International Symposium on
Aircraft Technology, MRO & Operations

ISATECH

14th-16th September 2022

University of Belgrade
Belgrade, SERBIA

Abstract BOOK

ISBN: 978-605-71166-5-9

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International Symposium on Aircraft Technology ISATECH'22 Abstract Book

International Sustainable Aviation and Energy Research Society

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Republic of Türkiye, Ministry of Culture and Tourism Department of Libraries and Publication ISBN Türkiye Agency Publication Data

International Symposium on Aircraft Technology 2022 (ISATECH'22) Edited by Prof. Dr. T. Hikmet Karakoc, Prof. Dr. Ivan Kostić, Prof. Dr. Aleksandar Grbović, Assoc. Prof. Dr. Jelena Svorcan, Assoc. Prof. Dr. Ognjen Peković, Asst. Prof. Dr. Ali Haydar Ercan, Asst. Prof. Dr. Alper Dalkıran.

ISBN: 978-605-71166-5-9

This book contains abstracts submitted to International Symposium on Aircraft Technology, MRO and Operations 2022 (ISATECH'22).

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Symposium Founding Chair

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Message from the Symposium Chairs

It is our great pleasure to invite you to the International Symposium on Aircraft Technology, MRO & Operations (ISATECH) which will be held in an Online/Hybrid Mode on September 14–16, 2022.

Given the significance and the fast growth of the aerospace sector, this symposium intends to make a positive contribution to the research in the field of aerospace science and technology. ISATECH, an international, multi-disciplinary symposium, aims to address current issues in the aerospace fields such as aircraft design and optimization, aerospace propulsion systems, aircraft guidance and control, state-of-the-art manufacturing, MRO, air transportation operations, use of artificial intelligence in aerospace, clean energy and emission reduction, aerospace legislation, and so on.

The ISATECH'22 provides a unique opportunity for contributors dealing with Aircraft Technology, MRO, and Operations to exhibit their solutions. The conference offers a platform for exchanging insights about the latest trends in aircraft design, propulsion systems, contemporary manufacturing, aircraft maintenance, repair and overhaul market development, and maintaining airworthiness to provide innovative solutions to the challenges the aviation industry is facing.

As we are in an era in which there is continuous progress in aviation, we would like to invite researchers, scientists, engineers, practitioners, policymakers, and students to the International Symposium on Aircraft Technology, MRO & Operations (ISATECH'22) to exchange information and experience, present best practices, new technologies, and developments, and discuss future research directions, strategies, and priorities.

ISATECH also aims to promote a broad range of topics involving the electrification of aerial vehicles such as design of all-electric aircraft, electric propulsion, electric generation, and storage in aerial vehicles, and so on. ISATECH will include several keynote presentations, specialized sessions, and oral and poster presentation sessions from the participants on different subjects related to electric use in aviation.

We look forward to welcoming you to this remarkable event in September 2022.

Yours Sincerely,

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CONTENTS

KS01
Optical Velocity Measurement and Fluid Flow Visualization Techniques

Đorđe S. Čantrak, Professor

University of Belgrade, Faculty of Mechanical Engineering, Department of Hydraulic Machinery and Energy Systems, Serbia

Abstract: Numerous fluid flow phenomena intrigue researchers worldwide. Flow visualization usually precedes experimental research and gives insight in flow structures. It can be used to show how the fluid flows around the model, in jet, in closed systems, in turbomachinery, etc. In numerous cases geometries are very complex and even some chemical reactions occur, but they are not treated here. Smoke, tufts, paints, sewing thread, smoke and tuft probes, are employed together with illumination systems, like LED lamps or lasers. With the laser development, a new era of fluid flow velocity measurement techniques started. Soon after laser invention, a laser Doppler velocimetry (LDV) is developed and applied in fluid mechanics. Non-intrusive era of fluid flow investigation has started. Various laser models, from continuum, and diode ones to impulse are widely used. Three component systems, even five beams probes, are employed today in complex researches. In-plane, stereoscopic, multi-plane stereoscopic, time-resolved, micro, holographic, scanning, tomographic and thermographic particle image velocimetry (PIV) have been used. In this case, besides illumination devices, contemporary applications employ fast cameras nowadays. Research of the turbulent swirling flow in pipe, behind the axial fan impeller, with the help of the LDV and PIV systems, as well as some results on wing tip vortex research in wind tunnel tests are presented.

KS02
Maintenance of Unmanned Aircraft

Petar Mirosavljević, Professor

University of Belgrade, Faculty of Transport and Traffic Engineering, Serbia

Abstract: The topic of this paper is the maintenance of unmanned aircraft. The paper will present the maintenance process itself, as well as the basic principles of maintenance. The reason that this paper is dedicated to unmanned aerial vehicles is that they are expanding today and there are more and more of them. Nowadays, people who buy and use drones are not aware of the consequences they can cause. In order to safely handle unmanned aircraft, it is necessary that they are in perfect condition, which requires their maintenance.

KS03
Noise of High-speed Jets: Recent progress and open questions

Sanjiva K. Lele, Professor

Stanford University, Department of Aeronautics & Astronautics, and Department of Mechanical Engineering, CA, USA

Abstract: The noise of high-speed jets is relevant in many aerospace applications, from civilian and military aircraft to space launch. The noise consists of turbulent mixing noise as well as additional noise due to the interaction of turbulence with shock structures in the jet flow. I will present highlights of computational predictions of high-speed jet noise using Large-eddy simulations where the nozzle geometry is full represented, its validation against available experiments, and how such databases are being used to improve mechanistic understanding of noise generation and engineering level noise prediction methods. I will also discuss some open questions and opportunities for further research in this field.

KS04
New Approaches in Gas Turbine Cycle Simulation

Milan V. Petrovic, Professor

University of Belgrade, Faculty of Mechanical Engineering, Serbia

Abstract: Gas turbines have made significant progress in recent years. The efficiencies of the compressor and turbine were improved based on achievements in aerodynamics, i.e., the introduction of numerical flow simulation. The introduction of massive cooling and thermal barrier coating permitted a considerable increase in the turbine inlet temperature. These developments led to a significant increase in the thermal efficiency of gas turbines. However, most existing tools for predicting cycle performance are based on 0D compressor and turbine maps for the efficiency and pressure ratio as a function of the mass flow. Such tools cannot simulate all new trends in gas turbines in the most efficient way. New 2D methods based on detailed flow calculations in the compressor and the gas turbine will be presented. Through-flow tools for compressor/turbine flow simulation and performance prediction were applied for this purpose. The methods allow the accurate prediction of performance at every operating point. Air cooling bleeds in the compressor, and its injections in the turbine blades can be simulated precisely. Also, the application of the method to the simulation of the transient behavior of gas turbines will be presented.

KS05
Method for Forming Auto Rotations in Mechanical System with Two Degrees of Freedom in Application to Double-Rotor Vertical Axis Wind Turbines

Liubov Klimina, Leading Researcher

Lomonosov Moscow State University, Institute of Mechanics, Russia

Abstract: The approach for forming autorotations is applied to a model of a double-rotor vertical axis wind turbine. The turbine consists of two rotors located one above the other. One carries a rotor of electric generator, the other carries a stator of the same generator which is connected to the local electrical circuit. Blades of wind rotors are oriented in a way to support counter rotation of the rotor and the stator. Two types of wind rotors are discussed: Darrieus and Savonius. The quasi-steady model of aerodynamic action is used. The mathematical model of the device has the form of a fourth-order dynamical system. Autorotations of the turbine correspond to attractors of this system characterized by monotonous change of both angular coordinates. To describe such attractors depending on parameters, a numerically analytical approach is applied. It is based on construction of two second-order comparison systems and forming consentaneous attractors in these systems. As a result, approximations of attractors of the fourth-order dynamical system are constructed. In particular, a hidden attractor is revealed that corresponds to autorotation of double-rotor Darrieus turbine characterized by maximum trapped power.

KS06
Innovations for a Smarter and Sustainable Aviation MRO

Konstantinos Stamoulis, Professor

Amsterdam University of Applied Sciences (AUAS), Netherlands

Abstract: This talk is both a short introduction to recent developments, challenges and opportunities in Aviation Maintenance, Repair and Overhaul (MRO), and at the same time, a presentation of the AUAS Aviation Engineering research focal areas towards smarter and more sustainable maintenance. Currently, evolutions in aircraft design, materials and production techniques are ahead of the MRO practices in use. This gap is creating demand for new knowledge to develop and operationalise adaptive and smarter MRO tools, applicable or integrated in modern aircraft systems and components. The AUAS Aviation Engineering group seeks advanced technologies and methodologies to optimize MRO processes and reduce aircraft downtime through practice-oriented research. This research is focused on two main topics: data analytics and prognostics to predict the maintenance needs and novel inspection and repair methodologies to improve the maintenance implementation.

