in Memory of
Dr. Fuad Mirzayev
Rest in Peace

ISTRAS'26 Online

International Sustainable Transportation Symposium

Abstract Book

Springer

Scopus

International Sustainable Transportation Symposium

ISTRAS'26
Abstract Book

Editors:

T. Hikmet Karakoç
Khagani Abdullayev
M. Ziya Sogut
Fuad Mirzayev
Elgun Aghayev

Editorial Assistants:

Kanan Heydarov
Gulgun Garibli
Govhar Saatova
Aygul Yagubova

The International Sustainable Transportation Symposium (ISTRAS'26), organized by the National Aviation Academy (NAA) under Azerbaijan Airlines CJSC and hosted by Piri Reis University (PRU) was held online on June 17 - 19, 2026.

This book includes abstracts submitted to ISTRAS'26.

Edited by T. Hikmet Karakoç, Khagani Abdullayev, M. Ziya Sogut, Fuad Mirzayev, Elgun Aghayev.

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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’26 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’26 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.

In memory of Dr. Fuad Mirzayev

This year's symposium carries special significance as we honor the memory of Dr. Fuad Mirzayev, a distinguished scholar and one of the key visionaries behind the establishment and development of ISTRAS. His vision, leadership, and dedication played an invaluable role in transforming the symposium into a respected international platform for scientific collaboration and knowledge exchange. His contributions will remain an enduring part of the history and future of ISTRAS.

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
- Triple Helix Collaboration for Sustainable Mobility and Transport Innovation
- 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

- Low-Emission Road and Rail Transport Systems
- Sustainable Urban and Intercity Rail Transport Solutions
- Decarbonization Strategies for Road Freight and Rail Logistics
- Autonomous and Connected Vehicles in Sustainable Land Transport
- Infrastructure Resilience and Climate Adaptation in Road and Rail Networks
- Electrification and Energy Efficiency in Road and Rail Transport
- Green Shipping Technologies and Low-Emission Vessels
- Alternative Fuels and Energy Systems in Maritime Transport
- Smart Ports and Digital Transformation of Maritime Logistics
- AI-Based Navigation and Decision Support Systems for Ships
- Autonomous and Unmanned Maritime Transportation Systems
- Energy Efficiency and Optimization in Ship Design and Operations
- Environmental Impacts of Maritime Transport and Mitigation Strategies
- Climate Resilience and Sustainability of Maritime Infrastructure
- Intelligent Rail Systems and Smart Signaling for Sustainable Mobility
- AI and Data-Driven Traffic Management for Road Transport

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,
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Nafiz Arıca

Rector of the Piri Reis University,
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Director of the Research Institute for Sustainable Futures at Abu Dhabi University,
UAE

Subhan Namazov

Vice Rector of Azerbaijan Technical University,
Azerbaijan

It was a great pleasure to invite you to the International Sustainable Transportation Symposium (ISTRAS’26), which was held online on June 17 - 19, 2026, hosted by the Piri Reis University, Istanbul, Türkiye.

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’26 to exchange knowledge, present cutting-edge developments, and discuss strategies for a more sustainable future.

ISTRAS’26 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'26 Committees

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Max F. Platzer, Lifetime Honorary President of SARES, USA
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Sharul Sham Bin Dol, Abu Dhabi University, United Arab Emirates
Subhan Namazov, Azerbaijan Technical University, Azerbaijan

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Rovshan Ahmadov, National Aviation Academy, Azerbaijan
Shahla Huseynova, National Aviation Academy, Azerbaijan

Symposium Program

Day 1: 17 June 2026

ISTRAS'26 PROGRAM - DAY 1

	Main Hall - 17 June 2026 - ISTANBUL TIME (UTC+3)	
10:00 - 10:30	Opening Session	Khagani Abdullayev, Founding Chair of ISTRAS'26, Vice-rector of National Aviation Academy, Baku, Azerbaijan
		M. Ziya Sogut, Chair of ISTRAS'26, Vice-rector of Piri Reis University, İstanbul, Türkiye
10:30 - 11:00	Opening Keynote Session	T. Hikmet Karakoç, Founding Chair of ISTRAS'26, President of SARES, Dean of Research of Piri Reis University, İstanbul, Türkiye
11:00 - 12:00	1st Keynote Session	Session Chair: M. Ziya Sogut
		ON THE USE OF MODERN VOLTAGE AND CURRENT SENSORS IN ON-BOARD EQUIPMENT OF VEHICLES Islam Isgandarov, National Aviation Academy, Baku, Azerbaijan
		GLOBAL, REGIONAL AND NATIONAL CHALLENGES OF AVIATION SAFETY Dmytro Bugayko, National University "Kyiv Aviation Institute", Kyiv, Ukraine
12:00 - 13:00	1st Industrial Special Session	Session Chair: T. Hikmet Karakoç
		BEYOND THE MAP: ENGINEERING A LIVING DIGITAL TWIN FOR RESILIENT MOBILITY Barış Uz, ESRİ Türkiye, Türkiye
		FROM REACTIVE TO PREDICTIVE: THE FUTURE OF AIRPORT SAFETY MANAGEMENT Elmir Guluzadeh, Head of Safety and Quality at Azerbaijan Airports
13:00 - 14:00	Lunch Break	
14:00 - 15:15	1st Parallel Session	Istanbul Hall (Chair: TABRIZ OSMANLI)
		Decarbonization Model and Transformation Framework for Small Scale Marine Vessels Of Marmara Sea
		Mehmet Ziya Sogut, Ezgi Özer
		Mitigation of Errors in Civil Aviation Navigation Systems Using Intelligent Algorithms
		Jeyran Agamaliyeva
		Materials Science and Engineering for Green Transportation
		Shafagat Mahmudova
		Explainable Predictive Maintenance for Aircraft Landing Gear: Joint Fault Diagnosis and Remaining Useful Life Estimation Using Digital Twin Data
		Ergun Arı, Ezgi Özülkü
		Digital Twin Technology for Sustainable Urban Transport: A Conceptual Framework and Research Agenda
		Nurana Rustamova Hasanli
14:00 - 15:15	1st Parallel Session	Karabakh Hall (Chair: SHOLA SHEKILI)
		Energy Management and Clean Energy Transition in Azerbaijan's Transport Sector: Challenges and Opportuniti
		Eldar Gasumov, Gazanfar Suleymanov
		A conceptual risk-oriented safety management model for international transport corridors using UAVs
		Heybatulla Ahmadov, Balaga Karimov, Dana Sosunova-Tahirova
		Financial Control, Audit Authority, and Cargo Security in Air Cargo Logistics: A Comparative Constitutional and Financial Accounting Analysis of Indonesia and Azerbaijan

		Fuad Mirzayev, Laura Tifani Zahra
		International transport corridors as catalyst socio-economic transformation of Azerbaijan's logistics system
		Azad Babayev, Allahverdi Sharifov, Mahir Mustafayev
		The Impact of Tax Policy on Demand Elasticity in the Aviation Industry: A Descriptive Analysis of the United Kingdom (2021–2025)
		Elmar Aliyev
14:00 - 15:15	1st Parallel Session	Baku Hall (Chair: ELGUN AGHAYEV)
		Toward new airports, aerodromes and airfields in a new UAV context
		Fatih Kılıç , Olcay Ölçen
		Modeling and Simulation of Quadcopter Rotational Dynamics Using MATLAB/Simulink
		Aftandil Mammadov, Gurban Hasanli, Nikolay Ryabchikov
		Advancements in Bio-Inspired Flight Systems and Bionic Aerodynamics Through Adaptive Morphology: The Preliminary Study
		Joaquin Rafael Pagaling, Marjan Mohammad Aref Shadmani Fard, Sharul Sham Dol, Mohammed Alavi
		Edge – AI driven Traffic sign detection and Voice assistance system for vehicle drivers
		Suthagar Subramaniyan, Naveen Kuttimani, Sahana Varsini Santha Kumar Santhi
		A method for Controlling Ground Vehicles Traffic Flow in Airport Zones
		Afig Hasanov, Elgun Aghayev, Rovshan Ahmadov
15:15 - 15:30	Break	
15:30 - 17:00	2nd Parallel Session	Istanbul Hall (Chair: KOVSAR DADASHOVA)
		Analysis of Transit Time Through the Zangezur International Transport Corridor Based on Imitation Modeling under Uncertainty Conditions
		Heybatulla Ahmadov, BalaAgha Karimov, Aytaj Mustafayeva
		Quality-of-Service Assessment of Logistics Information Flows in Next-Generation Network Environments
		Elshan Hashimov, Bayram İbrahimov, Aziz Talibov, Ramil Akhundov, Kostiantyn Dergachov
		Wind-Powered Galleon Technology and the Manila Galleons: Sustainable Maritime Transport from a Zero-Emission Perspective (16th–19th Centuries)
		Hakan Mehmet Köktürk
		From the 15-Minute City to the Shaded City: Thermal Comfort as a Transport Variable in Algerian Urban Mobility
		Mohammed Bouguelaa, Salim Bouguenna
		Sustainable Urban Transportation and Social Development: Policy Implications for Azerbaijan
		Samira Mammadova, Elvin Aliyev
15:30 - 17:00	2nd Parallel Session	Karabakh Hall (Chair: ROVSHAN AHMADOV)
		Automatic Search System that Ensures Selection of the Antenna with the Greatest Signal in the Decameter Radiocommunication System
		Afig Hasanov, Aytan Seyfullayeva
		Multi-Orbital Satellite Constellations and High-Throughput Systems: A Comparative Analysis of Technical Determinants, Spectral Challenges, and Future Architectures
		Ramiz Bayramov, Niqar Mahmudova
		Cursor Method for Cut-Off Frequency Measurement in Aerospace Electronic Circuits
		Afig Hasanov, Ruslan Hasanov, Elgun Aghayev, Rovshan Ahmadov

		Shore Power, Electrification, Hydrogen and Alternative Fuels for Sustainable Ports and Short-Sea Shipping: A Technical Evaluation and Strategic Framework
		Murat Saka, Tayfun Acarer
		Satellite Navigation Signal Integrity Assessment Block for Enhancing Receiver Reliability
		Gurban Sadigov, Gurban Hasanli, Khadija Jafarova
15:30 - 17:00	2nd Parallel Session	Baku Hall (Chair: KANAN HEYDAROV)
		Insider Threats in Intelligent Transportation Systems
		Shola Shekili, Ramil Mukhtarov
		Design of a Multi-Sensor Gas Monitoring System for Aviation Security Applications
		Saida Ahmadova
		Arctic Maritime Cybersecurity: A Realist Assessment
		Selen Baldıran, Pelin Bolat
		Long-Run Effects of Accident Structure on Road Traffic Fatalities in Azerbaijan
		Yadulla Hasanli, Arzu Safarova
		Evaluation of Student Pilots' Mental Workload Under Emergency Scenarios During Takeoff Using Physiological and Subjective Measurements
		Tamer Savas, Utku Usanmaz, Berkay Turkeli

Day 2: 18 June 2026

ISTRAS'26 PROGRAM - DAY 2

	Main Hall - 18 June 2026 - ISTANBUL TIME (UTC+3)	
10:00 - 11:00	2nd Keynote Session	Session Chair: Munir Ali Elfarra
		TEACHING CONFIDENCE IN THE CLOUDS, ARTIFICIAL INTELLIGENCE AND DESKTOP FLIGHT TRAINING DEVICES FOR COMPETENCIES DEVELOPMENT IN UNIVERSITY PROGRAMS *Gerasimos Kontos, Abu Dhabi University, Abu Dhabi, Uni*
		FAULT TOLERANT ESTIMATION OF UAV DYNAMICS UNDER ACTUATOR/SURFACE FAILURE CONDITIONS *Chingiz Hajiyev, Istanbul Gelisim University, Istanbul, Türkiye*
11:00 - 11:15	Break	
11:15 - 13:00	1nd Parallel Session	Istanbul Hall (Chair: KOVSAR DADASHOVA)
		Women in Urban Mobility: Emerging Workforce Trends in the Transportation Sector of Hyderabad, India
		Shradha Binani, Shaik Rehan
		Legal Regulation of UAV Use in Airport Environments: A Conceptual Approach for Azerbaijan
		Fuad Mirzayev, Asmar Aghayeva, Aynur Adigozalova
		The Applicability of the Maritime Labour Convention to Autonomous Ships: Revisiting the Legal Definition of Seafarer
		Fevzi Topsoy
		Transportation Business and Management for a Sustainable Future
		Ulviyye Huseynova, Tughay Aliyev
		Legal-Economic Assessment of the Boundary Between Criminal and Administrative Liability in the Caspian Sea Context
		Shahla Huseynova, Aida Tagiyeva
		Analyzing the impact of Women in C-Suite Roles on Transportation Sustainability
		Shaik Rehan, Shradha Binani

11:15 - 13:00	1nd Parallel Session	Karabakh Hall (Chair: TABRIZ OSMANLI)
		Assessment of the Efficiency of the "E-Dispatcher" System in Train Traffic Management
		Shahnoza Otakulova, Natalya Yaronova
		A Hybrid Deep Learning and Fuzzy Logic Framework for Condition Monitoring of Railway Traction Motors
		Farid Huseynov, Elshan Manafov, Huseyngulu Guliyev, Tural Jabrayilov
		Assessment of Dispatcher Decision-Making Capability at Large Railway Stations Using Fuzzy Logic
		Elshan Manafov
		Experimental Investigation and Optimization of Bending Stress in Laser-Welded AISI 316L Stainless Steel for Green Transportation Applications
		Emrah Arda
		Hydrodynamic Performance of a Small Autonomous Underwater Vehicle Using an Inverted NACA 2412 Wing: CFD Simulation and Prototype testing
		Long H. Vo, Hao N. Le, Tai D. Duong, Anh T. Tran
		Waste Heat-Driven sCO2 Cycle System for Energy Conversion onboard Ships
		Cüneyt Ezgi, Haydar Kepekci
11:15 - 13:00	1nd Parallel Session	Baku Hall (Chair: KANAN HEYDAROV)
		Economic Efficiency of AI-Driven Operational Management in Civil Aviation under Environmental Constraints
		Elmira Jafarli
		Development of a Digital Simulator for Evaluating the Logistics Potential of the Zangezur Corridor
		Elman Najafov, Aytaj Mustafayeva
		From Waste to Infrastructure: A GPM-Based Governance Model for Second-Life EV Batteries in Azerbaijan
		Fuad Mirzayev, Kovsar Dadashova, Arzu Abdullayeva
		Sustainable development in the context of green transport investments and green energy corridors: The Azerbaijani experience
		Gunay Madjidova
		Adaptive Optimization Model Based on Risk and Delay Factors in Multimodal Transportation
		Balaga Karimov, Saadat Mikayilzade
		Measuring the Impact of Artificial Intelligence on Transport Service Competitiveness: Evidence from Azerbaijan and the Middle Corridor
		Kanan Heydarov
13:00 - 14:00	Lunch Break	
14:00 - 15:15	2nd Parallel Session	Istanbul Hall (Chair: ELGUN AGHAYEV)
		Improving the Accuracy of Object Detection in Video Recordings Obtained from UAVs
		Dmytro Krytskyi , Alina Artomova, Elvira Kaidan
		Numerical Investigation of the Effect of Laminar Separation Bubbles on Nusselt Number Distribution over a NACA 4412 Airfoil
		Nhat N. M. Mai, Duc T. Tran, Tai D. Duong, Anh T. Tran
		Critical Gaps in PEM Fuel Cell Modelling for Unmanned Aerial Vehicle (UAV) Integration
		Sergii Boichenko, Vitalii Korovushkin, Iryna Shkilniuk, Leonid Listovshchyk, Victor Stoudenets, Yehor Brodnikovskyi
		Assessing the Social Impact of Innovative Air Mobility and U-space: Evidence from Antwerp
		Anna Palaiologk, Emmanouil Pantelidis, Athanasios Arvanitidis

		Comparative Modelling of Classical and Aerometric Smart-Probe-Based Yaw Damper Systems
		Toghrul Karimli, Turgut Khalilli, Rauf Guliyev
14:00 - 15:15	2nd Parallel Session	Karabakh Hall (Chair: RAMIL MUKHTAROV)
		Fire Risk of Electric Vehicles in Underground Airport Parking: A Scenario-Based Assessment Using the Potential Lethality Gap
		Shola Shekili, Nadir Xaliqov
		An Assessment of the Selection Criteria for the Northern Sea Route Through the Swara Method
		Selen Baldıran, Ali Cem Kuzu
		Enhancing airport security through AI-based smart surveillance systems: A case study of Heydar Aliyev International Airport passenger terminal
		Ruslan Rustamov
		The Study on Hybrid VTOL Drone for Offshore Search and Rescue
		Mansour Khalid Alnaqbi, Shamma Nasser, Alyazia Mohamed Alshehhi, Sharul Sham Dol, Mohammed Alavi
		Defining the Airport's Baggage Handling Process AI Alignment Properties: An Agent-Based Approach
		Fatos Fatma Erendemir, Alper Dalkiran
14:00 - 15:15	2nd Parallel Session	Baku Hall (Chair: AYGUN ZEYNALOV)
		Finite Element Analysis of Residual Stresses in MIG/MAG Welded AH36 Steel Joints for Shipbuilding Applications
		Furkan Ertural, Atilla Savaş
		Energy Consumption Analysis and Flight Endurance Optimization of a Medical Payload Quadcopter UAV
		Aftandil Mammadov, Sara Mammadova
		Increasing The Wear Resistance of Titanium Alloys Under Conditions of Nominally Fixed Contact of Ti-CFRP/GFRP by Chemical-thermal Treatment Methods
		Andrii Khimko, Oksana Mikosianchyk, Oleksandr Filonenko, Marharyta Khimko
		The Effect of Transition Contact Resistance and Adhesion of $Bi_{0.85}Sb_{0.15}$ Samples with Various Alloys on the Efficiency of Environmentally Friendly Termoelements
		Mail Tagiyev, Khadija Aliyeva, Aida Mammedzade, Ilaha Abdullayeva, Sevda Dzhafarova, Arzu Akhmedova
		Assesment of exergetic performance based on comparative analysis considering Centers of Arctic Route
		Mehmet Ziya Sogut, H. Funda Yercan
15:15 - 15:30	Break	
15:30 - 17:00	3rd Parallel Session	Istanbul Hall (Chair: ISLAM ISGANDAROV)
		Applications of deep learning for safe urban transportation
		Gunel Jabbarli
		Assessment of Flight Safety Based on the Intelligent Analysis of Flight Events
		Turana Binnataliyeva
		Energy–Time Trade-offs in UAV Swarm Coverage for Aerial Monitoring: A Simulation-Based Scaling Study
		Ilham Mirzayev
		Evaluating the Decarbonization Vision in Shipping with a Sound Decision Making (RDM) Approach
		Mehmet Ziya Sogut, Oktay Çetin
		A Deep Learning Framework for Distinguishing Real and Synthetic Aircraft Images

		Ezgi Ozer
15:30 - 17:00	3rd Parallel Session	Karabakh Hall (Chair: ROVSHAN AHMADOV)
		Application of ACARS for remote monitoring of the pilot's psychophysiological state
		Aftandil Mammadov, Gurban Sadigov
		An Integration model of hybrid solar energy systems with second life EV batteries for remote sites in oil and gas facilities
		Aygun Zeynalova, Aygun Heydarova
		Continuous monitoring of the operational reliability of critical aircraft components in flight
		Toghrul Karimli, Ramin Babayev
		The Role of Differential Equations in Fuel Systems in Marine Navigation Engineering
		Rovshan Humbataliyev, Aynur Abdullayeva, Shahin Agazade, Bahruz Agarzayev
		Enhanced Flight Time Estimation for UAVs Using an Intelligent Battery Management System
		Islam Isgandarov, Muahammadali Hajizadeh
15:30 - 17:00	3rd Parallel Session	Baku Hall (Chair: JAMAL HUSEYNOV)
		Management of Sustainability in Logistics Warehouses: A Maritime Perspective
		Mehmet Ziya Sogut, Murat Koray
		Assessment Carbon Management and Sustainability on Ships within the EU/ETS Framework
		Mehmet Ziya Sogut, Erkan Kıyak
		Stress Calculation on Rudder Blade and Linkages of a Ship Using Fluid Structure Interaction Method
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		Real-Time UAV Swarm Control Interface with Simulation Integration
		Gurban Hasanli, Farid Novruzlu, Fariza Hajiyeva
		Negative Impacts of Extreme Weather Conditions on Sea Port Operations: Türkiye as a Case Study
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Day 3: 19 June 2026

ISTRAS'26 PROGRAM - DAY 3

	Main Hall - 19 June 2026- ISTANBUL TIME (UTC+3)	
10:00 - 11:00	3rd Keynote Session	Session Chair: Gerasimos Kontos
		HE MIDDLE EAST VISION: LEADING THE TRANSITION TO SUSTAINABLE TRANSPORTATION Munir Ali Elfarra, Abu Dhabi Polytechnic, Al Ain, United Arab Emirates
		THIRD-PARTY RISK ASSESSMENT FOR SUSTAINABLE LAND USE MANAGEMENT AROUND AIRPORTS Oleksandr Zaporozhets, Łukasiewicz
11:00 - 11:15	Break	
11:15 - 13:00	1th Parallel Session	Istanbul Hall (Chair: KOVSAR DADASHOVA)
		Mechanical Design and Preliminary Torque-Oriented Analytical Evaluation of a Crankless Oscillating Disk-Type Internal Combustion Engine
		Tuğrul Orhan
		A Hybrid AI and Optimization Model for Sustainable Warehouse Inventory and Transport Coordination in Industrial Supply Chain
		Fidan Khanim Ahmadzada, Seymur Shamkhalov

		Development of Hybrid Polymer Composite Materials for the Aviation Industry
		Oksana Mikosianchyk, Oleksandr Yakobchuk, Rudolf Mnatsakanov, Ruslan Kostyunik, Kateryna Chava
		Analysis of Hamming Based FEC for Mitigating Soft Errors In Avionics Hardware
		Fidan Shiralizada, Gurban Hasanli
		Design and sizing of a solar PV charging system for electric municipal buses
		Safiullah Shirzad, Tugba Gurler
		Nonlinear Genetic Algorithm-Based OTP Architecture for Secure Communication in Aerospace Transportation Systems
		Sevda Ibrahimova, Isa Huseynzade
11:15-13:00	1th Parallel Session	Karabakh Hall (Chair: TALEH ASGAROV)
		Theoretical Analysis of Intake Valve Closing Delay Angle Effects on Marine Engine Performance
		Alivahid Aliyev, Alihuseyn Haziyev, Kamala Valiyeva
		Machine Learning-Based System for Detecting Military Objects Using UAVs
		Gurban Sadigov, Rushniyya Eyvazova
		Simulation Modeling for Improving the Efficiency of Intersections
		Fuad Dashdamirov, Ulvi Javadlı, Turan Verdiyev
		A Comparative Study of Classical Approximate Riemann Solvers: Accuracy, Diffusion, and Contact Wave Resolution
		Bach T. Tran, Tai D. Duong, Anh T. Tran
		Advantages, Shortcomings, and Areas for Improvement in the Use of UAVs in Disaster Response
		Ilkay Orhan, Onur Ozsoy
		Computational Analysis and Conceptual Design of a Scramjet Inlet Isolator System
		Mansour Khalid Alnaqbi, Shamma Nasser, Alyazia Mohamed Alshehhi, Sharul Sham Dol, Mohammed Alavi
11:15-13:00	1th Parallel Session	Baku Hall (Chair: KANAN HEYDAROV)
		Enhancement of UAV Flight Range and Endurance Through Parametric Aerodynamic Evaluation
		Adalat Samadov, Arif Alihuseynov
		Integration of self-healing cellular architectures, dynamic partial reconfiguration, and on-chip rerouting for enhancing the reliability of spacecraft onboard computing systems
		Islam Isgandarov, Sakinakhanum Abdullayeva
		Mitigation Strategies for the Lunar Dust Challenge and a Systematic Review for Sustainable Surface Operations
		Selin Ateş, Alper Şanlı, Tuncay Yunus Erkeç
		Design of an integrated control system for ground military vehicles and drones based on sparse approximation of their dynamic models
		Manafaddin Namazov, Zaur Ashirov
		Performance Analysis of Power Systems Integrated with SVC (FACTS Device) using ETAP Simulation
		Tofiq Yaqublu
		Intelligent Tribological Monitoring and Wear Prediction in Automated Machine Tool Systems Using Smart Sensor Technologies
		Farid Muradov, Farid Huseynov
13:00 - 14:00	Lunch Break	
14:00 - 15:15	2th Parallel Session	Istanbul Hall (Chair: TABRIZ OSMANLI)

