minimal modification to the overall vehicle front-end architecture.

**Keywords:** Lowerleg, Tibia Bending, UNR127, EUNCAP, aPLi, Flex-PLI

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# Influence of Trailer Hitch–Body Connection Modeling Strategy on Virtual Fatigue Life Prediction under CARLOS TC and ECE R55 Loading

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*Sude GÜNEY*[2]
*Tamer AYDINER*[3]

**Abstract**

In this study, the influence of different modeling approaches for the connection between a trailer hitch system and the vehicle body on fatigue life prediction is investigated through virtual durability analyses. As a safety-critical component subjected to complex multi-axial loading conditions, the trailer hitch requires accurate fatigue assessment to ensure structural reliability and regulatory compliance. Within this scope, the trailer hitch structure and its body-mounted connections were evaluated using finite element–based durability analyses. All analyses were conducted according to the CARLOS TC multi-axial loading methodology and ECE R55 fatigue requirements to represent realistic service conditions. For comparative assessment, the trailer hitch–body connection was modeled using two different approaches. In the first approach, the connection regions were simplified using rigid elements to represent a fully constrained attachment. In the second approach, bolts and contact interfaces between the trailer hitch and vehicle body were explicitly modeled to provide a higher level of structural detail. Both approaches were subjected to identical loading conditions, boundary conditions, and fatigue evaluation procedures to ensure a consistent comparison. Fatigue analyses were performed using a cumulative damage approach, and the ECE R55 block cycle loading defined within the CARLOS TC framework was applied to simulate realistic service load histories. The results indicate that the rigid connection modeling approach cannot accurately capture local stress concentrations in connection regions, potentially leading to non-conservative fatigue life predictions. In contrast, the detailed connection model provides more realistic stress distributions and results in lower and more reliable fatigue life estimations, particularly in critical body attachment regions. The findings demonstrate that the adopted connection modeling strategy has a significant influence on fatigue life prediction. While rigid idealization may reduce the reliability of virtual durability assessments, detailed connection modeling is essential for obtaining regulation-compliant and trustworthy fatigue evaluations of trailer hitch systems.

**Keywords:** Trailer hitch; Fatigue analysis; Connection modeling; CARLOS TC; ECE R55

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# Impact of Crash Sensor Bracket Design and Mounting Location on Airbag Signal Quality

*Halil İbrahim SANCAR*[1]
*Fırat ARAS*[2]

**Abstract**

Airbag systems are critical passive safety components designed to protect vehicle occupants during crash events. The correct deployment of airbags depends on reliable signals obtained from crash sensors mounted on the vehicle structure. These sensors measure acceleration and velocity changes during impact and transmit the data to the airbag control unit, which determines the airbag deployment timing. Therefore, both the mounting location of the sensor and the structural stiffness of the bracket connecting the sensor to the vehicle body are important design parameters for obtaining stable and accurate signals.In vehicle structures, crash sensors are commonly integrated into structurally rigid regions of the body such as underbody rails, the central tunnel area, and structural pillars including A, B, and C pillars through dedicated mounting brackets. If the bracket design lacks sufficient stiffness or if the sensor is mounted on regions prone to deformation during a crash event, structural vibrations and local instabilities may occur. These conditions can introduce oscillations and noise into the acceleration signals measured by the sensor.In this study, the impact of crash sensor bracket design and mounting location on signal quality was investigated using finite element crash simulations. Different bracket stiffness levels and mounting configurations were evaluated. The results show that insufficient bracket rigidity or mounting sensors on structurally unstable regions can produce oscillatory acceleration curves and unreliable crash signals, potentially affecting airbag triggering performance.
**Keywords:** Airbag System, Crash Sensor, Sensor Bracket Design, Signal Quality, Crash Simulation

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# Simulation–Test Correlation of Ece R17 Luggage Retention Performance in A Commercial Vehicle

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*Tamer AYDINER*[2]

## Abstract

This study presents a simulation methodology developed in FEA to accurately predict seatback performance for the ECE R17 homologation test. The objective was to establish a reliable numerical approach capable of supporting design evaluation during early development stages. In addition to this primary goal, the methodology also aims to reduce development time and cost by enabling engineers to identify potential design weaknesses before conducting physical tests.
The methodology was first validated using an existing vehicle configuration for which physical test data were available. A detailed finite element model representing the tested seat system and boundary conditions was developed, and the simulation results showed strong agreement with the measured test responses. This correlation confirmed the reliability of the modeling strategy, material definitions, and applied loading conditions. Furthermore, the validation phase demonstrated that the numerical model was capable of capturing complex structural behaviors such as deformation modes, load transfer paths, and localized stress distributions with high accuracy.
Following the validation phase, the same simulation approach was applied to a new vehicle prototype to evaluate its expected behavior under ECE R17 loading conditions during the development process. At this stage, the methodology provided valuable insights into the structural performance of the seat system, allowing design improvements to be implemented prior to physical prototyping. After the prototype vehicle was physically tested, the experimental measurements were compared with the corresponding simulation results.
The comparison revealed an almost perfect correlation between numerical predictions and test data, demonstrating that the validated FEA workflow can reliably reproduce ECE R17 test behavior and effectively support seat system development while reducing reliance on extensive physical prototyping. This outcome highlights the importance of integrating advanced simulation techniques into modern vehicle development processes to ensure both efficiency and accuracy.
**Keywords:** Luggage Retention, Test, CAE, correlation

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# A Design Approach for Meeting NVH Requirements in Reinforcement-Free Instrument Panel Structures

*Ahmet AKMAN* [1,3]
*Çağri GENÇOL* [2]

**Abstract**

In automotive interior trim development, simplified instrument panel (IP) architectures are increasingly preferred in order to achieve weight reduction, cost optimization, part simplification, and improved manufacturability. Within this context, eliminating the reinforcement component traditionally welded to the Upper IP provides several engineering advantages, while also creating critical challenges in terms of NVH performance. In conventional IP designs, the reinforcement structure not only carries major attachment interfaces such as air ducts, cross-car beam (CCB), lower carrier, and related subcomponents, but also significantly improves overall structural stiffness by supporting a large portion of the technical surface of the Upper IP. In addition, since the reinforcement is produced as a separate part without styling constraints, it allows a molding direction closer to pure Z-axis and enables the use of stronger rib geometries.
This study investigates how NVH requirements can be achieved in a reinforcement-free IP architecture through theoretical engineering assessment, CAE-based modal analysis, benchmarking, and design iterations. The starting point of the study is a first mode natural frequency result below the targeted level in virtual analysis. Therefore, key design parameters such as rib design, wall thickness, material selection, attachment point location and stiffness, part split strategy, interface management, clip/screw/fastener strategy, and structural interaction with the CCB were systematically evaluated. The results indicate that approaches based only on local wall thickness increase are not sufficient, and that load path continuity, attachment architecture, and structural geometry optimization must be considered together. It was demonstrated that NVH targets can be achieved without additional reinforcement when these parameters are properly optimized. Furthermore, this approach provides a feasible engineering solution that preserves weight and cost advantages while remaining compatible with styling and package constraints.
**Keywords:** Instrument Panel (IP), NVH Optimization, Reinforcement-Free Design

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# The Role and Importance of Door Reinforcement Bars in Passenger Vehicle Safety

*Erdem GÜRSOY*[1]

**Abstract**

Passenger vehicle safety is a critical issue that directly affects the lives of occupants. This paper presents a simplified yet comprehensive explanation of the role and function of door reinforcement bars in vehicle doors. Door bars are structural components placed inside vehicle doors to protect occupants during side impacts, which are among the most dangerous types of collisions due to the limited space available for energy absorption. They are typically made of high-strength steel, known for its superior strength and durability, although lightweight materials such as aluminum and advanced composites are also used in some applications to improve fuel efficiency and reduce overall vehicle weight. The geometry, thickness, and positioning of door bars, along with material selection, significantly influence how energy is absorbed and distributed during a collision, thereby directly affecting occupant protection and injury severity. This study explains the working principles of door bars, highlighting how they limit door intrusion and help maintain the integrity of the passenger compartment. It also emphasizes their contribution to overall vehicle structural rigidity and crash performance. Furthermore, the impact of different material choices on both safety performance and fuel consumption is discussed, supported by practical and real-world examples. In conclusion, door reinforcement bars are highlighted as essential yet often unseen safety components that play a vital role in saving lives. This paper is intended to help individuals interested in the automotive field easily understand the function, considerations, and significance of door bar systems in modern vehicle safety.

**Keywords:** Door reinforcement bar, side impact safety, high-strength steel, lightweight materials, automotive safety, energy absorption

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# From Waste Beverage Cans to Functional Composites: Characterization of Graphene-Reinforced Recycled Aluminum Matrix Composites

*Burak ÖZTOP*[1]
*Mevlüt GÜRBÜZ*[2]

**Abstract**
In this study, graphene-reinforced composite materials were produced using an aluminum matrix obtained from waste aluminum beverage cans, and the microstructural and mechanical properties of these composites were investigated. Due to its cost-effectiveness and practical applicability in the production of aluminum matrix composite materials, the stir casting technique was preferred. The aim of the study was to evaluate recycled aluminum as a low-cost and sustainable matrix material and to demonstrate the potential for improving its mechanical performance through graphene reinforcement. In the experimental studies, graphene was added to the matrix at weight fractions of 0.1 wt.%, 0.3 wt.%, and 0.5 wt.%. The density, porosity, hardness, tensile strength, and impact strength of the produced samples were determined. In addition, scanning electron microscopy/energy-dispersive spectroscopy (SEM/EDX) analyses were carried out. The results showed that the addition of graphene significantly improved the mechanical properties of the composites. The highest hardness, 80.05 HV, and the highest impact strength, 30.04 J, were obtained in the sample reinforced with 0.1 wt.% graphene, while the highest tensile strength, 158.96 MPa, was achieved in the sample reinforced with 0.3 wt.% graphene. It was also determined that density decreased and porosity increased with increasing graphene content. Among the composite materials, the highest density (2.517 g/cm$^3$) and the lowest porosity (6.74%) were obtained in the sample reinforced with 0.1 wt.% graphene. Furthermore, microstructural analyses revealed that graphene platelets were located along the aluminum grain boundaries. Overall, the findings indicate that the mechanical properties of graphene-reinforced aluminum matrix composites can be improved when the graphene content is maintained within an optimum range. Accordingly, it was concluded that the most suitable graphene reinforcement ratio lies between 0.1 wt.% and 0.3 wt.%.
**Keywords:** Metal matrix composite, Waste aluminum, Graphene, Stir casting, Mechanical property.

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# Electromagnetic Investigation of Magnet Embrace and Offset Effects on Torque Ripple in In-Runner Servo Motors for Precision CNC Feed-Drive Applications

*Mustafa ÖZSOY*[1]

**Abstract**

With the rapid advancement of precision manufacturing technologies, the demand for high-accuracy positioning systems in CNC-based machining applications has significantly increased. Particularly in compact CNC feed-drive systems, stable low-speed operation, precise positioning capability, low vibration level, and high dynamic performance are critically important. For these reasons, permanent magnet synchronous servo motors are widely preferred in CNC axis drive applications due to their high power density, compact structure, fast dynamic response, and precise speed control capability. However, torque ripple occurring in servo motors may negatively affect positioning accuracy, especially at low-speed operating conditions, leading to vibration, acoustic noise, mechanical oscillations, and deterioration of machining surface quality

Among the electromagnetic design parameters affecting torque ripple in permanent magnet servo motors, magnet embrace ratio and magnet offset structure play critical roles. While the magnet embrace ratio directly affects the air-gap magnetic flux distribution, the magnet offset structure is highly effective in reducing harmonic components and suppressing cogging torque. Proper optimization of these parameters can significantly improve the torque production characteristics of the motor and enhance the precision positioning performance of CNC feed-drive systems. In this study, the effects of magnet embrace ratio and magnet offset parameters on the torque ripple characteristics of an in-runner servo motor designed for precision CNC feed-drive applications are investigated using the finite element method. The studied motor is a three-phase, 1-kW servo motor operating with a 220-V drive system at a nominal speed of 3000 rpm. Within the scope of the study, different magnet embrace and magnet offset combinations are modeled, and detailed electromagnetic analyses are performed for each design configuration. The obtained results demonstrate that the relationship between magnet embrace and magnet offset directly influences the air-gap flux density distribution, cogging torque behavior, and dynamic torque ripple characteristics of the motor. In particular, it is observed that appropriately selected offset structures combined with specific embrace ratios can considerably reduce torque ripple levels. The study aims to contribute to the electromagnetic design optimization and positioning performance improvement of servo motors used in precision CNC feed-drive systems.

**Keywords:** Permanent Magnet Synchronous Motor, Torque Ripple, Magnet Embrace Ratio, Magnet Offset, Finite Element Analysis.

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# Dynamic Features of Seat Pneumatic Systems Used in Automotive Applications and Their Effects on the Driver

*Furkan Melih EFE*[1]

**Abstract**

Automobiles have become an indispensable part of human life in line with technological developments and increasing user expectations. This situation has intensified competition among automotive manufacturers pushing them to develop innovative solutions not only in terms of performance and safety but also in enhancing driving comfort. In this context, seat systems that directly affect in-cabin ergonomics have emerged as a significant area of research and development. In particular, pneumatic systems integrated into seats stand out as remarkable technologies due to their potential to improve both driver and passenger comfort and safety.

Conventional seat pneumatic systems generally provide fixed or manually adjustable structures and operate based on user intervention. However, next-generation systems adopt an dynamic approach capable of analyzing vehicle dynamics and driving conditions in real time through advanced sensor technologies and control algorithms. These systems evaluate parameters such as lateral acceleration, longitudinal acceleration, vehicle speed, and steering angle, and accordingly adjust the pressure levels and support points of the air bladders within the seat in real time. As a result, the driver's body stability is enhanced providing a more balanced seating position, especially during cornering and sudden maneuvers.

In addition, muscle fatigue and discomfort experienced during long drives are reduced contributing to the maintenance of the driver's attention level. Dynamic seat pneumatic systems also provide indirect safety benefits by optimizing the driver's contact with the seat, thereby improving vehicle control.

In this paper, the fundamental structure and working principles of seat pneumatic systems are examined in detail, existing system functions are explained and how these functions are dynamically adapted based on varying vehicle parameters is discussed. Furthermore, the effects of these systems on driver comfort and safety are comprehensively evaluated and inferences for their future development potential are presented.

**Keywords:** Automotive Seat Systems, Seat Pneumatic Systems, Dynamic Features, E&E System Development, Electronic Control Uni

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# STATCOM Tabanlı Reaktif Güç Kontrolü ile Dağıtım Sistemlerinde Gerilim Kararlılığının Analizi: Diyarbakır-3 Trafo Merkezi Uygulaması

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*Tuncay KARAMAN*[2]
*Yurdagül BENTEŞEN YAKUT*[3]

**Abstract**

The maintenance of voltage stability, energy quality, system reliability, and sustainable operation in electrical power systems is of critical importance. Increasing load demands, uneven load distributions, and variations in reactive power can all lead to voltage oscillations in distribution systems, which can have a detrimental effect on system performance. This study uses the Diyarbakır-3 Transformer Substation as an example to examine how STATCOM, a FACTS-based power electronics device, affects voltage stability in distribution systems. This study used the MATLAB/Simulink environment to model a distribution system with three power transformers and seven feeders with various load characteristics that operates at a voltage level of 33.6 kV.
The system's active, reactive, and apparent power values as well as the feeder current distributions were computed in the analyses, and a comparison of the system's performance before and after STATCOM integration was made. The results showed that STATCOM contributed to maintaining the voltage profile by providing rapid reactive power supply to the system. However, it was found that some feeders saw current increases and power factor drops as the system's reactive power balance altered. Additionally, it was noted that the STATCOM's impact was not uniform throughout the system and that its effects were more noticeable, particularly in regions around the connecting point.
The study found that STATCOM affects power flow, transformer loading, and system dynamics in addition to serving as a compensation element that regulates voltage. The results demonstrate that STATCOM provides an efficient way to improve voltage stability in distribution systems with the right installation techniques and control parameters. This study contributes to the management of reactive power and the evaluation of the dynamic performance of modern distribution systems.
**Keywords:** STATCOM, Reactive Power, Voltage Stability, Power Systems

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# Automotive Sensor Technologies and Automatic Headlamp Leveling Systems

*Hüseyin CELAP*

**Abstract**

Modern vehicles increasingly rely on electronic systems, making sensor technologies essential for vehicle safety, driving comfort, and system control. Automotive sensors measure physical parameters such as position, acceleration, pressure, and environmental conditions and transmit this information to electronic control units (ECUs). These measurements support the proper operation of various vehicle subsystems, including engine management, advanced driver assistance systems, safety functions, and lighting control systems. This study presents an overview of automotive sensor technologies with a particular focus on leveling sensors used in automatic headlamp leveling systems. Leveling sensors detect suspension displacement and determine the inclination of the vehicle body. The measured information is transmitted to the headlamp control unit, which automatically adjusts the vertical orientation of the headlamp beam to prevent glare for oncoming drivers and improve nighttime driving safety. The operating principle of Hall-effect-based leveling sensors is explained and sensor outputs are analyzed through pulse-width modulation (PWM) duty cycle variations under different vehicle load conditions. Experimental results show that load distribution significantly influences sensor output signals.
**Keywords:** Automotive sensors, automatic headlamp leveling system, leveling sensor, pulse-width modulation, vehicle lighting systems.

# From Domain to Central Compute: Zonal Network Integration for Software-Defined Vehicle Architectures and System Requirements

*Berkant AHMET* [1]
*Sıla BOZEN TAŞÇI* [2]

## Abstract

This study examines the evolution of vehicle electronic architectures from traditional distributed and domain-based structures to the Software-Defined Vehicle (SDV) approach. The new comfort, safety, autonomous driving, and connectivity functions added to vehicles have led to increase in the number of electronic control units, software code volume, and need for high-bandwidth communication. These developments have lead to traditional E/E architectures be insufficient in terms of both technical capacity and functional manageability. In particular, the integration, validation, and lifecycle management of increasingly complex E/E functions have become unsustainable with current architectures.

As a solution to these problems, the automotive industry has accelerated the transition to a zonal architecture that includes an Ethernet-based communication, centralized high-performance computers (HPCs), and zonal ECU structures. Within the scope of this study, the SDV architecture was examined from the perspective of integrating centralized computing units with the zonal structure, and the system requirements of this architectural transformation were analyzed in detail. Additionally, the effects of the architectural transformation on system complexity, functional distribution, and software management have been evaluated.

Furthermore, the Over-the-Air (OTA) update and Vehicle-to-Everything (V2X) integration were examined. The effects of these technologies on functional updates, data management, and the vehicle lifecycle were explained using example applications. Despite the flexibility and scalability provided by the zonal architecture, risks such as increasing software complexity, cybersecurity threats, and the critical nature of data management requirements were also addressed within the scope of this study, and future engineering challenges were discussed.

