



# *Abstract Book*

## *Editors*

*T. Hikmet Karakoç - Siripong Atipan - Ali Haydar Ercan  
Navatasn Kongsamutr - Alper Dalkıran - Vis Sripawadkul*



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International Symposium on Sustainable Aviation -  
ISSA21 - Abstract Book

International Sustainable Aviation and Energy  
Research Society

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**Prof. Dr. T. Hikmet Karakoç**  
(Symposium Founding Chair)



**Siripong Atipan**  
(Symposium Chair)

## **Message from the Symposium and Course Chairs**

On behalf of the Organizing Committee, it is my great pleasure to invite you to the International Symposium on Sustainable Aviation (ISSA), which will be held online, hosting by Kasetsart University, on 25 - 27 November 2021.

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 will include a variety of opening presentations, specialist sessions, and oral video and poster presentation sessions on different topics related to sustainability in aviation. In November 2021 we look forward to inviting you to this extraordinary event.

Sincerely,

**T. Hikmet Karakoç** (Symposium Founding Chair) & **Siripong Atipan** (Symposium Chair)

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Yunus Çengel, Duke University, Professor Emeritus of Mechanical Engineering, University of Nevada, Reno, USA

Raj Das, Aerospace and Aviation Department, RMIT University, Australia

Mary E. Johnson, School of Aviation and Transportation Technology Purdue University, USA

Max Platzer, University of California Davis, USA

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Natthawat Hongkarnjanakul, Space Innovation Collaboration and Connectivity, GISTDA (Geoinformatics and Space Technology Development Agency), Thailand

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Piyawut Tantimekabut, Air Traffic Management Network, AEROTHAI, ICAO APAC Air Traffic Flow Management Steering Group, Aeronautical Radio of Thailand Co., Ltd., Thailand

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## KS01

# Sustainability Initiatives at US Airports

**Mary E. Johnson, Ph.D., Professor and Associate School Head for Graduate Studies**

*School of Aviation and Transportation Technology, Purdue University*

**Abstract:** As one component of global air transportation systems, airports have a role in improving the sustainability of air transportation. The communities near airports may benefit in economic terms, and may also experience potentially detrimental environmental effects. In this presentation, airport sustainability initiatives will be presented that affect one or more components of airports. Smaller airports such as small hubs and general aviation airports are participating in sustainability initiatives, even though their budgets may be smaller than the budgets of larger airports. Results from research studies will be presented.

## KS02

# The Future of Sustainable Aviation Fuels

**Nadir Yilmaz, Professor and Department Chair**

*Department of Mechanical Engineering, Howard University, Washington DC, USA*

**Abstract:** The aviation sector has an increasing need for conventional and alternative fuels, and thus, is a major consumer of fuels and producer of pollutants. Because of ongoing efforts to minimize carbon dioxide (CO<sub>2</sub>) emissions, the aviation industry has set ambitious targets for CO<sub>2</sub> reduction strategies in the coming years, such as the use of potential biofuels to replace petroleum fuels for greater sustainability and environmental protection. A sustainable aviation fuel (SAF) can be produced from sustainable sources (municipal solid waste, used cooking oil, food waste, and sugars) and is very similar in its chemistry to traditional fossil jet fuel. SAFs give an impressive reduction of up to 80% in carbon emissions over the lifecycle of the fuel compared to the traditional jet fuel it replaces, depending on the sustainable feedstock used, production method, and the supply chain. Therefore, in the long term, it is important to invest in advanced technologies to process feedstocks more efficiently at larger scales and develop sustainable and scalable feedstock options for cost-effective biofuel production processes. Considering the aviation industry's future, the successful integration of biofuels in aviation will have to be effective, efficient, and advantageous from the environmental, social, and economic points of view.

## KS03

# Aviation Industry in the Post Pandemic Covid-19: Resetting the Landscape

**Professor Ir. Ts. Dr. Abd. Rahim Abu Talib**

*Universiti Putra Malaysia*

**Abstract:** Aviation sector is one of the most impacted industry during the pandemic Covid-19. The impact cut across all aviation sectors from aircraft manufacturers, component suppliers, maintenance, airport operators and the airlines. Many aircraft being grounded, business closed down, workers losses their jobs, etc due to the Covid-19 pandemic situation. This keynote address will highlight the steps taken by aviation sector to bring back the industry on track. Now, many countries have declared that Covid-19 as an endemic. The landscape of the global aviation industry has been reset. Hence, the aviation industry players need to implement new strategies of conducting business. Lesson learned during the Covid-19 situation may be used to develop robust emergency plan if a new pandemic situation arises in the future. The compliance on health and safety aspect need to become the main priority in the aviation sector. New advanced technology in aviation being developed to reduce the carbon emission and noise from aircraft propulsion. The recent development of alternative propulsion systems such as hydrogen fuel and electric aircraft can be further enhanced to ensure sustainability agenda being fulfilled. Furthermore, the aviation industry needs to actively play major role in achieving the Sustainable Development Goals.

## KS04

# Digital Transformation for Sustainability of Air and Space Transport Industry: Research and Innovation Perspectives

**Prof. Roberto Sabatini, PhD**

*Khalifa University of Science and Technology*

**Abstract:** Advances in aerospace Cyber-Physical Systems (CPS) and Artificial Intelligence (AI) are accelerating the introduction of automated decision-making functionalities and the progressive transition to trusted autonomous operations both in civil and military applications. Major benefits of these capabilities include de-crewing of flight decks and ground control centers, as well as the safe and efficient operations of air and space platforms in a shared, unsegregated environment. Significant research efforts are being devoted to the integration of Unmanned Aircraft Systems (UAS) in all classes of airspace, eliciting the introduction of UAS Traffic Management (UTM) services seamlessly integrated with the existing (and evolving) Air Traffic Management (ATM) framework. Research efforts are also ongoing to demonstrate the feasibility of CPS technologies capable of contributing to the emission reduction targets set by the International Civil Aviation Organization (ICAO), national governments and various large-scale international research initiatives. In addition to the aeronautical application domain, CPS will play a fundamental role in the successful development of the space sector and significant research efforts are needed in the field of reusable space transportation systems, Space Situational Awareness/Traffic Management (SSA/STM), and Intelligent Satellite Systems (SmartSats). In particular, the operation of space launch and re-entry platforms currently requires considerable airspace segregation provisions, which if continued will become increasingly disruptive to civil air traffic. Therefore, the development of an integrated approach to air and space traffic management (i.e., Multi-Domain Traffic Management - MDTM) is seen as an essential evolution towards a more sustainable aviation future.



## KS05

# Quality Category in Aviation's Modern Fuel Supply Technologies

**Sergii Boichenko, professor, Doctor of Science**

*National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute", Scientific and Technical Union of Chemmotologists*

**Abstract:** The QUALITY of Aviation Fuels and Lubricants is the most important condition for Aviation Safety. Substandard or poor-quality Aviation Fuels and Lubricants are considered as a possible cause of air crashes. The main regulatory document is Guidelines for the supply of aviation fuel to civil aviation (ICAO Doc 9977 AN / 489). ISO 8402 treats QUALITY as a set of characteristics of an object related to its ability to meet established and anticipated needs. Chemmotological reliability is the reliability of equipment, which depends on the QUALITY of Fuels and Lubricants (the ability of the technique to maintain high reliability during its operation on grades and brands of Fuels and Lubricants of an economically feasible level of quality). Aviation fuel supply – a system of technological and organizational operations providing for the provision of delivery, storage, pumping, metering, dispensing and refueling aircraft (aircraft) with aviation fuel as in its pure form, and in a mixture with anti-water crystallization additives; monitoring quantitative and quality characteristics of aviation fuel and anti-water crystallization additives.

## KS06

# Multi-Camera Multi-Target Tracking Systems with Trajectory-Based Target Matching and Re-Identification

**Dr. Sutthiphong Srigrarom**

*Associate Professor, Mechanical Engineering, National University of Singapore*

**Abstract:** This talk presents the integrated use of multiple cameras to detect, track and localize multiple moving aerial objects, especially drones, in real-time by computer vision. The algorithm of the integrated system incorporates target tracking, localizing and identifying schemes, with the ability to use multiple cameras from different viewing angles and simultaneously track moving objects in the cameras' frames. Moving objects are detected by hybrid motion-based blob detection appearance-based detection, and movements are predicted with Extended Kalman Filter. For motion-based detection, the trajectories of the tracked objects are analyzed using trajectory features variable. For appearance-based detection, motion is tracked with Yolo V3 detection algorithm. The integrated target identification algorithm matches and reidentifies targets between frames (intra-camera) and among cameras (inter-camera). This algorithm subsequently cross-correlate every tracked object in the different camera frames, and pair all the tracked targets to each other so that the cameras track the same objects for subsequent 3D localization. We tested our multi-cameras system to track multiple aerial and ground targets, and were successful in the re-identification of targets in real time.

