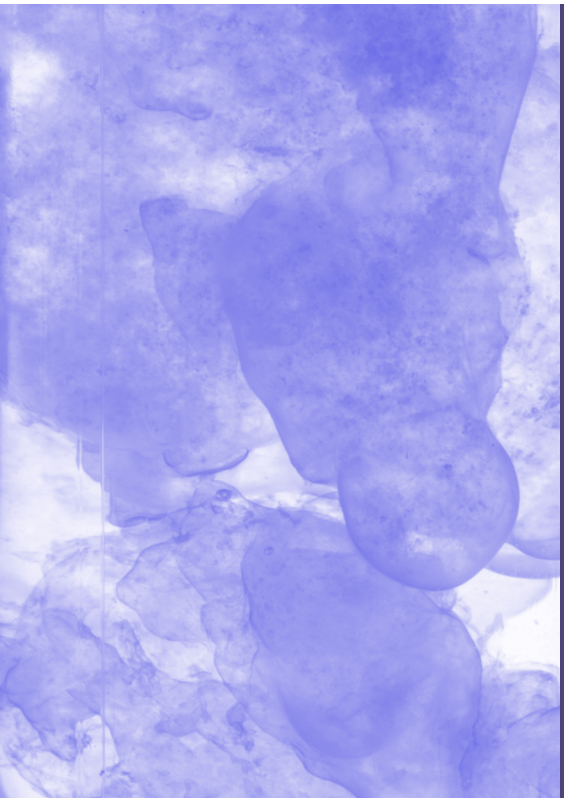
Applied Sciences
an Open Access Journal by MDPI

Impact Factor 2.5
CiteScore 5.3

Section
Aerospace Science and Engineering



mdpi.com/
journal/
applsci

MDPI

Section Information

The Section “Aerospace Science and Engineering” aims to advance our understanding of aeronautics and astronautics by publishing novel and high-quality work ranging from aircraft design to artificial intelligence control. The Section welcomes contributions from theoretical, numerical, and experimental studies in a wide range of aerospace science and technologies, from fundamentals to application studies.

Section Editor-in-Chief
Prof. Dr. Dongsheng Wen

Subject Areas

- Aircraft design and manufacturing
- Jet engine and propulsion
- Aerodynamics and design
- Structure and properties
- Environmental control and life protection systems
- Flight control and dynamics
- Astrodynamics
- Space science and engineering
- Artificial intelligence in aerospace applications

Content Highlights

Remaining Useful Life Prediction of Aircraft Turbofan Engine Based on Random Forest Feature Selection and Multi-Layer Perceptron

Authors: Hairui Wang ,Dongwen Li, Dongjun Li, Cuiqin Liu, Xiuqi Yang and Guifu Zhu

Abstract: The accurate prediction of the remaining useful life (RUL) of aircraft engines is crucial for improving engine safety and reducing maintenance costs. To tackle the complex issues of nonlinearity, high dimensionality, and difficult-to-model degradation processes in aircraft engine monitoring parameters, a new method for predicting the RUL of aircraft engines based on the random forest algorithm and a Bayes-optimized multilayer perceptron (MLP) was proposed here. First, the random forest algorithm was used to evaluate the importance of historical monitoring parameters of the engine, selecting the key features that significantly impact the engine's lifetime operation cycle. Then, the single exponent smoothing (SES) algorithm was introduced for smoothing the extracted features to reduce the interference of original noise. Next, an MLP-based RUL prediction model was established using a neural network. The Bayes' online parameter updating formula was used to solve the objective function and return the optimal parameters of the MLP training model and the minimum value of the evaluation index RMSE...

https://doi.org/10.3390/app13127186

Solar Sail Orbit Raising with Electro-Optically Controlled Diffractive Film

Authors: Alessandro A. Quarta and Giovanni Mengali

Abstract: The aim of this paper is to analyze the transfer performance of a spacecraft whose primary propulsion system is a diffractive solar sail with active, switchable panels. The spacecraft uses a propellantless thruster that converts the solar radiation pressure into propulsive acceleration by taking advantage of the diffractive property of an electro-optically controlled (binary) metamaterial. The proposed analysis considers a heliocentric mission scenario where the spacecraft is required to perform a two-dimensional transfer between two concentric and coplanar circular orbits. The sail attitude is assumed to be Sun-facing, that is, with its sail nominal plane perpendicular to the incoming sunlight. This is possible since, unlike a more conventional solar sail concept that uses metalized highly reflective thin films to reflect the photons, a diffractive sail is theoretically able to generate a component of the thrust vector along the sail nominal plane also in a Sun-facing configuration. The electro-optically controlled sail film is used to change the in-plane component of the thrust vector to accomplish the transfer by minimizing the total flight time without changing the sail attitude with respect to an orbital reference frame...