**Keywords:** Software Defined Vehicles, FOTA, OTA, System requirements, Vehicle Electronic, Network, Software Cycle Management

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# Thermal Runaway E&E Function Designs and Applications

*Musa Yılmaz*

**Abstract**

In the transition to the electric vehicle (EV) ecosystem, it is of great importance not only to have efficiency-oriented batteries but also to maintain a strong focus on safety. Due to their inherently high energy and power densities, batteries installed in vehicles pose hazards such as fire and thermal runaway under the influence of factors including short circuits, overcharging, and high temperatures. In this context, the UNECE R100 (Rev.3) standard mandates that vehicle manufacturers develop systems to protect users in the event of thermal runaway. These systems can be addressed separately at the cell, battery, and vehicle levels. Battery Management Systems (BMS) continuously monitor the system through various sensors and diagnostic-capable algorithms, and in the event of thermal runaway, they perform energy cutoff and protection functions. In addition, they transmit thermal runaway information to other Electronic Control Units (ECUs) via various communication protocols (CAN/Ethernet). In this way, beyond the battery level, units managing body functions can also support driver and passenger evacuation through dedicated functions. This paper focuses on vehicle-level functions developed for thermal runaway scenarios. These functions aim to ensure rapid and safe evacuation of users. Examples of such systems include opening vehicle windows within a defined reference range, activating interior lighting, enabling hazard warning flashers, stopping the ventilation fan, and automatically unlocking all locked doors. The study addresses the design process of these functions along with their impact on the vehicle's E&E system architecture.

**Keywords:** Thermal Runaway , E&E System Design, Battery, Cell, Electronic Control Unit.

# Impact of Gaussian Noise and Spatial Filtering on MobileNetV2-Based Breast Cancer Histopathological Image Classification

*Samiullah SHIRZAD* [1]
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**Abstract**

Breast cancer continues to be a major cause of cancer-related deaths among women worldwide. Histopathological examination plays a critical role in the definitive diagnosis of breast carcinoma. Deep learning models such as MobileNetV2 have emerged as effective tools for the automated diagnosis of Invasive Ductal Carcinoma (IDC) in histopathological images. However, benign and malignant histopathological images may be corrupted by noise artifacts, including Gaussian noise, which can reduce the robustness and accuracy of deep learning-based classification models. In this study, the effects of average and median filters on the benign-malignant classification performance of MobileNetV2 using histopathological images were investigated. First, Gaussian noise at different noise levels was added to the histopathological test images. Subsequently, the noisy test images were filtered using spatial filters with different kernel sizes and characteristics. The classification performance of the MobileNetV2 model was then evaluated on both filtered and unfiltered images. Experimental results showed that median filtering generally provided better classification performance than average filtering, particularly at larger kernel sizes. Under low Gaussian noise, the 9×9 median filter achieved the highest accuracy of 66.60%, while under high Gaussian noise, the 7×7 median filter achieved the best performance with an accuracy of 62.20%. Considering both Gaussian noise levels together, the 7×7 median filter can be regarded as the most suitable single filtering option, achieving a near-best accuracy of 64.93% under low noise and the highest accuracy of 62.20% under high noise. These findings indicate that an appropriately selected median filter, particularly the 7×7 median filter, can improve the robustness of deep learning-based histopathological image classification in noisy environments.
Keywords: Gaussian Noise, Breast Cancer Histopathology, MobileNetV2, Median Filter, Average Filter

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# Historical Evolution and System-Level Review of Energy Storage Technologies for Wheeled Vehicles

*Meltem SÜPÜRTÜLÜ*[1]
*Mustafa ALKIN*[2]

## Abstract

Energy storage systems have played a pivotal and transformative role in the evolution of transportation technologies, continuously adapting to the increasing demands for higher energy density, improved system efficiency, extended cycle life, and enhanced environmental sustainability. From early steam-powered mechanical systems to the widespread adoption of internal combustion engines, and more recently to electrochemical solutions such as lead-acid and lithium-ion batteries, as well as emerging hydrogen fuel cell technologies, this progression reflects a fundamental transition from consumption-driven energy paradigms toward regenerative, efficient, and optimization-oriented system architectures.In this study, energy storage methods utilized in transportation systems are examined through a structured chronological framework. Mechanical, chemical, and electrochemical storage technologies are comparatively evaluated based on key performance indicators, including specific energy, specific power, cycle efficiency, operational lifetime, and cost-effectiveness. Particular emphasis is placed on understanding the technological and economic factors that have led to the dominance of lithium-ion batteries in modern electric vehicles. In parallel, the study critically analyzes the existing barriers—such as infrastructure limitations, high production costs, and system complexity—that constrain the large-scale adoption of hydrogen fuel cell systems. Furthermore, future-oriented technological pathways are explored, including solid-state battery technologies, hybrid energy storage architectures combining multiple storage mechanisms, and artificial intelligence-driven energy management strategies aimed at optimizing performance in real time. The findings of this study highlight that energy storage systems should not be evaluated solely on the basis of energy density; rather, a holistic system-level perspective that integrates efficiency, durability, safety, and lifecycle optimization is essential for the sustainable advancement of next-generation transportation systems.
**Keywords:** Energy storage systems, electric vehicles, lithium-ion batteries, hydrogen fuel cells, hybrid energy architectures, sustainable mobility.

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# Sustainability in Software Defect Prediction Processes: A Conceptual Review from the Perspective of Green AI

*Turgay TAYMAZ*[1,2]
*Kökten Ulaş BİRANT*[3,4]

## Abstract

Software Defect Prediction (SDP) is widely utilized to enhance quality assurance, prioritize testing efforts, and significantly reduce maintenance costs within the software development life cycle. In recent years, the complexity of machine learning and deep learning models employed in this domain has increased exponentially to capture intricate software metrics. While the integration of Large Language Models (LLMs) and massive neural networks into software engineering problems has undeniably improved theoretical model accuracy, it has simultaneously introduced severe sustainability issues. These challenges primarily revolve around exorbitant computational costs, excessive memory usage, and massive energy consumption required for training and deployment. In response to these growing concerns, this paper conceptually examines the necessity and applicability of the "Green AI" paradigm within the software defect prediction literature. The study critically discusses the literature's necessary shift towards lightweight machine learning algorithms. These streamlined algorithms operate with significantly fewer parameters, offer high energy efficiency, and still provide acceptable, robust accuracy rates at industrial standards, serving as viable alternatives to computationally exhaustive, hardware-intensive "Red AI" models. Furthermore, the paper addresses how intelligent feature engineering and evolutionary context-based approaches directly contribute to long-term sustainability. Rather than relying on brute-force processing power and expensive computational resources to solve inherent problems like label noise encountered during data preprocessing, these targeted methodologies offer a more environmentally conscious solution. Consequently, this study presents a comprehensive theoretical framework that strongly invites software engineering researchers to shift their evaluation criteria. It advocates for focusing not only on traditional performance metrics, such as accuracy, precision, and F1-score, but also on the environmental costs, training times, and overall carbon footprints of their proposed models.

**Keywords:** Software Defect Prediction, Green AI, Sustainability, Machine Learning, Computational Cost

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# Classification of Tomato Leaf Diseases Using DenseNet121-Based Transfer Learning and Fine-Tuning: A Comprehensive Evaluation

*Gülcan Kavak*
*Tarık Talan*

**Abstract**

Climate change-induced increases in extreme precipitation events have significantly intensified the frequency and impacts of floods and inundation disasters. In particular, the narrowing of stream channels, degradation of natural floodplains, and reduction of vegetation cover disrupt the natural hydrological and ecological balance, thereby decreasing ecosystem resilience against flooding. Although conventional engineering practices play an important role in mitigating flood risks, the need for sustainable and ecologically based approaches has been steadily increasing. In this context, riparian ecosystems are regarded as critical natural buffer zones due to their essential functions in regulating hydrological regimes, controlling erosion, and maintaining habitat continuity.
A review of the ecological literature indicates that areas where natural riparian vegetation is preserved experience lower flood impacts, reduced erosion, and improved water quality. Furthermore, native flood-tolerant species contribute substantially to ecosystem resilience and biodiversity conservation owing to their high adaptive capacities. In this study, the ecological functions of native plant species naturally occurring in riparian ecosystems and capable of tolerating flood conditions were investigated. Species naturally distributed in riparian zones in Türkiye, including Salix alba, Populus nigra, Alnus glutinosa, Tamarix smyrnensis, Phragmites australis, Fraxinus angustifolia, and Platanus orientalis, were evaluated in terms of their root structures, sediment retention capacity, effects on reducing surface runoff velocity, and contributions to water infiltration. In addition, the role of riparian vegetation in minimizing soil loss during flood events and its potential to strengthen ecological connectivity between aquatic and terrestrial habitats were examined.
As a result, rather than focusing solely on structural engineering solutions in flood management, utilizing the ecological functions of riparian plant species should be considered an important strategy for sustainable disaster management. The conservation and widespread use of native flood-resistant plant species in flood-prone areas provide an effective ecosystem-based solution for reducing hydrological risks associated with climate change.
**Keywords:** Climate change, flash floods, riparian vegetation, native plant species, Türkiye.

# Physics-Informed Neural Network Approaches for 2D Magnetic Field Modeling in Cartesian Coordinates: Residual-Based and Energy-Based Training Strategies

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**Abstract**

Physics-Informed Neural Networks (PINNs) have become an alternative approach for solving partial differential equations without requiring traditional mesh-based numerical methods. In this study, a PINN-based framework is proposed for modeling the two-dimensional magnetic field distribution generated by a coil in the Cartesian coordinate system using Maxwell's equations. The study focuses on a region containing a coil in order to investigate the learning performance of PINNs under electromagnetic conditions. Two different training strategies are investigated within the same PINN framework. In the first, the loss function is constructed using the residuals of the governing differential equation and boundary conditions. In the second approach, a variational energy-based formulation is used by minimizing the magnetic energy functional of the system. The performances of both methods are comparatively analyzed in terms of convergence behavior, training stability, and smoothness of the obtained magnetic field distribution.

In addition, the magnetic field distribution obtained from the PINN models is compared with results computed using the Finite Difference Analysis (FDA) method. Numerical results demonstrate that both PINN approaches can successfully approximate the magnetic vector potential and magnetic field distribution in the coil domain with results consistent with FDA solutions. However, the variational energy-based approach provides more stable convergence and smoother field representations during training. The study highlights the applicability of physics-informed deep learning methods for computational electromagnetics and presents a comparison between residual-based and energy-based PINN optimization strategies.

**Keywords:** Physics-Informed Neural Networks, Maxwell Equations, Magnetic Field Modeling, Variational Learning.

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# Development of an Educational and Interactive Mobile Application for Children that Teaches Food Production Processes


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*Fatma Yağmur HAZAR SUNCAK*[4]



## Abstract

This study developed a mobile application that describes the factory production stages of food products such as meat and dairy products, fruit juices, and snacks, which children frequently consume in their daily lives. The application includes animations about the production process, an interactive do-it-yourself game, and a quiz section for reinforcement. It also features an AI chatbot that can be interacted with both verbally and in writing. This makes it possible for individuals with special needs to use the application. The product information section includes entertaining images and information that will attract children's attention. The application is designed to be suitable for children who cannot read or write, using images, text, and audio narration. Currently, most nutrition-related applications focus on calorie counting, therefore applications that provide information about the production process and contents of products, as in this study, are not commonly found. The content was prepared based on articles, master's and doctoral theses, and World Health Organization data. Since the application was developed using the Flutter infrastructure, it can be run on both Android and IOS platforms. The coding process was carried out in the Android Studio integrated development environment. The app's visual assets, character designs, and background images were created using Figma, Adobe Photoshop, and Canva. The app was also tested for usability at a university mobile app exhibition. As a result, a completely free app was developed, specifically designed to provide children with information about the foods they consume. The app's content is suitable for children of all ages. Therefore, it is believed that the app could be used as educational material for children in the future.



**Keywords:** Mobile application, production processing, nutrition, animation, artificial intelligence



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# Physicochemical and Microbiological Properties of Turkish Kefirs

*Kübra CİĞERCİ KARADEMİR*[1]
*Muhammet ARICI*

**Abstract**

Objective:In this study, certain quality attributes (pH, titratable acidity), microbiological characteristics (lactic acid bacteria, acetic acid bacteria, and yeast counts), and the presence of ethanol in nine different brands of commercial kefir purchased from various local markets in Istanbul, along with one homemade kefir sample, were investigated.
Method:For the microbiological analysis of the industrial and homemade kefir samples, serial dilutions were inoculated onto specific media: MRS agar (De Man–Rogosa–Sharpe Agar) for lactic acid bacteria (LAB), GYC agar (Yeast Extract Calcium Carbonate Glucose Agar) for acetic acid bacteria (AAB), and PDA (Potato Dextrose Agar) for yeasts. Following inoculation, the plates were incubated at $30^\circ\text{C}$ for 2 days prior to enumeration. Ethanol and other volatile components were analyzed using GC-MS.
Results:While lactic acid bacteria were detected in all kefir samples, yeast was not found in two of the samples, and acetic acid bacteria were absent in four. The LAB counts ranged from $3 \times 10^5$ to $3.39 \times 10^6 \text{ cfu/mL}$. Yeast counts varied between $10^4$ and $4.19 \times 10^5 \text{ cfu/mL}$ in 7 out of the 10 samples, while acetic acid bacteria counts ranged from $1.2 \times 10^4$ to $1.22 \times 10^5 \text{ cfu/mL}$ in 5 out of the 10 samples. The pH values of the analyzed kefir samples ranged from 3.99 to 4.44, and the titratable acidity (expressed as lactic acid equivalent) varied between 0.68% and 0.80%. Ethanol was not detected in any of the samples.
Conclusion:The results of this study revealed that some of the samples failed to meet the specified quality parameters. Furthermore, in terms of yeast counts, commercial kefir samples belonging to two different brands were found to be non-compliant with the Turkish Food Codex Communiqué on Fermented Milk Products.
**Keywords:**Turkish kefir; physicochemical properties; microbiological properties

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# Artificial Intelligence–Assisted Retinitis Pigmentosa Analysis: Automated Diagnosis from Fundus Images Using Deep Learning

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*Hüseyin IRMAK*[2]
*Ulviye KIVRAK*[3]

**Abstract**

Retinitis Pigmentosa (RP) is a genetically inherited and progressive retinal disease that typically begins with night blindness and gradually leads to irreversible vision loss. Conventional diagnosis of the disease mainly relies on ophthalmologic examinations performed by specialists, which often involve lengthy and subjective evaluations. The primary aim of this thesis is to develop an artificial intelligence–based automated clinical decision support system capable of diagnosing RP through the analysis of fundus images, detecting early-stage findings, and performing disease staging.
This retrospective, single-center study was approved by the Ethics Committee under decision number SBETKK 2026-02. Fundus images obtained from Kartal Dr. Lütfi Kırdar City Hospital, including images from patients diagnosed with RP and age-matched healthy control subjects aged 18 years and older, are utilized in this study. Following anonymization, the images will be labeled as either healthy or RP-positive cases. Subsequently, the model development process is being conducted in the Google Colab environment using deep learning and computer vision–based image classification algorithms. The proposed model is expected to learn characteristic retinal features associated with RP, including pigmentary changes, retinal atrophy, and vascular abnormalities.
This study is anticipated to contribute an original and automated diagnostic tool to the field of ophthalmology by supporting clinical decision support systems, reducing specialist workload, and enabling earlier and more consistent detection of RP. After the training phase in the Google Colab environment, the model performance will be evaluated using metrics such as accuracy, sensitivity, specificity, and F1-score. In addition, the outputs generated by the model will be clinically reviewed by an ophthalmology specialist to assess their diagnostic validity. The findings of this study are expected to accelerate the RP diagnostic process, improve diagnostic accuracy, facilitate early-stage detection, and reduce the workload of healthcare professionals. Furthermore, this research aims to contribute to the advancement of artificial intelligence–assisted diagnostic tools in ophthalmology while presenting an innovative approach with strong potential for integration into clinical decision support systems.
**Keywords:** Retinitis Pigmentosa, Artificial Intelligence, Deep Learning, Fundus Photography, Image Classification, Clinical Decision Support Systems

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# Toward Sustainable Materials: PCL/PEG-Based Biocomposite Films with Sepiolite Clay and *Pelargonium graveolens* Essential Oil

*Büşra MUTLU*[1]

**Abstract**

The growing demand for sustainable and environmentally friendly materials has driven the development of bio-based polymer systems with improved functional properties. In this study, poly(ε-caprolactone) (PCL)/poly(ethylene glycol) (PEG)-based biocomposite films containing sepiolite clay and Pelargonium graveolens essential oil were prepared using the solution casting method. The aim was to evaluate the effect of these natural additives on the morphological, surface, structural, and physical properties of the films. Morphological and surface characteristics were analyzed using scanning electron microscopy (SEM) and contact angle measurements. SEM images indicated that sepiolite improved the homogeneity of the films, while the addition of essential oil caused slight changes in the surface structure. Contact angle results revealed changes in surface wettability depending on the film composition. Structural properties were examined by X-ray diffraction (XRD) and Fourier-transform infrared spectroscopy (FTIR). These analyses confirmed the presence of sepiolite and essential oil in the polymer matrix and indicated interactions between the components. The physical and optical properties of the films were investigated by measuring thickness and color parameters. The results showed that the incorporation of sepiolite and essential oil influenced both film thickness and visual appearance. Overall, the results suggest that the combination of PCL/PEG with sepiolite clay and essential oil can be used to produce biocomposite films with modified properties, offering potential for the development of more sustainable material systems.
**Keywords:** Biocomposite films, Poly(ε-caprolactone) (PCL), Sepiolite clay, Essential oil, Sustainable materials

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# A corrosion problem about Fe & Al Contamination on AISI 304 Stainless Steel Parts in Automotive Industry

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**Abstract**

Stainless steel is extensively utilized in the automotive industry for critical components such as exhaust systems and structural parts, owing to their high strength, durability, and corrosion resistance. Their lightweight properties contribute significantly to fuel efficiency and vehicle performance. The lustrous, sleek, and modern appearance of 304 stainless steel provides aesthetic opportunities for both exterior and interior automotive components. Despite the high corrosion resistance of stainless steel, the presence of ferrous and non-ferrous particles can lead to the formation of corrosion products, including oxides, which manifest in various colors such as orange, brown, red, or black on the surface. This phenomenon is known as rouging. Potential causes of rouging include machine tools (lathes, mills, jaws of chucks, etc.) and surface finishing equipment (blasting, grinding, and polishing abrasives) that have previously contacted steel parts, as well as improper assembly conditions. Additionally, even under optimal conditions, iron contamination in the air can induce similar corrosion formations. In this study, AISI 304 trim components were used to simulate rouging resulting from iron and aluminum contamination under different scenarios, which could occur during assembly operations and during the car's life. Suspension part burrs and dust served as the iron source, while polishing paste was used as the aluminum source. The components were subjected to a neutral salt spray test in accordance with ASTM B117, and red rust formation was observed within hours. The corrosion particles were analyzed using Scanning Electron Microscopy (SEM), and corrosion products in the surface craters were identified through SEM-EDX analysis as iron-oxide. Polishing paste also remained aluminum and iron oxide inside craters and caused red rust. Various chemicals were employed for the cleaning of the exposed parts, and their effectiveness was evaluated using a salt spray resistance test. The components were also left under atmospheric conditions to simulate natural weathering, and their corrosion behavior was observed.