## KS07

# Ramifications of the 2nd Law of Thermodynamics on Sustainability, Daily Life, and Philosophy

Yunus Cengel, Professor Emeritus

*University of Nevada, Reno, USA*

**Abstract:** The 2nd law of thermodynamics deals with the non-conserved entities of entropy and exergy as well as quality. The 2nd-law efficiency defines perfection, and helps us quantify how close we are to perfection. A process with a 2nd-law efficiency of 100% is thermodynamically perfect. As such, it involves no entropy generation, no exergy destruction and thus no waste of resources. The 2nd law is closely related to the concepts of sustainability, green practices, effectiveness, efficiency, and performance. Energy efficiency and the harvesting of renewable energy are also associated with the 2nd law. The concept of 2nd-law efficiency has important implications on daily life as well as the enterprises such as technology development and innovation activities to assess efficiency and effectiveness, and the best utilization of resources. The non-conserved quantities of entropy and exergy have intriguing ontological ramifications in philosophy.

## KS08

# Global, Regional and Local Issues of ICAO Balanced Approach to Aircraft Noise Management in Airports

Oleksandr Zaporozhets, Professor, DrSc

*National Aviation University, Kyiv, Ukraine*

**Abstract:** Noise has always been a major environmental issue in the field of aviation, primarily affecting residential communities close to airports. Environmental noise, in general, is an obvious example of unwanted technological and social outcomes in continuous human development, with obvious negative health and behavioural aspects for exposed the population. In 2001 the 33rd Session of the ICAO Assembly adopted a new policy for aircraft noise control globally, referred to as the "balanced approach" to noise management. The ICAO Balanced Approach guidance contains the explanation of all elements in general details, namely: reduction of aircraft noise at source; noise zoning, land-use planning and management; noise abatement procedures for aircraft operation; and restrictions for aircraft operation. The goal also is to identify the noise-related measures that achieve the maximum environmental benefit, using objective and measurable criteria, at any specific airport most cost-effectively. If the main goal in aircraft noise control to reduce noise level at source of its generation, the main goal for noise zoning and land use management to prevent the people from the levels, which are inconsistent with their health and welfare. Airports are usually located within or close to the limits of large urban areas, in better case a distance to existing noise-sensitive land usage (residential or recreational) may provide human protection from noise exposure and minimise the adverse impacts of their operations. Inside the zone of noise management, it is necessary to organise a set of plans (a program for noise protection) that govern urban planning and management with respect to the airport activities. In reality each airport is different in its operational, social, economic and political situation, as well as in the type of land use in its vicinity. That is why, the airport noise protection program should

include a land-use control system to assure that all the prescribed measures comply not only with the airport development plan but also with the plan of urban development and the goals of the communities involved. Local airport rules can include noise limits, curfews and penalties on excessive noise levels. These measures are considered mostly as constraints, they may limit the operational capacity of airports (for example, by restrictions for flights during night) and they may affect the economics of air transportation by limiting the take-off weight, payload and consequently reducing the economic benefit of specific flight. Operational procedures are intended for use by aircraft of the existing fleet and have the potential to make an immediate improvement in the environmental impact of aviation, as a rule locally emphasized at airports where the noise zoning and land use procedures are realized with omissions. Noise abatement operational procedures in use today can be broken down into three broad categories: noise abatement flight procedures and spatial management; ground management. Any progress in designing low noise aircraft would therefore lead to relax the stringency of the NAP to be used. The guidance recommends to avoid applying any operating constraints as a first measure to eliminate noise exposure, but after considering the exposure reduction to be obtained from the other three BA elements. If the total efficiency of the first three is not enough to reduce noise at any location in the vicinity of an airport, operating restrictions may be implemented, even to exclude it at all. The protection of the residents is understood as a dynamic process, meaning that the evaluation criteria must be repeatedly tested and – if necessary – adapted to new scientific findings [38]. Compared with traditional ICAO balanced approach elements, which are defined by physical effects of sound generation and propagation, involves non-acoustical factors must now be included to reduce the annoyance. Up to now, annoyance was mainly explained through acoustical factors like sound intensity, peak levels, duration of time in-between sound events, number of events. The non-acoustical factors (“moderators” and/or “modifiers” of the effect) have still received empirical attention but without a deep theoretical approach, despite the fact that various comparative studies reveal that they play a major role in defining the impact on people.

## IS01

### **Further beyond Green Destination: Challenges in creating airport sustainability**

**Mr.Jakrapop Charatsri**

*Airports of Thailand Public Company Limited*

**Abstract:** Air transportation have been facing with the economic impact from COVID-19, meanwhile the environmental challenges is driving to keep the balance between economic and environment. In the past decade, all airports were trying to be green airport, but it is not enough for today and tomorrow. We have to go further beyond green airport. It is Airport Sustainability. My presentation is the challenges in creating and airport sustainability in the context of Airports of Thailand PLC.

## IS02

### **Liberalisation, Competition and Pandemic Disruption: An LCC perspective on Thai airline business sustainability**

**Dr Narudh Cheramakara**

*Nok Airlines Public Company Limited, Adjunct Faculty, King Monkut's Institute of Technology, Ladkrabang*

**Abstract:** The aviation industry in Thailand has been witnessing dramatic changes since the liberalization of the airline market in 2001. Previously monopolistic routes are currently being served by up to seven airlines. This results the introduction of Low-cost airline business models to the country. The key features in Thailand airline market is the investment from foreign low cost airline businesses which are Thai Air Asia (Malaysia), Thai Lion Air (Indonesia), Thai Vietjet Air (Vietnam). The crowded market sees different airlines adopting different strategies to survive. These includesetting up subsidiary for long-haul operations (NokScot, Thai AirAsia X), regional fleet strategies (Bangkok Airways, Nok Air) to maintain monopoly on smaller airports, code-sharing (Bangkok Airways) strategy to feed international passengers domestically and inter-city service bypassing the crowded Bangkok Market. The overcapacity issue has become a dominating theme in the business only to be disrupted by the Covid pandemic. This results in the bankruptcy of NokScoot and the business rehabilitation plans for Thai Airways and Nok Air. All airlines have to adapt their business plans and models and reduce over reliance on specific foreign market such as China, Japan and Korea for business sustainability.

## IS03

# Aviation Sustainability and the Environment in Thailand

**Mr. Pasavi Ratchapongsirikul**

*The Civil Aviation Authority of Thailand (CAAT)*

**Abstract:** Thailand's Aviation Industry was growing rapidly from 2010. It was reflected by the number of commercial airlines, airports, and passengers. Air transport can drive Thailand's economic development and support long-term economic growth. It facilitates a country's integration into the global economy, through its positive impact on productivity and growth, resulted in better air connectivity, investment in air transport infrastructure including labor, energy, and access to export and import markets both globally and domestically. The Civil Aviation Authority of Thailand (CAAT) was established in 2016 and appointed to be a completed "Authority of Civil Aviation Sector" body. Environment is one of the organizational principles (Security, Economic Promotions, and Environment) aim to operationalization of the environmental issues associated with the aviation sector and to promote cooperation that can address the challenges of the day since the environmental issue becomes a grave attention from global communities. Although the growth of Aviation Industry feature in the prosperity and economic growth, on the other hand, underlying the growth in aviation emissions is the rapid, expansion of air travel, airports and flights tendency to cause the aviation noise exposure, air quality drop, climate change damages and others impact to the surrounding community. These may affect human health and social conflict as a consequence. CAAT, through the Aviation Environment Division, has the important role in managing the aviation environment by considering balancing the need for economic development with the imperatives of environmental protection in order to promote aviation sustainability.

## IS04

# Operators (Pilots, ATCOs)' Load Monitoring and Management

**Dr. Utku Kale, Assistant Professor**

*Department of Aeronautics, and Naval Architecture, Faculty of Transportation Engineering and Vehicle Engineering, Budapest University of Technology and Economics (BME)*

**Abstract:** Due to the introduction of highly automated vehicles and systems, the tasks of operators (drivers, pilots, air traffic controllers, production process managers) are in transition from "active control" to "passive monitoring" and "supervising". As a result of this transition, the roles of task load and workload are decreasing while the role of the mental load is increasing, thereby the new type of loads might be defined as information load and communication load. This research deals with operators' load monitoring and management in highly automated systems. This research (i) introduces the changes in the role of operators and requirements in load management, (ii) defines the operators' models, (iii) describes the possible application of sensors and their integration into the working environment of operators, and (iv) develops the load observation and management concept. There are some examples of analyses of measurements and the concept of validation is discussed. This research mainly deals with operators, particularly pilots and air traffic controllers (ATCOs).

019

## Investigation of Electromagnetic Effect of Lightning on Aircraft by Finite Element Method

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**Abstract:** Lightning is a rapidly developing discharge event in the atmosphere between clouds, between clouds and earth or from cloud to sky. During flight, aircraft may also be exposed to lightning strikes. a lightning strike can cause severe damage to critical and essential systems of any aircraft. Most direct effects result in physical damage to the aircraft fuselage. Indirect effects can cause damage to avionics systems of the aircraft. In this study, electric field intensity and electrical potential values created by lightning strikes on an aircraft are calculated by finite element method. The electric field intensity values have changed depending on the flight position of the aircraft. The roll and pitch positions of the aircraft increase the probability of lightning strike. If lightning protection is strengthened in areas with high electric field intensity and system installation is performed considering lightning zones, the damage caused by lightning to aircraft can be reduced in order to enable safe flight of the aircraft.

