Machine Learning-Based Predictive Analytics for Aircraft Engine

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1. Machine Learning- Based Predictive Analytics for Aircraft Engine

Big data and machine learning are transforming the global business environment. Data is now the most valuable asset for enterprises in every industry. With that, the adoption of machine learning-based data analytics is rapidly taking hold across various industries, producing autonomous systems that support human decision-making. This work explored the application of machine learning to aircraft engine conceptual design. Supervised machine learning algorithms for regression and classification were employed to study patterns in an existing, open-source database of production and research turbofan engines, and resulting in predictive analytics for use in predicting performance of new turbofan designs. He developed machine learning-based analytics to predict cruise thrust specific fuel consumption (TSFC) and core sizes of highefficiency turbofan engines, using engine design parameters as the input.

The predictive analytics were trained and deployed in Keras , an open-source neural networks application program interface (API) written in Python, with Google's Tensor Flow (an open source library for numerical computation) serving as the backend engine. The promising results of the predictive analytics show that machine-learning techniques merit further exploration for application in aircraft engine conceptual design.

2. Approach And Landing Aircraft on-board Parameters Estimation:

This addresses the problem of estimating aircraft on-board parameters using ground surveillance available parameters. The proposed methodology consists in training supervised Neural Networks with Flight Data Records to estimate target parameters. This paper investigates the learning process upon three case study parameters: the fuel flow rate, the flap configuration, and the landing gear position. Particular attention is directed to the generalization to different aircraft types and airport approaches. From the Air Traffic Management point of view, these additional parameters enable a better understanding and awareness of aircraft behaviors. These estimations can be used to evaluate and enhance the air traffic management system performance in terms of safety and efficiency.

3. Monitoring Of Aircraft Operation Using Statistics and Machine Learning:

This describes the use of statistics and machine learning techniques to monitor the performance of commercial aircraft operation. The purpose of this research is to develop methods that can be used to generate reliable and timely alerts so that engineers and fleet specialists become aware of abnormal situations in large fleet of commercial aircraft that they manage. We introduce three approaches that we have used for monitoring engines and generating alerts. We also explain how additional information can be generated from machine learning experiments so that the parameters influencing the particular abnormal situation and their ranges are also identified and reported. Various benefits of fleet monitoring are explained in the paper.

4. Aircraft Engine Reliability Analysis Using Machine Learning Algorithms:

In the aviation industry, the reliability analysis of aircraft engines is essential for ensuring the smooth functioning of each component of an aircraft engine. The reliability analysis is also important to predict their scheduled maintenance event and the Remaining Useful Life (RUL) of engine parts. Existing approaches for engine reliability are based on numerical methods, which do not predict RUL accurately. Hence, a more accurate model is required for predicting maintenance events. The reliability of an aircraft engine can be measured using readings of different sensors. In this work, the performances of different machine learning algorithms are studied, and finally, a better algorithm is suggested for predicting RUL. Additionally, a classification approach is proposed to classify the health state of an engine. The experimental results show that the XG Boost gives the best prediction accuracy in terms of root mean square error. The proposed Light GBM-based classifier further enhances the maintenance prediction based on the health state of the aircraft engine. Thus, the proposed analysis shows that XG Boost and Light GBM is a better choice for predicting the RUL, and for classifying the health state of the aircraft engine.

5. Predictive Maintenance and Performance Optimisation in Aircrafts using Data Analytics :

Airline industry has provided a significantly conventional, faster and reliable mode of transportation for passengers and freight over the decades in which the industry has been in service despite the pressure being applied especially in maintaining operational affordability. The study critically reviews the techniques and tools, infrastructure and general application architecture for discussing the applicability of data analytics based on both batch processing and real time stream data in general aviation for health monitoring and predictive analysis in order to predict maintenance and optimize the performance of aircrafts. In this respect, the study further evaluates the significant capability in addressing contemporary problems which are uniquely addressed by data analytics systems.

6. Application of Machine Learning Techniques to Web-Based Intelligent Learning Diagnosis System:

This work proposes an intelligent learning diagnosis system that supports a Web-based thematic learning model, which aims to cultivate learners' ability of knowledge integration by giving the learners the opportunities to select the learning topics that they are interested, and gain knowledge on the specific topics by surfing on the Internet to search related learning courseware and discussing what they have learned with their colleagues. Based on the log files that record the learners' past online learning behavior, an intelligent diagnosis system is used to give appropriate learning guidance to assist the learners in improving their study behaviours and grade online class participation for the instructor. The achievement of the learners' final reports can also be predicted by the diagnosis system accurately. Our experimental results reveal that the proposed learning diagnosis system can efficiently help learners to expand their knowledge while surfing in cyberspace Web-based "theme-based learning" model.