**Keywords:** Stainless steel, AISI 304, rouging, natural salt spray, SEM-EDX

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# Influence of Fabric Structure on Color, Gloss and Hardness in Automotive Textiles

*Burcu GÜL*[1]

**Abstract**

This study investigates the relationship between fabric texture and the color, gloss, and hardness measurements of fabrics used in the automotive industry, produced with yarns of the same color. For this purpose, samples with the same color code and material type were utilized, and the influence of texture on color and gloss was examined following testing. In addition, hardness measurements were conducted, and the relationship between texture variation and hardness was evaluated for fabrics composed of the same material. To ensure consistency, all measurements were performed under controlled laboratory conditions using validated testing methods. Color differences were measured using instrumental methods, while gloss values were assessed at specified measurement angles to characterize surface reflectance. The study highlights that even when the same raw material is used, small differences in fabric construction parameters, such as surface pattern, may significantly affect the perception of quality and the overall visual appearance in automotive interior applications. These results provide valuable insights for optimizing surface structure and design choices in the automotive industry, discussing new approaches to enhance both the aesthetic and functional qualities of automotive products. Furthermore, this research may contribute to future material development processes by supporting manufacturers in selecting fabric structures that provide both improved performance characteristics and enhanced customer satisfaction.
**Keywords:** fabric, texture, gloss, color, hardness

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# Flight Log-Based Stability Assessment and Fault Diagnosis in Swarm UAV Systems

*Mert GÜRTÜRK [1]*

**Abstract**

In swarm UAV systems, mission success depends not only on the simultaneous flight of multiple vehicles, but also on the stable, safe, and predictable behavior of each UAV throughout the mission. Even minor instabilities occurring during hover, attitude control, position holding, and landing phases can directly affect swarm integrity, mission safety, and operational continuity. In this study, flight logs obtained from field tests conducted using multi-rotor swarm UAV platforms were examined. The tests were carried out in August 2025 at the Fırat University Technopark area under flight-suitable weather conditions and an approximate wind speed of 5 m/s.

Within the scope of the study, drift, oscillation, and landing problems observed in UAVs flying under the same mission profile were evaluated through log-based analysis. Body attitude angles, angular-rate tracking performance, satellite-based positioning quality, magnetic field variations, motor output signals, system event records, and inertial measurement unit temperature data were jointly examined. The findings showed that, although the number of satellites and positioning quality were within acceptable limits for some UAVs, circular drift with an approximate radius of 3 m occurred. Sudden variations in magnetic field components, heading realignment events, and sensor-fusion warnings indicated that this drift behavior was more likely associated with heading/magnetometer-related issues rather than direct positioning insufficiency. In addition, oscillatory behavior around the roll, pitch, and yaw axes was observed in some flights, while safety-critical situations such as hard landing after RTL/LAND and continued motor operation on the ground were identified in certain missions.

**Keywords:** Swarm UAV, Flight Log Analysis, Flight Stability, Fault Diagnosis, Landing Safety

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# Comparison of clustering algorithms to construct data-adaptive network design for regional gravity field modeling via SRBFs

*Raşit Uluğ*[1,2]

**Abstract**

The accuracy of regional gravity modelling using radial basis functions (RBFs) is strongly dependent on the configuration of the RBF network, which is defined by the locations of the RBF centers and their spatial distribution. Although clustering algorithms are primarily designed to group data according to their similarities, they can also be effectively employed to construct a data-adaptive RBF network. In previous studies, several clustering algorithms have been implemented for this purpose, including the k-means clustering algorithm combined with a modified Iterative Self-Organizing Data Analysis Technique (ISODATA), referred to as k-SRBF, Hierarchical Density-Based Spatial Clustering of Applications with Noise (HDBSCAN), Mean-shift clustering, and the Balanced Iterative Reducing and Clustering using Hierarchies (BIRCH) algorithm. However, to the best of our knowledge, a comprehensive comparison of these algorithms for RBF network construction has not yet been reported. In this study, the aforementioned algorithms are evaluated with respect to their computational efficiency and algorithmic complexity for establishing a data-adaptive RBF network. The results indicate that both the k-SRBF and HDBSCAN algorithms require additional computational effort due to the necessity of post-processing steps, although HDBSCAN is slightly faster than k-SRBF. In contrast, the Mean-shift algorithm is significantly faster than both methods and requires only a single parameter, the window size, which must be carefully selected. However, the resulting RBF network is highly sensitive to this parameter; even a small change of 0.01° in the window size leads to substantial variations of approximately 66% and 83% in the numerical experiments. On the other hand, the BIRCH algorithm demonstrates considerable advantages in terms of clustering speed and its capability to handle very large datasets. This efficiency arises from its fundamental design, which condenses the data into a compact summary structure during an initial scan. This process significantly reduces input/output costs and allows subsequent processing to be performed efficiently in memory. Numerical tests show that the BIRCH algorithm can construct an RBF network within seconds, even for large datasets. Therefore, among the evaluated algorithms, BIRCH is recommended for constructing RBF networks.
Furthermore, additional clustering algorithms were examined to identify other potential candidates for RBF network construction. Among these methods, the Basic Sequential Algorithmic Scheme (BSAS) demonstrates promising performance, yielding results comparable to BIRCH in terms of both accuracy and computational speed. Consequently, BSAS is also suggested as a potential alternative that merits further investigation for the development of data-adaptive RBF networks.

**Keywords:** Regional Gravity Field, Radial Basis Functions, Clustering, Data-Adaptive Network Design

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# Spectral Analysis of GNSS Coordinate Time Series and Regional Variation of Noise Characteristics along the Northern San Andreas Fault Zone

*Ahmet MERTOĞLU*[1]
*Uğur ŞANLI*[2]

## Abstract

Global Positioning System (GNSS) coordinate time series play a critical role in monitoring tectonic plate motions and crustal deformations. However, the reliability of tectonic velocity estimates derived from these series directly depends on the accurate modeling of their inherent noise characteristics. In this study, spectral analyses of North, East, and Up coordinate time series belonging to 30 GNSS stations located along the Northern San Andreas
Fault Zone were performed, and the regional distribution of noise characteristics was modeled. Initially, hardware and seismic-induced offsets in the raw GNSS data were corrected, and outlier elimination was conducted by removing the linear trend. Data gaps were synthetically filled using statistically significant harmonics identified by the Lomb-Scargle periodogram, which is robust to irregular series, and a First-Order Autoregressive (AR(1)) noise model. For complex time series where autonomous algorithms were insufficient, a semi-autonomous recovery approach was applied to align the data by detecting change-points and simultaneously solving for offset coefficients and harmonic components (joint inversion).
Fast Fourier Transform (FFT) was applied to the completed continuous time series to calculate spectral index (κ) values for each station and component. The point data were spatially interpolated using exponential variogram models to produce regional noise maps.
The results demonstrated that the noise character in the horizontal components (North and East) predominantly converges to White Noise, which lacks temporal correlation. Conversely, in the vertical component (Up), a Flicker noise tendency (κ = -0.1 to -0.6) became dominant due to atmospheric and environmental loading. Variogram analyses confirmed that the regional noise distribution in the vertical component (RMSE = 0.1243) bears much more distinct spatial structure traces compared to the horizontal components (North RMSE = 0.0214, East RMSE = 0.0268). These generated maps provide a critical noise correction basemap for future fault slip rate modelings in the region.
**Keywords**: GNSS Time Series, Spectral Analysis, Lomb-Scargle, Variogram Modeling, San Andreas Fault Zone

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# Investigation of Conventional and Robust Outlier Detection Techniques in Levelling Networks

*Ali Hasan DOGAN*[1]

**Abstract**

Accuracies of the unknown parameters in estimation depend on the reliability of the observations. In parameter estimation, observations are expected to be free from systematic errors and outliers. Therefore, outliers must be detected and then excluded or downweighted before the final estimation. In this study, conventional and robust outlier detection techniques were used to investigate their performances in outlier detection. The Baarda and Pope methods were selected as conventional techniques, while the Danish, Huber, and Hampel methods were chosen as robust techniques. As a case study, a levelling network was designed and simulated for two scenarios: one without outliers and one containing a single outlier. The Monte Carlo simulation technique was used to obtain success rates for these scenarios. To compare the performances of the techniques, global mean success rates (MSRs) were first calculated. Then, local MSRs were computed to present the relationship between redundancy and success rate. The results indicate that the Baarda technique is more efficient when no outlier exists. However, for the scenario including an outlier, robust techniques, especially the Danish method, perform more efficiently. Analysis based on local MSRs also shows a clear relationship between redundancy and success rate. This result can be expected since the redundancy number represents the sensitivity of an observation to outlier detection. And, higher redundancy numbers improve the detectability of outliers.

**Keywords:** Outlier, Conventional techniques, Robust techniques, Mean success rate, Redundancy

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# Position Accuracy of RT-PPP Technique with Multi-GNSS System

*Furkan KARLITEPEI*[1]

**Abstract**

Improvements in real-time positioning techniques, increase in the number of satellite systems, development of RTCM correction messages, and real time generation of satellite orbit-clock information, have enabled improvements for position sensitivity. The increase in positioning accuracy has not only improved existing software services, but also created new searching areas for users. In this study, we performed three-hour real-time (RT-PPP) observations in BNC software using GPS, GPS-GLO, GPS-GLO-GAL and GPS-GLO-GAL-BDS satellite systems at three IGS stations. In RT-PPP observations, all correction products were provided instantaneously via RTCM-MSM messages from the internet. CLK90 for orbit-clock products and RTCM3EPH-MGEX for broadcast ephemeris product combined messages were preferred due to their feature of containing messages from all satellite systems. In order to test the real-time position accuracy, the NEU difference values were determined by estimating the post-measurement PPP with the GIPSY-OASIS-v.6.4 software using the RT-PPP observations. HDOP value was used to examine the satellite configuration. NEU values of RT-PPP technique at ABMF station for GPS only 0.536 m, 0.906 m, 2.911 m, for GPS-GLO 0.326 m, 0.615 m, 2.669 m, for GPS-GLO-GAL 0.213 m, 0.502 m, 1.971 m, and for GPS-GLO-GAL and BDS 0.218 m, 0.505 m, 1.979 m were determined. In this concept, it has been determined that the use Multi-GNSS at three IGS stations located on approximately the same longitude increases the position accuracy and makes improvements in the satellite configuration.
Keywords: RT-PPP,PPP, RTCM3-MSM, Multi-GNSS

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# Design and Numerical Investigation of a Full Germanium Metalens at 850 nm

*Şeyma YENER*[1]
*Ekin ASLAN*[2,3]

**Abstract**

Metalenses have attracted significant attention in recent years as planar optical components capable of controlling electromagnetic waves using subwavelength structures. In this study, a fully germanium-based metalens operating at a wavelength of 850 nm was designed and numerically investigated. Unit-cell analyses were performed using the Rigorous Coupled-Wave Analysis method, and suitable nanopillar geometries providing the desired phase and transmission characteristics were obtained.Using the resulting phase library, the metalens arrangement was constructed and the full structure was analyzed using the Finite Difference Time Domain method. Although a certain level of phase control was achieved in the simulation results, several factors limiting the focusing efficiency were observed. In particular, transmission losses of the germanium material in the 850 nm near-infrared region, phase discontinuities, and near-field interactions between adjacent nanopillars negatively affected the overall performance. The study reveals the design limitations of germanium-based metalenses in the near-infrared region and aims to contribute to future optimization studies.
**Keywords:** Metalens, Metasurface, Germanium, Nanophotonics, Near-Infrared Optics.
This study was supported by Scientific and Technological Research Council of Turkey (TUBITAK) under the Grand Number: 121E518. The authors thank toTUBITAK for their supports. The authors would like to thank Erdem Aslan, Erciyes University, for providing access to the Ansys Lumerical simulation software license used in this study.

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# Evaluation of Hourly Heating Demand and Photovoltaic Production Matching for PV-Supported Greenhouse Heating in Muğla/Fethiye Conditions

*Dilşah ONUŞ*[1]
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## Abstract

This study evaluates the feasibility of photovoltaic (PV)-assisted greenhouse heating under Muğla/Fethiye climatic conditions by focusing on the hourly matching between heating demand and PV electricity generation rather than relying solely on annual energy balances. In Mediterranean greenhouse production, high daytime solar irradiation coincides with a critical heating demand that mainly occurs during winter nights, creating a clear temporal asymmetry between energy generation and consumption. To quantify this mismatch, a zero-dimensional thermal energy balance model with hourly resolution was developed for a representative tomato greenhouse with a floor area of 1000 m². The calculated hourly heating load was then matched with a grid-interactive, battery-free PV system under electric resistance heating and air-source heat pump scenarios.
The simulation results show that the annual net heating demand of the reference greenhouse is 289,775 kWh, corresponding to 289.8 kWh/m²-year, with a peak heating load of 223.0 kW. Although the integrated 50 kWp PV system generates 79,017 kWh of electricity annually, only 3,627 kWh/year of the 98,594 kWh/year electrical heating demand in the PV-assisted heat pump scenario can be directly met by PV generation within the same hourly intervals. Accordingly, the PV self-consumption ratio remains at 4.6%, while the hourly PV coverage of the electrical heating demand is only 3.7%. The findings quantify the expected temporal mismatch between PV generation and greenhouse heating demand for the specific Muğla/Fethiye case and indicate that hourly matching indicators should be used as key decision metrics in preliminary feasibility assessments of battery-free PV-assisted greenhouse heating systems.
**Keywords:** PV-assisted greenhouse heating, hourly energy matching, heat pump, greenhouse energy balance, Muğla.

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# The Summer Period Ichthyoplankton Composition of Sinop Pier and Its Importance for the Coastal Ecosystem

*Merve MENEMEN*[1]
*Orçin UYGUN*[2]

**Abstract**

The sustainability of marine ecosystems depends on the recruitment success of fish stocks. The ecological role that artificial structures, such as piers, play for early life history stages (eggs/larvae) has not yet been sufficiently investigated. This study aimed to determine the ichthyoplankton composition in the marine area of Sinop Pier during the summer period (June–August 2025). Sampling was carried out monthly using a standard plankton net in the Sinop Inner Harbor area (~12 m depth).
In laboratory analyses, 12 fish species belonging to 11 families were identified (9 egg and 5 larval stages). Total egg abundance was calculated as 470 ind·10m⁻², and larval abundance as 131 ind·10m⁻². The highest egg species richness (5 species) and abundance (261 ind·10m⁻²) were recorded in June, whereas the highest larval species richness (5 species) and abundance (105 ind·10m⁻²) were recorded in July. Ninety percent of the detected larvae were in the prelarval stage. The overall egg mortality in the area was 14%, with the highest mortality rate detected in August (38%). In addition to Trachurus mediterraneus (Egg: 25.0%, Larva: 50.0%), Diplodus annularis (Egg: 22.0%), Chelon auratus (13.9%), and Engraulis encrasicolus (13.9%), which exhibited the highest dominance in the study area; demersal/coastal species such as Mullus barbatus, Serranus scriba, Chromis chromis and Sciaena umbra also contributed to the biodiversity. The fact that demersal species, which constituted 83.3% of the overall species richness and 61.1% of the total egg abundance, reached an equal split of 50%-50% with pelagics in larval abundance indicates that the pier may function as a sheltered nursery ground.
**Keywords:** Ichthyoplankton, Fish larvae, Species diversity, Sinop Pier, Black Sea.
**Acknowledgements**: This study was derived from the project data titled "Sinop İskelesi'nin Yaz Mevsimi İhtiyoplankton Kompozisyonu ve Demersal Balıklar İçin Üreme Alanı Potansiyeli" supported within the scope of TÜBİTAK 2209-A University Students Research Projects Support Program. We would also like to thank Prof. Dr. Funda ÜSTÜN for providing the samples.

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# Impact of Accelerated Weathering on Mechanical Behavior of Sheet Molding Compound Panels

*Selvi Naz Çetinl*[1]
*Çağrı Çalışkan* [2]

**Abstract**

Sheet Molding Compound (SMC) panels are widely used in automotive applications due to their high stiffness, dimensional stability, and corrosion resistance. In exterior applications, SMC components are generally preferred with painted surfaces because they are directly exposed to sunlight and environmental aging conditions. However, depending on vehicle geometry and component position, the inner surfaces of SMC panels may also be partially exposed to sunlight during service life. This partial UV exposure may affect not only visual appearance but also the long-term mechanical performance of the material.
In this study, the effect of xenon aging on the mechanical properties of an automotive SMC panel was investigated. Specimens were subjected to an interior trim xenon aging cycle for four weeks. Samples were removed weekly and characterized by tensile, flexural, and notched Izod impact tests.
The results showed that xenon aging caused a gradual reduction in the mechanical performance of the SMC material. After four weeks of exposure, tensile elongation at break decreased from 1.9% to 1.3%, while notched Izod impact strength decreased from 134 kJ/m² to 92 kJ/m². Flexural strength also decreased significantly from 184.2 MPa to 119.3 MPa. In contrast, tensile and flexural modulus values showed relatively moderate changes, indicating that the material partially retained its stiffness while its toughness and damage tolerance decreased.
Overall, the findings indicate that xenon aging may increase the brittleness of SMC panels and reduce their resistance to impact and flexural loading. Therefore, mechanical characterization after accelerated UV exposure is important for evaluating the long-term durability of SMC components used in automotive applications.
**Keywords:** SMC panel, xenon aging, UV exposure, automotive composites, mechanical properties, tensile test, flexural test, Izod impact strength.

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# Determination of Thermal Decomposition Kinetics and Thermodynamic Parameters of Shoe Manufacturing Industry Wastes by the Coats-Redfern Method

*Gülce ÇAKMAN*[1]

**Abstract**

Shoe manufacturing generates heterogeneous solid waste that currently lack efficient valorization pathways. This study investigated the thermal decomposition behavior, pyrolysis kinetics, and thermodynamic parameters of two distinct shoe waste fractions (salpa waste and waste leather) obtained from an industrial facility in Samsun, Turkey. Thermogravimetric analysis (TGA) was performed under nitrogen atmosphere at a heating rate of 40 °C/min from 30 to 800 °C. The decomposition profiles for both fractions revealed two distinct stages: moisture release below 200 °C, and intensive pyrolysis between 300 and 550 °C. Maximum mass-loss rates occurred at 375.0 °C for salpa waste and 387.8 °C for waste leather. Kinetic parameters were determined by applying eleven solid-state reaction models within the Coats-Redfern integral method. Among all models tested, the second-order reaction model yielded the best linear fit for both samples ($R^2 = 0.9994$ for salpa waste; $R^2 = 0.9973$ for waste leather), with activation energies of 137.76 and 88.85 kJ/mol, respectively. The activation energies were reflecting the more complex, multi-component nature of the salpa waste fraction. Thermodynamic analysis revealed endothermic enthalpy changes ($\Delta H = 132.37$ kJ/mol for salpa waste; 83.35 kJ/mol for waste leather), positive Gibbs free energy values indicating an energy barrier, and negative entropy changes consistent with a well-ordered activated complex. These results establish the thermal conversion necessary for designing pyrolysis reactors aimed at converting shoe waste into alternative liquid fuels.

