International Symposium on Sustainable Aviation

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ISSA 2023

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ABSTRACT BOOK

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International Symposium on Sustainable Aviation 2023

ISSA'23Abstract Book

International Sustainable Aviation and Energy Research Society (SARES)

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International Symposium on Sustainable Aviation (ISSA-2023)

Edited by Prof. Dr. T. Hikmet Karakoc, Assoc. Prof. Dr. Wu Chih-Yung, Asst. Prof. Dr. Currao Gaetano, Asst. Prof. Dr. Ali Haydar Ercan, Asst. Prof. Dr. Alper Dalkıran.

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This book includes abstracts submitted and presented at International Symposium on Sustainable Aviation 2023.

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T. Hikmet Karakoç

Symposium Founding Chair

Jan Shau-Shiun

Symposium Chair

Message from the Symposium Chairs

On behalf of the Organizing Committee, it is our great pleasure to invite you to the International Symposium on Sustainable Aviation (ISSA'23), which will be held hybrid (onsite/online) and hosted by National Cheng Kung University, Taiwan and supported by Eskisehir Technical University, Türkiye between 26 - 28 July 2023.

Aviation is regarded as one of the main sources of environmental problems and is considered as an important cause of sustainability. Future trends in aviation can be a major obstacle to having sustainable development in economic, social, and environmental perspectives. Sustainable Aviation is a long-term strategy aimed at providing innovative solutions to the challenges facing the aviation industry.

Since we are in an age of constant progress in aviation, we would like to invite researchers, scientists, practitioners, policy makers and students to this international symposium to exchange knowledge, to introduce new technologies and developments. Discuss the future strategies and priorities in the field of sustainability. The ISSA aims to address a broad range of aviation issues, with particular emphasis on sustainable environmental issues.

The ISSA'23 will include a variety of opening presentations, specialist sessions, and oral presentation sessions on different topics related to sustainability in aviation. In July 2023 we look forward to inviting you to this extraordinary event.

Sincerely,

T. Hikmet Karakoc - Symposium Founding Chair,

Jan Shau-Shiun - Symposium Chair,

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CONTENTS

KS01
The Energy Ship: A Proposal for Large-Scale Renewable Energy from Wind over Water

Max F. Platzer

University of California Davis, USA

Abstract: Seventy percent of the globe's surface is covered by water and the highest intensity winds occur over vast ocean areas. This fact raises the engineering challenge of finding a machine that makes it possible to convert this wind energy into storable energy in the form of hydrogen. We propose to challenge the two assumptions made in all previous wind power conversion approaches, namely the assumption that the wind turbine must by stationary and that it must be land-based or anchored in the water close to shore. We argue that the time has come to examine the validity of these two assumptions in light of the fact that sailing ships have successfully exploited the winds over the oceans for thousands of years. In this lecture, Prof. Platzer will review the development and the current status of the energy ship studies that are being carried out by his group as well as by groups in France, England and Japan.

KS02
Applications of CFD on the Analysis of Aerodynamic Characteristics of Modern Aircrafts.

Wen-Lih Chen

DAA, National Cheng Kung University, Tainan, Taiwan

Abstract: The advance in CFD has made it a very useful tool to study the aerodynamic characteristics of modern aircrafts. This talk presents two examples, one is the all moving leading-edge extension of the SU-57 fighter jet, and the other is the hysteresis of a NACA63415 wing. The CFD code is Siemens STARCCM+. It was first validated using the data of F16-XL fighter jet, and returned very good agreement in terms of Cp, CL and CD. For the all moving leading-edge extension case, CFD simulation indicated that it would be effective when deployed together with the leading-edge slat at an angle of 25 degree or more. It the case of the NACA63415 wing, CFD simulation revealed very complex flow behaviours which are quite different with those associated with an airfoil. These are caused by wing features such as dihedral angle, sweep-back angle, wing tip, and taper wing.

Keywords: CFD, aerodynamics, vortex generator, fighter jet.

KS03
Aircraft noise monitoring systems for greening the airports.

Oleksandr Zaporozhets

Institute of Aviation (Łukasiewicz Research Network – Institute of Aviation), Warsaw, Poland

Abstract: Aircraft noise (AN) exposure management on the population around the airports is defined by ICAO Balanced Approach (BA). ICAO guidance on BA (Doc 9829) recommends defining the efficiency of all the four fundamental elements with an assessment of noise index DNL at a point (area) of noise control. Overall, AN exposure around the airport is usually calculated in a form of AN contours – the contour DNL = 65 dBA is defined as inappropriate (prohibited) for residential development. Requirements for AN, calculations are defined by ICAO guidance Doc 9911, noise zoning and land use – by Airport Planning Manual (Doc 9184), aircraft noise itself – by Annex 16, vol. 1 'Aircraft Noise' to ICAO Convention.

The last one in Appendix 5 describes monitoring as 'to be the routine measurement of noise levels created by aircraft in the operation of an aerodrome. Monitoring usually involves a large number of measurements per day, from which an immediate indication of the noise level may be required'. The noise levels measured according to the Appendix 5 are approximations of perceived noise levels PNL, in PNdB, as calculated by the method described in Appendix 1 of Annex 16, volume 1. ICAO policy in protection from AN impact is defined as a reduced number of people affected by noise – in most cases the people are annoyed because of the number of possible noise disturbances.