		Impact of Closing Airspace on Sustainability of Global Air Transportation
		Ivan Ostroumov
		A Survey of Sliding Mode Control Based on Adaptive Neuro-Fuzzy Inference System for UAV Applications
		Samad Samadov, Firdovsi Mahmudlu, Vuqar Huseynov
		Development of a Computer Vision-Based Target Selection and Kamikaze Guidance System for Fixed-Wing Unmanned Aerial Vehicles
		Khagani Abdullayev, Inara Heydarova, Fuad Dadashov, Huseyn Hasanov, Namig Huseynov, Vagif Gasimov
		UAV Selection for Flood Monitoring Using a Multi-Criteria Decision Model
		Onur Ozsoy, Ali Emre Sarılgan
		A differential equation for estimating the speed of sound at different temperatures for modelling thermodynamic properties
		Lala Akhmedova-Azizova, Khagani Abdullayev, Adalat Samadov, Irada Seyidova
14:00 - 15:15	2th Parallel Session	Karabakh Hall (Chair: TALEH ASGAROV)
		Hydrodynamic Motion of Two Types of Charge in Doped Semiconductors and Internal Instability
		Eldar Hasanov, Shahla Khalilova, Ruhiyya Mustafayeva
		Health risk assessment of full-body scanners in aviation security: a comparative analysis of ionizing and non-ionizing radiation
		Ruslan Rustamov, Ragsana Hasanova
		Comparative Assessment of the Application Possibilities of Unmanned Aerial Vehicles in De-Icing and Anti-Icing Processes in Air Transport
		Gunel Alakberova, Rustam Ahmadzada
		Application of Smart Technologies in Transportation Systems
		Taleh Asgarov, Nigar Hajiyeva
		Use of unmanned aerial vehicles equipped with a hybrid power system
		Rasim Nabiyev, Kamal Askerov, Gadir Garayev, Vusal Abbasov, Garanfil Valiyeva
14:00 - 15:15	2th Parallel Session	Baku Hall (Chair: ELGUN AGHAYEV)
		Enhancing Aviation Security with Terahertz Spectrometry and Machine Learning
		Khagani Abdullayev, Turana Vazirova
		Feasibility of a Hybrid Power Supply Systems Based on Ionized Gas and Carbon Nanotubes for Spacecraft
		Islam Isgandarov, Aygun Aliyeva Sundhordvik
		Environmental Pollution on Transportation in Coastal Areas
		Khadija Khalilova
		Comparative Assessment of Supercooled Large Droplets Impingement Models for Capture Coefficient Prediction on the NACA 65-415 Airfoil
		Tai D. Duong, Thach-Thao T. Nguyen
		Energy Regeneration for Electric Aircraft: The Preliminary Study
		Karan Anoop Whabi, Mohammed Sazzad Hossain, Salim Mohamed Jadad Al kathiri, Mohamed Abbas Shibeika, Shammes Abdulla Al-Ali, Sharul Sham Dol, Mohammed Alavi
15:15 - 15:30	Break	
15:30 - 17:00	3th Parallel Session	Istanbul Hall (Chair: ROVSHAN AHMADOV)
		Hybrid Random Number Generator-Based Radar Deceptive Jamming Electronic Counter-Countermeasures Technique
		Ruslan Hasanov, Inci Cabbarova
		Automatic Control System for Local Oscillator Shunting in Passive Radar
		Ruslan Hasanov, Kevsar Hajiyeva
		Development of a Real-Time Multi-Parameter Monitoring System for the Technical Condition of Electric Motors

		Elshan Manafov, Farid Huseynov, Kenan Jabbarzadeh, Elshan Alisoy
		Modeling of Microprocessor-Based Complex Protection System for Locomotive Traction Transformer
		Elshan Manafov, Ali Aslanli, Farid Huseynov
		From Propensity to Causality: Enhancing Aviation Campaign Effectiveness via Uplift Modelling
		Ulkar Habibullayeva
15:30 - 17:00	3th Parallel Session	Karabakh Hall (Chair: JAMAL HUSEYNOV)
		Resilient Instrument Procedure Design through Integration of Conventional Schemes at Nakhchivan International Airport
		Ruslan Huseynzade
		Analysis of Operational Principles of Laser Position Reference Systems on Dynamically Positioned Vessels
		Namig Guliyev
		Assessment of Eco-Economic Risks in Gas Preparation for Transmission and Transportation Processes
		Yusif Alakbarov, Hajar Ismayilova, Ziver Farzalizade
		Some Aspects of Assessing Road Traffic Noise Levels in Residential Areas: A Case Study of Baku
		Bakhtiyar Azizov, Hikmat Mammadov, Fidan Shikhaliyeva
		ARI-Based Explainable Assessment of Asymmetric Operating Conditions in Electrified Railway Traction Networks
		Huseyngulu Guliyev, Shamkhal Aliyev, Elshen Soltanov , Aynura Allahverdiyeva
15:30 - 17:00	3th Parallel Session	Baku Hall (Chair: ISLAM ISGANDAROV)
		Modeling of air traffic control system
		Peyman Mukhtarov, Nurana Mammadova, Firudin Mukhtarov
		Telemetry-Based Mission State Classification for Multirotor UAVs Using Machine Learning: Implications for Operational Monitoring
		Salih Talha Paksoy, Hüseyin Önder Aldemir
		Computational Fluid Dynamics Simulation of the Aerodynamic Behavior of a Hawk Wing at Different velocities and Angles
		Ali Okan , Münir Süner
		Formation and Evaluation of a System of Efficiency Indicators for Cargo Transportation in Military Logistics Processes
		Aziz Talibov, Elshan Hashimov, Ramil Akhundov, Bayram İbrahimov

Contents

IST26-01.

Cursor Method for Cut-Off Frequency Measurement in Aerospace Electronic Circuits

Afig Hasanov, Ruslan Hasanov, Elgun Aghayev*, Rovshan Ahmadov

National Aviation Academy, Baku, Azerbaijan.

Abstract: In aerospace electronic systems, accurate determination of circuit bandwidth parameters is essential for ensuring reliable signal processing and stable operation. The cut-off frequency of an electrical circuit is considered as one of its main parameters. The relationship between the cut-off frequency and the time constant of the circuit is discussed. A cursor-based method is proposed for measuring the cut-off frequency using the known value of the time constant. The theoretical and experimental aspects of applying the cursor method are examined. Corresponding numerical examples are presented. The effectiveness of the cursor method for determining the cut-off frequency is experimentally verified. A comparative analysis of numerical calculations and experimental results is performed. This paper proposes a cursor-based measurement method for determining the cut-off frequency using the known relationship between the circuit's time constant and its frequency response. The method relies on observing the transient response of the circuit to a rectangular pulse and fixing, with an oscilloscope cursor, the time instant when the output reaches 63.2% of its steady-state value. This measured time constant is then used to calculate the cut-off frequency according to a simple analytical expression.

Keywords: Cut-Off Frequency, Electrical Circuit, Time Constant, Transient Response, Cursor-Based Measurement

IST26-02.

Development of a Computer Vision-Based Target Selection and Kamikaze Guidance System for Fixed-Wing Unmanned Aerial Vehicles

Khagani Abdullayev, Inara Heydarova, Fuad Dadashov, Huseyn Hasanov*, Namig Huseynov, Vagif Gasimov

National Aviation Academy, Baku, Azerbaijan.

Abstract: This article presents the design and implementation of a kamikaze mission framework for a fixed-wing flying-wing unmanned aerial vehicle (UAV) equipped with an operator in the loop (OL) ground control system. The proposed approach enables real-time target designation from an onboard camera stream operating at 30 FPS, where the operator selects the desired object through a graphical interface. Following selection, a vision-based tracking module utilizing optical flow techniques implemented in OpenCV establishes continuous target lock independent of object class or appearance. The tracked target maintained within a dynamically updated region of interest, providing persistent guidance information throughout the flight.

Upon operator authorization, the UAV transitions into a terminal guidance mode and autonomously executes a dive maneuver toward the designated target. The system was first validated in a RealFlight simulation environment and subsequently evaluated through field experiments conducted at multiple altitudes 100 m, 300 m and 500 m. Experimental results demonstrate impact accuracies of 6.4 m, 8 m and 4.8 m respectively. The proposed architecture integrates onboard visual processing with ground control operations, offering a class-agnostic and flexible targeting capability. The results confirm the effectiveness of combining operator-driven target selection with real-time optical tracking for reliable terminal guidance in mission scenarios.

Keywords: UAV, Autonomous Guided Navigation, Realflight-based Simulation, Optical Flow Tracking, Ground Control Software

■ IST26-03.

Public-Private Partnership as a Mechanism for Increasing Efficiency of Air Transport Infrastructure in Azerbaijan

Gulnara Ahmadova, Fuad Mirzayev*

National Aviation Academy, Baku, Azerbaijan

Abstract: This paper examines Public-Private Partnership (PPP) as a mechanism for increasing the efficiency of air transport infrastructure in Azerbaijan. Despite substantial public investment and modernisation efforts, challenges related to airport utilisation, capital intensity, and long-term financial sustainability remain relevant. In this context, PPP models offer an alternative framework for mobilising private capital, improving operational performance, and introducing modern management practices. The study combines the Azerbaijani institutional and regulatory context with international empirical evidence on airport concessions and ownership models. Comparative insights from global PPP airport projects indicate that efficiency gains are strongly linked to well-designed contracts, balanced risk allocation, transparent regulatory oversight, and performance-based incentives. The paper argues that concession-based PPP structures, adapted to national conditions, can enhance infrastructure productivity while preserving strategic public control. Policy recommendations focus on risk sharing mechanisms, performance indicators, and institutional capacity building to ensure long-term value for money. The findings contribute to the discussion on sustainable infrastructure governance and provide a practical framework for improving air transport infrastructure management in emerging economies.

Keywords: Public-Private Partnership, Airport Infrastructure, Transport Governance, Concession Model, Infrastructure Efficiency

- IST26-04.

Enhancement of UAV Flight Range and Endurance Through Parametric Aerodynamic Evaluation

Adalat Samadov, Arif Alihuseynov*

National Aviation Academy, Baku, Azerbaijan.

Abstract: This study examines the optimization of key aerodynamic parameters to enhance the flight range and endurance of unmanned aerial vehicles (UAVs). The research focuses on the influence of wing aspect ratio, wing loading, aerodynamic drag coefficient, and lift-to-drag ratio on overall flight performance. A combination of theoretical formulations and analytical evaluation methods is employed to assess how these parameters interact and contribute to energy efficiency during flight.

The findings indicate that careful aerodynamic refinement significantly reduces energy consumption, which in turn leads to measurable improvements in both endurance and operational range. In particular, increasing the lift-to-drag ratio and optimizing wing geometry are shown to play a decisive role in extending flight duration without additional energy input. The study further presents a comparative assessment of UAV performance before and after the optimization process, demonstrating clear gains in efficiency and stability.

Drawing on established principles of aircraft performance analysis, the results underscore the importance of aerodynamic design as a critical factor in UAV development. The outcomes of this research provide practical insights for the design of more efficient UAV configurations, particularly in applications where extended flight time and range are essential. Overall, the study contributes to the advancement of performance-oriented UAV design by offering a systematic approach to aerodynamic optimization grounded in classical aerospace theory.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: UAV, Aerodynamic Optimization, Flight Range, Flight Endurance, Aerodynamic Efficiency

■ IST26-05.

The Study on Hybrid VTOL Drone for Offshore Search and Rescue

Mansour Khalid Alnaqbi, Shamma Nasser, Alyazia Mohamed Alshehhi, Sharul Sham Dol*, Mohammed Alavi

Abu Dhabi University, Abu Dhabi, United Arab Emirates.

Abstract: Personnel incidents are time sensitive, as victims may deteriorate before rescue teams arrive. This study introduces a hybrid vertical takeoff and landing drone designed for offshore search and rescue, integrating quadrotor hovering with a fixed wing structure for stable positioning and efficient forward movement. The drone uses an AI camera that can be reprogrammed to detect the safety colour used on a vessel, such as a life vest. A servo motor controlled hook mechanism releases a flotation device near the victim. The structure was evaluated under 5.5 N per motor for rescue operation and 8.1 N per motor for maximum throttle load, while the aerodynamic benefit of the fixed wing was assessed using an L/D ratio of about 30. The drone is intended to provide rapid flotation support within an approximate 2 km vessel response radius, although wind, sea state, visibility, and battery endurance remain important operational limits during offshore deployment.

Keywords: Hybrid VTOL drone, Offshore Rescue, Man Overboard, Flotation Delivery, Artificial Intelligence Camera, Structural Simulation

■ IST26-06.

A Method for Controlling Ground Vehicles Traffic Flow in Airport Zones

Afig Hasanov, Elgun Aghayev*, Rovshan Ahmadov

National Aviation Academy, Baku, Azerbaijan.

Abstract: This paper examines the impact of ground vehicle traffic intensity within airport areas on flight safety using reported accident data. The study identifies uneven distribution of ground vehicle flow as a significant contributor to operational risk, particularly in high-density apron and taxiway zones. These findings highlight the need for real-time optimization of ground vehicle movements to enhance safety and operational efficiency. Existing control systems, including Surface Movement Guidance and Control Systems (SMGCS), GPS–GIS (Geographical Information Systems) - based monitoring solutions, and NextGen technologies, are analyzed to assess their effectiveness and practical limitations. Although these systems provide advanced surveillance and coordination capabilities, their implementation is technically complex, infrastructure-intensive, and often requires specialized personnel training. To address these challenges, a simplified control method based on delay-line principles is proposed to regulate ground vehicle traffic intensity and balance flow distribution. Compared to existing integrated surveillance systems, the proposed approach reduces infrastructure complexity, lowers implementation costs, and enables flexible deployment, making it suitable for airports with varying operational capacities.

Keywords: Airport, Ground Vehicle, Delay Line, Radio Transmitter, Radio Receiver

IST26-07.

Fire Risk of Electric Vehicles in Underground Airport Parking: A Scenario-Based Assessment Using the Potential Lethality Gap

Shola Shekili* , Nadir Xaliqov

National Aviation Academy, Baku, Azerbaijan.

Abstract: The rapid integration of electric vehicles (EVs) into transport infrastructures introduces new fire safety challenges, particularly in underground airport parking structures. Lithium-ion battery fires differ from conventional vehicle fires due to delayed ignition, prolonged heat release, and toxic gas emissions, which may complicate evacuation and emergency response in confined settings. This study applies a qualitative, scenario-based risk assessment based on published fire tests, simulation studies, and regulatory guidance to examine EV fire risks in underground airport facilities. The paper introduces the Potential Lethality Gap (PLG) as a governance-oriented indicator capturing temporal survivability deficits when Available Safe Egress Time (ASET) is outpaced by Required Safe Egress Time (RSET) under airport-specific constraints. The findings indicate that delayed ignition, rapid toxic gas accumulation, and extended evacuation timelines may reduce tenable conditions even where formal compliance requirements are met. The study supports the integration of time-based risk indicators into airport fire safety planning.

Keywords: Electric Vehicles, Lithium-ion Battery Fires, Underground Airport Parking, Airport Fire Safety, Evacuation Risk, Emergency Response

IST26-08.

A Conceptual Risk-Oriented Safety Management Model for International Transport Corridors Using UAVs

Heybatulla Ahmadov[1], Balaga Karimov[2], Dana Sosunova-Tahirova[2]*

1. Azerbaijan Technical University, Baku, Azerbaijan.
2. National Aviation Academy, Baku, Azerbaijan.

Abstract: The article examines the issue of ensuring the safety of international transport corridors (ITCs) amid their increasing strategic importance in the global economy and national security systems. ITCs perform not only a transportation function but also significantly influence the socio-economic and political development of regions. The expansion of their functional role is accompanied by growing technological, criminal, terrorist, social, and environmental risks, which necessitates a shift from reactive to preventive safety management approaches.

The aim of the study is to develop a conceptual model of risk-oriented safety management for ITCs based on the application of unmanned systems (USs). The methodological framework includes a systems approach, elements of risk management theory, analysis of scientific literature, and conceptual modeling.

The study proposes a four-level model comprising risk identification and classification; monitoring through unmanned aerial vehicles (UAVs); data processing and analysis; and managerial decision-making supported by a feedback mechanism. The model forms a continuous information and analytical cycle focused on timely threat detection and risk forecasting.

The practical applicability of the proposed approach and its potential integration into the management system of the TRACECA corridor ("Europe – Caucasus – Asia") are substantiated. The model contributes to enhancing infrastructure resilience, reducing response time to incidents, and strengthening coordination among corridor stakeholders, including infrastructure operators, logistics centers, and public authorities. Its implementation creates a foundation for comprehensive interstate risk management in the context of transport digitalization and growing cross-border flows.

Keywords: International Transport Corridors, Unmanned Aerial Vehicles, Unmanned Systems, Conceptual Model, Safety, Risks

■ IST26-09.

A Hybrid AI and Optimization Model for Sustainable Warehouse Inventory and Transport Coordination in Industrial Supply Chains

Fidan Khanim Ahmadzada*, Seymur Shamkhalov

National Aviation Academy, Baku, Azerbaijan.

Abstract: This paper introduces SIITCO (Sustainable Inventory–Transport Coordination & Optimization), an artificial intelligence and mathematical optimization framework that links warehouse inventory management with the implementation of sustainable transportation systems in the industrial supply chain. Although green mobility often concerns vehicle electrification and smart infrastructure, little attention is paid to coordination between warehouse replenishment strategy and transport frequency optimization.

The proposed model also combines demand forecasting via machine learning methods with a multi-objective optimization formulation such that it provides the lowest overall logistics cost and carbon emissions simultaneously. As such, the framework synchronizes inventory decisions (order quantity and safety stock levels) with transport consolidation policies to reduce unnecessary dispatch frequency and emergency shipments.

Simulation-based validation has shown that coordinated inventory–transport optimization can substantially reduce transportation frequency, CO_2 emissions, and operational costs while maintaining high service levels. The solution promotes sustainable transportation ecosystems through green transportation objectives in the coordination of the warehouse logistics strategy.

Keywords: Sustainable Transportation, Inventory Optimization, Ai Forecasting, Green Logistics, Carbon-Aware Supply Chains, Smart Warehouse Systems

■ IST26-10.

Modeling and Simulation of Quadcopter Rotational Dynamics Using MATLAB/Simulink

Aftandil Mammadov, Gurban Hasanli*, Nikolay Ryabchikov

National Aviation Academy, Baku, Azerbaijan.

Abstract: This paper presents the modeling and simulation of the rotational dynamics of a quadcopter using MATLAB/Simulink. The mathematical model is derived from Euler's rotational equations and Newton's second law to describe the angular motion of the vehicle about its body axes. A modular Simulink implementation is developed to represent roll, pitch, and yaw dynamics. Key physical parameters, including mass, moments of inertia, thrust coefficient, drag coefficient and arm length, are defined in the MATLAB workspace to ensure modularity and numerical consistency. Rotor angular velocities are computed from applied thrust and control torques using a MATLAB Function block. Simulation results demonstrate the dynamic response of the system under different torque inputs and confirm the correctness of the implemented rotational model. The proposed framework provides a reliable foundation for further development of quadcopter attitude control systems and full dynamic simulation.

Keywords: Quadcopter Dynamics, Rotational Dynamics, Attitude Dynamics, Matlab/Simulink Modeling, Nonlinear Dynamic Systems

▪ IST26-11.

Automatic Search System that Ensures Selection of the Antenna with the Greatest Signal in the Decameter Radiocommunication System

Afig Hasanov, Aytan Seyfullayeva*

National Aviation Academy, Baku, Azerbaijan.

Abstract: This article investigates the problem of fading caused by the multi-beam reflection of decameter waves in the ionosphere and their arrival at the Earth along different trajectories. When waves reach the receiving station along different trajectories, fading arises as a result of interference, since their phases differ. The purpose of the study is to ensure the stability of communication by minimizing the effect of fading. The stability of communication can be ensured by studying a multi-antenna system. For this purpose, a scheme of an automatic search system is proposed, and this system automatically connects an antenna with a high signal level to the receiver input and ensures stable acceptance. The proposed method can be applied in the field of aviation to increase stability in the implementation of long-distance communication.

Keywords: Decameter Wave, Fading, Ionosphere, Interference, Multi-antenna System, Automatic Search System

▪ IST26-12.

Multi-Orbital Satellite Constellations and High-Throughput Systems: A Comparative Analysis of Technical Determinants, Spectral Challenges, and Future Architectures

Ramiz Bayramov, Niqar Mahmudova*

National Aviation Academy, Baku, Azerbaijan.

Abstract: This paper presents a scientific analysis of the technological development and future pro-spects of satellite communication systems. Geostationary (GEO), Low Earth Orbit (LEO), and Medium Earth Orbit (MEO) satellites are comparatively examined in terms of technical specifications and functional capabilities, while the impact of High-Throughput Satellites (HTS) and emerging constellation networks on system performance, coverage, and data transmission rates is evaluated. Key challenges, including Ka-band optimization, signal latency, spectrum management, and the scientific applications of CubeSats, are addressed using analytical and comparative methods. The study demonstrates that Ka-band optimization, GEO–LEO hybrid models, and localized Cu-beSat applications significantly enhance satellite communication efficiency and contribute to the development of global communication infrastructure.

Keywords: Satellite Communications, Cubesat, Leo, Meo, Ka-Band, Constellation, Internet Of Things

■ IST26-13.

Insider Threats in Intelligent Transportation Systems

Shola Shekili*, Ramil Mukhtarov

National Aviation Academy, Baku, Azerbaijan.

Abstract: The rapid digitalization of transportation infrastructure and the expansion of intelligent mobility systems have transformed the operational environment of modern transport networks. Airports, railway terminals, logistics hubs, and multimodal platforms increasingly rely on interconnected digital systems, automated monitoring technologies, and integrated data environments. While these developments improve operational efficiency and support sustainable mobility, they also introduce new categories of security vulnerabilities. Among these risks, insider threats remain particularly difficult to detect because individuals with authorized access may exploit institutional trust, operational knowledge, or system permissions.

This paper examines insider risks within intelligent transportation systems using a qualitative risk-oriented analysis based on regulatory reports and recent research. The findings indicate that digital integration and operational complexity may increase insider vulnerabilities. The study highlights the importance of behavioural monitoring and structured insider risk management to strengthen the resilience of intelligent transportation systems.

Keywords: Insider Threats, Intelligent Transportation Systems, Transport Infrastructure Security, Behavioural Risk Indicator, Critical Infrastructure, Smart Mobility

■ IST26-14.

Improving the Accuracy of Object Detection in Video Recordings Obtained from UAVs

Dmytro Krytskyi, Alina Artomova, Elvira Kaidan*

National Aviation Academy, Baku, Azerbaijan.

Abstract: This paper presents an improved unmanned aerial vehicles (UAVs) computer vision system that combines RGB sensor-based illumination compensation with the YOLO11s detection model. Unlike conventional digital correction methods, the proposed approach uses physical measurements of ambient light to stabilize the image before inference. To further improve detection quality, white-stripe padding is applied during preprocessing to preserve object geometry and avoid distortions caused by frame stretching. In addition, the class set was reduced to four categories — armored_vehicle, support_vehicle, tank, and vehicle — which lowered interclass confusion and sped up inference. Experimental results showed that the system remained stable in grass, dry vegetation, smoke, and fog conditions. The model achieved an overall mAP@0.5 of 0.939, while the maximum F1-score reached about 0.89 at a confidence threshold near 0.4. Compared with the baseline configuration, detection accuracy increased by 9–11%, false positives decreased by about 18%, and missed targets were reduced by 26%. The sensor subsystem required only 0.18 W of additional power, which confirms the practicality of integrating the proposed solution into lightweight UAV platforms.

Keywords: Unmanned Aerial Vehicle, Rgb Sensor, Self-Calibration, Yolov8, Precision–Recall

▪ IST25-15.

Energy Consumption Analysis and Flight Endurance Optimization of a Medical Payload Quadcopter UAV

Aftandil Mammadov*, Sara Mammadova

National Aviation Academy, Baku, Azerbaijan.

Abstract: In the modern era, Unmanned Aerial Vehicles (UAVs) have become a vital solution for the rapid delivery of medical supplies in emergency and hard-to-reach areas. This study analyzes and optimizes the energy consumption of a quadcopter UAV designed to carry a 1.8 kg medical payload. The system utilizes a 6S LiPo 10,000 mAh battery, T-Motor MN3110 brushless motors, and 13×5.5-inch carbon fiber propellers. Hover-mode thrust tests demonstrated that the motor-propeller combination delivers an average power consumption of 440-575 W. At a Maximum Take-Off Weight (MTOW) of 4.3 kg, the thrust-to-weight ratio is approximately 1.16, providing sufficient lift reserve for safe operation. Based on these results, the practical flight endurance was calculated as 19-23 minutes, including a 15% battery energy reserve for safety. The integration of real-time energy monitoring with the Return-to-Launch (RTL) failsafe further enhances operational safety. The study established clear relationships between motor RPM, thrust, current draw, and power consumption through laboratory testing. These findings confirm that proper motor-propeller selection and efficient energy management make quadcopter UAVs an effective and environmentally friendly solution for emergency medical logistics, offering faster delivery and lower emissions compared to traditional transport methods. Future work will focus on integrating an RP2040-based autopilot to reduce system weight further and optimize power consumption.

Keywords: Quadcopter Uav, Energy Efficiency, Medical Drone Delivery, Thrust-To-Weight Ratio, Battery Management, Flight Time, Sustainable Logistics, Emergency Medical Aid

▪ IST26-16.

A Deep Learning Framework for Distinguishing Real and Synthetic Aircraft Images

Ezgi Ozer*

Piri Reis University, Istanbul, Türkiye.

Abstract: The rapid advancement of deep learning technologies has led to a substantial increase in the generation of highly realistic manipulated visual content, making the distinction between synthetic (AI-generated) and real images a critical challenge. In this study, a deep learning-based classification framework is proposed to distinguish between authentic and manipulated military images. To enhance the discriminative characteristics of the input data, a segmentation-based preprocessing step is applied prior to the classification stage. The proposed framework utilizes multiple pretrained deep learning models, including ResNet18, ResNet50, and MobileNetV2, to extract representative features and perform CNN based classification. Experimental results demonstrate that all model structures achieve 100% accuracy, precision, sensitivity, and F1-score on both the training and test datasets. These findings indicate that the proposed approach effectively captures the distinguishing patterns between real and synthetic military images. Overall, the results highlight the strong capability of deep learning-based methods for detecting manipulated military content and suggest their potential applicability in real-world and decision-support systems.