KS07
On the Effect of Residual Stresses on Fatigue Crack Propagation in Thin-Walled Structures

Željko Božić, Professor

University of Zagreb, Faculty of Mechanical Engineering and Naval Architecture, Croatia

Abstract: Under cyclic loading in thin-walled structures such as fuselages and wings of aircrafts, at sites of stress concentration fatigue cracks may initiate and further propagate, which can eventually lead to unstable fracture and result in structural failure. Extensive studies on crack initiation and propagation in riveted and welded aircraft stiffened panels have been conducted. A few studies have been conducted on the propagation of fatigue cracks in welded stiffened panels. Models for predicting fatigue crack propagation in welded stiffened panels which take into account the influence of residual stresses are presented. The finite element method is used to determine stress intensity factor values taking into account the impact of residual stress fields introduced by the welding process. The influence of residual stress on crack growth rate in numerical simulations is accounted for by replacing the nominal stress ratio R in empirical power laws by the effective stress intensity factor ratio. By using the power laws the crack propagation life was simulated for the considered welded stiffened panel specimen and compared with results of cyclic tension fatigue tests.

KS08
Trends in New Nanoparticle Enhanced Fluids: Experimental and Computational Approaches

Alina Adriana Minea, Professor

"Gheorghe Asachi" Technical University of Iasi, Romania

Abstract: In the last decades there was a tremendous work on new heat transfer fluids (called in the literature nanofluids or nanocolloids), as the least explored technique of heat transfer enhancement, besides extending surfaces. The research on nanofluids started with water and ethylene glycol as base fluids and mostly oxide nanoparticles as additives; however, the studies up to date include a larger area of base fluids (i.e. ionic liquids, oils, polyethylene glycol etc) and nanoparticles types, as carbon based, metals etc. In regard to nanofluids applications, there are mostly unlimited, starting with medicine related, chemical engineering, heat exchanger, basically wherever heat transfer in fluids or substance transport occurs. This lecture will try to cover as many aspects as possible in connection with both experimental and numerical findings, along with some insights in different configurations and applications.

IS01
Wind Tunnel Measurement of Pitch-Damping Derivative Using Forced Oscillation Technique

Marija Samardžić, Senior Research Associate

Military Technical Institute (VTI) in Belgrade, Serbia

Abstract: The main task of dynamic experiments in wind tunnels is to obtain model-scale stability information of an aircraft at realistic Reynolds and Mach numbers. The forced oscillation technique is the most widely used wind tunnel technique for stability derivatives measurements. The oscillatory motion is induce to a model in one (the primary) degree of freedom. The aerodynamic reaction measured in the primary degree of freedom determines direct damping derivatives. Stability derivatives are obtained from in-phase and out-of-phase components of the measured aerodynamic reactions. This paper describes determination of the pitch-damping derivative in the T-38 wind tunnel. The T-38 pitch/yaw apparatus is a full-model forced oscillation apparatus with primary angular oscillation around the wind tunnel model transversal axis. The model is forced to oscillate at constant amplitude. Test results obtained in the T-38 wind tunnel are compared with published experimental data of one of the world's leading wind tunnels: Arnold Engineering Development Center-von Karman (AEDC, USA).

IS02
Wind Tunnel Operation and Testing in the 21st Century: The Case of VTI's Test Facilities

Biljana Ilić, Research Associate

Military Technical Institute (VTI) in Belgrade, Serbia

Abstract: The concept of the 21st Century Laboratory emerged at the turn of the century, in preparation for future changes in conducting research that will have been brought by significant technological advances achieved in the previous period. At an extreme end, views were expressed that wind tunnels will have been mostly obsoleted and replaced by computational tools in the first decades of the century. Contrary to the expectations, however, there has been constantly rising demand for wind tunnel testing during the last twenty years, but ironically, it has been followed by the overall decline in the number of wind tunnel runs. This apparent contradiction can be explained by gradual abandoning of conventional wind tunnel test methods with high data volume as a main measure of productivity and transition to the techniques described collectively as the Modern Design of Experiments. Wind tunnel operation and testing in a new era of technology will be explained using the case of VTI's test facilities. These facilities were built 40 to 70 years ago, some of them are well beyond their design lifetimes, but they have constantly provided unique capabilities of testing in subsonic, transonic and supersonic speed ranges. The present paper summarizes capability upgrades and embracing the principles of modern design of experiments by the VTI's wind tunnels, in order to address current and future aerodynamic performance technical challenges.

IS03
Developing Heavy-Lift Drones for Last-Mile Resupply

Stephen D. Prior, Reader

The University of Southampton, UK

Abstract: Hybrid Drones Ltd was formed in late 2019 with the sole aim of disrupting the drone delivery, autonomous last-mile resupply sector. Our innovative solution of a flexible, compact and reconfigurable heavy-lift hybrid drone (HYDRA) will tackle the emerging airborne heavy-lift capability. Our initial design target was to be able to autonomously deliver an underslung nominal payload of 100 kg (up to 1 m3), over a return range of 16 km, within 20 min. The payload could be made up of medical supplies, shelter, water, food, fuel, etc. The current generation of fully-electric drone delivery systems are limited to about 50 kg of payload and an endurance of 20 min. They rely on heavy, low specific energy (180 Wh/kg) rechargeable Li-Po battery technology. Hybrid Drones Ltd won a £50k six-month UKRI COVID-19 R&D grant in June 2020 to enable development of the initial proof of concept (PoC) prototype, which is now complete. We have developed a patented, compact, hybrid propulsion system (Fuel-Electric), which can fly on both or fully-electric power sources; the user can infinitely trade-off fuel load (12,000 Wh/kg) for payload and vice-versa. Our HYDRA XL 300 platform is reconfigurable into four variants – fully-electric, two jets, four jets or six jets, each with its own range-payload capability. Our fully-electric version has a payload capability of 150 kg and can deliver this over a range of 25 km within 20 min.

IS04
Artificial Intelligence, Computational Fluid Dynamics and Sustainability

Ricardo Vinuesa, Associate Professor

KTH Royal Institute of Technology, Sweden

Abstract: The advent of new powerful deep neural networks (DNNs) has fostered their application in a wide range of research areas, including more recently in fluid mechanics. In this presentation, we will cover some of the fundamentals of deep learning applied to computational fluid dynamics (CFD). Furthermore, we explore the capabilities of DNNs to perform various predictions in turbulent flows: we will use convolutional neural networks (CNNs) for non-intrusive sensing, i.e. to predict the flow in a turbulent open channel based on quantities measured at the wall. We show that it is possible to obtain very good flow predictions, outperforming traditional linear models, and we showcase the potential of transfer learning between friction Reynolds numbers of 180 and 550. These non-intrusive sensing models will play an important role in applications related to closed-loop control of wall-bounded turbulence. We also draw relevant connections between the development of AI and the achievement of the 17 Sustainable Development Goals of the United Nations.

IS05
Implementation of RE in the 6R Strategy in Considering the Sustainable Development of Parts for the Aviation Industry using Additive Technologies

Miloš Vorkapić, Research Associate

University of Belgrade, Institute of Chemistry, Technology and Metallurgy, Serbia

Abstract: The 6R strategy plays an essential role in the sustainable development of the aviation industry, which is reflected in the application of new materials and new technologies. Additive technologies enabled rapid prototyping production and modified components as a quick response to market turbulence. The aim is to show the primacy of additive technologies concerning conventional manufacturing methods. This paper will define the reverse engineering (RE) implementation algorithm in the 6R strategy. The emphasis here is on using non-metallic materials: polymers, composites and other materials. Mentioned materials are gaining an increasing role in those places where the geometry of parts is complex. By definition, the 6R strategy includes reduction of waste material (Reduction); reuse of waste material (Reuse); waste collection (Recycling); regeneration of raw materials and energy from waste material (Recovery), redesign of a product or a complete business process (Redesign) and reproduction that includes disassembly, cleaning, measurement and testing of parts (Remanufacturing). Applying RE makes it possible to design a new spare part based on the existing fundamental machine part. The RE procedure is realized from creating a digital 3D model, through the permanent improvement and optimization of model parameters, to the production of the finished part using additive technologies.

IS06
Integrated Thermal Management for Electric Vehicles

Jelena Andric, Thermal Management Energy Optimization Leader

Volvo Technology AB, Sweden

Abstract: The automotive industry is intensively developing electric vehicles (EVs) to comply with stringent environmental regulations and mitigate climate change. Thermal conditions in EVs remarkably differ from those in conventional vehicles since no exhaust heat is available from an internal combustion engine (ICE). Efficient thermal management (TM) in EVs system plays a crucial role in extending the driving range and improving cabin comfort, particularly in cold ambient conditions. The traditional TM for ICE vehicles considered the cabin climatization and liquid-based coolant systems separately. EVs require integrating TM systems for the cabin, energy storage and electric motor. This integrated TM system makes it possible to select different operating modes based on driving and ambient conditions to provide cabin thermal comfort and satisfy electric powertrain cooling/heating demands. Dynamic digital twins of the TM system based on data-driven simulation models are required to analyze the synergy effects between the subsystems, component matching, and energy-saving potentials to utilize the thermal energy of EVs in a fully integrated manner. Finally, intelligent control algorithms should be employed to optimize the TM system in real-time and under foreseeable operating conditions.