**Keywords:** Lightning strike, aircraft, finite element method, lightning protection zones.

033

## APC E-Rostering System

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**Abstract:** The APC E-Rostering System has been developed as a tool to manage the scheduling of air traffic controllers (ATCOs). Provincial Approach Control Center is taking into account the conditions of fatigue of air traffic controllers which are designated by the Civil Aviation Authority of Thailand (CAAT) as an important. Provincial Approach Control Center is very diverse in the air traffic control operations of officers because there is a large number of air traffic control services in 17 areas. This makes managing air traffic controllers to be able to operate in all areas under conditions of fatigue, extremely complicated. Therefore, it is imperative to develop tools to assist in the scheduling of air traffic controllers. This is why we, who consist of air traffic controllers and program developers have jointly developed the APC E-Rostering System as a managing tool. During the development of this system, we have gained valuable experiences with practical solutions. So, we consider this system an interesting case in application of operations research.

**Keywords:** ATCO, Fatigue, Roster, Schedule, Stagger Shift.

049

## Effects of Alternative Aviation Fuels on Environment and Enviro-Economic

Selçuk Sarıkoç

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**Abstract:** This study investigated the effects of alternative aviation fuels such as methanol on the environment and enviro-economic aspects. Experiments were conducted with a methanol-gasoline fuel blend at full engine load. Assessment of environmental and enviro-economic effects was exhibited that the addition of methanol was slightly increased, while the emission of CO<sub>2</sub> value per power considerably decreased. According to obtained results, the environmental effect of CO<sub>2</sub> per year was calculated to be 45.11 tCO<sub>2</sub>/y and 45.47 tCO<sub>2</sub>/y for gasoline and methanol blend. Furthermore, it was calculated to be 901.203 \$/y and 908.48 \$/y enviro-economic cost of gasoline and methanol blend, respectively. However, the CO<sub>2</sub> per power of the engine decreased from 872.71 g/kWh to 865.10 g/kWh with the addition of methanol. These results show that further analysis needs to understand the effects of methanol as an alternative fuel additive.

**Keywords:** Alternative aviation fuels, fuel additive, methanol, environmental and enviro-economic analysis, spark-ignition engines.

050

## Assessment of Oxygenated and Nanofluid Fuels as An Alternative/Green Aviation Fuels

Selçuk Sarıkoç

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**Abstract:** The aim of this study was to evaluate the use of oxygenated and nanofluid fuels as an alternative and green aviation fuels. In this respect, the effect of oxygenated and nanofluid fuels experimental results and fuel properties were reviewed in the internal combustion engines which can be used as the engine for unmanned aerial systems. It can be concluded that oxygenated fuels can be supplied the extra oxygen at high altitudes. Thus, incomplete combustion can be avoided with oxygenated fuels such as methanol, ethanol, propanol, butanol, and pentanol which is included extra oxygen in their chemical structure. Furthermore, nanofluids can be improved the combustion process due to the catalytic effects of nanoparticles which have superior properties such as high thermal conductivity, high surface area, droplet evaporation. Overall, the oxygenated and nanofluid fuel can be improved the combustion process, and engine performance at high altitudes so the air vehicles can be reached higher altitude, or further distance, or carried more useful load.

**Keywords:** Alternative aviation fuels, fuel additives, oxygenated fuels, nanofluid fuels, internal combustion engines.

056

## Aero-Engine Emission Calculation Method and Its Limitation Analysis

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**Abstract:** With the rapid development of modern civil aviation industry, aero-engine emission is an important index for airworthiness. Whether in the engine design stage or in the airline practical application, how to accurately predict the engine emission is an important task. In this paper, the typical and widely used engine emission calculation methods and their limitations are analyzed, focusing on three calculation methods, including T3-P3 calculation method, fuel flow calculation method and multi reactor model calculation method. Based on the above analysis, suggestions for improving the accuracy of engine emission calculation methods are put forward.

**Keywords:** Aero-engine, emission, calculation method, limitation.

059

## An Evaluation of Particle Image Velocimetry in Terms of Correlation for Aviation

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**Abstract:** Non-intrusive flow measurement techniques gain importance in fluid mechanics from day to day. Among the non-intrusive flow measurement techniques, particle image velocimetry has a special place. In particle image velocimetry experiments, correlations and image processing are crucial steps. Image processing is one of the fundamental steps in PIV processes. Selecting right correlation type is significant in terms of accuracy of experimental results. In this study, correlations are used in particle image velocimetry experiments were examined. Correlation types were given in table. Important results and concluding remarks for aviation sector were clarified.

**Keywords:** Particle image velocimetry, non-intrusive, correlation type, velocity measurement.



060

## Software Assessment for Particle Image Velocimetry for Aviation Industry

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**Abstract:** Particle image velocimetry is both quantitatively and qualitatively flow velocity measurement technique that uses various software programs. Software packages exist in particle image velocimetry experiments can be used for various purposes. Analyzing, post processing, image processing, modeling and computational fluid dynamics are prominent purposes. Choosing right software and steps mainly affects the results. In this study, software programs are utilized in particle image velocimetry studies were investigated and explained. Software programs were given in table and main findings for aviation sector were examined.

**Keywords:** Particle image velocimetry, flow velocity, processing, software.

070

## Dye Visualization of Flow Structure of a Circular Cylinder Oscillating at $Re=1000$

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**Abstract:** In this study, flow structure behind a circular oscillating cylinder is investigated experimentally. Dye injected flow area was visualized with a line type continuous laser and captured with a high-speed camera. The cylinder was controlled by the active flow control method. This control method was provided by oscillating the cylinder at 90-degree angles at five different rotation rates ( $F_R=0.8, 1.7, 2.5, 3.3$ ). The study was carried out at Reynolds number  $Re=1000$  considering the geometric dimension and flow velocity. In the study, it was determined that with the increase of the rotation rate, the vortex shedding in the cylinder wake region decreased in the flow direction and the irregular flow structure around the body was controlled. Also, it was seen that vortexes around cylinder becomes more and more smaller with increasing rotational ratio.

**Keywords:** Dye injection, Visualization, Circular cylinder, Flow control.

072

## Highly Aligned Discontinuous Fibre Composite Filaments for Fused Deposition Modelling: Tensile Properties and Printability Investigation

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**Abstract:** High Performance Discontinuous Fibre (HiPerDiF) technology can produce aligned discontinuous, i.e., longer than critical length, fibre composites with mechanical performance comparable to those of continuous fibre composites and the high formability of short fibre ones. Using this technology with thermoplastic material may lead to a high mechanical performance material recyclable over infinite loops. Using this material in Fused deposition modelling (FDM) would allow to manufacture complex geometries that are impossible to build with conventional methods. In this preliminary research, carbon fibres aligned with HiPerDiF technology and impregnated with a PLA matrix were fabricated into a circular cross section 3D printing filament using a semi-autonomous custom-made machine. The filament was then printed, with an FDM machine, into tensile test specimens. The samples show higher tensile properties compared to the other carbon fibre-PLA composites produced with FDM in literature.

**Keywords:** Aligned discontinuous fibre composites, fused deposition modelling, thermoplastic composite, recyclable materials.

073

## Aerodynamic Performance Predictions of Martian Helicopter Co-Axial Rotor in Hover by Using Unsteady CFD Simulations

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**Abstract:** The aim of this study is to investigate the complex flow physics and performance characteristics of co-axial rotors in Martian atmospheric conditions using SU2. Both steady-state and unsteady Computational Fluid Dynamics (CFD) simulations are performed for the Martian Helicopter (MH) co-axial rotor. 3-D rotor geometry is generated by using the airfoils defined by CST method and the CFD simulations are carried out for hover condition by using SU2 open source CFD flow solver. The numerical results are compared with the available experimental data and detailed discussions of the flow characteristics are also presented.

**Keywords:** Rotorcraft, Co-axial Rotor, Mars Helicopter, SU2 Flow Solver, Open Source CFD.

075

## Moving Towards a Greener Aviation: Electrification Of Aircraft

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**Abstract:** For carbon-free and sustainable aviation, it is necessary to take radical actions. Electric aircraft is a new concept for the aviation industry as environmental considerations and regulations get noticed by people and governments. Technological developments and researches on the electrification of aircraft pave the way for a greener aviation experience. Components for electric aircraft power systems like electric motors are lighter in weight than conventional gas-powered aircraft engines and do not produce greenhouse gas emissions. Although the electrification of aircraft presents a reliable and environmentally friendly flight experience, there are still challenges for long-haul and commercial flights. For example, batteries with limited energy capacities are the main challenge for electrified aircraft for commercial flight. In this paper, challenges for electric aircraft are identified, and new technological strategies on the effort of aircraft electrification are assessed.

**Keywords:** Electrification, more electric aircraft (MEA), All electric aircraft (AEA), sustainable aviation, power electronics.

078

## Integration of Sustainability and Digitalization in Air Logistics: Current Trends and Future Agenda

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**Abstract:** Digitalization and sustainability are two important concepts that affect the entire supply chain, and, therefore, they should be considered together. As one of the most critical element of supply chains, logistics operations need consideration in terms of transforming through digitalization while taking sustainability goals into account. This study especially focuses on air logistics operations. Although sustainability in air logistics in terms of analysing environmental, social and economic impacts is a popular topic, there is a gap in the literature related to integration of sustainability and digitalization in air logistics operations. In order to fulfil the gap in the literature and to contribute the research field, this study conducts a content analysis to reveal the current trends and future agenda for sustainable air logistics in the digital era. In order to do that, VOSViewer program is used for bibliometric analysis. At the end of the study, potential research themes are proposed.