Keywords: Transfer Learning, Deep Learning, Fake Image Detection, Image Classification, Computer Vision

IST26-17.

Automatic Control System for Local Oscillator Shunting in Passive Radar

Ruslan Hasanov, Kevsar Hajiyeva*

National Aviation Academy, Baku, Azerbaijan.

Abstract: This article discusses the problem of radiation of the local oscillator in the superheterodyne receiver of a passive radar, which may lead to its detection. The aim of the study is to increase the stealth of a passive radar by reducing the level of local oscillator radiation. A scheme of an automatic control system for local oscillator shunting is proposed, and an analysis of its operation under conditions of the presence and absence of an unwanted object in the observation area is carried out. The results of the study show that the proposed automatic control system makes it possible to reduce unwanted local oscillator radiation by more than one hundred times without reducing the efficiency of reception. The proposed solution can be used in passive radar systems for military purposes to increase their stealth.

Keywords: Radar, Passive Radar, Radiation, Local Oscillator, Automatic Control

IST26-18.

Edge – AI Driven Traffic Sign Detection and Voice Assistance System for Vehicle Drivers

Suthagar Subramaniyan*, Naveen Kuttimani, Sahana Varsini Santha Kumar Santhi

Kongu Engineering College, Erode, India.

Abstract: This research utilizes deep learning techniques to analyze and compare advanced traffic sign detection systems integrated with voice assistance, aiming to enhance road safety and driving comfort. The study evaluates the performance of two algorithms for real-time traffic sign recognition: YOLOv9 and Convolutional Neural Networks (CNN). The comparison is based on key metrics such as detection accuracy and processing efficiency, with the objective of identifying a model that delivers high precision along with fast response time.The experimental results demonstrate that YOLOv9 significantly outperforms the CNN-based approach, achieving a mean Average Precision mAP@50 and mAP@50-90 is 0.995 and 0.900. In addition to its high accuracy, YOLOv9 shows superior real-time performance when deployed on a Raspberry Pi platform, operating efficiently without noticeable latency. This makes it highly suitable for practical, real-world applications where computational resources may be limited.To further enhance usability and driver safety, the system incorporates an audio feedback mechanism that provides voice alerts upon detecting traffic signs. This feature helps improve driver awareness while reducing the need for constant visual attention, thereby minimizing distractions.Overall, the findings highlight YOLOv9 as the most effective algorithm for real-time traffic sign detection. The integration of accurate detection with voice assistance demonstrates strong potential for intelligent transportation systems, contributing to safer driving conditions and supporting the advancement of autonomous vehicle technologies.

Keywords: Yolov9, Cnn, Voice Assistance, Road Safety, Traffic Signs, Driver Assistance Systems, Deep Learning Techniques

■ IST26-19.

A Hybrid Deep Learning and Fuzzy Logic Framework for Condition Monitoring of Railway Traction Motors

Farid Huseynov[1]*, Elshan Manafov[1], Huseyngulu Guliyev[2], Tural Jabrayilov[1]

1. National Aviation Academy, Baku, Azerbaijan.
2. Azerbaijan Technical University, Baku, Azerbaijan.

Abstract: In this research work, an innovative hybrid diagnostic approach was developed for a comprehensive assessment of the technical condition of locomotive traction electric motors (TEM) and prediction of the remaining useful life (RUL). The study was conducted taking into account the ranges of variation of electrical, thermal, mechanical, magnetic and insulation indicators characteristic of TEMs under real operating conditions. In the proposed methodology, the evolution of the technical condition of the motor is determined by analyzing the time dynamics of multi-parameter sensor data at the initial stage. In the next stage, the obtained data is processed using a risk assessment model based on fuzzy logic. Unlike the classical binary (normal/faulty) assessment principles, this approach provides a risk-based multi-level classification of the technical condition and allows for a more accurate interpretation of the motor condition into Allowable, Warning and Dangerous categories. The results of the modeling and simulations conducted show that the presented hybrid approach increases the reliability of the diagnostic system, reduces the number of false alarms and ensures the early detection of critical faults. At the same time, the system facilitates the optimization of maintenance strategies, especially the adoption of situation-based and predictive maintenance (PM) decisions in a more substantiated manner. As a result, the obtained scientific and applied results can be considered promising in terms of the development of intelligent diagnostic systems for locomotive TEMs and their industrial application.

Keywords: Traction Electric Motor, Technical Condition Monitoring, Remaining Useful Life, Fuzzy Logic System, Hybrid Diagnostics

■ IST26-20.

Hybrid Random Number Generator-Based Radar Deceptive Jamming Electronic Counter-Countermeasures Technique

Ruslan Hasanov, Inci Cabbarova*

National Aviation Academy, Baku, Azerbaijan.

Abstract: This paper proposes an effective method for improving the resistance of ground-based linearly frequency-modulated (LFM) radar systems to deceptive (imitative) jamming. The method is based on the stepwise random variation of key parameters of the probing signal, including pulse duration and initial carrier frequency. To implement this approach, a hybrid random number generator (HRNG) is developed, combining multiple physical entropy sources with linear feedback shift registers (LFSRs) to enhance randomness and eliminate predictability. The generated random sequences are used to control a pulse-width modulator and a frequency sweep generator, forming LFM signals with non-deterministic characteristics. A structural model of the proposed system is designed and implemented in the MATLAB/Simulink environment. Simulation results demonstrate that the probing signals exhibit significant variability in both time and frequency domains, preventing accurate estimation and reproduction by deceptive jamming systems. The absence of periodicity and low correlation between successive pulses increase the difficulty of signal interception and imitation. The proposed approach ensures improved robustness of radar detection and tracking processes while maintaining relatively low implementation complexity and compatibility with existing radar architectures. The results confirm that HRNG-based parameter randomization is a promising electronic counter-countermeasure.

Keywords: Frequency, Radar, MATLAB, Radio Pulse, Generator

■ IST26-21.

Assessment of Dispatcher Decision-Making Capability at Large Railway Stations Using Fuzzy Logic

Elshan Manafov

National Aviation Academy, Baku, Azerbaijan.

Abstract: This article examines the problem of assessing the ability of dispatchers at large railway stations to make correct decisions under conditions of high operational load, time pressure, and uncertainty. The relevance of the study lies in the fact that the effectiveness of dispatch decisions directly impacts traffic safety, the sustainability of the transportation process, and the extent of delays across the network. Unlike strict quantitative approaches, dispatcher performance is determined by a combination of qualitative and quantitative factors that are difficult to describe within strict boundaries. To solve this problem, it is proposed to use fuzzy logic.

This paper develops a Mamdani-type fuzzy inference model implemented in the MATLAB Fuzzy Logic Toolbox environment. Three key factors were selected as input variables: dispatcher experience, station load, and knowledge of regulatory documents. Value ranges and linguistic terms (low, medium, and high) are specified for each variable. The output variable is the dispatcher's decision quality level. Expert logic was used to create a database of 27 "IF-AND-THEN" rules, reflecting the combined influence of the selected factors on the final assessment. It is demonstrated that the proposed model allows for the formalization of expert opinions on the quality of dispatcher decisions, accounting for uncertainty, and ensuring the interpretability of the results. Visualization of membership functions, a rule viewer, and a surface viewer enable analysis of the model's behavior under various combinations of input parameters. The practical significance of the study lies in the potential use of the developed approach for dispatcher certification, human factors analysis, personnel training, and the development of decision support systems at large railway stations.

Keywords: Railway Station, Dispatcher Decision-Making, Fuzzy Logic, Mamdani Fuzzy Inference System, Human Factor, Decision Quality Evaluation, MATLAB Modeling, Operational Reliability

■ IST26-22.

Simulation Modeling for Improving the Efficiency of Intersections

Fuad Dashdamirov, Ulvi Javadlı*, Turan Verdiyev

Azerbaijan Technical University, Baku, Azerbaijan.

Abstract: One of the main problems arising from the expansion of the urbanization process in cities is traffic jams. One of the main reasons for the formation of traffic jams is improper management of intersections. The intersection located at the intersection of Azay Kazimov and Aydin Hajiyev streets in Goygol city, Ganja region, which has the highest intensity, was selected for the study. During monitoring, it was determined that 1100-1300 cars pass through the intersection within 1 hour. Numerous programs are used to simulate intersections, but one of the most effective programs is considered to be PTV VISSIM. After evaluating the throughput capacity of the intersection through the simulation program, it was determined that the traffic light duty cycle does not correspond to the traffic flow of vehicles. The phase signals of the traffic light were corrected in accordance with the Highway Capacity Manual (HCM) methodology and modeled in the simulation program. Finally, the existing and proposed options were compared in terms of throughput capacity, average vehicle speed, queue length, fuel consumption and exhaust gas emissions.

Keywords: Vehicle, Intersection, Traffic Jams, Simulation Program, Traffic Light Regulations

■ IST26-23.

The Effect of Transition Contact Resistance and Adhesion of $Bi_{0.85}Sb_{0.15}$ Samples with Various Alloys on the Efficiency of Environmentally Friendly Thermoelements

Mail Tagiyev[1,2,3*], Khadija Aliyeva[2], Aida Mammedzade[4], Ilaha Abdullayeva[2,3], Sevda Dzhafarova[1], Arzu Akhmedova[1]

1. Azerbaijan State University of Economics (UNEC), Baku, Azerbaijan.
2. Azerbaijan University of Architecture and Construction, Baku, Azerbaijan.
3. Ministry of Science and Education of the Republic of Azerbaijan, Baku, Azerbaijan.
4. Institute of Molecular Biology and Biotechnology, Baku, Azerbaijan.

Abstract: The dependence of the transition contact resistance rk and the adhesion work of extruded samples of the solid solution $Bi_{0.85}Sb_{0.15}$ with alloys containing lead and tin has been studied. The alloy compositions (wt. %) are: 25 Bi + 50 Pb + 12.5 Cd + 12.5 Sn and 57 Bi + 43 Sn, as functions of magnetic field strength (H) and temperature. The transition contact resistance rk of $Bi_{0.85}Sb_{0.15}$–contact alloy structures is determined primarily by the electrical properties of intermediate semiconductor phases formed at the interface of these structures. A correlation exists between rk the electrical resistivity, and the band gap width of the intermediate phases formed. It is shown that introducing tin atoms into the contact alloy based on bismuth—atoms that diffuse into the near-contact region of the crystals and substitute for bismuth and antimony atoms—can reduce rk of the structure. These improvements make it possible to develop space systems, thermoelectric coolers for photodetectors, and detectors based on extruded Bi–Sb samples with higher sensitivity and greater reliability.

Keywords: Solid Solution, Energy Converters, Extruded Samples, Infrared Detectors, Containing Lead

■ IST26-24.

Modeling of Microprocessor-Based Complex Protection System for Locomotive Traction Transformer

Elshan Manafov, Ali Aslanli*, Farid Huseynov

National Aviation Academy, Baku, Azerbaijan.

Abstract: The research work investigated the issue of PLC-based modeling of a complex protection system for traction transformers of locomotives. The operation of traction transformers under conditions of variable loads, transient processes, short-term overcurrents and internal insulation faults necessitates their multi-level and selective protection. In this work, a functional model was developed that simulates the logical interaction of maximum current, differential, thermal and pressure protections. The model was built on the basis of PLC functional blocks in the TIA Portal software environment, and the input signals were normalized and scaled using virtual sensors. Scenarios of normal operation, overload, internal short circuit, temperature increase and pressure increase were simulated. The results obtained show that the proposed model allows assessing the selectivity, response logic and coordination of protection functions at the scenario level.

Keywords: Traction Transformer, Complex Protection System, Differential Protection, Plc Based Modeling, Tia Portal

IST26-25.

Critical Gaps in PEM Fuel Cell Modelling for Unmanned Aerial Vehicle (UAV) Integration

Sergii Boichenko, Vitalii Korovushkin*, Iryna Shkilniuk, Leonid Listovshchyk, Victor Stoudenets, Yehor Brodnikovskyi

National Technical University of Ukraine, Kyiv, Ukraine.

Abstract:. Proton Exchange Membrane Fuel Cells (PEMFCs) represent a high-potential alternative to standard Lithium-Polymer (Li-Po) batteries for Unmanned Aerial Vehicles (UAVs), offering the possibility of extending flight times by a factor of two to ten. However, a significant gap in mathematical modeling remains a major obstacle to their practical implementation. Current steady-state electrochemical models are sufficient for laboratory settings but fail to account for the volatile, multi-physics environment encountered during actual UAV operations. Specifically, altitude fluctuations impact oxygen partial pressures and increase parasitic compressor loads, while the delicate balance of Water and Thermal Management (WTM) often fluctuates between membrane dehydration and electrode flooding. Additionally, the complexities of cold-start operations further complicate the system's behavior. These dynamic variables simultaneously affect all fundamental voltage components—including Nernst potential (ENernst) and activation, ohmic (Vohmic), and concentration (Vconc) overpotentials—rendering traditional static models ineffective for performance prediction. This issue is exacerbated by a severe lack of experimental data collected during flight, leaving many current models unvalidated. This study concludes that until research shifts toward establishing an empirical "ground truth" through flight testing, the development of reliable control-oriented models will remain stalled, preventing the optimization and adoption of PEMFC technology for the UAV sector.

Keywords: Hydrogen Fuel Cells (FC), Unmanned Aerial Vehicles (UAVs), Hybrid Power Systems, Power Management

IST26-26.

Analysis of Transit Time Through the Zangezur International Transport Corridor Based on Imitation Modeling under Uncertainty Conditions

Heybatulla Ahmadov[1], BalaAgha Karimov[2], Aytaj Mustafayeva[2]*

1. Azerbaijan Technical University, Baku, Azerbaijan.
2. National Aviation Academy, Baku, Azerbaijan.

Abstract: The efficient and sustainable operation of modern international transport corridors directly depends on the reliable forecasting and effective management of transit times. Especially under conditions of increasing global trade flows, growing complexity of logistics chains, and rising geopolitical risks, this factor emerges as one of the key indicators determining the competitiveness of transport systems. Although the Zangezur International Transport Corridor (ZITC) plays a significant strategic role in the diversification of interregional freight transportation and the formation of alternative transit routes, transit processes along this corridor are subject to various sources of uncertainty, including border-crossing procedures, infrastructure constraints, technical failures, and organizational factors.

In this article, the formation of transit times within the Zangezur Corridor is analyzed using a stochastic approach, and the variability of transit times under conditions of uncertainty is assessed through imitation modeling. Within the scope of the study, a mathematical model based on queueing theory is developed, and the Monte Carlo imitation method is applied in the Excel environment. The obtained results enable the formulation of practical recommendations for transport corridor planning, risk mitigation, and the optimization of managerial decision-making.

Keywords: Zangezur International Transport Corridor, Simulation Modeling, Transit Time, Uncertainty, Monte Carlo Method

■ IST26-27.

Comparative Modelling of Classical and Aerometric Smart-Probe-Based Yaw Damper Systems

Toghrul Karimli, Turgut Khalilli, Rauf Guliyev*

Baku Business University, Baku, Azerbaijan.

Abstract: Yaw stability is one of the critical factors in ensuring safe and controlled flight, as disturbances along the yaw axis can lead to Dutch roll oscillations and, in severe cases, contribute to Loss of Control In-Flight (LOC-I) events. Classical yaw damper systems rely solely on gyroscopic sensors to measure angular rate, meaning the control system only reacts after yaw motion has already developed in the aircraft. To address this limitation, this study proposes an enhanced yaw damper system that incorporates an aerometric smart probe alongside the conventional gyroscopic sensor, enabling earlier detection of lateral disturbances through pressure difference measurements. Two control system models — classical and aerometrically enhanced — were developed and compared in the MATLAB/Simulink environment using step disturbance inputs. Simulation results demonstrate that the aerometric signal activates prior to the gyroscope signal, resulting in faster yaw rate correction and improved directional stability. The proposed approach represents a practical and reliable enhancement to existing yaw damper architectures applicable to both commercial and military aviation.

Keywords: Yaw Damper, Loc-I, Aerometric Smart Probe, Gyroscopic Sensors, Yaw Stability

■ IST26-28.

Nonlinear Genetic Algorithm-Based OTP Architecture for Secure Communication in Aerospace Transportation Systems

Sevda Ibrahimova*, Isa Huseynzade

National Aviation Academy, Baku, Azerbaijan.

Abstract: An important aspect of modern aerospace systems is the secure transmission of visual telemetry. The One-Time Pad (OTP) provides perfect theoretical secrecy but its practical use is limited by the need to distribute keys of the same size as the plaintext. This study proposes a nonlinear GA-OTP architecture using genetic operators in order to overcome this limitation. The technique constructs full-length cryptographic sequences from compact high-entropy parameters by means of deterministic procedures such as uniform crossover and mutation. We experimentally show lossless reconstruction on high-resolution aerospace imagery with low computational overhead under limited hardware conditions. Cryptanalytic results show that the introduced nonlinearity increases algebraic complexity while maintaining the theoretical security of OTP. The approach in general reduces the key distribution overhead and provides a practical and efficient solution for secure transmission of aerospace telemetry.

Keywords: Aerospace Telemetry, One-Time Pad, Algebraic Complexity, Genetic Algorithm, Secure Image Transmission

■ IST26-29.

Continuous Monitoring of the Operational Reliability of Critical Aircraft Components in Flight

Toghrul Karimli*, Ramin Babayev

National Aviation Academy, Baku, Azerbaijan.

Abstract: This study examines aircraft accidents caused by severe vibration, excessive structural stress, and metal fatigue. To address these issues, the study proposes deploying miniature dual-channel piezoelectric accelerometers to measure vibration and overload on key aircraft and engine components. These accelerometers can measure vibration, overload, deformation, and the associated mechanical stress of aircraft components during flight. In future with combining and analyzing data from these accelerometers, the study describes a method for monitoring critical components subject to high loads in real time, helping to identify problems before they lead to accidents.

Keywords: Aircraft, Engine, Vibration, Overload, Piezoelctric Accelerometer

■ IST26-30.

Mitigation of Errors in Civil Aviation Navigation Systems Using Intelligent Algorithms

Jeyran Agamaliyeva

National Aviation Academy, Baku, Azerbaijan.

Abstract: This study investigates the intelligent mitigation of errors occurring in the Inertial Navigation System (INS) during Global Navigation Satellite System (GNSS) signal outages, with the aim of enhancing the navigation safety of civil aircraft. Although the INS possesses autonomous operational capability, it exhibits significant trajectory deviations over time due to "drift" errors. The proposed Long Short-Term Memory (LSTM)-based hybrid algorithm utilizes an LSTM neural network to model the time-series characteristics of navigation data. During the simulation process, the first 70 seconds of aircraft flight data were used for network training, and the predictive capability of the LSTM was subsequently tested in an 80-second GNSS outage scenario. Experiments conducted in the MATLAB environment demonstrate that the proposed model reduced position errors (RMSE) by more than 90% compared to a standalone INS, maintaining them at a level of 3.57 meters. The results prove that the LSTM-based intelligent processing unit is an effective solution for preserving navigation accuracy during signal loss.

Keywords: INS/GNSS Integration, Hybrid Navigation System, GNSS Outage, Long Short-Term Memory, Deep Learning

■ IST26-31.

Satellite Navigation Signal Integrity Assessment Block for Enhancing Receiver Reliability

Gurban Sadigov*, Gurban Hasanli, Khadija Jafarova

National Aviation Academy, Baku, Azerbaijan.

Abstract: This paper presents a software-based GNSS Signal Integrity Evaluation Block (SIEB) intended for receiver assessment of satellite measurement reliability. The proposed block evaluates observed pseudorange measurements, signal-to-noise ratio values, satellite ephemeris data and time-domain residual behavior in order to classify each satellite signal as valid or invalid before it is used in the navigation solution. The method consists of geometric range computation, expected pseudorange estimation, residual calculation, temporal stability analysis, SNR-based quality weighting and consistency index evaluation. Unlike hardware-based integrity monitoring units, the proposed SIEB is designed as an algorithmic module integrated into the existing GNSS receiver firmware or navigation processing software. The resulting validity flags and quality weights can be used to exclude unreliable satellite measurements and improve the robustness of GNSS positioning under degraded signal conditions.

Keywords: Gnss, Signal Integrity, Pseudorange Residual, Geometry Computation, Navigation Reliability

■ IST26-32.

A Survey of Sliding Mode Control Based on Adaptive Neuro-Fuzzy Inference System for UAV Applications

Samad Samadov*, Firdovsi Mahmudlu, Vuqar Huseynov

National Aviation Academy, Baku, Azerbaijan.

Abstract: This article is a review about Sliding Mode Control (SMC) based on Adaptive Neuro-Fuzzy Inference System (ANFIS) for Unmanned Aerial Vehicles (UAV). The Sliding Mode Control ensures stability but produces chattering in its operation. Research in recent times shows that when ANFIS is combined with the sliding mode controller, there is no chattering produced while at the same time stability is ensured. From the analysis conducted using the literature review, this review is focused on the improvement rate of the tracking performance from the use of ANFIS-SMC of more than 50% and approximately 90% decrease in chattering.

Keywords: UAV Control, ANFIS, Sliding Mode, Chattering Reduction, Literature Survey

IST26-33.

Experimental Investigation and Optimization of Bending Stress in Laser-Welded AISI 316L Stainless Steel for Green Transportation Applications

Emrah Arda

Sakarya University of Applied Sciences, Sakarya, Türkiye.

Abstract: Reliable joining of metallic components used in sustainable transportation systems is crucial for structural strength, service life, and maintenance requirements. In this study, butt welding of 1 mm thick AISI 316L stainless steel sheets was performed using a fiber laser, and the effect of welding parameters on maximum bending stress was experimentally investigated. The experimental design utilized three control factors: laser power (15%, 20%, and 25%), beam oscillation frequency (4, 8, and 12 Hz), and beam oscillation width (0.4, 0.6, and 0.8 mm). The experimental plan was based on a Taguchi L9 orthogonal array. Welding operations were performed at a constant speed of 0.7 m/min under shielding gas, and the welded specimens were subjected to a three-point bending test according to the TS EN ISO 7438 standard. According to the results, the maximum bending stress ranged from 476.438 to 599.156 MPa. The highest value was obtained at 599.156 MPa with 15% laser power, 4 Hz oscillation frequency, and 0.4 mm oscillation width, while the lowest value was measured at 476.438 MPa with 25% laser power, 12 Hz oscillation frequency, and 0.6 mm oscillation width. According to the S/N ratio analysis, the optimum parameter combination was determined as 20% laser power, 4 Hz oscillation frequency, and 0.4 mm oscillation width. ANOVA results showed that the oscillation frequency was the most influential parameter on the maximum bending stress. In this respect, the study provides experimental data for the reliable laser welding of corrosion-resistant 316L sheet metal components in the automotive industry.

Keywords: Green Transportation Materials, Stainless Steel, Welding, Taguchi Method, Bending Stress

IST26-34.

Quality-of-Service Assessment of Logistics Information Flows in Next-Generation Network Environments

Elshan Hashimov[1]*, Bayram İbrahimov[1], Aziz Talibov[1], Ramil Akhundov[2], Kostiantyn Dergachov[3]

1. Azerbaijan Technical University, Baku, Azerbaijan.
2. National Defense University, Baku, Azerbaijan.
3. National Aerospace University, Kharkiv, Ukraine.

Abstract: The digitalization of logistics systems has increased the volume, intensity, and functional complexity of information exchange. In modern logistics environments, management, monitoring, telemetry, decision support, and multimedia communication operate within a unified information space. Therefore, reliable assessment of the quality of service of these flows is of particular importance. Next-Generation Network (NGN) and IP Multimedia Subsystem (IMS) technologies provide broad opportunities for organizing such services, but quality in this environment is determined not only by packet transmission indicators, but also by the signaling load associated with session establishment and service management. This paper proposes an analytical model for assessing the quality of service of logistics information traffic in NGN/IMS environments. The model integrates self-similar traffic behavior, queuing processes, signaling load in the IMS core, and user-oriented service adequacy within a unified assessment framework. To demonstrate the applicability of the model, a scenario-based numerical analysis is performed using representative parameter sets for traffic condition, Hurst parameter, signaling load, service access delay, and the integrated quality index. The results show that an increase in self-similarity and signaling intensity leads to higher service access delay and a lower integrated service quality index, even when average traffic load remains unchanged. The proposed model can be used for planning NGN/IMS-based logistics information systems, prioritizing service classes, and designing quality-sensitive network services.

Keywords: Next-Generation Network, IP Multimedia Subsystem, Logistics Information Traffic, Quality Of Service, Quality Of Experience, Self-Similar Traffic, Sip, Diameter, Signaling Load

■ IST26-35.

Materials Science and Engineering for Green Transportation

Shafagat Mahmudova

Institute of Information Technology , Baku, Azerbaijan.

