ISTRAS'25 Online

International Sustainable Transportation Symposium

NATIONAL AVIATION ACADEMY

Abstract Book

International Sustainable Transportation Symposium

ISTRAS '25
Abstract Book

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The International Sustainable Transportation Symposium (ISTRAS'25), hosted by the Azerbaijan Airlines Closed Joint-Stock Company (AZAL), National Aviation Academy (NAA), was held online on September 23–25, 2025.

This book includes abstracts submitted to ISTRAS'25.

Edited by T. Hikmet Karakoç, Khagani Abdullayev, Fuad Mirzayev, Elgun Aghayev, Yasin Furkan Görgülü, Maryam Sadat Kiai.

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About the ISTRAS Symposium

Symposium Objectives

The sustainable transportation industry is one of the fastest-growing sectors globally, with a significant impact on advancements in various fields of science and technology. ISTRAS'25 was a multi-disciplinary international event that aimed to address current challenges and innovations in sustainable mobility. The symposium will cover a wide range of topics, including green mobility solutions, smart infrastructure, electrification, alternative energy sources, AI-driven transportation, and policy frameworks.

Symposium Format

The ISTRAS'25 symposium comprised the following components: short papers to be presented in oral sessions, keynote presentations by invited experts, and special industrial sessions on critical topics in sustainable transportation. Additionally, the symposium provided opportunities for virtual networking and social events, fostering collaboration among participants.

The proceedings of the symposium are to be published by the Springer Sustainable Aviation book series. This series is indexed by Scopus.

High-quality full papers with significant academic and practical contributions will be considered for publication in reputable international journals and edited books.

The online symposium was organised on the Microsoft Teams platform and participation was free of charge.

Symposium Topics

The Symposium welcomes a wide range of topics, including (but not limited to):

- Sustainable Transportation Development and Infrastructure
- Advanced Vehicle Dynamics and Sustainable Control Systems
- Advanced Sensing and Perception Technologies for Eco-Friendly Transportation
- Computational Models and Simulations for Sustainable Transport Solutions
- Materials Science and Engineering for Green Transportation
- Robotics and Automation in Sustainable Mobility
- Avionics and Sustainable Aviation Technologies
- Aerospace Engineering for Low-Emission Air Travel
- Sustainable Innovations in Naval Engineering
- Eco-Friendly Advances in Railway Engineering
- Radiosystems for Connected and Sustainable Mobility
- Intelligent Transportation Systems (ITS) for Sustainable Cities
- Security and Cybersecurity in Green Transportation Systems
- Transportation Business and Management for a Sustainable Future
- Policy, Regulation, and Economics of Sustainable Transportation
- Innovations in Logistics and Green Supply Chain Management
- Urban Freight, Logistics, and Sustainable Last-Mile Delivery
- Energy Management, Efficiency, and Clean Energy Technologies in Transportation
- Environmental Impacts of Transportation: Emissions, Noise, and Climate Change
- Future Trends and Emerging Technologies for Sustainable Transportation
- Electric Vehicles (EVs) and Hybrid Technologies
- Developments in Hydrogen Fuel Cells
- Solar-Powered Transportation Solutions
- Vehicle-to-Everything (V2X) Communication for Reduced Emissions
- Optimising the Efficiency and Accessibility of Public Transport
- Micromobility (e-scooters, e-bikes) and Urban Mobility
- Policy Frameworks for Urban and Rural Shared Mobility
- Decarbonization and Low-Emission Pathways
- Mobility as a Service (MaaS) and Integrated Transit Networks
- Autonomous Vehicles and Sustainable Urban Planning
- Digital Solutions for Traffic Management and Emission Reduction
- Intelligent Transportation Systems (ITS) and Real-Time Data Use
- Global Standards for Sustainable Transportation
- Climate Finance and Investment in Green Mobility Solutions
- Policy Interventions for Sustainable Freight and Logistics
- Incentives and Regulations for the Adoption of Sustainable Transport
- Green Shipping and Maritime Innovations
- Zero-Emission Trucks and Rail Solutions
- Supply Chain Optimization for Lower Carbon Footprint
- Circular Economy in Transportation Infrastructure
- Ensuring Inclusive Access to Sustainable Mobility
- Impact of Transportation on Socio-Economic Inequality
- Transportation Solutions for Developing Regions
- Gender and Age Considerations in Sustainable Transit Design
- Key Areas for Research and Technological Innovation
- Collaboration between Academia, Industry, and Government
- Exploring Future Modes: Hyperloop, Maglev, and Drone Delivery
- International Case Studies of Successful Transport Sustainability
- Adaptation and Resilience of Transport Systems to Climate Change
- Unmanned Transportation Systems

Message from the Honorary, Founding and Symposium Chairs

Arif Pashayev

Rector of the National Aviation Academy, **Azerbaijan**

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Lifetime Honorary President of SARES, **USA**

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President of SARES (International Sustainable Aviation and Energy Research Society), **Türkiye**

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Vice Rector of State University "Kyiv Aviation Institute", **Ukraine**

Vugar Sadigov

Vice Rector of State Marine Academy, **Azerbaijan**

It was a great pleasure to invite you to the ISTRAS'25, which was held online on September 23–25, 2025, hosted by the National Aviation Academy, Baku, Azerbaijan.

Sustainable transportation is a critical area of research and innovation, addressing environmental challenges, energy efficiency, and technological advancements in mobility. As the world moved toward more eco-friendly and intelligent transportation solutions, we invited researchers, scientists, engineers, policymakers, and students to ISTRAS'25 to exchange knowledge, present cutting-edge developments, and discuss strategies for a more sustainable future.

ISTRAS'25 was an international, multi-disciplinary symposium that explored key topics in sustainable transportation, including green mobility solutions, smart infrastructure, alternative energy sources, electrification, autonomous transportation, and policy frameworks. Participants are encouraged to share their insights on innovative designs, AI-driven mobility, and emerging trends in urban and intermodal transport systems.

The symposium featured keynote presentations, specialized sessions, and oral presentations (online) on various submitted topics. We sincerely thank you for your participation in this important event and for contributing to meaningful discussions on the future of sustainable transportation.

ISTRAS'25 Committees (All names are sorted alphabetically)

Symposium Honorary Chairs

Arif Pashayev, Rector of National Aviation Academy, Azerbaijan
Max F. Platzer, Lifetime Honorary President of SARES, USA

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Symposium Program

Day 1: 23 September 2025

ISTRAS'25 PROGRAM - DAY 1

	Main Hall - 23 September 2025 - BAKU/Azerbaijan Time (UTC+4)	
11:00 - 11:30	Opening Session	Arif Pashayev, Honorary Chair of ISTRAS'25, Rector of National Aviation Academy, Azerbaijan
		M. Ziya Sogut, Chair of ISTRAS'25, Vice-rector of the Piri Reis University, Türkiye
11:30 - 12:00	Opening Keynote Session	T. Hikmet Karakoç, Founding Chair of ISTRAS'25, President of SARES, Piri Reis University, Türkiye
12:00 - 13:30	1st Keynote Session	Session Chair: M. ZIYA SOGUT
		VALDES evaluation platform for new aircraft designs within environmental priorities *Oleksandr Zaporozhets, Institute of Aviation (Łukasiewicz Research Network – Institute of Aviation), Poland*
		Relative Navigation of LEO Satellites in Formation Using Probabilistic Adaptive EKF *Chingiz Hajiyev, Istanbul Technical University, Türkiye* *Tuncay Yunus Erkec, Istanbul Technical University, Türkiye* *Demet Cilden-Guler, Istanbul Technical University, Türkiye* *Ulviye Hacizade, Halic University, Türkiye*
		On The Possibilities and Prospects of Using Optoelectronic Pressure Sensors in Aircraft Air Data Systems *Islam Isgandarov, National Aviation Academy, Azerbaijan*
13:30 - 14:30	Lunch Break	
14:30 - 15:15	1st Industrial Special Session	Session Chair: KADIR EMRAH ERGINER
		Power of GIS in Sustainable Transportation *Barış Uz, CEO, Esri, Türkiye*
		Satellite Technologies for Sustainable and Safe Transport *Ismat Bakhishov, Director of the Geographical Information Systems Center, Space Agency of the Republic of Azerbaijan (Azercosmos)*
15:15 - 15:30	Break	
15:30 - 17:00	1st Parallel Session	Baku Hall (Chair: FUAD MIRZAYEV)
		Power Technologies used in Unmanned Aerial Vehicles: An Overview
		Jafar Sadig, Islam Isgandarov
		Application of artificial intelligence for protecting UAV control systems from cyberattacks
		Aftandil Mammadov, Gurban Sadigov, Gurban Hasanli, Elnur Asadov, Rauf Guliyev
		Nonlinear flight dynamics modeling and stability analysis for unmanned aerial vehicles
		Arif Alihuseynov, Adalat Samadov
		Application of BNO055 Sensor for Precise Orientation and Position Determination in UAVs
		Dayanat Heybatov, Aftandil Mammadov
		Why do civil aviators need an urgent, efficient, and effective ICAO Annex for UAVs?
		Olcay Ölçen
		Enhancing Runway and Apron Safety Using UAV-Based Surveillance and Object Detection

		Arif Hajiyev, Rafael Ibrahimov, Ibrahim Babayev
15:30 - 17:00	1st Parallel Session	Karabakh Hall (Chair: ELGUN AGHAYEV)
		Certification-Centric Architecture of Integrated Modular Avionics: Design, Standards, and System-Level Implications
		Aftandil Mammadov, Gurban Sadigov, Gurban Hasanli, Elnur Asadov, Orkhan Shikhverdiyev
		Graphene Based Sensors in Avionics Systems: A Review of Potential Applications
		Aygun Zeynalova
		Artificial Intelligence in Flight Simulation: A Literature Review on Learning Assessment and Quality Assurance in Aviation Education
		Khagani B. Abdullayev
		Aerodynamic Design of An Aircraft with Computational Fluid Dynamics
		Münir Süner
		Simulation and Analysis of Pitot Tube Air Data Sensing for Sustainable Avionics Applications
		Rauf Guliyev
		Enhanced ADS-B platform: A new generation of safety, radio frequency assessment and predictive systems in aviation
		Sakhavat Amirbayli, Islam Isgandarov
15:30 - 17:00	1st Parallel Session	Shusha Hall (Chair: ISLAM ISGANDAROV)
		Comprehensive Spacecraft Docking Process Based on a Hexagonal Euclidean Manipulator
		Rasim Alizade, Kanan Azimov, Javad Samadzade
		Research on the possibility of integrating satellite systems using new technologies
		Islam Isgandarov, Sakinakhanum Abdullayeva
		Design and Simulation of a Compact Piezoelectric Accelerometer Block with Prestressed Eigenfrequency Analysis
		Rauf Guliyev, Toghrul Karimli, Aftandil Mammadov, Elnur Asadov, Gurban Hasanli Gurban Sadigov
		Lightweight Predictive Model for Adaptive Global Navigation Satellite System Interference Mitigation Using Temporal Convolutional Networks and Tiny Transformers
		Stanislava Kudrenko, Valerii Kozlovskyi, Vitalii Alkema, Oleh Shklyar
		Small-Size Turbojet Engines: Design Problems, Development Prospects and Optimization of Parameters
		Teymur Tahirov, Adalat Samedov
		Optimizing Turbojet Fan Blades: Computational Fluid Dynamics (CFD) Analysis of Lean and Sweep
		Fatima Ramazanova, Adalat Samedov

Day 2: 24 September 2025

ISTRAS'25 PROGRAM - DAY 2

	Main Hall - 24 September 2025- BAKU/Azerbaijan Time (UTC+4)	
11:00 - 12:30	2nd Keynote Session	Session Chair: MARYAM SADAT KIAI
		Entropy-Based analysis on Environment Considering Decarbonization for Chemical Tankers
		M. Ziya Sogut, Piri Reis University, Turkey
		Alkylbenzene fraction as a waste conversion product – a prospective component for the production environmental gasolines

		Sergii Boichenko, National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute", Ukraine
		Presentation Title Evaluating MRO Performance in Commercial Aviation: The Turkish Airlines Experience *Ismail Ekmekci, Academic Member, Istanbul Ticaret University, Türkiye*
12:30 - 13:15	2nd Industrial Special Session	Session Chair: HÜSEYIN GENCER
		The implementation of the Safety Management System at Airport and its impact on organization's economy *Elmir Guluzadeh, "AZAL" CSJC, Chief Safety and Quality at Airports, Azerbaijan*
		Sustainable Airspace Management: Enabling Efficiency in a Growing Sky *Ruslan Huseynzade, "AZAL" CSJC, Head of Aeronautical Information Service, Azerbaijan*
13:15 - 14:00	Lunch Break	
14:00 - 15:15	2nd Parallel Session	Baku Hall (Chair: FUAD MIRZAYEV)
		The Impact of No-Code Prototyping on Development Speed and System Flexibility in Serverless Architectures to Support Mobility as a Service Applications for Aviation *Olena Chebanyuk, Anton Stadnychenko*
		Digital logistics platform: Efficiency of transport-transit services *Vusal Gasimli, Agil Asadov, Arzu Suleymanov*
		Development directions of automated control systems in intelligent transportation systems *Ilknur Rajabli*
		A Vision-Driven Solution for Smarter events and Workspaces: Smart Meeting AI *Turkay Huseynova, Muhammadali Hajizadeh*
		AI-driven Transit Planning for Smart cities: Enhancing Efficiency in Public Transportation *Islam Isgandarov, Turkay Huseynova, Tarana Suleymanova*
		The Role of Artificial Intelligence in Eliminating Traffic Congestion During the Implementation of the Green Wave Regime *Heybatulla Ahmedov, Mirhamid Baghirov, Turkan Alimova*
14:00 - 15:15	2nd Parallel Session	Karabakh Hall (Chair: RAMIL MUKHTAROV)
		Lone-Wolf Terrorism in Civil Aviation: A Risk Assessment and Profiling-Based Framework *Shola Shekili, Ramil Mukhtarov*
		Information Uncertainty in Transport IoT Systems: Security Challenges and Adaptive Protection Mechanisms *Igor Parkhomey, Juliy Boiko, Oleksandr Shvydchenko*
		The Role of Cyber-Physical Systems in the Logistics Industry *Taleh Asgarov*
		Digital vulnerability of transport infrastructure in the context of global crises *Dmytr Myronchenko, Kateryna Sydorenko*
		Express Detection of Explosives: Device Design and Prospects for Implementation in Civil Aviation *Kamal Asgarov, Ramil Mukhtarov, Saida Ahmadova*
		Legal Challenges of Counter-Unmanned Aircraft Systems Technologies in Civil Airports *Kateryna Vodolaskova, Svitlana Holovko*
14:00 - 15:30	2nd Parallel Session	Shusha Hall (Chair: MARYAM SADAT KIAI)

		SCADA-Based Real-Time Monitoring System for the Technical Condition of Traction Motors
		Farid Huseynov, Elshan Manafov
		Enhancing Sustainable Aviation Through a Digital Twin Approach to Real-time Avionics Monitoring
		Madina Alishova
		Developing competitive capability in transport services within the framework of the Blue Ocean Strategy
		Kanan Heydarov
		The Application of the Green Leasing Model in Civil Aviation
		Gunel Amirova
		ESG Disclosure and Financial Performance: Causality Evidence from the Airline Industry
		Mehmet Yaşar, Kasım Kiracı
		Evaluating the Sustainability Performance of Turkish Airlines Using Data Envelopment Analysis
		İlinay Güllü, Sevim Yilmaz
15:15 - 15:45	Break	
15:45 - 17:00	3rd Parallel Session	Baku Hall (Chair: ELGUN AGHAYEV)
		Integration of Video Surveillance Systems Applied in Airports
		Ruslan Rustamov
		Sustainability Practices in Large-Scale Airport Operations: The Istanbul Airport Example
		Ahmet Ertek, Serap Ertek, Gülse Yetişir
		Important conditions in the time-based model of Air Traffic Control controller workload calculation
		Peyman Mukhtarov, Nurana Mammadova
		Modeling the Traffic Density of Ground Vehicles in the Airport Area Using Matlab/Simulink
		Afig Hasanov, Elgun Aghayev, Rovshan Ahmadov
		A Simulation-Driven Approach to Optimizing Public Transit Departure Protocols at Major Airport Facilities Under Emergency Evacuation Conditions
		Nurana Rustamova Hasanli
		Financial Sustainability Analysis in Airports
		Abdulkadir Alıcı
15:45 - 17:00	3rd Parallel Session	Karabakh Hall (Chair: KANAN HEYDAROV)
		Model of Inter-Airline Cooperation: A Simulation-Based Evaluation of Interline Agreements
		Seydulla Aliyev, Aygul Huseynova
		Urban Transport Transformation in Baku: A Critical Review of Current Mobility and the 2040 General Plan Vision
		Ulfat Alasgarov
		Transport System Development Strategy in the Context of the Country's Economic Growth
		Maryna Korzh, Kateryna Sydorenko, Igor Shkorina
		Modern Public–Private Partnerships in International Aviation Business: Governance, Innovation, and Sustainability Perspectives
		German Panikar, Oleksandr Dykyi, Volodymyr Morozov
15:45 - 17:00	3rd Parallel Session	Shusha Hall (Chair: MARYAM SADAT KIAI)
		A Strategic Approach to Battery Recycling for EVs in Azerbaijan: Public-Private Partnership Model for Sustainable Infrastructure

		Fuad Mirzayev, Kovsar Dadashova
		Analysis of Safer Alternatives to Lithium-Ion (Li-Ion) Batteries
		Arif Mammadov, Afat Jafarova, Farid Jafarov
		Second-life lithium-ion batteries storage for stationary energy systems in Azerbaijan
		Kovsar Dadashova, Aygun Zeynalova, Aygun Omarova, Arzu Abdullayeva
		Mitigating the Environmental Impacts of the Transport Sector in Azerbaijan
		Aliagha Gasimov, Bakhtiyar Ismayilov, Konul Mirzammadova, Amil Alili, Rashad Huseynov
		Cold Chain Sustainability in Transportation: The Emerging Role of Phase Change Materials
		Salih Bakkal, Pınar Gürol
		Decarbonization Responsibility of Route Planning To Ice-Covered Arctic Waters
		M. Ziya Sogut, Funda Yercan, S. Turgut Koçak