**Keywords:** Air Logistics, Sustainability, Digitalization, Content Analysis.

081

## Noise Contour Map Around Tan Son Nhat International Airport for Approach Phase by Numerical Method

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**Abstract:** The research uses analytical methods to analyze and survey aircraft noise as well as its impact on around Tan Son Nhat airport by presenting a theoretical basis of acoustics, approach methods, interpolations, and simulation conditions. Then, we will give preliminary results obtained and also the scientific and practical implications. In the simulation, students apply knowledge of acoustics, interpolation mathematics and combine it with noise measurement procedures of international organizations. Then research uses Google Earth software to locate and localize the area. After that, research uses Gmsh 3.0 software to mesh the identified area and use Matlab software to calculate the noise caused by aircraft around Tan Son Nhat airport area on average 1 day within 1 month. Finally, ArcGIS is the tool that method used to draw the noise.

**Keywords:** ISSA 2021, aircraft noise, noise contour, Tan Son Nhat International Airport.

084

## Effect of Work Shift Rotating on Fatigue Levels of Aircraft Mechanics in Line Maintenance

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**Abstract:** The objective of this research was to study the relationship of work shift rotating on that affect the fatigue of aircraft mechanics in line maintenance. The Swedish Occupational Fatigue Inventory (SOFI) questionnaire was used as tool to determine fatigue levels of aircraft mechanic in line maintenance. The five fatigue dimensions according to the SOFI model, including of Lack of energy, Physical exertion, Physical discomfort, Lack of motivation and Sleepiness, were measured by twenty expressions. The data were collected from 184 aircraft mechanics of two airlines who work in Don Mueang international airport. There are 3 types of shift system examined, including of 1) swing shift with slow rotation 2) permanent shift with slow rotation and 3) swing shift with fast rotation. The results shown that the swing shift have no effect on the level of fatigue. However, the shift rotation has an influence on the level of fatigue.

**Keywords:** fatigue, work shift rotating, aircraft line maintenance.

085

## Strength Analysis of a Wing Structure for a Single Turboprop Normal Category Aircraft

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**Abstract:** This paper presents the wing design and structural analysis of a single turboprop aircraft with a maximum takeoff weight of 2,200 lbs. The wing structure of the aircraft is a conventional mid-wing configuration of a straight trapezoidal planform with an aspect ratio of 0.6. The analysis involved determining the loads acting on the wing structure (the aircraft's flight envelope and the wing's critical loading condition according to Title 14 Code of Federal Regulations (CFR) Part 23). The wing CAD model, composed of the aircraft wing components of the spar, ribs, and skins including its layout, was developed, and analyzed based on available 7075T6 Aluminum sheets using the SolidWorks software. The results for the wing's critical loading condition showed that the wing tip displacement was less than 5% of the half-wingspan with a margin of safety of 0.5 and mass of 117.97 lbs which was less than the expected mass (132 lbs).

**Keywords:** Wing structural design, Finite element analysis, Normal category aircraft, 14 CFR part 23.

091

## Decision-making Modelling in Flight Emergencies

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**Abstract:** The authors present a new approach to modeling decision-making in emergency. The decision-making methods are applied for building integration models under conditions of certainty, risk, and uncertainty for search optimal solutions. The reliability and optimality of the result solutions are provided by the individuals and collaborative solutions of operators. The optimal solutions in emergency "Unlawful Interference" using collaborative-factor decision-making models for the pilot, flight dispatcher, and air traffic controller are obtained.

**Keywords:** Air traffic controller, pilot, Wald criterion, Hurwicz criterion, Laplace criterion, Savage criterion, uncertainty.

094

## Green Practices Adoption Among Leading Green Airlines

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**Abstract:** Air transport can cause negative effects on the environment, primarily because of greenhouse gases emission. Therefore, many airlines have adopted green practices to prevent or mitigate these effects. This article collected data from environment reports of the top ten environmentally friendly scheduled airlines ranked by the Atmosfair organization. The content analysis results reveal that the airlines have adopted various green practices both related and not related to flight operation.

**Keywords:** Green practices, Airline, Environment report.

096

## Design and Testing of Multiple Web Composite Wing Spar for Solar-Powered UAV

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**Abstract:** Polymer matrix fiber reinforcement composites are known for their high strength-to-weight ratio so it is a great option to increase the efficiency of the wing structure for solar-powered unmanned aerial vehicles (UAVs). This research aims to examine the mechanical properties of composite materials manufactured by hand lay-up and vacuum bagging technique at room temperature, which will be the same as the in-house low cost UAV wing production process in coming future. Mechanical properties result from the coupon test based on ASTM standard is used to create a multiple web wing design with the highest load factor and a manufactured wing spar prototype in one cure cycle for sandbag testing. Spar web structure is made of polyurethane foam core and plain weave carbon fiber sandwich structure. Additional unidirectional carbon fiber added to top of the web to improve compressive strength of the wing spar. The sandbag test result of wing spar is good agree with the calculation, the wing can withstand 1.3 safety factor and 2.5 load factor as expected.

**Keywords:** Composite structure, Composite Material Testing, Wing spar, Sandbag Testing, Solar powered UAV.

101

## Comparative Study Between Aluminium and Hybrid Composites for UAV

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**Abstract:** Most of the materials used in aviation industry are made of durable and lightweight materials known as the composite materials. However, the properties of classical composite materials (i.e., carbon fiber/epoxy composite) need to be improved to achieve the sustainable development goal regarding aviation technology. To enhance the material properties, the hybrid composite material is introduced to perform superior properties (e.g., stronger and lighter). This research proposes the study of hybrid composite material laminating with graphite fillers. The relative temperature and curing vacuum pressure are typically controlled. In addition to ply orientation affecting mechanical properties, two different orientations of the carbon fiber fabric are investigated (i.e., [45/-45]<sub>4s</sub> and [0/90]<sub>4s</sub>). As a result, it is found that the mechanical properties are enhanced when adding the graphite fillers to composite laminates. Specifically, the flexural strength of a hybrid material is higher than the classical carbon fiber composite laminates without graphite fillers. By placing the [0/90]<sub>4s</sub> orientation of the carbon fiber in a hybrid composite, it yields a higher strength, leading to durable performance. Moreover, the fracture of hybrid composite can trigger the significant damage on the fiber fabric when a hybrid composite specimen is subjected to a load.

**Keywords:** Hybrid composites, Carbon fiber/epoxy composites, Graphite fillers, Ply orientation, Hand lay-up.

102

## Static and Modal Analysis of UAV Composite-Based Structures

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**Abstract:** An unmanned aerial vehicle (UAV) wing must be strong to support heavy take-off weight and high impact load on landing. Hence, the wing is considered as a crucial structure to deal with lift force. Conventionally, the UAV wings were made from heavy metals. Nowadays, the wing structure should be lightweight to fly a longer distance, improving the flight operations. To fill in this research gap, this paper proposes a sustainable utilization of composite materials for constructing UAV wings. The static and modal structures of the wing are analyzed. The finite element method is used to examine the UAV wing structure. Then, the wing structure is designed by the SolidWorks® software. Later, the deformations, stresses and strains of the wing structure are evaluated through the ANSYS® Workbench software. Finally, to avoid the failure from the relative UAV components, the analysis of natural frequency is demonstrated.

**Keywords:** wing structure, composite materials, static structure, natural frequency.

103

## Design of Pi Controller for Longitudinal Stability of Fixed-Wing UAVS

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**Abstract:** Small aircrafts without on-board pilots are called Unmanned aerial vehicles (UAVs). UAVs have been used in various applications of civilian and military. The control movement of UAVs can be divided into pitching, yawing and rolling actions. The pitch control motion includes longitudinal stability, which is the ability to maintain the equilibrium of UAV pitch motion (nose up or down) after disturbances. Without the proper control of longitudinal stability, it can lead to system instability, causing the UAV stalling and loss of attitude. To solve the problem, the adaptive feedback controller (e.g., Proportional-Integral: PI) used in industrial systems can be applied. This paper proposes the design and analysis of the PI controller to maintain longitudinal stability of the fixed-wing UAV during disturbances. The mathematic pitch motion behavior of UAVs is analyzed by the derived state space model. The obtained results show that the designed PI controller could improve the UAV longitudinal stability and eliminate the disturbance effects by reducing the overshoot, steady-state error and settling time, leading to the UAV stability improvement.

**Keywords:** Fixed-wing UAVs, Longitudinal stability, PI controller, Pitch angle.

104

## Applying Glass Fiber Reinforced Composites with Microsphere Particles to UAV Components

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**Abstract:** Unmanned aerial vehicles (UAVs) are being employed in various industries. However, the strength-to-weight ratio of UAV materials can cause an extra (insufficient) use of energy during flight operation. In the manufacturing process, composite materials can replace conventional materials (e.g., plywood, aluminum, titanium) with similar or higher performances. The characteristics of the composite can be enhanced by applying the reinforcing material, matrix, and production techniques. This research proposes a hand lay-up technique in combination with vacuum bagging to produce better composite material based on glass fibers. The influences of glass microsphere (GM) fillers on mechanical properties of composite materials are investigated. The experimental results are carried out using a universal testing machine (UTM). It is found that the quantity of GM particles affect the composite mechanical properties, bending strength, fracture strength, and toughness.

