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Symposium  
on Sustainable Aviation



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August 2022

RMIT University,  
Melbourne, AUSTRALIA

# Abstract Book

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International Symposium on Electric Aviation  
and Autonomous Systems 2022

ISSA'22 Abstract Book

International Sustainable Aviation and Energy  
Research Society

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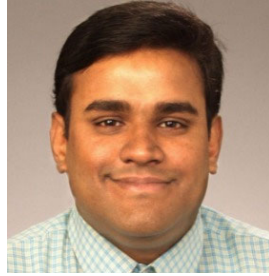
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T. Hikmet Karakoç  
**Symposium Founding Chair**



Raj Das  
**Symposium Chair**



İsmail Ekmekçi  
**Program Chair**

## Message from the Symposium and Course Chairs

On behalf of the Organizing Committee, it is our great pleasure to invite you to the International Symposium on Sustainable Aviation (ISSA'22), which will be held online, hosting by RMIT University, on 03 - 05 August 2022.

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 August 2022 we look forward to inviting you to this extraordinary event.

Sincerely,

**Raj Das** - Symposium Chair,

**T. Hikmet Karakoc** - Symposium Founding Chair,

**Ismail Ekmekci** - Program Chair

**Lifetime Honorary President of SARES**

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## KS01

# Aircraft Noise Monitoring Gaps in Exposure and Impact Management on the Population around the Airports

Oleksandr Zaporozhets, Professor, Dr.Sc.

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

**Abstract:** Aircraft noise (AN) exposure management on the population around the airports is defined by ICAO Balanced Approach (BA). ICAO guidance on BA (Doc 9829) recommends defining the efficiency of all the four fundamental elements with an assessment of noise index DNL at a point (area) of noise control. Overall, AN exposure around the airport is usually calculated in a form of AN contours – the contour DNL = 65 dBA is defined as inappropriate (prohibited) for residential development. Requirements for AN calculations are defined by ICAO guidance Doc 9911, noise zoning and land use – by Airport Planning Manual (Doc 9184), aircraft noise itself – by Annex 16, vol. 1 'Aircraft Noise' to ICAO Convention. The last one in Appendix 5 describes monitoring as 'to be the routine measurement of noise levels created by aircraft in the operation of an aerodrome. Monitoring usually involves a large number of measurements per day, from which an immediate indication of the noise level may be required'. The noise levels measured according to the Appendix 5 are approximations of perceived noise levels PNL, in PNdB, as calculated by the method described in Appendix 1 of Annex 16, volume 1. ICAO policy in protection from AN impact is defined as a reduced number of people affected by noise – in most cases the people are annoyed because of the number of possible noise disturbances. Noise monitoring in the vicinity of the airports still does not play the role which is usually covered by environmental monitoring, which is generally defined as gathering, assessing and reporting environmental information obtained through continuous or periodic sampling, observation and analysis of both natural variation or changes and anthropogenic pressures and their effects on humans and the environment.

## KS02

# Traditional and Non-traditional Approaches to Attitude Estimation of Small Satellites

**Chingiz Hajiyev, Prof.Dr.**

*Istanbul Technical University, Faculty of Aeronautics and Astronautics*

**Abstract:** To estimate the attitude of small satellites, Kalman filter algorithms can be used. In this case, the measurement inputs of the attitude sensors are easily integrated to accurately estimate the attitude parameters of the satellite. In general, two types of Kalman filter algorithms will be taken into consideration:

- a) Kalman filter based on nonlinear measurements
- b) Kalman filter based on linear measurements (non-traditional approach)

In the first method which is called traditional approach, measurement models are based on nonlinear models of reference directions. Therefore, there is a nonlinear relation between the measurements and the states. In the second case, based on linear measurements, called the non-traditional method, attitude angles are found by attitude determination methods based on vector measurements at each step. Then these are directly used as measurement input in Kalman filter. Hence measurement model is linear in this case since the states are measured directly. Traditional and non-traditional approaches to estimating the attitude of small satellites using the Unscented Kalman Filter (UKF) and Extended Kalman Filter (EKF) are investigated and compared in this study.