Abstract: Green transportation encompasses transport systems that are developed to minimize its negative impact on the environment. Green transportation can increase economic growth, reduce greenhouse gas emissions, and promote sustainable development by reducing waste and energy use. Moreover, it lessens air pollution, which is harmful to both the environment and human health. Materials science and engineering play a key role in the development of sustainable transport aimed at reducing environmental impact, increasing energy efficiency, and using renewable resources. Hence, the materials used directly affect both energy efficiency and emission reduction. Aluminum, magnesium alloys, and composite materials (carbon fibers) cut down the weight of vehicles. This in turn, reduces fuel consumption and energy consumption. Materials science studies the properties, structure, and application possibilities of materials used in the production of vehicles. Engineering provides the practical application of materials and the optimization of systems. This article studies materials science and engineering, their role, practical application, environmental and economic advantages, main areas of innovation, new technologies used, reducing the environmental impact of materials science and engineering, the purpose of green transportation, and transportation systems developed to minimize the environmental impact of green transportation, and discusses further research and makes recommendations.

Keywords: Green Transportation, Materials Science, Engineering, Environmental, Economic, Innovation

■ IST26-36.

Enhancing Airport Security Through AI-Based Smart Surveillance Systems: A Case Study of Heydar Aliyev International Airport Passenger Terminal

Ruslan Rustamov

National Aviation Academy, Baku, Azerbaijan.

Abstract: Ensuring aviation security at airports is one of the main conditions for the regular and efficient operation of the modern air transport system. The approaches applied in this area are not limited to traditional security measures, but are also based on complex and systematic mechanisms that include the preliminary identification, assessment, and operational management of risks. The application of innovative technologies for the timely detection and prevention of threats is of great importance, especially in terminals with intensive passenger traffic.

The article analyzes the functional capabilities of artificial intelligence-based smart cameras and justifies the effectiveness of their application at the passenger terminal of Heydar Aliyev International Airport. For this purpose, the role of video surveillance systems in aviation safety was investigated, the capabilities of traditional and artificial intelligence-based cameras were comparatively analyzed, and their effectiveness was evaluated based on computer vision techniques and video analytics.

The results of the study show that artificial intelligence-based smart cameras are highly effective in terms of identifying wanted persons, automatically detecting suspicious behavior, and monitoring passenger, baggage and cargo flows in real time. These technologies allow for earlier detection of threats and expansion of operational intervention capabilities. As a result, considering that artificial intelligence-based smart cameras increase the effectiveness of aviation security activities, the feasibility of implementing these cameras in the passenger terminal of Heydar Aliyev International Airport, where passenger flow is increasing day by day, has been noted.

Keywords: Airport Security Systems, Risk Management In Aviation Security, Artificial Intelligence, Ai-Based Smart Surveillance Systems, Computer Vision In Aviation, Video Analytics For Security, Passenger Flow Monitoring, Behavior Detection Systems

■ IST26-37.

Application of ACARS for Remote Monitoring of the Pilot's Psychophysiological State

Aftandil Mammadov*, Gurban Sadigov

National Aviation Academy, Baku, Azerbaijan.

Abstract: In this work, methods and devices for analyzing the psychophysiological state of pilots in flight are investigated, together with the functional capabilities of ACARS and its potential for enabling remote monitoring of pilot condition. The relevance of the study is driven by the continuous growth in air traffic, which necessitates improved flight safety through timely detection of human-related factors such as fatigue, stress, and sudden incapacitation that may critically affect flight performance. An approach to monitoring the pilot's functional state using ACARS-based data transmission is proposed. The approach includes a system architecture comprising onboard sensors, a biometric data processing module, and a message generation mechanism for transmission via ACARS channels. Algorithms for pilot state assessment and principles of integration with ground-based monitoring systems are also considered.

The proposed architecture employs a processing unit to analyze incoming data, perform filtering, and classify the pilot's condition, followed by the generation of event-driven messages. Data transmission is implemented in the form of aggregated diagnostic messages, which reduces communication load and improves the timeliness of informing ground services. The proposed approach can enhance flight safety by enabling early detection of critical pilot conditions.

Keywords: Flight Safety, Psychophysiological State, Sensors, Biometric Monitoring, Pilot's Condition

■ IST26-38.

Real-Time UAV Swarm Control Interface with Simulation Integration

Gurban Hasanli*, Farid Novruzlu, Fariza Hajiyeva

National Aviation Academy, Baku, Azerbaijan.

Abstract: The design and development of an integrated control interface for the real-time monitoring and control of swarms of unmanned aerial vehicles (UAVs) is presented in this paper. The Windows Presentation Foundation (WPF) and C# are used in the system's implementation to create an organized and user-friendly interface for multi-UAV operations. Coordinated yet adaptable swarm activity is made possible by the architecture's combination of distributed control and centralized supervision.

The real-time map-based visualization module of the suggested interface, which runs in tandem with a simulation environment, is one of its main features. Consistency between the virtual world and the control interface is ensured by the system's ability to reflect UAV movements produced in Gazebo. This integration makes swarm dynamics analysis more dependable and enhances situational awareness. The findings show that the approach improves control precision, increases operational awareness, and offers a useful foundation for managing UAV swarms.

Keywords: Windows Presentation Foundation (WPF), Unmanned Aerial Vehicle (UAV), Ground Control Station (GCS), Real-time monitoring, Swarm

IST26-39.

Development of a Real-Time Multi-Parameter Monitoring System for the Technical Condition of Electric Motors

Elshan Manafov, Farid Huseynov*, Kenan Jabbarzadeh, Elshan Alisoy

National Aviation Academy, Baku, Azerbaijan.

Abstract: Reliable operation of electric motors is of great importance for industry, transport, energy and automated technological processes. Failure to timely detect changes in the technical condition of the motor can lead to problems such as overload, temperature increase, increased vibration, mechanical wear, winding damage and sudden stop. This article presents a multi-parameter experimental monitoring prototype based on the Arduino microcontroller for real-time monitoring of the technical condition of a small-power electric motor. Eight informative parameters characterizing the electrical, thermal, mechanical and electromagnetic state of the motor were selected in the study: voltage, current, network frequency, temperature, magnetic field index, vibration, noise level and rotation speed. The data received from the sensors were collected using the Arduino microcontroller, pre-processed and visualized in real time on the LCD screen. The characteristics of changes in some signals were additionally observed using an oscilloscope. The main feature of the proposed approach is that the technical condition of the motor is assessed not only by traditional voltage, current and temperature control, but also by joint analysis of multi-source sensor data. Although the prototype built is at the laboratory level, its working principle can be considered promising in the future for creating real-time diagnostics and predictive maintenance systems for large-power industrial motors, transport electric drives, and especially traction motors of electric locomotives.

Keywords: Electric Motor, Real-Time Monitoring, Multi-Parameter Diagnostics, Multi-Sensor System, Condition Monitoring

IST26-40.

Assessing the Social Impact of Innovative Air Mobility and U-space: Evidence from Antwerp

Anna Palaiologk, Emmanouil Pantelidis*, Athanasios Arvanitidis

Future Needs Management Consulting Ltd, Strovolos, Cyprus.

Abstract: As Innovative Air Mobility (IAM) applications expand across sectors such as healthcare, infrastructure monitoring, and urban surveillance, attention is shifting from technical feasibility toward broader socio-economic impacts. While financial assessments often focus on operational viability, societal effects remain under-examined, particularly in the context of U-space. This paper examines the additional socio-economic benefits and trade-offs enabled by U-space beyond current IAM operations. Using a scenario-based framework, the study compares traditional non-drone operations, current IAM operations, and fully integrated IAM enabled by U-space. The analysis draws on qualitative insights from a structured stakeholder interview on port and railway infrastructure surveillance in the Province of Antwerp. Results show that IAM improves accessibility, emergency response, and early incident detection, while U-space further enhances these benefits through greater coordination, scalability, and safety.

Keywords: Innovative Air Mobility, U-Space, Drone Operations, Social Impact, Socio-Economic Assessment, Social Welfare, Public Acceptance, Aviation Policy

IST26-41.

Hydrodynamic Performance of a Small Autonomous Underwater Vehicle Using an Inverted NACA 2412 Wing: CFD Simulation and Prototype Testing

Long H. Vo[1], Hao N. Le[1], Tai D. Duong[2]*, Anh T. Tran[1]

1. Ho Chi Minh University of Technology (HCMUT), Vietnam National University Ho Chi Minh City (VNU-HCM), Ho Chi Minh City, Vietnam.
2. Tran Dai Nghia University, Ho Chi Minh city, Vietnam.

Abstract: Ocean exploration and underwater rescue operations increasingly depend on small autonomous vehicles capable of precise depth control. Conventional buoyancy-based systems add mechanical complexity and slow the vehicle response. An alternative approach uses inverted wing profiles to generate downward hydrodynamic force, allowing depth changes through propulsion rather than ballast adjustment. This paper describes the design, simulation, and prototype testing of a small AUV equipped with an inverted NACA 2412 wing. The vehicle was designed for shallow-water operation at speeds between 1.5 and 3 m/s, with a target depth of 2 m. Flow simulations were performed in SolidWorks Flow Simulation at an inlet velocity of 5 m/s, covering angles of attack from −1° to −10°. The angle of −7° produced the highest lift-to-drag ratio of 9.14 and was selected for the fabricated prototype. The hull was built from a PVC tube and the wings were 3D-printed in PLA plastic. Pond testing confirmed that the vehicle maintained waterproof integrity throughout operation. At operating speed, the inverted wings generated sufficient downward force to submerge the vehicle for approximately 10 seconds. The results support the feasibility of using an inverted airfoil as a simple and practical depth control mechanism in small, low-cost AUVs.

Keywords: Autonomous Underwater Vehicle (AUV), Inverted Airfoil, Hydrodynamic Performance, NACA 2412

IST26-42.

Comparative Assessment of Supercooled Large Droplets Impingement Models for Capture Coefficient Prediction on the NACA 65-415 Airfoil

Tai D. Duong[1]*, Thach-Thao T. Nguyen[2]

1. Tran Dai Nghia University, Ho Chi Minh City, Vietnam.
2. Ho Chi Minh City University of Technology (HCMUT), Vietnam National University Ho Chi Minh City (VNU-HCM), Ho Chi Minh City, Vietnam.

Abstract: Supercooled large droplets (SLD) with a median volumetric diameter above 50 μm pose a serious risk to aircraft because their impingement behavior differs substantially from that of smaller droplets. Accurate prediction of the capture coefficient β is therefore essential for ice accretion modeling. Three droplet impingement models - Mundo, Honsek, and Wright – were implemented in FENSAP-ICE and tested on the NACA 65-415 airfoil under two angles of attack (0° and 8°). The freestream conditions were: velocity 78.68 m/s, static pressure 95,000 Pa, MVD of 92 μm, and liquid water content of 0.22 g/m³. A structured mesh of approximately 237,000 cells with $y^+ \approx 0.2$ was used together with the k-ω SST turbulence model. Predicted β distributions were compared against experimental data from Papadakis et al. (2002). The Mundo model underestimates the peak at the leading edge but agrees reasonably in the downstream region. The Honsek model reproduces the leading-edge peak but substantially overpredicts β further downstream. The Wright model follows the overall distribution shape but shifts the entire curve upward, resulting in consistent overprediction across the surface. At AOA = 8°, the impingement zone extends toward the lower surface, and the model biases remain qualitatively similar. No single model matches the experiment across the full chord. These results suggest that hybrid or refined models are needed for reliable SLD-based ice accretion prediction.

Keywords: Capture Coefficient, Supercooled Large Droplet, Splashing Threshold, Liquid Water Content, Eulerian Approach

■ IST26-43.

Enhanced Flight Time Estimation for UAVs Using an Intelligent Battery Management System

Islam Isgandarov, Muahammadali Hajizadeh*

State University "Kyiv Aviation Institute", Kyiv, Ukraine.

Abstract: Accurate flight time estimations are a key factor in operation safety; therefore, the flight times can provide safety and reliability for UAV operations. The traditional methodology of obtaining an accurate flight time approximation uses the instantaneous battery voltage and current measurements to estimate the remaining battery life. Traditional methodologies do not consider issues such as battery aging, temperature, and capacity decline, resulting in inaccurate flight time approximations based on real-time operational conditions. This paper introduces an intelligent battery management system (IBMS) that enhances the accuracy of flight time predictions by considering multiple battery-related parameters that contribute to direct effects on battery predictions due to the charge and discharge cycles, the immediate temperature conditions, and the voltage drop characteristics of each battery. The IBMS also has a direct interface with the UAV autopilot system, providing real-time feedback to facilitate adaptive decision-making on the part of the UAV operator. The proposed IBMS improves both the accuracy and reliability of flight time prediction, and thus enhances operational safety and efficiency of UAV operations through proper flight time prediction function within the UAV system.

Keywords: UAV, BMS, Flight Time Estimation, Battery Aging, Energy Management

■ IST26-44.

Sustainable Development in the Context of Green Transport Investments and Green Energy Corridors: The Azerbaijani Experience

Gunay Madjidova[1,2]

1. Azerbaijan Universty, Baku, Azerbaijan.
2. Azerbaijan State Economic University, Baku, Azerbaijan.

Abstract: Reducing carbon emissions, minimizing environmental damage, increasing energy efficiency, and transitioning to ecological, clean, and sustainable transport systems are goals pursued by many countries in today's world. Green transport initially requires large amounts of capital investment, which makes partnership between the state and private sector essential. As a component of the green economy, green transport not only enhances economic efficiency but also serves social welfare. The economic efficiency of green transport investments includes improving the effectiveness of the transport system, developing railways, creating low-emission urban transport infrastructure, reducing fuel costs, decreasing energy dependence, and generating new "green jobs."

The social impacts of green transport investments include reducing air pollution, lowering noise levels in cities, and increasing accessibility of public transport.

Since green transport requires infrastructure and high costs, and does not yield high profits in the initial stage, entrepreneurs and investors show less interest in investing in this area. For this reason, in countries with high economic growth and budget revenues, cooperation between the state and private sector, as well as the triple helix model, plays an important role in green investments. Green transport investments, which contribute to economic efficiency, also improve social welfare, making them one of the key strategic directions for long-term sustainable development in the future.

Keywords: Green Transport, Railway Development, Low-Emission Urban Transport, Public Transport Accessibility, Transport System Efficiency

IST26-45.

Use of Unmanned Aerial Vehicles Equipped with a Hybrid Power System

Rasim Nabiyev, Kamal Askerov, Gadir Garayev*, Vusal Abbasov, Garanfil Valiyeva

National Aviation Academy, Baku, Azerbaijan.

Abstract: The article examines the necessity of applying a hybrid power system in unmanned aerial vehicles to perform various tasks and the technological advantages of such drones. The limited flight time of traditional battery-powered unmanned aerial vehicles makes their application impossible, especially for long-term monitoring of large areas and continuous observation of industrial facilities. In this context, the application of unmanned aerial vehicles with a hybrid power system is considered a promising solution in terms of increasing both energy efficiency and operational sustainability.

The article highlights the advantages of hybrid unmanned aerial vehicles in the field of cartography and three-dimensional modeling, such as high resolution, continuous data collection, large-scale mapping, and precise location determination based on satellite and differential navigation. Against the background of the operational limitations of fixed-wing horizontal flight and vertical take-off and landing platforms, hybrid hexacopter systems are shown to provide more flexible control, maneuverability, and high stability. It is shown that hexacopter-type drones increase the efficiency of energy consumption during flight and flight safety, and the hybrid power source increases the flight duration.

The developed hybrid power system was tested on a hexacopter platform adapted to real flight conditions. In the experimental study, the stable output voltage, current, and fuel consumption of the fuel-powered engine-electric generator as a hybrid power system were recorded. The flight time of the hexacopter was determined under loaded conditions in ground flight mode. The results confirm that hybrid power systems are a reliable, highly efficient, and promising solution for applications requiring long-term flight, such as monitoring, mapping, and industrial inspection.

Keywords: Hybrid UAV, Monitoring, Cartography, VTOL, Energy Efficiency, Long-Range Flight, Fixed Wing, Internal Combustion Engine, 3D Modeling

IST26-46.

A Comparative Study of Classical Approximate Riemann Solvers: Accuracy, Diffusion, and Contact Wave Resolution

Bach T. Tran[1], Tai D. Duong[2]*, Anh T. Tran[1]

1. Ho Chi Minh City University of Technology (HCMUT), Vietnam National University Ho Chi Minh City (VNU-HCM), Ho Chi Minh City, Vietnam.
2. Tran Dai Nghia University, Ho Chi Minh City, Vietnam.

Abstract: Accurate flux computation across discontinuities remains a fundamental challenge in numerical simulations of compressible flows. This study implements four classical approximate Riemann solvers—Lax–Friedrichs, Lax–Wendroff, HLL, and HLLC—within a in-house finite volume code to evaluate their performance against the exact Godunov solution. The solvers are rigorously tested across four one-dimensional benchmark problems capturing a wide range of wave intensities: the standard Sod shock tube, a strong shock wave problem, and a severe double-shock interaction. Numerical results indicate that the Lax–Friedrichs scheme introduces excessive numerical diffusion, severely smearing all discontinuities. The Lax–Wendroff scheme enhances sharpness but suffers from non-physical oscillations and suffers from severe instability in low-density, low-pressure regions. While the standard HLL scheme accurately captures shock and rarefaction waves, it exhibits significant dissipation across contact surfaces. Crucially, the HLLC scheme successfully restores the intermediate contact wave structure. Although its superiority over HLL is marginal in weak-wave configurations (Tests 1), the HLLC solver demonstrates substantial advantages in handling strong shock fronts and isolated contact discontinuities under extreme gradients (Tests 2 and 3), matching the exact density peaks with exceptional sharpness. These findings provide a comprehensive, practical benchmark for selecting appropriate Riemann solvers based on flow severity in one-dimensional compressible fluid dynamics simulations.

Keywords: Riemann Problem, Approximate Riemann Solvers, Euler's Equation, Shock-Capturing Schemes

■ IST26-47.

Numerical Investigation of the Effect of Laminar Separation Bubbles on Nusselt Number Distribution over a NACA 4412 Airfoil

Nhat N. M. Mai[1], Duc T. Tran[1], Tai D. Duong[2]*, Anh T. Tran[1]

1. Ho Chi Minh City University of Technology (HCMUT), Vietnam National University Ho Chi Minh City (VNU-HCM), Ho Chi Minh City, Vietnam.
2. Tran Dai Nghia University, Ho Chi Minh City, Vietnam.

Abstract: Heat transfer on airfoil surfaces is critical for aviation applications such as anti-icing systems and structural thermal management. Although the laminar separation bubble (LSB) is known to affect boundary layer behavior on low-speed airfoils, its effect on local Nusselt number (Nu) distribution has not been well studied. This study uses computational fluid dynamics (CFD) with the Transition SST turbulence model to simulate Nu distribution on a 2D NACA 4412 airfoil at two Reynolds numbers (Re=1×105 and 1×106) and a fixed angle of attack of 0 degrees. The results were compared against NASA pressure coefficient measurements, showing errors of 5–17% mostly near the leading edge. At higher Re, peak Nu at the leading edge was about 2.2 times larger. Within the LSB region, Nu drops sharply due to near-wall flow recirculation. After reattachment, Nu recovers with a jump of 24% and 40% of the peak value at Re=1×105 and 1×106, respectively. The findings suggest that LSB plays a direct role in reducing local heat transfer on curved airfoil surfaces.

Keywords: Nusselt Number, Laminar Separation Bubble, NACA 4412, Transition SST Model, Convective Heat Transfer

■ IST26-48.

Enhancing Aviation Security with Terahertz Spectrometry and Machine Learning

Khagani Abdullayev[1], Turana Vazirova[2]*

National Aviation Academy, Baku, Azerbaijan.

Abstract: Terahertz spectrometry is an advanced instrument that can discover chemical fingerprints of various materials. Because there are chemical fingerprints of many potentially harmful substances (explosives or drugs) in terahertz spectroscopy, this technique is especially efficient in aviation security when it comes to discovering concealed hazardous substances. At the same time, the presence of noise, interference between "fingerprints" of several substances, as well as environmental factors (e.g., temperature and humidity), can affect the accuracy of analysis because it may be unclear if the substance is really harmful. In this research paper, we suggest integrating terahertz spectrometry with machine learning.

Keywords: Terahertz Spectrometry, Aviation Security, Machine Learning, CNN, Spectroscopy, Explosive Detection

▪ IST26-49.

Energy–Time Trade-offs in UAV Swarm Coverage for Aerial Monitoring: A Simulation-Based Scaling Study

Ilham Mirzayev

National Aviation Academy, Baku, Azerbaijan

Abstract: Unmanned aerial vehicle swarms are increasingly used to monitor road and rail corridors as part of intelligent transportation systems. The prevailing literature assumes that mission energy and mission time scale smoothly with swarm size. This paper tests that assumption through a controlled scaling study at $N \in \{1, 2, 3, 4, 5\}$ drones. The Pareto frontier of swarm sizes is {1, 2, 4}, with N = 3 and N = 5 strictly dominated on both axes. The four-drone configuration is super-linear and reaches a parallel efficiency of 1.02 at speedup 4.08 times. It is simultaneously the fastest cell and the third-cheapest, completing in 237 s at 65 Wh. The five-drone configuration regresses and costs 29 Wh more than N = 4 while taking 52 s longer. Per-target energy rises 87 % across the sweep, from 6.3 to 11.8 Wh per target found. Hover accounts for 84–85 % of total mission energy in every cell. Shortening the mission is therefore more leveraged than reducing path length. The non-monotonicity has a geometric origin: strip width against camera footprint pitch predicts the frontier exactly. The result motivates geometry-aware swarm-size selection over uniform partitioning.

Keywords: UAV, Swarm, Energy Efficiency, Sustainable Transportation, Intelligent Transportation Systems

▪ IST26-50.

Feasibility of a Hybrid Power Supply Systems Based on Ionized Gas and Carbon Nanotubes for Spacecraft

Islam Isgandarov[1], Aygun Aliyeva Sundhordvik[2]*

1. National Aviation Academy, Azerbaijan.
2. Azerbaijan National Academy of Sciences, Baku, Azerbaijan.

Abstract: This conceptual study presents a hybrid spacecraft power supply architecture designed to address key limitations of traditional systems: excessive wiring mass, energy losses over long-distance transmission, and rigid network topology. The proposed Auxiliary Ionized Gas and Carbon Nanotube Energy Transfer System (AIG-CNT-ETS) integrates conventional energy sources (solar panels, batteries, RTGs) with auxiliary plasma-based transmission channels stabilized by carbon nanotube (CNT) field-emission electrodes. CNTs reduce the plasma initiation threshold by a factor of approximately 10 through geometric field enhancement ($\beta \approx 1000–3000$), enabling contactless, dynamically reconfigurable power routing. Two deployment scenarios are analysed: (1) sealed plasma conduits running along spacecraft structure, maintaining internal gas pressure of 10–100 Pa; and (2) ionospheric charge harvesting for LEO spacecraft at 100–1000 km altitude, where ambient electron densities of 10^{8}–10^{13} m^{-3} support current collection without onboard gas supply. Corrected feasibility calculations show that sealed conduit channels can deliver 10–50 A at efficiencies of 75–85%, with a mass crossover distance of ~15 m relative to copper wiring. The energy balance explicitly accounts for ionization overhead (5–15%), Joule heating (5–8%), and radiative losses (2–5%). Electromagnetic interference is addressed through coaxial plasma tube geometry, achieving >40 dB field reduction. The architecture offers significant potential for large orbital platforms, deep-space missions, and interplanetary habitats.

Keywords: Ionized Gas, Carbon Nanotubes, Spacecraft Power Systems, Plasma Channels, Ionosphere, Field Emission, Emi Mitigation, In-Situ Resource Utilization

- IST26-51.

Intelligent Tribological Monitoring and Wear Prediction in Automated Machine Tool Systems Using Smart Sensor Technologies

Farid Muradov[1]*, Farid Huseynov[2]

1. Baku Engineering University, Baku, Azerbaijan.
2. National Aviation Academy, Baku, Azerbaijan.

Abstract: Friction and wear in automated machine tool systems are among the main tribological factors that directly affect the functional durability and production quality of equipment. Traditional control methods have limitations in the timely detection of dynamic and local changes in these processes. This article analyzes the integration of smart sensor technologies into automated machine tools for real-time monitoring and control of tribological processes. The technological capabilities and application areas of modern sensor systems - including vibration, temperature, acoustic emission, oil analysis, and tribosensors - are evaluated.Traditional monitoring approaches are often insufficient for real-time detection of tribological changes, limiting their effectiveness in dynamic industrial conditions. This study investigates the integration of smart sensor technologies into automated systems within the framework of Industry 4.0 and sustainable manufacturing. Various sensor types, including vibration, temperature, acoustic emission, oil condition monitoring, and tribosensors, are analyzed for their capability to provide real-time tribological data. Furthermore, machine learning and artificial intelligence techniques are explored for wear prediction and predictive maintenance optimization. The proposed intelligent monitoring approach contributes to energy efficiency improvement, reduction of maintenance costs, and extension of equipment lifetime, supporting sustainable and smart industrial systems. The findings are also relevant for advanced manufacturing systems used in transport-related production industries, where reliability and precision are critical.

Keywords: Tribology, Smart Sensors, Automated Machine Tool System, Real-Time Monitoring, Intelligent Systems, Smart Transportation Manufacturing

■ IST26-52.

Comparative Assessment of the Application Possibilities of Unmanned Aerial Vehicles in De-Icing and Anti-Icing Processes in Air Transport

Gunel Alakberova, Rustam Ahmadzada*

National Aviation Academy, Baku, Azerbaijan.