Day 3: 25 September 2025

ISTRAS'25 PROGRAM - DAY 3

	Baku Hall - 25 September 2025 - BAKU/Azerbaijan Time (UTC+4)	
10:00 - 11:30	3rd Keynote Session	Session Chair: JULIY BOIKO
		The Vertical City: Foundational Concepts for Sustainable Urban Air Mobility *Alper Dalkıran, Suleyman Demirel, University, Türkiye* *Demet Dağlı, Isparta University of Applied Sciences, Türkiye*
		Integrating Drone Technology into Smart Urban Transport Systems: An Intelligent Management Approach *Dinh-Dung Nguyen, Le Quy Don Technical University, Vietnam* *Manh-Dung Duong, Le Quy Don Technical University, Vietnam*
		Technological Approaches for the Remediation of Anthropogenically Impacted Soils at Airport-Influenced Areas *Larysa Cherniak, State University "Kyiv Aviation Institute" Ukraine* *Daria Zabolotna, State University "Kyiv Aviation Institute" Ukraine* *Tomasz Maniecki, Lodz University of Technology, Poland* *Radoslaw Ciesielski, Lodz University of Technology, Poland* *Oleksandr Shtyka, Lodz University of Technology, Poland*
12:00 - 12:15	Break	
12:15 - 13:15	4th Keynote Session	Session Chair: LARYSA CHERNIAK
		IoT Project Management in Intelligent Transportation Systems *Juliy Boiko, Khmelnytskyi National University, Ukraine,* *Igor Parkhomey, Taras Shevchenko National University of Kyiv, Ukraine* *Dmytro Zahorodnii, Taras Shevchenko National University of Kyiv, Ukraine*
		Blue Horizons: Decarbonizing Maritime Transport Towards IMO 2050 *Kadir Emrah Erginer, Dokuz Eylül University, Türkiye*
13:15 - 14:00	Lunch Break	
14:00 - 15:00	4th Parallel Session	Baku Hall (Chair: KOVSAR DADASHOVA)
		Enhancing the exploitation efficiency of transport through AI technologies
		Heybatulla Ahmadov, Elshan Manafov, BalaAgha Karimov, Aytaj Mustafayeva
		Challenges of implementing AI for sustainable development
		Olha Horobets, Lesia Pobochenko
		The Economic Efficiency of Digital Technologies in Managing the Green Supply Chain
		Gunel Safarova

		Global Standards for Sustainable Development in the Context of Fragmentation of the World Economy
		Oleksiy Plotnikov
		The problem of minimizing transportation costs during consolidation of industrial waste by destination
		Elkhan Sabziev, Adalat Pashayev, Esmira Ahmadova, Esmira Mammadova
14:00 - 15:00	4th Parallel Session	Karabakh Hall (Chair: ISLAM ISGANDAROV)
		Carbon-Neutral Trains: Opportunities within the European Green Deal and Implications for Türkiye
		Mine Sertsöz
		Sustainable Transportation as a Vector of Regional Integration: The Role of EU Initiatives in the South Caucasus
		Anvar Ismayilli
		Environmental Comparison of the Eurasian Trade Corridors
		Ferhan Oral
		Positive Developments of Digitalization and Technology in the Commercial Activities and Management Systems of Maritime Businesses
		Tayfun Acarer
		The Effect of On-the-Job Training on Sustainability in Maritime Transportation
		Hande Kul Gelal, Saip Kaya Ardıç
		The Impact of Tsunami Hazard in the Sea of Marmara on Ports and Maritime Transportation
		Yalçın Tamer
14:00 - 15:00	4th Parallel Session	Shusha Hall (Chair: ELGUN AGHAYEV)
		Artificial Intelligence-Driven Strategies for Sustainable Maritime Transportation: Enhancing Efficiency, Safety, and Environmental Performance
		Abdülkadir Akturan
		Assesment of pathway to Green Port-Led Logistic Centers for shipping
		Orkun Burak Tafralı, M. Ziya Sogut
		Assessment of Circular Indicators for Sustainable Shipping
		Nagihan Kudu, M. Ziya Sogut
		Assessment of Energy Efficiency Design Strategy for Ships Considering Functional Analysis
		Barış Yıldız, M. Ziya Sogut
		Maritime Digital Transformation: Opportunities and Challenges for Sustainable Development
		Umut Taç, Ali Cem Kuzu
		Some aspects of infrasound noise assessment from motor vehicles in large industrial cities
		Bakhtiyar Azizov, Hikmet Mammadov, Khadija Khalilova
15:00 - 15:15	Break	
15:15 - 16:15	5th Parallel Session	Baku Hall (Chair: JAMAL HUSEYNOV)
		In-Warehouse Volume Measurement & Space Utilization Optimization
		Zeki Yetgin, Nadir Aghayev, Arif Hajiyev, Sabina Aghazade
		Exploring Various Options For Efficient Intermodal Freight Transportation With Containers
		Heybatulla Ahmadov, Qazanfar Akhundov
		Econometric evaluation of customs revenues from container transportation in Azerbaijan: trade facilitation and growth implications

		Rahima Nuraliyeva, Kovsar Dadashova, Hajar Ismayilova
		Multi-objective Optimization Model to Reduce Carbon Emissions from Empty Container Movements
		Hüseyin Gençer, Kenan Tata, M. Taner Albayrak, Tutku Eker İşçioğlu
15:15 - 16:15	5th Parallel Session	Karabakh Hall (Chair: KANAN HEYDAROV)
		Analytical study of balancing mechanisms of novel mechanical drive of non-beam spr
		Yusif Hasanov, Beyali Ahmedov, Anar Hajiyev
		Multi-agent system for predictive diagnostic maintenance of production lines based on spiking neural networks
		Yusif Hasanov, Vitaly Kargin, Viktor Artemyev, Beyali Ahmedov, Anar Hajiye
		Emergency Power Supply
		Viktor Tikhonov, Tetiana Mazur, Nataliia Sokolova, Iyna Prokchorenko, Nataliia Tymoshenko
		Enhancing Customer-Centric Management in E-Commerce through Unmanned Delivery Systems
		Abdulla Abdullayev
		Computational Models and Simulations for Sustainable Transport Solutions and Environmental Crimes in the Caspian Sea Region
		Aida Taghiyeva, Shahla Huseynova
15:15 - 16:15	5th Parallel Session	Shusha Hall (Chair: AYGUN ZEYNALOVA)
		Simulation of Visual References to the Aerodrome Approach Lighting System in the Visual Segment of Flight
		Svitlana Deviatkina, Yuliia Kvach, Olga Ivanet
		The Sustainable Flight Path: Adopting the Tesla Model to Address Production, Cost, and Scaling Issues in the Emerging eVTOL Sector
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IST25-01.

Nonlinear Flight Dynamics Modeling and Stability Analysis for Unmanned Aerial Vehicles

Arif Alihuseynov*, Adalat Samadov

National Aviation Academy, Baku, Azerbaijan.

Abstract: The accurate modeling of unmanned aerial vehicles (UAVs) has become a crucial requirement for both research and practical applications, especially in scenarios where conventional linear approximations fail to capture the complex dynamics of flight. This paper focuses on the formulation of a nonlinear six-degrees-of-freedom (6-DOF) flight dynamics model and the subsequent stability analysis of UAVs. The nonlinear model accounts for coupled translational and rotational motion, aerodynamic forces and moments, and environmental effects. Stability analysis is conducted using eigenvalue methods for the linearized system, as well as Lyapunov-based approaches to evaluate the nonlinear dynamics. The results demonstrate that nonlinear models provide greater fidelity for evaluating UAV behavior under large perturbations, high angles of attack, and turbulent flight conditions. The findings highlight the necessity of nonlinear modeling as a foundation for advanced control law design and autonomous navigation in UAVs.

Keywords: UAV, Nonlinear dynamics, Stability analysis, 6-DOF modeling, Flight mechanics

IST25-02.

Information Uncertainty in Transport IoT Systems: Security Challenges and Adaptive Protection Mechanisms

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Abstract: The paper considers the problem of information uncertainty in transport IoT systems and its critical impact on the safety and stability of the transport infrastructure. The uncertainty resulting from noise, data loss, or targeted interference (attack, falsification) makes it impossible for autonomous control systems to make decisions correctly. An approach to building an adaptive protection system based on artificial intelligence methods (neural networks, logical-entropy models) for dynamic assessment of the reliability of input data, detection of anomalies and adaptive response is proposed. A conceptual model of the architecture of such a system and examples of its application in an unstable environment are presented. The article concludes about the effectiveness of AI-based solutions in ensuring trust in data in dynamic and cyber-hazardous transport environments.

Keywords: Information Uncertainty, IoT, Transport Systems, Adaptive Protection, Artificial Intelligence, Trust in Data, Cybersecurity, Telemetry

■ IST25-03.

Why do civil aviators need an urgent, efficient, and effective ICAO Annex for UAVs?

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2. İstanbul Gelisim University, Turkiye.

Abstract: Ensuring the harmony and congruence of UAVs (Unmanned Aerial Vehicles) and the Rules and Regulations of Civil Aviation is not a new subject. This research aims to investigate UAVs in a governance structure that forms around the Annexes of ICAO. Throughout the research, different Annexes and especially Annexes of 1, 5, and 17 will be interpreted regarding UAVs and the causes, the means and end chains of relationship between UAVs and a safety structure will be analysed. The research findings show that a new regulatory basis will be needed and required at the International Civil Aviation Organisation (ICAO) level. And the research concludes that this legal structure should be detailed and sophisticated, as in the example of 19 Annexes.

Keywords: Unmanned Aerial Vehicles, Annex, Legal Structure, UAV, Aviation

■ IST25-04.

Modeling the Traffic Density of Ground Vehicles in the Airport Area Using Matlab/Simulink

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Abstract: This paper analyzes the impact of ground vehicle traffic intensity within airport areas on flight safety, based on accident data reported in existing sources. The analysis reveals that the uneven distribution of ground traffic intensity can lead to serious accident risks. To evaluate this issue, a simulation model of ground vehicle traffic density was developed using the MATLAB/Simulink. As a result, a dynamic simulation approach has been proposed to improve airport operational efficiency, reduce traffic congestion, and minimize safety risks. The findings of the study demonstrate that the proposed approach is an effective tool for optimizing airport transportation systems. Its application facilitates the decision-making process in traffic management and enhances the overall performance of the airport.

Keywords: Optimization, Simulink, Airport, Traffic density, Ground vehicles, Accident

IST25-05.

IoT Project Management in Intelligent Transportation Systems

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Abstract: This paper explores the methodology and project management models used in the development and implementation of IoT-based solutions within Intelligent Transportation Systems (ITS). It focuses on the integration of IoT architectures with adaptive traffic control, smart parking, and real-time analytics, emphasizing both the technical and economic feasibility of such systems. Through an analytical study of international case examples including SURTRAC, SCATS, and Smart Parking platforms the research highlights best practices and challenges in project execution, scalability, and cybersecurity. A composite project efficiency index (CPI) is proposed to formalize project evaluation. The findings confirm that strategically managed IoT deployments can significantly improve traffic efficiency, reduce urban congestion, and ensure economic return on investment, especially in the context of sustainable urban mobility.

Keywords: IoT, Intelligent Transportation Systems, Project Management, Smart Traffic, Urban Mobility

IST25-06.

A Strategic Approach to Battery Recycling for EVs in Azerbaijan: Public-Private Partnership Model for Sustainable Infrastructure

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Abstract: The rapid growth in the use and production of electric and hybrid vehicles, encouraged by the United Nations' sustainable development goals (SDGs) and global environmental safety standards, has also become evident in Azerbaijan. This transformation marks a new stage in the country's transport sector and contributes to a steady rise in the production and use of lithium-ion batteries. However, the disposal of these batteries presents a serious environmental challenge, as they contain hazardous substances such as heavy metals and electrolytes that can harm the ecosystem if not properly managed.

Ensuring the safe and efficient disposal of these batteries requires advanced technological processes, qualified specialists, and modern infrastructure. Therefore, establishing a specialized enterprise for battery recycling and disposal in Azerbaijan is of strategic importance both environmentally and economically.

International experience indicates that such enterprises require significant financial resources, access to innovative technologies, and effective long-term management. In this context, the application of the Public-Private Partnership (PPP) model appears to be a viable solution. PPP mechanisms allow the state and private sector to share risks, combine resources, and ensure efficient project implementation.

The study explores the feasibility of applying the PPP model to establish a national system for the disposal of electric vehicle batteries in Azerbaijan. Based on the analysis of international experience and local socio-economic conditions, it concludes that PPP-based cooperation offers a sustainable and effective framework for developing this critical environmental infrastructure.

Keywords: Electric vehicle, Hybrid vehicle, Transport, Public-Private Partnership, Battery recycling, Sustainable infrastructure, EV

■ IST25-07.

Lone-Wolf Terrorism in Civil Aviation: A Risk Assessment and Profiling-Based Framework

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Abstract: Lone-wolf terrorism poses a growing challenge to civil aviation due to its unpredictable and decentralized nature. Operating without direct ties to known groups, these individuals often avoid detection by traditional intelligence methods.
This paper examines recent aviation-related incidents involving lone actors and proposes a profiling-based risk assessment framework incorporating behavioral, psychological, and operational indicators. The model integrates psychological traits, motivational factors, operational access, and observable pre-attack behaviors. Drawing on data from global terrorism databases (2020-2024), the study outlines indicators useful for early threat identification. Practical implications for behavioral screening and aviation security protocols are also presented, emphasizing the need for predictive and adaptive approaches.

Keywords: Lone-wolf terrorism, Civil aviation, Risk assessment, Behavioral indicators, Threat detection

■ IST25-08.

The Role of Cyber-Physical Systems in the Logistics Industry

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Abstract: This paper explores the establishment of a smart supply chain by leveraging the "Logistics 4.0" concept within the framework of cyber-physical system formation and integration. To this end, the coordinated structure linking cyber-physical systems with smart logistics is examined, and the components comprising this structure are described. Furthermore, the advantages offered by the core components of the "Industry 4.0" platform (the Internet of Things, the Internet of Services, the Internet of Data, and Radio Frequency Identification) for warehouse management systems are outlined. Through a telecommunications network, warehouse objects are interconnected via the Internet. Sensors within the cyber-physical system monitor the position, temperature, humidity, and other critical parameters of warehouse items. These parameters are processed in real time, and actuators execute physical processes by responding to commands received from the sensors. All collected data are then transmitted directly to the services integrated into the warehouse management system.

Keywords: Industry 4.0, Logistics 4.0, Digital transformation, Smart warehouse, Data collection, Data management.

■ IST25-09.

Metal Fatigue Indicators for Preventing the Unpredicted Failure of Complex Transportation Systems

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Abstract: The article is devoted to the prevention of the unpredicted fatigue failure of complex transportation systems by application of the metal fatigue indicators. The research and development of the family of the fatigue indicators for metal structures have been described. The article primarily focuses on the issue of metal fatigue in aircraft structures, extending then the analysis and conclusions to other engineering systems susceptible to cyclic loading: steel bridges, oil and gas pipelines, gas storage systems, etc. The behaviour of the indicator under the loading reflects the nature of the metal fatigue phenomenon. The operation of these indicators is based on the idea that the surface extrusion/intrusion pattern of the metal under cyclic loading can be used to quantitatively assess accumulated fatigue damage. The reliability of the information obtained through surface condition analysis has been confirmed by numerous fatigue test experiments. Recommendation for the practical use of the fatigue indicator have been discussed.

Keywords: Transportation Systems, Metal Fatigue, Damage Monitoring, Aircraft, Bridges, Gas Transportation

■ IST25-10.

Enhancing the exploitation efficiency of transport through AI technologies

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Abstract: The analysis presented in this article reveals that, in the current integrated digital environment, the development of standards for the collection, processing, storage, and transmission of data that enables the optimization of passenger and freight transportation using transport vehicles has become one of the key priorities. However, considering that personal data may be included among the information obtained during the operation of transport vehicles, it becomes necessary to introduce additional requirements for the processing of such data. In this context, the concept of public transportation is expected to undergo significant transformation. Specifically, under conditions of urban traffic congestion, scenarios are likely to favor the use of small-capacity autonomous city buses based on artificial intelligence. These vehicles could connect major urban agglomeration nodes (such as airports, railway and bus stations), and even some metro stations. They may also be integrated with technologies that support the principle of shared mobility enabling joint use of transportation by individuals opting for taxis or minibuses instead of private cars, and even sharing the road with cyclists, motorcyclists, and scooter users. Additionally, such systems would facilitate seamless transitions between different modes of transport for passengers in a multimodal travel format. In recent years, there has been a growing trend toward micromobility in major cities, particularly through the use of shared bicycles and scooters for short-distance travel.

Keywords: Transport logistics, Digitalization, Artificial intelligence, Transport vehicles, Logistics supply chain, Public transportation, Urban micromobility.

IST25-11.

Relative Navigation of LEO Satellites in Formation Using Probabilistic Adaptive EKF

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3. Halic University, Istanbul, Türkiye.

Abstract: This research introduces a novel approach to autonomous relative navigation for dual satellite formations, employing a strategy that utilizes two Extended Kalman Filters (EKFs) based on Global Navigation Satellite System (GNSS) measurements. The method leverages nonlinear GNSS data and Keplerian orbital parameters to estimate the dynamic states of both the primary (mother) satellite and its accompanying (follower) satellite, while explicitly accounting for perturbations caused by the Earth's oblateness (J2 effect). The presented probabilistic adaptive extended Kalman filter (pAEKF) algorithm is based on tracking normalized innovation sequences in the filter and calculating the probability of normal operation of the estimation system. To estimate the parameters of the Hill-Clohessy-Wiltshire (HCW) relative motion model, it is proposed to use the traditional Kalman filter without the adaptation procedure.

Keywords: Small Satellites, Formation Flight, Estimation, Relative Navigation, Extended Kalman Filter

IST25-12.