## KS03

# Green Future of Civil Aviation on the Land Side and the Air Side

**Birol Kilkis, Professor**

*OSTIM Technical University*

**Abstract:** This presentation will be a compilation of the speaker's all previous presentations in the past SARES meetings, with updates and special focus on green hydrogen/hybrid propelled aircrafts. Comparisons and current weaknesses of electric propulsion will be pointed out. Green and nearly-zero carbon terminal buildings and land-side infrastructure with renewables will be outlined. Carbon responsibility of civil aviation will be compared with military aviation activities and campaigns worldwide, and suggestions will be made to limit their airborne activities and unpeaceful uses of the space against UN resolutions.

## KS04

### How are We Going to Solve the CO<sub>2</sub>-Problem of Aviation?

Joris Melkert

*TU Delft, Faculty of Aerospace Engineering*

**Abstract:** In this keynote lecture the author is going to explain what will be the best and most logical approach in solving the CO<sub>2</sub>-problem of aviation.

## KS05

### Morphing Design Aspects for Business Aircraft for Fuel Consumption Reduction

Ruxandra Mihaela Botez, Full Professor

*École de technologie supérieure ÉTS*

**Abstract:** The Research Laboratory in Active Controls, Avionics and AeroServoElasticity LARCASE at ÉTS is equipped with the Research Aircraft Flight Simulator (RAFS). The RAFS is equipped with a flight dynamics toolbox certified at its highest-Level D for the Cessna Citation X, that is the fastest business aircraft today, and is designed and manufactured in collaboration with CAE Inc. The morphing technique consisted in shapes changes of the horizontal tail shapes for several static cruise conditions according to known shapes of NACA airfoils series. A maximum fuel reduction of 5.6% has been obtained for these NACA 6 digits series. In addition, it was possible to trim the Cessna Citation X by use of the NACA6 series airfoils for the horizontal tail while its fuel consumption was reduced by approximately 3%. This work is interesting because is done in the frame of Green Aircraft Technologies as its main aim is to reduce the fuel flow.

## KS06

# Aero-Engine Performance and Its Emissions Using Biodiesel Fuels and Its Blends

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

*Universiti Putra, Malaysia*

**Abstract:** Biodiesel is still one of the important sources used to replace the utility of commercial fuels in engines. Despite the advantages of using biodiesel, there are challenges to using it in gas-turbine such as low heating value, freezing point, and storage stability. Due to the limited number of studies that touched on the field of running biodiesel in gas-turbine engines, this study aims to enhance the turbojet engine performance and its emissions by using the blend of Jet-A with green fuels. In addition to that, the research goal is to predict the engine performance and the emissions characteristics using GasTurb software. The green fuel has been used as an additive with biodiesel and Jet-A enhanced the Thrust, fuel consumption, exhaust gas temperature, and the emissions (CO, CO<sub>2</sub>, and NO<sub>x</sub>). As well, the GasTurb software was developed to predict the emissions of running the biodiesel in turbine engines. The effect of utilizing a nano-additive in biodiesel was studied in this research as well.

## KS07

# Chemmotological Reliability in the use of Sustainable Aviation Fuels

**Sergii Boichenko, Professor, Doctor of Science (Technical)**

*National Technical University of Ukraine*

**Abstract:** 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. Sustainable Aviation Fuels is a biofuel used to power aircraft that has similar properties to conventional jet fuel but with a smaller carbon footprint. Depending on the feedstock and technologies used to produce it, SAF can reduce life cycle GHG emissions dramatically compared to conventional jet fuel. I represent the main world trends and developments of the Ukrainian Chemmotological Scientific School of in the field of alternative aviation fuels.

## ISS01

# Green Flight Path - Optimizing Flight Procedures to Improve Environmental Performance

**Dr. Annie Liang**

*RMIT University, STEM College*

**Abstract:** In Post-COVID, the air transport sector will eventually recover and grow faster than the global economy, which is introducing significant technological and operational advances. The overall environmental impact is bound to increase since the gap between the growth rate of air traffic and the rate of environmental improvements is widening with respect to important aspects such as emission of greenhouse gases, noise around airports, and contrails at high altitudes. In mid-long term, aircraft operations should be optimized with more focus on improving environmental performance while maintaining safety. With Green Trajectory-based Operation (G-TBO) concept in Intelligent Air Traffic Management system, advanced CNS system, and digital aviation technologies, the eventual achievement of sustainable aviation will become possible.