**Keywords:** Glass fiber, Glass microspheres, Hand lay-up, Vacuum bagging.



109

## A More Electric Aircraft Application: Starter/Generator

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**Abstract:** The More Electric Aircraft (MEA) concept aims to more efficient, more reliable and more environmentally friendly aircraft come with an increased demand for electric power. The conventional electric power production system is not sufficient enough and needs to be improved. The relatively new starter/generator (SG) system comes forward with a better solution. It doesn't only provide efficient generator operation, also starter operation is secured. In this study, a permanent magnet synchronous machine (PMSM) with flux-weakening operation is simulated as SG on MATLAB/Simulink environment, for required necessities of future SG machine design. The outcomes shown that the SG design should be discussed as a whole system consists of the SG, controller and power electronics. Hence the SG simulation on system level is highly recommended.

**Keywords:** More Electric Aircraft, Starter/Generator, PMSM, Speed Control, Flux-weakening, Simulation.

111

## Numerical Validation Study of a Helicopter Rotor in Hover by Using SU2 CFD Solver

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**Abstract:** One of the challenging problems in sustainable aviation electric air vehicle design for eVTOLs is to obtain accurate solutions both for aerodynamic performance of rotors/propellers and for complex flow field around rotating blades. Flow field around a model rotor is investigated by performing Computational Fluid Dynamics (CFD) simulations by using an open-source CFD Flow solver, SU2. Two numerical approaches, rigid motion (RM) and rotating frame (RF), are used and described. Validation of the inviscid computational simulations are done by comparisons of pressure distributions with the available experimental data. Analyses are conducted for different angular velocities and collective pitch angles.

**Keywords:** CFD Validation, SU2, Helicopter, Rotor, Hover, Rotating Frame, eVTOL.

115

## Application of a Virtual Chamber Used as Aircraft Passenger Cabin in The Evaluation of Comfort

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**Abstract:** In this work the application of a virtual chamber used as aircraft passenger cabin in the evaluation of comfort, namely the thermal comfort and the air quality, is made. The dimensions of the virtual chamber are equal to an experimental chamber existing in the laboratory. The work considers three numerical models, namely, the Aircraft Passenger Cabin numerical model and the coupling of the Computational Fluids Dynamics and Human Thermo-Physiology Response numerical models. The output of the Aircraft Passenger Cabin numerical model is used as input in the coupling numerical model. The study is made in a virtual chamber occupied by twenty-four virtual occupants, twenty-four seats and a ceiling-mounted air distribution system. The inlet airflow is located above the head level, while the outlet airflow is located in the aircraft passenger cabin central area at the ceiling level. The ADI, that considers the thermal comfort level, the indoor air quality level and the effectiveness of the heat and contaminant removed, is used to evaluate the Heating Ventilation Air Conditioning system performance. The thermal comfort and air quality levels are assessed by, respectively, the Percentage of People Dissatisfied index and the carbon dioxide concentration in the respiration area. One Case study with a mean internal air temperature of 20 °C and with an external air temperature of -25°C was implemented.

**Keywords:** Aircraft Passenger Cabin, Virtual Chamber, Numerical Simulation, ADI, Thermal Comfort, IAQ.

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## Numerical Design of Aircraft Passenger Cabin

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**Abstract:** The numerical philosophy used in the design of aircraft passenger cabin is developed and presented in this work. The numerical model used is based on the coupling of an Aircraft Passenger Cabin Thermal Response and a Human Thermo-Physiology Response numerical model. The first numerical model is used to develop the aircraft passenger cabin geometry, while the second one is used to develop the human geometry. The aircraft passenger cabin and human geometry, developed in this two numerical software, are transferred to the Computer Aided Design. The geometry is associated with the thermal response. The Aircraft Passenger Cabin Thermal Response numerical model considers the surrounding panels, the transparent surfaces and interior bodies, while the Human Thermo-Physiology Response numerical model considers the thermoregulatory system, the circulatory system,

the human and clothing system, the respiratory system, the comfort and the Draught Risk level. In this study, a numerical design of occupied aircraft passenger cabin considering two and four occupation rows is developed. In this design the aircraft passenger cabin surrounding panels and the interior seats are developed and the passenger design is considered.

**Keywords:** Design, Computer Aided Design, Numerical Simulation, Aircraft Passenger Cabin.

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## Safety Culture and Safety Management System in Aviation

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**Abstract:** Aviation is an activity in which a person, a machine and the environment must be managed in a way that is compatible with each other for the purpose of a task or service. The share of each of these components in the successes, failures and accidents achieved in aviation activities is undeniable. However, aviation is one of the areas where human factors are more prominent, especially in aviation. Therefore, the development of aviation safety and aviation culture, the development of capabilities to identify the interest of safety management in accidents and incidents is necessary in order to prevent aircraft accidents. Thus, the necessary measures are taken to prevent recurrent events and more such experiences are used to prevent similar events from happening again. The aim of this study is to examine the positive impact of the safety management system and safety culture in civil aviation.

**Keywords:** Safety Management, Safety Culture, Civil Aviation, Human Factors.

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## Airline Service Quality Attributes

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**Abstract:** Quality of services play an important role for airlines to sustain their passenger experiences and increase passenger satisfactions. It is important to explore attributes and assessment of airline service quality. Focus-group meetings with air carriers and regulators were used for collecting primary data. The review of literature relevant were incorporated to strengthen the research results. Reliability, assurance, tangible, empathy, and responsiveness are suitable for monitoring the service level along the passenger journey. PDCA cycle would be integrated to improve the level of service.

**Keywords:** Service quality, Airline services, PDCA cycle.

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## Free Vibration Characteristics of a Variable-Span Morphing Wing

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**Abstract:** In recent years, there has been an increasing interest to morphing wing technology. Telescopic span morphing mechanism may cause some dynamic instability problems. This study analyzed the dynamic characteristics of span-morphing wings. The differential transformation method is employed to obtain natural frequencies of the system. The Euler-Bernoulli beam is used as structural model. The unswept cantilevered wing is modeled as three-stepped beam model. Prior to analyzing the free vibration characteristics of bending-torsion coupled three-stepped Euler-Bernoulli beam, validation cases are performed. Several span configurations of Goland and HALE wings are analyzed, and natural frequencies are obtained. Based on the results of this study, it can be stated that the increasing wingspan decreases the natural frequencies in a significant margin. The findings of the numerical analyses show that there is a significant difference in natural frequencies between fully retracted and fully extended wing configurations.

**Keywords:** Span-Morphing Wings, Free Vibration, Differential Transformation Method, Euler-Bernoulli Beam.

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## Transient Behavior of a Hybrid Electric Air-taxi

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**Abstract:** Thanks to its typical speeds and altitudes up to 1000ft, Urban Air Mobility represents an interesting application for electric and hybrid-electric power systems. Moreover, short-range requirements are compatible with limited performance of today batteries. In the present study, a Hybrid Electric Propulsion System (HEPS) has been simulated on four different sets of operating conditions, with a transient signal as input for PLA. The goal of this investigation is to analyse transient behaviour of a hybrid electric propulsion system for UAM, to underline the role of electric motors in assisting thermal engine during transients.

**Keywords:** Urban Air Mobility, Hybrid electric vehicles, Transient behavior.

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## Design of Hybrid Laminar Flow Control System for Aircraft Wings

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**Abstract:** The Aviation industry is working towards making the future flights fuel efficient by improving the performance of the aircraft technology. Thus, this report is based on an experimental aircraft inspired by NASA's X-48 Blended wing body, taken as a full scale and a hybrid laminar flow control system is introduced into the wings so as to see its effect on the aerodynamic performance and thus try to lower the aircraft drag. The project will involve taking the baseline aircraft, deciding the design parameters and carrying out CFD simulations in ANSYS on the same so as to see the aircraft's initial aerodynamic parameters. Further, an HLFC system would be comprehensively designed and modelled for the aircraft. CFD simulations will be carried out for the passive suction system and tubes system based on requirements of active and passive suction control and these CFD results would be compared with original baseline values so as to see improvements in L/D ratios lowering of aircraft drag. Performance estimation is to be also carried out on the system analytically and drag reduction will be seen based on aerodynamic equations. The fuel and weight saving is to be estimated as well so as to see whether the system can help to increase range with same fuel quantities or if it can provide more payload capacities by saving fuel-weight. The HLFC system is hence expected to lower drag somewhere in the range of 29-33 percentage and hence a value close to a third almost. **Keywords:** mixed fuel, biodiesel, bio-pollution, corrosion, metal.

**Keywords:** X-48, Blended wing body, CFD, ANSYS, CATIA.

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## Exposure potential of Environment by Entropy continuity for Cruise Altitude of Aircraft Engine

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**Abstract:** The generation of entropy due to irreversibility in energy systems is basically shaped as a dimension of environmental parameters and this is the main source of environmental vocabulary. Aircraft engines are especially affected by the changing weather conditions of altitude and this process is an important potential in terms of environmental effects caused by engines. In this study, first of all, performance analyzes based on entropy exposure on environmental were developed in the cruise process of a piston engine depending on the flight cycles. In the analyzes made, while the exergy efficiency change depending on the number of revolutions changed 30.1%, the entropy change developed as 85.81%. This change shows an 84.52% change in fuel consumption. In addition, the improvements that can be achieved in the engine performance with the effective parametric controls of the engine were evaluated in terms of both efficiency and entropy load. At the end of the study, especially environmental impacts evaluated related to process analyzes were assessed.