Integration of Video Surveillance Systems Applied in Airports

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Abstract: Considering that improving aviation security is an important issue in modern civil aviation, there is a need for the integration of video surveillance systems. The article analyzes the characteristic features of video surveillance systems applied at airports and identifies their integration capabilities. It is noted that video surveillance systems, in addition to implementing real-time control at airports, are also considered an effective tool for detecting and preventing potentially dangerous situations.
As a result of the integration of video surveillance systems, it has been shown that it is possible to automatically block access to protected restricted areas in the event of any emergency. Because the cameras installed in these areas can be activated immediately during the event and transmit the images of the event to the monitoring center in real time. At the same time, if the system is equipped with analytical modules based on artificial intelligence, it is possible to eliminate weaknesses related to the human factor.

Keywords: Airport, Aviation security, Video surveillance system, Artificial intelligence, Thermal imaging camera

■ IST25-13.

Artificial Intelligence in Flight Simulation: A Literature Review on Learning Assessment and Quality Assurance in Aviation Education

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Abstract: The era of Artificial Intelligence has extended into aviation education nowhere more prominently than in flight simulator-based training. This article reviews the potential of AI to enhance both learning assessment and quality assurance in higher aviation education. Based on recent academic and industry literature, the study explores how AI technologies including machine learning, intelligent tutoring systems, and predictive analytics are being used to assess pilot competencies, personalize training paths, and optimize simulator response and reliability.

The review includes case scenarios from academic and airline environments that illustrate AI's role in performance monitoring, skill progression, and system availability. It also examines how AI supports personalized feedback, situational awareness, and data-driven instructional decision-making. At the same time, it addresses challenges such as transparency, human–AI interaction, and regulatory considerations.

The findings suggest that AI-based training approaches have the potential to improve the effectiveness of pilot preparation and enhance the reliability and safety of simulation systems. This conceptual synthesis contributes to the understanding of how AI can link educational outcomes with operational readiness, helping shape the next generation of intelligent, sustainable aviation training systems.

Keywords: Artificial Intelligence, Flight Simulation, Aviation Training, Learning Assessment, Quality Assurance, Simulator Systems

■ IST25-14.

Model of Inter-Airline Cooperation: A Simulation-Based Evaluation of Interline Agreements

Seydulla Aliyev, Aygul Huseynova*

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Abstract: Interline agreements are partnership arrangements between two or more airlines, enabling passengers to travel on multiple carriers using a single ticket. This allows for more convenient and cost-effective travel without delays at intermediate stops. Initially developed by the International Air Transport Association (IATA), the interline model has evolved into a complex commercial and operational framework. The study explores the historical background of interline cooperation, including the influence of the 1978 Airline Deregulation Act in the United States, the liberalization of air transport markets, and the emerging dynamics of airline partnerships. The structures of bilateral and multilateral agreements, are analyzed in detail, alongside procedures for ticket recognition, revenue allocation, and flight coordination. In the empirical part of the study, a simulation involving three partner airlines on three different routes was conducted to evaluate the impact of interline models on transportation costs. Using mathematical methods, the analysis demonstrates that interline cooperation enhances logistical efficiency, increases customer satisfaction, and strengthens market competitiveness.

Keywords: Interline Agreement, Airline Cooperation, IATA, Simulation Model, Logistics

IST25-15.

Optimizing Turbojet Fan Blades: Computational Fluid Dynamics (CFD) Analysis of Lean and Sweep

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Abstract: The aerodynamic shaping of fan blades remains a critical factor in improving the efficiency and stability of modern turbojet and turbofan engines. This study presents a computational fluid dynamics (CFD) investigation of lean and sweep effects on turbojet fan blades, carried out in ANSYS CFX using the SST k–ω turbulence model. The objective is to quantify how three-dimensional geometric modifications influence pressure ratio, isentropic efficiency, and secondary flow structures.

A baseline fan configuration was first simulated to establish reference performance (pressure ratio = 1.335; efficiency = 0.82). Lean and sweep parameters were then introduced into a Design of Experiments (DOE) framework with Latin Hypercube Sampling and quadratic response surface modeling. The surrogate model demonstrated high accuracy ($R^2 \approx 0.997$), confirming its suitability for aerodynamic optimization.

The results highlight the coupled and nonlinear influence of lean and sweep on blade aerodynamics. Mid-span modifications, particularly Sweep_3 and Lean_3–Lean_5, had the greatest impact. Moderate forward sweep improved pressure ratio by redistributing aerodynamic loading and weakening shock–boundary layer interactions, while controlled lean enhanced efficiency through reduced secondary flow losses.

The findings emphasize that performance improvements require careful trade-off between pressure ratio and efficiency. Integrating lean and sweep into multi-objective optimization offers significant potential for robust, high-performance fan blade designs. Future work will focus on extending these results to optimized geometries and experimental validation, contributing to the development of next-generation turbojet and turbofan engines.

Keywords: Fan Blade, Lean, Sweep, Efficiency, CFX

IST25-16.

Integrated Modular Avionics for UAVs: Real-Time Communication and Traffic Prioritization Using Avionics Full-Duplex Switched Ethernet

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Abstract: The integration of Integrated Modular Avionics (IMA) into Unmanned Aerial Vehicles (UAVs) represents a pivotal advancement in the development of autonomous and mission-critical flight systems. This paper explores the application of IMA in UAV platforms, emphasizing its role in enhancing modularity, reducing SWaP (Size, Weight, and Power) constraints, and supporting mixed-criticality operations. Central to this architecture are ARINC 653-based partitioning for time and space isolation, and the Avionics Full-Duplex Switched Ethernet (AFDX) protocol, which ensures deterministic, high-throughput, and fault-tolerant data communication across distributed modules. The study analyzes how the synergy between ARINC 653 and AFDX enables the consolidation of avionics functions while maintaining safety, reliability, and real-time responsiveness. The findings position IMA, underpinned by AFDX, as a transformative enabler for next-generation UAV architectures.

Keywords: Integrated Modular Avionics, Unmanned Aerial Vehicles, ARINC 653, Avionics Full-Duplex Switched Ethernet, Real-Time Communication, Modular Avionics Architecture

- IST25-17.

Certification-Centric Architecture of Integrated Modular Avionics: Design, Standards, and System-Level Implications

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Abstract: This paper explores the architecture and certification landscape of Integrated Modular Avionics (IMA) systems, emphasizing the interplay between modular software deployment, hardware abstraction, and deterministic communication. Key standards; including ARINC 653, ARINC 664, DO-178C, DO-254, and DO-297 are examined to assess their collective role in enabling certifiable and scalable avionics platforms. The findings reveal significant advancements in reusability, fault isolation, and system integration, supporting IMA as a foundation for next-generation airborne systems.

Keywords: Integrated Modular Avionics; ARINC 653; ARINC 664; DO-178C; DO-254; DO-297; Partitioning; Certifiability; Real-time systems; Avionics architecture

- IST25-18.

A Vision-Driven Solution for Smarter events and Workspaces: Smart Meeting AI

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Abstract: Punctuality and preparedness are core elements while ensuring productive collaboration in academic institutions, corporate environments, and large-scale events. However, common challenges such as late arrivals, unattended sessions, and forgotten essential items often reduce the overall efficiency of such gatherings. This paper presents Smart Meeting AI, an intelligent, camera-based attendance and notification system designed to optimize participation, enhance user responsibility, and support efficient event management. By integrating Hikvision people-counting cameras with facial recognition algorithms, the system accurately monitors room occupancy in a real time. Here each participant's image and schedule are securely registered in advance. If a scheduled attendee is not present within 10 to 15 minutes before the event begins, Smart Meeting AI triggers a personalized notification via SMS or e-mail. The system also offers an embedded, customizable checklist feature, allowing users to prepare for events by listing essential items (e.g., laptop, notebook, documents). These items are included in reminder notifications to reduce forgetfulness and help users maintain a professional appearance. Users may also define their preferred notification timing (e.g., one week, one day, or hours in advance). Smart Meeting AI exemplifies a novel fusion of AI, IoT, and user-centered design to improve attendance accuracy, punctuality, and preparedness across educational and professional domains.

Keywords: Cognitive environment, Facial recognition, Smart workplace, Optimization, Automation

IST25-19.

Simulation and Analysis of Pitot Tube Air Data Sensing for Sustainable Avionics Applications

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Abstract: Aviation industry moves very fast toward sustainable and autonomous systems, that is why understanding how flight data is gathered and used is critical. One of the essential systems in avionics is the Air Data and Inertial Reference System (ADIRS), it provides very important data such as airspeed, altitude, and attitude—which support optimized fuel consumption, autonomous control, and emissions reduction. This system comprises components such as Pitot tube, Static port, Total Air Temperature (TAT), Angle of Attack (AOA), Air Data Computers (ADC) and Inertial Reference Systems (IRS) with gyroscopes and accelerometers. This paper's main focus is the one essential part of the ADIRS: the air data system, and in particular, how it measures airspeed using a Pitot tube. Instead of trying to simulate the full ADIRS system which would be too complex for the scope of this work using COMSOL Multiphysics, a simplified 3D model of a Pitot tube placed in an airflow domain is developed to simulate the collection of stagnation and static pressure values and used to compute airspeed based on Bernoulli's equation. The goal of this study is to show how such simulations can help us better understand and improve critical sensing technologies used in sustainable and automated aircraft. The results demonstrate how accurate the device is and the value of computational fluid dynamics (CFD) in modeling sensor behavior under controlled conditions.

Keywords: Air Data Systems, Pitot Tube, Avionics, Sustainable Aviation, Autonomous Flight

IST25-20.

Graphene Based Sensors in Avionics Systems: A Review of Potential Applications"

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Abstract: This paper presents an overview of the work done on graphene in recent years. It explains the preparation techniques, the properties of graphene related to its physico-chemical structure and some key applications. This study explores the potential application of graphene-based sensors in avionics systems. The development of lightweight and miniaturised sensor architectures is critical for reducing onboard system mass and improving fuel efficiency in aircraft. Graphene allows for this because of its atomically thin structure and high flexibility. Additionally, its compatibility with multifunctional sensing (e. g. gas, temperature and strain) offers significant advantages for integrated flight monitoring and fault detection systems.

Keywords: Graphene, Sensors, Avionics, Sustainability, Multifunctional sensing, Lightweight Materials

- IST25-21.

Simulation of Visual References to the Aerodrome Approach Lighting System in the Visual Segment of Flight

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Abstract: To ensure an approach and landing with acceptable levels of risk, it is essential to establish the required visual reference with the aerodrome approach lighting system during the visual segment of flight. Failure to acquire the full pattern of approach lights imposes certain limitations on the runway visual range at which an acceptable level of risk can be maintained. Modelling the conditions for acquiring the required visual reference, taking into account the probability of detection of light signals from the approach lighting system, makes it possible to substantiate the minimum runway visual range values at which the pilot can establish the necessary visual reference with ground-based visual aids.

Keywords: Visual Segment of Flight, Approach Lighting System, Runway Visual Range, Light Signals Detection, Risks.

- IST25-22.

Lightweight Predictive Model for Adaptive GNSS Interference Mitigation Using Temporal Convolutional Networks and Tiny Transformers

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Abstract: This paper presents a lightweight predictive architecture for adaptive interference mitigation in GNSS using TCNs and compact transformer models (Tiny Transformers). Unlike traditional spatio-temporal processing methods, which react only after signal degradation, the proposed approach forecasts interference events 1–3 seconds in advance, enabling proactive adaptation of beamforming and STAP algorithms. The model operates efficiently on low-power embedded platforms such as ARM Cortex-M and DSP modules, achieving sub-1 ms inference latency with minimal memory footprint. A hybrid design combines TCN-based local temporal feature extraction with Tiny Transformer-based global dependency modeling, utilizing diverse GNSS signal features including SNR, spectral characteristics, phase shifts, and direction-of-arrival estimates. Experimental results, obtained on both synthetic and real GNSS datasets, demonstrate superior classification accuracy and robustness compared to rule-based detectors and recurrent architectures (LSTM, GRU), particularly in scenarios involving spoofing, impulsive, and broadband interference. The approach bridges the gap between high-accuracy machine learning models and real-time constraints of resource-limited GNSS receivers, offering a practical solution for mission-critical navigation, synchronization, and autonomous systems.

Keywords: Interference Mitigation, Fault tolerance, Real-time data processing, Predictive modeling, Networks, Adaptive filtering, GNSS

IST25-23.

Application of artificial intelligence for protecting UAV control systems from cyberattacks

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Abstract: As the functionality of unmanned aerial vehicles (UAVs) increases, their systems use new technologies, which increases the chances of attacks. Cyber attacks play a special role here, and this issue is very relevant today.
This article examines the methods and prospects of using artificial intelligence (AI) to protect the UAV control system from cyber attacks. The existing approaches, the architecture of the secure system are presented, and a new structural scheme is proposed to protect the control system from possible cyber attacks. The implementation of a specialized AI unit in the UAV control system is being considered. Such a unit is capable of reserving control commands, building alternative routes based on sensory information, and ensuring safe navigation in the presence of signs of cyber interference. An approach is proposed in which AI not only monitors the current situation, but can also take full control of the device in case of attacks. includes an analytical stability analysis of the Bayesian filter under data dropouts and derivation of asymptotic prediction variance, which would enable broader applicability of the system to more traditional classes of manufacturing processes.

Keywords: Unmanned aerial vehicles, Cyber attacks, Artificial intelligence, Protection, Control system, Machine learning.

IST25-24.

Analytical study of balancing mechanisms of novel mechanical drive of non-beam SPR

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Abstract: The article provides investigates balancing mechanisms for a novel beamless Sucker Rod Pumping unit (SPR) to enhance operational efficiency and energy savings. Classic beam SPRs face significant energy losses and dynamic stresses due to unbalanced cyclic loads during rod string reciprocation. The proposed novel mechanical drive of beamless SPR employs movable counterloads on a cross-beam, enabling rotary or combined balancing methods. Mathematical models are derived to determine the forces acting on rope branches and the torque on the gearbox output shaft during the rod attachment point ascent and descent. The combined method proves superior, minimizing torque deviations on the gearbox shaft by simultaneously optimizing movable and crankshaft counterloads. This reduces peak motor loads, extends equipment lifespan, and improves energy efficiency. The analytical framework facilitates industrial deployment of beamless SPRs, particularly in mature oil fields where efficiency gains are critical. This research advances SPR technology by providing validated balancing methods for new generation, energy-efficient artificial oil lift systems.

Keywords: Mechanical Drive, SPR, Non-beam, Balancing, Counterloads, Rod String

IST25-25.

Multi-agent system for predictive diagnostic maintenance of production lines based on spiking neural networks

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Abstract:.This paper presents a multi-agent architecture for predictive diagnostic maintenance of equipment on modern general engineering production lines equipped with a distributed network of vibration and thermal sensors. Each sensor node runs a convolutional spiking neural network that detects stable multi-band degradation features without the need to transmit full time series data to the cloud. Local shutdown potentials are communicated via a bus system, where a Bayesian filter reliably aggregates them into an integral health index. The central coordinator formulates maintenance planning as a partially observable decision-making problem, minimizing the consequences of downtime and false alarms. The existence of an ε-optimal finite-memory strategy is proven, and its convergence to a probabilistic optimality criterion is theoretically justified. To ensure robustness against data drift, a method of dynamic agent stability based on gradient exploration of Dirichlet distribution parameters is developed. The proposed approach is validated both on an open-source acoustic bearing failure dataset and a proprietary 1.8-terabyte dataset collected over twelve months from a beverage bottling line. Experimental results show an 18% increase in the residual life prediction horizon and a 12% reduction in unplanned shutdowns compared to a shifted back-recurrent model. An economic evaluation using discounted cash flow analysis yields an an internal rate of return exceeding 30% with a payback period of less than one year. Future work includes an analytical stability analysis of the Bayesian filter under data dropouts and derivation of asymptotic prediction variance, which would enable broader applicability of the system to more traditional classes of manufacturing processes.

Keywords: Predictive Maintenance, Spiking Neural Networks, Data Integration, Multi-Agent System, Neural

IST25-26.

Enhanced ADS-B platform: A new generation of safety, radio frequency assessment and predictive systems in aviation

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Abstract: This paper explores the ADS-B (Automatic Dependent Surveillance-Broadcast) system via integration of artificial intelligence technology currently employed in modern aviation systems. The aim is to enhance the safety level of existing infrastructure, optimize frequency evaluation, and improve traffic management through predictive modeling, allowing for more efficient and anticipatory control. The proposed integration architecture utilizes AI-based machine learning and deep learning algorithms to analyze aircraft signals, enabling functionalities such as signal congestion management, real-time risk forecasting, and proactive prediction of weather and traffic variations. Additionally, the paper presents a performance assessment of the system operating on 1090 MHz and 978 MHz frequencies, introducing methods for frequency optimization. Research findings indicate that incorporating AI into the ADS-B platform not only improves security and operational efficiency but also significantly enhances the system's adaptability and responsiveness. This approach opens new pathways for the development of smarter and more predictable future aviation networks.

Keywords: ADS-B technology, Aviation safety, Frequency optimization, Real-time data processing, Air traffic control

- IST25-27.

Development directions of automated control systems in intelligent transportation systems

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Abstract: This paper examines the development directions and functional capabilities of automated control systems in intelligent transportation. Automated control systems play a crucial role in enhancing safety, efficiency, and management processes in modern transport services by minimizing human intervention and integrating advanced information and communication technologies. The study outlines their core functionalities, including vehicle movement monitoring, autonomous vehicle operation, traffic congestion management, safety systems, freight management, navigation and route planning, integration into intelligent transportation systems, and automated maintenance. These systems contribute to reducing operational costs, improving service quality, and ensuring sustainable and competitive transportation solutions. The research emphasizes the importance of applying digitalization and ICT tools to optimize transport operations. Moreover, political, legal, and socio-cultural factors are highlighted as essential conditions that should be aligned with the long-term goals of intelligent transport development.

Keywords: Automated control systems, Intelligent transportation, Autonomous vehicles, Safety systems, Digitalization

- IST25-28.