IS07
Extending the Orbital Lifetime of a CubeSat in Low Earth Orbit by Optimizing its Attitude Control Algorithm

Dušan Marčeta, Assistant Professor

University of Belgrade, Faculty of Mathematics, Department of Astronomy, Serbia

Abstract: The orbital decay of CubeSats in low Earth orbits (LEO) caused by atmospheric drag becomes significantly more pronounced during the seasons of high solar activity. This activity varies over the 11-year cycle and the next maximum is expected to occur in 2025. During this period, increased extreme ultra violet radiation from the Sun heats the thermosphere causing it to expand significantly. This results in an increase in the density of the thermosphere at a given altitude by order of magnitude compared to the seasons of low solar activity. As a consequence, a typical orbital lifetime of a CubeSat can be reduced by a factor of few, compared to its counterpart orbiting during the season of low solar activity. On the other hand, geometry of a typical 3U CubeSat with deployable solar panels, which form a significant part of the CubeSat fleet, allows variation of its ballistic coefficient by order of magnitude, depending on the spacecraft attitude. This talk presents possibilities for modelling aerodynamic environment around 3U CubeSat in LEO, currently under development at University of Belgrade, with the aim of observing the Sun in soft X-ray domain. The main focus is on optimizing its attitude control algorithm in order to extend its orbital lifetime, allowing it to conduct observations over larger portion of the next solar maximum season and to maximize its scientific output.

IS08
Education of Future Mechanical and Aeronautical Engineers

Dragan Komarov, Professor of Applied Studies

Academy of Applied Technical Studies Belgrade, Serbia

Abstract: A fast-paced development of new technologies across a broad range of industry sectors has been transforming the world. Education in long-established engineering disciplines, such as mechanical engineering and aeronautics, has been gradually adjusting in response to the growing needs of the industry for skilled engineers. Many paradigms and methodologies (such as outcome-based education, project-based learning, CDIO, technology-driven learning, student-centered learning, and interdisciplinary and multidisciplinary approach) have been appearing. They tend to adapt the study programs to the present and future industry demands, to attract talents, and make the learning process more effective. Although skills are essential and demanded by the companies, the significance of knowledge, both specific engineering as well as fundamental, should be emphasized. It presents a solid foundation to build upon for necessary skills and to provide proper conditions for further specific personal improvements through life-long learning. Efforts to reduce the gap between industrial stakeholders' needs and higher education study programs in mechanical and aeronautical engineering should result in large-scale active engagement and additional resource allocation for education processes by all interested parties and further changes in learning methods and curriculums.

IS09
Management of Life-Limited Parts in Aircraft Engines

Branimir Stojiljković, Associate Professor

University of Belgrade, Faculty of Transport and Traffic Engineering, Division of Aircraft, Department of Air Transport and Traffic, Serbia

Abstract: Engine maintenance costs have the largest share in direct aircraft maintenance costs. The most significant part of engine maintenance costs is the material replacement cost which may be substantially increased by the replacement of life-limited parts during a shop visit. Therefore, the reduction of engine shop visit costs relies on carefully planning the engine removals and making operational decisions on the replacement of life-limited parts and the workscopes during shop visits. The main issues that influence the management of life-limited parts will be presented and discussed, including catalogue list prices and escalation rates, life limits, thrust ratings, severity of engine operation and shop visit workscope optimization criteria.

IS10
Artificial Intelligence for Predictive Maintenance in Gas Turbines

Asteris Apostolidis, Associate Professor

Amsterdam University of Applied Sciences, Netherlands

Abstract: The use of data and relevant algorithms is essential to the development of Predictive Maintenance (PdM) in aviation. Operationalised applications of PdM can enhance aircraft availability, minimise operational disruptions, promote sustainability in maintenance and improve cost efficiency. In addition, PdM applications for aero engines is of high interest, as propulsion systems are complex, costly and the primary source of CO2 emissions in aviation. The prediction of critical engine health indicators, such as the Exhaust Gas Temperature (EGT), and the Remaining Useful Life (RUL) of engine parts and components can enhance maintenance decision support by aircraft operators and optimize the way assets are maintained. However, there are different technical, operational and regulatory challenges that need to be tackled before we see a large-scale deployment of such tools. When it comes to data, industry-wide issues on ownership, confidentiality and availability hamper the prospects of create common value for different parties. The most promising technologies in data exchange systems are related to the introduction of federated learning architectures for data-driven methods. At the same time, as aviation is a safety-critical and highly regulated industry, the development of autonomous PdM models is essential and related to industry-wide efforts for certifiable AI.

IS11
Aspects of the Crashworthiness of Modern Civil Passenger Aircraft Design

Andrija Ekmedžić, Director and Head of Engineering

Konelek D.O.O., Serbia

Abstract: There are specific requirements of the CS 25 and FAR 25 regulations which influence design of the aircraft components and overall aircraft architecture which would be covered by this presentation. In particular there are requirements that prohibit the fuel tanks to be penetrated by other aircraft components in the crash situation. The presentation will show some of the examples in life and real service what can happen in the following situations and how this task was designed and implemented on the case of Airbus A350 aircraft.

001
Influence of Thickness Ratio on the Aerodynamic Characteristics of a Family of Hybrid Semielliptical Dolphin Airfoils

Zorana Z. Dančuo, Ivan A. Kostić, Olivera P. Kostić, Aleksandar Č. Bengin and Goran S. Vorotović

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Abstract: The authors of this paper have recently been involved in the development of a novel family of semielliptical hybrid Dolphin airfoils for general aviation applications. The previous work has shown noticeable improvements in aerodynamic characteristics of the modified hybrid Dolphin 2415 airfoil. In this paper the same method has been applied on the airfoils of different thickness ratios. All numerical calculations were performed using RANS equations with the k- ω SST turbulence model. A comparison between a series of four-digit NACA 24xx, the original Dolphin, and the novel hybrid semielliptical Dolphin airfoils was made. Results have shown that in the range of thickness ratios above 15% and under 12%, the semielliptical hybrid Dolphin airfoils have shown a slight decrease in some aerodynamic characteristics compared to their NACA counterparts. This led to the conclusion that the semielliptical modification approach of the airfoil in its nose domain shows the best results within the 12% to 15% range of thicknesses, which is an important clue for further research of the hybrid Dolphin airfoils.

Keywords: thickness ratio, hybrid Dolphin airfoil, aerodynamic efficiency, turbulence model, shape optimization.

002
Role of the Pressure Field Harmonic Oscillations in the Flutter and Flutter-Buffet Phenomena of High Aspect Ratio Swept Wings

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Abstract: The characteristics of the aeroelastic responses occurring in the transonic regime for high aspect ratio swept wings are analyzed in detail and a comparison between a conventional swept wing and a curved planform wing is presented. Power spectral density diagrams for aerodynamic coefficients are plotted and discussed. The interaction of structural and/or pressure field oscillations are investigated. Structural oscillations refer to the natural vibrations of the wings, while pressure field oscillations concern small variations of pressure in transonic regime that, under specific physical conditions, have the characteristics of a nonlinear multiple-degree-of-freedom resonant system. Transient CFD analyses performed on rigid wings, with modified geometries, provided the frequency contents of the pressure fields allowing investigating their role in critical conditions. The modified geometries were extracted from the results of 2-way fluid structure interaction (FSI) analyses. For a swept-wing model, with straight leading and trailing edges, the aeroelastic deflections strongly influence the transonic buffet onset and a clear interaction between a structural mode and pressure field oscillations occur. Conversely, for a curved planform wing, although the pressure field fluctuates significantly, this work demonstrated that transonic pressure field oscillations do not interact with the wing's structural modes.

Keywords: Swept wing, Transonic flow, Buffet, Flutter, FSI analyses, URANS model.

003
The Effect of T6 Heat Treatment on AlSi12 Alloy

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Abstract: Al-Si alloys are widely preferred in aerospace, defense, automobile, and general engineering industries. Major alloying element is silicon, and it is main reason for achieving good mechanical properties. AlSi12 is the most studied and preferred alloy in literature. The impact of T6 heat treatment process is investigated on the microstructure and mechanical properties of AlSi12 alloy. According to obtained results, the improvement of mechanical properties of AlSi12 alloy is attributed to morphological transformation in the microstructure.

Keywords: Aluminum alloy, aerospace alloy, AlSi12, T6 heat treatment.

004
Outline the Possible Application of Artificial Intelligence in the Aircraft MRO Process Development

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Abstract: Aircraft maintenance development is connected directly to aircraft technology, and today in a field characterized by being fast-growing and innovative, technology becomes a crucial asset for operation and process optimization. The maintenance industry must adapt to the continuous aircraft changes, which can also be well visible in the technology roadmap of aircraft development. The air transportation sector is aiming to reach higher safety levels which can only be achieved by minimizing the risk of human-based errors. Additionally, the stakeholders expect cost reduction and higher market share. With the start of the industry 4.0 revolution, new possibilities for data analysis, evaluation, and decision-making algorithms are being explored and investigated. It is well observed that Artificial Intelligence (AI) is present in most of the research work conducted in this field. AI can influence the daily workflow for companies working in the field of Maintenance, Repair, and Overhaul (MRO) as well as the machine-human synergy and cooperation. Hence, the present paper aims to introduce and discuss the possibilities of AI application in aircraft maintenance, its contribution, and its influence on the industry.

Keywords: Aircraft Maintenance, Repair, and Overhaul, Industry 4.0, Artificial Intelligence, Process Development, and Optimization.