Noise monitoring in the vicinity of the airports still does not play the role, which is usually covered by environmental monitoring, which is generally defined as gathering, assessing and reporting environmental information obtained through continuous or periodic sampling, observation and analysis of both natural variation or changes and anthropogenic pressures and their effects on humans and the environment.

Today the Airport Noise and Operations Management System (ANOMS) is a sophisticated, acoustical system which monitors aircraft flight tracks, fleet mix, and noise levels by time of day, season and on an annual basis. Four main ways of reporting measurements of aircraft noise were identified by the research – online platforms, reporting of noise monitor data, bespoke noise reports for a given community and noise contours.

The goal of the ANOMS usage is to maximize aircraft operations within environmental constraints. Reduce operating costs while improving noise office productivity, reporting regulatory compliance, and increasing community tolerance for airport growth. It becomes a tool necessary to be used for proactive (not simply reactive as mostly realized now around the airports worldwide) and even collaborative system of noise management in airports.

Keywords: Aircraft noise, monitoring system, green airport, exposure, impact.

KS04
Dynamics by Design: Evolutionary Design of Irregular Multiscale Metamaterial Systems

Raj Das

School of Engineering, RMIT University, Melbourne, Australia

Abstract: The paper will present overview of advanced materials research at the Simulation of Advanced Materials and Structures (SAMS) Group of RMIT University, Australia. SAMS is primarily engaged in the design, processing, manufacturing and testing of multifunctional materials and structures. The focus of the present seminar will me research on metamaterials and metastructures undertaken at the SAMS group of RMIT University.

Metamaterials are a 21st century innovation that can access as yet untapped material property regions in mechanics, acoustics, electromagnetics and thermal. That is because metamaterials derive their effective properties from their internal micro- or meso-scale architecture more than from their composition, obscuring the conventional distinction between material and structure. In principle metamaterial properties are constrained only by fundamental physical laws but in practice, metamaterials have generally been based on unit cell structures that are repeated to fill a structural domain, resulting in periodic structures with a homogeneous topology, and this limits what can be achieved.

By discarding periodicity a new class of mechanical architected material systems can be created, and such non-uniform or irregular multiscale architectures can markedly surpass the performance of existing engineering materials. Our research focuses on what we term irregular mechanical metastructures (IMM), i.e. aperiodic hierarchical metamaterial systems that are hypothesised to offer greatly expanded design possibilities. Potential applications bracket a correspondingly wide spectrum, ranging from shape morphing and flexible robotics through vibroacoustic isolation or stealth to mechanical wave-based neural networks and smart structures. However, that expansion of the design space also creates a key hurdle to IMM design, which is the large expansion of the number of design variables needed to define spatially varying metamaterial systems and the complexity of their structure-property relationships.

Our approach to overcoming this hurdle of the computational efficiency with the large number of design variables and constraints is based on applying computational intelligence techniques, an area that is undergoing rapid advancement. This project has developed an evolutionary metaheuristic framework to more efficiently search many-dimensional design spaces for multimaterial or multiscale IMM architectures that provide the desired performance, be they extreme mechanical properties, resonance frequencies, or motions.

As an initial test case, this evolutionary framework has been applied to the generation of heterogeneous IMM that behave as bimode or 2D pentamode materials. Varying the Young's modulus of each voxel in a voxelised structural domain over a continuous range, the evolutionary framework generated irregular metrastructures with B/G ratios of up to 25,000 in remarkably few generations. These values are an order of magnitude greater than those obtained experimentally and reported in the literature. The final optimised multiscale metastructures maintained these effective B/G ratios within a 10% error margin and an overall increased porosity was obtained, which have been shown to offer energy absorption capabilities in the literature. These results show the effectiveness of the proposed computational design approach and its ability to provide a path to manufacturable structures with effective values of the B/G ratio that significantly exceed those previously reported, which serves to demonstrate the wide range of mechanical behaviours that can be achieved through heterogeneity and irregularity.

KS05
Hydrogen and Hydrogen Blending Fuels

Mustafa İlbaş

Department of Energy Systems Engineering, Gazi University, Ankara-Türkiye

Abstract: Hydrogen is a very important fuel and energy carrier for energy secure and clean energy future. Hydrogen will be the fuel of the future and gradually it will replace all current fossil fuels. Hydrogen can be used as a fuel for gas turbines, vehicles, to heat homes and offices, to produce electricity, and to fuel ships and aircraft. Hydrogen is an alternative fuel, which can be used in gas turbines, industrial burners, internal combustion engines and in fuel cells. Hydrogen can be produced by using renewable energy sources such as solar energy. Hydrogen blending fuel is defined as a mixture of hydrogen and different gases such as methane, carbon monoxide etc.

Keywords: Hydrogen, Hydrogen Blending Fuels, Alternative Fuel

KS06
Electric Propulsion for Cube Satellite

Yueh-Heng Li

Dept. Aeronautics and Astronautics, National Cheng Kung University, Taiwan

Abstract: Micro Plasma Thrusters (MPTs) have become increasingly important for CubeSats propulsion systems due to their high specific impulse and low thrust requirements. This talk provides a comprehensive review of four types of MPTs for CubeSats: Pulsed Plasma Thrusters (PPTs), Vacuum Arc Thrusters (VATs), ion engines, and Hall thrusters. We will introduce the concept and design of these MPTs, including factors such as propellant type, ignition method, and discharge chamber configuration. The advantages and limitations of each type of MPT are also presented, highlighting their potential applications in CubeSats for various space missions such as atmospheric probing, relay communication, and deep space exploration.