Prevention of environmental pollution in the transportation of low-flowing cargoes

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Abstract: Problems related to environmental pollution in the transportation of liquid cargoes with the use of numerous means of transport are known.It is known that the problem will create greater environmental and economic opportunities as a result of joint intervention of researchers working in various fields of science - (synergism). The study of the problem from the point of view of the object of research of engineering science is no exception. The mandatory requirements of the technical regulations on "standardization of agricultural machinery, technological equipment, irrigation systems sets and tools" imposed on the operation of various transport and agricultural vehicles, especially trailers in our republic, should be especially noted. The main issue in the aforementioned documents is the prevention of pollution of our flora and fauna, along with safety measures on the road during the movement of relevant technical vehicles.Taking into account the urgency of the problem as a result of pollution of the environment - especially water bodies, etc., the innovative technology proposed by us is aimed at increasing the capabilities of similar vehicles currently in operation.

As a result of our research, a signal device is proposed to solve the problem, which automatically regulates the position of the trailer of trucks. The signal device is designed to automatically regulate the position of the trailer during its movement on the same road, both along the width of the road and along the road, depending on the terrain of the road. The proposed signal device can also be used in the creation of signal devices to prevent disruption of the technological process as a result of oscillations arising from episodic effects of some elements of the devices in various technological processes.

The proposed signal device eliminates undesirable situations arising from the inclination of the trailer during transportation, especially when transporting dispersive loads, building materials, some food raw materials, etc., depending on the shape of the road surface. Which is of particular importance in preventing both the rapid failure of car tires and the pollution of the ecological environment during the transportation of fluid (dispersible) materials.

Keywords: Ecological environment, Pollution, Fluidity, Cargo, Transportation

IST25-29.

Sustainability Practices in Large-Scale Airport Operations: The Istanbul Airport Example

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Abstract: This study aims to examine sustainability practices at large-scale airport operators, using the example of Istanbul Airport. A thematic analysis, based on official sustainability reports from 2020 to 2024, comprehensively evaluated activities carried out across social, environmental, and economic dimensions. The findings revealed that Istanbul Airport pursues an integrated sustainability strategy, expanding its scope of practice each year and improving its performance indicators. In the social arena, practices focused on employee well-being, occupational safety, human rights, and passenger experience have been strengthened; operational efficiency has focused on energy management, reducing baggage and passenger flow, and reducing delay rates. In the environmental dimension, energy savings, carbon emission reduction, waste management, and biodiversity protection projects have made significant progress. The study demonstrates that Istanbul Airport not only meets legal requirements but also develops innovative and sustainable solutions that serve as an example in the sector.

Keywords: Airport Management, Aviation Industry, Istanbul Airport Sustainability, Sustaiable Transport, Passenger

IST25-30.

The Impact of No-Code Prototyping on Development Speed and System Flexibility in Serverless Architectures to Support Mobility as a Service Applications for Aviation

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Abstract: When making modern enterprise software for Mobility as a Service (MaaS) platforms, it needs to be delivered quickly without making the system less adaptable in the future. This study compares no-code prototyping with Microsoft Power Platform to traditional .NET development by using a controlled experiment to build an Internal Corporate Messaging and Task-Tracking System. The no-code prototype took 32 hours to make, while the .NET version took 60 hours. This cut the time it took to make the software by about half. But the traditional method was better for long-term flexibility and ease of maintenance. Our quantitative analysis shows that no-code prototyping speeds up the first stages of the SDLC and early user validation by a lot, while traditional coding makes sure that the system can grow and work on its own. These results show that strategic decision-making in MaaS application development is based on real-world data, and they suggest that a mix of approaches will work best.

Keywords: Mobility as a Service (MaaS); No-code prototyping; Microsoft Power Platform; .NET Core; Serverless architecture; Models of Software Development Life Cycle Management (SDLCM)

IST25-31.

Aerodynamic Design of An Aircraft with Computational Fluid Dynamics

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Abstract: Aviation is one of the fields that has undergone significant change in recent years. Aircraft hold a significant place in aviation. Today, a significant portion of transportation is carried out by air. The geometry of objects such as airplanes, helicopters, wings, and rockets moving through the air is one of the most important parameters affecting the pressure distribution and therefore the drag force, the lift force, the dynamic stability of the object, the velocity field, the power, and the energy consumption. This parameter affects the energy consumed and, consequently, the fuel consumed. Energy efficiency is one of the most important issues today. In this study, the aerodynamic design of a newly designed aircraft was conducted. The flow around an aircraft was modeled using CFD (computational fluid dynamics) to obtain the pressure, wall shear stress, distributions. The theoretical and numerical results are consistent and coherent with the literature.

Keywords: CFD, Aircraft, Aerodynamic Design, PressureDistrubition, Flow around Aircraft, Modeling

IST25-32.

AI-driven Transit Planning for Smart Cities: Enhancing Efficiency in Public Transportation

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Abstract: In smart cities, efficient and adaptive public transportation is essential for reducing travel times, easing congestion, and ensuring reliable service. Conventional scheduling methods, typically based on static routing, lack the flexibility to adapt to real-time variations in traffic, passenger demand, and environmental factors. To address this gap, this paper presents an AI-driven scheduling engine that dynamically optimizes transit routing and timetables using live data from IoT sensors and vision-based systems installed in vehicles, bus stops, and traffic infrastructure. The framework integrates user profiles covering origin-destination patterns, time preferences, cost sensitivity, and mode choices with current network conditions to deliver personalized and adaptive planning. By combining predictive analytics with machine learning models, the system anticipates demand fluctuations and supports the coordination of electrified and autonomous fleets. A real-time optimization algorithm enables continuous adjustment of schedules, enhancing both operational efficiency and commuter satisfaction. Experimental evaluation demonstrates that the proposed approach reduces average travel times, improves service reliability, and supports sustainable multi-modal urban transport networks.

Keywords: AI, IoT integration, Intelligent transportation system, Predictive scheduling, Sustainable cities

■ IST25-33.

Comprehensive Spacecraft Docking Process Based on a Hexagonal Euclidean Manipulator

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Abstract: This paper presents the concept of a hexagonal Euclidean manipulator designed to ensure high-precision and reliable docking of spacecraft. The proposed system is characterized by Euclidean structure, symmetry, and a rational geometric design, which potentially contribute to improved positioning accuracy and spatial alignment without the need to maneuver the entire spacecraft. Key docking stages are described, including soft capture, rigid mechanical connection, activation of data and power interfaces, and sealing of the transfer tunnel. The proposed approach demonstrates potential for enhancing docking precision, fixation reliability, and automation of operations, which may be in demand in future orbital projects.

Keywords: Spacecraft docking system, Hexagonal Euclidean manipulator, Soft capture system, Hard capture system, Degree of Freedom, Sphere in cylindrical slot

■ IST25-34.

The Sustainable Flight Path: Adopting the Tesla Model to Address Production, Cost, and Scaling Issues in the eVTOL Sector

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Abstract: This article examines the challenges, obstacles and necessary strategies to overcome them for the new and developing electric vertical take-off and landing (eVTOL) ventures. Technological limitations such as insufficient battery energy density, which impede the sustainability of the eVTOL industry, have been analyzed. The analysis also identifies high certification costs and the incompatibility of traditional venture capital models with the long development cycles of the aviation industry as the primary reasons for the financial difficulties and bankruptcies of eVTOL ventures. In the article, it is argued that to overcome these obstacles, the eVTOL sector must abandon the low-volume, high-cost production model of traditional aviation manufacturers. It is put forward that it is of vital importance to adopt and adapt the approaches pioneered by Tesla in the automotive industry, such as vertical integration, automated mass production, and a software-driven approach, in order to lower costs by using the necessary economies of scale for commercial success. As a result, it is argued that sustainable urban air transport can be achieved not only with technological development and innovation but also with a change in perspective in business and production models.

Keywords: Sustaiable Urban Transport, Aviation Industry, Aerospace Engineering, Electric Vertical Take-Off And Landing Aircraft, Aircraft and Automative Industry

■ IST25-35.

Power Technologies used in Unmanned Aerial Vehicles: An Overview

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Abstract: The rapid development of unmanned aerial vehicle (UAV) technologies has brought with it more ecological, effective and sustainable solutions. Therefore, these innovations aim to optimise both the energy consumption of unmanned aerial vehicle (UAV) power source technologies and the useful work proportional to this consumption by bringing a new perspective to these technologies. The primary energy source for many UAVs in use today is reliable and efficient lithium-ion batteries. However, another battery technology, nuclear batteries, despite producing significantly less energy compared to lithium-ion battery technology, are smaller in size, have a long service life, emit zero carbon, and, thanks to modern technological methods and developments, have the ability to provide UAVs with uninterrupted flight capability for topographical and other measurement purposes, exploration and monitoring, and digital mapping. In this article, the latest Nickel-63 isotope (Ni-63) batteries have been compared with other existing UAV power supply systems (Li-ion, Li-polymer, supercapacitors, and so on.) and explores the application possibilities of a more advanced hybrid version, proposing an application model.

Keywords: Sustainable Energy Technologies, Power Supply Systems, Hybrid Green Energy, Effective Flight, Nuclear Batteries

■ IST25-36.

Research on the possibility of integrating satellite systems using new technologies

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Abstract: This paper considered the possibility of applying multifunctional biomimetic materials. It was shown that improving the quality and durability of satellite systems since the beginning of their practical use also ensures increased reliability. The analysis indicates that this is achieved through redundancy methods, the use of component bases with lower failure rates, and the introduction of new technologies and materials. The multifunctionality of the system makes it possible to improve its consumer properties, reduce mass and occupied volume, decrease the number of elements and interconnections, and enhance reliability and safety. Based on the analysis of multifunctional solutions, the most promising ones for research were identified: memristors, graphene sensors, and piezoelectric polymers. In the search for a single material serving as a sensor, processor, and actuator, it was concluded that integrating all three proposed options into one material—forming a unified functional cell capable of responding to an external signal, making a decision, and converting it into mechanical action—is feasible. Using MATLAB modeling, the interaction logic of the GFET sensor, memristor, and piezoactuator was tested, demonstrating a threshold response to external signals.

Keywords: Satellite, Reliability, Memristor, Graphene-based sensors, Piezoelectric polymers

IST25-37.

Enhancing Runway and Apron Safety Using UAV-Based Surveillance and Object Detection

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Abstract: The safety and operational efficiency of airports depends on having runways and aprons that remain clear of obstacles. One of the initial single-stage object detection methods called YOLO (You Only Look Once) is revolutionizing the field by providing real-time results. The YOLOv12-based unmanned aerial vehicle (UAV) vision system received enhancements through the addition of Coordinate Attention and self-supervised contrastive pretraining. The FOD (Foreign Object Debris) detection mAP@0.5 achieved a 66.4% baseline but reached 78.2% after this combination. The model achieves detection accuracy of 85.1 for aircraft and 82.5% for vehicles on apron surfaces. We achieve reliable performance in rain and low-light conditions through the combination of RGB (Red, Green, and Blue) imagery with thermal and Light Detection and Ranging (LiDAR) data. The real-world coordinate mapping of detections allows response teams to dispatch within 12 seconds instead of their previous 30 seconds. The integrated solution enhances safety boundaries on runways and aprons while producing quantifiable reductions in operational delays and costs and fuel usage.

Keywords: YOLOv12, Coordinate Attention, Self-Supervised Learning, Multi-Sensor Fusion, UAV-Based Monitoring

IST25-38.

A Preliminary Approach to Modeling Secondary Radar Surveillance Interference Using a Microwave Radio Module

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Abstract: SSR systems are essential for air traffic control but encounter significant interference issues such as FRUIT, garble, overlaps from airborne sources, and impulsive noise. This paper offers a technical review of these interference types, referencing ICAO standards and academic studies. To encourage further research, we present a preliminary setup that emulates SSR signal transmissions and interference utilizing nRF24L01 modules. The transceiver's high-speed data transfer enables a realistic simulation of SSR band signals. The proposed setup allows precise injection of various interference types such as FRUIT, synchronized garble, and impulsive noise by modifying transmission timing, power, and payloads. This initial proof-of-concept shows that nRF24L01-based platforms can successfully simulate complex SSR scenarios, offering a practical and cost-effective testbed for developing jam-resistant air traffic surveillance systems.

Keywords: Secondary Surveillance Radar; False replies and garble interference; Air traffic control radar signal emulation; Low-cost transceiver experimental platform; Interference mitigation algorithms

IST25-39.

Application of BNO055 Sensor for Precise Orientation and Position Determination in UAVs

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Abstract: Accurate determination of orientation and position is a fundamental requirement for ensuring the stability and navigation performance of unmanned aerial vehicles (UAVs). Conventional inertial measurement units (IMUs) often suffer from drift and sensor fusion limitations under dynamic flight conditions, directly impacting flight safety and mission reliability. This study investigates the implementation of the Bosch BNO055 sensor, an intelligent 9-axis absolute orientation sensor with integrated fusion algorithms, for real-time attitude and position estimation in UAVs. Experimental results demonstrate that the BNO055 achieves improved accuracy in roll, pitch, and yaw estimation compared to conventional low-cost IMUs (Bosch Sensortec, 2019), particularly during short- to mid-duration flights. The integration of this sensor into UAV control systems enhances flight stability, reduces orientation errors, and provides a cost-effective solution for lightweight aerial platforms. These findings contribute to the advancement of reliable navigation systems for UAV applications in both civilian and defense sectors.

Keywords: UAV, BNO055 sensor, Orientation accuracy, Position estimation, Inertial measurement unit, Flight stability

IST25-40.

Important conditions in the time-based model of Air Traffic Control controller workload calculation

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Abstract: "Essential conditions in the time-based model of calculating the workload of the ATC controller". The practical mechanism of flight safety management is based on a purposeful search for factors that contribute to the occurrence of aviation incidents in order to protect against their impact. Detection of dangerous factors can be carried out in the form of regular monitoring, processing and collection of information on factors that cause aviation incidents that do not lead to serious consequences. These factors make time-based calculations of ATC (Air Traffic Control) controller workloads extremely complex, and encourage further research in this area.

Keywords: Air Traffic Control Controller, Phraseology Radio Communication, Airspace, Airways, Coordination, Data collection

■ IST25-41.

SCADA-Based Real-Time Monitoring System for the Technical Condition of Traction Motors

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Abstract: Reliable operation of high-power electric locomotives requires real-time monitoring of the technical condition of traction motors. Existing SCADA (Supervisory Control and Data Acquisition) systems are limited by limited parameter monitoring, incomplete analysis of the causes of failures, weak predictive maintenance capabilities, and lack of multi-parameter diagnostics. As a result, operational information about the motor condition is insufficient, sudden failures are not prevented, and service costs increase.
In the proposed work, a multi-parameter diagnostic system is built based on Siemens controllers, the control logic is implemented in the TIA Portal (Totally Integrated Automation Portal) environment in the Ladder Diagram (LD) language, and the results are visualized via the WinCC interface. The indicators received from the sensors are simultaneously collected and processed and reflected both on the driver's panel and in the dispatch center. This approach makes it possible to detect failures in a timely manner, provide preventive maintenance, and increase the operational reliability of locomotives, which in turn reduces costs, increases safety, and increases efficiency.

Keywords: SCADA Systems, Traction Electric Motor, Multimable Diagnosis, Real Time Control, Siemens TIA Portal and Wincc

■ IST25-42.

Effect of high density polyethylene content on mechanical properties in tensile strength test

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Abstract: The main objective of this study was to investigate the effect of HDPE (High Density Polyethylene) content to achieve the same tensile mechanical properties for film samples of different thicknesses. The production task was to achieve mechanical properties for a 110 µm thick roll film similar to those for a 130 µm thick roll film by varying the HDPE percentage under production conditions. Laboratory mechanical tensile tests were performed on MD (machine direction) films of 130 and 110 µm thickness for strength with low and high HDPE percentages. To achieve the same tensile mechanical properties for film samples of different thicknesses, it is necessary to take into account the dependence of the mechanical properties on the thickness and apply appropriate compensation methods. This may include adjusting the test results, using standardized samples, or applying special processing methods for different thicknesses. Blending HDPE and LDPE (low density polyethylene) is often used to produce various types of films where a balance between strength, flexibility, and elasticity is required. In our case, as a result of laboratory tests, the optimal ratio of HDPE and LDPE was determined and selected for use in production.

Keywords: Mechanical properties, Tensile Strength Test, Mechanical Testing, Yield Stress, Maximum Stress

- IST25-43.

Digital vulnerability of transport infrastructure in the context of global crises

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Abstract: This article examines the problem of increasing digital vulnerability of transport infrastructure in the context of global crises, armed conflicts, energy issues, and geopolitical instability. The main focus will be on the resilience of transport systems under the influence of cyber threats, which will directly affect the economic security of countries through the disruption of logistics chains. Possible vectors of attacks on transport digital platforms and infrastructure are analyzed. An analysis of international practices is conducted on the involvement of tools for strengthening cyber resilience as a component of the economic stability of states through the study of policy settings and standards in the EU, ITU, and their recommendations. This study employs systems analysis methods and case methods, enabling the identification of the root causes of digital vulnerability and their connection to economic instability. The article outlines the prospects for the implementation of national and international cyber protection mechanisms for the transport industry. Practical steps are proposed to strengthen cyber protection in the transport sector, including the development of legislative regulation, technical modernization of infrastructure, and the formation of a culture of digital security among transport market participants. Prospects for the use of cloud security platforms will be discussed, using the example of the Spin.AI software solution for risk monitoring, access management, and ensuring the security of SaaS environments in critical transport structures.

Keywords: Cybersecurity risks, Digital transformation, Transport infrastructure, Efficiency in logistics, Digital vulnerability, Crises, Economic security, Risk management in transport structures

- IST25-44.