005
A Computational Study of the Heat Transfer Coefficient for Lithium-Ion Battery Temperature

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Abstract: In this study, the thermal behavior of a prismatic lithium-ion battery was examined by considering both the maximum battery temperature and the minimum battery temperature. The battery temperatures were obtained by implementing the NTGK modeling. A commercially available computational fluid dynamics software, ANSYS Fluent was used to model the battery thermal profile. The highest maximum battery temperature was obtained for the battery with the lowest heat transfer coefficient while the lowest maximum battery temperature was observed for the battery with the highest heat transfer coefficient. The results showed that the battery temperature could be controlled by the heat transfer coefficient. The results also indicated that if a temperature difference of 1 K was acceptable, the heat transfer coefficient of 20 W m-2 K-1 was sufficient for the battery. The heat transfer coefficient should be adjusted to its optimum value for a battery thermal management system. This study can be used to select suitable heat transfer coefficients for battery thermal management systems.

Keywords: Lithium-ion battery, thermal behavior, computational modeling, heat transfer coefficient.

006
Assessment of Entropy Management for Piston Engines Considering Fuel Preference in the Flight Process

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Abstract: Piston engines, which have increased their sectoral potential with the developments in their technologies in recent years, include features that can be used in different preferences for emission management together with fuel preferences. While the fuel preferences in the piston engines sector mostly use AVGAS, the use of LNG and LPG has been discussed from different perspectives in recent years. In this study, a comparative thermodynamic and environmental analysis is presented over three fuel preferences for the reference engine. By investigating the entropy potentials of the engine depending on fuel preferences, the environmental effects they cause are discussed through two different parameters: the Environmental Performance Index and the Sustainability Index. The environmental performance effects of fuel preference in the engine were also evaluated over the outputs obtained in the study.

Keywords: Airport, Carbon management, Technology, Exergy, Emission.

007
CO_2 Dilution Effect of Methane Combustion at Premixed Model Gas Turbine Combustor

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Abstract: As a result of the climate crisis caused by energy efficiency and post-combustion emissions, the importance of studies on alternative fuels and combustion processes has also increased. In this study, the effect of dilution effect on flame temperature, brightness and flue gas emission values was investigated by adding CO2 gas to a pure methane flame at constant thermal power in a swirl supported and premixed burner. The thermal power of the burner was determined as 5 kW and the equivalence ratio was fixed at 0.9. While the burner outlet temperature of the pure methane flame was 1058 K under the specified conditions, it decreased to 1032 K with the addition of 30% CO2. With the decrease in the combustion temperature, the NOx value measured at 17 ppm in the pure methane flame was reduced to 13 ppm as a result of 30% CO2 dilution. On the other hand, as a result of the addition of CO2 under the same conditions, CO emissions increased from 303 ppm to 1687 ppm.

Keywords: Methane Combustion, Pollutant Emission.

008
Torsional Divergence Analysis of Missile Fins Based on Galerkin's Method

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Abstract: In the present paper the static aeroelastic phenomenon known as torsional divergence is investigated on rocket stabilizers (fins) made of composite materials. Using analytic approach, the differential equation for torsional divergence of composite trapezoidal stabilizer is derived. The equation obtained was in the form of second order differential equation with variable coefficients. The solution to divergence equation was obtained using Galerkin's approach and the complete solution procedure is presented. It was found that Galerkin's approach can be successfully deployed in solving differential divergence equation and divergence speed (VD) of composite stabilizer in subsonic air-flow can be effectively calculated.

Keywords:

009
Express Method for Detection of Microbiological Contamination of Aviation Fuel for Preventing Damage to Aviation Military Equipment

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Abstract: Microbiological contamination is a specific type of contamination, capable of self-reproduction and expansion, which under favorable conditions can cause biological damage to fuel systems and fuels for military aviation (as well as civil aviation, marine vessels, and fuel and refueling complex). The interrelation of the occurrence of microbiological contamination and the consequences it causes for fuel and means of operation, transportation, and storage testifies to the complex influence of microbiological contamination and justifies the importance of ensuring the microbiological stability of fuels at each stage of their life cycle. The proposed method using ninhydrin makes it possible to promptly detect the presence of microbiological contamination in fuels and prevent the occurrence of biological damage to fuel systems and tanks and ensures the airworthiness of aircraft.

Keywords: Microbiological contamination, aviation fuel, ninhydrin.

010
Assessment of Thermodynamics Performance for Prop Engine Based on Temperature Effect of Flight Altitude

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Abstract: In recent years, significant gains have been made in aircraft engine technologies, which have increased their sectoral potential. However, irreversibility based on fossil fuel consumption has an important environmental pollutant role. For engines, the fuel consumption combined with the emission management-related altitude conditions is an important input to evaluate the potential. Generally, three different altitude definitions are valid for airplanes in engine performance measures. In particular, flight altitude is an important input for decision processes and this is valid for 9000 ft in sectoral structure. First law and second law analyses were developed for the defined boundary temperature values of the flight altitude for the prop engine referenced in this study. Then, the entropy potential of the temperature effect at the boundary conditions for the altitude conditions was evaluated, and the environmental effect was evaluated. At the end of the study, evaluations of entropy management were made for performance effects.

Keywords: Aircraft, jet-prop, entropy analysis, emission, sustainability.

011
An Unmanned Flying Wing as a Carrier of Small Launchers for Satellite Deployment in LEO

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Abstract: A proposal is presented for a low-weight "carrier-launcher" system for space missions in Low Earth Orbit. The carrier is a remotely controlled unmanned flying wing. As occurs for other existing solutions on the market, the carrier is deputed to cover part of the role of the first stage of actual two- or three-stage earth-to-orbit rockets. The "flying wing" configuration makes it possible to use a carrier significantly lighter than a common aircraft. The launcher is carried on the top of the wing in order to allow a free release during a parabolic manoeuvre at high altitude at "almost zero g". Starting from state of the art study, a conceptual configuration of the carrier is defined selecting its initial design parameters. A preliminary study of both aerodynamics and flight mechanics was carried out by simulating the carrier with the public Athena Vortex Lattice (AVL) software. The study of the aeromechanical performance concerned the take-off manoeuvre, landing manoeuvre, and the launcher release maneuver at an altitude of approximately 12,000 meters Two configurations having four and two motors respectively were compared. Finally, some numerical analyses were performed with the NASTRAN software to evaluate, as a first approximation, the aeroelastic behavior of the proposed "carrier-launcher" system.

Keywords: Flying Wing, Satellite Launcher, UAV, Low Earth Orbit, Parabolic Maneuver, Aeroelastic Analyses.

012
Design Methodology Development for UAS Integrating Business Assessment and Optimisation Processes

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Abstract: Unmanned Aircraft Systems represent a young, dynamically growing market, with significant value potential and high growth rate. In order to unlock this market potential, UAS need to be designed to match the value generating business direction defined. This paper presents the overview of the method development and application for a business assessment based conceptual level design methodology for UAS integrating optimization tools into the process. The methodology is presented through the example of an industrial-academic collaborative research project, where an existing BWB configuration UAS and the related potential business application had to be developed simultaneously. As the project does not present a clean sheet design opportunity, significant, conflicting constraints were placed towards the UAS design. As such widespread exploration of the design space was necessary, which was performed using an optimization-based methodology. Further optimization of shortlisted concept designs was performed in order to develop the designs with the potential to achieve the identified business potential.

Keywords: UAS, Conceptual design, optimization, operational investigation.

013
Experimental Thermal Analysis of Prismatic Lithium Iron Phosphate (LiFePO4) Battery

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Abstract: Characterizing the thermal parameters of a lithium-ion battery is an important step for estimating the temperature distribution of battery cell modules. In this study, an experimental method based on distance-dependent heat transfer analysis of the battery pack has been developed to simultaneously determine the thermal conductivity of the battery cell and the specific heat of the battery pack. Prismatic lithium iron phosphate cells are used in this experimental test. The time-dependent results were measured by measuring the temperature change of the cell surface. It is observed that the thermal parameters of the cell increase linearly with increasing operating temperature. Moreover, while the operating temperature has a more significant effect on the specific heat of the cell than the thermal conductivity, the effect of its state according to the C ratios used in charging and discharging has a maximum effect on these two parameters. The current method shows an effective and practical way to simultaneously determine the thermal conductivity of the cell and temperature changes.

Keywords: Thermal Analysis, Prismatic Battery, Lithium Iron Phosphate (LiFePO4) Battery, Experimental Test.

014
Flow Analysis Inside the Blade of Tip-jet Cold Cycle Helicopter

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Abstract: This paper is focused on the flow inside the blades of cold type tip-jet helicopters. The phenomena of additional compression of the air through the blades due to the existence of the centrifugal effect, shows that there is more potential in such types of tip-jet helicopters compared to hot cycle ones. CFD 3D analysis is used to simulate the flow and results are compared to values obtained by 1D hand calculation with differential equations. Results clearly indicate that not only all pressure losses, i.e. pressure drop, inside the blades are compensated by the effect of centrifugal force there is a significant increase of pressure at the blade tip.

Keywords: Flow analysis, Tip-jet helicopter, Cold cycle, Computational Fluid Dynamics, Propulsion system.

015
Numerical Investigation of Impinging Synthetic Jets on the Flow Field and Heat Transfer at Low Orifice-to-Plate Distances

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Abstract: A numerical study has been performed in order to investigate synthetic jet impingement on a flat plate for orifice-to-plate distances (H/d) of lower than one. The aim was to show the effect of low H/d on heat transfer and flow field for a single circular orifice. Investigations have been done for frequencies of f=250 Hz and 500 Hz, and $0.10 \leq H/d \leq 0.75$. The results showed that at the stagnation region the highest heat transfer values could be obtained for H/d=0.75. On the other hand, a more uniform temperature distributions have been observed for H/d=0.10. In overall, this study provides guidance for the design of synthetic jet impingement cooling in small spaces with high thermal power densities.