**Keywords:** Shoe waste, thermogravimetric analysis, Coats-Redfern method, pyrolysis kinetics, thermodynamic parameters

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# *Optımızation Of Paracetamol and Metformin Removal from Aqueous Solutions Using a Clay-Chitosan Composite Adsorbent: Statistical Modeling, Taguchi Design, and Multi-Parametric Process Evaluation

*Şazimet Sinem AYCAN*[1]

**Abstract**

This study investigates the adhesion performance of PC/ABS thermoplastic substrates bonded with polyolefin-based and polyurethane (PU)-based adhesive systems under different surface preparation methods and application temperatures. Surface treatments included isopropyl alcohol (IPA) cleaning and sanding, while adhesive application temperatures ranged from 190°C to 210°C. Each experimental condition was tested with three replicates (n = 3). Adhesion performance was evaluated through a 16-hour constant load durability test conducted at 23 ± 2°C and 50 ± 5% relative humidity, as well as lap shear strength measurements in accordance with ISO 4587 standards. The polyolefin-based adhesive exhibited poor durability and failed within approximately two hours under all test conditions, indicating inadequate compatibility with PC/ABS substrates. In contrast, the PU-based adhesive successfully completed the entire 16-hour durability test without failure, demonstrating significantly superior long-term performance. Lap shear test results further confirmed the effectiveness of the PU system, which achieved approximately 97% higher average shear strength compared to the polyolefin-based adhesive. This improved performance is mainly attributed to the stronger chemical affinity of polyurethane adhesives, whose polar urethane groups promote enhanced intermolecular interactions with the PC/ABS surface. Additionally, sanding treatment contributed positively to the adhesion strength of the PU system, while temperature showed a non-linear influence, with 200°C providing the highest lap shear strength for both adhesive systems. Overall, the findings indicate that adhesive chemistry is the primary factor affecting bonding performance, whereas process parameters have a secondary influence.
**Keywords:** PC/ABS, polyurethane adhesive, polyolefin adhesive, lap shear strength, adhesion durability

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# Current Status and Future of Sage Cultivation in Türkiye

*Belgin COŞGE ŞENKAL[1]*

**Abstract**

Sage (Salvia spp.) holds a significant place among plants with high medicinal, aromatic, and economic value worldwide. The Salvia genus is particularly widespread in the Mediterranean basin, exhibiting natural distribution up to approximately 1500 m altitude above sea level. The sage species with the highest commercial value is Salvia officinalis, known as medicinal sage. Turkey has a rich flora in terms of sage, hosting important genetic resources with a total of 114 taxa, 58 of which are endemic. Among these species, S. fruticosa (Anatolian sage) and S. tomentosa stand out due to both their natural distribution and commercial value. Although S. officinalis is not found in the natural flora, it has adapted well to Türkiye's ecological conditions and has begun to be widely cultivated. Sage is used in many areas such as herbal tea, spices, phytotherapy products, cosmetics and pharmaceutical industries, and essential oil production. According to 2024 data, a total of 2.359 tons of sage were produced in Turkey on an area of 14.914 decares. Antalya, Denizli, and Kütahya provinces are the main production centers where sage production is concentrated. While Anatolian sage (S. fruticosa) constitutes most of the production areas, medicinal sage (S. officinalis) is cultivated in more limited areas. In addition, studies on the cultivation of clary sage (S. sclarea) have also begun in recent years. Parallel to the increase in sage cultivation areas in our country, there has been a significant increase in spice and essential oil production. However, to increase competitiveness in the global market and to offer products of the desired quality and standards to target markets, some strategic steps need to be taken in the areas of production, quality, standardization, and marketing. In this context, the presentation will address the diversity of sage in the Turkish flora, the current state of sage cultivation in Türkiye, its economic importance and uses, as well as the problems encountered in cultivation and future perspectives.
**Keywords:** Salvia spp., sage, medicinal and aromatic plants, essential oil, Türkiye

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# Morphological Characteristics and Essential Oil Profile Investigation of Salvia verticillata L.

*Belgin COŞGE ŞENKAL*[1]

**Abstract**

The genus Salvia is one of the largest genera in the Lamiaceae family, containing over 900 species worldwide. Turkey has a very rich flora in terms of Salvia species. Salvia verticillata L. is a perennial herbaceous species that naturally occurs in many regions of Turkey and is represented in the Flora of Turkey by two subspecies: S. verticillata subsp. amasiaca (Freyn & Bornm.) Bornm. and S. verticillata subsp. verticillata L. This species, which can generally grow to a height of 30-80 cm, has purple or purplish-blue flowers. In this study, the aim was to determine the essential oil composition of S. verticillata subsp. amasiaca. As material in the research, the aerial parts of plants propagated from seed and collected from their natural habitat during the flowering period were used. Essential oil was obtained from the plant material by hydro-distillation method. The chemical composition of the obtained essential oil was determined by gas chromatography-mass spectrometry (GC-MS) analysis. According to the analysis results, the main components of the essential oil were identified as β-caryophyllene, germacrene-D, aromadendrene, 4-epi-cubedol, and α-gurjunene. These compounds are reported in the literature to possess various biological activities such as antioxidant, antimicrobial, and anti-inflammatory properties. In conclusion, S. verticillata subsp. amasiaca was determined to be a species containing important secondary metabolites. In this presentation, the morphological characteristics of the species and its essential oil profile will be discussed together, and the biological activities of the main components of the essential oil will be evaluated in line with literature data.
**Keywords:** Salvia verticillata subsp. amasiaca, Lamiaceae, essential oil, GC-MS, chemical composition, biological activity

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# Herbicide registration applications in Çukurova region: Changes in active ingredients and modes of action — the case of Adana Province

*Hilmi TORUN*[1]
*Mine ÖZKİL*[2]
*Özcan TETİK*[3]

**Abstract**

This study used data from the authorised public institution responsible for processing herbicide registration applications in Adana Province. The aim was to evaluate applications submitted between 2023 and 2025 in terms of crop types, active ingredients, mixing formulations and modes of action. As part of the study, application data from a three-year period was examined. The applications were analysed based on product distribution, the number of active ingredients, mixture ratios, and classification according to the Herbicide Resistance Action Committee (HRAC) mode of action. The findings reveal that the number of herbicide registration applications fluctuates from year to year, peaking in 2023. When evaluated by crop type, it was found that applications were concentrated primarily on wheat and corn, with a notable increase in corn specifically in 2025. It was determined that a large proportion of the applications consisted of herbicides effective against both broadleaf and grass weeds. Examining the active ingredients revealed that the proportion of herbicides with a single active ingredient decreased over time, while those containing two or three active ingredients mix increased. In three-year assessment, two-component mixtures accounted for the largest share (48.33%), while three-component mixtures accounted for 20.00%. The most frequently used groups in terms of mode of action were identified as HRAC 2 (Acetolactate synthase inhibitors), HRAC 12 (Glutamine synthase inhibitors) and HRAC 27 (Carotenoid biosynthesis inhibitors; 4-hydroxyphenylpyruvate dioxygenase). Active ingredients such as pinoxaden, diflufenican, clomazone, mesotrione and terbuthylazine were found to have gained prominence at different times. In conclusion, it has been determined that herbicide registration applications in Adana Province have increasingly shifted towards products containing multiple active ingredients and different modes of action. This trend is considered significant in relation to managing weed resistance and promoting sustainable agricultural practices.
**Keywords:** agricultural sustainability, herbicide registration applications, HRAC, pesticide management, resistance

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# Genomic Selection in Cattle Breeding

*Eda TAYFUR*

**Abstract**

For decades, traditional cattle breeding programs have relied on phenotypic records and progeny testing methods. However, in species with long generation intervals like cattle, these methods entail several disadvantages, including high costs, significant time investment, and limited genetic progress for lowly heritable traits such as fertility and disease resistance. Over the past two decades, advancements in molecular genetics and bioinformatics have ushered in the era of "Genomic Selection" (GS) in the livestock sector. Genomic selection is based on estimating Genomic Estimated Breeding Values (GEBV) at an early age using genome-wide Single Nucleotide Polymorphism (SNP) panels, well before the animals' phenotypic performances or progeny outcomes are manifested. With the integration of this method, the generation interval in cattle breeding has been radically shortened, selection accuracy has increased, and remarkable genetic progress has been achieved, particularly for hard-to-measure traits such as mastitis resistance, residual feed intake, and longevity. Nevertheless, the accuracy of genomic prediction models (e.g., GBLUP, Bayesian variants) directly depends on the size of the reference population, the genetic architecture of the breed, and the continuous updating of reference phenotypes. Within the scope of this paper, the operational mechanisms of genomic selection in cattle breeding, its current global and national applications, economic advantages, and ongoing optimization challenges are evaluated in light of recent literature. In conclusion, genomic selection is likely to be the most powerful and indispensable tool of modern cattle breeding for achieving sustainable and profitable animal production.

**Keywords:** Cattle Breeding, Genomic Selection, SNP, GEBV, Genetic Gain.

# Women in Beekeeping: Challenges, Opportunities and Future Perspectives

*Mustafa GÜNEŞDOĞDU*[1]
*İsmail Yaşhan BULUŞ*[2]

**Abstract**

Beekeeping is an important agricultural activity that contributes significantly to biodiversity conservation, pollination services, and rural economies through the production of honey and other valuable bee products. Although agriculture is often perceived as a male-dominated sector, women make substantial contributions to agricultural production worldwide. However, women's participation in beekeeping remains limited due to various socio-economic, physical, and cultural barriers. In Türkiye, women represent a relatively small proportion of registered beekeepers despite the country's high apicultural potential. Factors limiting women's participation include the physical demands of migratory beekeeping, concerns related to safety in remote apiary locations, limited access to training and financial resources, and traditional gender roles. Increasing women's involvement in beekeeping could contribute significantly to rural development and economic sustainability. Women can play an important role, particularly in the production and value-added processing of non-traditional bee products such as royal jelly, pollen, propolis, bee venom, perga, and apilarnil. Supporting women through education, institutional incentives, cooperative structures, and marketing opportunities can strengthen both gender equality and the beekeeping sector.

**Keywords:** Beekeeping, beekeeper, gender equality, rural development, apiculture

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# Manufacturing Technologies for Automotive Interior Decorative Components: A Comparative Study

*Cem İÇİER*
*Mesut Can DÖNDÜ*
*Mehmet Burak AKSU*

**Abstract**

Automotive interior components require high quality, durability, and cost-effective manufacturing solutions while meeting increasing design complexity and lightweight targets. Various decorative manufacturing technologies have been developed to satisfy these requirements in cockpit trim components. Among them, conventional wrapping, in-mold decoration (IMD), slush molding and back injection technologies are widely used in the production of interior decorative parts such as instrument panels, center consoles, and dashboard trims. This study presents a comparative analysis of these manufacturing technologies with respect to surface quality, design flexibility, production complexity, weight, and cost considerations. The fundamental process principles of each technology are first described, followed by an evaluation of their applicability to different types of cockpit components. Particular attention is given to back injection technology, which has recently gained importance for decorative trim parts due to its ability to integrate aesthetic surfaces with structural plastic substrates in a single manufacturing step. The advantages and limitations of each technology are discussed based on typical automotive interior applications. The results highlight the conditions under which each manufacturing method becomes preferable from both engineering and production perspectives. This study aims to provide a comprehensive overview of decorative manufacturing technologies used in automotive interiors and to support engineers in selecting appropriate production methods during the early design phase of cockpit components.
**Keywords:** Decorative Manufacturing Technologies, Automotive Interior Trim, Back Injection, Surface Quality, Cost Optimization

# Advantages of Hot Stamping and Press Hardening in Automotive Body Structures

*Enes CEBE*[1]

**Abstract**

This study evaluates the advantages of hot stamping and press hardening components used in automotive body structures through a literature review. The process is discussed along the typical production route, including blank preparation, austenitization in a furnace, transfer to the press, press forming with in-die quenching, trimming and piercing operations, and coating options, particularly aluminum–silicon (Al–Si) coatings. These coatings play an important role in preventing oxidation during the heating stage and improving surface quality.The findings indicate that the high strength achieved through martensitic transformation significantly improves the mechanical performance of automotive body components. In addition, tailored or graded property concepts enable the combination of different mechanical properties within the same component. This approach helps balance intrusion resistance and energy absorption, which are essential factors for improving vehicle crashworthiness.For safety-critical regions of the vehicle body, press hardening also supports lightweight design strategies through thickness reduction and part integration. However, the thermal cycle and in-die quenching requirements introduce certain challenges. These include higher line investment costs, increased energy consumption, and sensitivity of the process window to temperature and transfer conditions.Potential quality risks in hot stamping processes include oxidation, decarburization, variability in hardness distribution, coating-related brittleness, and part distortion. In this context, hardness mapping and standardized measurement methods are essential for process validation and quality control. From a sustainability perspective, low-carbon hot stamping approaches are mainly addressed through appropriate steel grade selection, improved heating efficiency, and optimized component design.

**Keywords:** hot stamping, press hardening, martensite, Al–Si coating, in-die quenching

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# Assessment of Damping Ratio Sensitivity on Mode Shapes, Resonance Response, and Lambda Accuracy

*Mustafa NAZLI*[1]
*Uğurcan SERBEST*[2]

**Abstract**

This study examines the influence of damping definition on the dynamic response of a structural system using frequency response function (FRF) analysis, with particular emphasis on modal behavior and frequency-domain characteristics. The main objective is to evaluate how different damping formulations affect resonance representation and modal contributions in numerical dynamic analyses. Two damping approaches are compared: (1) a conventional definition without modal or frequency-based correlation, and (2) a physically informed correlated definition intended to better represent structural behavior. Numerical investigations demonstrate that variations in damping formulation do not alter statically derived structural parameters but significantly influence the amplitude, bandwidth, and frequency location of the FRF responses, as well as the relative contribution of vibration modes. The conventional, non-correlated approach leads to excessive suppression of resonance peaks, wider effective bandwidths, and altered modal contribution patterns, reducing the physical interpretability of the dynamic response. In contrast, the correlated definition provides clearer resonance behavior, improved modal separation, and frequency-domain responses more representative of the physical system. A lambda factor derived from static structural analysis is used as a reference parameter to assess consistency between static and dynamic behavior. While the lambda factor itself remains unaffected by damping formulation, improved coherence between static stiffness characteristics and dynamic frequency-domain responses is observed when the correlated approach is employed. The findings underline the importance of physically informed damping modeling in FRF-based structural dynamic analyses and highlight its role in obtaining reliable and realistic dynamic response predictions for safety-critical automotive components such as wheel rims.

**Keywords**: Modal Analysis, Frequency Response Function (FRF), Lambda Factor, Damping Definition, Wheel Rim, Finite Element Analysis (FEA)

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# Modal Analysis of Automotive Wheel Rims: Comparative Study of Meshless Methods and Conventional Finite Element Method

*Uğurcan Serbest*[1]
*Mustafa Nazlı* [2]

**Abstract**

This research investigates the modal characteristics of automotive wheel rims, comparing a meshless external approximation method against conventional finite element analysis using the Lanczos eigenvalue solver. The study encompasses 16 geometric variants covering wheel diameters of 17–21 inches, spoke counts from 3 to 18, and three material systems: aluminum A356, A357, and steel AISI 1018. Meshless results are benchmarked against FEM predictions as the reference baseline. Natural frequency deviations for the primary bending and circumferential (chip) modes remained below 2.15% and 3.23% respectively, with mean absolute deviations of 0.86% and 1.34%. Mode-shape correlation exceeded 0.95 for all 16 variants after systematic boundary-condition calibration. The meshless workflow reduced preprocessing time by approximately 87% relative to the FEM baseline, demonstrating compelling efficiency advantages for early-stage design exploration without sacrificing predictive reliability.

**Keywords:** Modal analysis, Meshless methods, Wheel rim dynamics, Finite element analysis, Boundary condition optimization, Mode-shape correlation

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# The Use of Gigacasting Technology in Safety Critical Automotive Structural Components

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*Yağız SELÇUK*[2]
*Ferhat Can Köse*[3]

**Abstract**

Gigacasting technology enables the production of large-scale automotive structural components as a single piece by using the High Pressure Die Casting (HPDC) process. In recent years, this manufacturing approach has gained increasing attention, particularly in electric vehicle platforms, due to its advantages in manufacturing efficiency, structural integration, and cost reduction. By replacing multiple welded or bolted parts with a single large aluminum casting, gigacasting significantly simplifies assembly processes and reduces the number of joining operations in vehicle body structures.This study investigates the use of gigacasting technology in safety critical automotive components and evaluates its potential effects on crash performance and structural behavior. A literature-based analysis was conducted focusing on the mechanical properties and deformation characteristics of aluminum alloys used in large high-pressure die cast structural parts. Particular attention was given to parameters such as torsional stiffness, energy absorption capability, and load distribution during crash events.The findings indicate that gigacasting structures can provide improved torsional rigidity and enhanced crash energy absorption due to optimized load paths and the elimination of multiple joints. However, the technology also introduces several engineering challenges. The control of casting defects such as porosity and the optimization of ductility in aluminum alloys remain critical factors influencing crashworthiness and structural reliability.Overall, gigacasting represents a promising manufacturing approach for next-generation electric vehicles, offering significant advantages in production efficiency and structural performance while requiring careful optimization of casting processes and material properties.

**Keywords:** Gigacasting, High Pressure Die Casting, Crashworthiness, Structural Aluminum, Electric Vehicles

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# Applications of Cold Welding in the Automotive Industry

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## Abstract

The automotive industry continuously seeks advanced manufacturing technologies to improve structural performance, reduce vehicle weight, and increase production efficiency. Among emerging joining technologies, cold welding and other solid-state welding methods have gained significant attention due to their ability to join metals without melting. Unlike conventional fusion welding processes, cold welding occurs through the application of high pressure that enables atomic bonding between clean metallic surfaces at or near room temperature. This characteristic makes cold welding particularly attractive for joining materials that are difficult to weld using traditional techniques. In the automotive sector, cold welding and related solid-state joining technologies are increasingly applied in electrical connections, lightweight structures, and electric vehicle battery systems. This study presents a literature-based review of cold welding principles and evaluates its applications in automotive manufacturing. The fundamental mechanisms of cold welding, including surface preparation, plastic deformation, and atomic diffusion, are discussed. In addition, several solid-state joining techniques closely related to cold welding—such as friction stir welding, ultrasonic metal welding, and cold roll bonding—are examined in terms of their applicability to automotive structures. The study highlights the advantages of these methods, including reduced heat input, minimal distortion, improved joint reliability, and the capability of joining dissimilar materials. The findings indicate that solid-state welding technologies will play an increasingly important role in future automotive manufacturing systems.

**Keywords:** Cold welding, automotive manufacturing, solid-state welding, friction stir welding, ultrasonic welding

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# Rheocast Components for BIW Structures in Automotive Manufacturing

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**Abstract**

The increasing demand for lightweight and high-performance vehicle structures has encouraged the development of advanced manufacturing processes for automotive components. Rheocasting, a semi-solid metal processing technique, has gained significant attention as an alternative production method for aluminum components used in Body-in-White (BIW) structures. This process combines certain advantages of casting and forging, enabling the production of components with improved mechanical properties and reduced defects compared to conventional high-pressure die casting.In the rheocasting process, molten metal is partially solidified to a semi-solid state before being injected into a die. This semi-solid slurry typically consists of globular primary solid particles suspended in a liquid matrix. The globular microstructure reduces turbulence during die filling and helps minimize common casting defects such as porosity, shrinkage, and air entrapment. As a result, rheocast components can achieve better structural integrity and improved mechanical performance.For BIW applications, rheocast aluminum components offer significant potential for weight reduction and part integration. Complex geometries and thin-walled structures can be produced with relatively high dimensional accuracy, allowing the consolidation of multiple steel components into a single lightweight aluminum part. This capability contributes to improved fuel efficiency and reduced carbon emissions in modern vehicles.However, the implementation of rheocasting technology also presents certain challenges. Process control, slurry preparation, and equipment investment are critical factors that influence production stability and component quality. In addition, proper alloy selection and process parameter optimization are essential to achieve the desired microstructure and mechanical properties.Overall, rheocasting represents a promising manufacturing technology for the production of lightweight BIW components, supporting the ongoing transition toward more efficient and sustainable automotive structures.