Urban Transport Transformation in Baku: A Critical Review of Current Mobility and the 2040 General Plan Vision

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Abstract: With over 700,000 registered cars and a 70% modal share, Baku faces major urban mobility challenges. Additionally, the city's monocentric urban form exacerbates traffic and long commutes. The infrastructure for active mobility is still in its infancy, and public transportation, mainly metro and diesel buses, is not integrated with the surrounding districts. In order to improve accessibility and lower transportation-related greenhouse gas emissions (28% of Baku's total), the Baku General Plan 2040 calls for revolutionary reforms such as a polycentric city model with five new sub-centers, eleven multimodal transport hubs, transit-oriented development (TOD), and 150 km of bike lanes. This study uses a comparative methodology, combining spatial analysis of transport infrastructure, policy analysis of the General Plan, and quantitative data from local authorities. The results show enduring difficulties: implementation is threatened by unclear financing mechanisms, informal peri-urban growth, misaligned land regulations, and fragmented governance. Sustainable outcomes are further complicated by socio-spatial disparities, especially in informal settlements, and a lack of climate-resilient design. Densifying transit nodes, shifting funds to public and active transportation, and incorporating inclusivity and climate resilience into urban planning are all critical to the Plan's success, despite its progressive vision. Aligning Baku's urban form with sustainability, equity, and accessibility requires effective governance, sustainable financing, and civil engagement. This will turn the General Plan into a foundation for a cutting-edge, low-emission metropolitan transportation system.

Keywords: Baku, Transport Planning, Sustainable Mobility, Urban Design, Multimodal Hubs

IST25-45.

In-Warehouse Volume Measurement & Space Utilization Optimization

Zeki Yetgin[1], Nadir Aghayev[2], Arif Hajiyev[1], Sabina Aghazade[2]*

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Abstract: The ongoing need for faster, more precise and spatially efficient warehouse operations has raised the importance of accurate volume measuring and storage planning. Therefore, our work integrates stereo-vision depth estimation with a learning-driven optimization process in a unified framework that addresses both tasks jointly. Pairs of shelving images are captured with a stereo camera setup and processed through a hybrid architecture combining GC-Net for geometric accuracy and PSMNet for contextual modeling. High-resolution disparity maps are converted to point clouds, which are then processed using VoxNet, a lightweight 3D convolutional network, to segment and determine pallet and box volumes with millimeter-level precision. The system transforms these measurements into semantic occupancy grids, which are then used by a genetic algorithm to generate optimal rack configurations for improved storage strategies. Controlled experiments demonstrated up to a 25% increase in usable capacity. Tests on a mixture of public RGB-D datasets and synthetic warehouse scenes achieved a mean volumetric accuracy of ±2.3 cm^3 and sustained an inference rate of 15 FPS on a single NVIDIA RTX GPU. The method reduced manual inventory-checking time by 30% and improved measurement accuracy. Designed for seamless integration with existing warehouse management systems, the proposed solution offers a scalable, cost-effective step toward fully autonomous storage optimization.

Keywords: Stereo Vision, Deep Learning, Warehouse Optimization, Genetic Algorithm, Semantic Occupancy Grid.

IST25-46.

Carbon-Neutral Trains: Opportunities within the European Green Deal and Implications for Türkiye

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Abstract: This paper quantifies the operational costs and CO_2 outcomes of diesel, grid-electric, renewable-electric (PPA), battery-electric, and green-hydrogen traction on a 100 km reference route. A simple, transparent model combines energy demand, conversion efficiency, energy prices, emission factors, and a carbon price aligned with CBAM. Results show that renewable and battery-electric traction achieve near-zero operational emissions at the lowest total cost (~€139/100 km). Grid-electric is cheaper than diesel but still emits greenhouse gases due to the current power mix (~568 kg CO_2e/100 km). Diesel remains the most carbon-intensive and cost-exposed option (~829 kgCO_2e and €561/100 km). Green hydrogen delivers zero emissions but is currently more expensive (~€432/100 km). We conclude with a dual strategy for Türkiye: accelerate renewable electrification now while investing in green H_2 for non-electrified corridors.

Keywords: Carbon-neutral trains, European Green Deal, CBAM, Hydrogen trains, Battery trains.

- IST25-47.

Small-Size Turbojet Engines: Design Problems, Development Prospects and Optimization of Parameters

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Abstract: The article "Small-size turbojet engines: design problems, development prospects, and optimization of parameters" examines the challenges and issues related to the design of small turbojet engines. It also explores how different design configurations affect the optimal parameters of their operational processes. The relevance of this study stems from the growing use of small turbojet engines in aviation and related industries, as well as the rising demands placed on their performance.
In their study, the authors explore the key design issues and future development prospects of small turbojet engine configurations. They propose solutions to several challenges related to achieving optimal operating parameters. These solutions include improving the design of individual engine components, incorporating ceramic-based heat-resistant materials in turbine designs, and selecting the appropriate engine configuration based on its intended use. All actions will focus on enhancing the overall performance and efficiency of UAVs.

Keywords: Unmanned Aerial Vehicle, Missile, Small-size Turbojet Engine, Optimization, Working Process.

- IST25-48.

Design and Simulation of a Compact Piezoelectric Accelerometer Block with Prestressed Eigenfrequency Analysis

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Abstract: We present an original finite-element study of a compact piezoelectric accelerometer block for aerospace use. The device has a drive piezo layer and a separate sense layer with polymer interlayers and aluminum seismic masses. The model couples solid mechanics and electrostatics. We report the main resonance and mode shape, the frequency response near the target mode, the time-domain sensitivity under a base acceleration of 1 m/s^2, and the prestressed eigenfrequency (Campbell) behavior as acceleration increases from 0 to 1 m/s^2. The resonance at zero acceleration is 86,000 Hz. The peak sensed voltage near resonance is 0.18 V. The incremental sensitivity in time domain is 0.15 V per (m/s^2). The Campbell analysis shows the resonance increases by about 250 Hz per (m/s^2). These results indicate a sensitivity–bandwidth trade-off suitable for small airborne navigation and structural monitoring.

Keywords: piezoelectric accelerometer; finite element analysis; sensitivity; Campbell diagram

- IST25-49.

Dynamic U-Space Corridor Reconfiguration for Urban Drone Operations in City Areas

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Abstract: This paper introduces a minimal, reproducible workflow for dynamic U-Space corridor reconfiguration in a typical city district. The study addresses rapid adaptation of low-altitude routes while preserving clear safety margins and producing decision-ready maps. OpenStreetMap data and QGIS are used to trace straight-segment routes between hubs and gates with snapping; a 10m baseline horizontal clearance from building buffers is enforced, and a 20m conservative option is evaluated. A compact energy-use framing is outlined to compare multicopter and small VTOL/fixed-wing operations across altitudes. The contribution is a practical bridge from U-Space concepts to deployable, district-scale maps and policies that can be filtered by UAS type and corridor class.

Keywords: U-Space; urban airspace; safety buffer; corridors; multicopter

- IST25-50.

Approach to AI-Powered Architecture Quality Assessment in Airline Ticket Booking Systems

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Abstract: Research presented in this paper contributes to the development of sustainable aviation technologies by ensuring a more efficient and objective evaluation of software architectures in the aviation domain. As aviation software systems grow in complexity, traditional manual methods for assessing architectural decisions become less accurate, time-consuming, and often yield subjective results (Ithriah et el, 2022). This paper proposes an approach to evaluating the quality of architectural solutions in airline reservation systems using artificial intelligence technologies. The main advantages of the proposed approach are that it aims to automate and improve the efficiency of the architecture evaluation process while incorporating domain-specific knowledge. The approach considers critical quality attributes of airline ticketing systems, such as transaction security, scalability under concurrent loads, regulatory compliance, and integration capabilities with global distribution systems. To validate the proposed approach, an experimental analysis was conducted on the architecture of a ticketing system (Tomar et el, 2021). The results of the experiment demonstrate that the proposed approach can effectively identify architectural quality issues and scalability, while also providing practical recommendations for improvement.

Keywords: Airline Reservation Systems, Artificial Intelligence, Aviation security, QR-code Validation, Software Architecture Quality

IST25-51.

Challenges of implementing AI for sustainable development

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Abstract: Human sustainable development currently faces serious obstacles: according to UN estimates, about half of the goals of the 2030 Agenda are significantly behind schedule, and for most of the Sustainable Development Goals (SDGs) there is a lack of sufficient monitoring data. In such conditions, increasing attention is paid to artificial intelligence (AI) as a tool that can accelerate progress in many areas. Research shows that AI can contribute to the achievement of about 134 of the 169 SDG tasks - from precise agricultural analytics to medical diagnostics and energy optimization. However, realizing the potential of AI for sustainable development faces a number of challenges. This paper analyzes international reports, scientific studies and real-world cases to identify key issues in implementing AI for the SDGs. The main groups of challenges are identified: the digital divide and lack of infrastructure, lack of data and localization, ethical and social risks, regulatory gaps, and the ecological footprint of AI itself. Case studies illustrating these issues are discussed. The conclusions emphasize the need for comprehensive solutions - from investments in digital infrastructure and data to policy development and international cooperation to use AI to promote sustainable development and avoid increasing inequalities.

Keywords: Artificial intelligence; Sustainable development; Digital divide; Ethical aspects; Environmental sustainability

IST25-52.

The Economic Efficiency of Digital Technologies in Managing the Green Supply Chain

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Abstract: The application of digital technologies in green supply chain management is a crucial approach aimed at enhancing both environmental sustainability and economic efficiency. The green supply chain is characterized by the procurement of raw materials from environmentally friendly sources, reducing the carbon footprint of production and logistics processes, and minimizing waste. To effectively manage this chain, the use of digital technologies such as blockchain, big data, artificial intelligence, and IoT is rapidly expanding. This article analyzes the economic significance of the green supply chain, the implementation of digital technologies, the current situation in Azerbaijan, and future development prospects.

Keywords: Green supply chain, Digital technologies, Economic efficiency, Environmental sustainability, Blockchain, Artificial intelligence, Logistics integration

IST25-53.

Emergency power supply

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Abstract: Existing dynamic UPS systems offer limited autonomy, creating risks during the startup of backup diesel generators. This paper presents a novel kinetic energy storage system based on a dual-rotation asynchronous machine that integrates the functions of a flywheel and a generator.
The system features an external flywheel-rotor (up to 3000 RPM) and a mechanically decoupled internal rotor maintained at a constant speed (1500 RPM). During a grid failure, the deceleration of the external rotor converts stored kinetic energy into electrical power. The key innovation is that the output frequency stability (50 Hz) is determined not by the absolute speed of the flywheel, but by the constant relative speed of its magnetic field, maintained by the internal rotor. A unique mathematical model and an equivalent circuit were developed for system analysis.
The results demonstrate that the proposed design can provide a stable power supply for 30-45 seconds, significantly outperforming existing technologies and greatly enhancing the resilience of power systems for critical facilities.

Keywords: Dynamic UPS, Special Category I Consumers, 'Ventilation' Mode, Power Grid, Kinetic Energy Storage System

IST25-54.

Legal regulation of the use of Unmanned Aerial Vehicles in International transport corridors: challenges and solutions through the example of TRACECA

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Abstract: International transport corridors are becoming a key platform for the integration of unmanned aerial vehicles (UAVs) - ranging from infrastructure inspection to the creation of advanced logistics services. Their use has the potential to increase the efficiency of transportation, accelerate cargo delivery, and improve infrastructure monitoring. However, regulatory gaps, differences in national legal regimes, and the absence of harmonized international mechanisms hinder the establishment of "seamless" UAV operations across multiple jurisdictions.
Using the example of Azerbaijan and the TRACECA international transport corridor, the article analyzes international, regional, and national legal sources (the Chicago Convention, ICAO RPAS documents, EASA regulations, the Aviation Law of the Republic of Azerbaijan), as well as examines key challenges such as the inconsistency of legal regimes, authorization procedures, allocation of responsibility, fragmentation of geozones, and issues of digitalization. Special attention is given to possible solutions, including mutual recognition of authorizations, simplification of customs procedures, and the development of minimum standards that could ensure the cross-border use of UAVs within the TRACECA framework.

Keywords: Unmanned Aerial Vehicles, International transport corridors, TRACECA Transport Corridor, Legal Regulation, Challenges and Solutions.

■ IST25-55.

Algorithm For Constructing Asymptotic Solutions For Periodic Optimization Problems In Discrete Systems With Liquid Dampers

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Abstract: This paper investigates the development of control and stabilization systems for oil extraction processes utilizing a rod pump unit, modeled through differential equations that incorporate a small parameter in fractional form. Fractional-order modeling is employed to capture the inherent memory effects and complex dynamics of the pumping mechanism, providing a more accurate representation of real-world behavior compared to classical integer-order approaches. The study formulates an optimal control problem aimed at minimizing deviations from desired operating conditions while considering system constraints, external disturbances, and parameter uncertainties typical in oil field operations. By applying asymptotic methods and small-parameter techniques, the stabilization problem is analyzed in the first approximation, allowing for the derivation of simplified control strategies that maintain system stability and improve operational efficiency. The methodology emphasizes the interplay between fractional calculus and optimal control theory, demonstrating how fractional dynamics influence system design and performance. Numerical and analytical results illustrate the effectiveness of the proposed approach, highlighting its potential for improving reliability, reducing energy consumption, and enhancing production safety in rod pump-driven oil extraction. The findings contribute to the advancement of fractional-order modeling and optimization techniques in engineering, offering a framework adaptable to other industrial systems governed by similar dynamics.

Keywords: Discretization, Euler-Lagrange Equation, Algebraic Discrete Riccati Equation, Control and Stability, Asymptotics.

■ IST25-56.

Enhancing Customer-Centric Management in E-Commerce through Unmanned Delivery Systems

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Abstract: The rapid growth of e-commerce has transformed customer expectations around speed, convenience, and service personalization. In response, businesses are increasingly exploring unmanned delivery systems such as drones and autonomous ground vehicles as a means to enhance last-mile logistics. This paper examines how these technologies can be integrated into customer-centric management strategies to improve service quality, reliability, and overall user experience. Through a conceptual review of existing delivery models and emerging technologies, the study proposes a framework that aligns unmanned transportation capabilities with key dimensions of customer satisfaction. Findings suggest that when strategically implemented, unmanned delivery can reduce friction in the post-purchase phase, foster customer loyalty, and enable scalable, efficient service models. The paper concludes with practical considerations for e-commerce firms and directions for future research and development.

Keywords: E-commerce, Customer Experience, Unmanned Delivery, Last-Mile Logistics, Service Innovation

■ IST25-57.

Sustainable Transport Innovation through the Triple Helix Model: AI Mobility, Green Aviation, and Digital Logistics

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Abstract: Innovation has become a critical determinant of sustainable economic development and competitiveness in the 21st century. This paper examines the Triple Helix model the dynamic collaboration between academia, industry, and government as a framework for advancing technological innovation in the transport sector. By combining literature review with case-based evidence from the European Union, Japan, and Azerbaijan, the study demonstrates how the Triple Helix fosters the translation of research into practice, accelerates digital and green transitions, and supports sustainable mobility. Special attention is given to transport-related domains AI-driven smart mobility, sustainable aviation fuels, digital logistics infrastructure, and green urban transport because transport is one of the most carbon-intensive sectors globally and provides a critical testing ground for applying the Triple Helix model to sustainability challenges. Findings indicate that structured collaboration enhances efficiency, reduces emissions, and strengthens economic resilience, while simultaneously addressing climate and urbanization challenges. However, barriers such as intellectual property disputes, inconsistent funding, and regulatory delays hinder progress. To overcome these, transparent governance, stable co-investment schemes, and harmonized innovation policies are essential. Ultimately, the paper underscores that the Triple Helix provides not only a conceptual model but also a practical road map for aligning technological progress with environmental sustainability and social well-being.

Keywords: Triple Helix model; Sustainable transport; Innovation ecosystems; Smart logistics; Green mobility

■ IST25-58.

Digital logistics platform: Efficiency of transport-transit services

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Abstract: The article explains the essence of the Digital Logistics Platform (DLP) and justifies the need for its formation. The work done in the Republic of Azerbaijan to form the DLP is described and analyzed. The article provides a schematic description of the DLP, which creates conditions for the implementation of electronization, and documents that are initially intended to be sent electronically. Based on the research and analysis conducted, the authors note that in the near future, transit cargo volumes will increase in international transport corridors, especially along the Middle Corridor, and cargo flows will become more intensive. The article, which lists projects and measures that will affect the increase in transportation volumes and cargo turnover, presents digitalization as an inevitable process of flexible reception, processing and dispatch of cargo flows. According to the authors, not only dynamically increasing cargo flows, but also the fierce competition in the global transport and transit services market necessitates the application of digital technologies. Only in this way is it possible to quickly and easily receive and send cargo, which ensures its attractiveness for carriers and cargo owners. At the end of the article, relevant proposals and recommendations are given regarding the digitalization of transport and transit services, which may be of theoretical and practical importance.

Keywords: Digitalization, Transport and transit services, International transport corridors, Middle corridor, Zangezur corridor, Artificial intelligence, Logistics, Single digital platform

IST25-59.

Some aspects of infrasound noise assessment from motor vehicles in large industrial cities

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Abstract: Currently, urban transport is one of the main sources of infrasound in large cities. It is known that numerous studies are devoted to the investigation of audible sound, its sources in vehicles, and the development of methods for its reduction. Relatively little attention is given to the problem of the generation and propagation of infrasound in urban environments, and consequently, to its negative impact on the environment.
The aim of this article is to provide a methodological framework for studying infrasound in residential areas adjacent to transport highways. To determine the actual levels of infrasound from traffic flows, we conducted field instrumental measurements. During the measurements, the observation intervals included daytime hours on weekdays during peak periods, and the average number of vehicles per hour in the traffic flow was calculated. Acoustic measurements were carried out at five observation points in different districts of the city.

Keywords: Infrasound, Environmental impact, Traffic noise, Infrasound monitoring, Infrasound parameter

IST25-60.

Assessing Air Traffic Controller Workload Under Notice to Airmen-Based Airspace Restrictions Using Fast-Time Simulation

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Abstract: Air traffic controller (ATCO) workload arises not only from the number of flights handled but from the complexity of the traffic situation. Sector design, flow geometry, and restrictions such as Notice to Airmen (NOTAM) closures can rapidly amplify workload by concentrating demand and creating conflict hot spots. In such cases, simple counts of aircraft no longer capture the real burden on controllers, as coordination, conflict resolution, and radio-telephony exchanges grow in intensity. This study applies fast-time simulation (FTS) with AirTOP to examine how sudden airspace closures reshape workload. Two scenarios were evaluated: normal baseline operations and a restricted-area closure that forced traffic rerouting through adjacent sectors. Workload definitions were grounded in controller surveys and time-and-motion task observations. Results show that rerouting significantly increased entry rates, occupancy, and interaction complexity, producing higher conflict management and coordination needs. The findings demonstrate that FTS is an effective tool for quantifying workload under dynamic restrictions and can support proactive ATFM planning during crises and contingencies.