Keywords: Impinging synthetic jet, Heat transfer, Computational Fluid Dynamics (CFD), Electronics cooling.

016
Energy and Environmental Evaluation on LPG Transition for Piston Engine of the Plane

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Abstract: Sectoral pressures created by the awareness of global warming and climate change have made the control of emissions important in the aviation industry. Fuel preference is a priority issue, especially for fuel-based energy and environmental sustainability. Liquefied petroleum gas (LPG), a solution for land vehicles, may be a choice for aircraft using piston engines. In this study, first of all, performance analyses were made for one piston engines together with the current AVGAS consumption. Then, the performance effect of the engine due to LPG usage was examined. In this context, the environmental effects of engine performance changes are also discussed within the scope of entropy management. The review aircraft were compared at different altitudes and flight conditions. The analysis shows a 54,372 % saving in LPG consumption due to classical consumption. At the end of the study, the sectoral use of LPG was evaluated.

Keywords: Airport, Carbon management, Technology, Exergy, Emission.

017
Operating eVTOLs in the Emergency Response Service

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Abstract: One of the electric vertical take-off and landing vehicles (eVTOLs) most promising field of application is the medical emergency response service. The aim of this study is to demonstrate a method suitable for the analysis of the benefits of integrating eVTOL vehicles into the services. In Hungary, due to the scattered location of settlements and natural obstacles, it is often not possible to reach rural areas on road within the desired timeframe. This problem could be solved by integrating eVTOL vehicles into the services. They could help to reduce emergency response times and hospital arrival times. They can have lower operating costs and a locally smaller environmental footprint than traditional helicopters, facilitating a wide range of applications. According to the analysis results, the percentage of the population receiving emergency care within 15 minutes can be increased from 85% to 99%. This requires 30 eVTOL stations with about 40 vehicles, which have at least 34 km service radius and are capable of 157 km/h cruise speed.

Keywords: eVTOL, emergency response, electric aircraft, air ambulance, doctor shuttle.

018
Comparison of Flow Characteristics of Wake Regions of Single and Lined up in a Row Torpedo-Like Geometries at Uniform Flow Conditions

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Abstract: In this study, the comparison of the flow characteristics in the wake of two identical torpedo-like geometries having an elliptical nose and conical stern lined up in a row with a single model for a length-diameter ratio L/D=5, was investigated using the Particle Image Velocimetry (PIV), method in a closed loop open water channel. The Reynolds number calculated based on the characteristic length (L=200 mm) of the model is Re=20x103. The experiments were carried out under uniform flow conditions. The uniform flow velocity is 100 mm/s. The space between the two models is denoted by G. The dimensionless space ratio between the models is taken as G/L=0.15. In comparisons, instantaneous velocity field (V), time-averaged streamline topologies $<\Psi>$, pointwise variations of streamwise velocity component $<u/U_\infty>$, cross-streamwise velocity contours $<v/U_\infty>$, velocity fluctuations in cross-streamwise $<v_{rms}/U_\infty>$ and instantaneous vorticity contours $\omega L/U_\infty$ were found to be different significantly from the single-torpedo-like geometry. It has been observed that the flow separations in the torpedo-like geometry wake region at G/L=0.15 are delayed and move towards the end of the geometry stern section. In addition, it has been observed that the rotational flow regions areas covered by the contours get smaller and approach the geometry.

Keywords: Elliptical nose, PIV, Torpedo-like geometry, Tandem arrangement, Viscous flows.

019
Accounting for the Effects of Experimental Setting in Propeller Flow Computation

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Abstract: Various computational approaches differing in complexity and accuracy can be used to simulate flows around rotating lifting surfaces. Here, flow field around a hovering propeller is estimated by two disparate methods, Reynolds-averaged Navier-Stokes (RANS) equations vs. wall-modeled large eddy simulation (WMLES), and compared to experimental data. In both cases, the computed thrust is somewhat lower than the measured value, mostly because the measuring equipment, located behind the propeller, disrupted the wake, thus changing the aerodynamic loads over the blades. However, the effect of the computational grids, approaches to resolving the rotational motion and turbulence are not negligible, and can be quantified in a particular case of a small-scale propeller operating at nominal angular frequency. For that reason, different computational domains, grids, and numerical set-ups are tried and compared. It is observed that by careful geometric modelling, fine meshes, LES and inclusion of actual experimental set-up, a much-improved correspondence between the two sets of data can be achieved.

Keywords: Propeller, Turbulence, RANS, WMLES, Hover.

020
Improve Aircraft Pilots' Training Using Structural Failure Incidents: a Serious Game Approach

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Abstract: Problem-based learning (PBL), as well as serious games and simulations, allow students to understand and associate theory discussed in class with its applications in real-life incidents. In this paper, we support the view that successful air disaster management during flight needs a proactive multifaceted educational approach with a combination of theoretical knowledge, simulation, and actual flying training. Using simulations and games in education increases students' motivation and engagement, improves their skills and optimizes their learning, but also enhances their critical thinking and decision making. To this end, we propose the development and use of a digital, interactive educational platform that can bridge academic education and flight training using case-study analysis for in-flight risk management. An added bonus of our digital platform is that the trainees can also access it remotely and use the educational material anytime and, in any place, even if they are away from their training squadron.

Keywords: Aeronautical Decision Making, Structural Failure Incident, Air Disaster, Pilots' Training, Serious Game, Flight Safety.

021
Neural Control of Space Trajectories with Pseudolinear Models

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Abstract: This paper describes an approach to neural control of a satellite trajectory. A pseudolinear model is created to generate the necessary training data for the neural network. This model uses an H∞ to stabilize the relative motion of a satellite concerning another satellite. The purpose of this paper is to show the feasibility of such an approach and to better understand the benefits of using a previously trained neural network to control a satellite.

Keywords: pseudolinear, relative motion, ANN.

022
H-infinity Control of Orbital Trajectories with Stochastic Models

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Abstract: This paper describes the formulation and numerical investigation of the robust H control problem for the orbital transfer of a spacecraft between two non-coplanar orbits subject to parameter uncertainties and external disturbance. The dynamic model of relative motion illustrated by Tschauner-Hempel (T-H) equations is used to define the orbital transfer model. An illustrative example is provided to show the effectiveness of the proposed control design method.

Keywords: Orbital Transfer, H robust controller, Tschauner-Hempel (T-H) equations.

023
Numerical Analysis of Narrow-Body Fuselage Upper Panel Re-Design

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Abstract: As a consequence of a huge risk that development of a new structural solution inevitably brings, (which is additionally emphasized by the compelling need of the profits increase), the importance of striving for the best technical solution is now quite diminished. As a result, instead of pursuing for the new and more advanced structures, today we aspire for partial redesign of the old models which proved to be reliable in the past. Yet, this may be the right way if it involves keeping those options that still do not have a better alternative, instead of chasing innovation at any cost, but can become very dangerous if the mentioned approach is so abused that it settles to the application of alterations in which even basic principles are not followed, that we all know has happened within 'the Max affair'. However, when it comes to the concept of redesign, between the two mentioned extremes, there is a whole range of different approaches, of which we will analyze the one we have observed within Boeing's structural solutions and would simply define it as a mitigation of a bad design in the case where, according to our opinion, the whole solution should be completely rejected.

Keywords: Finite element analysis, Fatigue, Damage tolerance, Numerical methods.

024
Structural and Flow Analysis of Launch Vehicle for Cubesats

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Abstract: Space has always been a matter of curiosity for humanity. With the development of satellite technologies, the number of cubesats has increased. Accessibility to space has become easier with cubesat technology. Cubesats are provided with access to space with launch vehicles. In this study, the structural and flow analyzes of the previously designed launch vehicle were examined. The main task of the launch vehicle is to bring the cubesat placed in the POD into the stratosphere layer of the atmosphere. Cubesat will be used for educational purposes. Information about the launch vehicle and the cubesat to be placed is given. Structural analysis and flow analysis were carried out taking into account atmospheric conditions. For the structural analysis, total deformation, equivalent stress, maximum and principal stresses analysis under the effect of maximum acceleration that the launch vehicle will encounter were examined. For flow analysis, a wind turbine model with the launch vehicle was created. Flow path, flow velocity values and dynamic pressure analyzes on the launch vehicle were examined. In this study, the structural and flow analyzes of the launch vehicle, which will take the cubesat to be used for educational purposes up to the stratosphere layer of the atmosphere, were examined and its suitability for the task was discussed.

Keywords: Launch vehicle, Rocket, Structural analysis, Flow analysis, Stratosphere.

025
Development of a Model of the TCAS Autonomous Diagnostic System Using Non-Contact Current Sensors

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Abstract: In the work, the problem associated with a false alarm of the TCAS system is investigated, when there is not a single conflicting aircraft in the system's coverage area. The article analyzes the existing problem and ways to solve it using non-contact current sensors for autonomous diagnostics of the TCAS system. As a solution to the problem, a model of autonomous diagnostics with non-contact current sensors is proposed. As a result, it is shown that autonomous diagnostics of the TCAS system can be implemented using a Hall sensor and a Rogowski coil, which allow non-contact monitoring of operating currents, which makes it possible to detect and eliminate false alarms of the system.