## ISS02

# World Aviation Recovery: Over Again

**Alper Dalkıran, Dr.**

*SDU University, Isparta, Turkiye*

**Abstract:** After more than two years of fighting against the new Covid-19 pandemic, many countries' prevention and control over the pandemic have achieved good results. The domestic air transport industry has recovered rapidly throughout the world and soon returned to the level of 2019. However, because of the continuous international pandemic situation changes, superimposed on the different prevention and control strategies of various countries global air transportation industry seems to recover too.



## ISS03

# Path to Short-Haul Hybrid-Electric Flights: A Case of a Small 19-Seater Hybrid-Electric Aircraft

**Maršenka Marksel**

*University of Maribor*

**Abstract:** This presentation addresses a way to implement greener aviation technologies, such as hybrid-electric propulsion, into the air transportation network to respond to the increasing environmental challenges posed by growing air traffic. New routes could be established between small airports to ensure better air connectivity in Europe while also connecting disadvantaged areas and relieve congestion at hub airports. Such routes could, for example, be served by micro feeder or 19-seat hybrid-electric aircraft, which produce low or no emissions, have lower operating costs, and are more applicable to environmental constraints. To achieve this and overcome the various challenges posed by the new hybrid-electric technologies, a new strategic roadmap for short-haul air transport is needed to optimize network services with small hybrid-electric aircraft.

## ISS04

# Sustainable Composites for Aircraft Interiors

**Dr. Sanjeev Rao**

*Khalifa University of Science and Technology*

**Abstract:** In the current age of environment awareness, bio-composite alternatives are gaining importance. A combination of carbon neutral natural fibres along with recyclable thermoplastic matrices provides an attractive alternative to the current synthetic ones. Moreover, several current composite manufacturing processes can be utilized to manufacture natural counterparts. In this lecture, hollow core biopanel for aircraft interior panels such as cabin class dividers is introduced. Details of its manufacturing, assembly, testing and modelling will be covered.

## ISS05

# Computing Flows around Rotors Designed for Small-Scale Electric Rotorcraft

**Jelena Svorcan, PhD in ME, Associate Professor**

*University of Belgrade, Faculty of Mechanical Engineering*

**Abstract:** Aviation industry is constantly developing, particularly in the field of sustainable and unmanned aircraft. Although this engineering field is all-inclusive and multidisciplinary, much work is performed on enhancing different computational models suitable for the estimation of flow variables. The ultimate goals are performance and efficiency improvement as well as minimizing noise and negative effects on environment. This presentation will provide insight into several different numerical approaches befitting the rotational lifting surfaces. Special attention will be given to the issues/phenomena appearing at lower Reynolds numbers. Some basic propeller design aspects will be covered. In addition, the presentation will demonstrate and compare different sets of results (also corresponding to different flight regimes). Furthermore, different flow visualizations (velocity, pressure, vorticity fields) will be provided. Some conclusions and guidelines will be given in the end.

## ISS06

# How sustainable is SAF?

**Rafael Silva Capaz, PhD**

*Federal University of Itajubá, MG, Brazil*

**Abstract:** The decarbonization of the aviation sector – which is typically based on cost-intensive projects with rigorous quality control – is a challenge. Even so, initiatives for expanding the use of biofuels “from the road to the sky” have popped-up in several places. In this context, it is reasonable to consider that a sustainable energy transition of the highly competitive aviation sector should be tackled from a broader perspective, i.e., combining environmental and socio-economic issues beyond GHG reductions and different assessment methods. This study summarizes, in a harmonized analysis, the techno-economic and environmental performance of twelve promising pathways for producing alternative jet fuels, considering: i) six different methods for carbon emissions accounting, i.e., attributional LCA, consequential LCA, and four regulatory schemes: the Renovabio in Brazil, CORSIA for international aviation, the Renewable Fuel Standard (RFS) in the United States and the Renewable Energy Directive (RED) in Europe; ii) the mitigation costs (USD/tCO<sub>2e</sub> reduced) into an economic feasibility analysis, and iii) other seven environmental impact categories in a life cycle perspective. All the pathways were evaluated in a Brazilian context. Although Brazil corresponds to a tiny share of 2% of global aviation operations, its huge biomass potential and recognized expertise in bioenergy production could place Brazil as a strategic global supplier of AJF in the future, as already pointed out by some studies.