Abstract: Aircraft ground de-icing is a safety-critical operation that incurs substantial costs, occupational hazards, and environmental burdens at airports worldwide. Conventional glycol-spray systems, while effective, require large ground crews, consume 300–500 litres of fluid per wide-body aircraft, and generate significant chemical runoff. This paper investigates whether unmanned aerial vehicles (UAVs) equipped with precision spray modules and thermal-imaging sensors can serve as a technically and operationally viable alternative. Using a structured multi-criteria framework, we compare a UAV-based de-icing configuration centred on a Griff 60-class heavy-lift drone against conventional boom-truck operations across five dimensions: operational efficiency, fluid consumption, personnel safety, environmental impact, and regulatory readiness. The analysis draws on ICAO and FAA advisory standards, peer-reviewed icing research, and engineering specifications of currently available UAV platforms. Our findings indicate that targeted UAV application can reduce glycol consumption by an estimated 30–50% relative to blanket-spray methods, while removing ground personnel from the hazardous icing zone entirely. We also identify the principal technical constraints—limited endurance (15–25 min per charge cycle), wind-speed operational ceiling (~12 m/s), and the absence of type-certified UAV de-icing procedures—and propose a phased pathway from prototype validation to regulatory integration. The contribution of this work lies in providing, for the first time in the Azerbaijani aviation research context, a quantitatively grounded and criterion-based comparison that can inform both airport operational planning and future regulatory dialogue.

Keywords: Air Transport, Icing, De-Icing, Anti-Icing, Unmanned Aerial Vehicles, Ground Services

■ IST26-53.

Machine Learning-Based System for Detecting Military Objects Using UAVs

Gurban Sadigov*, Rushniyya Eyvazova

National Aviation Academy, Baku, Azerbaijan.

Abstract: This paper presents a machine learning-based object detection system designed for unmanned aerial vehicles (UAVs) in aerial image analysis tasks. The relevance of the study is driven by the need to automate visual data processing and improve the efficiency of geospatial intelligence (GEOINT) applications. The proposed approach is based on deep learning methods using convolutional neural networks and the YOLOv8 object detection algorithm for identifying objects in images and video streams. The system is implemented in Python using the Ultralytics library, and the model is trained on an aerial dataset containing images of airborne objects. The simulation results demonstrate that the system is capable of effectively detecting and classifying objects in real time and processing continuous video frames. The developed model shows stable performance under different input conditions. However, the accuracy and robustness of the system depend on the quality of the training dataset and environmental conditions during visual observation. The proposed approach can serve as a foundation for further development of intelligent UAV data analysis systems and automated monitoring solutions.

Keywords: UAV, Object Detection, YOLOv8, Computer Vision, Deep Learning

IST26-54.

Some Aspects of Assessing Road Traffic Noise Levels in Residential Areas: A Case Study of Baku

Bakhtiyar Azizov, Hikmat Mammadov, Fidan Shikhaliyeva*

National Aviation Academy, Baku, Azerbaijan.

Abstract: This article presents a rationale for the social significance of noise pollution in large cities and its assessment as a contemporary scientific problem in environmental studies. At present, urban transport constitutes one of the primary sources of noise pollution in city districts. The substantial increase in urban traffic intensity in recent years has given rise to serious problems in the social environment. The methodology developed for the purpose of evaluating the indicators of noise impact exerted by vehicles on urban populations is examined in this article. To this end, the CNOSSOS-EU model, based on the open-source Noise Modelling framework, was applied. Taking into account the conditions that influence sound propagation according to the model under consideration, the sequence for conducting a comprehensive assessment of traffic-induced noise emissions is established. The proposed method is based on data processing that accounts for factors affecting traffic intensity, including traffic flow at different times of day, the number of vehicles passing per unit time, average speed measured at the field site during natural measurements, and the probability of congestion occurrence. Subsequently, a noise level distribution map is compiled for residential areas surrounding the arterial road. As a result, the extent to which noise levels deviate from sanitary standards at different times of day in the residential area under consideration is determined, and proposals are advanced for its reduction.

Keywords: Noise Pollution, Targeted Traffic Intensity, Residential Zones, Environmental Assessment, Field Measurements, Data Processing Methods

IST26-55.

Integration of Self-Healing Cellular Architectures, Dynamic Partial Reconfiguration, and On-Chip Rerouting for Enhancing the Reliability of Spacecraft Onboard Computing Systems

Islam Isgandarov, Sakinakhanum Abdullayeva

National Aviation Academy, Baku, Azerbaijan.

Abstract: Modern spacecraft onboard computing systems operate under conditions of elevated radiation levels, limited energy resources, and the impossibility of immediate maintenance or repair. Conventional reliability assurance methods are primarily based on hardware redundancy, which inevitably leads to increased system mass, power consumption, and architectural complexity.

This paper investigates the integration of the SABRE (Self-healing Cellular Architectures for Biologically Inspired Highly Reliable Electronic Systems) paradigm, dynamic partial reconfiguration (DPR), and on-chip rerouting as an alternative approach to fault tolerance enhancement. An architectural model is proposed that enables system self-recovery through fault localization and dynamic bypassing of defective components at the chip level, without relying on excessive hardware redundancy. The advantages and limitations of the proposed integrated approach are analyzed, and directions for further research in the field of adaptive and self-healing spacecraft onboard computing systems are identified.

Keywords: SABRE, DPR, On-Chip Rerouting, Self-Healing Systems, FPGA, Fault Tolerance

IST26-56.

Computational Fluid Dynamics Simulation of the Aerodynamic Behavior of a Hawk Wing at Different velocities and Angles

Ali Okan*, Münir Süner

Tarsus University, Tarsus/Mersin , Türkiye.

Abstract: This study examines the aerodynamic analysis of an airfoil profile derived from a uniquely designed hawk model, at speeds of 100 m/s and 200 m/s, using angles of attack of 40° and 130°. The results analyze velocity distribution, pressure distribution, and wall shear stress, leading to the achievement of an optimum solution. The airfoil profile was designed using a 3D modeling program, and analysis was performed under steady-state conditions using CFD (Computational Fluid Dynamics). The results show that drag and lift coefficients vary depending on velocity and angle of attack.

Keywords: Computational Fluid Dynamics, Aerodynamics, Hawk, wing, Pressure Distribution, Flow around Aircraft, Modeling, Skin friction

IST26-57.

Toward New Airports, Aerodromes and Airfields in a New UAV Context

Fatih Kılıç, Olcay Ölçen*

Istanbul Gelisim University, Istanbul, Türkiye.

Abstract: Current airports, aerodromes and airfields are more widely governed by Annex 14 of ICAO under the general name of aerodromes and with the help of Annex 9 and Annex 6 of ICAO. If it is concentrated on the technical development and needs of UAVs, Annex 14 and all other Annexes greatly suffer from technical, legal and procedural details. Especially, a UAV is thought of as a toy in the contemporary aviation world by the public or ordinary person, even though they are utilised for different serious purposes, such as observation, photographing, and small cargo shipping. This paper mainly concentrates on this situation, proposing the possible impacts of UAVs on the development of ground movements. According to annex logic, air vehicles are classified and evaluated due to their dimensions and engine capacity. And depending on these features of aircraft, the aerodromes, airports and airfields are classified. Nevertheless, a UAV is a different air vehicle, without a standard shape, dimension and airspace utilisation, so there will be differences between an aerodrome system and a UAV system.

Keywords: Unmanned Aerial Vehicles, Annex, Legal Structure, Aerodromes, Operation

IST26-58.

Formation and Evaluation of a System of Efficiency Indicators for Cargo Transportation in Military Logistics Processes

Aziz Talibov[1], Elshan Hashimov[1]*, Ramil Akhundov[2], Bayram İbrahimov[1]

1. Azerbaiyan Technical University, Baku Azerbaijan.
2. National Defense University, Baku Azerbaijan.

Abstract: This study develops a multi-criteria framework for assessing the effectiveness of road freight transportation in military logistics. The research argues that military freight transportation cannot be evaluated only through economic and technical indicators, since operational responsiveness, security, resource utilization, and management flexibility also determine overall logistics effectiveness. The proposed approach classifies indicators into five groups: operational, resource-related, economic, safety and security, and management indicators. These groups are integrated into an adaptive assessment model in which weighting coefficients may vary depending on operational conditions, route risk, transportation urgency, and the nature of logistical support. The study also incorporates a transportation cost model into the integral assessment framework. Empirical analysis of conditional military units over a five-year period shows that actual transportation costs considerably exceed optimal levels, while productivity remains significantly below the calculated optimum. The proposed framework can support logistics planning, route optimization, resource allocation, cost reduction, and decision-making in military transportation systems.

Keywords: Military Logistics, Road Freight Transportation, Effectiveness Indicators, Integral Assessment, Transportation Costs, Route Optimization, Resource Utilization

IST26-59.

Design of a Multi-Sensor Gas Monitoring System for Aviation Security Applications

Saida Ahmadova

National Aviation Academy, Baku, Azerbaijan.

Abstract: Maintaining high levels of safety in civil aviation requires the development of reliable technologies capable of identifying hazardous chemical substances in airport environments. In many cases, explosive materials or their precursors can release trace amounts of volatile compounds during storage, handling, or chemical decomposition processes. Therefore, the detection of abnormal gas concentrations may serve as an additional indicator of potential threats. This study presents the conceptual design of a multi-sensor gas monitoring system intended for aviation security applications. The system integrates MQ-series semiconductor gas sensors with a microcontroller-based processing unit to detect chemical vapors that may be associated with hazardous environments. The proposed architecture includes MQ-7 and MQ-137 sensors for monitoring carbon monoxide and ammonia concentrations, as well as a BMP085 module for measuring temperature and atmospheric pressure parameters. Data acquisition and visualization are performed using an ATmega1281 microcontroller and a compact LCD display interface. The sensing mechanism of MQ-series detectors is based on changes in the electrical resistance of a semiconductor sensing layer when exposed to specific gases. These variations are converted into voltage signals that can be processed and analyzed by the microcontroller system. The integration of multiple sensors enables improved reliability of measurements and allows cross-comparison of environmental parameters. The proposed system demonstrates the potential for continuous environmental monitoring and early detection of hazardous gas concentrations. Although such systems cannot replace advanced explosive detection technologies, they may serve as an additional layer of situational awareness in aviation security infrastructure.

Keywords: Aviation Security, Explosive Detection, Gas Sensors, MQ Sensors, Environmental Monitoring, Safety Systems

IST26-60.

Fault Tolerant Estimation of UAV Dynamics Under Actuator/ Surface Failure Conditions

Chingiz Hajiyev

Istanbul Gelisim University, Istanbul, Turkiye.

Abstract: For fault tolerant estimation using Kalman filter (KF) tuning, a state correction sequence-based system noise covariance estimation technique is suggested. The Q-adaptive Kalman with recursive system noise covariance estimation is derived. The impact of actuator/surface faults on the KF state correction sequence was investigated. It has been demonstrated that the flight control system's loss of effectiveness type actuator/surface defects will alter the Kalman filter state correction sequence's average. The proposed adaptive method for correcting the system noise covariance in a Kalman filter is applied to the motion model of an unmanned aerial vehicle (UAV). The algorithm was tested in several loss of effectiveness scenarios, due to actuator/surface faults.

Keywords: Actuator Fault, Kalman Filter, Filter Tuning, Estimation, UAV

IST26-61.

Management of Sustainability in Logistics Warehouses: A Maritime Perspective

M.Ziya Sogut[1]*, Murat Koray[2]

National Aviation Academy, Baku, Azerbaijan.

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, Sustainability

IST26-62.

Stress Calculation on Rudder Blade and Linkages of a Ship Using Fluid Structure Interaction Method

Ömer Üzümcü, Atilla Savaş*

Piri Reis University, Istanbul, Türkiye.

Abstract: Ship rudders are essential components for changing the course of a vessel. This study examines stress distribution on a semi-balanced rudder and linkages. The one way fluid structure interaction (FSI) is utilized to analyze the influence of pressure on the rudder. A momentum source is modeled to give the influence of the propeller. The rudder cross-section is a NACA 0018 profile. Maximum stress and displacement values were calculated, and fatigue life was analyzed via S-N curve approach. Results show the stress concentrations on the blade and linkages during 35 degree rudder angle , and offer a practical numerical approach for rudder design and structural optimization. Suitably optimized rudders contribute directly to sustainable maritime transportation by reducing required maintenance, extending service life, and supporting the safe operation of the vessels.

Keywords: Fluid Structure Interaction, Semi-Balanced Rudder, Momentum Source, Actuator Disk, S-N Curve

IST26-63.

Hydrodynamic Motion of Two Types of Charge in Doped Semiconductors and Internal Instability

Eldar Hasanov[1,2], Shahla Khalilova[1,2]*, Ruhiyya Mustafayeva[1]

1. Baku State Universaty, Baku, Azerbaijan.
2. Institute of Physics, Baku, Azerbaijan.

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

IST26-64.

Waste Heat-Driven sCO2 Cycle System for Energy Conversion onboard Ships

Cüneyt Ezgi[1], Haydar Kepekci[2]*

1. Reis University, Istanbul, Turkey.
2. Istanbul Gelisim University, Istanbul, Turkey.

Abstract: In this study, a closed-loop supercritical CO_2 (sCO_2) Brayton cycle with a regenerator has been designed, and its thermodynamic performance has been investigated for the utilization of waste heat from ship exhaust gases. In the proposed system, waste heat from gas turbine exhaust is transferred to the sCO_2 via a heat exchanger and converted to mechanical energy within the cycle using a turbine. Analyses have been conducted to determine the effect of the compressor pressure ratio on system performance. According to the results, increasing the pressure ratio from 2 to 5 increased the heat input from 39.53 kW to 77.97 kW, and the net power generation from 13.16 kW to 26.27 kW. However, as compressor power consumption increases, efficiency decreases beyond a certain point. The maximum thermal efficiency was obtained at a pressure ratio of 3, with a value of 0.3437. These results clearly show that the optimal operating point for system performance is a pressure ratio of 3.

Keywords: Supercritical CO_2, Brayton Cycle, Waste Heat Recovery, Ship Energy Systems, Energy Conversion

IST26-65.

The Impact of Tax Policy on Demand Elasticity in the Aviation Industry: A Descriptive Analysis of the United Kingdom (2021–2025)

Elmar Aliyev

National Aviation Academy, Baku, Azerbaijan.

Abstract: This study examines how the Air Passenger Duty (APD) in the United Kingdom affects demand, using descriptive analysis for 2021–2025. The research is motivated by post-pandemic structural changes in aviation and the need for fiscal tools aligned with global environmental standards. It focuses on the impact of distance-based tax differentiation on passenger behaviour. Methodologically, descriptive analysis was applied. Passenger data were taken from the UK CAA's "Terminal and Transit Passengers" database, and APD rates from official UK government statistics. The findings show that although the Band B (long-haul) tax rose from £82 to £90, passenger numbers grew rapidly from 2021 to 2024. However, during 2024–2025, the growth rate slowed noticeably. This temporary correlation between the tax increase and slower growth may indicate some sensitivity of demand to taxation.
Nevertheless, despite regular tax rises in 2021–2024, passenger numbers continued to increase, suggesting that the tax policy's ability to restrain demand remains limited. Other factors, such as post-pandemic recovery, appear to play a more decisive role. Finally, for any tax policy to be effective, it must simultaneously consider not only budget revenues but also changes in passenger behaviour and environmental impacts.

Keywords: Air Passenger Duty (APD), Demand Elasticity, Descriptive Analysis, Tax Policy, United Kingdom

IST26-66.

Finite Element Analysis of Residual Stresses in MIG/MAG Welded AH36 Steel Joints for Shipbuilding Applications

Furkan Ertural, Atilla Savaş*

Piri Reis University, Istanbul, Türkiye.

Abstract: This study presents a combined experimental and numerical investigation of welding-induced residual stresses and angular distortion in multi-pass Gas Metal Arc Welded (GMAW) joints of AH36 shipbuilding steel. A sequentially coupled three-dimensional thermo-mechanical finite element model is developed in ANSYS Workbench using a Gaussian volumetric heat source with temperature-dependent material properties up to the melting temperature. The novelty lies in the simultaneous parametric assessment of three coupled welding factors—heat input, travel speed and preheat temperature—on the residual-stress field and angular distortion of free-plate single-V butt joints in AH36 hull steel, supported by quantitative regression and sensitivity analysis. Five specimens were welded under preheat temperatures of 25–200 °C and heat inputs of 1.51–1.82 kJ/mm, then inspected by non-destructive testing and tested in transverse tension. Numerical fusion-zone and HAZ boundaries agreed with macrographs within a Mean Absolute Percentage Error (MAPE) of 4.27 % and $R^2 = 0.94$. The peak equivalent (Von Mises) residual stress varied in a narrow band of 371–386 MPa, plasticity-limited just above the yield strength of 355 MPa, while angular distortion varied threefold—from 0.424 mm at the highest travel speed to 1.262 mm at 200 °C preheat. Multivariate linear regression yielded $R^2 = 0.96$ for distortion and identified heat input as the dominant driver, followed by preheat temperature and travel speed. Practical welding-window recommendations for ABS/IACS-compliant shipyard production are proposed.

Keywords: Residual Stress, Finite Element Method, AH36 Steel, MIG/MAG Welding, Thermo-Mechanical Simulation, Shipbuilding

IST26-67.

Analysis of Operational Principles of Laser Position Reference Systems on Dynamically Positioned Vessels

Namig Guliyev

Azerbaijan State Marine Academy, Baku, Azerbaijan.

Abstract: Precise and reliable positional data acquisition represents a fundamental requirement for vessels operating under dynamic positioning (DP) control. Among the various technologies deployed for this purpose, laser-based position reference systems (PRS) stand out for their exceptional measurement accuracy, rapid update cycle, and structural independence from satellite-based navigation infrastructure. This study investigates the functional architectures of four commercially deployed laser PRS — Fanbeam, CyScan, SpotTrack, and the targetless SceneScan — through examination of their underlying physical measurement principles, engineering specifications, and domain-specific operational constraints. The phase-shift ranging method and the angular coordinate framework governing laser PRS output are presented analytically, together with their integration into the Kalman filter estimation pipeline of the DP controller. Comparative performance metrics are tabulated across all four systems. To ground the theoretical analysis in operational reality, a field experiment conducted aboard the subsea construction vessel (SCV) Khankendi at the Shah Deniz offshore field in the Caspian Sea is reported. A box test was executed with CyScan deployed as the sole active reference system under moderate sea conditions. The maximum recorded position deviation was 0.5 m, confirming full compliance with IMCA positioning accuracy requirements for DP-class operations. These findings substantiate the capability of laser PRS to sustain autonomous vessel station-keeping without auxiliary reference support.

Keywords: Dynamic Positioning, Laser Position Reference System, CyScan, Phase-Shift Ranging, IMCA, Caspian Sea, Station-Keeping

IST26-68.

Increasing the Wear Resistance of Titanium Alloys Under Conditions of Nominally Fixed Contact of Ti-CFRP/GFRP by Chemical-thermal Treatment Methods

Andrii Khimko*, Oksana Mikosianchyk, Oleksandr Filonenko, Marharyta Khimko

National University "Kyiv Aviation Institute", Kyiv, Ukraine.

Abstract: The titanium alloy-composite material (CFRP/GFRP) contact combination is quite common in aircraft and other modern machines that require such characteristics as high strength at low weight. Which in turn reduces the weight of the aircraft and reduces carbon dioxide emissions. In most cases, the contact is nominally stationary, but with the appearance of vibration, micro-displacement occurs between the surfaces with the destruction of both surfaces as a result of fretting. One of the methods of protecting titanium alloy parts from damage and ensuring the reliability of the connection is chemical-thermal treatment. The paper presents tests on the wear resistance of nitrided titanium alloys and analyzes the effect of various methods of chemical-thermal treatment on the fretting resistance of the contact. It was determined that under vibrational contact loads, the wear resistance of TiN compounds on the titanium alloy Ti6Al4V is 3.47 times greater than that of CFRP and 3.71 times greater than that of GFRP contact.

Keywords: Titanium Alloys, Composite Materials, Wear Resistance, Vibration, Chemical-Thermal Treatment, Aviation

■ IST26-69.

Analysis of Hamming Based FEC for Mitigating Soft Errors in Avionics Hardware

Fidan Shiralizada, Gurban Hasanli*

National Aviation Academy, Baku, Azerbaijan.

Abstract: Any modern aircraft heavily depends on reliable data for flight control, navigation and system monitoring. An error during the transmission of this information could lead to incorrect system response or potentially catastrophic event. Primary concern in aircraft avionics architecture is Single Event Upsets (SEU) caused by high-altitude atmospheric radiation. This paper reviews Hamming (7,4) and Hamming (31,26) Forward Error Correction (FEC) scheme by simulating a Additive White Gaussian Noise (AWGN) channel. The study compares Bit Error Rate (BER), Frame Error Rate (FER) and explores why standard aviation protocols, such as ARINC 429, prefer error detection over the correction capabilities of Hamming codes. Results indicate that while Hamming codes are optimal for internal Error Correction Code (ECC) memory, the safety-critical nature of inter-system communication favors "detection and discard" strategies.

Keywords: Avionics Systems, Error Correction, Hamming Code, Single Event Upsets, MATLAB Simulation

■ IST26-70.

Development of a Digital Simulator for Evaluating the Logistics Potential of the Zangezur Corridor

Elman Najafov, Aytaj Mustafayeva*

National Aviation Academy, Istanbul, Türkiye.

Abstract: This article presents the development principles and application results of an artificial intelligence-based digital simulator designed to optimize cost and time parameters of freight transportation along the Zangezur International Transport Corridor. In modern transport and logistics systems, the accurate evaluation of key indicators such as route selection, transit time, and transportation costs is of critical importance. The proposed simulator models various logistics scenarios based on real statistical data and user-defined parameters, thereby identifying optimal solutions.

The architecture of the simulator consists of a database, an artificial intelligence module, a simulation engine, and a user interface. The AI component performs functions such as delay prediction, route optimization, and risk assessment using machine learning algorithms. The simulation engine, in turn, imitates different transport conditions based on discrete-event modeling.

The study demonstrates that the developed simulator enables more efficient freight transportation along the Zangezur Corridor in terms of both time and cost compared to alternative routes. According to simulation results, the selection of an optimal route significantly reduces transit time and minimizes overall transportation costs.

The proposed AI-based simulator serves as an effective decision-support tool in logistics management and makes a significant contribution to the digitalization of transport corridors. Future research is expected to integrate the simulator with real-time data streams and advanced analytical technologies.

Keywords: Zangezur Corridor, Artificial Intelligence, Digital Simulator, Logistics, Optimization, Transport Models

■ IST26-71.

Assessment of Eco-Economic Risks in Gas Preparation for Transmission and Transportation Processes

Yusif Alakbarov, Hajar Ismayilova*, Ziver Farzalizade

Azerbaijan State Oil and Industry University, Baku, Azerbaijan.

Abstract: Violations of technological regimes, equipment failures, and accidents in the processes of gathering, preparing for transportation, and transporting hydrocarbon gases are among the main factors that negatively impact the environment. During these processes, the release of gas, liquid, and solid waste into the atmosphere, water bodies, and soil leads to a deterioration of the ecological situation, as well as increased economic losses. Gas and condensate leaks, especially as a result of damage to gas pipelines, both cause production losses and increase the risk of fire and explosion. The article examines environmental aspects in the processes of gas preparation and transportation, and systematizes the main sources of pollution. The volumes of gas released into the atmosphere under various pressure and damage conditions in pipelines were analyzed, and the economic and environmental consequences of accident scenarios were assessed. A methodological approach based on the probability of an accident, the probability of disruption of normal operation, and maximum economic damage indicators has been proposed for calculating eco-economic risks. The results of the study showed that in some cases, even if the risk probability is low, large-scale gas leaks can result in serious environmental consequences and large economic losses. The proposed approach is of great importance in terms of early risk assessment, accident reduction, and ensuring the safe operation of gas transportation systems.

Keywords: Gas Transportation, Ecological Factor, Risk, Hydrocarbon Leakage, Accidents

■ IST26-72.

From Propensity to Causality: Enhancing Aviation Campaign Effectiveness via Uplift Modelling

Ulkar Habibullayeva

National Aviation Academy, Baku, Azerbaijan.

Abstract: In today's aviation industry, personalized marketing strategies are essential for gaining a competitive edge. This study explores the implementation of Uplift Modeling within aviation CRM (Customer Relationship Management) systems and evaluates its impact on driving campaign effectiveness. A synthetic database was developed for this research, incorporating passenger flight histories, price sensitivity, and behavioral archetypes. Methodologically, the Two-Models approach was employed to predict outcomes for both treatment and control groups, utilizing Logistic Regression as the base algorithm. The model's performance was rigorously assessed using AUUC (Area Under the Uplift Curve) and Qini coefficients. The findings demonstrate that by specifically targeting "persuadable" passengers, airlines can significantly reduce marketing and commercial overheads while maximizing conversion rates. The high correlation coefficients observed during implementation further validate that this model serves as an effective tool for optimizing personalized offers within the aviation sector.

Keywords: Uplift Modelling, CATE, CRM, Two-Model Approach, Treatment Effect

■ IST26-73.

Health risk assessment of full-body scanners in aviation security: a comparative analysis of ionizing and non-ionizing radiation

Ruslan Rustamov*, Ragsana Hasanova

National Defence University, Baku, Azerbaijan.