Keywords: Noncontact sensors, Rogowski coil, Hall sensor, thermocouple, the safety of flights, current measurement, false alarms, TCAS system.

026
Testing and Integration of a Hydrogen Fuel Cell in a Hybrid-Electric Propulsion Rig for UAVs

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Abstract: A parallel architecture hybrid-electric propulsion system for unmanned aerial vehicles has been proposed based on a hydrogen fuel cell. The system was tested in hybrid mode, to evaluate the performance of the fuel cell to power one of the motors and to demonstrate the combination of two power sources in a parallel hybrid layout.

Keywords: hybrid-electric propulsion, parallel configuration, hydrogen fuel cell, unmanned aerial vehicle.

027
Effects of the Partial Use of Diesel Fuel with Kerosene on the Exergetic Sustainability Performance of an UAV Jet Engine in Case of Emergency

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Abstract: In this study, it is aimed to analyze the effects of using diesel fuel partially with kerosene on the jet engine's performance by using exergetic sustainability parameters in obligatory cases where there is no or limited access to JP-8 fuel. Low altitude use will also overcome the negative effects of diesel use at low temperatures. In this extent, firstly the exergy analysis was implemented to the jet engine components. Exergy flows were determined as fuel and product for each component, namely compressor, combustion chamber, gas turbine and nozzle. Exergy destructions for each component were obtained. The calculated exergy destructions were one of the key figures to understand the improvement potentials of the jet engine components. Then four exergetic sustainability parameters: exergy efficiency (EE), waste exergy ratio (WER), environmental effect factor (EEF) and exergetic sustainability index (ESI) were studied. According to the findings, it was concluded that partial use of diesel can be an alternative for low altitudes in small UAV turbojet engines in case of emergencies.

Keywords: Exergy analysis, Sustainability parameters, Jet engine, UAV.

028
Effects of Flight Level on Fuel Consumption and Emissions in the Cruise Phase: A Case Study

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Abstract: This paper addresses the financial and environmental concerns surrounding fuel usage and emissions in the commercial aviation industry. To address these challenges, airlines have conducted various studies to minimize fuel consumption and its impact on the environment. The research evaluates aircraft engine performance parameters dependent on altitude, atmospheric conditions, trajectories, routes, and aircraft-engine pairings, as well as their effects on airport environmental conditions. The main focus of this work is to provide critical insights to investigators, scientists, airline operators, policy analysts, and legislators through a computer simulation approach that analyzes fuel consumption and emissions in aircraft-engine pairings. Specifically, the study examines the hazardous emissions produced by commonly used engine combinations in the first composite-constructed narrow-body aircraft for commercial aviation, extensively deployed by various airlines to meet passenger transportation demands. The study's findings emphasize the significance of cruise altitude selection in fuel consumption and emission production. As altitude increases, fuel consumption and emissions rise across all engine options. The critical altitude is determined to be 39500 feet, above which fuel consumption and emissions increase significantly. In conclusion, this paper offers essential guidance to stakeholders in the airline industry, aiding them in making informed decisions on aircraft-engine pairings to improve fuel efficiency and reduce emissions. By implementing the research's insights, the commercial aviation sector can adopt more sustainable practices, striking a balance between economic considerations and environmental preservation for a greener future.

Keywords: Fuel usage, Emissions analysis, Aircraft-engine pairings.

029
Swarm Control of a Group of Unmanned Aerial Vehicle Under Fixed Consensus Topology

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Abstract: In this paper, a consensus-based formation control of a group of UAV is realized to obtain a deltoid formation. Before designing the CC algorithm, the mathematical expressions of the double integrator UAV dynamics are given briefly. Then to achieve a deltoid formation shape, the communication graph between UAVs was first descript to define adjacency matrix. After that, the Laplacian matrix was obtained via adjacency and degree matrix. By using the graph Laplacian matrix and local information exchange between the vehicles, the proposed CC algorithm was designed depending on the DID of the UAV. Also, a collision avoidance algorithm was added the main control algorithm to avoid any collision between the UAVs. The simulation results show the effectiveness of the CC algorithm.

Keywords: Unmanned Aerial Vehicle, Collision Avoidance, Consensus Control, Swarm Control.

030
Aviation MRO Operators Assessment by SHELL Model

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Abstract: The human factor influences the performance of aviation maintenance services in the dynamic socio-technical environment of aircraft maintenance operations and overhauls. Management's contribution and capacity to offer the necessary facilities, equipment, spare parts, and labor, together with a convenient environment and maintenance processes, are key performance indicators for maintenance operations. There are numerous ways to measure and assess the human factor in aviation MRO systems. In this research, the SHELL model is used to represent the impact of aircraft operators in the maintenance system. In order to do this, the analytical hierarchy process (AHP) was applied to construct a questionnaire of a two-level hierarchy model based on the SHELL model to evaluate, prioritize the key functions and rank the significant and crucial maintenance criteria of the present MRO systems, 14 participants of two groups of aviation MRO professionals contributed to this study namely: (i) aircraft maintenance technicians & mechanics (ii) aircraft maintenance engineers.

Keywords: Human factor, Aviation maintenance, MRO operators, multi-criteria decision making, analytical hierarchy process.

031
Comparative Analysis of Flow Fields Around NACA 23012 Airfoil at Three Characteristic Angles-of-Attack

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Abstract: Flow fields around the airfoil NACA 23012, developed over 80 years ago but still much employed, at Mach number M = 0.18 and Reynolds number Re = 1.8 million were experimentally and numerically investigated. Three different characteristic angles-of-attack (AoA) were selected. The angle include a zero degree AoA where drag is minimal, optimal AoA where the lift-to-drag ratio is maximal, and critical AoA where lift is maximal. These selections are made to understand better the main flow features such as transition, flow separation, (unsteady) wake behavior, and turbulent structures appearing around the airfoil, as well as to investigate the possibilities of their modelling. Two principally different numerical approaches were employed: Reynolds-averaged Navier-Stokes (RANS) equations vs. wall-modelled large eddy simulation (WMLES). Both results were compared to recent experimental data. In both cases, the computational domain was the same (circular, spanning 0.2 chord length in spanwise direction), and the two generated meshes are comparable, particularly in the vicinity of the wall. Values of velocity and pressure were assigned to the outer boundaries, and sides were periodic. In contrast, airfoil walls were treated differently depending on the solver (no-slip vs. algebraic equilibrium wall model). Excellent correspondence between global results (aerodynamic coefficients) was achieved, particularly at lower AoAs. However, it was found that in order to accurately predict flow behavior at critical AoA and to capture the main turbulent structures, WMLES should be utilized.

Keywords: Airfoil, Turbulence, RANS, WMLES, Aerodynamic coefficients.

032
Fuel Optimal Aircraft Conflict Resolution Under Various Wind Characteristics.

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Abstract: One of the main weather components that must be considered in aircraft conflict resolution is the wind. Wind includes two essential elements which affect the individual routes of flights: speed and direction. Studies show that stochastic programming approaches considering both wind speed and direction uncertainties have advantages in terms of efficient air traffic management compared to the deterministic approaches. However, the savings of the stochastic approaches may change regarding the wind uncertainty parameters considered. Prevailing wind directions, average wind speeds, and wind speed variation between levels may vary regionally. The study aims to evaluate the performance of the stochastic approach in terms of fuel savings under various wind characteristics. Wind data are obtained from three different wind stations provided by the weather sound database. A stochastic conflict resolution model is developed, and flight level change strategy is used for conflict resolution. The objective function is determined as the minimization of total fuel consumption. As a result, it is revealed how the savings of the stochastic model vary according to different wind characteristics.

Keywords: Aircraft conflict resolution problem, Flight level assignment, Wind characteristics, Stochastic programming, Fuel consumption.

033
Implicit LES Using New Slope Limiters

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Abstract: In this paper we study the Implicit Large-Eddy Simulation (ILES) based on new unstructured-grid polynomial-ratio slope limiter functions proposed recently (Jan/2022) by Hiroaki Nishikawa. The slope limiters showed the improved resolution characteristics on simple convection test problems. Following that, the ILES approach is tested here on Taylor and Green vortex test case representing complex flow with transitional and turbulent behavior. The results showed favorable characteristics of the methodology.

Keywords: Computational Fluid Dynamics, Turbulent Flows, Monotone schemes, Implicit Large Eddy Simulation, Taylor-Green vortex.

034
Nanoceramics as Reinforcement for Polymer Matrices and Composite Materials for Aircraft Structures

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Abstract: In the recent development of structural composite materials, there is approach of enhancing existing and synthesis of new, strong and resistant fibers, and there is approach of synthesis of more efficient interlayer adhesives and polymer matrices. This research considers potential new hybrid composite binders based on epoxy resin and poly(vinyl butyral), PVB, reinforced with nanostructures of several engineering ceramics: SiC, INT-WS 2 , BN, and B 4 C. First stage of the research consisted of preparation and examination of hybrid polymer matrices in the form of thick films for the characterization. FTIR was applied to confirm the chemical interaction between the two polymer components and to exclude their chemical interaction with the nano reinforcement. Mechanical performance was examined trough tensile test and hardness measurement. The addition of nano reinforcements has induced improved tensile strength and the Shore hardness values of composite polymer matrix films, especially in case of INT-WS 2 . Second stage of research was implementation of the reinforced binders in carbon fiber laminated composites. INT- WS2 reinforced composite was selected and examined trough tensile testing and resistance to bending test. Results obtained encourage further research and more detailed characterization of the new composites may for potential application in the field of automotive, naval, and aerospace industry, in civil engineering, protective equipment, etc.