## ISS07

# Combining Modal Decompositions and Neural Networks to Develop Predictive ROMs

Assoc. Prof. Soledad Le Clainche

*Universidad Politécnica de Madrid*

**Abstract:** Modelling turbulent flows solving the engineering problem mentioned, is a highly complex task that requires a large amount of computational resources. The alternative is developing Reduced order models (ROMs) using (among others): (i) modal decompositions (i.e., singular value decomposition - SVD [1], higher order dynamic mode decomposition - HODMD [2]), (ii) clustering based methods (i.e. principal component analysis - PCA and local PCA [3]) and (iii) machine learning tools [4,5]. The main goal of this work is applying these techniques to solve several engineering problems with applications in aerospace engineering, presenting new strategies to develop efficient and accurate ROMs. More specifically, HODMD is used to identify the main patterns and to develop a ROM in an axisymmetric, time varying, non-premixed co-flow flame and, PCA and LPCA are applied to develop a ROM in a synthetic jet. Finally, machine learning tools (artificial neural networks) are combined with modal decompositions (SVD) to develop a novel and efficient ROM [4].

002

## A Covariance Matching Based Adaptive EKF for Nanosatellite Attitude Estimation

Hasan Kinatas and Chingiz Hajiyev

*Istanbul Technical University, Turkey*

**Abstract:** This study discusses and compares the performance of R-Adaptive Extended Kalman Filters (EKF) with different covariance matching techniques for a nanosatellite attitude estimation. A non-traditional approach is used for the estimation process where the TRIAD and an EKF is integrated to reduce the computational load. In order to make the EKF adaptive, covariance matching techniques are used with single scaling factor (SSF), multiple scaling factors (MSFs) and fading factors (FFs) which is an alternative approach to MSFs. To compare the performance of the proposed algorithms one simulation is performed where a noise increment is applied to the x-axis magnetometer. As a result of the simulation, it is seen that MSFs and FFs approaches are superior to the SSF approach. On the other hand, no differences in performance are observed between the MSFs and FFs approaches.

**Keywords:** Nanosatellite, fault, attitude estimation, covariance matching, Kalman filtering.

003

## Internal Heat Gain in Airport Buildings via Occupants

Okan Kon and İsmail Caner

*Balikesir University, Balikesir, Turkey*

**Abstract:** In airport buildings where there is a very high number of people circulation, the heat gains caused by occupants should be taken into account when calculating the total energy consumption of the buildings. In complex structures used by many people, such as airports, heat gains from people should be calculated. In the study, heat gains from people's clothing surface through convection and radiation were taken into account. The heat gain used here is the amount of heat produced by people. Heat generation occurs in a mechanically ventilated environment in airport buildings, unlike naturally ventilated residential buildings. Therefore, convection heat transfer can occur both naturally and forcedly. In airport buildings, the total heat gain values are found by multiplying the heat gain value calculated for one person with the number of passengers in the airport. As a result, the sum of the amount of convection and radiation heat transfer interior heat gain for a passenger is calculated between 135.719 and 223.711 W, depending on the indoor air velocity.

**Keywords:** Airport buildings, heat generation by occupants, indoor heat gain, convection heat transfer, radiation heat transfer.

008

## Innovative Process for the Purification of Green Aviation Fuel Additive "Dimethoxymethane" : Pervaporation

Derya Unlu

*Bursa Technical University, Bursa, Turkey*

**Abstract:** The aim of this study is purification of aviation fuel additive "Dimethoxymethane" by using pervaporation process. Polyetherimide (PEI) membrane utilized for the purification of dimethoxymethane from dimethoxymethane/methanol mixtures. Membranes characterized by Scanning electron microscopy (SEM) and Fourier transform infrared spectroscopy (FTIR). Purification tests were performed in different feed methanol concentration and operation temperature. Methanol selectivity value was obtained as infinite. The obtained results show that high purity dimethoxymethane green aviation fuel additive can be achieved by pervaporation process.