Keywords:

KS07
Experience and prospects of SAF use in Ukraine

Sergii Boichenko

National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute", Scientific and Technical Union of Chemmotologists, Ukrainian Oil and Gas Academy

Abstract: Sustainable Aviation Fuels is a biofuel used to power aircraft that has similar properties to conventional jet fuel but with a smaller carbon footprint. Depending on the feedstock and technologies used to produce it, SAF can reduce life cycle GHG emissions dramatically compared to conventional jet fuel.

I represent the main world trends and developments of the Ukrainian Chemmotological Scientific School of in the field of alternative aviation fuels.

IS01
The Practical Examples of Aerospace Technology Applications

Yung-Lan Yeh

GEOSAT Aerospace & Technology Inc., Taiwan

Abstract: The development of aerospace technology is always the key leader of technology development in the world for so many years. However, the aerospace technology is not applied to most industrial products based on many reasons. In order to widely apply the aerospace technology to improve the product performance, Dr. Yeh devotes to apply related technology to the research and following production. In this speech, two main industrial products will be introduced from their original requirement and their development history. They all adopted basic aeronautical knowledge including mass conservation and basic aerospace dynamics theorem. Currently, they had already become the practical product. They also get the order and are in mass production now. The most important in this speech is to provide researchers with a methodology which is an effective way to approach the topic from a research to a product.

Keywords: Fluid mechanics, Flow control, Aerospace engineer, Composite material, UAV system.

IS02
The development of Sustainable Aviation Fuel (SAF): Production, Engine Combustion, and Evaluation

Wei-Cheng Wang

Department of Aeronautics and Astronautics, National Cheng Kung University, Taiwan

Abstract: For the purpose of "Fly Net Zero", sustainable aviation fuel (SAF) has been applied as an important fuel blend in most of the airline companies for reducing carbon emission. In this presentation, we are looking at the three most significant steps for developing SAF: fuel production process, engine combustion examinations, and process evaluations. Through the hydro-processing process, the SAF which meets all the specifications of jet fuel was produced. The combustion examinations, including ignition behaviours, laminar flame speed, and soot formation, were performed for the produced SAF. The SAF production process was evaluated in terms of energy, economy, and environment, for the purpose of being toward sustainability.

Keywords: Sustainable Aviation Fuel, Fly Net Zero, Fuel specifications, Engine Combustion, Process Evaluation

IS03
Exploring Sustainable Development Potential of Spent Coffee Grounds

Kuan-Ting Lee

Department of Chemical and Materials Engineering, Tunghai University, Taiwan

Abstract: Spent coffee grounds (SCGs) pose a significant waste issue and can potentially lead to environmental pollution if not appropriately managed. Torrefaction, a promising method of low-temperature carbonization, offers an efficient approach for addressing waste-related challenges, promoting resource sustainability, and enabling a circular bioeconomy. The primary objective of this study is to enhance the fuel quality of thermally degraded SCGs by maximizing the retention of lipids, thereby increasing their potential as a valuable resource. Additionally, this research investigates the impact of different carbonization temperatures and durations on the calorific value of biochar, with a specific focus on lipid contributions. The biochar obtained from torrefied SCGs at a temperature of 300 °C for a duration of 30 minutes demonstrates a lipid content of 11.00 wt% and a higher heating value (HHV) of 28.16 MJ kg-1. Notably, lipids account for approximately 14.84% of the calorific value in this biochar, while the remaining carbonized solid contributes 85.16%. Consequently, biochar derived from SCGs exhibits substantial potential as a solid fuel source.

Keywords: Spent coffee grounds, Torrefaction, Lipids, Circular bioeconomy, Biochar

IS04
Bio-based Hierarchical Porous Carbon Application in Energy Storage

Hsieh, Tzu-Hsien

CPC, Taiwan GTRI, Taiwan

Abstract: CPC, Taiwan GTRI develops hierarchical porous carbon is made from biomass pyrolysis oil by mix biomass pyrolysis oil and nano-template particle through carbonization process. This method can adjust surface area and porosity and scale up the process to 20kg precursor per batch. Bio-based hierarchical porous carbon can be applied to supercapacitors (SCs, capacity 150F/g) by water-based binder (loading mass>5mg/cm2). Formulation of electrode with bio-based hierarchical porous carbon in 40138 type supercapacitors has excellent performance (1200F, 1.35~2.7V@40A CCD, 75% retention after 100000 cycles). Now 40138 type supercapacitor is packed to 48V module and integrate with battery and install on electric vehicle. We will optimize supercapacitor performance and develop novel 40138 lithium ion capacitor (LIC) and sodium ion battery to enhance energy density in the future.

Keywords: Hierarchical, porous carbon, supercapacitors

IS05
Design, Modeling and Testing of a Tilt – Rotor Tricopter VTOL UAV

Hong-Hieu Le

Department of Aerospace Engineering, Faculty of Transportation Engineering, Ho Chi Minh City University of Technology (HCMUT), Ho Chi Minh City, Vietnam

Abstract: With the advancement of technology in both hardware and software, the unmanned aerial vehicle (UAV) industry is flourishing due to its diverse applications in many fields. Vertical take-off and landing aircrafts (VTOL UAVs) are attracting a variety of attention and research in the field of UAVs recently thanks to their ability to operate with long range without depending on terrain or runways. This paper presents the design and manufacture and testing phase of an unmanned aircraft model for vertical take-off and landing with a tilt rotating propeller mechanism (Tilt-rotor UAV abbreviated TRUAV). It aims at carrying a payload of 1 kg, achieving the maximum flight time of 20 minutes at a cruising speed of 19 m/s at 35-50 m altitude, and 2 km to 3 km endurance with a 2 km video transmission range. In the first place, the paper discusses the choice of the configuration of the UAV by the flight requirements and mission profile, then the configuration design and sizing for each component of the TRUAV are presented. Individual elements and components are built in CAD that pave the way to the manufacture of the TRUAV. Next, a mathematical model of the TRUAV is derived by calculating the propulsive and aerodynamics-based equation of motion. The fixed-wing module is generated in the XFLR5 tool to analyze the aerodynamic performance and stability. In addition, wind tunnel experiments are implemented to obtain a characteristic behavior of the propulsion system. Finally, the result of various flight tests is performed to validate the flight capabilities of the proposed design.