**Keywords**: rheocasting, semi-solid metal processing, BIW structures, aluminum alloys, lightweight manufacturing

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# Joining Technologies for Non-Ferrous Sheet Metals in Modern Manufacturing

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**Abstract**

The increasing demand for lightweight and high-performance vehicle structures has encouraged the development of advanced manufacturing processes for automotive components. Rheocasting, a semi-solid metal processing technique, has gained significant attention as an alternative production method for aluminum components used in Body-in-White (BIW) structures. This process combines certain advantages of casting and forging, enabling the production of components with improved mechanical properties and reduced defects compared to conventional high-pressure die casting.In the rheocasting process, molten metal is partially solidified to a semi-solid state before being injected into a die. This semi-solid slurry typically consists of globular primary solid particles suspended in a liquid matrix. The globular microstructure reduces turbulence during die filling and helps minimize common casting defects such as porosity, shrinkage, and air entrapment. As a result, rheocast components can achieve better structural integrity and improved mechanical performance.For BIW applications, rheocast aluminum components offer significant potential for weight reduction and part integration. Complex geometries and thin-walled structures can be produced with relatively high dimensional accuracy, allowing the consolidation of multiple steel components into a single lightweight aluminum part. This capability contributes to improved fuel efficiency and reduced carbon emissions in modern vehicles.However, the implementation of rheocasting technology also presents certain challenges. Process control, slurry preparation, and equipment investment are critical factors that influence production stability and component quality. In addition, proper alloy selection and process parameter optimization are essential to achieve the desired microstructure and mechanical properties.Overall, rheocasting represents a promising manufacturing technology for the production of lightweight BIW components, supporting the ongoing transition toward more efficient and sustainable automotive structures.

**Keywords:** non-ferrous sheet metals, joining methods, friction stir welding, adhesive bonding, mechanical fastening

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# BIW Fastening Strategies in Automotive Body Structures

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**Abstract**

The automotive industry is currently undergoing a transformative shift toward multi-material vehicle architectures to satisfy stringent fuel efficiency standards and safety regulations. This transition has positioned the Body-in-White (BIW) assembly process as a critical focal point for engineering innovation. This study provides a comprehensive overview of modern fastening strategies utilized in automotive body structures, with a specific emphasis on the integration of Advanced High Strength Steels (AHSS), aluminum alloys, and composite materials.Traditional Resistance Spot Welding (RSW), while remaining the cost-effective benchmark for steel-intensive designs, faces significant metallurgical challenges such as liquid metal embrittlement and heat-affected zone softening when applied to latest-generation AHSS grades. Consequently, the industry is increasingly adopting alternative thermal methods like laser welding and brazing to minimize thermal distortion and improve joint integrity. Furthermore, the necessity of joining dissimilar materials—where thermal methods are often inapplicable due to galvanic corrosion and different melting points—has accelerated the adoption of mechanical fastening technologies. Techniques such as Self-Piercing Riveting (SPR), Flow Drill Screws (FDS), and clinching are evaluated for their structural performance and cycle time efficiency.The study also highlights the strategic role of structural adhesive bonding, which is frequently paired with mechanical fasteners or spot welds to create hybrid joints. These hybrid systems enhance torsional stiffness, improve fatigue life, and provide superior Noise, Vibration, and Harshness (NVH) characteristics. Through a literature-based assessment, this review discusses the selection criteria for fastening strategies, including flange width requirements, single-sided access constraints, and coating compatibility within the paint shop environment. It is concluded that a holistic Design-for-Manufacturing (DFM) approach, supported by robust Finite Element Analysis (FEA), is essential for optimizing BIW assembly, ensuring that the final structure meets both lightweighting goals and rigorous crashworthiness standards.

**Keywords:** BIW, Fastening Strategies, AHSS, Joining Technologies, Automotive Engineering.

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# A Comparative Study of Backbone Architectures in Faster R-CNN with Feature Pyramid Networks for PCB Defect Detection and Classification

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*Mehmet Gökhan HABİBOĞLU*[2]

## Abstract

Early detection of Printed Circuit Board (PCB) manufacturing defects is crucial for ensuring product reliability and reducing production costs. While deep learning has advanced automated visual inspection, the influence of backbone architecture selection on detection performance across diverse defect morphologies remains insufficiently explored. This paper presents a systematic comparative study of five backbone architectures—ResNet-152, ConvNeXt-S, Swin Transformer-Tiny, EfficientNet-B0, and a novel domain-specific architecture termed PCBMicroNet—each integrated into a Faster R-CNN detection framework with Feature Pyramid Network (FPN) for multi-scale feature fusion. PCBMicroNet introduces four specialized modules: Trace-Aware Depthwise Convolution (TADConv), Micro-Defect Attention Gate (MDAG), Frequency-Guided Feature Refinement (FGFR), and Cross-Scale Defect Correlation (CSDC), specifically designed to exploit the structural regularity inherent in PCB images. All models are rigorously evaluated using nested 5-fold cross-validation on the PKU PCB defect dataset encompassing six defect categories, with hyperparameters systematically optimized via Bayesian search. Experimental results demonstrate that ConvNeXt-S FPN achieves the highest mAP@0.5 of 96.84% (±0.24%), while the proposed PCBMicroNet attains a competitive 94.10% mAP@0.5 and a COCO mAP of 48.89%—surpassing ResNet-152 FPN (43.82%) and closely approaching ConvNeXt-S (49.41%) —with significantly fewer parameters. The findings establish a comprehensive accuracy–efficiency trade-off framework to guide optimal backbone selection for real-time industrial PCB inspection deployment.
**Keywords:** Backbone architecture, comparative study, ConvNeXt, deep learning, Faster R-CNN, feature pyramid network, object detection, PCBMicroNet, printed circuit board (PCB) defect detection, Swin Transformer.

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# Simulating V2V-Based Dynamic Priority Management of Autonomous Vehicles at Unsignalized Intersections

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*Abdulkerim ÇEKİNMEZ*[4]
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## Abstract

This research examines the implementation of dynamic priority management for autonomous carrier vehicles at unsignalized intersections within industrial factory settings using Vehicle-to-Vehicle (V2V) communication. Addressing the limitations of static traffic control, a high-fidelity co-simulation framework was established by integrating SUMO for microscopic mobility and OMNeT++ for network simulation, synchronized through the Veins framework and TraCI protocol. The proposed algorithm operates through four specialized stages: V2V Beaconing, Geometric Conflict Detection, Distributed Leader Election, and Smart Yielding. By utilizing computational geometry to analyze vehicle trajectories as coordinate vectors, the system ensures vehicles only yield when physical path intersections are imminent, effectively maximizing factory throughput. Experimental results across three distinct scenarios validated the system's efficiency compared to unintervened traffic flows. In the first simulation, travel time was reduced from 90.6 to 70.05 seconds. The second simulation demonstrated that path-clearing Convoy Logic reduced completion time from 62.9 to 43.6 seconds. Even in complex mutual exclusion scenarios involving two priority vehicles, the system successfully managed right-of-way through ETA based leader election, reducing the yielding vehicle's travel time from 54.55 to 41.6 seconds. Consequently, transitioning to dynamic V2V-based management significantly enhances logistics efficiency and safety in industrial facilities by optimizing junction throughput and reducing stop-and-go costs.
**Keywords:** Autonomous Vehicles, Intersection Management, OMNeT++, SUMO, V2V Communication.

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# The general anatomy and histology of the eye of *Phrynocephalus horvathi*

*Melodi YENMİŞ[1]*

**Abstract**

Reptilian eyes show substantial structural diversity, particularly in eyelids and visual adaptations. In this study, the eye anatomy and morphology of Phrynocephalus horvathi, one of the four Agamidae lizards in Anatolia, distributed along the foothills of Mount Ararat, were examined using stereomicroscopy and scanning electron microscopy, while its fine structure was investigated through histological sections. Skin and optic scales surrounds the ocular region. The dissection revealed major ocular components including the cornea, iris, lens, retina, and optic nerve. The organization of these structures indicates a compact and well-developed visual system typical of diurnal reptiles. The sectional images further show the structural arrangement of the eye wall. The cornea forms the anterior surface of the globe, followed internally by the anterior chamber and iris. Posteriorly, the large lens is at the ocular cavity. The optic nerve connects the retina to the central nervous system. Scleral ossicles and scleral cartilage reinforce the eye structurally. The sclera forms the outer supportive layer, whereas the choroid lies internally between the sclera and retina. These features demonstrate the complex organization and mechanical reinforcement of the reptilian eye, likely associated with maintaining ocular shape and supporting visual function. Visual acuity is excellent in most diurnal lizards, afforded by a complex and highly organized retina that contains specializations including a single fovea for increased spatial resolution. The well-developed lizard retina receives nutrition from a conus papillaris. The retina of P. horvathi consists of seven main layers: from outside in, the pigmented epithelium, photoreceptor layer, outer nuclear layer, outer plexiform layer, inner nuclear layer, inner plexiform layer and ganglion cell layer. The eye is also supported by many muscle fibers and blood vessels. In conclusion, this study represents the first description of the general ocular structure, its layers, and the components of the retina in P. horvathi.

**Keywords:** vision, retina, photoreceptor, Agamidae, lizard

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# *In Vitro* Antibacterial and Synergistic Potential of *Lavandula stoechas* Essential Oil with Ampicillin

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**Abstract**

Increasing antimicrobial resistance is becoming a serious global health problem, gradually reducing the effectiveness of treatments for both common and severe infections. Meanwhile, the development of new antibiotics has slowed, necessitating the exploration of alternative antimicrobial agents, including natural products. In this context, this study aimed to evaluate the antibacterial activity of *Lavandula stoechas* essential oil (EO) and its synergistic interaction with ampicillin against selected bacterial strains. Antibacterial activity was determined using agar disc diffusion and microbroth dilution assays, synergistic interactions between EO and ampicillin were evaluated by the checkerboard method and fractional inhibitory concentration index (FICI) analysis. *L. stoechas* EO exhibited inhibition zones of 12.25 ± 0.50 mm against *E. faecalis*, 17.75 ± 3.10 mm against *S. aureus*, and 23.25 ± 1.50 mm against *P. aeruginosa.* Synergistic interaction with ampicillin was observed against E. faecalis (FICI = 0.375), whereas additive and antagonistic effects were detected against *S. aureus* (FICI = 1.0) and *P. aeruginosa* (FICI = 4.125), respectively. These findings suggest that *L. stoechas* EO may enhance the antibacterial activity of ampicillin against certain bacterial strains; however, further *in vivo* studies and advanced delivery strategies are required to evaluate its clinical potential.

**Keywords:** Agar disc diffusion, antimicrobial resistance, bioactive compounds, natural products

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# Effects of *Origanum laevigatum* (Mountain Oregano) Extract and the Chemotherapeutic Agent Cisplatin on Mouse Blood Tissue*

*Miray MEMİŞ*[1]
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*Çetin Yiğit ÇOĞUN*[3]

**Abstract**

This study aimed to investigate the biochemical effects of Origanum laevigatum (mountain oregano) extract and cisplatin, a widely used chemotherapeutic agent, on mouse blood tissue. In the study, Swiss albino mice were divided into four groups: control, O. laevigatum, cisplatin, and combination treatment groups. The plant extract was prepared using ethanol extraction and administered orally via gavage. At the end of the experimental period, serum ALT, AST, total protein, and cholesterol levels were analyzed using spectrophotometric methods. The findings demonstrated that ALT and AST levels were significantly elevated in the cisplatin-treated group, indicating hepatotoxic effects associated with cisplatin administration. In contrast, lower increases in these enzyme levels were observed in the groups treated with O. laevigatum. A decrease in total protein levels was detected, suggesting that the plant extract may exert a protective effect on protein metabolism. Furthermore, alterations in cholesterol levels were considered to be associated with the metabolic effects of cisplatin. In conclusion, O. laevigatum extract may possess potential protective effects against cisplatin-induced biochemical alterations and could serve as a promising biomarker source in toxicological studies.
**Keywords:** Origanum laevigatum, cisplatin, hepatotoxicity, biochemical parameters, ALT, AST, mouse model, plant extract, oxidative stress, toxicology.
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# HPLC-Based Evaluation of Phenolic Constituents in *Leucojum aestivum* L. Leaves Across Different Localities and Developmental Stages

*Arzu Birinci YILDIRIM* [1]
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**Abstract**

Leucojum aestivum L. is an important geophyte of the Amaryllidaceae family. Although previous studies on the species have mainly focused on Amaryllidaceae alkaloids such as galanthamine and lycorine, limited information is available regarding its phenolic composition. In the present study, the phenolic profiles of L. aestivum leaf extracts collected from six different localities in Türkiye (Bolu-Gölcük, Bolu-Yeniçağa, Sakarya-Kaynarca, Yalova-Delmece, Bursa-Uluabat, and İstanbul-Terkos) during different phenological stages were investigated by HPLC analysis. Plants were harvested before flowering, during flowering, and after flowering periods. Chlorogenic acid, rutin hydrate, quercetin, and apigenin were identified and quantified in methanolic leaf extracts. Considerable variations in phenolic composition were observed depending on locality and developmental stage. Rutin hydrate was determined as the major phenolic compound in most samples, with the highest content detected in Sakarya and İstanbul populations during flowering and post-flowering periods. In contrast, chlorogenic acid accumulation was generally higher during vegetative stages, particularly in Sakarya, Gölcük, and Yeniçağa populations. Quercetin and apigenin were detected at relatively lower concentrations but showed noticeable regional and seasonal variations. The results demonstrated that both geographical origin and phenological stage significantly influence phenolic accumulation in L. aestivum. These findings provide valuable information for the selection of suitable harvest periods and natural populations for obtaining phenolic-rich plant material and contribute to a better understanding of the phytochemical variability of L. aestivum in Türkiye.

**Keywords:** Leucojum aestivum, Rutin hydrate, Chlorogenic acid, HPLC, Phenolic compounds

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# Impact Of Conservation Strategies on Phenolic Profile of Local Endemic *Cirsium Boluense*

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**Abstract**

Cirsium boluense P.H.Davis & Parris (Kartal Kangalı), a member of the Asteraceae family, is a local endemic plant restricted to Kartalkaya (Bolu, Türkiye). This study aimed to characterize the individual phenolic profile of this species using Liquid Chromatography Tandem Mass Spectrometry (LC-MS/MS). Rosette leaves were collected from four different sources: in vitro-propagated plants (AIV), ex-situ conserved plants (AES), in situ conserved plants (AIS), and naturally grown individuals (ADH). Methanolic extracts were analyzed for a wide range of phenolic acids and flavonoids. The results revealed clear differences in phenolic composition among the plant sources. Chlorogenic acid was identified as the predominant compound across all samples. Flavonoids such as apigenin and luteolin were more abundant in plants grown under natural and in situ conditions, whereas lower levels were generally observed in in vitro-propagated plants. Ex situ samples exhibited intermediate profiles between controlled and natural environments. Overall, plants grown under natural and in situ conditions showed a richer and more diverse phenolic composition compared to those obtained through in vitro propagation. These findings indicate that environmental factors and conservation strategies significantly influence secondary metabolite production in C. boluense. The study highlights the importance of in situ conservation not only for species preservation but also for maintaining phytochemical diversity and potential bioactivity.
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**Keywords:** Cirsium boluense, phenolics, LC-MS/MS, in situ conservation, ex situ conservation, in vitro propagation

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# Architectural Challenges Related to Fire Evacuation and Patient Mobility in Healthcare Facilities

*Bilgehan BAKIRHAN*[1]

## Abstract

Fire safety in healthcare facilities constitutes one of the most challenging areas of architectural design due to the high vulnerability of user groups and the complex requirements of medical equipment. A review of the literature indicates that the majority of fire evacuation models and regulatory frameworks are primarily based on "independently mobile occupants," while the spatial needs of groups such as bed-dependent patients and elderly individuals with limited mobility are insufficiently represented within these models. This study aims to move beyond a purely engineering-oriented approach to fire evacuation in healthcare facilities by analyzing the direct relationship between patient mobility, stretcher/bed circulation, and spatial organization. The primary problem addressed by the research is the lack of spatial planning standards for bedridden patient evacuation—an important gap in the architectural literature—and the inadequacy of existing designs in horizontal evacuation scenarios.

The methodology of the study is based on a literature review, architectural plan analyses of three hospital buildings representing different plan typologies, and a conceptual-comparative evaluation of hospital evacuation strategies. Within the scope of the research, corridor organization, fire compartments, stretcher maneuvering areas, and safe refuge zones are discussed within a theoretical framework. In particular, the study examines how horizontal evacuation approaches, which rely on the creation of safe zones on the same floor level, can be improved during the architectural design process for units where vertical evacuation is limited, such as operating rooms and intensive care units. As a result, this research aims to fill a conceptual gap in the literature by presenting architectural design recommendations that integrate patient-oriented evacuation strategies into hospital design processes and by offering a strategic roadmap for future healthcare facility projects.

**Keywords:** Healthcare facilities, Fire safety, Patient mobility, Fire evacuation

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# Minimally Invasive Sensor Deployment in Historic Buildings Using Digital Twins

*Bilgehan BAKIRHAN*[1]

**Abstract**

The protection of historic buildings against fire presents significant challenges in practice due to the conflicts arising between cultural heritage conservation principles and the implementation of modern safety measures. A review of the fire safety and conservation literature reveals that the integration of digital twin technologies into historic buildings is still at an early stage and lacks a comprehensive and holistic perspective. This study aims to analyze digital twin-based fire risk management processes in historic buildings within the framework of their strategic opportunities, existing limitations, and architectural potentials. The primary problem addressed by the research is the development of recommendations for sensor placement configurations that are compatible with the principle of "minimum intervention," which limits physical intervention to the historic fabric while preventing damage to the existing structure.

Within the scope of the study, the relevant literature was first examined, followed by a conceptual evaluation and a comparative analysis of current fire safety approaches. The research theoretically discusses real-time risk monitoring and emergency response mechanisms supported by sensor data through a Historic Building Information Modelling (HBIM)-based data infrastructure. In particular, the study examines how the virtual modelling capacity offered by digital twin platforms can serve as a guide for determining optimum sensor locations that provide maximum efficiency without compromising the aesthetic and structural integrity of historic buildings. Furthermore, issues such as high installation costs, interoperability problems between software systems, and data management constraints are also evaluated. The study aims to contribute to the literature by presenting recommendations on how digital technologies can establish a security layer compatible with conservation principles. As a result, this research offers a roadmap and architectural recommendations for the integration of digital twin technologies and heritage management within future fire safety strategies.

**Keywords:** Historic buildings, Fire safety, Digital twin, HBIM, Sensor placement

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# Fire Safety Issues in Sustainable Façade Design

*Bilgehan BAKIRHAN*[1]

**Abstract**

In modern architecture, the goals of improving energy efficiency and reducing carbon footprints have accelerated the use of complex and multilayered facade systems. However, these sustainability-oriented architectural decisions are increasingly coming into conflict with fire safety requirements. A major gap in the current literature is that existing fire testing standards may be insufficient for evaluating the real-life fire behavior of innovative systems such as photovoltaic panels, green walls, and bio-based insulation materials. This study aims to analyze the emerging fire risks associated with sustainable facade systems and to propose holistic approaches that can minimize these risks during the architectural design process.

The methodology of the research is based on a literature review, a comparative analysis of contemporary facade systems, and a conceptual architectural evaluation. Within the scope of the study, the chimney effect in double-skin facades, the impact of combustible cladding systems on vertical fire spread, and the smoldering characteristics of bio-based insulation materials are examined. In particular, in light of the discussions that emerged after the Grenfell Tower fire, the ignition risks of photovoltaic systems, the impact of vertical gardens on firefighting intervention, and the smoke toxicity caused by synthetic and bio-based insulation materials are discussed from an architectural perspective.

The findings of the study indicate that existing regulations and testing procedures may remain limited in evaluating the complex fire behavior of sustainable facade systems, and that some sustainability-oriented design decisions may carry the potential to increase fire spread risks. As a result, the study recommends the integration of interdisciplinary design strategies that address sustainability goals and fire safety requirements in a balanced manner into architectural design processes, while emphasizing the importance of performance-based design approaches.