**Keywords:** Aircraft, Piston engine, Entropy analysis, Efficiency, Emission.

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## Examining Thermo-Economic and Environmental Performance of Piston Engine Considering LNG Fuel Transition of Aircraft

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**Abstract:** The sectoral pressures created by the awareness of global warming and climate change have made it important to control emissions in the aviation industry. In this study, the effects of LNG use in reciprocating aircraft engines as an alternative fuel were handled with a thermodynamic approach and performance analyzes were made. In particular, it was observed that the LNG conversion of the engine provides an advantage of 21.4%, while it provides an advantage of 53.72% in emissions. In the study, especially evaluations were made on the performance effect.

**Keywords:** Aircraft, Piston engine, LNG, Efficiency, Emission.

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## Breaking the Aircraft Vortex Wake Near the Ground - Mitigation of Turbulence Wake Hazard

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**Abstract:** Vortex hazard is one of the dangers that aircraft must avoid. The trailing vortices in ground proximity can maintain their strength for a long-time cause of the bottlenecks of airport capacity. Understanding the three-dimensional instability of a vortex pair is necessary to find the methods of vortex hazard mitigation. The direct numerical simulation (DNS) was performed to observe the dynamics in the scenario of a vortex pair with Crow instability descending to the ground. The effect of sinusoidal waves from Crow instability perturbs the foundation of secondary vortex structures that arise into vertical loops, called vortex tongues. The vortex tongues rotate around the primary vortex structures due to the primary vortex induction and mutually interact with each other. Thus, the vertical  $\Omega$ -loop structures are generated and eventually slowly decays in time.

**Keywords:** Vortex hazard, Vortex breakdown, Vortex instability, Wake hazard mitigation.

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## Beyond Technology: Digital Transformation in Aerospace and Aviation

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**Abstract:** This is a conceptual study based on extensive review of various survey reports on aspects related to digital technologies in aerospace and aviation industry. In the beginning of the paper, theoretical description about digital evolution has been discussed and described as change levels. The study shows the characteristics of business and the successful digital adoption, how they use digital technology for the growth of the organization in aerospace and aviation. Digital challenges and consequence of Covid-19 pandemic have been discussed. The paper also indicates different perspective of digital transformation and its relevance. References of different studies and examples of different organizational readiness have been used to justify that there are several aspects of organization, have to be considered for success of digital transformation. At the end of the paper conclusion drawing the importance of other aspects, apart from technologies, for digital organizational transformation in aerospace and aviation industry.

**Keywords:** digitalization, digital transformation, aerospace, aviation, organizational readiness, soft-skill.

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## Circulation Control Flap - En Route Toward Sustainable High-Lift Devices

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**Abstract:** Circulation control flap by means of a blown jet over a flap offers an alternative way to augment lift and reduce wing weight; hence sustainable aviation. The purpose of this study was to examine flap configuration (dual radius flap – DRF) and effect of blown jet on lift augmentation and drag via CFD. Lift was further augmented by blown jet. The study revealed that the optimal flap configurations depended on momentum coefficient i.e., low momentum coefficients preferred large  $r_2$  flap configuration while high momentum coefficients preferred small  $r_2$  flap configuration. Blown jet also reduced the drag at maximum lift, though as the momentum coefficients of the blown jet increased the form drag increased due to stronger adverse pressure gradients induced.

**Keywords:** circulation control, jet flap, dual radius flap, high lift device, Coanda surface.

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## Sustainability Indices for Airport Sustainability Evaluation

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**Abstract:** Demand for air transport is increasing steadily with the technological advances and the increase in the global trade. Parallely, there is an ambition for continuous growth and increase of infrastructure capacity by aviation companies, government agencies and business circles. The understanding of sustainability, which takes into account the environmental and social impacts as well as economic concerns for businesses, is becoming widespread. Airline transportation industry is one of the sectors that come to the fore due to the magnitude of its environmental impacts. Airports, on the other hand, are an important focal point to examine sustainability impacts, especially air pollution and noise, due to landing and take-off and many activities taking place in between. In this study, a new set of airport sustainability indices is developed by using extant research and expert opinion.

**Keywords:** Aviation Management, Airport, Sustainability, Environment, Index.

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## An Approach to Optimizing Aircraft Maintenance

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**Abstract:** Maintenance costs which account for a significant percentage of operational costs, largely depends on the reliability of aircraft systems. This study explores the optimization of maintenance task intervals of aircraft systems using the average operational cost per unit time as a measure of efficiency. Efficiency was determined using the Exponential and Erlang probably density functions. Analytical and simulation results show that for the Erlang model, there is a minimum which corresponds to an optimal aircraft maintenance task interval while for the exponentials model the maintenance interval tends to infinity.

**Keywords:** aircraft maintenance, optimization, reliability, aircraft systems.



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## Research on The Effects of Flight Procedures on Noise Contours Map Around Tan Son Nhat International Airport

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**Abstract:** The International Civil Aviation Organization (ICAO) has stated in Annex 16 that noise in the aviation environment is a critical issue that has far-reaching consequences for the community's livelihood and health, particularly for those living near the airports. An accurate evaluation of both the intensity and extent of the noise is extremely necessary to take action to prevent noise increases caused by flight operations. Dealing with that problem, this paper is a comprehensive study on the establishment of an airport noise map based on the recommendation of the ICAO, which applies to Tan Son Nhat International Airport and all airports in Vietnam in the future. Through the calculation and analysis of two flight procedures NADP 1 and NADP 2 equivalent to ICAO A and ICAO B, the noise contours generated from flight operations were successfully simulated.

**Keywords:** Noise map, Noise contours map, Airport noise contours.

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## In Search of Environmental Protection Element in the Thai Aviation Law: A Result from CORSIA

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**Abstract:** Thailand's participation in the carbon offsetting and reduction scheme for international aviation (CORSIA) has prompted the Civil Aviation Authority of Thailand to regulate airlines. Before passing any regulation, the first two concerns are (1) selecting the legislation to serve as a foundation for passing the subordinate law and (2) ensuring that the chosen legislation is equipped with economic and punishment mechanisms to enforce the regulation effectively. This paper examines the International Civil Aviation Organization publications, as well as legislation and subordinate laws in France, the United States of America, and Australia in order to propose a solution for Thailand.

**Keywords:** domestic implementation, CORSIA, Annex 16, carbon offset, Thai aviation law.

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## Seamless Passenger Experience for the Airport Environment: Research at DARTeC

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**Abstract:** Surveillance systems have been used in daily life for security purposes. There is a wide range of applications such as visual tracking, crowd area tracking, queue detection and face recognition that are used to integrate within the airport. In recent years, tracking passenger in airports have become more and more automated. Face detection and recognition in visual tracking framework is a significant pipeline for digital aviation. Despite the importance of that, there remains a lack of the presence of occlusion regarding previous research. The challenges have been increased due to Covid-19 restrictions and the necessity of mask-wearing. In this paper, we have developed a facial recognition system for DARTeC environment which is one of the subclasses of our seamless passenger experience at the airport research.

**Keywords:** Airport Surveillance, Visual Tracking, Face Recognition, Deep Learning.

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## Critiques and Challenges of Air Transport Liberalisation Policy in Thailand

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**Abstract:** This study determines the impact of national air transport liberalisation policy implementation on the country's airline market landscape in Thailand by taking key stakeholders' opinions as a prime recipients. The mixed research method is undertaken by utilising qualitative and quantitative data collected from both primary and secondary sources. Key findings reveals that the policy has led to economic and air traffic growth noticeably, gained by lower regulatory entry barrier inducing more competition in the market, domestically and internationally. However, there are number of small domestic routes were abandoned and price war in domestic market has been witnessed during the past six years (2014-2019). For international market, the invasion from foreign low cost carriers and middle east carriers are still the key challenges. The critiques of the country's air transport liberalisation policy from airlines and government shares some common views in success issues of the policy, but many contradictions on failure ones. More holistic and integrated policy from the ruling government and continuous improvement of regulatory functions, especially for economic regulation, are expected to be effective solutions.

**Keywords:** Air Transport, Airline Market, Liberalisation, Policy Impact, Competition.

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## Digitalization in The Way of Aviation Sustainability

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**Abstract:** Digitalization and sustainability are among the most popular topics of discussion in aviation. With the technological development in recent years, aviation businesses have had to adapt to digital transformation. While digital transformation affects all processes, its effect on environmental sustainability has begun to be observed. The two processes, which have to be carried out together by investigating the effects of digitalization on environmental sustainability, whether positive or negative, should be solved without creating additional costs to businesses and without encountering greater consequences later on. In line with the sustainable development goals of the United Nations, a roadmap to global goals has been prepared all over the world. Due to the carbon emission created by the aviation industry, environmental sustainability efforts have gained more importance. In order for both processes to be carried out together without any problems, examples of digitalization applications were examined and their positive and negative effects on sustainability were discussed. In this study, the concepts of sustainability and digitalization are discussed first separately and then together, and the difficulties that digitalization will bring, as well as the contribution of digitalization to sustainability in aviation.