Keywords: VTOL, TRUAV, Aerodynamic performance, Stability analysis, Flight test

IS06
Bioenergy for Sustainable Development

Chi Yi Kai

Tainan University, Taiwan

Abstract: Biofuels are viable replacements for petroleum or other fossil fuels in the world's ongoing effort for sustainability, for they can be used with conventional combustion engines without modification. These renewable sources of energy can be produced at a commercially viable level of cost-efficiency, which makes it an affordable option for consumers to switch from fossil fuels to biofuels. Provided the stable supply of agricultural raw materials, biofuels can also help to strengthen global energy security. The renewability of raw materials for biofuels helps to realize sustainable development not only in the environmental aspect but also in terms of global energy supply. Unlike fossil fuels, which took millions of years to form and have thus had limited reserves, biofuels are better able to meet future energy demand since crops are grown and harvested in short and ceaseless cycles. An indispensable piece of the puzzle for a sustainable future, bioenergy is playing an ever-greater role in global energy supply with bio-oils replacing gasoline and diesel in various modes of transportation.

Keywords: Bioenergy, Hydrogen energy, Renewable energy, Catalyst materials, Sustainable

IS07
On-board Standalone Stereo Vision Assisted Landing System Development for Fixed-Wing UAVs

Chao-Chung Peng

National Cheng Kung University, Taiwan

Abstract: Current fixed-wing aircraft landing assistance systems often rely on third-party ground equipment such as Instrument Landing System (ILS) and Precision Approach Path Indicator (PAPI). However, these systems are costly, limited to specific airports, and not conducive to installation on low payload aircraft, and therefore lacking flexibility. To provide more landing options for commercial fixed-wing light aircraft and mitigate the risks associated with emergency landings on special runways, this talk is going to present a stereo visual-based landing assistance system (VLAS). The system combines the ORB-SLAM2 algorithm for simultaneous localization and mapping (SLAM) to provide real-time position and attitude estimation of the aircraft, while also calculating the appropriate glide slope based on the ground slope to guide the pilot and ensure safety. To achieve the estimation of gliding angle without the aid of 3rd party instruments, we employed the Gaussian Mixture Model (GMM) to segment the image and extract ground points. Additionally, the Iterative Weighted Plane Fitting (IWPF) algorithm is developed to effectively reduce the interference of outliers on the plane equation calculation and therefore the relative pose of the aircraft with respect to the ground can be estimated. Based on these achievements, a standalone VLAS for a fixed-wing UAV can be realized. Finally, to evaluate the performance of the proposed system, simulations are conducted to evaluate the feasibility, performance and robustness of the proposed VLAS. Simulation results demonstrate that the developed VLAS is able to provide meaningful guidance flight information to pilots especially in the unexpected and emergency landing scenarios.

Keywords: Simultaneous Localization and Mapping, UAV Control System, Control Theory, System Diagnosis, Data Science and Machine Learning

ISS1
The Introduction of Aerospace Technology of GEOSAT

Yung-Lan Yeh

GEOSAT Aerospace & Technology Inc., Taiwan

Abstract: The GEOSAT aerospace & technology Inc. is the biggest UAV company in Taiwan which owns very good ability about system integration including aerospace design, flight control and various avionics equipment et al. For past two decades, it had made great achievements in the use of drones for national land surveying and 3D modelling. It had also produced a variety of UAV with different mission orientations. Nowadays, it devotes to develop and produce new generation micro-UAV and unmanned helicopter for military. The most important is that it is working on transforming into a real military industry and becomes the leader of national UAV team in the meantime. In this dominated period, it will import more aerospace technology to the development of all products which are battery box for E-vehicle, lifting-fuselage UAV and trainer UAVs. According to the support of these key technologies, it will surely become the most important UAV company in Taiwan even in the world.

Keywords: Fluid mechanics, Flow control, Aerospace engineer, Composite material, UAV system.

ISS2
Sensor Applications in Aerospace Industry

Luigi Yang

Micro-Epsilon Taiwan, Taiwan

Abstract: In aviation, the highest requirements are placed on installed components in terms of safety and reliability. This especially applies to sensors which are used in different places. Micro-Epsilon develops displacement and position sensors for aircraft measurement tasks landing gear, wing assembly, fuselage and engines, where they enable reliable determination of measurement values. In this session, the speaker will go through some of the sensor applications in Aerospace industry to give the audience a clear picture of how high precision sensor brings added-value.