Keywords: Air traffic control, Workload, Fast-time simulation, AirTop, NOTAM, Air traffic complexity

■ IST25-61.

Enhancing Sustainable Aviation Through a Digital Twin Approach to Real-time Avionics Monitoring

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Abstract: Technical advances of innovative technology have become labeled as vitally important as the aviation industry grows under increasing pressure to be able to operate to demanding sustainability criteria while continuing to operate efficiently and safely. In efforts to improve predictive maintenance, increase on-demand operational time, and foster environmental sustainability, this study examines the definition and use of a digital twin-based architecture designed specifically for avionics systems.
Further, there's more to digital twin technology than just enhancing maintenance capability; it's central to driving sustainability goals within the aviation industry. The digital twin extends the operational life of avionics equipment and improves performance of systems, thereby reducing waste and unnecessary resources. By identifying degradation patterns earlier, this approach enhances operational safety while minimizing environmental impact. To quantify this effect, a simulation was conducted over a 100-hour operational cycle. Traditional maintenance strategies, which fail to detect early deterioration, result in approximately 12,475 kg of CO_2 emissions. In contrast, the Digital Twin-enabled predictive maintenance model identifies failure signs by hour 53, enabling timely intervention. This optimized approach limits emissions to 6,115.5 kg, demonstrating a CO_2 savings of approximately 6,359.5 kg a reduction of more than 50% over the same operational timeframe.

Keywords: Digital Twin, Sustainable Aviation, Avionics Monitoring, Predictive Maintenance, Intelligent transportation, Green mobility

■ IST25-62.

Technological Approaches for the Remediation of Anthropogenically Impacted Soils at Airport-Influenced Areas

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Abstract: Airport operations exert significant anthropogenic pressure on surrounding soils by pollution with petroleum hydrocarbons, heavy metals, and other pollutants. Effective remediation of such impacted soils is critical for environmental protection and sustainable land use. This study focuses on technological approaches that utilize mineral fertilizers to enhance soil recovery in airport-influenced areas. Mineral fertilizers supply essential nutrients, stimulate microbial activity, and improve soil physicochemical properties, thereby accelerating the degradation of petroleum hydrocarbons. Experimental data indicate that targeted application of nitrogen, phosphorus, and potassium-based fertilizers significantly improves remediation outcomes. The results highlight effectiveness of soil remediation with mineral fertilizer as a cost-effective, scalable, and environmentally sustainable strategy for rehabilitating soils affected by airport activities. This approach supports sustainable restoration with reintegration of impacted lands into productive environmental and economic use.

Keywords: Sustaiable Aviation, Eological Safety, Aviation Fuels, Soil pollution, Remediation

■ IST25-63.

Analysis of Safer Alternatives to Lithium-Ion (Li-Ion) Batteries

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Abstract: The article analyses the principle of operation, charge-discharge processes, and energy management of Li-ion batteries. The popularity of Li-ion batteries is well-founded. The main problems of Li-ion batteries arise at the next stage. These include the limited capacity of such batteries, overheating and ignition, loss of capacity over time, and memory effect.
Safer alternatives to Li-ion batteries are being examined. For example, the working principle of lithium-iron-phosphate (LiFeO4) batteries is examined, and the reasons why they are a good alternative are shown. The working principle, application areas, and differences from Li-ion batteries are analyzed.
Other safe alternatives are hydrogen fuel cells and metal-air batteries. Despite the significant advantages of these batteries, each has been shown to have its own shortcomings and technical complexities. Therefore, the production of batteries with safer, more efficient, and sustainable energy storage systems continues to be on the agenda in the future.

Keywords: Lithium-ion batteries, Energy storage, Metal-air batteries, Energy management, Hydrogen fuel cells

■ IST25-64.

The Vertical City: Foundational Concepts for Sustainable Urban Air Mobility

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Abstract: Cities today face two big problems: terrible traffic and the need to meet ambitious sustainability goals. Traditional transportation systems that use the ground are already under a lot of stress from more people moving to cities. They also make a lot of greenhouse gases, air pollution, and provide unfair access to transportation. Urban Air Mobility (UAM) has become a game-changing idea that adds a third, vertical dimension to urban transportation. UAM wants to build a safe, sustainable, and efficient network of passenger and goods transport above cities using new technologies like electric propulsion, automation, and lightweight materials. This paper lays the groundwork for sustainable UAM by defining the urban mobility crisis, placing UAM within the larger urban transport ecosystem, and outlining its main parts: vehicles, infrastructure, and operational subsystems. The framework also includes principles of environmental, economic, and social sustainability to see if UAM could be a good and fair solution. This work aims to help create well-informed policies, strong research agendas, and long-term deployment plans for the vertical city of the future by clearly defining important terms and analytical dimensions.

Keywords: Urban Air Mobility (UAM), Vertical City, Sustainable transportation, EVTOL Aircraft, Vertiports, Smart Cities, Mobility innovation

- IST25-65.

Transport System Development Strategy in the Context of the Country's Economic Growth

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Abstract: The national economic system is presently undergoing a challenging developmental phase, marked by Ukraine's integration into globalization processes, further complicated by ongoing military operations within Ukrainian territory and the lingering consequences of Covid-2019. This situation necessitates the objective formulation of a quantitative and qualitative systemic and situational justification for the advancement of Ukrainian Railways through the adoption of advanced technologies and approaches. This article substantiates theoretical provisions, develops methodological approaches, and formulates practical recommendations for enhancing the management mechanism governing the development of business-integrated processes within the Ukrainian transport system, specifically the Ukrainian railway. This enhancement is achieved through the utilization of lean manufacturing tools to augment the competitiveness of the Ukrainian transport system in the international market of transport services and to position it as a full-fledged participant in the global system of international transport corridors. The proposed management mechanism incorporates universal marketing tools, enabling the formation or adjustment of marketing strategies to secure additional competitive advantages in a dynamic international market environment.

Keywords: International transport corridors, Transport system, Lean manufacturing, Marketing strategy, Sustainable development, International business, Economic development, Economic crises

- IST25-66.

VALDES evaluation platform for new aircraft designs within environmental priorities

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Abstract: EU EFACA project considers conceptual designing of two new types of aircraft – 80-seat regional jet with hydrogen-powered hybrid electric propulsion system (HEP) and 150-seat short-medium range jet with liquid hydrogen (LH2) fueling of the engines. For both types the TLAR are defined so as their conceptual aircraft layout, main dimensions and flight masses, schemes of power supply during the flight. The reference aircraft for both of them proved: ATR72-600 for the HEP aircraft and Airbus-320neo for the LH2-fueled aircraft. The principles of aircraft fuel burn, emission, noise analysis and assessment of the baseline aircraft in comparison with reference aircraft in the EFACA project are formulated for three levels of their evaluation – aircraft, airport and fleet scenarios of current and future air traffic in the European perspective. For these purposes the VALDES evaluation platform was designed and developed further in current EFACA project with detailed analysis of the aircraft design and its flight performances' influence on environmental impact assessment. VALDES platform considers three levels of the assessment – beginning from the certification principles (zero level) and after the landing-take-off footprints, the airport and fleet impact analysis.

Keywords: Sustaiable Aviation, Hybrid Electric Propulsion, Liquid Hydrogen, Noise, Emission, Fuel Burn

IST25-67.

Global Standards for Sustainable Development in the Context of Fragmentation of the World Economy

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Abstract: The issues of developing global standards for sustainable development in the context of fragmentation of the world economy are considered. Attention is paid to the development of the world economy in the context of its transition from globalization to fragmentation. It is determined that the fragmentation of the world economy determines the development of the main risks at the global level. It is concluded that multipolarity is a reality that develops along with the process of fragmentation of the world economy. It is necessary not only to perceive multipolarity as a reality of global economic and political processes, but also to strive to use it to achieve the goals of sustainable development.

Keywords: Sustainable Development, Globalization, Fragmentation, World Economy, Global Economic Risks

IST25-68.

Integrating Drone Technology into Smart Urban Transport Systems: An Intelligent Management Approach

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Abstract: Rapid advances in unmanned aircraft technologies have produced compact, affordable platforms capable of increasingly autonomous flight, enabling a range of use cases from parcel logistics to on-demand personal mobility. Bringing large numbers of these vehicles into the urban low-altitude airspace, however, stresses systems that were initially built for crewed aviation. Legacy air traffic infrastructure lacks the scalability, automation, and staffing models needed to handle dense operations in complex city environments. This work proposes an intelligent drone management system tailored to smart-city transportation. We (i) define a city-specific reference framework for integrating drones within multimodal transport networks, (ii) design an advanced urban airspace coordination layer for strategic and tactical deconfliction, (iii) incorporate Internet-of-Things and Internet-of-Drones capabilities for resilient fleet supervision and data exchange, and (iv) outline safe, efficient procedures for approach, landing, and turnaround at designated sites. Together, these elements provide a pathway for reliable, scalable, and safe integration of unmanned aerial vehicles into future smart-city mobility ecosystems.

Keywords: Intelligent transportation system, Drone, Smart City Transportation, Low Altitude Airspace, Intelligent Drone Management System

IST25-69.

Developing Competitive Capability in Transport Services within the Framework of the Blue Ocean Strategy

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Abstract: This article examines the role of Blue Ocean Strategy and innovation-based models in achieving competitive advantage in the transport services sector. In a context where traditional competitive strategies create limited opportunities in saturated markets, differentiation and value innovation have become one of the main strategic goals. Blue Ocean Strategy allows companies to simultaneously implement both differentiation and low-cost strategies by creating new, untapped areas in the market by avoiding competition. On the other hand, innovation-based models applied in transport services – especially smart mobility, digital platforms and multimodal logistics systems – not only improve service quality, but also increase operational efficiency and customer satisfaction. As a result of the qualitative analysis conducted during the study based on various country and company experiences, as well as scientific sources, it was found that companies adopting these strategies are able to achieve sustainable competitive advantage in the market, optimize costs and form different value propositions in the market. The results of the article show that the integration of technological and organizational innovations with Blue Ocean tools (e.g., Strategy Canvas) serves to build business models in the transportation sector that are flexible, sustainable, and able to meet modern market demands.

Keywords: Blue Ocean Strategy, Innovation-based models, Competitive advantage, Transport services, Sustainable mobility

IST25-70.

A Multi-objective Optimization Model to Reduce Carbon Emissions from Empty Container Movements

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Abstract: Maritime transportation, which is indispensable for world trade, causes approximately three percent of the world's carbon emissions. Container shipping is significantly affected by international regulatory environments and technological developments in terms of carbon emissions, as it carries more than fifty percent of the cargo in global trade in terms of cargo value. Many organizations, especially IMO, have set various targets for reducing carbon emissions. Container shipping companies are taking initiatives to reduce carbon emissions. ECM (empty container movements), a logistical necessity arising from imbalances in world trade in container shipping, also causes carbon emissions and operational inefficiencies in the maritime sector. As is known, ECMs do not provide customers with added value and cause both high costs and carbon emissions. For that purpose, this study introduces a multi-objective optimization model that has been developed to minimize ECM costs and carbon emissions caused by ECM. The first objective of the model minimizes total ECM costs, while the second objective function minimizes carbon emissions from ECM. We tested the model with real data and found that ECM planning can significantly reduce carbon emissions. In this respect, the model developed in this study can be used as a decision support tool for real-life applications in the container shipping industry.

Keywords: Explosive detection, Ion mobility spectrometry, Aviation security, Express detection systems, Civil aviation

■ IST25-71.

Express Detection of Explosives: Device Design and Prospects for Implementation in Civil Aviation

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Abstract: In the face of escalating global threats and the persistent risk of terrorism targeting the aviation industry, the development and deployment of rapid, highly sensitive, and reliable systems for the detection of explosive materials have become an essential component of modern civil aviation security infrastructure. Ensuring the safety of passengers, personnel, and critical aviation assets requires not only rigorous screening procedures but also the implementation of advanced technologies capable of identifying even trace quantities of explosive substances with high accuracy and minimal delay. This paper focuses on the design principles, detection mechanisms, and operational characteristics of an express detection device based on ion mobility spectrometry (IMS), a technology that enables real-time identification of explosive vapors or particles. The study explores the core advantages of IMS, such as fast response time (typically under 10 seconds), high selectivity, and compact form factor, which make it particularly suitable for use in busy airport environments.
We further analyze the practical considerations associated with deploying IMS-based systems in civil aviation, including optimal integration points within the airport security workflow, personnel training, maintenance requirements, and potential challenges such as false alarm rates and environmental interferences. Special emphasis is placed on evaluating the adaptability of such systems to diverse operational conditions (e.g., temperature, humidity, and passenger flow density). By identifying the critical performance parameters and evaluating real-world test scenarios, this research highlights the strong potential of IMS-based express detection devices to significantly enhance threat detection capabilities and overall aviation security.

Keywords: Explosive detection, Ion mobility spectrometry, Aviation security, Express detection systems, Civil aviation

■ IST25-72.

Artificial Intelligence-Driven Strategies for Sustainable Maritime Transportation: Enhancing Efficiency, Safety, and Environmental Performance

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Abstract: This paper investigates AI as a strategic enabler with sustainability in maritime transport discussing how AI-driven applications will be able to meet the IMO 2023 targets for greenhouse gases while improving operational efficiency and safety. Thus, the key managerial and policy issues under consideration include predictive maintenance, smart routing, port automation, and digital twin technologies that are raised together with broader incentive policies, digital infrastructure, and human capital development. The methodology rests on the contemporary literature systematically reviewed and enriched by case-based evidence from leading maritime hubs like Rotterdam and Singapore. The results show that fuel consumption may be reduced by 5-20%, vessel idle time by 15-30%, and operational downtime by up to 45%. Also, AI-based navigation and decision support systems reduce the human element which is about 80% of maritime accidents, thus enhancing safety management. The novelty and value of this paper are in conceptualizing AI not as an additive tool but rather as a transformative driver of maritime decarbonization, competitiveness, and risk minimization. In essence, this paper puts forward that to achieve successful AI adoption, coordinated actions by policymakers, industry stakeholders, and international organizations towards scalable, fair, and sustainable adoption.

Keywords: Artificial Intelligence, Maritime Transportation, Sustainability, IMO Decarbonization, Port Automation

IST25-73.

The problem of minimizing transportation costs during consolidation of industrial waste by destination

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Abstract: The problem of minimizing transportation costs during consolidation of industrial waste by destination is considered, which generalizes the classical traveling salesman problem. The route that provides the lowest fuel consumption of the vehicle that carries all the intended industrial waste is considered profitable. The work introduces a rule for determining fuel consumption, depending on the weight of the waste and the vehicle itself, and builds a mathematical model of the problem of determining the optimal transportation route. Since the problem turns out to be nonlinear, it is proposed to build a possibly acceptable transportation route using a greedy algorithm.

Keywords: Industrial Waste Transportation, Non-Classical Traveling Salesman Problem, Profitable Route, Mathematical Model, Greedy Algorithm

IST25-74.

Assessment of Circular Indicators for Sustainable Shipping

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Abstract: The maritime sector, which is vital to global trade, must align with IMO's 2050 decarbonization targets as soon as possible. This study addresses the complex interplay of environmental, economic, and technical challenges, identifying and prioritizing critical indicators for sustainable shipping and including an action plan for stakeholders. Using the Analytical Hierarchy Process (AHP), key criteria such as carbon emission reduction potential, capital investment (CAPEX), operating costs (OPEX), and alignment with renewable energy sources were evaluated based on expert opinions. The results revealed that reducing carbon emissions was the most important indicator. The findings provide a viable framework for guiding strategic investments and stakeholders, emphasizing the need for integrated solutions to achieve a sustainable maritime future.

Keywords: Shipping, Sustainable Shipping, Energy Management, AHP, Efficiency and sustainability

■ IST25-75.

A Simulation-Driven Approach to Optimizing Public Transit Departure Protocols at Major Airport Facilities Under Emergency Evacuation Conditions

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Abstract: Large-scale airports encounter significant challenges in managing ground transportation systems that must efficiently accommodate routine passenger flows while maintaining rapid emergency evacuation capabilities. This study employs a discrete-event simulation model integrated with multi-criteria optimization algorithms to establish optimal bus departure intervals, route configurations, and capacity allocation strategies. The optimization framework evaluates multiple performance metrics: passenger waiting times, vehicle utilization efficiency, fuel consumption, CO_2 emissions, and emergency response effectiveness. Computational validation using real-world airport data demonstrates substantial system performance enhancements. The research advances sustainable airport operations by providing transportation planners with comprehensive optimization tools for ground access systems while preserving emergency preparedness standards. The synthesis of environmental sustainability metrics with operational efficiency establishes a holistic framework for contemporary airport ground transportation management, supporting aviation industry commitments to environmental impact reduction while improving passenger experience and safety protocols.

Keywords: Airport ground transportation, Bus scheduling optimization, Passenger flow management, Real-time optimization, Environmental impact assessment

■ IST25-76.

Assessment of Energy Efficiency Design Strategy for Ships Considering Functional Analysis

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Abstract: The responsibilities arising from the global climate change have necessitated energy-efficient design and applications in shipbuilding processes. This study aimed to develop an energy-efficient design model of a reference dry cargo vessel using a functional analysis-based methodology. Within the scope of the study, the design process of the ship with a capacity of 20,000 DWT and four holds, which was evaluated to operate on the Mediterranean-Northern Europe line, was shaped by five different parametric evaluations. These functions, technical components such as dual-fuel engines, energy management systems, function-component matrices, connection matrices and functional block diagrams were created and design priorities were determined. Based on the IMO's 2050 vision, the approach shows that the results are in line with the targets and that adaptation to future technological and legislative changes can be achieved. At the end of the study, a guideline evaluation of the energy-efficient approach in the ship design process is also presented.

Keywords: Shipyards, Energy Management, Frontier Analysis, Efficiency, Sustainability

IST25-77.