**Keywords:** Sustainable facade systems, Fire safety, Facade fires, Photovoltaic systems

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# Digital Ecosystems for Sustainable Cities: Digital Twin Integration in Climate and Resource Management

*Ebru KILIÇ BAKIRHAN*[1]

**Abstract**

The built environment is inherently a holistic structure comprising multiple systems and their mutual interactions. Natural and built environments can come into conflict due to global factors such as climate change, escalating waste generation, and rising energy consumption. However, through accurate and innovative solution proposals, it is possible for these two domains to operate in harmony and to develop solutions for global challenges.
This study, which focuses on the energy, waste, and climate nexus and incorporates social participation and community resilience, examines potential solutions that can be developed through the use of digital twins (DT). Supported by contemporary research articles and real-world implementations, this review seeks answers to how current architecture can shape and contribute to the future. At this stage, the challenges and research gaps in the utilization of DT technologies are also explicitly addressed.
In conclusion, it is demonstrated that DT technologies can mitigate the urban heat island effect during the climate change adaptation process. Furthermore, they can increase sorting accuracy in construction and demolition waste (CDW) to 85–95% through smart selective demolition techniques, reduce building energy consumption by 30–40%, yield a 25% savings in operational costs alongside a 20–30% reduction in dismantling costs, and improve material recovery by 15–25%. The findings of this study offer actionable insights suitable for use by architects, engineers, stakeholders, and decision-makers.
**Keywords**: Digital twin, circular economy, climate adaptation, energy efficiency, sustainable cities.

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# Shaping the Architecture of the Future with Innovative Building Materials

*Ebru KILIÇ BAKIRHAN*[1]

**Abstract**

The building materials sector is a continuously expanding and evolving field driven by advancing technology. Tracking developments in this domain provides a roadmap for architects and engineers to address current and future challenges. The objective of this study is to examine contemporary, innovative, and widely recognized building materials. The properties, application areas, and performances of these manufactured construction materials are evaluated from multiple perspectives. To achieve this, six distinct experimental research articles published in the Web of Science (WoS) database within the last six years, each receiving over one hundred citations, and focusing on the production of innovative building materials were identified.

The findings indicate that next-generation construction materials ranging from transparent wood to geopolymers, and from living materials to silica aerogels, enhance the performance of conventional building materials across various metrics. The improved properties encompass a wide spectrum, including light transmittance, mechanical strength, thermal conductivity, freeze-thaw resistance, acoustic absorption, thermal insulation, crack remediation, waste utilization, and water absorption. Conclusively, the results demonstrate that beyond-imagination solutions for the architecture of the future are within the scope of current capabilities, and that challenges can be transformed into potentials through appropriate solutions. Realizing this potential requires innovative solution proposals, extensive research, and scientific curiosity. The study findings provide strategic insights for architects, material manufacturers, material engineers, and decision-makers.

**Keywords:** Innovative building materials, future architecture, advanced material performance, material science, literature review.

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# Solution based on the litho-stabilization of crushed granite from Djajiri for pavement base layer for road (Kabalewa-N'guigmi, Diffa region, Est Niger)

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*Ibrahim MAMAN OUMAROU*[2]

**Abstract**

The rehabilitation of road infrastructures in Sahelian regions presents major challenges due to the rareness of conventional materials and the high costs of transportation. This study proposes an alternative solution based on the lithostabilization of local materials. The material studied is crushed granite from Djajiri (Diffa region), intended for use as a pavement base layer for the Kabalewa-N'guigmi road (RN1-Est), which is part of a rehabilitation project.
The methodological approach includes an in-depth geotechnical characterization of local materials (crushed granite, sand, clay) and lithostabilized formulations. Laboratory tests (Proctor, CBR) and numerical simulations using the Alizé LCPC software (version 1.3) were conducted to evaluate the mechanical performance of the variants. A comparative economic analysis quantified cost reductions compared to traditional solutions using natural lateritic gravels (GLN).
The results demonstrate that lithostabilized formulations achieve high bearing capacity (CBR > 121% at 95% of OPM) and offer better durability under heavy traffic conditions. Economically, the use of local materials reduces material transport costs by 39%, while also limiting environmental impacts by valorizing local resources and reducing emissions associated with the transportation of imported materials.
This study shows that lithostabilization is a viable and sustainable alternative for road infrastructures in Sahelian contexts. It paves the way for the generalization of this technique in similar projects, with prospects for future research on optimizing formulations and monitoring long-term performance.
**Keywords:** Valorization, Lithostabilization, Pavement base layers, Local materials.

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# Solution based on the litho-stabilization of crushed granite from Djajiri for pavement base layer for road (Kabalewa-N'guigmi, Diffa region, Est Niger)

*Sabiou NAMATA SAIDOU* [1]
*Ibrahim MAMAN OUMAROU*[2]

**Abstract**

The rehabilitation of road infrastructures in Sahelian regions presents major challenges due to the rareness of conventional materials and the high costs of transportation. This study proposes an alternative solution based on the lithostabilization of local materials. The material studied is crushed granite from Djajiri (Diffa region), intended for use as a pavement base layer for the Kabalewa-N'guigmi road (RN1-Est), which is part of a rehabilitation project.
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**Keywords:** Valorization, Lithostabilization, Pavement base layers, Local materials.

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# Period-Based b-Value Variation in the Karlıova-Yedisu Region Using an Mw*-Homogenized Earthquake Catalog

*Muhammed Gürbüz [1]*

## Abstract

The Karlıova-Yedisu region is one of the key active tectonic domains in eastern Türkiye, located near the interaction zone of the North Anatolian Fault and the East Anatolian Fault. This study evaluates the temporal and spatial characteristics of regional seismicity using an earthquake catalog containing 675 events recorded between 2010 and 2026. To reduce bias caused by mixed magnitude scales, all catalog magnitudes were converted to equivalent moment magnitude (Mw*) using the generalized orthogonal regression relations proposed by Tan (2021) for the Turkish seismic network. Regional seismicity was mapped together with active fault traces from the General Directorate of Mineral Research and Exploration, and the frequency-magnitude behavior was examined for three sub-periods: 2010-2015, 2016-2020, and 2021-2026. The b-values were calculated using the Aki-Utsu maximum-likelihood estimator at an adopted completeness threshold of Mc = 2.50 Mw*. Uncertainties were quantified using 2,000 bootstrap resampling iterations, and differences between periods were tested using a z-test. The estimated b-value is 0.99 for 2010-2015 (n = 135), 0.69 for 2016-2020 (n = 116), and 0.65 for 2021-2026 (n = 75). The decrease from the early period to 2016-2020 is statistically significant (Delta b = -0.30, p = 0.004), and the contrast between 2010-2015 and 2021-2026 is also significant (Delta b = -0.34, p = 0.003). In contrast, the difference between 2016-2020 and 2021-2026 is not statistically significant (p = 0.70), suggesting that the main transition occurred after the first sub-period. These results indicate a shift toward lower b-values after 2016, which may reflect a change in the frequency-magnitude regime of fault-proximal seismicity around the Karlıova-Yedisu region. Considering the active fault geometry and the pronounced seismicity concentration observed in 2020, the findings emphasize the need for continued monitoring of seismic behavior around the Karlıova triple junction.
**Keywords**: Karlıova, Yedisu, b-value, Mw* homogenization, active fault

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# Hatay Airport Passenger Demand Modeling

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## Abstract

Global technology, population growth, and globalization are rapidly gaining importance in the transportation sector. The availability of the safest, fastest, and most comfortable means of transportation in the aviation sector, coupled with the valuable time it takes, is attracting passengers from other modes of transportation. Furthermore, long travel distances, such as intercontinental transport, are rapidly increasing the number of passengers carried by air. To meet increasing passenger demand, airport facilities must be properly designed. The design of airports, including terminal buildings, runways, and aprons, is directly related to air traffic demand. This passenger demand is derived in units of the forecast. Once the air traffic forecast is determined, it is compared with the airport's capacity. This informs decisions about the construction of additional or new facilities.
In line with global developments and investments in the aviation sector, air travel, which primarily catered to high-income individuals before the 2000s, has become more accessible and in demand for middle and low-income people since the 2000s, especially with the strong entry of low-cost carriers into the market. Air transportation is preferred over land, rail, and sea transportation due to its advantages such as speed, safety, and comfort.
This is based on a time-series analysis of domestic and international passenger numbers at Hatay Airport in Türkiye for the years 2008-2025. Following these analyses, domestic and international passenger forecasts were generated for the next five years.
This study aims to determine the demand structure by analyzing the time-dependent changes in passenger traffic specifically at Hatay Airport. In this context, the effects of variables such as population size, income level, regional economic activities, tourism movements, transportation facilities, and extraordinary circumstances on passenger demand are evaluated.
**Keywords**: Air transportation, air traffic forecasting, airline passengers, demand forecasting, facility structure, new facility construction, time and speed.

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# Analytical Reduced Differential Transform Method (RDTM) Solution of a Complex Differential Equation

*Sami Ghalib Hasan ALABBAS*
*MURAT DÜZ*

**Abstract**

In this study, the Reduced Differential Transform Method (RDTM) is employed to obtain analytical solutions for complex ordinary differential equations (ODEs) and partial differential equations (PDEs). RDTM is considered an effective semi-analytical method derived from the differential transformation technique, offering a simplified mathematical procedure for solving differential equations without requiring discretization, perturbation, or linearization methods.
The proposed method transforms differential equations into recursive algebraic relations that facilitate the construction of exact or approximate series solutions. One of the major advantages of RDTM is its ability to reduce computational effort while preserving solution accuracy. Compared with traditional analytical and numerical approaches, the method provides a more direct and systematic framework for handling various types of differential equations.
Several complex examples involving ordinary and partial differential equations are examined to evaluate the performance and applicability of the method. The obtained results demonstrate that RDTM produces highly accurate solutions with significantly simplified calculations. Furthermore, the method proves particularly efficient for equations whose exact solutions exhibit polynomial behavior, where solutions can be achieved rapidly using only a few iterative steps.
The findings indicate that the Reduced Differential Transform Method is a powerful, reliable, and computationally efficient mathematical tool for solving complex differential equations arising in applied mathematics, physics, and engineering sciences. Therefore, RDTM can serve as an attractive alternative to conventional analytical methods in mathematical modeling and advanced differential equation analysis.
**Keywords:**Reduced Differential Transform Method (RDTM), Ordinary Differential Equations, Partial Differential Equations, Analytical Solutions, Mathematical Modeling.

# Multiple scales expansion method for the Lax equation form of the fifth order KdV equation

*Murat KOPARAN* [1]

**Abstract**

The mathematical models of problems arising in many branches of science are nonlinear evolution equations (NLEEs). For this reason, nonlinear equations of evolution have served as a language in formulating many engineering and scientific problems. Although the origin of nonlinear evolution equations dates back to ancient times, significant developments have occurred in these equations to the present day. The main reason for this situation is that nonlinear equations of evolution involve the problem of nonlinear wave propagation. Therefore, many effective techniques have been developed for nonlinear evolution equations and their solution methods. Studies conducted in recent years show that evolution equations are becoming increasingly important in applied mathematics. This study is about the multiple scales methods, known as the perturbation method, for nonlinear equations of evolution (NLEE). In this report, the multiple scales method was applied for the analysis of the (1 + 1) dimensional higher-order nonlinear Lax equations, and the nonlinear Schrödinger (NLS) equation was obtained. Also, the approximate solution of the (1 + 1) dimensional higher-order nonlinear Lax equation is obtained.

**Keywords**: Perturbation, The multiple scales method, Nonlinear Schrödinger (NLS) equation, Fifth-order Korteweg-de Vries equation (fKdV), Lax equation.

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# Approximate solution of the nonlinear equation (fKdV) using the multiple scale method

*Murat KOPARAN* [1]

**Abstract**

Studies in science and engineering demand the visualization of mathematical models of real-life phenomena and the development of formulas. A wide variety of physical, chemical, and biological phenomena are described by nonlinear evolution equations (NLEEs). The study of exact solutions of nonlinear evolution equations (NLEEs) plays a crucial role in the study of nonlinear physical phenomena. Recently, NLEEs have emerged as an important field of study in applied mathematics. Many nonlinear differential equations may not be exactly solvable. However, approximate solutions can be obtained using numerical methods and perturbations. Perturbations are asymptotic expansions with respect to a small or large parameter or coordinate. This method allows us to find the solution of the given nonlinear equation depending on the solution of the linear part by using multiple scales, which are defined as the slow variables and depend on a parameter in time and space variables. First, Zakharov and Kuznetsov showed that integrable systems can be reduced to other integrable systems using this method. This study relates multiple scale method, which is known as a perturbation method for nonlinear evolution equations. In this report, a method of multiple scales is presented for the analysis of the (1+1)-dimensional fifth-order Kaup-Kupershmidt (KK) equation, and we derive a nonlinear Schrödinger (NLS) type equation. Finally, we obtain an approximate solution of the fifth-order (1 + 1) dimension Kaup-Kupershmidt (KK) equation.
**Keywords:** Perturbation, The multiple scales method, Nonlinear Schrödinger (NLS) equation, Fifth-order Korteweg-de Vries equation (fKdV), Kaup-Kupershmidt (KK) equation.

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# A multiple scales method for solving nonlinear (fKdV) equation

*Murat KOPARAN* [1]

## Abstract

The mathematical models of problems that arise in many branches of science are nonlinear equations of evolution (NLEE). For this reason, nonlinear equations of evolution have served as a language in formulating many engineering and scientific problems. Although the origin of nonlinear evolution equations dates back to ancient times, significant developments have been made in these equations up to the present day. The main reason for this situation is that nonlinear equations of evolution involve the problem of nonlinear wave propagation. Therefore, many different and effective techniques have been developed regarding nonlinear evolution equations and solution methods. Studies conducted in recent years show that evolution equations are becoming increasingly important in applied mathematics. This study is about the multiple scales method, known as the perturbation method for nonlinear equations of evolution (NLEE). This method allows us to find the solution of the given nonlinear equation depending on the solution of the linear part by using multiple scales, which are defined as the slow variables and depend on a parameter in time and space variables. First, Zakharov and Kuznetsov showed that integrable systems can be reduced to other integrable systems using this method. In this report, the multiple scales method was applied for the analysis of (1+1)-dimensional fifth-order Korteweg-de Vries (fKdV) equation, and we derived a nonlinear Schrödinger (NLS) type equation. Finally, we obtain an approximate solution of the fifth-order (1 + 1) dimension Sawada-Kotera (SK) equation.

**Keywords:** Perturbation, The multiple scales method, Nonlinear Schrödinger (NLS) equation, Fifth-order Korteweg-de Vries equation (fKdV), Sawada-Kotera equation (SK)

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# Decoding the Universal Drought Response in Wheat: A Genotype-Aware Transcriptomic Approach

*Musa KAR*[1]

## Abstract

Bread wheat productivity is increasingly threatened by climate-driven water limitation, yet the inherent genetic diversity among cultivars often obscures conserved transcriptional stress signals. To overcome this challenge, we applied a genotype-aware modelling framework across 14 genetically diverse wheat accessions to disentangle genotype-specific transcriptional variation from universal drought-responsive signals. This stability-guided analysis identified a robust conserved transcriptional core comprising 7,228 genes. Within this core, we prioritized a hierarchical regulatory layer of 286 candidate transcription factors using a novel composite ranking metric (HubScore) that integrates transcriptional effect size with cross-accession reproducibility.

To evaluate the universality of these prioritized regulators, independent cross-dataset validation was performed using an external RNA-seq dataset (GSE136683). The validation successfully reproduced 128 regulators, demonstrating an exceptionally high directional concordance of 99.2% and strong effect-size preservation (Pearson $r \approx 0.92$) between the discovery and validation cohorts. Functional enrichment analysis indicated that this highly reproducible regulatory layer converges on crucial biological processes for drought adaptation, including abscisic acid signalling, complex hormone crosstalk, and developmental plasticity such as adventitious root formation. Overall, this genotype-aware analytical strategy successfully isolates a highly reproducible regulatory architecture from genetically heterogeneous populations, providing robust candidate targets for future functional studies and molecular breeding strategies aimed at improving drought tolerance in wheat.

**Keywords:**Triticum aestivum, drought stress adaptation, transcriptome meta-analysis, genotype-aware modelling, master regulators, cross-dataset validation

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# Effects of Salinity and Drought Stress on Morphological Parameters of Wheat (*Triticum aestivum L.*)

*Seymen CIMBIZ*[1]
*Ergun KAYA* [2]

**Abstract**

Wheat (Triticum aestivum L.) is one of the major staple crops worldwide due to its contribution to approximately 20% of the global human energy requirement, balanced amino acid profile, broad ecological adaptability, and ease of utilization as a raw material in various agricultural products. However, its productivity is severely affected by abiotic stress factors such as drought and salinity. Increasing soil salinization and water scarcity associated with climate change pose significant threats to sustainable agricultural production. Therefore, understanding the molecular and morphological responses developed by wheat under stress conditions is of great importance for the development of stress-tolerant cultivars. In this study, it was aimed to investigate the morphological changes in wheat plants exposed to drought and salinity stress. Wheat seeds were cultivated under controlled in vivo pot conditions and subjected to salinity stress using different NaCl concentrations (10, 25, 50, and 100 mM). For drought stress, water restriction was established by completely withholding irrigation. On the 7th day of stress application, root and shoot lengths were measured and morphological analyses were performed. Preliminary morphological findings demonstrated that both salinity and drought stress caused significant alterations in wheat seedling development compared to the control group. While drought stress resulted in reductions in root and shoot development, increasing salt concentrations exerted varying levels of suppression on root architecture and shoot elongation. In particular, the control group exhibited higher average shoot length, whereas growth was significantly inhibited in drought-treated groups. The obtained findings indicate that wheat develops different adaptive response mechanisms under drought and salinity conditions. This study is expected to contribute to the understanding of stress tolerance mechanisms in wheat at the molecular level and provide valuable data for future breeding studies.
Note: This paper was derived from the morphological analysis section of the MSc thesis entitled "Investigation of Transcriptional Responses of Wheat (Triticum aestivum L.) under Salinity and Drought Stress Conditions" conducted by Seymen Cımbız, a graduate student in the Department of Molecular Biology and Genetics, Graduate School of Natural and Applied Sciences, Muğla Sıtkı Koçman University.
**Keywords:** Wheat (Triticum aestivum L.), drought stress, salinity stress, abiotic stress, morphological analysis.

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# Morphological Responses of Maize (Zea mays L.) under Salinity and Drought Stress Conditions

*Numan Arda ÖZTÜRK*[1]
*Ergun KAYA*[2]

## Abstract

Maize (Zea mays L.) is one of the most important cereal crops worldwide due to its high nutritional value, broad utilization potential, and critical role in food and feed production. However, its productivity is significantly affected by abiotic stress factors such as drought and salinity, as well as by biotic factors. Increasing soil salinization and water scarcity associated with climate change pose serious challenges for sustainable agricultural production and food security. Therefore, understanding the morphological responses developed by maize under stress conditions is of great importance for the development of stress-tolerant cultivars. In this study, it was aimed to investigate the morphological changes in maize seedlings exposed to drought and salinity stress. Maize seeds were cultivated under controlled in vivo pot conditions and subjected to salinity stress by exposure to different NaCl concentrations. In drought stress applications, water restriction was established by reducing irrigation. On the 7th day of stress treatment, morphological analyses were performed by measuring root and shoot lengths. Preliminary findings demonstrated that both salinity and drought stress caused significant alterations in maize seedling development compared to the control group. While drought stress resulted in reductions in root and shoot development, increasing salt concentrations negatively affected shoot elongation and root architecture depending on stress exposure. In particular, plants grown under control conditions exhibited greater shoot development, whereas growth was significantly suppressed in drought-treated groups. In addition, high salinity levels caused reductions in root development and overall seedling vigor, as well as chlorosis symptoms in leaves. The obtained findings indicate that maize develops different morphological responses under drought and salinity stress conditions. This study is expected to contribute to the understanding of stress tolerance mechanisms in maize and provide valuable data for future abiotic stress-oriented breeding projects.