Keywords: Displacement Sensor, Aerospace sensor, Gap monitor, Paint inspection, Distance sensor

RS01
Selection of Sustainable Aviation Fuels: An Expert-Based Comparative Approach

Omar Alharasees and Utku Kale

Department of Aeronautics and Naval Architecture, Budapest University of Technology and Economics, Budapest, Hungary

Abstract: SAFs play a vital role in achieving global carbon neutrality and mitigating the environmental impact of aviation. However, selecting the optimal SAF alternative necessitates a comprehensive assessment of economic, technical, and social considerations. To address this, a multi-criteria decision-making (MCDM) approach employing the Analytic Hierarchy Process (AHP) method was used. Seventeen international aviation experts, comprising both experienced and less experienced individuals, participated in this study. AHP facilitated the prioritization of factors based on their relative significance, enabling well-informed decision-making that reconciles divergent stakeholder objectives. The evaluation outcomes emphasize the utmost importance of environmental impact criteria, followed by economic and technical feasibility. These insights are invaluable for policymakers and decision-makers in identifying the most suitable SAF alternative aligned with their specific goals and objectives.

Keywords: Analytic Hierarchy Process, Sustainable Aviation Fuels, Environmental Impact, Economic Feasibility.

RS02
Shear Thickening Fluid Based Triboelectric Nanogenerators

Selim Gürgen

Department of Aeronautical Engineering, ESOGU, Eskişehir, Türkiye

Abstract: Conventional-based sensors are generally composed of thin films that can be easily damaged by external impact. As interest in wearable electronics continues to increase, a triboelectric nanogenerator (TENG) that uses a conductive liquid as a single electrode has attracted considerable attention. Even though a liquid-based TENG is attractive for a power supply to drive a wearable device due to its intrinsic shape-adaptability, a mechanical weakness is problematic. To improve its weak mechanical robustness, the smart rheology of shear thickening fluid (STF) is benefitted. Shear thickening fluid is a smart material that is adapted to many different applications. TENG is one of application areas for STF.

Keywords: Shear thickening fluid, triboelectric; energy harvesting, impact energy.

RS03
A Short Review of Aircraft Noise Effects on Children's Learning in Auditory, Non-auditory, and Cognitive Development

Korawit Fakkhong[1], Sophita Sa-Ngobkai[2], Supansa Yamee[2], Tipavinee Suwanwong Rodbundith[1], Nattaphon Rangsaritvorakarn[1]

[1]Mae Fah Luang University, School of Management, Aviation Business Management, Healthcare Logistics Research Center, Chiang rai, Thailand.
[2]Mae Fah Luang University, School of Management, Aviation Business Management, Chiang rai, Thailand.

Abstract: This paper gives a systematic assessment of present evidence with respect to the impacts of noise, particularly aircraft noise on students' learning performance. Areas covered includes children's performance in auditory, non-auditory tasks, and children's cognitive development. The evidence available suggests that aircraft noise has a significant impact on children's learning, particularly older children are affected than younger children. The finding indicate that effects of aircraft noise appear to be long term, leading to reduced memory, motivation, abilities in reading and writing. These results provide further evidence of the detrimental impact of aircraft noise upon children at school, which required an appropriate acoustic design and collaboration between multi sectors to minimise these effects.

Keywords: Noise pollution, Aircraft noise, Children's learning.

RS04
Ranking of Indian Airlines

Mayank[1], T Bangar Raju[2]

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Abstract: Data Envelopment Analysis (DEA) is a non-parametric linear programming technique that evaluates the relative efficiency of a set of decision-making units (DMUs) that use multiple inputs to produce multiple outputs. DEA is widely used in various fields, including finance, healthcare, education, and manufacturing. DEA is especially useful for evaluating the performance of DMUs where there are no clear benchmarks or when traditional statistical methods are inappropriate. This abstract provides an overview of DEA analysis for Indian Airlines, including its basic principles, mathematical formulations, and applications. DEA can help decision-makers identify inefficiencies in their operations and provide insights into how to improve performance.

Keywords: Data Envelopment Analysis, Indian Airlines, Efficiency, Ranking

RS05
Energy Minimization in CO_2 Capture in a Natural Gas Power Plant

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Abstract: High concentrations of greenhouse gases in the atmosphere cause global warming; It is one of the main environmental problems to be solved in the 21st century. In the liquefied natural gas (LNG) power plant, amine scrubbing and CO2(g) liquefaction are often used for CO2(g) capture and storage (CCS) as it is suitable for large-scale installations. A large amount of LNG hot and cold energy is required for CO2(g) absorption, regeneration and liquefaction. Waste LNG cold energy discharged into seawater from the LNG regasification process and waste LNG hot energy from the natural gas combined cycle (NGCC) can be recovered and reused. In this study is a model for CCS for waste hot and cold energy recovery of LNG power plants; Regasification of LNG includes NGCC, CO2(g) capture and regeneration, and CO2(g) liquefaction. In the process model, waste LNG cold energy is recovered in the lean amine cooler in the CO2 capture process (CCP) and in each heat exchanger in the CO2(g) liquefaction process (CLP). For CO2(g) regeneration, waste hot energy from NGCC is recovered in the stripper reboiler. Exergy and economic analyzes are discussed to evaluate the economic feasibility of process energy conversion. Finally, the net power generation and exergy efficiency of the proposed process increased by 20% and 11%, respectively, compared to the base process. Economic feasibility net profit increased by 78%. The overall energy efficiency and economic feasibility using waste cold and hot energy were observed to increase, which resulted in decreased fuel usage.

Keywords: Amine scrubbing process, CO2(g) capture and storage (CCS), CO2(g) liquefaction process (CLP), Energy minimization, Exergy analysis, Liquefied natural gas (LNG), Waste LNG hot energy, Waste LNG cold energy.