Keywords: fiber-reinforced polymers, composite materials, nano reinforcement, ceramics.

035
Evaluation of Architectural Structures in Electric Taxiing Systems

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Abstract: In order to reduce the dependence on fossil fuels, which are limited in our world, and to minimize the emissions caused by the use of these fuels, fully electric aircraft are being developed. In the context of this concept, the taxiing systems of aircraft are also designed as electrical. Different architectural systems have been proposed for the development of electric taxiing. In this study, the differences of the proposed systems are discussed and it is aimed to help the developers to design a new system.

Keywords: Sustainability, Aviation, Electric Taxiing, Electric Taxiing Architecture.

036
High-altitude Wind Resource Potential for AWE in Portugal

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Abstract: Airborne Wind Energy (AWE) systems aim to harvest wind energy at higher altitudes than conventional technology. To dimension the system and assess the potential power one can extract from a given location, its wind resource, namely the wind speed vertical profile, has to be characterized. The vertical profile is influenced by the location's topography, surface roughness and atmospheric stability conditions, which are often disregarded in AWE studies. This paper aims to assess the impact of these factors in wind speed and power vertical profiles for a region of Portugal and, by doing it, estimate the wind resource for a potential AWE exploration. One concluded that harnessing high-altitude wind energy was more advantageous in on-shore locations; in addition, stable atmospheric conditions provided larger wind speeds and therefore the wind power available was larger. For the studied region of Portugal, one projected a maximum sustained wind speed of 18 m/s at a height of 250 m. Finally, one studied the wind resource for three specific locations, potential sites for AWE exploration employing a "Drag-mode" system, and verified that the rural site of Alenquer presented the best wind resource.

Keywords: Airborne Wind Energy, Atmospheric Stability, Wind Speed, Wind Power, Portugal.

037
Conceptual Design, Development, Test and System Identification of a Novel Tri-Rotor Configuration for a VTOL Fixed Wing Aircraft

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Abstract: In this paper a novel tri-rotor configuration is proposed with the goal of enabling vertical take-off and landing capability to a canard fixed-wing aircraft while minimizing the overall weight of the vehicle and the aerodynamic drag developed in horizontal flight. The novelty in the presented configuration is related not only to the thrust vectoring capabilities of all three rotors but also to the constraints surrounding the action of the rear rotor which will be required to operate both in vertical and horizontal flight phases while drawing power from an internal combustion engine fixed inside the aircraft's fuselage. The proposed design will later be translated into a test vehicle which will serve as a proof of concept of the solutions developed. Finally, both a time and a frequency-response based system identification technique is applied to flight test data in order to obtain a more robust computational model of the aircraft's dynamics.

Keywords: Unmanned Aerial Vehicle, Vertical Take-Off and Landing, Flight Dynamics Model, Tri-rotor, System Identification.

038
Measurement, Exploitation and Method Finalization of PIV Systems

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Abstract: Other than in aerodynamic laboratories that primarily deal with aircraft tests, PIV visualization methods can be successfully used to test currents in various technical systems (pipes of different geometries and dimensions), biological systems, flows around buildings, buildings, bridges, overpasses, towers, flows around means of transport, trains, cars, ships, for testing fluids of different properties. Modern development of computer technology and digital image processing enable automatic analysis of the effects of current visualization and obtaining qualitative and quantitative values of current parameters, which cannot be obtained by classical, conventional measurement techniques.

Keywords: PIV, Particle Image Velocimetry, visualization, wind tunnel.

039
Methodology for Testing Damaged Composite Helicopter Rotor Blades

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Abstract: The proposed methodology defines the procedure for testing composite blades of helicopter rotors that have suffered damage due to direct hits of projectiles of different origins. The methodology involves the integration of a number of types of tests in order to assess the quality of the composite structure of the blade on the one hand as well as in order to determine the ability of the blade to perform vital function on a helicopter. It is known that the evident lack of data on the behavior of helicopter rotor blades that are damaged (particularly in combat conditions of military use) causes a carefully approach to the problem of defining the plan and program of testing such structures, especially from the aspect of using composite materials in blade structure.

Keywords: composite, blade, stiffness, FFT.

040
Aeroelastic Stability Analysis of 3D Printed Tapered PLA Plates

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Abstract: In the present work, the aeroelastic stability of tapered PLA plates subjected to low Mach number flows is investigated. In recent years, many of the structural components (especially on drones, UAVs, and unmanned aircraft systems) have been manufactured using 3D printing techniques. The static behavior of these components is well-investigated; however, dynamic behavior of these structural components needs further investigation. Theodorsen unsteady aerodynamic theory based on the binary flutter model is used to obtain PLA tapered plate equations of motion. Analytical solutions for flutter velocities (stability loss) are compared to the experimental results obtained by wind tunnel testing at low Mach numbers. Good agreement between analytical and experimental results is found, and it was concluded that the methodology presented in this paper can be used in the aeroelastic analysis of PLA tapered plates and can be used in the design of lifting aerodynamic surfaces on unmanned flying vehicles.

Keywords: 3D print, PLA plates, aeroelastic stability, flutter.

041
Preliminary Full Configuration Drag Estimation of Fixed Wing UAV Using Analytical Aerodynamics

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Abstract: This paper presents an estimate of the drag polar of the complete configuration of fixed-wing UAV using equivalent skin friction coefficient accounts for light aircraft derived for similar categories. Coefficients are derived from an aerodynamic analysis of UAV used for surveillance, reconnaissance, and artillery support in various civilian and military operations. The UAV's parasitic drag is significantly influenced by the presence of miscellaneous components like non-retractable landing gears, motors and propellers on the tail-boom section or gimbal. These components are responsible for more than half of an UAV's total parasitic drag. This calculation is used for the initial sizing of the UAV for a surveillance or reconnaissance mission.

Keywords: Analytical aerodynamics, parasitic drag, UAV.

042
Procedures in Testing the Mechanical Characteristics of Composite Structures and the Possibility of Application to Biodegradable Materials: An Overview

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Abstract: This paper presents the static testing of the composite material's mechanical characteristics. An overview of the standards is made by which various tests are performed, and then an analysis of the results of the parameters obtained by the conventional method-stretching and optical (DIC system-bending) of carbon epoxy composite structures is given. These results represented the basis for the preparation and further application of biocomposite materials; that is, the testing procedure will be performed identically on composites containing mycelia. The mould for pressing biomaterial connected with mycelium is made of two parts. The primary purpose of the mould is to bring the loose natural material into a solid preparation following the standards ASTM D3039 and ASTM D7078, which include testing the technologically prepared and hardened sample for bending and shearing.

Keywords: composite, biomaterial, experimental testing, mechanical characteristics, DIC system.

043
Aviation Carbon Accounting for Climate Change Mitigation: The Case of Turkey

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Abstract: Global Warming has become one of the biggest challenges of our World. Aviation Industry as a major contributor, is expected to play its own part in fighting the Global Warming by accounting for its carbon emissions. This study examines the approaches and strategies of airline companies for carbon accounting and reducing their contribution to Global Warming. Turkish Airlines, Turkey's largest airline, is studied to reflect how Turkey's air transport industry addresses the challenges of global warming and accounts for its carbon emissions. The study aims to set an example for other countries and businesses by showcasing the approaches and strategies of Turkish airline companies on carbon accounting.

Keywords: Carbon Accounting, Climate Change, Emissions, Aviation.

044
Electrical Conductivity Characteristics of Nanoparticle Reinforced Polymers Produced by Additive Manufacturing.

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Abstract: Nowadays, the technological, scientific, and industrial use of micro or nanoscale products has become rapidly widespread. Nanoparticles are added to metal, ceramics, and polymer materials, producing nanocomposite material. Polymeric nanocomposites are advantageous to other materials in terms of weight, performance, and price. Because of the lack of the mechanical properties of thermoplastic materials as the literature is known, it is possible to make nanoscale additions to thermoplastic materials, to give a new feature, or to improve its existing feature. The use of thermoplastic matrix in the industrial area has been the focus of nanocomposites due to its low cost, ease of manufacture, and recycling. Research on the use of 3D printers in the production of nanoscale-contributed thermoplastics has been found to be fewer. 3D prints are an additive manufacturing method compared to traditional processing methods. Additive manufacturing is based on the added layer by layer to reduce production costs and reduce the production cycle. In this study, nanocomposite material will be prepared by adding nano-sized Graphene and Silicon Nitride (Si3N4) to the thermoplastic material. Samples will be produced using the Fused Filament Fabrication (FFF-3D) printer. The electrical conductivity of the sample will then be examined.

Keywords: Thermoplastic, Material, Nanocomposite, Additive manufacturing, 3D printer.