Second-life lithium-ion batteries storage for stationary energy systems in Azerbaijan

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Abstract: The accelerated proliferation of electric and hybrid vehicles (EHVs) in Azerbaijan has resulted in a substantial increase in the quantity of end-of-life lithium-ion batteries (LIBs), thereby giving rise to pivotal challenges pertaining to the disposal of these batteries and the safeguarding of environmental safety. In circumstances where domestic recycling infrastructure is not available, alternative strategies, such as the repurposing of second-life batteries, are garnering attention. The present study explores the feasibility of reusing retired automotive LIBs in stationary energy storage systems, particularly when integrated with photovoltaic solar power systems. This study focuses on the second life approach of LIBs, which involves evaluating the technical, ecological and economic viability of repurposing automotive LIBs for use in stationary storage applications. Unlike recycling, which involves breaking down battery materials, second-life use makes use of the residual capacity of retired batteries, which typically retain 70 – 80% of their initial performance. These batteries can be redeployed effectively in applications with lower demand, such as grid stabilisation and renewable energy storage, particularly in solar and wind systems. This repurposing can extend battery life by an additional 5 to 8 years, contributing to environmental sustainability and economic efficiency.

Keywords: Lithium ion batteries, Solar energy, Second life reuse, Circular economy, Energy storage

IST25-78.

Cold Chain Sustainability in Transportation: The Emerging Role of Phase Change Materials

Salih Bakkal, Pınar Gürol*

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Abstract: Cold chain logistics is indispensable for ensuring the safety and quality of perishable products. However, conventional refrigeration systems contribute significantly to greenhouse gas emissions and rising operational costs. This paper provides a structured literature review of Phase Change Materials (PCMs) as a sustainable alternative in cold chain transportation. PCMs, with their ability to store and release large amounts of latent heat during phase transitions, enhance energy efficiency, stabilize temperature fluctuations, and reduce carbon footprint. Comparative analysis shows that PCM-based systems can lower energy demand, mitigate product spoilage risks, and improve resilience against energy interruptions. Yet, challenges such as supercooling, leakage, and high initial investment remain barriers to large-scale adoption. The findings suggest that PCMs should be integrated into hybrid cold chain systems, complementing conventional refrigeration. This integration not only supports Sustainable Development Goals (SDGs) and ESG criteria but also fosters circular economy practices.

Keywords: Cold chain logistics, Phase Change Materials (PCM), sustainability, Energy efficiency, Transport emissions

IST25-79.

The Application of the Green Leasing Model in Civil Aviation

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Abstract: In an era where countries and industries are applying innovative development for ecological and economic sustainability, the green leasing model in civil aviation has become competitive with the traditional leasing model. The leasing model that finances and quickly incorporates environmentally friendly, ecologically sustainable green aircraft into a fleet is called green leasing. The implementation of this model reduces carbon emissions and noise pollution, and by increasing energy efficiency, it ensures airlines sustainable economic activity by allowing them to achieve higher profits. Green leasing encourages the purchase and use of ecological, energy-efficient, and low-emission aircraft among aircraft manufacturers, airlines, and leasing companies. The article includes the theoretical foundations, advantages, and challenges of the green leasing model, as well as the airlines that use it in global practice, the types of aircraft operated, and the incentive programs of international organizations. Based on the economic evaluation of the green leasing model in the civil aviation industry's progress towards zero-emission flights, several recommendations have been noted in accordance with its future prospects and relevant results.

Keywords: Green Leasing, Civil Aviation, Carbon Emission, Noise Pollution, Fuel Efficiency

IST25-80.

Decarbonization Responsibility of Route Planning to Ice-Covered Arctic Waters

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Abstract: While the impact of maritime transport in world trade is increasing rapidly, the advantages of arctic routes in the global cycle of traffic between east and west have become an important issue in sectoral evaluations. However, only route change over existing technologies can create a significant problem area in terms of environmental impact. This study, which was developed in this context, revealed the possible effects of an entropy-based evaluation on the environment in the possible arctic route preference. In the study, a modeling study was presented based on the container ship data derived. In the study, the possible decarbonization rate was found to be 77.80%, especially within the scope of sectoral responsibility. This performance was also found to be 44.60% for the improvement potential (IP) for 11 container vessels examined in terms of possible environmental impact. At the end of the study, evaluations were made on the current fuel-induced artic route effect of ships in sectoral decarbonization

Keywords: Shipping, Arctic Route, Decarbonization, Environment, Sustainability

IST25-81.

Modern Public–Private Partnerships in International Aviation Business: Governance, Innovation, and Sustainability Perspectives

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Abstract: This paper explores the evolving role of Public–Private Partnerships (PPPs) in the aviation sector, with a particular focus on sustainability-oriented arrangements. While traditional PPPs have largely focused on infrastructure financing and service delivery, recent years have seen the emergence of new forms such as Regulatory/Policy PPPs and Innovation PPPs. These models reflect deeper shifts in governance logics, industry transformation, and sustainability imperatives. Drawing on international examples and comparative insights, we propose a refined typology of aviation PPPs and discuss their relevance for achieving decarbonization, efficiency, and regulatory coherence in global aviation. The findings demonstrate the increasing importance of collaborative arrangements not only for infrastructure development, but also for rule-making, technology co-development, and long-term systemic transition.

Keywords: Aviation, Economic Regulation, EU, Germany, Public–Private Partnerships, Ukraine

IST25-82.

Environmental Comparison of the Eurasian Trade Corridors

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Abstract: While the most traditional maritime trade corridor between Asia and Europe is the Bab el-Mandeb Strait-Red Sea-Suez Canal route (SCR), traffic through the region has halved since the end of 2023 following Houthi attacks on Israeli-linked merchant ships operating along SCR. This development, which enables the environmentally friendly distribution of large cargo amounts, has led ships to reroute to the safer Cape of Good Hope route (CR), thereby increasing fuel consumption and associated emissions. Furthermore, the attacks have increased the popularity of the Northern Sea Route (NSR). Finally, with recent developments regarding the Zangezur Corridor, the Middle Corridor, or the Trans-Caspian International Transport Route (TITR), it is expected to increase its capacity for Asia-Europe freight transport. Secondary sources are used in this study to assess these corridors from an environmental perspective. It is concluded that international cooperation, infrastructure investment, and policy support are necessary to shift freight flows to sustainable corridors.

Keywords: Sustainable Transport, Suez Canal Route, Cape of Good Hope Route, Northern Sea Route, Middle Corridor

IST25-83.

Exploring Various Options For Efficient Intermodal Freight Transportation With Containers

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Abstract: Compared to conventional transportation methods, research on various alternatives of efficient intermodal freight transport using containers has revealed that, in addition to comparing certain transportation indicators through calculations, positive outcomes can also be achieved by testing and implementing high-risk projects in real practice. It should not be overlooked that the most challenging aspect of such transportation is the establishment of unified and precise management of operations. Nevertheless, it must also be taken into account that, under local conditions, the application of multimodal, intermodal, amodal, container, roadrailer, and railtrailer transportation technologies can accelerate shipments, reduce traffic congestion and time losses on highways, and improve the processes of regulating complaints in cases of accidents or container losses.

Keywords: Railway transport, Intermodal transportation, Transportation distance, Combined transportation, Acceleration of transportation

IST25-84.

GO Nanoparticle-Doped κ-Carrageenan Ecofriendly Antifouling Hydrogels: Experimental Deformation Analysis under Marmara Sea Water Condition

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Abstract: This study focuses on the development of ecofriendly antifouling gels through free-radical crosslinking copolymerization, incorporating nanoparticles to enhance mechanical performance. 5, 20, 30 and 50 µl of multi-walled carbon nanotubes (MWCNTs) were used as nanofillers in κ-carrageenan (κC)-based hydrogels to investigate their effects on mechanical behavior under Marmara sea water condition.Experimental results in laboratory scale demonstrated a significant enhancement in mechanical strength and durability of the gels with increasing MWCNTs nanoparticle concentration that swells out in Marmara seawater.This work presents a novel, sustainable approach to antifouling technologies by combining environmentally safe biopolymer matrices with mechanically reinforcing nanomaterials, offering a green alternative to conventional coatings.

Keywords: Ecofriendly antifouling gel, Multi-walled carbon nanotubes (MWCNTs), Mechanical properties, Experimental approach, Marine coatings

■ IST25-85.

Financial Sustainability Analysis in Airports

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Abstract: The aim of the study is to analyze the financial sustainability of airport operators in terms of financial, environmental, social, and governance aspects. Based on 2023 data from 28 airport operators, financial sustainability levels were determined using LOPCOW-CRADIS methods. The study evaluated financial profitability indicators (ROA, ROE, GPM, OPM, EBITM) and sustainability criteria (Environmental, Social, and Governance and ESG) together. The weights determined using the LOPCOW method showed that ROE and ROA are the most important criteria in determining financial sustainability. The study's findings suggest that the sustainability of airport operators depends not only on environmental, social, and governance impacts but also on a strong financial structure. It is recommended that financial, environmental, and social indicators be evaluated in a balanced manner, asset utilization efficiency be improved, ESG investments be supported, and revenue diversification strategies be developed.

Keywords: Financial Sustainability, Sustainable Transport, MCDM, ESG, Aviation Management

■ IST25-86.

Maritime Digital Transformation: Opportunities and Challenges for Sustainable Development

Umut Taç*, Ali Cem Kuzu

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Abstract: Digital transformation has emerged as a defining feature of modern industries, characterized by the integration of advanced technologies into core processes to enhance efficiency, competitiveness, and adaptability. In the maritime sector, this shift is particularly significant given the industry's role in global trade and its dependence on complex logistics and operational systems. This study investigates the opportunities and challenges of digital transformation in maritime operations through a combination of systematic literature review and expert consultation. The research followed three stages: thematic analysis of academic and industry sources, validation through structured meetings with twelve maritime professionals, and clustering of findings based on relevance, feasibility, impact, and urgency. The results produced eight key opportunities and eight key challenges. Opportunities include efficiency gains through IoT, AI, and blockchain, improved decision-making, enhanced supply chain transparency, sustainability benefits, and immersive training. Challenges center on high costs, legacy system integration, regulatory complexity, workforce skill gaps, organizational resistance, and cybersecurity risks. The study concludes that targeted investment, workforce development, and collaborative frameworks are essential to achieving effective and sustainable digital transformation in the maritime sector.

Keywords: Digital Transformation, Digitalization, Maritime Industry, Sustainability, Innovation Management

IST25-87.

The Role of Artificial Intelligence in Eliminating Traffic Congestion During the Implementation of the Green Wave Regime

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Abstract: Activity flag control is a critical portion of shrewdly transportation. Effective activity flag control techniques not as it were lightening activity clog, move forward vehicle activity productivity, but to diminish debilitate contamination amid the holding up period. The conventional numerous crossing point flag light control strategy are by and large confronted with detached control and cannot adjust to complex changes. In see of this, the think about to begin with combines support learning and Markov choice to develop a flag control issue show for numerous crossing points. Besides, profound Q-learning systems are presented for choice tackling, and multi-head consideration components and chart convolutional systems are assist presented for optimization and advancement. At long last, a spatial lightweight show for different crossing point versatile chart convolution is proposed. This article examines the causes of traffic congestion and analyzes the role of the "Green Wave" regime in preventing these problems. At the same time, the role and prospects of artificial intelligence technologies in optimizing this regime are discussed. The approaches presented in the article aim to effectively manage traffic flows, maintain ecological balance, and increase urban mobility.

Keywords: Traffic congestion, Green wave mode, Artificial intelligence, Road monitoring systems, Intelligent transport system

IST25-88.

Maritime Transport and Its Alignment with the Sustainable Development Goals

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Abstract: United Nations' Sustainable Development Goals (SDGs) were adopted to end poverty, protect our planet, and ensure all people enjoy peace and prosperity by 2030. Of the 17 SDGs, almost all are related to sustainability in one way or another, and some address the maritime sector directly or indirectly. This study approached the SDGs from the perspective of sustainable transportation in the maritime sector, classifying them based on their impact on sustainability. It was found that three of them, SDG 9 – Industry, Innovation, and Infrastructure, SDG 13 – Climate Action, and SDG 14 – Life Below Water, are directly linked to sustainable maritime transport, since they focus on the development of resilient infrastructure, the reduction of environmental impacts, and the protection of marine ecosystems. On the other hand, SDG 7 – Affordable and Clean Energy, SDG 8 Decent Work and Economic Growth, SDG 11 – Sustainable Cities and Communities, and SDG 12 – Responsible Consumption and Production are indirectly related, as they support sustainability by promoting the adoption of clean energy, efficient resource use, and collaborative frameworks among stakeholders. The study demonstrates that aligning maritime transport practices with these SDGs can enhance environmental performance, foster technological innovation, and encourage global cooperation.

Keywords: Sustainability, Maritime Transport, Sustainable Development Goals (SDGs), Green Shipping, Blue Economy

IST25-89.

Legal Challenges of Counter-Unmanned Aircraft Systems Technologies in Civil Airports

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Abstract: The proliferation of Unmanned Aircraft Systems (UAS) has introduced significant security and operational challenges for civil airports worldwide. Counter-Unmanned Aircraft Systems (C-UAS) technologies offer a potential solution, but their deployment is constrained by complex legal frameworks, jurisdictional ambiguities, and privacy concerns. This paper analyses the legal challenges associated with implementing C-UAS systems in civil aviation environments. The study examines national and international regulatory approaches, including European and global frameworks, as well as relevant case law. Findings reveal key gaps in legislation, such as unclear authority over drone interdiction, limitations on technology deployment due to privacy laws, and the absence of harmonized certification standards. The paper concludes by proposing regulatory and policy measures to facilitate the safe and lawful integration of C-UAS systems in airports, balancing operational security with human rights and public safety considerations. The analysis contributes to the understanding of how legal frameworks can adapt to emerging unmanned threats while supporting resilient and sustainable civil aviation operations.

Keywords: Drone law, Counter-UAS, Airport security, Aviation regulation, Unmanned aircraft systems

IST25-90.

Positive Developments of Digitalization and Technology in the Commercial Activities and Management Systems of Maritime Businesses

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Abstract: Information technology is a sector that has given its name to our era and is a driving force for all other sectors. This sector, where the impact of technological advancements is most evident, has been experiencing rapid and aggressive changes in recent years. The IT sector's dependence on technology and its continuous developments mean that all other sectors are affected to varying degrees.

The IT sector is causing significant changes in both the work and working styles of individuals and businesses. Recent advances, particularly in the fixed and mobile infrastructures that form the communication element of IT, are increasing data speeds and reducing latency with each new generation. As a result, the work and working conditions of employees have been changing significantly in recent years.

One of the areas most affected by IT today is the Maritime Sector. The business structures, competitive conditions, and applicable regulations of this sector necessitate seafarers to closely monitor and utilize technological advancements to the fullest extent. As technology advances, seafarers' duties and the systems they use change significantly.

Therefore, seafarers in different roles are required to receive additional training on specific processes related to the systems they use. This training is also mandated and certified by national/international regulations.

In recent years, as manual systems on ships have been replaced by smart, remote-operated systems, additional training, particularly for officer-class personnel, focuses on the use of remote-controlled systems, basic electronics and software training, and the use of artificial intelligence in these systems.

Keywords: IT Sector, Developments of Digitalization, Maritime Business, Maritime Communication, Ship Management

IST25-91.

The Implementation of the Safety Management System at Airport and Its Impact on Organization's Economy

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Abstract: The article outlines the key elements of the idea of developing an international system to guarantee national flight safety in the Republic of Azerbaijan's air transportation. Mechanisms for lowering the number of incidents in air travel are suggested, along with examples of the primary elements influencing flight safety. During busy civil aviation flights, effective preventive measures are suggested to avoid emergency and unusual situations as well as aviation incidents.

To create a modern Flight Safety System for Azerbaijani air transport, it is necessary to analyze all the factors that can lead to possible aviation accidents. A factor is understood as a certain action, event, situation or condition, the presence or absence of which increases or decreases the probability of a favorable outcome of an aviation flight. The technical and organizational complexity of aviation technical systems, the large number of aviation personnel of various services involved in the organization, preparation, execution and support of flights, as well as the operation of aircraft and helicopters in a wide range of weather and climatic conditions create a significant number of components that affect the final outcome of the flight.

Keywords: Airplane, Aircraft, Aviation transport, Flight safety system, Aviation acciden

IST25-92.

The Distinction Between the Carrier and the Actual Carrier in Turkish Law and the Emerging Legal Issues

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Abstract: In practice, carriers frequently delegate the performance of carriage to third parties, referred to as subcarrier or subcontractors or actual carriers, for various reasons. This leads to the conclusion of multiple carriage contracts in respect of the same goods or passengers. Such circumstances particularly raise the question of which party or parties are liable for compensation in case of damage. Accordingly, the precise determination of the status of the parties engaged in a carriage relationship is of considerable importance. This study therefore examines certain legal issues arising from the determination of the carrier and the actual carrier.

Keywords: Carrier, Actual carrier, Carriage, Goods, Turkish law

IST25-93.

ESG Disclosure and Financial Performance: Causality Evidence from the Airline Industry

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Abstract: Sustainability has become a key focus not only for individuals but also for firms. There is strong evidence suggesting a close relationship between firms' sustainability efforts and profitability. However, the causality between ESG disclosure and profitability within the airline industry has been largely overlooked. This study examines the causal relationship between sustainability and financial performance using ESG disclosure and ROA data from 25 airlines over the period 2010–2024. The Dumitrescu-Hurlin panel causality test is employed to analyze this relationship. The findings indicate that financial performance (ROA) significantly influences firms' sustainability practices.

Keywords: Airline Industry, ESG disclosure, Environmental sustainability, Financial performance, Dumitrescu–Hurlin panel causality test

IST25-94.

The Effect of On-the-Job Training on Sustainability in Maritime Transportation

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Abstract: The maritime transportation sector plays a critical role in international trade and global economic development, but it also faces significant challenges regarding safety, energy efficiency, and environmental sustainability. On-the-job training (OJT) has become an essential component of human resource development for maritime sector, as it bridges the gap between formal education and operational competence. This study investigates the contribution of OJT to sustainability in maritime transportation, emphasizing how well-trained seafarers can reduce operational risks, enhance energy efficiency, support the adoption of green technologies, and ensure compliance with international regulations. The study highlights that investing in OJT is not only a matter of human capital development but also a pathway to achieving the environmental, social, and governance (ESG) objectives of the maritime industry.