Abstract: The health risks associated with full-body scanners used in aviation security, focusing on backscatter X-ray and millimeter-wave technologies. The rapid growth in passenger traffic and the increasing complexity of potential threats have necessitated the adoption of advanced screening systems, replacing traditional methods that are no longer sufficient. These modern devices operate based on different types of electromagnetic radiation and generate images by analyzing signals reflected from the human body.

The article analyzes a comparative of the radiation types employed in these systems, investigate their physical properties, evaluate their biological effects on human health, and determine their compliance with international safety standards. To achieve this, the main types of airport screening devices were analyzed, and their radiation characteristics and potential health impacts were systematically assessed.

The results show that both backscatter X-ray and millimeter-wave scanners operate within internationally accepted regulatory limits. Backscatter X-ray systems deliver extremely low radiation doses, far below safety thresholds, and harmful exposure would require an unrealistic number of repeated scans. Millimeter-wave scanners use non-ionizing radiation, which does not cause ionization, making them inherently safer. The study concludes that these technologies are effective and justified for aviation security. Continuous monitoring, calibration, staff training, and transparent passenger communication are necessary to ensure safety. Overall, no significant health risk is identified under normal use.

Keywords: Aviation security, risk management, airport security screening, full-body scanners, backscatter X-ray scanners, millimeter-wave technology, electromagnetic radiation exposure, radiation safety assessment

■ IST26-74.

Digital Twin Technology for Sustainable Urban Transport: A Conceptual Framework and Research Agenda

Nurana Rustamova Hasanli

National Aviation Academy, Baku, Azerbaijan.

Abstract: Digital twin technology — the real-time virtual replication of physical systems — has emerged as a transformative paradigm for sustainable urban transport planning and management. Despite its growing adoption in manufacturing and smart city contexts, a coherent conceptual framework linking digital twin capabilities to sustainable transport objectives remains absent from the literature. This paper addresses that gap by proposing a structured framework that maps digital twin functionalities — including real-time monitoring, scenario simulation, and predictive optimisation — to sustainability dimensions encompassing carbon emission reduction, energy efficiency, and multimodal mobility integration. A synthesis of recent literature from 2015 to 2025 is conducted to identify key application domains, enabling technologies, and critical research gaps. The proposed framework highlights the role of Internet of Things (IoT) sensors, artificial intelligence (AI)-driven analytics, and cloud computing infrastructure as foundational enablers of transport digital twins. Findings indicate that while technical feasibility is well established, barriers related to data interoperability, institutional governance, and lifecycle cost modelling remain underexplored. This paper concludes by outlining a research agenda to advance the deployment of digital twins as decision-support tools for sustainable urban mobility.

Keywords: Digital Twin, Sustainable Transport, Urban Mobility, Simulation, Carbon Emissions, Smart City, IoT

■ IST26-75.

Mechanical Design and Preliminary Torque-Oriented Analytical Evaluation of a Crankless Oscillating Disk-Type Internal Combustion Engine

Tuğrul Orhan

National Defence University, Istanbul, Türkiye.

Abstract: This study presents a novel oscillating disk-type internal combustion engine concept based on a crankless mechanical architecture. Unlike conventional engines that rely on piston, connecting rod, and crankshaft mechanisms, the proposed system employs an oscillating disk structure with combustion chambers positioned radially on the disk surface. Combustion-induced pressure acts directly at a relatively large radial distance from the shaft axis, providing a relatively large effective torque arm for mechanical power transmission. A simplified first-order analytical model was developed using effective pressure-loaded area and radial force transmission characteristics. According to the preliminary estimations, the effective torque arm is approximately 125 mm and the effective displacement volume of one disk module is approximately 351 cm^3. Under simplified assumptions, the proposed architecture suggests potential low-speed torque-generation capability compared to conventional piston-engine configurations of similar displacement class. Although thermodynamic modeling, CFD analysis, structural simulations, and experimental validation are outside the scope of the present work, the findings indicate that the proposed architecture represents a mechanically plausible alternative approach for future crankless internal combustion engine development.

Keywords: Oscillating Disk Engine, Crankless Engine, Alternative Internal Combustion Engine, Torque Mechanism, One-Way Bearing Transmission

■ IST26-76.

Telemetry-Based Mission State Classification for Multirotor UAVs Using Machine Learning: Implications for Operational Monitoring

Salih Talha Paksoy*, Hüseyin Önder Aldemir

Özyeğin University, Istanbul, Türkiye.

Abstract: This study examines whether onboard telemetry data can be used to classify the mission states of a multirotor unmanned aerial vehicle through supervised learning. The analysis is based on a DJI Matrice 300 RTK dataset with five operational states: IDLE_HOVER, ASCEND, TURN, HMSL, and DESCEND. To support modeling, the data were reordered according to temporal sequence, the target variable was reconstructed from the provided state columns, and several motion related features were derived from raw telemetry signals. A flight based train, validation, and test split was used to avoid leakage between highly similar observations from the same mission. Random Forest and XGBoost were then applied as baseline models and evaluated using accuracy, precision, recall, and macro F1 score. The results showed that telemetry signals contain sufficient behavioral information for mission state classification. ASCEND and TURN were classified most successfully, while IDLE_HOVER was the most difficult state to separate. The main confusion occurred between IDLE_HOVER and HMSL, which suggests that low motion hover behavior and slow horizontal mission movement can produce similar telemetry patterns. Overall, the findings indicate that telemetry based mission state classification is a practical approach for multirotor UAV monitoring and flight behavior interpretation.

Keywords: UAV Telemetry, Mission State Classification, Machine Learning, Multirotor UAVs, Operational Monitoring, Flight Behavior Analysis

IST26-77.

Development of Hybrid Polymer Composite Materials for the Aviation Industry

Oksana Mikosianchyk, Oleksandr Yakobchuk*, Rudolf Mnatsakanov, Ruslan Kostyunik, Kateryna Chava

National University «Kyiv Aviation Institute», Kyiv, Ukraine.

Abstract: The article analyzes the influence of the epoxy matrix type on the strength characteristics and the nature of multi-stage fracture in interlayer hybrid polymer composite materials reinforced with carbon and glass fibers. The relevance of this work is driven by the necessity to implement aviation decarbonization strategies by reducing the structural weight of aircraft. The research aims to determine how epoxy matrix properties affect the deformation mechanisms and survivability of hybrid structures. For the experiments, samples were fabricated using the vacuum molding process with two types of binder systems: high-viscosity and low-viscosity epoxy resins, employing an identical lay-up scheme [02/0-90/±45]S. Static tensile tests revealed a complex multi-stage fracture behavior. It was established that the use of a low-viscosity matrix (LR285) provides significantly higher strength indicators: at the second rupture stage, this material maintained 275.53 ± 9.85 MPa, which is 2.5 times higher than the result of the sample based on the viscous L 20 resin. Scanning electron microscopy proved that the quality of the adhesive contact is the key factor in increasing strength. Due to the low viscosity of the binder, complete impregnation of the structure is achieved, which initiates the glass fiber pull-out mechanism and ensures effective dissipation of fracture energy. This prevents catastrophic failure of the composite after the carbon layers within the laminate structure break, realizing a "positive hybrid effect." The results of this work justify the selection of rational technological parameters for creating high-performance aviation composites with enhanced survivability.

Keywords: Experimental Testing, Hybrid Composites, Tensile Strength, Epoxy Matrix, Fracture

IST26-78.

An Integration Model of Hybrid Solar Energy Systems with Second Life EV Batteries for Remote Sites in Oil and Gas Facilities

Aygun Zeynalova*, Aygun Heydarova

National Aviation Academy, Baku, Azerbaijan.

Abstract: This paper presents the development of an integration model for a hybrid energy system based on second-life batteries (SLB), designed to supply remote sites in oil and gas facilities. The primary objective is to ensure reliable and uninterrupted power delivery to low-power systems operating in remote and harsh industrial environments.

The study analyzes the technical characteristics of second-life batteries, including capacity degradation, internal resistance, and operational constraints. In parallel, The proposed system integrates solar photovoltaic (PV) generation with repurposed SLBsto form a sustainable and cost-effective energy solution. A mathematical energy balance model is developed to describe system dynamics, including PV output, battery state of charge (SoC), and load demand profiles. Simulation results demonstrate that the hybrid system can reliably supply 50–300 W communication loads with second-life batteries operating at 70–80% state of health (SoH), substantially reducing diesel generator runtime by up to 74% and associated fuel costs and emissions.

The study further evaluates battery chemistry selection, power conversion architecture, battery management system (BMS) requirements, and integration of IoT-based monitoring for predictive maintenance and optimized energy dispatch.

Keywords: Second-Life Batteries, Hybrid Energy System, Oil And Gas, Solar Energy, Battery Management System, Remote Power Supply, Sustainable Energy

■ IST26-79.

Long-Run Effects of Accident Structure on Road Traffic Fatalities in Azerbaijan

Yadulla Hasanli, Arzu Safarova*

Azerbaijan State University of Economics, Baku, Azerbaijan.

Abstract: Road Traffic Fatalities (RTAs) remain one of the major socio-economic challenges requiring a deeper understanding of the factors shaping their dynamics. Existing literature primarily focuses on exogenous determinants, such as the level of economic development, the quality of infrastructure, and the effectiveness of healthcare systems, while the role of accident structure at the macro level remains insufficiently explored.

The purpose of this study is to quantitatively assess the impact of the structure of RTAs on fatality levels. The empirical analysis is based on annual data for Azerbaijan covering the period 1995–2024. Given the presence of a cointegrating relationship among the variables, the Fully Modified Ordinary Least Squares (FMOLS) method is employed to estimate long-run parameters.

The scientific novelty of the study lies in treating the structure of RTAs as an independent macro-level determinant of fatalities, as well as in applying a cointegration-based approach to quantify its impact.

The findings indicate that fatality levels are determined not only by the overall scale of RTAs but also by their structural composition. An increase in the share of the most dangerous accident types—particularly head-on collisions and pedestrian-involved accidents—is associated with a substantial rise in the number of fatalities, even when the total number of accidents remains unchanged.

Keywords: Road Traffic Fatalities, Accident Structure, Head-On Collisions, Pedestrian-Involved Accidents, Cointegration, FMOLS

■ IST26-80.

ARI-Based Explainable Assessment of Asymmetric Operating Conditions in Electrified Railway Traction Networks

Huseyngulu Guliyev[1], Shamkhal Aliyev[1]*, Elshen Soltanov[2], Aynura Allahverdiyeva[2]

1. Azerbaijan Technical University, Baku, Azerbaijan.
2. Azerbaijan State Marine Academy, Baku, Azerbaijan.

Abstract: Electrified railway traction networks are exposed to asymmetric operating conditions because single-phase traction loading is supplied from a three-phase power system. These conditions may increase the negative-sequence voltage ratio ku2(t), voltage deviation δU(t), transformer loading, and the duration of unbalanced operation. Conventional threshold-based practice generally relies on ku2(t) alone and does not explicitly combine loading intensity or disturbance duration in the decision layer. This paper presents an explainable decision model based on a four-parameter Asymmetry Risk Index (ARI). The revised ARI formulation uses $|\delta U(t)|$ so that both undervoltage and overvoltage contribute to operational risk, and it applies normalized engineering scaling values for ku2(t), $|\delta U(t)|$, loading factor $\xi(t)$, and duration τ. The method is examined through analytical, normalized scenarios adapted to Azerbaijani railway modernization contexts, not through direct field measurements. The results indicate that operating windows that remain below a single ku2(t) threshold may still require earlier balancing, compensation, or maintenance action when cumulative risk is considered.

Keywords: Electrified Traction Network, Negative-Sequence Voltage, Voltage Asymmetry, Asymmetry Risk Index, Explainable Assessment Model

■ IST26-81.

Decarbonization Model and Transformation Framework for Small Scale Marine Vessels of Marmara Sea

M.Ziya Sogut*, Ezgi Özer

Piri Reis University, Istanbul, Türkiye.

Abstract: With the International Maritime Organization's (IMO) regulations based on decarbonization, the 2050 vision is developing as an important problem area for all sectoral stakeholders. Possible problem areas of emission control in 5000 DWT and cold ships are a process that should be questioned for marine vessels below this. This study, which is discussed in this context, focuses on the electrification of small marine vehicles in the Sea of Marmara. A multi-layered feasibility study was planned within the framework of a scaling-based decision and planning model developed for this purpose. In this study, the scalable action framework, which is the first step of this model, was developed and the logical action framework related to it was also presented. Within the framework of the developed action, the development logic of the separation of micro, small, medium and heavy-scale structures and transformation was defined. Within the framework of this structural scaling, it has been seen that micro and medium applicability can develop for the Marmara Sea, especially in the example of Gemlik and Mudanya, and pilot application areas can be formed. In addition, the action frameworks of hybrid technology applications for medium and severe conditions were evaluated together with regional conditions. At the end of the study, possible steps for the development of the model of the action framework outputs were evaluated and suggestions were presented.

Keywords: Small-Scale Marine Vessels, Electrification, Efficiency, Sustainability, Decarbonization

■ IST26-82.

From Waste to Infrastructure: A GPM-Based Governance Model for Second-Life EV Batteries in Azerbaijan

Fuad Mirzayev, Kovsar Dadashova, Arzu Abdullayeva*

National Aviation Academy, Baku, Azerbaijan.

Abstract: The rapid proliferation of electric vehicles (EVs) in Azerbaijan necessitates a structured, long-term approach to managing end-of-life lithium-ion batteries. While traditional research primarily focuses on the technical aspects of recycling, this study proposes a strategic governance model based on Green Project Management (GPM) and the P5 Standard for Sustainability. By evaluating the second-life battery ecosystem through five key dimensions: Planet, People, Prosperity, Process, and Product, this research identifies a scalable pathway for transforming hazardous battery waste into a strategic national energy asset. The findings suggest that integrating these sustainability pillars into Azerbaijan's renewable energy roadmap can bridge the current institutional gap between the transport and power sectors, fostering a resilient circular economy. Furthermore, the study emphasizes the strategic importance of data transparency and technical certification to gain public trust. Ultimately, this framework supports Azerbaijan's 2030 "Green Growth" targets by providing a roadmap for decentralized energy storage in reconstructed regions, thereby ensuring sustainable infrastructure development.

Keywords: Second-Life Batteries, Green Project Management, Circular Economy, Azerbaijan, Sustainability, Governance

■ IST25-83.

Evaluation of Student Pilots' Mental Workload Under Emergency Scenarios During Takeoff Using Physiological and Subjective Measurements

Tamer Savas*, Utku Usanmaz, Berkay Turkeli

Eskisehir Technical University, Eskisehir, Türkiye

Abstract: Aviation operations involve complex processes requiring high levels of attention, decision-making, and cognitive resource management. Especially during the takeoff phase, pilots are exposed to intense mental workload due to limited reaction time and critical operational conditions. In this study, the effects of emergency scenarios during takeoff on student pilots' mental workload were evaluated using physiological and subjective measurement methods. Experimental applications were conducted in a flight simulator environment with student pilots studying at Eskisehir Technical University. Emergency scenarios including engine failure, airspeed indicator malfunction, and bird strike were applied. Participants' heart rate (HR) data were recorded in real time, and the NASA Task Load Index (NASA-TLX) questionnaire was administered after each simulation. The findings demonstrated that emergency scenarios caused approximately 5–10% increases in student pilots' heart rate values compared to standard takeoff conditions. Particularly, the engine failure scenario produced the highest physiological response levels. NASA-TLX results also indicated increases in mental demand and temporal demand dimensions, supporting the physiological findings.

Keywords: Mental Workload, Student Pilot, Flight Simulator, Heart Rate, NASA-TLX, Aviation Safety

■ IST26-84.

Assessment of Flight Safety Based on the Intelligent Analysis of Flight Events

Turana Binnataliyeva

National Aviation Academy, Baku, Azerbaijan.

Abstract: This paper presents Machine Learning approach for analyzing flight event sequences based on flight data processing. The goal is to detect risky event patterns and predict the next group of events. The study aims to identify repeating structures between flight events, assess risk dynamics at these transitions and predict the next event group based on information about previous events, their severity, and the flight phase. Comparative experiments evaluated Dummy Baseline, Logistic Regression, Random Forest, XGBoost, and LightGBM models. The results show that event sequences and their contextual features carry important information for assessing flight safety. The proposed approach can be used as a practical decision-support tool within Flight Data Monitoring (FDM) and Safety Management Systems (SMS) in the future.

Keywords: Flight Data, Aviation Safety, Event Sequence, Machine Learning, Flight Data Monitoring

IST26-85.

Explainable Predictive Maintenance for Aircraft Landing Gear: Joint Fault Diagnosis and Remaining Useful Life Estimation Using Digital Twin Data

Ergun Arı*, Ezgi Özülkü

Istanbul Bilgi University, Istanbul, Türkiye.

Abstract: Aircraft landing gear is exposed to the impact loads, vibration response and structural degradation effects as a safety-critical sub-system in landing and ground operations. This is why predictive maintenance is important for landing gears in terms of both operational safety and sustainable aviation maintenance. This study proposes compact and explainable predictive maintenance framework utilizing a digital twin based balanced landing gear dataset. The approach tackles two complementary tasks together: multi-class fault diagnosis and remaining useful life (RUL) estimation. To reduce the information leakage risk, RUL is not included in input parameters in fault classification phase. RUL estimation is evaluated under two scenarios, the first scenario is described as when Fault_code variable is used and the second one when it is not used. According to the results, Gradient Boosting classified all test samples in fault diagnosis task, and Random Forest Regressor computed the best performance for RUL estimation. Feature importance and correlation-based interpretations show that diagnosis task is mostly explained by structural parameters such as K_Stiffness and B_Damping. On the other hand, prognosis task is mostly explained by dynamic response indicators such as Max_Velocity and Settling_Time. With respect to these, the study integrates diagnosis, prognosis and interpretability components under a single leakage-aware predictive maintenance pipeline.

Keywords: Aircraft Landing Gear, Predictive Maintenance, Digital Twin, Fault Diagnosis, Remaining Useful Life, Explainable Machine Learning

IST26-86.

Transportation Business and Management for a Sustainable Future

Ulviyye Huseynova, Tughay Aliyev*

Azerbaijan State Oil and Industrial University, Baku, Azerbaijan.

Abstract: This article examines how transportation business and management can be reorganized for a sustainable future. Transport is no longer treated only as the movement of goods and passengers from one point to another. It is now a managerial system connected with competitive advantage, energy use, urban quality, supply-chain reliability and environmental responsibility. The article contributes a compact managerial framework that links three levels of sustainable transport management: strategic orientation, operational decision-making and measurable performance indicators. Green logistics, multimodal transport, digital decision-making, energy transition and risk-based management are analysed as the main components of this framework. The study is based on qualitative document analysis. International reports, strategic documents and recent academic approaches were selected, classified and interpreted according to their relevance to sustainable transport management. To make the discussion more practical, the article also presents a step-by-step illustrative calculation of annual fuel use and carbon dioxide equivalent emissions for road freight transport. The calculation shows that reducing fuel consumption from 0.32 to 0.27 litre/km can lower annual emissions from 126.3 to 106.6 t CO_2e per truck. This equals a 15.6% reduction and a fuel saving of 6,000 litres per year. The result demonstrates that sustainability in transport business begins not only with large technological investment, but also with better route planning, lower empty mileage, clearer indicators and stronger management discipline.

Keywords: Sustainable Transportation, Transportation Business, Logistics Management, Decarbonization, Multimodal Transport, Digital Transformation, Green Supply Chain

IST26-87.

Mitigation Strategies for the Lunar Dust Challenge and a Systematic Review for Sustainable Surface Operations

Selin Ateş[1]*, Alper Şanlı[2], Tuncay Yunus Erkeç[2]

1. Robert College, Istanbul, Türkiye.
2. National Defence University, Istanbul, Türkiye.

Abstract: The effects of lunar regolith on satellite hardware which are the operation of satellite subsystems, living organisms and operating efficiently are all negative. The purpose of this study is to be a systematic evaluation of strategies that have been developed to reduce the abrasive, electrostatic and toxic effects of lunar regolith. By combining past studies based upon previous data with present research, it will classify the technologies designed to reduce the negative effects of lunar regolith into three categories; Passive, Active and Operational. Also, it will evaluate the technological readiness level (TRL) of each category's technology relative to next generation robotic/satellite missions focused on chaotic environments such as lunar surfaces and current and near term lunar programs. In addition, this study will emphasize the need for a hybrid decontamination method using an integrated electrodynamic shield with advanced materials coatings to allow for the long- term success of surface operations.

Keywords: Lunar Dust Removal, Regolith Dynamics, Sustainable Space Exploration, Surface Operations, Hybrid Decontamination Method

IST26-88.

UAV Selection for Flood Monitoring Using a Multi-Criteria Decision Model

Onur Ozsoy*, Ali Emre Sarılgan

Eskişehir Technical University, Eskişehir, Türkiye.

Abstract: Floods are among the most destructive natural hazards. They can affect large areas in a short time and cause serious damage to people, infrastructure, and the environment. For this reason, rapid and reliable data collection is critical during flood monitoring. UAVs have become useful tools in such operations. They can be deployed quickly, operate flexibly, and provide aerial data with high detail. However, choosing the right UAV for flood monitoring is not always straightforward. This study presents an AHP-based model to evaluate and rank UAV alternatives for flood monitoring missions. The model is based on expert judgments and a comparison of three UAV alternatives.

Keywords: UAV Selection, Multi-Criteria, AHP, Disaster Management, Flood Monitoring

IST26-89.

Advantages, Shortcomings, and Areas for Improvement in the Use of UAVs in Disaster Response

Ilkay Orhan*, Onur Ozsoy

Eskişehir Technical University, Eskişehir, Türkiye.

Abstract: Unmanned aerial vehicles (UAVs) are now used in many civilian and emergency-oriented fields. In disaster response, they are valued because they can reach damaged areas quickly, collect near-real-time data, and support time-sensitive tasks such as mapping, search and rescue, logistics, and temporary communication support. The literature shows that these systems can improve situational awareness and reduce the exposure of human responders to dangerous conditions. However, their contribution is not uniform across all missions. Flight endurance, payload limits, weather sensitivity, communication vulnerability, regulatory barriers, and privacy concerns continue to affect operational performance. This paper reviews the literature on the main advantages, shortcomings, and improvement areas of UAV use in disaster settings. The reviewed studies suggest that UAVs create the greatest value when they are integrated into broader emergency management systems rather than treated as stand-alone tools. Future progress depends not only on better airframes and sensors, but also on stronger communication resilience, clearer regulation, better operator training, and more responsible data governance. Using a focused literature review approach, the study synthesizes the main operational benefits, persistent limitations, and development priorities of UAV deployment in natural disaster response. The analysis is structured around three themes: advantages, shortcomings, and areas for improvement. The findings show that UAVs provide the highest operational value when they are embedded in emergency management systems through clear procedures, trained operators, resilient communication links, and responsible data governance.

Keywords: Unmanned Aerial Vehicle, Disaster Response, Emergency Management, Situational Awareness

IST26-90.

Design of an Integrated Control System for Ground Military Vehicles and Drones Based on Sparse Approximation of Their Dynamic Models

Manafaddin Namazov, Zaur Ashirov*

Azerbaijan Technical University, Baku, Azerbaijan.

Abstract: This study investigates the dynamic modeling and integrated control design for the coordinated operation of ground military vehicles and unmanned aerial vehicles (UAVs) using a sparse approximation framework. In modern defense and security scenarios, ground platforms are no longer limited to transportation and mobility functions; they increasingly operate as mobile command units, sensor fusion hubs, and decision-making centers.

UAVs complement these capabilities by providing aerial surveillance, reconnaissance, trajectory refinement, and early threat detection from an elevated perspective. However, the integration of these inherently different systems introduces significant challenges, including complex dynamic couplings, communication delays, environmental uncertainties, sensor noise, and external disturbances.

In the proposed approach, both the ground vehicle and the UAV are represented within a unified state-space framework. Sparse identification and sparse approximation techniques are then employed to extract only the dominant dynamic interactions governing the system behavior. This reduction enables the development of control algorithms that are computationally efficient, robust, and suitable for real-time implementation.

The paper presents an integrated control architecture, the corresponding mathematical formulation, the principles of sparse approximation, and a coordination strategy based on Model Predictive Control (MPC).

Keywords: Dynamic Model, Unmanned Ground Vehicle, Ground Transportation Vehicle, Sparse Approximation

IST26-91.

Shore Power, Electrification, Hydrogen and Alternative Fuels for Sustainable Ports and Short-Sea Shipping: A Technical Evaluation and Strategic Framework

Murat Saka*, Tayfun Acarer

Piri Reis University, Istanbul, Turkey.

Abstract: Frequent port calls by ships engaged in short-distance maritime transport lead to increased harmful gas emissions in the region. Considering these negative environmental impacts, this study analyzes the applicability of shore-based electrical interconnection systems, electric and hybrid propulsion systems, and alternative fuels such as hydrogen and methanol for sustainable port operations. The research concludes that instead of focusing on a single technology, there is a need to develop systems that enable the combined use of energy management systems, alternative fuels, and shore-based electricity.

Keywords: Short-Sea Shipping, Sustainable Ports, Shore Power, Alternative Fuels, Clean Energy Technologies, Hybrid Propulsion, Maritime Management

IST26-92.

Financial Control, Audit Authority, and Cargo Security in Air Cargo Logistics: A Comparative Constitutional and Financial Accounting Analysis of Indonesia and Azerbaijan

Fuad Mirzayev, Laura Tifani Zahra*

National Aviation Academy, Baku, Azerbaijan.