**Keywords:** Digitalization, Sustainability, Aviation Sustainability.

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## Effect of Phase Change Material Dimension on Maximum Temperature of a Lithium-Ion Battery

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**Abstract:** In this study, the effect of phase change material dimension on the maximum temperature of a lithium-ion battery was investigated. The Newman, Tiedemann, Gu, and Kim (NTGK) model was used to predict the maximum battery temperature. The battery was discharged from 100% state of charge to 0% state of charge at 3C-rate and 300 K. Phase change material was used to maintain maximum battery temperature within safe temperature limits. Results showed the effect of PCM width on the maximum battery temperature and temperature distribution. Results also revealed that the 40 mm PCM cooled battery showed better cooling performance owing to its low maximum battery temperature and more uniform temperature distribution.

**Keywords:** Thermal management, lithium-ion battery, phase change material, maximum battery temperature.

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## Global, regional and local issues of ICAO balanced approach to aircraft noise management in airports

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**Abstract:** In 2001 the 33rd Session of the ICAO Assembly adopted a new policy for aircraft noise control globally, referred to as the “balanced approach” to noise management. The ICAO Balanced Approach guidance contains the explanation of all elements: reduction of aircraft noise at source; noise zoning, land-use planning and management; noise abatement procedures for aircraft operation; and restrictions for aircraft operation. The goal also is to identify the noise-related measures that achieve the maximum environmental benefit, using objective and measurable criteria, at any specific airport most cost-effectively. In reality each airport is different in its operational, social, economic and political situation, as well as in the type of land use in its vicinity. Airports are usually located within or close to the limits of large urban areas, in better case a distance to existing noise-sensitive land usage (residential or recreational) may provide human protection from noise exposure and minimize the adverse impacts of their noisy operations. Inside the zone of noise management, it is necessary to organize a set of plans or general program for noise protection that govern urban planning and management with respect to the airport activities.

**Keywords:** aircraft noise, protection, impact, abatement, flight procedure.

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## Fuel Consumption Analysis of Gradual Climb Procedure with Varied Climb Angle and Airspeed

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**Abstract:** This paper provides fuel consumption analysis of an aircraft during climbing phases with gradual climb procedure. The analysis is based on BADA aircraft performance model and applied to an A320 aircraft climbing performance with varied true airspeeds optimal to the flight altitudes. The acceleration and angle of climb at specific altitudes were consequently varied with altitudes and calculated using numerical techniques. The comparisons of the fuel consumptions of continuous climbing with gradual reduced climb angle procedure and with constant climb angle procedure were presented. The results showed that the gradual climb procedure provides better fuel-saving by 8.1% of the climbing fuel compared to the continuous climb of constant climb angle procedure. It is suggested that the procedure can be improved with optimization of varied true airspeed, acceleration, angle of climb, and aircraft thrust.

**Keywords:** Gradual Climb, Continuous Climb, CCO, Bada Model.

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## Effects of Strategic Alliance Membership on the Environmental Performance of Airlines

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**Abstract:** In recent years, the world has started to grapple with the climate crisis and the concept of environmental sustainability has gained importance in every field. The concept of sustainability in aviation has also brought the concept of environmental performance. While the environmental performance of airline companies is being measured voluntarily today, it will be measured mandatory in the future. Global strategic alliances affect member airlines in various ways and levels in this regard. Membership of global alliances may have the potential to contribute positively to more environmentally sustainable aviation in the framework of airlines operations. In addition, global alliances have common goals for their members to contribute to environmentally sustainable aviation and share these with their stakeholders. In this study, we evaluate the prospective effects of One world Alliance on its members' environmental performance, as well as the members' actual environmental performance and practices in this setting.

**Keywords:** Strategic alliances, Airlines, Environmental performance, Air transportation.

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## Safety Factor Analysis in Ramp Operation with AHP Approach

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**Abstract:** Many different groups of individuals occupy airport ramps, each with a different purpose but all working toward the same objective. Everyone wants to be efficient and safe, so it's simple to see how all of these tasks happening at the same time on a crowded ramp may become dangerous. Due to the complexity and ambiguity of factors, we present the Analytical Hierarchy Process (AHP) in this study to construct a weight model for safety considerations by assessing and selecting the value of various aspects. This paper serves as a stronger base for managing personnel.

**Keywords:** Analytical hierarchy process, Air transportation, Flight safety, Human factor, Multi criteria decision making.

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## Misunderstandings in Aviation Communication

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**Abstract:** The consequences of ineffective communication can be life-threatening and dramatic. Communication misunderstandings are often cited as the cause of paranormal events in aviation which could lead to accidents/incidents. As a result, the risk of lack of communication is relatively high. Many factors that directly or indirectly influence the rate of misunderstandings in communication, such as language barriers, non-standardized Phraseology, ambiguous communication, regional differences, and premature communication, are the causes of communication errors in flight. The study focuses on distinguishing and emphasizing various perspectives of communication and making suggestions to operators to reduce misunderstandings in aviation communications. The study is based on a survey highlighting the important communication loads such as flight training, standard expressions, operator's native language, and cultural background. The survey collected 110 responses from pilots and ATCOs, from various countries, with approximately 20% being ATCOs and 75% being pilots. Some suggestions concluded based on the results of this study, (i) improving aviation training by further focusing on radiotelephony communications, and (ii) familiarizing and permanently updating standard used phraseology among operators.

**Keywords:** Communication, operator total load, Radiotelephony, misunderstanding.

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## Overview of Hydrogen-Powered Air Transportation

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**Abstract:** This study provides an overview of hydrogen's utilization in the aviation industry. The aviation industry is still dependent on carbon-based fuels today. Kerosene, which is used as an aircraft fuel, is not environmentally friendly due to greenhouse effect and is not a renewable energy source. Sustainable aviation fuels are being investigated as a possible replacement for kerosene fuel. Hydrogen is the most promising energy carrier among these alternative fuels. Many research has been performed in the aviation industry to be utilized as fuel in aircraft and airports. This study presents a summary of the findings into using hydrogen energy in airports and aircraft, as well as its future viability.

**Keywords:** Liquid hydrogen, sustainable aviation fuel (SAF), hydrogen airport, hydrogen aircraft, renewable energy.

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## Evaluation of Nanostructured Materials: PEM Fuel Cell Applications

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**Abstract:** The increase in energy demand day by day, the rapid depletion of fossil energy sources and the environmental pollution they cause during their use have increased the search for alternative energy sources. Fuel cells, which directly convert the chemical energy of the fuel into electrical energy, come to the fore among alternative energy sources. Among the fuel cell types, proton exchange membrane type fuel cells (PEMFC) have been a technology frequently applied by researchers with the advantages of high energy efficiency, low operating temperatures and no waste other than pure water. With the development of nanostructured materials and their use in existing technologies, the bottlenecks of the systems can be overcome. In this study, nanostructured materials used in PEMFCs were evaluated. Evaluation was made using the Analytic Hierarchy Process method. Among the alternatives compared, Metal Based nanomaterials were found to be more advantageous than others.

**Keywords:** Proton exchange membrane fuel cell, Nanostructured materials, Nanoparticles, Analytic hierarchy process.

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## Evaporative Hydrocarbon Emission of Gasoline during Storage in Horizontal Tanks and Their Energy and Environmental Efficiency

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**Abstract:** The evaporation of petroleum products during storage and transportation is usually between 1% and 6% of total anthropogenic emission sources. Up to 40% of hydrocarbons emitted by road transport, evaporate from fuel tanks and fuel systems of cars with gasoline engines. Such emissions lead to significant pollution of the environment and can cause fire hazard. In the context of the global problem of depletion of energy resources and the associated environmental degradation, the relevance of this problem is not in doubt and only confirms that the reduction of gasoline losses from evaporation remains an important environmental and economic problem. The solution to it requires the introduction of the latest scientific achievements and improvement of petroleum products evaporation capture technologies.

**Key words:** petroleum products, fuel, gasoline, evaporation, emission, light fraction, vapor-air mixture, losses from evaporation, fuel tank, hydrocarbons.

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## Research of Tribological Characteristics of Modern Aviation Oils

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**Abstract:** The relevance of this work consists in creating a methodology for assessing the quality of aviation lubricants by expanding the list of their standardized indicators, which include tribological properties of lubricants. The estimation of commodity batches of aviation hydraulic oils was performed on the basis of operational indicators. Research of experimental lubricant samples was carried out on the software-hardware complex for estimation of tribological characteristics of triboelements, for which a software for control of stepper engines was developed, and visual on-line estimation of kinetics of change in the basic tribological indicators of tribocontact is offered. The antifriction, rheological, energy, and antiwear characteristics of the friction contact in the conditions of rolling with sliding are analyzed and the most significant indicators influencing the linear wear of contact surfaces are determined. An empirical relationship for determination of the linear wear of friction pairs has been obtained. It is established that the most significant tribological indicators that affect the wear of triboelements include SWF, friction coefficient, effective viscosity of the oil, volumetric temperature of the oil in contact, and the thickness of the boundary lubrication layers.