Note:This paper was derived from the morphological analysis section of the MSc thesis entitled "Determination of Gene Expression Responses of Maize (Zea mays L.) under Salinity and Drought Stress" conducted by Numan Arda Öztürk, a graduate student in the Department of Molecular Biology and Genetics, Graduate School of Natural and Applied Sciences, Muğla Sıtkı Koçman University.
Keywords:Maize (Zea mays L.), drought stress, salinity stress, abiotic stress, morphology, plant growth.

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# The *GPX* Gene Family in *Phaseolus vulgaris*: genome-wide characterization and in silico abiotic stress responses.

*Ayşe Gül KASAPOĞLUI*[1]
*Damla ÇAKMUR* [2]

## Abstract

When plants are exposed to abiotic and biotic stressors, reactive oxygen species are produced, which can damage cellular components such as DNA, proteins, and lipids, leading to cell death. Plant glutathione peroxidases (GPXs) are important enzymes for removing reactive oxygen species in plant cells and are closely related to plant stress resistance. In this study, the genome-wide characterization of GPXs in Phaseolus vulgaris and in silico investigation of stress responses to salt and drought were conducted using bioinformatics tools. Seven members of the GPX gene family were identified in P. vulgaris, located on chromosomes Chr01, Chr02, and Chr07. Both tandem (Pv-GPX4/Pv-GPX6) and segmental duplications (Pv-GPX1/Pv-GPX3) have been effective in expanding GPX gene family during evolution. Alpha helix and beta sheet folding were dominant in Pv-GPX proteins. In addition to these structures, a TM helix structure was observed in Pv-GPX7. It was determined that promoter regions of the Pv-GPXs contain cis elements associated with responses to various stresses, hormones, and environmental stimuli. Orthology analysis of Pv-GPXs revealed 10 between bean and Arabidopsis thaliana, and 18 syntenic relationships between Glycine max and bean. A heat map was created using RPKM values obtained from RNA-seq data for salt and drought stresses in beans. According to the analysis results, under salt stress, expression of Pv-GPXs increased at 24 hours compared to the control. The expression level of Pv-GPX1 decreased. Under drought stress, Pv-GPX1, Pv-GPX2, and Pv-GPX6 were down-regulated, while other Pv-GPXs remained almost stable. Furthermore, in a heat map of RNA-seq (FPKM) data showing tissue-specific expression patterns of Pv-GPXs, Pv-GPX1 expression is low in all tissues except root_10. Pv-GPX6, on the other hand, showed high expression in all tissues. All genes except Pv-GPX1 have high expression in floral tissues. These findings supported that Pv-GPXs play an active role in salt and drought stress. Pv-GPX1 acts as a negative regulator, while the other genes act as positive regulators in the stress response. Pv-GPX6 is a potential target for future functional studies.

**Keywords**: glutathione, bean, bioinformatics, stress, salt and drought

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# Machine Learning-Based Hybrid Portfolio Optimization on Bist100 Using the Artificial Bee Colony Algorithm

*Büşra POLAT*[1]
*Büşra BİRİŞİK*[2]

## Abstract

Portfolio optimization is an important decision-making problem that aims to determine the investment distribution that can provide maximum return under a certain level of risk. Traditional portfolio optimization methods may be insufficient in modeling the nonlinear, complex, and highly volatile structure of financial markets. Therefore, machine learning algorithms and metaheuristic optimization methods have recently been widely used in financial decision-making processes.

In this study, a machine learning-based hybrid portfolio optimization model was developed for stocks listed in the BIST100 index. Daily closing prices, trading volumes, and financial statements between 01.01.2020 and 01.01.2025 were used within the scope of the study. In the first stage, data quality and liquidity analyses were conducted, and stocks with high missing data ratios were excluded from the analysis. Then, a financial robustness score was created using the current ratio, net working capital, return on equity (ROE), and debt-to-assets ratio to evaluate the financial structures of companies. Financial ratios were standardized using the Min-Max normalization method, and the financial resilience levels of companies were determined through weighted evaluation.

A Random Forest regression model was used to predict stock returns. Lagged returns, moving averages, and volatility indicators were evaluated as feature variables in the model. Predicted returns obtained from the Random Forest model and financial robustness scores were combined to calculate the final stock selection score. In the final stage, the Artificial Bee Colony (ABC) algorithm was applied to determine the optimal portfolio weights that maximize the Sharpe ratio.

According to the results, the proposed hybrid model generated approximately 70% annual return and a Sharpe ratio of 0.9509. In addition, the model achieved higher risk-return performance compared to equal-weighted and random portfolios. The findings demonstrate that the combined use of machine learning, financial robustness analysis, and metaheuristic optimization methods can significantly improve portfolio performance.

**Keywords:** Portfolio Optimization, Artificial Bee Colony Algorithm, Random Forest, Machine Learning, BIST100, Metaheuristic Optimization, Sharpe Ratio

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# Human–Robot Collaborative Assembly Line Balancing Problems: Optimization Approaches, Ergonomics, and Future Research Directions

*Seçil KULAÇ*[1]

## Abstract

Human–Robot Collaborative Assembly Lines have received increasing attention in manufacturing research due to advances in collaborative robotics and the transition toward human-centered production systems. In these systems, human operators and collaborative robots jointly perform assembly activities by combining complementary capabilities such as human flexibility and robotic precision. Compared with conventional assembly systems, collaborative environments introduce additional challenges related to resource allocation, task execution modes, synchronization requirements, safety constraints, and ergonomic considerations. Consequently, Human–Robot Collaborative Assembly Line Balancing Problems involve more complex decision structures beyond traditional task-to-workstation assignment problems. This study presents a review of Human–Robot Collaborative Assembly Lines with a focus on optimization approaches, ergonomic integration, and recent research directions. Existing solution methodologies are examined under several categories including mathematical programming, constraint programming and decomposition approaches, metaheuristics, hybrid and hyper-heuristic methods, and learning-based intelligent approaches. The reviewed studies indicate a gradual transition from exact optimization models toward adaptive and data-driven approaches designed to address increasing problem complexity and dynamic manufacturing requirements. In addition to operational considerations, the integration of ergonomics has become an important aspect of human–robot collaborative assembly research. Consistent with the human-centered perspective of Industry 5.0, recent studies increasingly incorporate factors such as energy expenditure, fatigue, workload distribution, ergonomic risk, and cognitive workload into balancing and scheduling models. This trend reflects the increasing consideration of worker well-being alongside traditional operational objectives. The reviewed literature also reveals several research gaps, including limited industrial implementations, reliance on static assumptions, and insufficient consideration of adaptive decision-making and cognitive factors. Future research directions include dynamic balancing environments, integration of digital twins and sensing technologies, and intelligent decision-making frameworks aimed at improving the adaptability and applicability of collaborative assembly systems.

**Keywords:** Human–Robot Collaboration; Assembly Line Balancing; Ergonomics; Industry 5.0; Intelligent Manufacturing.

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# Decision Surface Design Based on Classification Algorithms for Water Pipes in Smart Water Network Systems

*Halil AKBAŞ*[1]

**Abstract**

The dataset, obtained from the water supply network and including observation values for various water pipes, is analyzed in detail. Machine learning algorithms are used to classify each pipe by using the values in the dataset that represent physical properties, environmental conditions, and leakage classifications of the water pipes. The objective is to use the data to build prediction models, particularly for the design of smart water supply systems. The dataset includes observation values related to water pressure, water flow rate, water velocity, ambient temperature around the pipe, pipe age, pipeline material, soil corrosion level around the pipe, and leakage status. Water pressure, water flow rate, water velocity, ambient temperature around the pipe, and the pipe age are represented by numerical matrices, while the pipe material, soil corrosion level around the pipe, and leakage status are classified by creating a cell array using character vectors. Various decision rules for the water pipes are generated using the naive Bayes model, discriminant analysis classifier, classification decision tree, and k-nearest neighbor classifier algorithms. A decision surface is created to visualize and interpret the decision rules. For each observation in the dataset, classifications and posterior class probabilities are estimated based on the pipe material, soil corrosion level around the pipe, and leakage status. Inferences are derived from the probability distributions of the classifications depicted, based on the assumption that the probability of a data point belonging to a particular classification decreases as it approaches the decision boundary.
**Keywords:** Smart water network, Water pipes, Classification algorithms

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# Improving Service Processes in University Libraries: Web-Based Dynamic Appointment System and Queue Management Design

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*Nagihan KARSLI* [2]
*Safiye AKBAŞ* [3]
*Emine DADAŞOĞLU* [4]
*Belkız TORĞUL* [5]

**Abstract**

The effective and organized management of group and project study rooms in university libraries has become increasingly important due to the rising number of students and the limited physical space. This study aims to develop a web-based reservation system to address the operational and administrative challenges associated with using group and project study rooms at the Erzurum Technical University (ETU) Central Library. The primary hypothesis of the study is that digitalizing the reservation process, supported by physical access control mechanisms, will enhance the efficiency of study room usage and reduce users' perceptions of unfairness. Additionally, it is expected that automating procedures will significantly reduce time loss and staff workload. The sample for this study includes the group and project study rooms located in the ETU Central Library and the students who utilize these facilities. The research involves designing a web-based reservation system based on a client-server architecture. To ensure alignment between reservations and actual usage, the system has been integrated with a card-access turnstile infrastructure. Furthermore, features for automatic cancellations, dynamic rebooking, and notifications have been included in the system. The findings reveal that the proposed system minimizes idle capacity, largely eliminates unauthorized use, and resolves congestion-related access issues. It also provides a traceable decision-support infrastructure for library management. Consequently, the developed system presents a practical solution for the sustainable, equitable, and effective management of study spaces in university libraries.
**Keywords:** University Libraries, reservation management, study room reservation, web-based system, access control

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# Examination of the Adequacy of Urban Open and Green Areas in the City of Manisa

*Şevval VARLIK[1]*
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## Abstract

Urban open and green spaces, as fundamental components of the urban ecosystem, are important indicators of the livability of cities due to their ecological and socio-cultural functions. The study was conducted to evaluate the quantity, distribution, and adequacy of existing urban open and green spaces in the city of Manisa. The study is based on the World Health Organization's recommendation of at least 9 m² of green space per person and the 10 m²/person standard specified in the Turkish Spatial Planning Regulations. The data was obtained from open sources of Manisa Municipality and TUİK (Turkish Statistical Institute), as well as from Google Earth satellite images. The analysis revealed that the amount of green space per capita in Manisa falls below these standards, and existing green areas are concentrated in the city center. The study, concluded that open green spaces need to be improved both quantitatively and qualitatively in the city. The study results are considered important because it highlights the importance of urban green spaces and provides data for future research on the adequacy of open green space amounts in cities.
**Keywords:** Urban green space, open space adequacy, sustainable city, Manisa.

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# Evaluation of Rumex patientia Extract as an Environmentally Friendly Corrosion Inhibitor for Mild Steel

*Dilan ACAY*[1]
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**Abstract**

Mild steel and other steel-based materials are extensively utilised in numerous industrial sectors, including pipelines, refineries, mining, and construction. Nevertheless, corrosion remains a significant challenge in the effective utilisation of these materials. Despite being a natural process, corrosion can cause substantial economic losses, particularly in aggressive environments. Mild steel (MS) is a material of choice due to its high strength, ease of workability, and low cost. However, it is highly susceptible to corrosion in acidic environments. The utilisation of inhibitors to reduce the corrosion rate offers more economical solutions compared to the use of expensive and durable materials. In recent years, there has been increasing interest in environmentally friendly inhibitors, with particular attention being drawn to plant extracts due to their renewable, low-cost, and non-toxic nature. As reported in, phytochemical compounds present in plant extracts can adsorb onto metal surfaces, thereby forming a protective layer. In this study, the corrosion-inhibiting effect of the extract obtained from Rumex patientia (RP) on mild steel in a 1 M HCl environment was investigated. The inhibitor performance was evaluated using EIS, LPR, and PDP methods, while the surface morphology was examined by SEM analysis. The experimental results demonstrated that the RP extract at a concentration of 1000 ppm yielded inhibition efficiencies of 96% and 93% at exposure times of 1 and 120 hours, respectively. Adsorption analyses revealed that the inhibitor molecules follow the Langmuir adsorption isotherm model. The calculated adsorption free energy ($\Delta G°_{ads}$) value was −25.43 kJ mol⁻¹, indicating that the adsorption process occurs spontaneously. These results demonstrate that the RP extract is an effective and environmentally friendly corrosion inhibitor.

**Keywords**: Mild steel, Corrosion, Inhibitor, Rumex patientia

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# Silver-Boron Based İnorganic Pigments: Synthesis, Structural, Morphological and Optical Properties

*Dilek ÇANAKÇI*[1]

## Abstract

Three different inorganic pigments were synthesized by doping copper, cobalt, and nickel oxides into silver oxide and boron oxide phases. UV-vis, XRD, FTIR, SEM/EDX, and color measurements of the pigments were performed at room temperature. XRD data showed that the pigments consisted of different phases, while FTIR spectra indicated that they were composed of different metal oxide structural units. SEM images revealed that the morphology of the pigments varied depending on the type and amount of metal oxide they contained. The pigments have formed agglomerations and crystalline structures of varying sizes. EDX analysis was performed to determine the chemical composition and elemental content of all pigments at the microscopic level. It was observed that changes in the percentages of elements in the pigments directly affected their morphology. Adding three different metal oxides to the boron and silver oxide base structure caused changes in the micro/nano-level external structural properties and surface topography of the pigments. When the chromatic parameters of pigments are compared It is seen that the highest C* and b* parameters are in Pg/Co, and the L* and a* parameters are in Pg/Cu. When the h° color parameter is examined, it is observed that Pg-Co and Pg-Ni have a negative angle, while Pg-Cu has a positive angle.

**Keywords**:Inorganic pigment; Sol-gel synthesis; Powder X-ray diffraction; Silver Acetate.

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# Landscape Design Proposal for the Area Around Akdamar Church (Van)

*Safiye Münevver SİVRİTEPE*[1]
*Nurhan KOÇAN*[2]

## Abstract

The Akdamar Monument Museum (Church), built in the name of the Holy Cross by King Gagik I of Vaspurakan for the monk Manuel, is a structure that fully reflects the cultural diversity and interaction of the Vaspurakan Kingdom, which ruled Van and its surroundings between 908 and 1021 under the Abbasid Caliphate, and holds an important place in World architectural history with both its architecture and decorations. Akdamar Church has attracted the attention of various communities since its existence and has become an important tourist attraction in Türkiye. Akdamar Church is of great importance to Türkiye in terms of cultural heritage tourism, cultural tourism, and religious tourism. The study examines Akdamar Church, one of our important cultural assets, in terms of its historical development from the past to the present and its importance in terms of cultural heritage tourism. The study presents usage suggestions and plant design proposals for the open space surrounding the monument museum. The proposed projects, developed as a result of the study, anticipates that the area can be used more effectively for visitors, that its visually rich surroundings will be enhanced, and that the preservation of the area and tourism development will increase positively.
**Keywords:** Tangible cultural heritage, landscape design, Akdamar Church, Van.

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# Bio-Based Cross-Linked Polyurethane Films from Stevioside and L-Lysine Diisocyanate: Feed Ratio-Dependent Structural Tuning

*Zeynep OKAN* [1]
*Çağatay ALTINKÖK* [2]

## Abstract

Due to increasing environmental concerns, bio-based and biocompatible materials have become a focal point of materials science in recent years. Particularly in biomedical applications, they stand out as an ideal choice due to critical advantages such as not inducing a continuous inflammatory response, having tunable degradation parameters within a targeted timeframe, and possessing mechanical properties suitable for the intended use. Furthermore, their degradation products are non-toxic and easily excreted from the body, and they offer appropriate permeability and processability for application (Ulery et al., 2011). Polymeric materials, which can be designed to meet the requirements of biomedical applications, are preferred over other material classes thanks to their flexibility for physical and chemical modification during synthesis. Polymers derived from bio-based monomers are categorized into different classes according to their chemical structures and the functional groups they contain. Polymers containing urethane linkages, obtained through the addition reaction of a diisocyanate and a diol (or polyol) structure, are termed polyurethanes (Yash Desai, 2023). Within the several types of polymeric materials, polyurethane (PU) systems are prominent due to their potential for high customizability. PU materials derived from renewable resources enable the design of versatile platforms with tunable physicochemical properties, offering a sustainable path toward advanced functional materials. Found in nature as a glycoside, Stevioside performs the role of an efficient multi-functional polyhydroxylated co-monomer during the creation of bio-originated polyurethane architectures. The high concentration of reactive hydroxyl groups in its composition supports intensive cross-linking, acting as a primary controller of the polymer's vital physical and chemical properties, covering aspects from swelling patterns to enzyme sensitivity (Wang A, 2025). As a bio-based aliphatic alternative, L-LDI offers superior biocompatibility and degradability compared to conventional aromatic diisocyanates. The precise adjustment of the Stevioside:L-LDI feed ratio serves as a critical tool for tailoring the network architecture, directly influencing the films' cross-link density, surface wettability, and degradation kinetics.

This study presents a novel approach by leveraging the inherent bio-based properties and multifunctional nature of stevioside and L-LDI monomers to develop a unique polyurethane system; a series of films were synthesized to systematically elucidate the correlation between network density and the resulting physicochemical performance, establishing a sustainable and innovative platform for advanced functional materials.

**Keywords:** Polyurethane, bio-based polymeric materials, step-growth polymerization, stevioside, L-LDI.

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# Environmentally friendly eutectic solvents and ultrasonic-assisted extraction for obtaining vitamin D from different lichen species

*Ayşenur ÖZ*[1]

**Abstract**

Lichens are symbiotic organisms formed through the association of fungi with algae or cyanobacteria, and they are highly resistant to harsh environmental conditions. They are rich in secondary metabolites and particularly contain sterols such as ergosterol, which can act as precursors of vitamin D under suitable conditions. This characteristic makes lichens a valuable natural and alternative source of vitamin D.

The environmental and operational drawbacks of conventional extraction methods have encouraged the use of deep eutectic solvents (DES) developed within the framework of green chemistry. DESs offer an effective alternative for the extraction of biologically active compounds, such as phenolics and vitamins, due to their low toxicity, biodegradability, and high solubilization capacity. In addition, their ease of preparation and safe handling make them prominent among sustainable solvent systems.

Ultrasonic-assisted extraction is an innovative technique that enhances the transfer of target compounds into the solvent by disrupting cell structures through cavitation effects. When combined with DES, improvements in solubility and mass transfer significantly increase extraction efficiency. Therefore, the combination of DES and ultrasound is considered an environmentally friendly and effective approach for obtaining vitamin D precursors from lichens.

Lichen species widely found in our country hold significant potential for the exploration of natural products due to their valuable biological components. However, studies focusing on environmentally friendly extraction methods for obtaining vitamin D from lichens remain limited. This study aims to investigate the use of green deep eutectic solvents and ultrasonic-assisted extraction techniques to obtain vitamin D from various lichen species and to determine the most effective extraction conditions. Additionally, it seeks to evaluate the impact of sustainable approaches on extraction efficiency and to perform optimization studies for the isolation of vitamin D at high purity.