Abstract: Air cargo logistics is a capital-intensive and high-risk industry in which audit quality, internal control effectiveness, and financial transparency are critical for reliable financial reporting. Although accounting research has extensively examined audit and internal control mechanisms, limited evidence exists from logistics-intensive sectors. This study addresses this gap through a comparative analysis of financial control and audit practices in air cargo operations in Indonesia and Azerbaijan, focusing on Garuda Indonesia Cargo and Silk Way West Airlines. Using a qualitative comparative approach based on publicly available audited financial statements and corporate governance disclosures, the study examines internal control orientation, audit design, transparency practices, cost behavior, and risk recognition mechanisms. The findings indicate that Indonesia's compliance-oriented audit framework enhances reporting reliability but is associated with higher compliance costs. In contrast, Azerbaijan's risk-based approach emphasizes decision usefulness and operational flexibility. The results suggest that cargo security outcomes reflect the effectiveness of internal control systems and have implications for cost recognition and financial reporting quality. The study highlights the trade-offs between compliance-based and risk-based governance models in shaping financial transparency in global logistics industries.

Keywords: Audit Quality, Internal Control Effectiveness, Financial Reporting Quality, Air Cargo Logistics, Comparative Financial Governance

■ IST26-93.

Small-Scale Public-Private Partnerships as a Regional Growth Instrument: A Proportionate Governance Framework for Transport Projects in Azerbaijan

Fuad Mirzayev[1]*, Turkan Vusat[2]

1. National Aviation Academy, Baku, Azerbaijan.
2. ADA University, Baku, Azerbaijan.

Abstract: This paper examines small-scale public–private partnerships (SSPPPs) as instruments of regional transport development within centralized PPP governance systems. Although Azerbaijan has established a comprehensive PPP framework, its uniform multi-stage approval and procurement procedures create scale-related inefficiencies for smaller projects. Drawing on an institutional-comparative design approach and international PPP governance benchmarks (OECD, World Bank), the study assesses how procedural intensity affects the feasibility of community-scale transport initiatives. The findings indicate that fixed transaction costs, centralized approvals, and full feasibility requirements disproportionately burden small regional projects, limiting implementation despite potential socio-economic benefits.
The paper argues that SSPPPs should be treated as structurally distinct instruments of regional growth. A proportionate governance model based on simplified screening, streamlined procurement, standardized documentation, and optional bundling is proposed to align oversight intensity with project scale and fiscal exposure, thereby expanding the feasibility of regionally distributed transport investments.

Keywords: Small-Scale PPPs, Regional Transport Development, Proportional Governance, Transaction Costs, Infrastructure Policy, Azerbaijan

■ IST26-94.

Modeling of Air Traffic Control System

Peyman Mukhtarov, Nurana Mammadova*, Firudin Mukhtarov

National Aviation Academy, Baku, Azerbaijan.

Abstract: As a result of the increase in the intensity of air traffic, there is a need to create a special service for flight management, which should determine and ensure the landing and take-off times and intervals of aircraft and the sequence between them, and place them in airspace in such a way as to prevent dangerous approaches of aircraft and at the same time reduce the distance between them and solve potential conflict problems in the area of responsibility. For the efficient, planned, safe and economical use of airspace, the Air Traffic Management System has been created. This system performs the Organization of Air Traffic and Air Traffic Management bodies, their planning, direct operational management and flight safety. A large number of Air Traffic Management aircraft and their purposeful activities can only be carried out by a well-organized system with perfect radio equipment and high-quality specialists. Such a system is called the ATC system.

Keywords: Airspace, Operation of the air traffic controller, Air traffic control equipment, Coordinating services, Air traffic flow, Risk factor, Flight safety, Aircraft, Aerodrome

■ IST26-95.

Advancements in Bio-Inspired Flight Systems and Bionic Aerodynamics Through Adaptive Morphology: The Preliminary Study

Joaquin Rafael Pagaling, Marjan Mohammad Aref Shadmani Fard, Sharul Sham Dol*, Mohammed Alavi

Abu Dhabi University, Abu Dhabi, United Arab Emirates.

Abstract: The manuscript aims on the research, development, and implementation of a bio-inspired flight system and bionic aerodynamic design for an unmanned aerial vehicle (UAV), utilizing natural design principles to enhance flight dynamics, energy efficiency, environmental adaptability, and sustainability. The study aims to improve aerodynamic performance, develop sustainable technologies inspired by natural processes, increase design flexibility through biomimicry, and achieve cost-effective solutions. An adaptive morphology approach is employed to integrate the conceptual designs, enabling the emulation of natural flight characteristics observed in flying organisms. Among the proposed concepts, the Amphibious UAV was identified as the most feasible configuration, incorporating tubercle-modified propellers as an alternative to conventional designs to enhance lift generation, reduce drag, and improve thrust performance. Computational Fluid Dynamics (CFD) simulations were conducted using ANSYS Fluent at varying rotor speeds and angles of attack (AOA), with comparative analysis performed between conventional propellers, tubercle propellers, and a NACA 0012 airfoil. The results indicate that angles of attack exceeding 15° lead to a reduction in lift coefficient and a significant increase in drag coefficient, indicating stall conditions, while tubercle propellers demonstrated improved aerodynamic performance, including higher dynamic pressure and increased tip velocity across different operating conditions.

Keywords: Biomimicry, Aerodynamics, Tubercles, Energy Efficiency, Flow Separation

■ IST26-96.

Negative Impacts of Extreme Weather Conditions on Sea Port Operations: Türkiye as a Case Study

Ferhan Oral*, Ergün Demirel

Piri Reis University, Istanbul, Türkiye.

Abstract: This study examines the disruptive impacts of extreme weather conditions on maritime port operations, focusing on Türkiye as a primary case study. The research aims to evaluate how the increasing frequency and intensity of meteorological disasters threaten logistical efficiency and economic sustainability. The methodology involves a comprehensive literature review and quantitative analysis of longitudinal data (1940–2024) from the Turkish State Meteorological Service (TSMS), specifically focusing on storm frequencies and temperature anomalies. Findings reveal a critical escalation in extreme events, with 2024 recording 1,257 disasters—the second-highest in history—and a 2°C temperature increase compared to the 1970 mean. These conditions correlate directly with operational downtime, infrastructure damage, and increased occupational safety risks. Key recommendations include strengthening climate-resilient infrastructure, updating Occupational Safety and Health (OSH) protocols for heatwaves, and integrating real-time meteorological data into dynamic operational planning. Future research should focus on quantitative regional assessments to determine specific resilience levels of Turkish ports and explore the impact of extreme winds on port capacity through localized simulation models and comparative operational vulnerability under different climate scenarios. This research addresses a critical oversight in current literature by providing a localized assessment of climate resilience within Türkiye's maritime sector.

Keywords: Extreme Weather Events, Türkiye, Turkish State Meteorological Service, Port Operations, Sustainability

■ IST26-97.

International Transport Corridors as Catalyst Socio-Economic Transformation of Azerbaijan's Logistics System

Azad Babayev*, Allahverdi Sharifov, Mahir Mustafayev

Azerbaijan Technical University, Baku, Azerbaijan.

Abstract: This article analyzes the impact of transport logistics development in Azerbaijan on its socio-economic growth from 2019 to 2025, with emphasis on the Trans-Caspian International Transport Route (Middle Corridor) and the Zangezur Corridor (TRIPP). Utilizing data from the State Statistical Committee of Azerbaijan, Azerbaijan Railways (ADY), Baku International Sea Trade Port, and international organizations, the study examines dynamics in transit volumes, container turnover, and infrastructure investments, alongside their contributions to GDP, employment, and non-oil sector diversification.

Results indicate significant growth: total cargo volume through key corridors reached 32.6 million tons in 2025; the Middle Corridor showed a 90% increase over three years, with approximately 5.2 million tons expected in 2025; Baku Port achieved a record container turnover of 100,000–107,000 TEU in 2025; and ADY handled 123,992 TEU in the first 11 months of 2025. The non-oil sector constituted approximately 52.7–71% of GDP in 2025, with the transport sector contributing 7.1–7.8%. The Zangezur Corridor is projected to increase annual exports by $700 million and boost non-oil GDP by about 2%. Despite geopolitical risks and infrastructure constraints, recommendations include digitalization and tariff harmonization.

Keywords: Transport Logistics, Zangezur Corridor, Middle Corridor, Economic Diversification, Non-Oil Sector

■ IST26-98.

Assessment of the Efficiency of the "E-Dispatcher" System in Train Traffic Management

Shahnoza Otakulova*, Natalya Yaronova

Tashkent State Transport University, Tashkent, Uzbekistan.

Abstract: This article develops an approach for evaluating the operational efficiency of the E-dispatcher system in train traffic management based on a stochastic failure model. The shortcomings of existing control processes, which rely on paper documentation, telephone communication, and decentralized information exchange, are analyzed. Their negative impact on processes such as failure recording, task assignment, inter-service coordination, and document closure is demonstrated. The functional architectural structure of the E-dispatcher system is described, and a mathematical model is proposed that takes into account event flows, service stages, waiting times, and resource utilization.

Keywords: Efficiency Assessment, Faults, Stochastic Fault Model, Digitalization, Technical Reliability

■ IST26-99.

Wind-Powered Galleon Technology and the Manila Galleons: Sustainable Maritime Transport from a Zero-Emission Perspective (16th–19th Centuries)

Hakan Mehmet Köktürk

Piri Reis University, Istanbul, Türkiye.

Abstract: The expansion of global trade has strengthened the role of maritime transport within the global economy, while simultaneously intensifying environmental impacts, particularly carbon emissions. In response to increasing regulatory and commercial pressures, the maritime sector has undergone a process of decarbonization, with wind energy emerging as a prominent zero-emission alternative. This study has examined wind-powered galleon technology used between the 16th and 19th centuries within the context of the trade system between Manila (Philippines) and Acapulco (Mexico), evaluating it from the perspective of sustainable maritime transport. Employing a qualitative and comparative approach, the study has analyzed historical maritime literature alongside contemporary sustainability studies. The structural characteristics, equipment, and transoceanic navigation capabilities of galleons have been examined within this framework. The findings have demonstrated that galleons, through wind-powered propulsion systems, enabled long-distance maritime transport in a sustainable manner and sustained a continuous trade network for approximately 250 years. The Manila galleon system played a decisive role in the formation of the early global economy by facilitating the exchange of American silver and Asian goods. Wind-based maritime transport has thus been shown to represent not only a historical practice but also a significant conceptual reference for contemporary zero-emission objectives.

Keywords: Galleon Technology, Manila Galleons, Early Modern Period, Maritime Trade, Sustainable Transport, Naval Engineering

■ IST26-100.

Women in Urban Mobility: Emerging Workforce Trends in the Transportation Sector of Hyderabad, India

Shradha Binani*, Shaik Rehan

Hyderabad Institute of Technology and Management, Hyderabad, India.

Abstract: The participation of women in urban transportation systems has increased significantly in recent years due to urbanization, technological advancements, and policy initiatives promoting gender inclusion and sustainable mobility. The transportation sector, traditionally dominated by men, is gradually becoming more inclusive as women take up roles such as cab drivers, delivery personnel, metro staff, and logistics coordinators. Hyderabad, one of the fastest-growing metropolitan cities in India, provides an appropriate context to study emerging workforce trends among women in transportation services. This study examines the participation of women in the transportation sector in Hyderabad, identifies employment opportunities, and analyzes challenges faced by women workers in urban mobility systems. A descriptive research methodology was adopted using primary and secondary data sources. Primary data was collected through structured questionnaires and informal interviews with women working in transportation-related occupations. The findings indicate that women participation in transportation services is increasing steadily, leading to improved financial independence and social empowerment. However, safety concerns, irregular working hours, and limited infrastructure support remain key challenges. The study concludes that targeted training programs, supportive workplace policies, and improved safety measures are essential to enhance women participation in sustainable urban transportation systems.

Keywords: Women Workforce, Urban Mobility, Transportation Sector, Sustainable Transportation, Gender Inclusion, Employment Trends, Hyderabad

■ IST26-101.

Analyzing the Impact of Women in C-Suite Roles on Transportation Sustainability

Shaik Rehan, Shradha Binani*

Hyderabad Institute of Technology and Management, Hyderabad, India.

Abstract: The global transportation sector remains a primary contributor to the climate change, accounting for approximately 25% of the energy-related CO2 emissions. As the industry reorients towards 2030 and 2050 Net-Zero targets, a critical question arises: Does the leadership composition influence the speed and the transparency of the sustainable transition? This study investigates the "ROI of Diversity" by analysing how the gender-diverse leadership in the C-suite acts as a catalyst for Environmental, Social, and Governance (ESG) outcomes. It explores the transition from "brawn-based" manual operations to "brain-based," data-driven logistics, where cognitive diversity becomes a technical necessity for innovation. Using the Upper Echelons Theory and Critical Mass Theory, this research employs a qualitative comparative analysis of five global transport leaders: Maersk, DHL, Volvo, Tata Motors, and IndiGo. Data synthesis was carried out based on the FY2025/26 Sustainability Reports and MSCI ESG Ratings to identify the relationship between the share of female leaders and the rate of implementation of green technologies such as Green Hydrogen and Fleet Electrification. The findings reveal a relationship between the "Critical Mass" (at least 30%) of female leaders and better ESG performance. Those companies whose technical decision-making was more gender-diverse showed 12–15% faster adoption of the infrastructure for non-fossil fuels and a well-established circular economy approach. The study shows that gender diversity is the key "Tech-Enabler" for the process of decarbonizing the planet, because it eliminates "cognitive tunnel vision" and lowers environmental liabilities by speeding up eco-innovation.

Keywords: Sustainable Transportation, Gender Diversity, Upper Echelons Theory, ESG Transparency, Decarbonization, Critical Mass Theory, Eco-innovation

■ IST26-102.

Economic Efficiency of AI-Driven Operational Management in Civil Aviation under Environmental Constraints

Elmira Jafarli

National Aviation Academy, Baku, Azerbaijan.

Abstract: In the era of global decarbonization, the civil aviation industry faces critical challenges such as maintaining economic viability while adhering to increasingly stringent environmental regulations. This research explores the transformative role of Artificial Intelligence (AI) as a key driver of economic efficiency in airline operational management. By integrating machine learning algorithms into flight path optimization, carriers can achieve a dual strategic objective: a significant reduction in direct operating costs and a minimized carbon footprint. The article examines the theoretical foundations, operational advantages, and implementation challenges of AI-driven models through an analysis of global best practices of airlines that successfully utilize intelligent systems for resource management. Furthermore, the study reviews incentive programs from international aviation organizations that support digital innovation. Based on an economic evaluation of AI's impact on the industry's progress toward net-zero targets, several strategic recommendations are proposed regarding future prospects and the scalable integration of smart technologies in civil aviation.

Keywords: Economic Efficiency, Artificial Intelligence, Civil Aviation, Decarbonization, Operational Management, Machine Learning, Sustainable Transportation

▪ IST26-103.

Impact of Closing Airspace on Sustainability of Global Air Transportation

Ivan Ostroumov

Kyiv School of Economics, Kyiv, Ukraine.

Abstract: Over the past decade, civil air transportation has been significantly affected by airspace closures resulting from armed conflicts and military operations worldwide. In particular, the closure of Ukrainian airspace in Eastern Europe, along with restrictions in parts of the Middle East, has led to a substantial redistribution of global air traffic flows. These disruptions have notably impacted long-range connections, especially between South Asia and destinations in the Americas, where direct routing options have been constrained. This paper analyzes the impact of restricted airspace on flight connectivity between Europe and Asian countries. Airspace closures force aircraft to follow detour trajectories, which increase flight distance, duration, and associated air navigation charges. To quantify these effects, a horizontal flight efficiency metric is employed to assess the impact of airspace restrictions on connections between selected nodes within the air transportation network. The results provide insight into the operational and economic consequences of airspace limitations and highlight the importance of adaptive routing strategies for maintaining efficient global air connectivity.

Keywords: Intelligent Transportation System, Infrastructure Sustainability, Air Navigation, Air Transportation, Air Traffic

▪ IST26-104.

Legal Regulation of UAV Use in Airport Environments: A Conceptual Approach for Azerbaijan

Fuad Mirzayev, Asmar Aghayeva*, Aynur Adigozalova

National Aviation Academy, Baku, Azerbaijan.

Abstract: The rapid development of unmanned aerial vehicle (UAV) technologies has created new opportunities for airport operations, particularly in runway and taxiway inspection, airport infrastructure monitoring, aircraft surface assessment, wildlife control, mapping, and emergency-response support. At the same time, airport environments are safety-sensitive and security-sensitive areas where UAV activity is normally restricted or subject to special authorization. This creates a regulatory paradox: UAVs may support airport safety and efficiency, yet their use in airport areas is legally constrained because such areas are treated as no-fly or highly controlled zones.

This study examines the legal regulation of UAV use in airport environments with a specific focus on Azerbaijan. It adopts a doctrinal legal research approach supported by comparative legal analysis. The study evaluates international aviation safety and security materials, selected foreign practices, EASA/EU risk-based UAV regulation, and Azerbaijani legislation, including the Law on Aviation and the rules on the operation, registration, and classification of civil UAVs.

The findings show that Azerbaijan has established general rules on civil UAV operation, registration, classification, and authorization. However, these rules do not yet form a complete airport-specific regulatory regime. In particular, the existing framework does not sufficiently regulate airport-use UAVs, operational coordination, cybersecurity, liability and incident reporting.

The paper argues for a controlled, risk-based and airport-specific authorization model for Azerbaijan, covering legal classification, technical compliance, operational coordination, cybersecurity, liability and incident reporting.

Keywords: Unmanned Aerial Vehicles (UAVs), Airport Environments, Aviation Safety, Aviation Security, Legal Regulation, Airport-Specific Regulation, Cybersecurity, Liability, Risk-Based Approach, Azerbaijan

■ IST26-105.

The Applicability of the Maritime Labour Convention to Autonomous Ships: Revisiting the Legal Definition of Seafarer

Fevzi Topsoy

Piri Reis University, Istanbul, Türkiye.

Abstract: The most important convention regulating working life at sea is the Maritime Labour Convention, 2006 (MLC). The MLC applies to all seafarers covered by the Convention. A seafarer is defined as any person who is employed, engaged, or works in any capacity on board a ship. In this respect, the MLC can only be applied to persons serving on board a ship. However, autonomous ships are becoming increasingly widespread in maritime trade. There are no humans on board for navigation and operation on fully autonomous ships. These developments have brought into question the definition of "seafarer" which is one of the fundamental concepts of maritime labour law. In this study, the applicability of the MLC to autonomous ships is discussed within the framework of the definition of seafarer in national and international legislation. In particular, the study seeks to answer whether there is a need to amend the MLC.

Keywords: Maritime Labour Convention (MLC), Autonomous Ships, Seafarer, MASS, Liability

■ IST26-106.

Application of Smart Technologies in Transportation Systems

Taleh Asgarov*, Nigar Hajiyeva

National Aviation Academy, Baku, Azerbaijan.

Abstract: The article is devoted to the application of smart technologies in transportation infrastructure based on digital transformations. For this purpose, the classification scheme of indicators, their components, and operating principles within transportation infrastructure are analyzed. The data obtained from transportation infrastructure are classified into five main groups according to their functional characteristics. This classification facilitates the organization of large-scale data and supports more efficient decision-making. In addition, a relational database has been developed for the collection, storage, and processing of sensor data. Data exchange is carried out in a coordinated manner. The article also provides a detailed justification of the key advantages of transportation information systems that enable real-time monitoring. Furthermore, both hardware and software components have been utilized for the implementation of the smart information system. Based on the data obtained from sensors, environmental indicators within the transportation infrastructure are monitored. The system has been designed using the Arduino platform, the C++ programming language, and a MySQL database.

Keywords: Smart Systems, Digital Transformation, Database, Data Collection, Sensor Management

IST26-107.

Design and Sizing of a Solar PV Charging System for Electric Municipal Buses

Safiullah Shirzad, Tugba Gurler*

Hitit University, Corum, Türkiye.

Abstract: Electric buses are among the most promising alternatives to conventional diesel buses due to their lower operational costs and reduced greenhouse gas emissions. Therefore, this study aimed to design an off-grid solar PV charging center for electric buses in Central Kabul, Afghanistan. The available rooftop area of bus shelters was estimated at 27,115 m². The solar PV system was designed and sized based on the maximum demand data of the charging station. The proposed system requires 2324 PV modules, 1500 flooded deep-cycle batteries, a 623 kW bi-directional DC-DC converter, and 8750 m² installation area to satisfy the charging demand. Furthermore, the same system was modeled using PVsyst 7.4.7, which required 2328 PV modules and 1500 batteries, validating the mathematical modeling results. The total estimated system cost was $667,104. Using an 8% discount rate, the system achieved a payback period of 3.7 years and a return on investment (ROI) of 246.2% by selling electricity at $0.05/kWh compared to the commercial grid price of $0.15/kWh.

Keywords: Solar Photovoltaic (PV) System, Electric Bus Station, Sustainable Urban Transportation, Charging Station, Battery Energy Storage Systems (BESS)

IST26-108.

The Role of Differential Equations in Fuel Systems in Marine Navigation Engineering

Rovshan Humbataliyev[1,2], Aynur Abdullayeva[1]*, Shahin Agazade[1,3], Bahruz Agarzayev[1]

1. Azerbaijan State Marine Academy, Baku, Azerbaijan.
2. Azerbaijan University of Engineering and Architecture, Baku, Azerbaijan.
3. Baku State University, Baku, Azerbaijan.

Abstract: In Marine Navigation Engineering, the performance and dynamics of marine fuel systems are primarily modeled using differential equations. These systems involve complex physical and chemical processes such as fuel flow, variations in pressure and temperature, and the spatial and temporal distribution of properties like viscosity and density. As a result, their analysis represents a key and strategic area in modern marine engineering. The main objective of this study is to systematically evaluate the impact of new processing and technological approaches on fuel behavior. Special attention is given to pre-combustion processes, including atomization, heating, and mixing, as well as the physicochemical properties of the fuel. These factors directly affect combustion efficiency, engine performance, and overall energy losses. Differential equation-based models allow for a more accurate description of the dynamic behavior of marine fuel systems, enabling the analysis of transient and non-stationary processes. This modeling framework covers both linear and nonlinear systems and employs analytical and numerical methods such as finite difference and finite element techniques. Furthermore, these mathematical models are essential for solving optimization and control problems. Key engineering challenges, including reducing fuel consumption, minimizing emissions, and improving system reliability, can be effectively addressed using differential equation-based approaches. Ultimately, research in this field contributes significantly to enhancing energy efficiency and reducing the environmental impact of marine transportation.

Keywords: Marine Fuel, Differential Equations, Fuel Processing, Engine Dynamics, Mathematical Modeling, Performance Analysis, Technological Innovations

■ IST26-109.

Theoretical Analysis of Intake Valve Closing Delay Angle Effects on Marine Engine Performance

Alivahid Aliyev*, Alihuseyn Haziyev, Kamala Valiyeva

Azerbaijan State Marine Academy, Baku, Azerbaijan.

Abstract: This study presents a theoretical investigation of how variations in the intake valve closing delay angle affect on the indicator and effective performance parameters of marine internal combustion engines. The intake valve timing is a critical component of the gas exchange process, directly influencing cylinder filling, effective compression, and overall engine efficiency. A mathematical simulation model developed in MATLAB was employed to analyze the effects of varying the closing delay angle within a ±5° range around a nominal value of 33°, specifically from 28° to 38° after bottom dead center. The results indicate that increasing the delay angle improves the volumetric efficiency due to airflow inertia and turbocharging effects, while slightly increasing maximum pressure and decreasing peak temperature. However, both indicator and effective efficiencies show a decreasing trend, accompanied by increased fuel consumption. The findings highlight a trade-off between improved cylinder filling and reduced thermodynamic efficiency, emphasizing the importance of optimal valve timing selection.

Keywords: Intake Valve Timing, Valve Closing Delay, Volumetric Efficiency, Engine Performance, MATLAB Simulation, Fuel Consumption

■ IST26-110.

Environmental Pollution on Transportation in Coastal Areas

Khadija Khalilova

National Aviation Academy, Baku, Azerbaijan.

Abstract: This study examines the relationship between environmental pollution and transportation dynamics in coastal zones, with a particular focus on the city of Baku. Coastal areas are characterized by high economic activity, intensive transport flows, and increased ecological sensitivity. The research analyzes the impact of air, water, and soil pollution on transportation systems, highlighting how environmental degradation affects traffic safety, speed, and infrastructure durability. The findings indicate that air pollution reduces visibility and increases accident risks, while water pollution disrupts maritime transport operations and port efficiency. Soil contamination and chemical exposure accelerate road surface deterioration, leading to higher maintenance costs and reduced transport efficiency. Additionally, the study emphasizes that transportation itself is a major contributor to pollution through vehicle emissions, maritime discharges, and port activities, creating a feedback loop between environmental degradation and transport performance. A comprehensive and integrated approach is proposed to address these challenges, including the adoption of eco-friendly transport technologies, improved infrastructure resilience, and real-time environmental monitoring systems. The results underline the necessity of aligning environmental and transport policies to ensure sustainable development in coastal urban areas.

Keywords: Coastal Areas, Environment, Efficiency, Transport, Development

■ IST26-111.