**Keywords:** Dimethoxymethane, Fuel Additive, Membrane, Pervaporation.

011

## Deceleration Behavior of Super-Lightweight XPS Foams: Number of Layers Effect

Mohammad Rauf Sheikhi<sup>1</sup>, Selim Gürgen<sup>2</sup>, Onder Altuntas<sup>1</sup>, and Melih Cemal Kuşhan<sup>2</sup>

*Eskişehir Technical University, Eskişehir, Turkey<sup>1</sup>*  
*Eskişehir Osmangazi University Eskişehir, Turkey<sup>2</sup>*

**Abstract:** The design of a lightweight structure is extensively researched and implemented in various industries, especially in aircraft applications, and is tied to the green aviation concept. Because a smaller mass requires less lift force and thrust during flight, reducing the weight of an aircraft is an effective way to improve energy efficiency and reduce fuel consumption. In this study, the deceleration properties of XPS foam materials used in the core of composite structures are investigated. The effect of the gradual increase of XPS layers on its deceleration property was discussed. The deceleration of the designed specimens was measured by a drop-tower impact system. The results showed that by increasing the number of layers from one to ten, although their weight increased by only 2 grams, but reduced the deceleration of the samples five times.

**Keywords:** XPS foam, Deceleration, Multi-layer composites, Light-weight structures.

013

## **Green Purchase Intention in the Air Travel Industry: Influence of Environmental Knowledge and Attitude**

**Mahmut Bakır**

*Samsun University, Samsun, Turkey*

**Abstract:** Today, air travel accounts for a significant portion of global carbon dioxide emissions and is a major source of greenhouse gases. Therefore, sustainability concerns are central to all efforts within the air travel industry. Increasing awareness of environmental sustainability also drives customers' purchasing decisions. Although the literature on green purchasing behaviors has been thoroughly researched, explanations for travelers' green purchasing behaviors are limited. This study aims to provide a deeper understanding of green purchase intention within the context of the air travel industry. In doing so, this study investigates the direct and indirect effects of environmental knowledge through green attitude in general on green purchase intention. The data collection process was completed with the questionnaire technique collected from 156 respondents from Turkey. The partial least squares structural equation modeling (PLS-SEM) technique was employed in the analysis of the research model. Research findings showed that there are significant and positive relationships between environmental knowledge, green attitude in general, and purchase intention. Moreover, green attitude appeared to significantly mediate the relationship between environmental knowledge and green purchase intention. As a result, increased environmental knowledge among consumers should not be ignored as it influences purchase intention directly and indirectly in air travel consumption.

**Keywords:** Environmental knowledge, Green purchase intention, PLS-SEM, Air travel, Sustainable aviation.

017

## A Comparative Study of the Reporting Approach for Corporate Social and Environmental Responsibility between Iberia and Turkish Airlines

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**Abstract:** The aim of the present study is to make a side-by-side comparison between the two flag carriers of Turkey and Spain on the method they use to communicate with the public on how they face the social and environmental problems and their responsibility towards the community. Two different frameworks for addressing CSR are analyzed, one based on the UN Sustainable Development Goals (SDGs) on other based on Global Reporting Initiative Standards (GRI), the reports taken in account were sustainability reports published during 2019, 2020 and 2021 by both companies. The results showed that Iberia, using the SDG method, published reports with less content and in general not very technical focusing more on social responsibility, unlike Turkish Airlines, which used the GRI method, publishing more technical reports, however, they used more infographics and images to make the display of the information more didactic. It worth mentioning that Iberia didn't outsource the redaction of the reports whereas Turkish Airlines did it, being a de-balancing factor in the quality and approach.

**Keywords:** Corporate social responsibility, airline industry, sustainability reporting, Iberia, Turkish Airlines.

018

## Fuel Efficient Flight Level Assignments under Wind Uncertainties for the Conflict Resolution Problem at the En-Route Phase

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**Abstract:** Conflict resolution problem can be solved using three different approaches that are airspeed change (SC), heading angle change (HAC), and flight level change (FLC). SC and HC do not affect the vertical position of aircraft; however, changing the flight level of an aircraft causes an interaction between different levels. Also, the wind effect may change between the levels, which can affect the aircraft's ground speeds. In such a situation, controllers may need to intervene to ensure minimum separations between aircraft. Even though FLC is performed with a single instruction, conflict resolution using this approach creates follow-up difficulties for the controllers. This study develops a stochastic conflict resolution algorithm by considering the FLC instructions to help the controller decisions. To find out the possible benefits of the model, it is compared to deterministic and expected value approaches. Real wind data is obtained from the weather sound database and integrated into the model. Both wind speed and wind direction uncertainties are considered, and the differences between the wind speeds for different levels are reflected in the model as coefficients. As a result, the presented model provided an average of 3.5% fuel savings compared to the deterministic approach and resulted with resilient solutions applicable under wind uncertainties.