045
1D Modeling of an on Board Inert Gas Generation System During Flight Conditions

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Abstract: In the event of an attack on aircraft or lightning strikes, there is a risk of fire in fuel tanks. Different methods are used to eliminate the risk of fire, one of which is to reduce the oxygen content in fuel tanks. OBIGGS (ONBOARD INERT GAS GENERATION SYSTEM) is a system that reduces the concentration of oxygen in the tank and increases the nitrogen partial pressure. This paper includes the 1D modeling of an OBIGGS application during flight. The results show that, 17 airplane crash has been reported until 2005 due to fuel tank explosion without usage of the OBIGGS and this study aims to show how this system prevents the explosions in any specific flight scenario.

Keywords: OBIGGS, OBOGS, Inert Gas System, Hollow Fiber Membrane.

046
Validation of the Laboratory Facility for the Nanofluids Forced Convection Research

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Abstract: This paper deals with a laboratory setup intended for nanofluid forced convection research. It presents a technical solution for the part of the laboratory facility related to the measurement of convective heat transfer parameters and the results of its validation. The facility parameters were validated with distilled water, and the measured data were compared with the results obtained from the theory equations. It has been shown that the measured data match theoretical data very well. The maximum relative deviation of the experimental and theoretical local Nusselt number is 9.8% which follows the values from the literature.

Keywords: Nanofluid; local Nusselt number; laminar flow; forced convection, validation.

047
B-spline Parameterization Based Flight Trajectory Optimization

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Abstract: Achieving the first heavier-than-air powered flight in the course of the 20th century was certainly a great landmark in human history. However, flight itself generally is not the final objective. To perform the desired mission effectively, it is necessary to determine the path to follow according to the objective, for instance minimizing time, path length, etc. Trajectory Optimization is the subject that deals with such problems, and the object of study of the present work. We propose the use of B-spline as a parameterization method for flight trajectory optimization problems formulated in terms of Optimal Control problems; satisfactory results were obtained using the *Python* language.

Keywords: B-spline Parameterization, Optimal Control, Trajectory Optimization.

048
Markov Chain Model Development for Forecasting the Lisbon TMA Capacity

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Abstract: The increase in demand registered in the air transport sector is directly reflected in the increase in the aircraft flow density in all essential regions for its operations, especially in Terminal Maneuvering Areas (TMAs). The main objective of this paper was to analyze, in a concrete and critical way, the complexity in optimizing the TMAs capacity management via the predictive estimation of the traffic flow to a given TMA, preventing the occurrence of congestion. Using Markov Chain Theory, it was possible to detect the operating pattern of the air traffic flow in the Lisbon TMA related to which the proposed concepts were computationally tested using actual traffic flow data. The genericity of the methodology makes it possible to be used for other TMAs.

Keywords: Air Traffic Flow Optimization, TMAs, Markov Chains.

049
Design and Analysis of a Mid-Range Business Jet to Reduce the Carbon Footprint

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Abstract: The following paper presents the design of a medium-range passenger aircraft with special emphasis on incorporating safety and greener aspects. We opted to design a new-age futuristic super mid-sized business jet with a maximum passenger capacity of 11. The market analysis of this category of aircraft projected promising returns to new entries in the upcoming years for both end-users and shareholders. The design process was carried out, keeping the clientele in mind, to yield a felicitous design which optimized safety, luxury and greener aspects by strategic integration of meticulous planning, innovations and advanced technology. The forthcoming contents in this report will detail the design and analysis of the 11-passenger super mid-sized business jet P-11.

Keywords: Business Jet, Boundary Layer Ingestion, Computational Fluid Dynamics, CAD, Lower Emissions.

050
Design of Submerged Air-Intake for UAV Application

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Abstract: The design approach and performance analysis of a custom s-duct submerged inlet are presented in this paper for a stealth subsonic swept-back Unmanned Aerial Vehicle (UAV). The UAV must provide good efficiency in a wider range of operating conditions. The duct is designed in such a way that it is the best compromise between the fuselage-engine frameworks and delivers maximum pressure recovery. Important geometric parameters of the s-duct inlet consist of a length-to-engine diameter ratio of 5.18, an offset-to-length ratio of 0.12, and an area ratio of 1.89. A review of fundamental concepts and the design process is presented to provide a foundation for future design iterations. METACOMP CFD++ software has been used to analyze the inlet design performance. Pressure recovery and circumferential total pressure distortion are used to analyze inlet performance at zero incidence angle.

Keywords: Submerged Air Intake; S-Duct Designing; Computational Fluid Dynamics; Inlet Design Aerodynamics, Pressure Recovery, Total Pressure Distortion; Unmanned Aerial Vehicles.

051
Analysis of Sustainability Activities in Airlines

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Abstract: Air transport affects people mainly through air pollution and climate change at the local and regional levels and on a global scale. It contributes to approximately 4.9% of total human-induced climate change emissions. As air travel demands continue to rise, so has an awareness of the potential environmental hazards associated with air travel. Emissions from the aviation industry, which account for about 5% of national greenhouse gas emissions, will need to be decarbonized and reduced. With the increasing demands, the aviation industry needs to consider activities for sustainability practices. In this study, the sustainability activities of the world's top 5 airlines and Turkish Airlines are compared and evaluated to analyse how sustainability creates value for the aviation industry.

Keywords: Air Transportation, Civil Aviation, Covid-19, Sustainability in aviation, Sustainability.

052
Analysis of Ground Services for Air Carriers: System Dynamics Approach

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Abstract: In the years when commercial flights started, airline companies carry out their ground operations with their own means, with the growth of the sector, today they are mostly carried out by Ground Service Agents (GSA). Airlines flying to hundreds of different destinations around the world with their wide international flight networks can carry out ground operations at airports in different countries, only by cooperating with local service providers. Ground Service Agents, which receive services in many areas such as Ground Operations, Passenger Services, Lost and Found, and Ticket Sales, directly or indirectly affect the profitability of the airlines as well as the quality of service provided. One of the biggest expense items of airline companies is fuel consumption. For this reason, many studies are being carried out in the field of fuel saving, and airlines are implementing many new applications to reduce fuel consumption. This study, which was prepared from a master's thesis, is aimed to show that differences can be made by small contributions during the standard services given to an aircraft prepared for flight. The results obtained by using the system dynamics approach show that ground services personnel can contribute to fuel savings, due to reducing the difference between the average weight values and the real values, by updating the flight plan according to actual data and planning the load distribution on the aircraft in the ideal CG range. At the end of the study, it is aimed to show how much the study can contribute to the airlines with similar calculations to be made for different aircraft types and different flight routes, by revealing the average earnings that can be obtained per flight over the sample taken at the end of the study.

Keywords: Airlines, Ground Service Agents (GSA), Ground Service Personnel, Fuel Saving.

053
Effects of Covid-19 on Aviation Sector in Turkey

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Abstract: The civil aviation industry is one of the sectors most affected by the pandemic. In this study, it is aimed to reveal how the civil aviation industry in Turkey has been affected by the Covid-19. In this research, document analysis method, which is the quantitative research methods, was used to obtain the results. The universe of the research is the flight data of Turkish Airlines. The sample of the research consists of Turkish Airlines' number of flights, revenue, number of passengers, cargo revenue, load factor and flight cancellations in 2019, 2020 and 2021. According to the results obtained from the study, the number of flights, revenue, number of passengers and load factor of Turkish Airlines in 2020 decreased significantly compared to 2019.

Keywords: Air Transportation, Civil Aviation, Covid-19.

054
Energy and Retentate Recoveries/Recycling in Single and Sequential Reverse Osmosis Process for Sea Water Treatment

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Abstract: The effects of retentates water fluxes (4.0, 12.0, 17.0 and 20.0 L/m2.h), temperatures (21^{o}C, 25^{o}C and 30^{o}C) and transmembrane pressures (5.0 bar, 10.0 bar, 15.0 bar and 20.0 bar) on the yields of the single and sequential reverse osmosis operations on salt rejection and retentate recycling from the second reactor in sequential system. The pump and energy recovery efficiencies were investigated based on sequential reverse osmosis process. In the single and in sequential reverse osmosis processes high salt rejection (99.90% and 99.99%, respectively) was detected. In the sequential process, the specific energy consumption minimized compared to alone RO process. For high Br-1, SO4-2, NO3-1, PO4—3 rejections (99.90%) the sequential reverse osmosis process exhibited lower energy consumption. Retentate recycling from the second sequential reverse osmosis process to the single reverse osmosis feed decreased the specific energy consumption in the sequential reverse osmosis process. The optimised operational conditions for the aforementioned data were 20.0 L/m2.h water flux, 15.0 atm transmembrane pressure and 30oC temperature.

Keywords: Br-1 , SO4-2, NO3-1,PO4—3 rejections; Energy recovery; Membrane rejection retentate recycling; Reverse osmosis; Salt; Sequential reverse osmosis; Single reverse osmosis.

055
Removing Kerosene Tax Exemption from Aviation: The Future of Taxation Principles in Europe

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Abstract: Kerosene is used in aircrafts, and it causes the environment to damage. However, there was a tax exemption concerning this fuel within the European Union borders. At the same time, there was no exemption about such a tax for the countries out of the union. But the aircraft operating in the European Union have emitted more gas than other countries. This normally requires a tax. Nevertheless, when levied such a tax, some criteria should be considered. These criteria are called taxation principles. When considering this exemption, it is understood that removing kerosene tax exemption is realized on the basis of universal taxation principles. Therefore, in this study, it is concluded that taxation principles are going to become stronger day by day in eliminating the damage of fuels such as kerosene.

Keywords: Kerosene, kerosene tax, taxation principles.