RS06
The Impact of SAF on Reducing NO_x, SO_2, and non-CO_2 Emissions

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Abstract: This research focuses on the non-CO2 benefits of using Sustainable Aviation Fuel (SAF). Because of its potential to reduce air pollution, SAF is gaining traction as a viable alternative to traditional aviation fuels. We explore the impact of SAF deployment on important air pollutants using a thorough literature review and data analysis. SAF adoption demonstrates promising reductions in NOx, SO2, PM, and soot emissions, providing additional advantages to relying more on SAF which is helping to achieve the EU air quality standards, reduce aviation's environmental effect, and contribute to better air quality and public health.

Keywords: SAF, CAF, NOx, SO2, soot, TKT-1.

RS07
Strength Prediction of T-joint Composite Laminates Using Continuum Damage Modelling Methodology

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Abstract: T-joint composite structures are widely used in modern aircraft structures due to their excellent strength-weight ratio. However, the complex stress distribution in T-joints and the limitations of traditional finite element methods in accurately predicting the progressive damage mechanisms have led to increased interest in numerical methods for addressing these challenges.

In this study, a progressive damage analysis of T-joint composite structures was performed. The failure criterion LaRC04 was utilized to predict the damage initiation of the composite material. The cohesive zone model (CZM) was adopted for the inter-ply damage. Two continuum damage models (CDM) including gradual softening method (GSM) and instantaneous softening method (ISM) were employed to describe the intra-ply damage of the T-joint model. The comparisons between two CDM models were investigated for the assessment of progressive damage mechanisms in T-joint composites.

A modeling strategic and progressive damage analysis procedure was conducted to provide a cost-effective approach for T-joint composite laminates, aiming to reduce the reliance on block-by-block engineering verification methods. The results showed that the combination of the GSM for intra-ply damage and CZM for inter-ply damage effectively simulated both intra-ply and inter-ply damages in the laminates and bonding regions. The predicted strength of T-joint showed a good agreement with the experimental results from the literature. This work also demonstrated the adaptability of different continuum damage models and verified the influence of mesh density on T-joint model. Overall, the proposed work contributes valuable insights for understanding the progressive damage behaviour of composite T-joint structures and design applications.

Keywords: T-joint composite structures, progressive damage analysis, continuum damage model, cohesive zone model

RS08
Gaining of Conductivity in Shear Thickening Fluids

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Abstract: Shear thickening fluids are made of polymeric carrier liquids and organic or inorganic nano/micro particles distributed in them. These special fluids naturally show dielectric properties due to polymeric composition. However, some attempts have been done to gain conductivity with these intelligent fluids. In the present work, a conventional shear thickening fluid was fabricated by using nano-size silica particles distributed in a polyethylene glycol medium. The rheology of this material was investigated under increasing shear rates. Moreover, electrical conductivity measurements were carried out to understand the conductive performance. Then, a conductive phase, carbon nanotubes (CNTs) were included into the suspension to enhance the electrical conductivity. The effect of CNTs on both rheology and conductivity was investigated.

Keywords: Shear thickening fluid, rheology, electrical conductivity.

RS09
Air Traffic Management Principles: A Case Study on How to Create a Sustainable System.

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Abstract: This paper presents the basic principles of Air Traffic Management (ATM)- especially Air Traffic Control operations, performance based navigation schemes, and how they can correlate to sustainability and create viable aviation activities. The current paper is part of a wider research study that shows what are the essential elements for creating a sustainability framework through a training process. Identification of the primary ATM principles and professional activities, in link with sustainability and what sustainability means for ATM, are some of the elements elaborate in the case study/training provided in ATM professionals. Presenting sustainability in the boundaries of ATM operations, made trainees more open and assertive to accept sustainability as a new concept for their professional tasks.

Keywords: Sustainability, Air Traffic Management, Sustainable Aviation, Environment, Performance Based Navigation, Training.

RS10
Airline Technological Services and Airline Passengers' Purchase Intention: An Investigation

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Abstract: Liberalization has brought global competition to a high level. The increase in the level of competition has caused the transition to the product differentiation phase in airlines. It is seen that the competitive environment has caused the airline industry to innovate, and new strategic models have emerged. The developments in the sector contribute to an increase in the welfare level in sociocultural and socioeconomic terms. Airlines support tourism and the economy through travel and product/service exchange. The need for travel has caused airline companies to increase their offerings. It is known that airline companies see technology as one of their revenue-increasing methods. Developing technological applications affects passengers' travel perceptions and experiences. Younger generations are more technology addicted and they take a larger share from the pie. These younger generations heel technological developments because they were born and grew up in the world of technology; mobile phones bridges an uninterrupted link with social networks, demonstrating the impact of technology on generations. Purchasing, which is the last stage of the consumer behavior process, follows the decision-making stage and experiencing is the last step in this process. As recognized, understanding consumer behavior, the purchasing decision process and purchasing intention should be analyzed in detail to reveal the purchase intention. This study aims to examine the travel perception of airline passengers based on technology and to reveal the relationship between technology and purchasing behavior.