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

019

## MCDM Risk Assessment in Ground Operation

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**Abstract:** Performing operations on time is imperative to aviation on both the ground and flight sides. Minutes, considered worthless in daily life, are crucial for airlines to carry out various processes. Failure to conduct an operation on expected time causes delays correlatively. In addition, airlines prioritize preventing safety gaps caused by time constraints. The avoidance of accidents in aviation in which the human factor has to be taken into account, is possible with proactive solutions. This study examines safety issues and accident sources in ramp operations using the Multi-Criteria Decision Making approach. The risk factors determined by classification and pairwise comparisons are scored on a 5-point Likert scale according to the PROMETHEE Method, considering weight percentages.

**Keywords:** Air transportation, Ground operation, Multi criteria decision making, Ramp safety, Risk assessment.



020

## Optimization of Cutting Parameters in Face Milling of Waspaloy Superalloy

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**Abstract:** Waspaloy is a superalloy material with wide applications in the aerospace industry. In this study, Waspaloy superalloy was face milled using coated carbide inserts under dry cutting conditions. The effect of cutting parameters on cutting force was investigated experimentally and statistically. The Taguchi Method was used as a statistical method. Cutting speed, feed rate and cutting tool were selected as input parameters. 16 experiments were performed with a Taguchi orthogonal experimental design. A comparison of the experimental data with the data obtained from the prediction models showed results with acceptable accuracy. In measuring the prediction adequacy of the test results, the quadratic model was used and the coefficient of determination  $R^2 = 87.58\%$ . The effects of cutting parameters on cutting forces were analyzed using ANOVA. According to the results of the analysis, it was determined that the most effective parameter on the cutting forces was the cutting tool (GC2030) with a rate of 82.99%. The feed rate is 2.75% and the cutting speed is 1.80% effective. As a result of the optimization made with the Taguchi method, it was determined that the cutting speed was 20 m/min, the feed rate was 0.1 mm/tooth, and the cutting tool gave better results in GC2030. The data obtained as a result of the validation experiment is within the confidence interval. This result confirms the suitability of Taguchi optimization for shear force.

**Keywords:** Cutting force, Waspaloy, Taguchi method, Face milling.

021

## The Role of Additive Manufacturing Towards Sustainable Aerospace Structures

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**Abstract:** The continual increase in aviation and aerospace operations globally has ushered in a large increase in the development of innovative materials and structures. With the need for sustainable aerospace platforms and operations paramount, the creation of more efficient, lightweight structures is necessary for future operations. Additive manufacturing (AM) presents the unique ability to fabricate highly optimised, complex structures that can reduce the associated environmental impact in their development, sustainability and operation. Whilst still yet to be fully utilised, the abundant benefits that arise from AM technology have and will enable a plethora of new avenues to be explored. This paper outlines the importance of AM technology towards a more sustainable aerospace sector and flags the novel opportunities it provides for future development. The primary advantages of AM that contribute to this are analysed, including reduced mass, material usage and production costs, as well as its prospective capabilities of in-space manufacturing and in-situ resource utilization.

**Keywords:** Additive manufacturing, Sustainable outlook, Structural optimisation, Material efficiency, Future opportunities.

022

## Cost and Weight Optimization of Recyclable Honeycomb Sandwich Panels

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**Abstract:** In this study, four-parameter sub-optimization considering their failure modes has been performed on honeycomb core sandwich panels to obtain optimal weight. Five common failure criteria were used in the analysis of sandwich beam under four-point bending (quarter-span), considering the core material to be isotropic or specially-orthotropic. The five chosen failure criteria yielded five different failure mode combinations. The sub-optimal weights for the five failure mode combinations were obtained at the confluence of four failure criterion, of which one is the global optimum. Aluminium (5052-H34 alloy), was chosen as the facesheet material with the core material types (unreinforced and fiber reinforced composites). The shear strength of all fiber-reinforced cell wall materials has been assumed to be 0.6 times the tensile strength of the material in the direction of the fibers and the fiber volume fraction,  $v_f$  was taken to be 0.3 for all fiber-reinforced core materials.