From the 15-Minute City to the Shaded City: Thermal Comfort as a Transport Variable in Algerian Urban Mobility

Mohammed Bouguelaa*, Salim Bouguenna

University of Batna 1, Batna, Algeria.

Abstract: The 15-minute city has become a prominent framework for sustainable urban mobility; however, its operational assumptions have largely been shaped by temperate-climate urban experiences. This study reformulates the concept for Algeria by arguing that in hot-arid and heat-stressed urban environments, proximity alone is insufficient unless walking routes are thermally comfortable, safe, continuous, and functionally meaningful. It develops the shaded city as a climate-adaptive extension of the 15-minute city and treats shade as critical mobility infrastructure rather than as a secondary urban-design amenity. Methodologically, the study combines a focused literature and policy review with a diagnostic re-analysis of a 997-record urban mobility dataset. Fieldwork was conducted between 11 October 2025 and 28 February 2026 using convenience sampling in public urban facilities and bus-stop areas. From 1068 initially collected questionnaires, incomplete and ineligible responses were excluded, resulting in 997 valid cases. IBM SPSS was used for descriptive statistics, reliability analysis, Pearson's correlations, and robust ordinary least squares regression. The findings show that Algerian urban density can support proximity-based planning; however, weak functional diversity, uneven access to work or shared work hubs, sidewalk discontinuity, safety concerns, and heat exposure reduce the practical usability of short distances. Only 38.0% of respondents reported access to work or a realistic work/study hub within a 15-minute active commute. Shade and thermal comfort were positively associated with willingness to shift towards walking, cycling, or low-carbon mobility ($r = 0.554$), whereas shaded built environment quality significantly predicted willingness to shift ($B = 1.06$, $p < 0.001$). This study contributes to sustainable transport planning by positioning thermal comfort as a transport variable and proposing the shaded city as a context-sensitive framework for decarbonising mobility in North African cities.

Keywords: 15-Minute City, Shaded City, Thermal Comfort, Walkability, Algeria, Sustainable Urban Mobility, Transport Planning

IST26-112.

Sustainable Urban Transportation and Social Development: Policy Implications for Azerbaijan

Samira Mammadova*, Elvin Aliyev

Sumgayit State University, Sumgayit, Azerbaijan.

Abstract: Sustainable transportation is increasingly recognized as an important component of sustainable urban development and social welfare. Efficient transport systems contribute not only to environmental sustainability but also to economic productivity, social inclusion, and accessibility to urban opportunities. This study investigates the relationship between sustainable urban transportation and social development in Azerbaijan, focusing on the city of Baku. Unlike previous studies that primarily examine environmental dimensions of sustainable mobility, this paper analyzes the interaction between transport modernization, accessibility, and social inclusion within the context of a post-Soviet developing economy. The study applies qualitative document analysis and thematic analysis supported by secondary statistical data obtained from international organizations, Azerbaijani state institutions, and transport policy reports. The analytical framework is based on three dimensions: environmental sustainability, transport accessibility, and social inclusion. The findings demonstrate that recent transport reforms in Baku, including expansion of electric buses, digital ticketing systems, dedicated bus lanes, and metro modernization, contribute to reduced congestion, improved mobility efficiency, and greater accessibility to public services. Comparative observations from Tbilisi and Almaty further indicate that integrated transport reforms can significantly improve urban sustainability in transitional economies. However, challenges remain regarding uneven transport accessibility, limited integration between urban planning and transport policy, and insufficient regional mobility infrastructure. The study concludes that sustainable transportation strategies should be integrated into broader social development policies to support long-term sustainable urban development in Azerbaijan.

Keywords: Sustainable Transportation, Urban Mobility, Social Development, Smart Mobility, Green Transport, Public Transportation, Azerbaijan

IST26-113.

Computational Analysis and Conceptual Design of a Scramjet Inlet Isolator System

Mansour Khalid Alnaqbi, Shamma Nasser, Alyazia Mohamed Alshehhi, Sharul Sham Dol*, Mohammed Alavi

Abu Dhabi University, Abu Dhabi, United Arab Emirates.

Abstract: Scramjet engines require effective compressible flow management at hypersonic speeds. This paper presents the conceptual design and CFD analysis of a multi ramp mixed compression scramjet inlet with a concave cowl geometry. A decision matrix selected the double ramp concave cowl configuration due to its improved shock control, pressure recovery, and flow stability. CFD simulations in ANSYS Fluent under Mach 5 conditions showed staged oblique shock compression while maintaining supersonic flow in the main inlet region. Post processed Fluent results showed an inlet mass flow rate of 53.51 kg per second and a downstream mass flow rate of 10.84 kg per second, with total pressure decreasing from 931751 Pa to 466084 Pa, giving a pressure recovery of 0.500 and a total pressure loss of 49.98 percent.

Keywords: Scramjet Inlet, Compressible Flow, Oblique Shock Waves, CFD, Hypersonic Flow, Mixed Compression

■ IST26-114.

Energy Regeneration for Electric Aircraft: The Preliminary Study

Karan Anoop Whabi, Mohammed Sazzad Hossain, Salim Mohamed Jadad Al kathiri, Mohamed Abbas Shibeika, Shammes Abdulla Al-Ali, Sharul Sham Dol*, Mohammed Alavi

Abu Dhabi University, Abu Dhabi, United Arab Emirates.

Abstract: This paper presents the design, analysis and performance assessment of a solar-assisted, hybrid-energy electric RC aircraft developed as a small-scale technology demonstrator for long-range electric aviation. The platform integrates wing-mounted photovoltaic cells and a retractable ducted micro-turbine to supplement the primary lithium-polymer battery, thereby extending flight endurance without additional battery mass. Structural integrity was validated through finite element analysis (FEA) using ANSYS Mechanical, yielding a maximum von Mises stress of 17.14 MPa and a factor of safety of 1.45 against the allowable stress of balsa wood. Aerodynamic analysis at a cruise speed of 12.5 m/s confirmed that the semi-tapered NACA 2412 wing generates 24.6 N of lift, sufficient to sustain the 2.5 kg aircraft. Energy calculations show that solar augmentation reduces net battery discharge, extending baseline flight endurance from 69 minutes to 94 minutes a 36% improvement. The twin-boom pusher-propeller configuration was selected via weighted decision matrices for its superior aerodynamic efficiency, payload integration, and manufacturability. Results validate the viability of hybrid renewable energy integration in small UAVs and establish a reproducible baseline for future long-endurance electric aircraft research.

Keywords: Energy Regeneration, Solar UAV, Finite Elemet Analysis, Aerodynamics, Electric Aircraft, Renewable Energy

■ IST26-115.

Defining the Airport's Baggage Handling Process AI Alignment Properties: An Agent-Based Approach

Fatos Fatma Erendemir[1], Alper Dalkiran[2]*

1. SITA, Rotterdam, Netherlands.
2. Suleyman Demirel University, Isparta, Turkiye.

Abstract: This study reframes airport baggage handling not as a purely mechanical flow but as a distributed decision-making system and proposes an AI agent ecosystem capable of perceiving disruptions, reasoning across constraints, and starting corrective action before failures become passenger-facing, according to the Baggage Disruption Index. The relevance of this work lies in a structural gap within current aviation operations. Provides insight by integrating delay, misrouting, congestion, and mishandling data into a unified system-level performance metric for decision-making purposes. In a tightly coupled and time-sensitive network, such latency does not remain isolated; it propagates, amplifies, and ultimately impacts both operational efficiency and passenger experience. The findings indicate that baggage disruption is positively correlated with passenger volume; however, volume alone does not explain system performance. The alignment of resource allocation, ground handling capacity, and airline operational decisions strongly influences the rate and severity of disruption. Seasonal peaks further reveal that disruption is fundamentally a coordination challenge, where localized inefficiencies cascade into system-wide outcomes. From a strategic standpoint, these results suggest that baggage performance should be interpreted as an emergent property of the broader operational ecosystem. Empirical validation and real-world implementation remain essential next steps for assessing scalability and return on investment.

Keywords: AI agents, multi-agent systems, baggage handling systems, baggage disruption index, mishandled baggage, Aviation operations

IST26-116.

A Differential Equation for Estimating the Speed of Sound at Different Temperatures for Modelling Thermodynamic Properties

Lala Akhmedova-Azizova*[1,2], Khagani Abdullayev[1], Adalat Samadov[1], Irada Seyidova[3]

1. National Aviation Academy, Baku, Azerbaijan.
2. Institute of Geotechnological Problems of Oil and Gas and Chemistry, Baku, Azerbaijan.
3. Azerbaijan State University of Oil and Industry, Baku, Azerbaijan.

Abstract: Problems in continuum mechanics are highly relevant in both fundamental science and engineering and technological development. Accurate data on thermodynamic properties are essential for exploration, energy production, and the efficient use of geothermal resources. A comparative analysis of geothermal waters from different regions of the world revealed key patterns in the studied systems. The results provide valuable insights into the physicochemical properties of fluids relevant to the energy sector, particularly geothermal waters and biofuel components.

Previously measured density and sound velocity values for geothermal spring samples in Kizlyar, Dagestan, were critically assessed for accuracy and internal consistency and used to develop reference correlation models in the temperature range of 278–323 K and at an atmospheric pressure of 101.325 kPa.

The comparative analysis showed that geothermal waters from the studied regions exhibit similar thermodynamic behaviour, although their mineral composition may vary depending on the specific source. A differential equation describing the temperature dependence of the speed of sound was derived, enabling the prediction of system behaviour without additional experiments.

The proposed analytical approach allows estimation of the speed of sound at various temperatures and supports modelling of the corresponding thermodynamic properties. These results may be useful for evaluating geothermal waters as heat transfer fluids in energy systems under various operating conditions, regardless of their mineral composition.

Keywords: Geothermal Energy, Regions, Mineral Content, Measured, Densities, Speed Of Sound, Derived Values, Adiabatic Coefficient Of Bulk Compressibility

IST26-117.

Applications of Deep Learning for Safe Urban Transportation

Gunel Jabbarli

National Aviation Academy, Baku, Azerbaijan.

Abstract: Automated monitoring of road infrastructure and the classification of surface conditions play a pivotal role in the advancement of Intelligent Transportation Systems (ITS). This study presents a comparative analysis of MobileNetV2, EfficientNetB0, and ResNet50 Convolutional Neural Network (CNN) architectures to identify five distinct road surface conditions: dry, wet, water-covered, snowy, and icy. Utilizing the Road Surface Condition Dataset (RSCD), the research employs transfer learning techniques to optimize performance. Experimental results demonstrate that the ResNet50 architecture achieved the highest accuracy at 92.89%. To ensure computational efficiency, an "Early Stopping" mechanism and a RAM-efficient prediction algorithm were integrated into the training pipeline. This approach significantly mitigates the risk of overfitting while ensuring the model is optimized for real-time deployment on hardware-constrained systems.

Keywords: Automated Road Distress Detection, Convolutional Neural Networks (CNN), Smart City Logistics, Intelligent Transportation Systems, Computer Vision

- IST26-118.

Legal-Economic Assessment of the Boundary Between Criminal and Administrative Liability in the Caspian Sea Context

Shahla Huseynova, Aida Tagiyeva*

National Aviation Academy, Baku, Azerbaijan.

Abstract: This article clarifies the boundary between criminal and administrative liability for offences concerning protection of the Caspian Sea in Azerbaijan. The study examines Articles 250 and 252 of the Criminal Code and Articles 238, 239, 263 and 264 of the Code of Administrative Offences, and specifies the scientific innovation of the research: an integrated legal-economic and formal-analytical test for distinguishing administrative violations from criminal environmental harm. The methodology combines doctrinal legal analysis, comparative reference to modern environmental-crime standards, economic deterrence theory and a decision model based on ecological evidence. Administrative liability covers illegal discharge from ships, platforms and artificial installations, inaccurate ship documentation, pollution of water bodies and damage to drinking-water sources. Criminal liability should arise where the same conduct causes substantial or serious harm to the marine environment, fish resources, water bodies or human health. To make the model usable for courts and regulators, the article interprets each variable as a legal evidentiary indicator: pollutant concentration, hydrological conditions, biological damage, economic benefit and risk level. It also proposes practical assessment guidelines, including satellite monitoring, laboratory analysis, ship documents, expert reports and an income-proportional sanction test. A practical Caspian Sea scenario demonstrates how authorities may move from administrative qualification to criminal qualification when measurable harm, causal connection and risk thresholds are established.

Keywords: Caspian Sea, Criminal Liability, Administrative Liability, Criminal Code, Code Of Administrative Offences, Marine Pollution, Substantial Harm, Legal-Economic Assessment, Risk-Based Liability

■ IST26-119.

Measuring the Impact of Artificial Intelligence on Transport Service Competitiveness: Evidence from Azerbaijan and the Middle Corridor

Kanan Heydarov

National Aviation Academy, Baku, Azerbaijan.

Abstract: The integration of artificial intelligence into transportation and logistics is changing the sources of competitive advantage in global supply chains. This issue is especially important for Azerbaijan, given the growing strategic role of the Middle Corridor – Trans-Caspian International Transport Route – as an alternative link between Asia and Europe after the restrictions affecting traditional routes following the Russia-Ukraine war. In this context, transport service competitiveness should be assessed not only through physical infrastructure, but also through digital coordination, real-time information exchange, transit-time reliability, customs flexibility, service quality, and environmental efficiency.
This study examines the impact of artificial intelligence technologies on the competitiveness of Azerbaijan's transport services within the Middle Corridor. A mixed methodological approach is applied, combining systematic literature review, official statistics, international reports, operator data, and stakeholder analysis. The assessment focuses on operational efficiency, cost optimisation, transit time, digital document flow, border-crossing procedures, traceability, and sustainability. The findings show that predictive logistics, smart routing, automated customs processes, real-time tracking, and blockchain-based documentation can improve transparency, flexibility, and reliability in transport services. However, the full competitive potential of AI remains limited by fragmented digital infrastructure, weak interoperability, insufficient cross-border data exchange, and a shortage of qualified specialists. The study concludes that AI can become a strategic instrument for strengthening Azerbaijan's position in the Middle Corridor, provided that its implementation is supported by unified digital governance, institutional coordination, and deeper regional data integration.

Keywords: Artificial Intelligence, Competitiveness of Transport Services, Middle Corridor, Azerbaijan, Logistics Optimization

■ IST26-120.

Assessment Carbon Management and Sustainability on Ships within the EU/ETS Framework

M.Ziya Sogut*, Erkan Kıyak

Piri Reis University, Istanbul, Türkiye.

Abstract: The European Union Emissions Trading System, which was put into effect in 2005, is a management system that includes 30 countries, 27 of which are EU countries, and directly affects global trade, especially within the borders of the European Union. This system, which has been put into effect by the European Union since 2024, has a system framework that aims to receive the necessary allocation, that is, to make payments in 2025 for the emissions emitted, taking into account 2025, and imposes important responsibilities on sectoral stakeholders. EU-ETS responsibility in the Maritime Transport sector; It has revealed a managerial business process of shipping companies, shipowners or other organizations and individuals. This study reveals a framework developed and modeled in this context. In particular, the framework modeled together with a ship data set includes a management model and comprehensive evaluation that includes the ETS infrastructure. In the study, suggestions especially regarding process management were also developed.

Keywords: Shipping, EU/ETS, Energy Management, Emission, Sustainability

IST26-121.

Evaluating the Decarbonization Vision in Shipping with a Sound Decision Making (RDM) Approach

M.Ziya Sogut*, Oktay Çetin

Piri Reis University, Istanbul, Türkiye.

Abstract: Maritime transportation is one of the most important components of global trade and plays a critical role in the world economy. However, since the shipping sector operates largely using fossil fuels, it accounts for a significant portion of carbon emissions worldwide and poses challenges in the fight against climate change. Decarbonizing maritime transportation stands out as a critical step in reducing the environmental impacts of this sector, increasing energy efficiency, and realizing energy transformation in the long term. In this study, a framework that supports the decision processes for the decarbonizing process in shipping was developed using 324 scenarios with the RDM Analysis method and action plans were proposed.

Keywords: Maritime Transportation, Decarbonization, Sustainability, Emissions, Electrification

IST26-122.

Arctic Maritime Cybersecurity: A Realist Assessment

Selen Baldıran*, Pelin Bolat

Istanbul Technical University, Istanbul, Turkiye.

Abstract: The Arctic region, becoming increasingly accessible due to the impact of climate change, is transforming into a strategic arena of competition for maritime transport, energy transmission lines, and autonomous marine systems. This study, based on a qualitative research design, relies on a systematic literature review and structured document analysis; data were evaluated using thematic content analysis and a two-stage coding process. The realist concepts of power, security dilemma, deterrence, self-help, and relative gains were used as analytical categories in the analysis. According to realism, states are rational actors constantly competing to increase their security and power capabilities. The findings show that cyberattacks targeting maritime and satellite communication systems are not only technical risks but can also be used by states for purposes of competition, maximize power, and deterrence. At this point, the study evaluates the potential of threats to maritime infrastructure, ship navigation systems, and all other cyber systems in the region within the framework of realist concepts. In this context, the vulnerability of autonomous ship control modules, satellite navigation networks, and digital infrastructures to cyberattacks is assessed; It has been shown that such interventions can have transformative effects on the Arctic balance of power and security. The findings indicate that cybersecurity vulnerabilities in the region are rapidly deepening alongside great power competition, directly threatening not only military security but also green and sustainable maritime goals. In this context, the study describes cyber threats as one of the threats to Arctic maritime security, based on the security perspective offered by realism.

Keywords: Arctic, Cybersecurity, International Relations, Realism, Maritime Security, Cyber Threats

- IST26-123.

An Assessment of the Selection Criteria for the Northern Sea Route Through the Swara Method

Selen Baldıran[1]*, Ali Cem Kuzu[2]

1. Istanbul Technical University, Istanbul, Turkiye.
2. Piri Reis University, Istanbul, Turkiye.

Abstract: The Arctic Ocean, especially the Northern Sea Route (NSR), is becoming an increasingly critical maritime route due to climate change and evolving geopolitics. This article aims to identify priorities the selection criteria of the NSR using SWARA (Step-Wise Weight Assessment Ratio Analysis) method. Firstly, based on comprehensive literature review, it has been determined that cost, navigation and safety, security, and infrastructure are the four main criteria influencing the selection of shipping routes. Expert opinions obtained through the SWARA method enabled the four criteria to be assessed and prioritised as potential selection criteria to this route. The findings aim to analyse the most important selection criteria for sailor and policy makers and provide guidance on the decision-making process for Arctic shipping routes. Within the scope of the study, according to the SWARA method applied to analyse the selection criteria of the NSR route, cost is identified as the most significant criterion in the selection process. The main objective of the research is to provide a better understanding of the factors and criteria that will shape the future of Arctic shipping route selection and also contribute to the existing literature on Arctic maritime safety and security.

Keywords: Arctic, Decision Making, Northern Sea Route, Shipping Route Selection, SWARA

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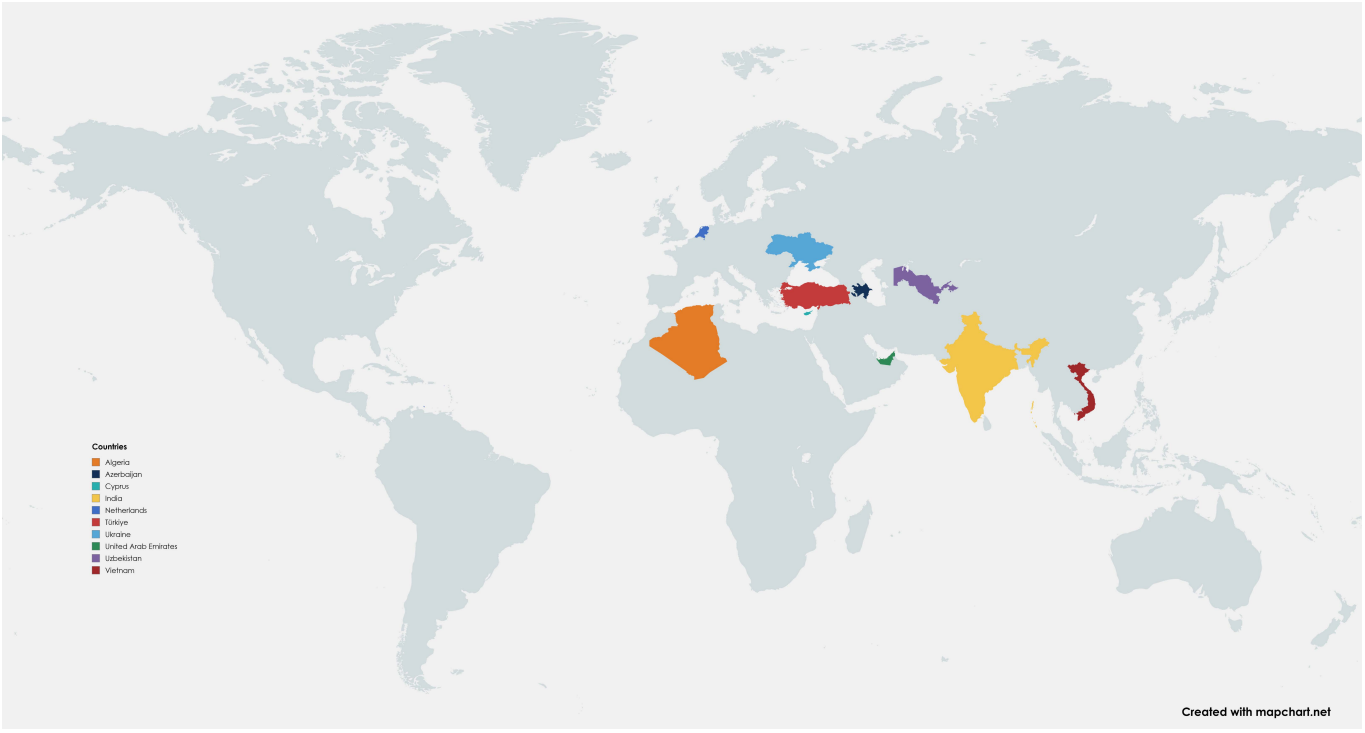
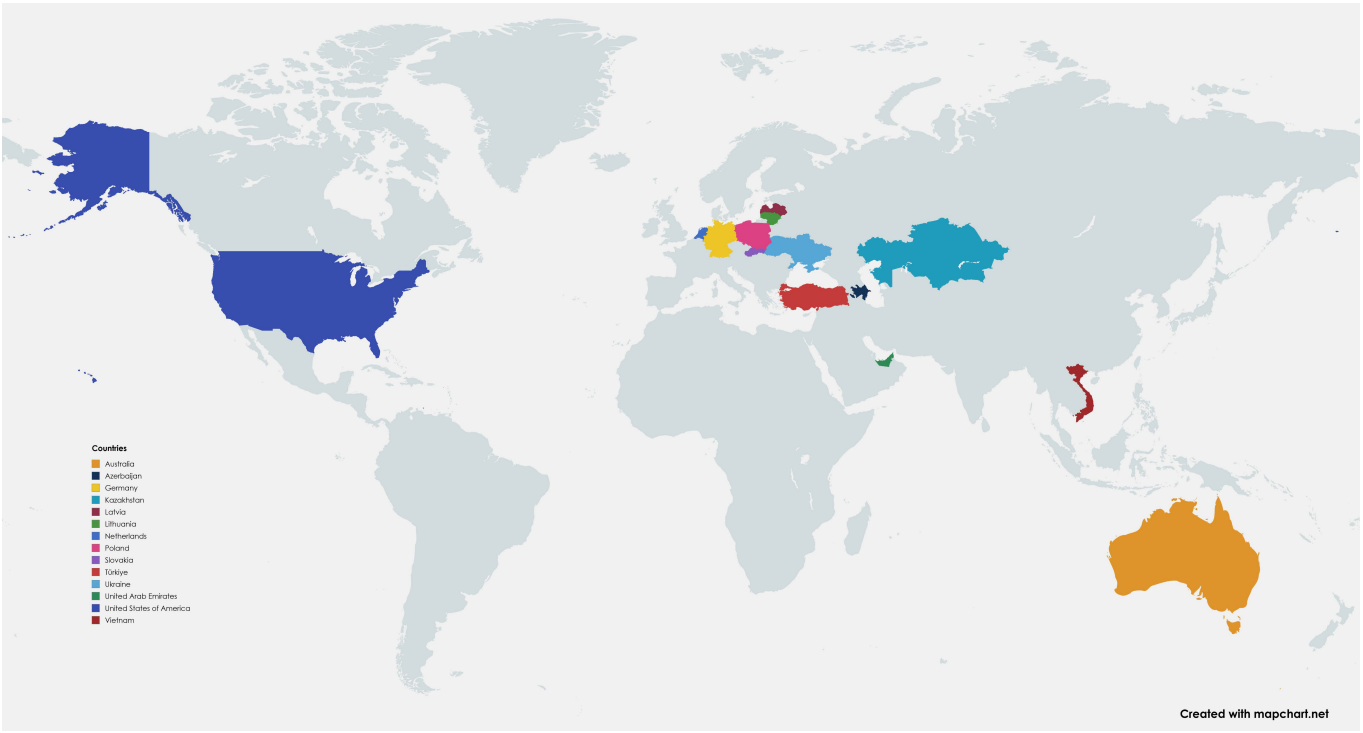
- Geographical Distributions

Geographical Distribution of Authors



Geographical Distributions of Committees



International Sustainable Transportation Symposium

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