**Keywords:** vitamin d , lichens, eutectic solvents, hplc, ultrasound

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# Effect of the addition of starch and collagen to donkey milk on physicochemical, microbiological and sensory properties of yoghurt

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## Abstract

Cow's milk is one of the most common food allergens in infants and children. Donkey milk offers a safe alternative for individuals with a Cow Milk Protein Allergy. Donkey milk closely mimics human milk and possesses a lower casein concentration than cow's milk, hence significantly reducing its allergic potential. Moreover, its unique macronutrient composition-characterized by low levels of fat and cholesterol, with high concentrations of lactose, calcium, selenium, and vitamin D3-provides essential nourishment for early childhood development.

As the most widely consumed fermented dairy product worldwide, yoghurt provides a highly advantageous strategy for the dietary inclusion of donkey milk. The low levels of proteins and fats in donkey milk adversely affect the consistency and viscosity of yoghurts. Various thickener agent can be utilized to address this issue.

This study aimed to develop donkey milk yoghurt with enhanced physicochemical properties through the incorporation of varying concentrations (2.0 or 4.0%) of rice starch and collagen. The total solids, protein, fat and ash content of yoghurt samples ranged between 8.65-12.37%, 2.02-5.46%, 0.90-1.00% and 0.41-0.61%, respectively. The highest titratable acidity and apparent viscosity values were found in yoghurt samples produced with donkey milk incorporating 4.0% starch. The incorporation of collagen into donkey milk did not enhance the apparent viscosity of the yoghurts. The viability of Lactobacillus delbrueckii subsp. bulgaricus and Streptococcus thermophilus remained above $10^8$ cfu/g during 28 days of storage. The incorporation of starch in the composition of donkey milk represents an effective technological strategy.

**Keywords:** Allergy, Apparent viscosity, Donkey, Yoghurt

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# Comparative Control of a Ball and Beam System Using Different Controllers

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**Abstract**

This study focuses on the ball and beam system, a classical control problem used to implement various control methods. The system is based on controlling the position of a ball on a beam by rotating the beam. The ball and beam system is unstable, nonlinear, and open loop. A closed-loop control system must be used to linearize and regulate the system in order for it for operation correctly. The aim of the study is to design different controllers for this system, including Full State Feedback, Linear Quadratic Regulator (LQR) and Particle Swarm Optimization (PSO) optimized PID, and compare the results. Firstly, the mathematical model of the system was developed. This model was divided into two subsystems: DC servo motor, ball and beam. The model uses a DC motor to generate the rotational displacement from the controller's signal, while the ball and beam model is utilized to convert the servo motor's rotational displacement into a linear displacement. After the system is linearized and deriving the open-loop transfer function of the system, three different controllers are designed for ball and beam system. When the performance of these controllers designed according to the requirements is compared; full state feedback controller is successful to meet the design criteria of the system, other controllers have also met the criteria, but PSO algorithm provided better performance than LQR in the studied ball and beam system.
**Keywords:** Ball and Beam System, Control Methodologies, Full State Feedback, LQR, PSO

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# Integration of Supply Chain Companies into Production and Product Development Processes

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**Abstract**

In modern industry, competition is increasingly shaped not by the performance of individual firms, but by the collective efficiency and innovation capability of supply chain ecosystems. This study examines the integration of supply chain firms into manufacturing and product development processes from a strategic and organizational perspective. The research focuses on the roles of Original Equipment Manufacturers (OEMs), supplier industries, auxiliary industries, and strategic partners within integrated production ecosystems.

The study highlights that OEMs have evolved into "ecosystem orchestrators" managing complex supplier networks rather than merely assembling final products. In this context, Tier 1, Tier 2, and Tier 3 suppliers contribute actively to product development through the Early Supplier Involvement (ESI) approach, enabling cost optimization, improved product quality, reduced design errors, and shorter time-to-market. In addition, auxiliary industries providing molds, fixtures, automation systems, logistics, and maintenance infrastructure play a critical role in ensuring operational continuity and manufacturing efficiency.

The research also emphasizes the importance of strategic partnerships established to enhance technological capability, share risks, and strengthen innovation capacity. Successful collaborations require multidimensional supplier selection criteria including technical competence, financial sustainability, organizational compatibility, and long-term strategic alignment.

Furthermore, the study discusses the role of Product Lifecycle Management (PLM) and System Lifecycle Management (SysLM) platforms in integrating supply chain stakeholders into production and product development activities. These systems function as a "Single Source of Truth" (SSoT) across the extended enterprise and support the establishment of a continuous "Digital Thread" throughout the product lifecycle.

As a result, effective integration of supply chain firms is identified as a key factor for achieving sustainable competitive advantage, operational excellence, and digital transformation in modern manufacturing ecosystems.

**Keywords**: Product Development Process, Supply Chain Management, Production

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# The Ecological Significance of Native Flood-Tolerant Riparian Species in Floodplain Ecosystems

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*Nagihan SEKİ* [3]

**Abstract**

Climate change-induced increases in extreme precipitation events have significantly intensified the frequency and impacts of floods and inundation disasters. In particular, the narrowing of stream channels, degradation of natural floodplains, and reduction of vegetation cover disrupt the natural hydrological and ecological balance, thereby decreasing ecosystem resilience against flooding. Although conventional engineering practices play an important role in mitigating flood risks, the need for sustainable and ecologically based approaches has been steadily increasing. In this context, riparian ecosystems are regarded as critical natural buffer zones due to their essential functions in regulating hydrological regimes, controlling erosion, and maintaining habitat continuity.

A review of the ecological literature indicates that areas where natural riparian vegetation is preserved experience lower flood impacts, reduced erosion, and improved water quality. Furthermore, native flood-tolerant species contribute substantially to ecosystem resilience and biodiversity conservation owing to their high adaptive capacities. In this study, the ecological functions of native plant species naturally occurring in riparian ecosystems and capable of tolerating flood conditions were investigated. Species naturally distributed in riparian zones in Türkiye, including Salix alba, Populus nigra, Alnus glutinosa, Tamarix smyrnensis, Phragmites australis, Fraxinus angustifolia, and Platanus orientalis, were evaluated in terms of their root structures, sediment retention capacity, effects on reducing surface runoff velocity, and contributions to water infiltration. In addition, the role of riparian vegetation in minimizing soil loss during flood events and its potential to strengthen ecological connectivity between aquatic and terrestrial habitats were examined.

As a result, rather than focusing solely on structural engineering solutions in flood management, utilizing the ecological functions of riparian plant species should be considered an important strategy for sustainable disaster management. The conservation and widespread use of native flood-resistant plant species in flood-prone areas provide an effective ecosystem-based solution for reducing hydrological risks associated with climate change.

**Keywords**: Climate change, flash floods, riparian vegetation, native plant species, Türkiye.

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# Assessing the Relationship Between Digital Health Literacy and Safe Use of Home Medical Devices: A Cross-Sectional Observational Study

*Khaled Abusamra*[1]
*Selden Çepni* [2]

**Abstract**

The safe and effective use of home medical devices is a key component of modern healthcare, yet user-related errors remain a significant risk factor. This study aims to investigate the relationship between digital health literacy (DHL) and the objective performance of individuals using common home medical devices. A cross-sectional observational design was employed involving 120–150 adult participants who had used devices such as blood pressure monitors, glucometers, or pulse oximeters within the past six months. DHL levels were assessed using the eHealth Literacy Scale, while device usage performance was evaluated through structured task-based checklists measuring accuracy, completion time, and critical error rates. Data was collected from healthcare settings including hospitals, family health centers, and university clinics. Reliability analyses were conducted using Cronbach's α for eHEALS and Cohen's κ and intraclass correlation coefficients (ICC) for observational scoring. Preliminary analysis is expected to demonstrate a significant association between higher DHL levels and improved device usage performance, including lower critical error rates and higher task accuracy. Multivariate regression models will be used to control demographic and experiential variables such as age, education level, and prior device familiarity. This study introduces a novel biomedical engineering perspective by integrating subjective literacy assessment with objective performance evaluation. The findings are expected to contribute to the development of user-centered medical device designs, improved instructional interfaces, and targeted patient education strategies. Ultimately, this work aims to enhance patient safety and optimize the usability of home healthcare technologies.
**Keywords**: digital health literacy, eHEALS, home medical devices, device usage performance, human–device interaction

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# Determination of the characteristics of tectonic lines in the southern part of the Niğde Massif (Ören, Çukurbag-Niğde, Turkey) using remote sensing methods

*Ramazan DEMİRCİOĞLU*

**Abstract**

In recent years, remote sensing has played a significant role, particularly in the exploration of mineral deposits, geothermal fields, and water resources. In this study, linearity features, satellite imagery, and field surveys have been used to determine the polyphase deformation of the Nigde Massif and its overlying units along the southern margin of the Paleozoic–Quaternary-aged rocks. In this study, tectonic lines and linearity features identified through remote sensing, as well as linear structures such as faults and fractures identified during fieldwork, were examined. When creating a tectonic lineament map for the study area (lineaments derived from satellite imagery and computer programmes), a Landsat-8 OLI image was obtained from the website, and the image corresponding to the area in question was selected; tectonic lineament maps were then prepared using GIS methods. When preparing the tectonic linearity map, images are created using appropriate filters and threshold values. Furthermore, in highly fractured and folded metamorphic rocks, significant aquifers have formed, and there are abundant water-source outlets. Most of these water source outlets are associated with tectonic lines. Some water sources, however, are not associated with tectonic lines. These sources show discharges from discontinuities at formation boundaries. According to satellite and field studies, the highest fracture trend densities have been determined as N5-150E, N25-350E, and N45-550E, as well as N35-450W and N75-900W.

**Keywords:** Central Anatolia, Nigde Massif, Remote sensing, Linearity,

# The Technological Capabilities Provided by New Communication Systems for Remote Access to Ships.

*Tayfun ACARER*

**Abstract**

Throughout maritime history, technological innovations have fundamentally transformed the safety, efficiency, and operational capacity of ships. Today, the maritime sector stands on the cusp of perhaps the most radical transformation in its history: the widespread adoption of unmanned autonomous ship technologies. This category of technology, known as Maritime Autonomous Surface Ships (MASS), is defined by the International Maritime Organization (IMO) with varying degrees of autonomy.
The fundamental motivations behind the development of these technologies are multifaceted. First and foremost, a significant portion of maritime accidents are caused by human error, and automation and remote control reduce this margin of error. Furthermore, with the growth of global trade, the demand for maritime transport is increasing, but there are difficulties in employing qualified seafarers. The goals of reducing carbon emissions also encourage the development of autonomous systems that can optimize energy efficiency. On the other hand, with the growth of the digital economy, the concepts of "smart port" and "smart ship" are becoming central to maritime policies.
In the design of remote access systems for unmanned vessels, communication infrastructure is a critical determining factor. The ability of a vessel to maintain a continuous, reliable, and low-latency connection with a shore-based Remote Operation Center (ROC) while at sea is essential for safe operation, COLREG compliance, and emergency management.
The Global Maritime Distress and Safety System (GMDSS) is an international regulation that became mandatory in 1992 and forms the basis of maritime communication technologies. Covering satellite communication, digital selective calling (DSC), Navtex, and other systems, GMDSS legislation enables ships to make distress calls and receive safety information in times of distress. The SOLAS Chapter IV amendments, which came into effect in January 2024, further modernize GMDSS legislation to incorporate new technologies and, in particular, grant official status to satellite systems (including Iridium).
The most important point here is that the mandatory systems stipulated by current GMDSS regulations are primarily designed for manned ships. The continuous command and control link, high bandwidth, low latency, and cybersecurity requirements necessitated by unmanned operations are technologically unavailable in traditional GMDSS infrastructure.

**Keywords:** Remote Operation Center, Maritime Autonomous Surface Ships, Marine Communication Systems

# Thickness-Dependent Responsivity Enhancement in $HfO_2$-Gated GaN MIS-HEMT UV Photodetectors

*Mustafa KILIN*[1]

**Abstract**

In this study, the influence of gate dielectric thickness on the optoelectronic performance of GaN MIS-HEMT UV (Gallium Nitride Metal-Insulator-Semiconductor High-Electron-Mobility Transistor Ultraviolet) photodetectors is systematically investigated using Silvaco ATLAS TCAD simulations. Hafnium oxide ($HfO_2$) is employed as a high-k gate dielectric, and its thickness is varied from 5 nm to 30 nm to analyze thickness-dependent device behavior.

The electrical analysis reveals that increasing the dielectric thickness significantly suppresses reverse gate leakage current, with a reduction of approximately one to two orders of magnitude as the thickness increases from 5 nm to 30 nm. Under UV illumination, the photocurrent characteristics show consistent enhancement across all configurations, indicating effective photocarrier generation.

The spectral responsivity analysis demonstrates a clear dependence on dielectric thickness, where the normalized peak responsivity increases from approximately 0.89 to 0.96 as the thickness increases from 5 nm to 30 nm. This improvement is primarily attributed to reduced leakage-induced recombination losses and enhanced carrier stability.

The results reveal a trade-off between electrostatic control and leakage suppression, where thinner dielectrics provide stronger gate coupling, while thicker dielectrics improve overall device stability and photoresponse. These findings highlight that dielectric thickness is a critical design parameter for optimizing the performance of GaN MIS-HEMT UV photodetectors and provide valuable guidelines for the development of high-sensitivity UV detection systems.

**Keywords:** GaN MIS-HEMT, UV Photodetector, $HfO_2$, Responsivity, Silvaco ATLAS TCAD.

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# Design of an In-House RAG-Based Knowledge Assistant for Manufacturing Quality Control Teams Under Data Security Constraints

*Beyza BOZ*[1]

**Abstract**

Engineers responsible for quality assurance in smartphone production environments face significant challenges in accessing information when analyzing defective devices. Locating relevant log files, finding solution notes from previous cases, and accurately identifying the root cause of errors are processes that are both time-consuming and heavily dependent on individual experience. This study aims to address these issues by designing and prototyping a Retrieval-Augmented Generation (RAG) architecture that operates exclusively within the company's infrastructure.The developed system leverages open-source large language models, semantic vector databases, and natural language processing components to enable engineers to ask questions in everyday language and receive instant responses. The most critical design constraint of the project is the corporate privacy policy, which prohibits the transfer of production data to external systems; this requirement necessitates that all components be hosted on internal servers. Prototype tests conducted on a synthetically generated dataset without referencing any real production records demonstrated the system's practical usability, achieving an 87% retrieval accuracy and an average response latency of 4.2 seconds.

**Keywords:** Retrieval-Augmented Generation, Large Language Model, Manufacturing Quality Control, In-House Artificial Intelligence, Data Security

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# Design of an In-House RAG-Based Knowledge Assistant for Manufacturing Quality Control Teams Under Data Security Constraints

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## Abstract

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# The Impact of Digitalization Tools on Vehicle Integration Process

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*Alper GÖL*[2]
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**Abstract**

Engineering systems in the automotive industry are becoming increasingly complex, while product development schedules are expected to be completed in shorter time frames. This situation creates a clear need for engineering processes that are faster, more traceable, and easier to manage across different functions. In vehicle packaging and layout development, evaluations generally start with manual checks on CAD models. The outputs of these checks are then followed through predefined engineering indicators that represent design maturity, integration quality, and overall development progress. Although this approach is widely used, it may also create repetitive work, limited traceability, and difficulties in transferring previous engineering decisions to new vehicle programs.

Digitalization offers an important opportunity to improve these workflows. Parametric automation can reduce repetitive verification activities, while artificial intelligence and natural language processing can support the interpretation, classification, and reuse of engineering information generated during development. In this way, digital tools can contribute not only to faster technical evaluations, but also to more consistent decision-making and better coordination between cross-functional teams.

This study proposes a conceptual framework for the use of digitalization tools in vehicle integration processes. The framework is structured around three complementary domains: design support, process monitoring, and accessibility of engineering know-how. The potential contribution of these domains is discussed through indicators such as iteration reduction, development lead time, coordination efficiency, knowledge retention, and decision traceability. The proposed approach aims to show how vehicle integration can evolve from a mainly experience-based workflow toward a more systematic, data-supported, and reusable engineering process.

**Keywords:** Automotive Integration, Digitalization, Rule-Based Checking, Configuration Management, Knowledge Management

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# Effect Of Sidewall Bleed On The Suppression Of Boundary Layer Separation In An External Compression Intake

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**Abstract**

Supersonic external compression intakes are widely employed in high-speed air-breathing propulsion systems; however, interactions between shock waves and the boundary layer may induce flow separation, resulting in performance degradation. In this study, the role of sidewall bleed in mitigating boundary layer separation within a single-ramp compression intake is investigated through CFD analysis. The simulations are performed by solving the RANS equations using the realizable k–ε turbulence model, while the bleed region is modeled via a porous jump approach using the pressure drop equation derived from the Darcy–Forchheimer relation to obtain viscous and inertial resistance coefficients. In the reference study, bleed is applied on the ramp and the shock structure is stabilized. However, at low bleed flow ratios, shock–boundary layer interaction is observed along the sidewalls, reducing shock stability. When sidewall bleed is additionally applied, the shock structure becomes stabilized and the stability margin is extended under low mass flow ratio conditions. At 35,000 ft under α = 0° and β = 0° conditions, with an engine face Mach number of 0.3, the pressure recovery is approximately 0.88 when bleed is applied only on the ramp. In contrast, when bleed is applied on both the ramp and sidewalls, the pressure recovery increases to nearly 0.96. Furthermore, the incorporation of sidewall bleed enables the observation of the subcritical operating region at lower flow ratios in the supersonic regime. Overall, the results confirm that sidewall bleed is an effective strategy for improving both intake performance and flow stability.
**Keywords**: intake , bleed, shock-boundary layer interaction, pressure recovery

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# Production, Characterization, and Determination of In Vitro Biological Activity of Malva Sylvestris Extract Nanoformulation

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## Abstract

Colorectal cancer is one of the leading causes of cancer-related deaths worldwide and affects the colon or rectum, which are parts of the large intestine. Current treatment methods for colorectal cancer include chemotherapy, targeted therapies, immunotherapy, and surgical interventions. However, these approaches may cause severe side effects, be costly, and not be readily accessible to all patients. Therefore, researchers have focused on developing safer and more effective alternative treatment strategies. In this context, plant-based therapies have attracted increasing attention because of their low toxicity, affordability, accessibility, and reduced side effects.

Nevertheless, plant-derived compounds often show low bioavailability and limited therapeutic efficacy. Recently, nanotechnology-based drug delivery systems have emerged as promising approaches to overcome these limitations. Malva sylvestris (MS) is a medicinal plant rich in bioactive compounds and has been traditionally used to treat wounds, bronchitis, cough, digestive disorders, diabetes, eczema, and inflammation.

Literature studies revealed that no previous research has investigated the effects of nanoformulated Malva sylvestris on colorectal cancer. In this study, polycaprolactone nanoparticles loaded with Malva sylvestris leaf extract were synthesized and characterized by UV-Vis spectroscopy and Dynamic Light Scattering. The synthesized nanoparticles showed a PdI value of 0.067, an average particle size of 176.2 nm, a zeta potential of -18.5 mV, an encapsulation efficiency of 63%, and a loading capacity of 14.13%. In vitro cytotoxicity studies conducted on the L929 cell line showed that MS extract-loaded PCL nanoparticles were not toxic at varying concentrations and demonstrated a safe profile. Furthermore, in vitro anticancer activity analyses performed on the HT29 cell line revealed that these nanoparticles exhibited anticancer activity. Based on the findings, MS extract-loaded PCL nanoparticles may be a promising drug delivery system and a potential therapeutic candidate for the treatment of colorectal cancer.

**Keywords:** Malva Sylvestris, Polymeric Nanoparticle, Colorectal Cancer, Drug Release System

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