The optimal weight index was determined for load indices ranging from  $1 \times 10^{-8}$  to  $1 \times 10^{-6}$ , which corresponds to loads (per unit width) between 703Nm and 70300Nm. On close examination the dominant mode of failure for these panels at lower relative densities closer to  $10^{-4}$  is intracellular buckling, which changes to core buckling when the relative densities get closer to  $10^{-3}$ , but at higher relative densities this changes to facings cracking in tension. The optimal weight index predicted by the manual and Matlab procedure was 0.42 kg/m<sup>3</sup> at a failure combination of FC-FW-IB-CB. However, the Matlab optimization predicts the same weight index at the confluence of only three (FW, IB and CB) failure criteria, as opposed to the confluence of four failure criteria (FC, FW, IB and CB) in the manual optimization method.

**Keywords:** Recyclable, Honeycomb, Sandwich panel, Optimisation, Failure.

023

## Non-Uniform Inlet Thermal Conditions Inside a Virtual Aircraft Cabin - Part I: Human Thermal Response

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**Abstract:** This article describes the influence of a non-uniform inlet thermal conditions on the indoor air quality and thermal comfort provided by a personalized ventilation (PV) system for the occupants of an aircraft cabin. The PV system is based on a ceiling-mounted air distribution system consisting of individual air inlets positioned over the breathing zone of the occupant and air exhausts positioned close to the ceiling over the space between every two occupants seated side by side. The non-uniform environment was simulated by a distribution of different air inlet velocities over the occupants. The study is performed numerically inside a virtual section of an aircraft cabin similar to an experimental chamber available in the laboratory. The numerical simulation was carried out using own research software consisting of three numerical models, one to simulate the thermal response of the cabin, and one to simulate the airflow around the occupants coupled to another to simulate the environmental variables distribution around the occupants. For all occupants, the results show that both thermal comfort, evaluated here by the Predicted Mean Vote index, and air quality in the breathing area, evaluated here by the concentration of dioxide carbon, are acceptable according to international standards.

**Keywords:** Ceiling-mounted Ventilation System, Indoor Air Quality, PMV, Virtual Aircraft Cabin.

024

## A Research on Determination of Fuel Properties of Biofuel Mixtures in Aviation Fuels

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**Abstract:** Cold flow properties in aviation fuels are very important in terms of flight safety. The cold flow properties of biofuels are worse than aviation fuels, but their cold flow properties can be improved with additives added to the fuels. There is no study in the literature when the studies done so far regarding the onopordum biodiesel used in this study are examined. The production method of Onopordum biodiesel has been patented by the author of the Turkish Patent Institute's document numbered 2022/05453. Onopordum biodiesel was mixed with JP-8 fuel, which is a military aviation fuel, in certain proportions (B2, B3, B5) to obtain biojet fuel. To test the cold flow properties of the obtained biojet fuel, experiments were carried out by adding TBHQ, BHT, Pentanol and PMA additives to the mixtures. According to the results of the experiment, the most advanced cold flow properties were achieved by adding TBHQ and PMA additives together. This study has been done for the first time in the world literature for Onopordum biofuel, and it is possible to test the additives added to the fuel mixtures with different ratios or to produce different alternative fuels by diversifying the types of additives used.

**Keywords:** Fuel, Biojet, Environment, Aviation, Sustainability.

025

## Evaluation of Air Transport Projects Development by (AHP)

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**Abstract:** Due to the accelerated and high competition levels of the transport market conditions in the aviation sector, the structured approach of aviation has generated a sophisticated air transport systems where the quality is sensitive and immediately responsive to the supply side. Quantifications of quality have become increasingly important. Due to the system's diversity, interdependency, and unsupportable properties, calculating quality factors is not an easy process. In order to do this, the analytical hierarchy process (AHP) employed for four groups of aviation specialists to create a Survey based on three-level hierarchy model of the quality of the air transport supply in order to assess and balance the important and critical factors of the current air transport system. A general air transport supply quality model built by hierarchical structure with four primary criteria, fifteen first-level sub-criteria, and twelve second-level sub-criteria.