Keywords: Airline passenger, Purchase intensions, Airlines, Purchase behavior, Air transportation, Technology preference, Technological services

RS11
Theoretical Performance Analysis of High Entropy Alloys in Hybrid Rocket Motors

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Abstract: A hybrid rocket motor (HRM) is a type of rocket motor that combines features of both solid and liquid rocket motors. Hybrid rocket motors typically have lower specific impulse than liquid rocket motors, which can limit their performance in certain applications. While most hybrid rocket motors use traditional fuel and oxidizer combinations, this research aims to investigate HRM's propulsive performance in a novel fuel additive design. The propulsive performance parameters are numerically determined for its' characteristic's velocity, specific impulse, and adiabatic flame temperature. Simulations were run using the CEA-NASA software. High Entropy Alloy (HEA) was doped with paraffin wax at various concentrations to study the effects of the fuel and different oxidisers on the performance of the hybrid rocket. The highest overall performance for all parameters examined was achieved with the lowest HEA content and O_2 as the oxidiser.

Keywords: High entropy alloy, hybrid rocket, oxidiser

RS12
Operation of New Generation Aircraft in the Emergency Response Service

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Abstract: One of the pioneers of urban air mobility and new generation aircraft is the emergency medical service (EMS) application. Thanks to the potential public benefit from the emergency operation, efforts to realize this vision are supported by both the relevant authorities and the general public. Even though the core electric powertrain technology is advancing at a rapid rate, the required performance for safe and sustainable EMS operations still an open question. In this article, the requirements for an operational concept for Hungary was investigated. The goal was to determine whether today's electric aircraft designs that potentially could be used as EMS vehicles can perform the missions with the current technology level, taking the current regulatory environment into account. The investigated vehicles are eVTOL concepts designed for UAM applications. Based on the analysis, the proposed 34 km operational radius concept is on the edge of feasibility, but it is very sensitive to the mission profile. The duration of the vertical climb and hovering is the most energy intensive and the feasibility relies on keeping it short.

Keywords: Electric flight, UAM, eVTOL, emergency response, EMS

RS13
A Brief Assessment of Aircraft Fuel Consumption and Pollutant Emissions for Departure Operations.

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Abstract: The purpose of this study is to assess the quantities of fuel consumed and pollutant emissions of departure aircraft at Istanbul Sabiha Gokcen Airport during taxi operations. To only incorporate information relevant to taxi operations, Automatic Dependent Surveillance-Broadcast (ADS-B) data was filtered. The International Civil Aviation Organization's (ICAO) Engine Emissions Databank was used by considering different aircraft engine types to calculate the fuel and emission parameters. This allowed the calculation of fuel consumption and emission levels, including hydrocarbons (HC), carbon monoxide (CO), and nitrogen oxides (NOx). The obtained results were then compared to the results of the previously reported model for fuel calculation considering the number of acceleration events. The findings of this study illustrated the variation in the differences between the ICAO emission databank and the model results across aircraft types.

Keywords: Airport ground operations, Fuel consumption, Pollutant emissions.

RS14
Progress on PEM Fuel Cell Powered Unmanned Aerial Vehicle Research

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Abstract: Unmanned aerial vehicle platforms have been widely studied worldwide over the past decades. It is predicted that it will be a trending topic for the next decades as well. When the development of unmanned aerial vehicles is analysed, it is seen that they were initially used and developed only for military purposes. However, thanks to the widespread use of four-motor multirotor and the relatively simple operation protocols introduced by electric motors, the number of unmanned aerial vehicles used for civilian purposes has increased much faster than for military purposes and has already surpassed this number. Battery-powered only electric UAVs cannot stay in the air for long periods due to their high battery weights. Today, fuel cells are one of the topics being studied to increase the flight time of electric UAVs. Due to their high efficiency, fuel cells can significantly increase the flight time. In this study, fuel cell UAV studies in the open literature are reviewed and the differences between them are analysed.

Keywords: UAV, Flight Time, Fuel Cell, Endurance, Hydrogen

RS15
High Impact Resistance with Aerogel-Based Composites

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Abstract: Numerous researchers worldwide have studied protective composites, but no literature has presented advanced systems that provide both improved protection and light-weight properties. Although some researchers have attempted to develop such systems, they are still in the early stages of basic research. Scientists have investigated various light-weight materials, including Shear Thickening Fluid (STF) or Shear Stiffening Polymer (SSP), but these advanced structures are still being formulated and have not resulted in significant weight reduction. Aerogel is a promising material for light-weight structures due to its extremely low density, but conventional aerogel is brittle and prone to fracture. To overcome this, flexible polymer fillers such as polyurethane are combined with aerogel to enhance the mechanical properties, making it suitable for various applications.

Keywords: Aerogel, lightweight structures, impact resistance.

RS16
The Importance of Exergy for Sustainability Aviation

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Abstract: The concept of sustainability, as a word meaning, expresses the continuity and permanence of an existing balance. Sustainability can be expressed as a participatory process aiming at the prudent use of the society's economic, social, cultural, scientific, natural and human resources.

Rapid population growth and constantly developing production techniques increase the global energy demand day by day. Sustainability of energy resources is one of the main difficulties that countries have to solve. One of these problems is that traditional energy sources will run out after a certain period of time. The second is that greenhouse gases produced by the burning of fossil resources are among the main causes of global warming and environmental pollution. The third is the expectation that traditional resources will become increasingly inadequate to meet the increasing energy demand due to the developing technology and rapidly increasing population volume due to the limited reserve.

The world's understanding of development has shifted to the use of technology and resources, where energy can be obtained more efficiently and more economically, instead of energy abundance and unlimited consumption. Reducing climate change and global warming forms the basis of this new understanding. Efficient use of energy, ensuring the security of its supply, access to less polluting and reliable energy sources are the essential elements for sustainable development. The breadth is determined by the density of global energy resources, oil and natural gas.