https://doi.org/10.3390/app13127078

Learning Methods and Predictive Modeling to Identify Failure by Human Factors in the Aviation Industry

Authors: Rui P. R. Nogueira, Rui Melicio, Duarte Valério and Luís F. F. M. Santos

Abstract: This paper proposes a model capable of predicting fatal occurrences in aviation events such as accidents and incidents, using as inputs the human factors that contributed to each incident, together with information about the flight. This is important because aviation demands have increased over the years; while safety standards are very rigorous, managing risk and preventing failures due to human factors, thereby further increasing safety, requires models capable of predicting potential failures or risky situations. The database for this paper's model was provided by the Aviation Safety Network (ASN). Correlations between leading causes of incident and the human element are proposed, using the Human Factors Analysis Classification System (HFACS). A classification model system is proposed, with the database preprocessed for the use of machine learning techniques. For modeling, two supervised learning algorithms, Random Forest (RF) and Artificial Neural Networks (ANN), and the semi-supervised Active Learning (AL) are considered. Their respective structures are optimized applying hyperparameter analysis to improve the model. The best predictive model, obtained with RF, was able to achieve an accuracy of 90%, macro F1 of 87%, and a recall of 86%, outperforming ANN models, with a lower ability to predict fatal accidents. These performances are expected to assist decision makers in planning actions to avoid human factors that may cause aviation incidents, and to direct efforts to the more important areas.

https://doi.org/10.3390/app13064069

Design and Reliability Analysis of a Series/Parallel Hybrid System with a Rotary Engine for Safer Ultralight Aviation

Authors: Teresa Donateo and Ludovica Spada Chiodo

Abstract: The conventional powertrain for ultralight aviation consists of a fixed pitch propeller connected to an internal combustion engine (ICE). Since ICEs have a limited thermal efficiency (<40%), new and more efficient powerplant configurations have recently been proposed in the scientific literature by adopting hybrid electric solutions. Hybridization has the additional benefit of increased safety thanks to redundancy. This is a very important issue in ultralight aviation, where a high percentage of accidents are caused by engine failure. In a previous investigation, the authors proposed the design of a series/parallel hybrid electric power system to increase safety and optimize fuel economy by controlling the engine working points during flight. A new powertrain, derived from an automotive Honda i-MMD system, is analyzed in this study and a reliability analysis is performed to underline the improved safety obtained with the proposed system.

https://doi.org/10.3390/app13074155

A Review on Ultrafast Laser Enabled Excellent Superhydrophobic Anti-Icing Performances

Authors: Lizhong Wang, Huanyu Zhao, Dongyu Zhu, Li Yuan, Hongjun Zhang, Peixun Fan and Minlin Zhong

Abstract: Fabricating and developing superhydrophobic anti-icing surfaces have been a research hotspot for eliminating undesired icing issues. Among various fabricating strategies, ultrafast laser micro-nano fabrication is regarded as a greatly promising technique owing to its advantages of high geometric accuracy, highly flexible microstructure or dimension availability, no contact, and no material limitation. A number of diverse micro-nanostructured superhydrophobic surfaces have been developed by ultrafast lasers and demonstrated extraordinary anti-icing properties. They are collectively known as ultrafast laser-fabricated superhydrophobic anti-icing surfaces (ULSASs). In this article, we reviewed the recent advances in ULSASs from micro-nano structure fabricating to anti-icing performances and to potential applications. The surface wettability and mechanisms of ultrafast laser micro-nano fabrication are first introduced, showing the strong ability of ultrafast laser for fabricating superhydrophobic surfaces...

https://doi.org/10.3390/app13095478

MDPI is a member of

Editorial Office
applsci@mdpi.com

MDPI
Grosspeteranlage 5
4052 Basel, Switzerland
Tel: +41 61 683 77 34
mdpi.com