Keywords: On-the-job training, Human capital development, Energy efficiency, Maritime Safety, Sustainability in maritime

IST25-95.

Econometric evaluation of customs revenues from container transportation in Azerbaijan: trade facilitation and growth implications

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Abstract: This study investigates the role of customs control and clearance in container transportation within the Unified Transport System of Azerbaijan, emphasizing trade facilitation and economic security in international freight operations. Using statistical data from 2010–2024 and econometric modeling with EViews-12, the paper evaluates the impact of customs revenues from container transportation on economic growth. The analysis shows that maritime transport dominates imports and exports, while road and air modes have gained importance in recent years. Rail transport, though less significant in overall trade value, has demonstrated resilience in times of crisis. Econometric analysis for 2013–2023 reveals a strong correlation between revenues from container transport and foreign trade turnover. Forecasting suggests that revenues from maritime container transport will continue to grow, reaching approximately 46.1 million AZN by 2030. The findings underline the necessity of strengthening container logistics, modernizing maritime and rail infrastructure, and harmonizing customs procedures with international best practices to enhance Azerbaijan's trade competitiveness and economic growth.

Keywords: Unified transport system, International freight transportation, Container transportation, Customs clearance, Customs regulation

IST25-96.

The Impact of Tsunami Hazard in the Sea of Marmara on Ports and Maritime Transportation

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Abstract: This paper examines the tsunami hazard in the Sea of Marmara and its potential impacts on ports and maritime transportation, particularly focusing on Istanbul's coastal infrastructure. Simulation studies indicate that tsunami waves can reach Istanbul's shores within 7 minutes, posing significant risks to key ports such as Haydarpaşa, Ambarlı, and Asyaport. The vulnerability of port structures, including the lack or inadequacy of breakwaters, increases the risk of container and equipment drifting into the sea, which could disrupt maritime traffic and logistics operations. From a maritime business and operations perspective, the potential interruption of shipping routes, damage to port facilities, and the risk to vessels and cargo highlight the critical need for robust emergency response plans and resilient infrastructure. The study highlights the importance of integrated hazard and risk analyses, emergency preparedness, and resilient infrastructure design to mitigate the effects of both earthquakes and tsunamis in this seismically active region.

Keywords: Maritime Transportation, Maritime Business, Tsunami, Marmara Sea, Ports

■ IST25-97.

Sustainable Transportation as a Vector of Regional Integration: The Role of EU Initiatives in the South Caucasus

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Abstract: This paper examines the potential role of the EU's reentrance to the South Caucasus relying on its active participation in sustainable transport initiatives. Adopting historical-comparative analysis to demonstrate evolvement of the EU's integration policy in the region through revising integration interests of Azerbaijan, Armenia and Georgia, the research presents relatively short overview of the EU's posture in the South Caucasus. Considering the EU as an international actor possessing capacity to exert influence both from values and interests paradigm, the paper concludes that despite experiencing unprecedented levels of geopolitical pressure in contemporary times the EU has a potential to advance its integration policy strategy in the South Caucasus.

Keywords: EU integration policy, Regional Integration, Sustainable Transportation, Global Gate Strategy, South Caucasus

■ IST25-98.

Study of Convolutional Neural Network Algorithm Potentials for Automatic Wheat States Classification for sustainable development of agriculture

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Abstract: This paper considers the combined use of modern and prospective technologies - unmanned aerial vehicles (UAV) and artificial intelligence for the industrial tasks particularly for the smart and sustainable agriculture. We developed the algorithm visual inspection of wheat crops for identification of infected and healthy plants using the digital images of plants. The algorithm is realized using the UAV and is proposed for early detection of the wheat brown rust. We focused on this wheat disease as the most widely spread in Ukraine. We use and study the Convolutional Neural Network (CNN) algorithm to analyze the peculiarities model training demonstrate the accuracy of about 0.8 for the test and about 0.65 for training. The results are rather good, especially when using the limited number of available images at the first iterations and demonstrate the potential for future smart agricultural industry.

Keywords: Convolutional Neural Network CNN, UAV, Sustainable agriculture, Wheat rust, Intelligent transportation system (its)

■ IST25-99.

Evaluating the Sustainability Performance of Turkish Airlines Using Data Envelopment Analysis

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Abstract: This study examines the sustainability performance of Turkish Airlines between 2018 and 2023 using input-oriented Data Envelopment Analysis (DEA). Emission credits (Total delivered emission credits–CO2) and fleet age were considered as inputs, while Revenue Passenger Kilometers (RPK), Freight Tonne Kilometers (FTK), and fuel efficiency were used as outputs. The findings indicate that Turkish Airlines was fully efficient under the Banker, Charnes, and Cooper model (BCC) in all years, demonstrating strong technical efficiency. However, under the Cooper and Rhodes model (CCR), full efficiency was achieved only in 2020 and 2023, while in other years, scale-related factors prevented the company from reaching absolute efficiency. Notably, 2022 recorded the lowest CCR efficiency score (0.911), suggesting relative inefficiency in the use of emission credits and fleet age. In contrast, 2020, marked by the pandemic, and 2023, as the recovery year, emerged as the strongest benchmark years. Reference sets further highlight 2020 as the most critical efficiency benchmark across the period, while 2023 played a key role in the recovery process. Analysis of potential improvement ratios revealed fluctuations in emission credits, with high values in 2019, 2020, and 2023, indicating significant room for carbon reduction. In 2021, emissions remained relatively low, whereas 2022 showed the highest potential for improvement. Overall, the findings suggest that Turkish Airlines maintains strong technical efficiency but needs to strengthen scale efficiency and enhance environmental sustainability strategies to align with international carbon reduction standards.

Keywords: Aviation Sustainability, Emission Credits in Airlines, Turkish Airlines, Data Envelopment Analysis, Efficiency Analysis

■ IST25-100.

Computational Models and Simulations for Sustainable Transport Solutions and Environmental Crimes in the Caspian Sea Region

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Abstract: The Caspian Sea region faces significant ecological challenges due to industrial activities, oil extraction, and maritime transport, which contribute to environmental crimes and pollution. This study integrates legal frameworks, mathematical modeling, and sustainable transport solutions to provide a multidisciplinary approach to ecosystem protection. Specifically, a predictive model of oil spill dispersion using based simulation identifies high-risk ecological zones, while satellite monitoring and in-situ measurements validate model accuracy. Additionally, the impact of sustainable transport solutions, such as electric ships and optimized port logistics, on reducing emissions and potential environmental violations is assessed. This paper demonstrates how combined legal, technological, and computational strategies can enhance environmental governance, reduce ecological risks, and guide future policy interventions.

Keywords: Sustainable Transport, Environmental Crimes, Mathematical Modeling, Remote Sensing, Caspian Sea

IST25-101.

Mitigating the Environmental Impacts of the Transport Sector in Azerbaijan

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Abstract: Environmental pollution continues to be a critical global issue, threatening human health, economic growth, and ecological sustainability. The transport sector, while economically significant, is a major source of air pollutant emissions, a trend also evident in Azerbaijan. Effective mitigation requires promoting sustainable mobility and reducing dependence on private vehicles, with public transport playing a key role in lowering energy consumption and environmental impact. This study employs time series econometric methods to examine the link between public transport usage and CO2 emissions in Azerbaijan. Results indicate that higher metro ridership contributes to a reduction in CO2 emissions, highlighting the metro system's environmental efficiency. In contrast, increased bus usage correlates with higher emissions, likely due to the prevalence of older diesel- and gasoline-powered buses. The findings suggest that expanding the metro network and modernizing the bus fleet with energy-efficient technologies could significantly reduce the transport sector's environmental burden. Overall, the study underscores the importance of integrated transport policies that align environmental sustainability with urban development objectives.

Keywords: Transport, CO2 emissions, Public transport, Environmental impacts, Econometric models

IST25-102.

Implementation of innovative technologies for growing agricultural crops using unmanned aerial vehicles

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Abstract: The article discusses theoretical aspects revival of aviation work in Ukrainian agriculture, taking into account the reduction of sown areas. Precision farming is an innovative method of farming, which involves the use of the latest technologies to improve crop quality. This creates a need for wider use of air transport in the process of growing agricultural crops. It was found that agricultural manned aircraft do not provide the necessary flight safety, and also cannot be mass-produced by industry, since they require large capital investments in organizing their production. Unmanned aerial vehicles (UAVs) have proven to be a universal tool for precision agriculture, helping farmers spray agricultural land, monitor and map yield data, apply fertilizers, and diagnose crops for the presence of pests and diseases. Therefore, the use of UAVs in the agricultural sector is a promising direction, given their advantages compared to manned aircraft. The statistical analysis showed that during 2021-2024 more than 4 million hectares of land were cultivated using UAVs. So, the Ukrainian market for agricultural UAVs is still in its infancy, but in recent years it can be said with confidence that demand exists and is growing, which indicates the prospects for research in this direction.

Keywords: Aviation Transport Technologies, Precision Agriculture Technology, Unmanned Aerial Vehicles, Aero-Chemical Work, Remote Sensing

IST25-103.

Assessment of pathway to Green Port-Led Logistic Centers for shipping

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Abstract: The logistics sector, which is one of the active stakeholders of global trade, has an integrated structure by the cooperation of land, sea and air transportation together. Today, logistics centers, which include intensive mobility, are energy-intensive structures that also contain systems managing the transportation. The logistics centers that are taken as the basis in this study have a controlled impact in terms of cost and environmental sustainability, because of their high energy consumption and heavy traffic density.

Keywords: Shipping, Logistic centers, Energy management, Sustainability, Green Ports

IST25-104.

Assessment of the Frontier Approach for Energy Management of the Shipyard

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Abstract: Shipyards are structural organizations with very high energy use, standing as central points of technological and structural transformation in the maritime sector. These organizations, depending on their functional abilities, are open to transformation and continuous change. For this reason, together with the responsibility of energy management, they can also have a strategic role in the targets of decarbonization. In this study, by using the data of a selected shipyard, energy consumption values were derived, and frontier analysis was applied to evaluate the efficiency of consumption. The results show that in the shipyard, which has an average 38% energy efficiency, in a 48-month observation, only in electricity, there were 19 months with high consumption behavior. In natural gas, this number was found to be 27 months. At the end of the study, based on these findings, a strategic action plan for energy efficiency in shipyards was outlined, and practical recommendations were developed.

Keywords: Shipyards, Energy Management, Frontier Analysis, Efficiency and Sustainability, Decarbonization

- IST25-105.

Green Innovations in Air Transport: Review of Sustainable Practices and Future Directions

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Abstract: The aviation industry is undergoing a critical transformation towards sustainability, driven by environmental concerns, regulatory pressures, and technological advancements. This paper reviews the literature on "green innovations" in air transport, focusing on sustainable practices such as the adoption of alternative fuels, improvements in aircraft technology, digital solutions for operational efficiency, and international policy initiatives. The analysis demonstrates that while progress has been made in reducing emissions and enhancing efficiency, significant challenges remain in achieving large-scale implementation. The paper concludes by outlining future directions for sustainable aviation and emphasizing the need for global collaboration and continued research.

Keywords: Air transport, Green innovations, Sustainable aviation, Alternative fuels, Operational efficiency, Environmental policies

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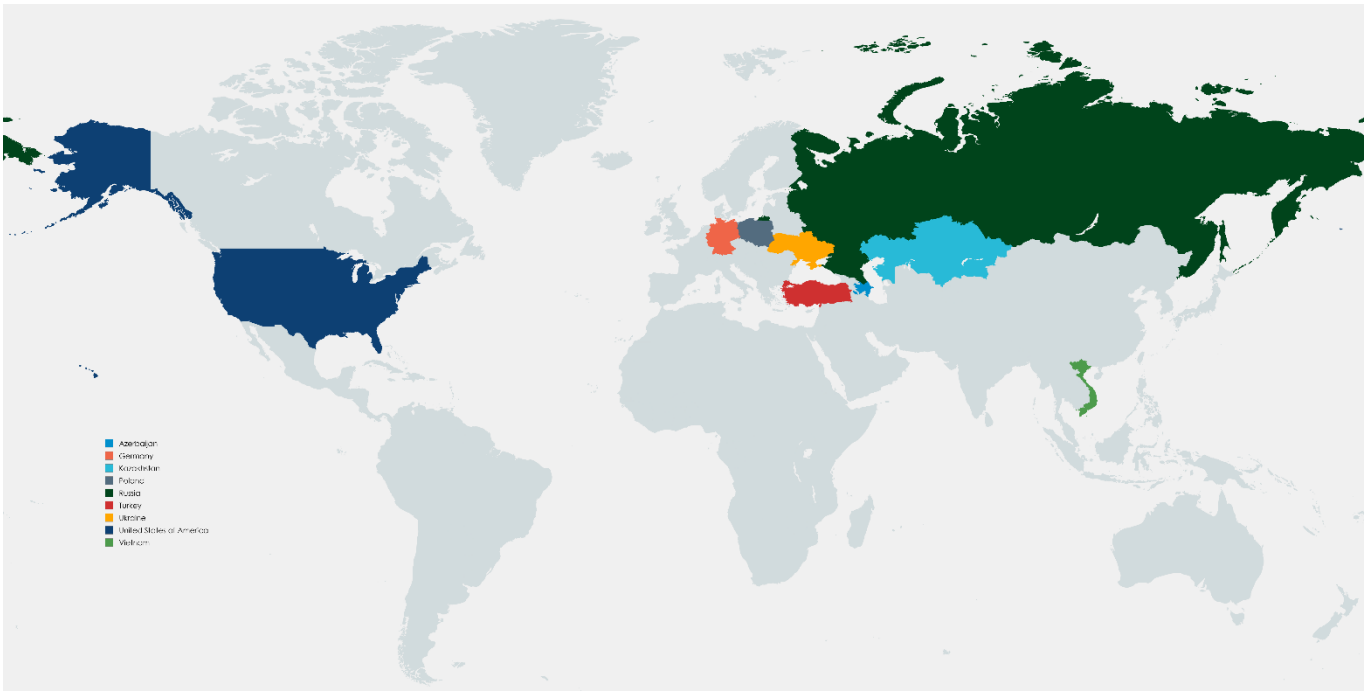
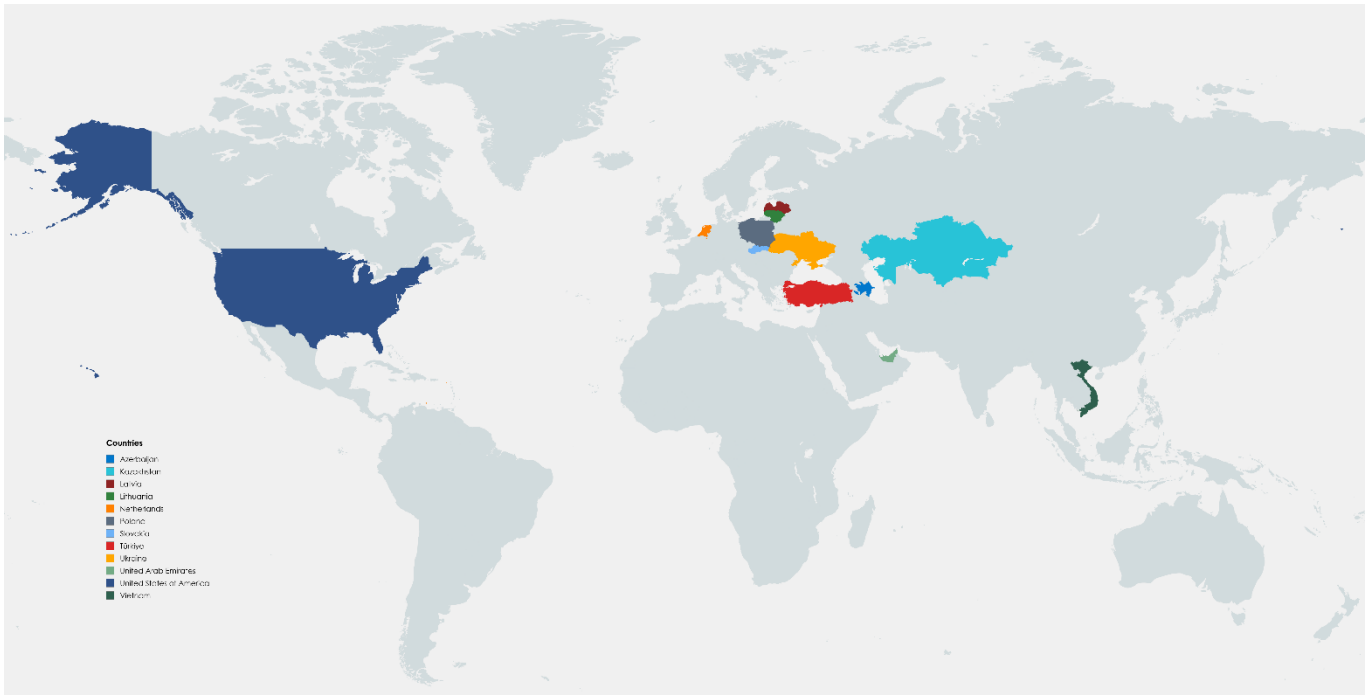
- Geographical Distributions

Geographical Distribution of Authors



Geographical Distributions of Committees



International Sustainable Transportation Symposium

ISTRAS'25

Abstract Book

ISTRAS, an international and multidisciplinary symposium, focuses on addressing contemporary challenges and advancements in the field of sustainable transportation. The symposium brings together researchers, engineers, policymakers, and industry professionals to discuss innovations in areas such as aviation, intelligent transportation systems, maritime and land mobility, energy efficiency, green logistics, and digital transformation in transport.

Particular attention is given to studies that contribute to the development of environmentally friendly, energy-efficient, and technologically advanced transport solutions, supporting the transition toward sustainability in both public and private sectors.

This book includes abstracts submitted to ISTRAS'25

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