Keywords: Exergy, Energy, Sustainability, Aviation

RS17
Optimization of Vortex Generators for a Subsonic Aircraft Wing using Taguchi Method.

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Abstract: As an aircraft stall under high angle of attack, air flow is separated from wing surface, resulting in drastic lift loss and drag increase. Consequently, the performance of wing is impaired, jeopardizing the safety of the aircraft. To mitigate this problem, a common practice is to install vortex generators on the upper surface of the wing. They function by introducing high-energy vortices into the sluggish boundary-layer, thus delay the separation to a higher stall angle. They can effectively improve lift during take-off and landing. In this study, several important parameters of vortex generators are optimized to produce the maximum lift at a high angle of attack. The results are very useful for the design of vortex generators to improve the safety of an aircraft.

Keywords: Vortex generators, flow control, stall, optimization

RS18
Properties and Specifications of Sustainable Aviation Fuels and Conventional Aviation Fuels

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Abstract: As the aviation industry seeks to lessen its environmental effect, Sustainable Aviation Fuels (SAF) have emerged as a possible alternative to Conventional Aviation Fuels (CAF). This paper compares the properties and specifications of SAF and CAF, offering knowledge of their unique features and consequences for engine fuel system performance and sustainability. Key criteria such as Sulphur content, Density, Flashpoint, Freezing point, composition, carbon intensity, and emissions profiles are investigated to emphasize the unique characteristics of each fuel type. In addition, the possibility of SAF integration into the CAF is investigated, considering any necessary adjustments or needs. The findings add to a thorough understanding of the technical concerns related to SAF adoption, allowing for better-informed decision-making, and promoting the aviation industry's transition to more sustainable fuel choices.

Keywords: SAF, CAF, Fuel System, Sulphur Content, TKT-1.

RS19
Evaluation of an UAS Based Service Business Model for Road Surface Monitoring

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Abstract: Drones are already being used for several monitoring and data collection tasks. It has already been demonstrated that taking photos, videos or collecting data even autonomously along a predefined path is not just possible, but drones are particularly well suited and efficient at it. However, feasibility is not enough to make a business based on that application viable in the market. The aim of this paper is to investigate whether UAS based road surface monitoring and object detection is competent in today's business environment, especially in Hungary and Türkiye. The approach involved listing the potential business models that could be adopted, and then they were evaluated by experts using criteria relevant to the drone market. The chosen 8 business aspect was considered with equal weight, and the highest scoring idea was the provision of processed data about sections of interest to the customers. This model had the highest potential because the company can focus on the efficient collection of data, with the possibility to secure recurring inspection activity assignments that would provide a stable, plannable income for the company.

Keywords: UAS, Road surface monitoring, GIS, quality assessment, object detection

RS20
The Impact of COVID-19 on Air Cargo Transportation in Türkiye

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Abstract: Despite being the newest mode of transportation, Air Cargo has become one of the fastest-growing industries due to the social and economic benefits it provides. The aim of this study is to examine the impact of the pandemic on the Turkish Air Cargo Transportation sector. The present study involved an analysis of data obtained from reports released by the civil aviation authority in Türkiye. Furthermore, the collection of data on alterations in freight patterns during the pandemic was facilitated by means of semi-structured interviews conducted with managers and experts affiliated with four air cargo businesses operating within the geographical boundaries of Türkiye. The COVID-19 pandemic has led to an observed correlation between the transportation of medical equipment and vaccines and the rise in air cargo traffic in Türkiye. This increase in traffic has resulted in a corresponding expansion of cargo tonnage capacity among firms, which may be attributed to the growing number of aircraft involved in these operations. In summary, it is noteworthy that air cargo companies have experienced a notable surge in both the quantity of aircraft utilized and the volume of cargo transported during the COVID-19 pandemic, which stands in contrast to the trends observed in passenger transportation.

Keywords: Air Cargo, COVID-19, Türkiye

RS21
The Effect of Air-Blast Injector Design on Swirl Number and Spray

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Abstract: This study investigates the impact of the air-blast injector design on airflow vortex intensity and spray characteristics. Flow field simulation is used to calculate the number of airflow vortices, and PLIF technology and a particle size measuring instrument are employed for spray observation. Analysis is conducted on spray atomization angle, liquid mass distribution, spray non-uniformity, and sauter mean diameter (SMD) among other atomization characteristics.

The results demonstrated an inverse relationship between the airflow vortex intensity and the average particle size of the spray, as well as the spray hollow intensity. On the other hand, a positive correlation was observed between the airflow vortex intensity and the spray atomization angle, spray hollow range, and spray uniformity. Therefore, the design of air-blast injectors with larger airflow vortex numbers, such as increasing blade angles or adopting airfoil-shaped blade designs, resulted in sprays with smaller average particle sizes, larger spray atomization angles, weaker hollow intensity, wider spray hollow range, and more uniform spray distribution. Under conditions where the gas mass flow rate continued to increase or the gas channel width was narrower, the airflow exhibited higher axial velocities, lower airflow vortex numbers, and stronger recirculation ranges and velocities. Consequently, the spray atomization angle, spray hollow intensity, and spray hollow range increased. The study also revealed an inverse relationship between the axial velocity of the airflow and the SMD of the spray. Thus, increasing the axial velocity of the airflow led to sprays with smaller average particle sizes.

Keywords: Air-blast Injector, Swirl Number, SMD, PLIF