**Keywords:** Hydraulic oil, Antifriction properties, Specific work of friction, Wear, Microhardness.

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## The Influence of Fuels Containing Fatty Acids Ethers on Fuel Systems

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**Abstract:** The corrosive effect of mixed diesel fuels, which contain fatty acid methyl esters, on materials of fuel systems, such as copper, aluminum, their alloys, steel and rubber is comprehensively considered in the study. Corrosion activity was studied by the method of static immersion in fuel. Biodiesel fuel is prone to microbiological damage due to high hygroscopicity and composition, which impairs performance and reduces shelf life. The corrosiveness of biodiesel fuel is insufficiently known, therefore this study is relevant.

**Keywords:** mixed fuel, biodiesel, bio-pollution, corrosion, metal.



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## Analysis of World Practices of Using Liquid Hydrogen as A Motor Fuel for Aviation

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**Abstract:** This article provides research on some world practices, challenges, advantages, and disadvantages of using hydrogen as a fuel for aviation. The essence of the work is to highlight the current stage of hydrogen technologies and their readiness to serve the global purpose of significant greenhouse gases reduction by 2050. To scale the hydrogen-powered aircraft industry, several technological and infrastructural unlocks need to happen, especially within the accumulation and storage technologies.

**Keywords:** Hydrogen, alternative fuel, harmful emissions, airline, carbon dioxide, biomass, hybrid engine, fuel cell, airport infrastructure.

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## Experimental and Analytical Principles of Improving Waste Management Technologies in the Technosphere

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**Abstract:** This article provides research on waste dumps of transport infrastructure in Kyiv and microorganisms, that are recommended to use to neutralize petroleum products and solid organic waste, were specifically separated. The essence of the work was the selection of such strains of microorganisms that were able to absorb hydrocarbons of solid, liquid, and gaseous petroleum products without the formation of toxic products. We propose to use the potential of microorganisms, which are characterized by wide adaptation reactions in different environmental conditions, in particular, a powerful synthesis of biologically active compounds. Specifically separated and researched microorganisms-fuels destructors allow the development of cheap technologies for the utilization of diesel and aviation fuel, which is quite cost-effective for oil refineries, transport enterprises, fuel supply facilities.

**Keywords:** landfills, microorganisms complex, destructor, diesel fuel, jet fuel, technosphere.

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## Waste-Free Technology for The Production of Building Materials by Mining and Processing Plants

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**Abstract:** The purpose of the study is to develop a waste-free technology for the production of building materials by mining and processing plants. The emission spectral analysis method was used to determine the chemical composition of mining waste and substantiate the possibility of using waste as raw material for the production of new products - building materials. The results of the analysis of the chemical composition of mining waste showed the possibility of using them as raw materials for the production of fiberglass. The method of waste utilization with the production of type D fiberglass for mining and processing plants is proposed. The method includes extraction of rock from the dumps of stone crushing plants, fine grinding of waste to a fraction of 0.1-0.5 mm, extraction of iron (III) oxides on a magnetic separator, adding B<sub>2</sub>O<sub>3</sub> and MgO in appropriate proportions, supply of raw materials to the glass furnace for the production of fiberglass. Waste-free technology for the production of building materials by mining and processing plants, which includes the production of gravel, the production of fiberglass based on the proposed method of waste disposal and the production of pigment for paints from extracted iron oxide (III) is proposed.

**Keywords:** waste-free mining technology, mining waste disposal, fiberglass production, mining and processing plant, silicon oxide.

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## Technologies of Alternative Jet Fuels Production from Alcohols

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**Abstract:** Modern tendencies in air transport concerning the necessity of transition from conventional oil-derived fuel to alternative one are considered. The article analyzes variety of available today renewable feedstock and technological processes of its processing, which are used today for production of alternative aviation fuels. The comparative analysis of characteristics of technological processes of alternative jet fuels production based on biomass was done. Processes of alcohols (ethanol, n-butanol and iso-butanol) production from renewable plant feedstock and processes of its further conversion to alternative jet fuel are considered. It was shown that today to types of alcohol jet fuels are produced: Alcohol To Jet – Synthesized Paraffinic Kerosene and Alcohol To Jet – Synthesized Kerosene with Aromatics. It was shown that today application of alternative aviation fuels produced from alcohols is allowed in blends with conventional oil-derived jet fuels in quantity up to 50 %.

**Keywords:** jet fuel, alternative fuel, alcohol, production, conversion, technology.

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## Sustainable Aviation of Textile Industry: Life Cycle Assessment of The Pollutants of a Denim Jean Production Process

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**Abstract:** In this study, environmental effects of denim jean production process are evaluated by applying the Life Cycle Assessment protocols. The impacts originate from the denim industry are eliminated by mechanical, chemical, thermal, and biological recycling processes. The challenges of the recycling procedures were examined by life cycle assessment methods, and relevant environmental impacts for denim jean textile industry were calculated and discussed by using the SimaPro software.

**Keywords:** Denim textile industry, Life cycle assessment, Waste, SimaPro software.

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## Sustainable Materials used by Additive Manufacturing for Aerospace Industry

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**Abstract:** The aerospace industry has been the pioneer of human life with its high technology. The sector in which the developments in materials science find the first application area and where research and development studies are carried out intensively is the aerospace industry. Developments in materials science are at the primary point in realizing the current performance of aircraft. The developments in additive manufacturing technologies and the applications of these technologies also play an important role in the aerospace industry. Additive manufacturing technologies offer important opportunities in the sector where complex geometries, a low number of parts without mass production, and lightness are at the forefront. The use of additive manufacturing technologies in the manufacture of aircraft structural parts, components, and equipment, where polymer-based materials are increasingly used, offers sustainability, cost reduction, and topology optimization opportunities. In this study, short carbon fiber reinforced thermoplastic matrix specimens were produced by the FFF method. The changes in the mechanical and thermal properties of short fiber reinforcement were investigated. Studies have been carried out to develop environmentally friendly materials that can be used in the aircraft cabin interior equipment.

**Keywords:** Additive Manufacturing, Polymer Composite, Sustainable Materials, Thermoplastic, FFF.

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## Investigation of Turbofan Engine Emissions at Different Cruise Conditions for Greener Flights

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**Abstract:** Greenhouse gas (GHG) emissions are responsible for anthropogenic global warming, which occurs primarily due to combustion process of fossil fuels for human needs. These gases induce global warming by creating a greenhouse effect. Limiting greenhouse gas emissions from all sources is necessary for a sustainable planet. Aviation is one of the elements in transportation to limit the emissions in the sector. During flight and ground operations, aircraft engines generate exhaust gases. In today's commercial aircraft, the turbofan engines are the most frequent kind. The operation of airplanes with turbofan engines can be organized to minimize emissions. Therefore, in this work, turbofan engine associated exhaust gas emissions were calculated in a range of flight speed and altitude and presented comparatively with respect to a baseline point for potential reduction of adverse impact of airplanes with turbofan engines on the environment.

**Keywords:** exhaust gas emissions; turbofan engine; cycle analysis; global warming, sustainability.

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## Development Strategy for Tan Son Nhat International Airport

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**Abstract:** Ho Chi Minh City and the southern provinces have economic, trade, service and tourism activities... creating demand for air travel for Tan Son Nhat International Airport, and Tan Son Nhat International Airport having an impact. to the economic development of the Ho Chi Minh city. In order to help Tan Son Nhat International Airport improve productivity to the maximum in the future, the issue "Strategic development for Tan Son Nhat international airport" is currently selected as the thesis topic.

**Keywords:**

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## Numerical Study of Porous Metal Foam Effect on Phase Transition Process in A Latent Heat Thermal Energy Storage Device

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**Abstract:** This paper performs a numerical evaluation of the geometric structure of metal foam such as pore density (PPI; number of pores per inch) and porosity effect on melting phenomenon heat transfer in an open-ended rectangular porous channel (metal foam) contained a phase change material (PCM: paraffin) under forced convection. The local thermal non-equilibrium condition (LTNE) is manifested between phases (thermal field) and the Darcy-Brinkman-Forchheimer model (DBF) for dynamic field. Governing equations are simulated using the thermal single relaxation time (T-SRT) lattice Boltzmann method (LBM) at the representative elementary volume (REV) scale. The effects of metal foam PPI ( ), porosity ( ) and Reynolds number ( ) on melting (charging) and solidifying (discharging) phenomena were investigated. Results show that to reduce the system irreversibility higher porosity (=0.9) with lower PPI (=10) should be use during melting case. In contrast, small porosity (=0.7) with larger PPI (=60) is recommended for solidifying process.

**Keywords:**

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## Evaluating Total Load of Aviation Operators by Analytical Hierarchy Process (AHP)

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**Abstract:** In today's modern aviation operator environment, the tasks of the aviation operator have shifted from active involvement to information management and supervision. Heavy information flow and transfer during operations can confuse operators, especially when making decisions. The operator's total load system (information, communication, mental, task, and workload) has also been considerably altered in tandem with these developments. Unbalanced operator load systems, poor situation awareness, untimely decision-making, and high-stress levels are associated with the highly automated system. For this purpose, the analytical hierarchy process (AHP) survey was distributed among three groups of aviation operators, namely, (i) less skilled pilots, (ii) skilled pilots, and (iii) ATCOs. The AHP was applied by creating a two-level hierarchy with 5 main criteria and 19 sub-criteria to evaluate and weigh the critical characteristics of the operators' total loads model.

**Keywords:** Operators total loads, pilot, ATCO, multi-criteria decision-making (MCDM), analytic hierarchy process (AHP).