**Keywords:** Air Transport, Supply Quality, Multi-criteria decision making, analytical hierarchy process, Pilot, ATCO.

026

## Non-uniform Inlet Thermal Conditions Inside a Virtual Aircraft Cabin Part II: CFD and HVAC System Performance

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**Abstract:** The non-uniform inlet thermal conditions inside a virtual aircraft cabin are analysed in this paper. The Computational Fluids Dynamics, CFD, and the Heating, Ventilating and Air Conditioning, HVAC, system performance is studied. This software consider three numerical models that simulate the Aircraft Cabin Thermal Modelling, a Passenger Thermal Modelling and a Computational Fluids Dynamics. This numerical study, that considers the inlet non-uniform conditions, simulates a virtual chamber, used as Aircraft Cabin, occupied by 24 passengers.

**Keywords:** CFD, HVAC System, ADI.

027

## Negative Emission Technologies: Miraculous Solution or Aberrant Blindness?

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**Abstract:** The IPCC tries to imagine scenarios to meet the objective of limiting global warming to +1.5°C compared to the pre-industrial period. One scenario places importance on negative emission technologies (NETs). NETs involve taking GHGs and storing them underground or in the oceans. CCS is complex in many ways: there are differing views on the feasibility of the technology, its sequestration capacity, its deployability, and its long-term safety and stability. It was therefore interesting to know if they are a miraculous solution or an aberrant blindness. This study aims to study the representations of NETs among academics and to see how representations of the economy and the environment are determinant in the representations of NETs. The research is based on semi-directive interviews with seven academics. The results show, through discourse analysis, that academics neither support nor totally reject NETs. These social representations vary on the place that academics give to NETs among solutions to address global warming. Support for NETs and CCS is conditional on the implementation of a range of other decarbonization solutions, particularly renewable energy and energy efficiency. Interviewees are quite critical of the environmental impacts of CCS, the economic cost and the carbon sequestration capacity.

**Keywords:** Carbon Capture and Storage, environment, economy, global warming, social representations.

028

## Sustainable Operations for Airport Warehouse Cargo Management

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**Abstract:** Examining and standardizing airport warehouse processes due to the changing management style, shifts, and management reports among managers is essential. Airport cargo warehousing standardization operations will ensure planning tasks with the standardized activity rules based on schedule-requirement analysis. Thus, non-standard approaches can be eliminated, and cargo operational efficiency and operational sustainability can be achieved. Key performance indicators must be defined and followed to ensure sustainable operational excellence. Also, workforce standards should be defined as local/global. Standard airport cargo procedures should be specified for critical decision points in daily operations. This study assessed the effectiveness and impact of buildup, breakdown, acceptance, delivery, and x-ray activities in airport cargo operations.

**Keywords:** Operational Sustainability, Air Cargo Handling, Warehouse Management, Standardization.

029

## Outlines of Sustainable Air Transportation in ICAO Annex Documents: Roots of Sustainability

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**Abstract:** Sustainability in aviation assesses three dimensions; social, economic, and environmental domains have many specific focus areas to measure sustainable aviation. On the other hand, ICAO Annex documents aim to standardize the aviation industry to harmonize the other elements of aviation, which are airlines, airports, and ground handling companies. Annex documents have succeeded these three stakeholders in those three domains of sustainability. The nature of standardization led organizations to survive for decades and centuries; if the concept remains alive that much, so sustainability will always be a part of standardization. This paper investigates the roots and index of sustainability by examining each possible index to match the sub-criteria of each domain. As a first step, studies have focused on economic sustainability, which is the key to commercial companies' primary target. However, standardization in the annex document targeted social and environmental factors rather than economic ones. Furthermore, all domains have been discussed in the conclusion section.

**Keywords:** Sustainability, Sustainable aviation, Economic sustainability, ICAO, Annex.

030

## World Air Transportation Recovery after COVID-19 Restricts

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**Abstract:** While the global domestic market trended sideways, international and domestic market recovery was revealed by the numbers of published reports. The significant international routes have already outperformed the figures of the previous peaks of 2019. Inflation appears to be exposing itself at the bottom through a lack of bookings, but changes in the price of jet fuel have not stemmed the rise. Countries that rely heavily on international travel, such as many developing countries, will not reach 2019 passenger numbers until 2025 or 2026. This study gathers many reports and papers together to have a current snapshot for the benefit of the authors in the symposium.

**Keywords:** Air transportation, Aviation recovery, Covid-19 effect, Traffic improvements, Global aviation market.