Machine Learning-Based Predictive Analytics for Aircraft Engine

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PRE-REQUISITE:

In order to develop this project we need to install following software/packages :

Anaconda Navigator-jupyter notebook,spyder.

Packages installation-Sklearn,Numpy,Pandas,Matplotlib,Flask.

GiTHUB ACCOUNT :

- Open https://github.com in a web browser, and then select Sign up.
- Enter your email address.
- Create a password for your new GitHub account, and Enter a username, too. Next, choose whether you want to receive updates and announcements via email, and then select Continue.
- Verify your account by solving a puzzle. Select the Start Puzzle button to do so, and then follow the prompts.
- After you verify your account, select the Create account button.
- Next, GitHub sends a launch code to your email address. Type that launch code in the Enter code dialog, and then press Enter.
- I have created my github account with the email id appubena2002@gmail.com

GitHub id: IBM-Project-45965-1660733782

Installation Anaconda navigator :

Head over to anaconda.com and install the latest version of Anaconda. Make sure to download the “Python 3.7 Version” for the appropriate architecture.

LITERATURE SURVEY

REVIEW- 1

Title Of The Paper:

Predictive Maintenance Of Aircrafts Engine

Name Of The Author:

Khalid Khan,Muhammed Sohaib,Azaz Rashid,Abdul Basit,Saddam Ali and Tanvir Ahmad.

Problem Description:

The predictive maintenance strategies are based on real time data for diagnosis of impending failures and prognosis of machine health.It is a proactive process,which needs predictive modelling to trigger an alarm for maintenance activities and anticipate a failure before it occurs.This paper provides a survey of recent work on predictive maintenance of aircrafts hydraulic system and engine ,identifying new trends and challenges.This work also highlights the importance of predictive maintenance and state-of-the-art data pre-processing techniques for large datasets.A review of state-of-the-art predictive maintenance techniques in use for aircrafts hydraulic system and engine has been explored in this work.The problem considered in this experimentation was to detect failure pattern when the fluid level reaches a critical value for creating an anomaly alert.Use off window-based pattern recognition has shown good results in detecting the failure well in advance.This paper also presents an LSTM based prognostics technique for aircraft fault prediction.The model is capable of correctly predicting engine behavior.

REVIEW 2:

Title Of The Paper :

Machine Learning Based Predictive Analysis for Aircraft Engine Conceptual design

Name Of The Author:

Michael T.Tong

Problem Description:

This work explored the application of machine learning to aircraft engines conceptual design.Supervised machine learning algorithms for regression and classifications were employed to study patterns in an existing ,open-source database of production and research turbofan engines,and resulting in predictive analysis for use in predicting performance of new turbofan designs.The promising results of the predictive analysis show that machine-learning techniques merit further exploration for application in aircraft engine conceptual design.Machine learning based predictive analytics can be an effective tool for engine design-space exploration during the conceptual design phase.

REVIEW- 3

Title Of The Paper:

Analysis Of Aeronautical Engines Based On Machine Learning

Name Of The Author:

Enrique Lopez Droguett.

Problem Description:

During the development of this work ie.. Once a portion of the data is selected and obtained, the next step is to process it. A feature of interest is selected as target (fuel consumption). Follow the standard approach independent train and test splits are selected and normalized (using constants obtained from train data). Temporal windows are applied to data and then it is feed it to a LSTM neural network architecture. The model aims to predict the fuel mass flow rate having as an input the remaining features (EGT, Altitude, high and low rotor's speed). This problem is defined as a supervised regression task, i.e., the prediction of a real numeric variable. • Finally the model is used as an anomaly detection model, considering a threshold that identifies abnormal differences between true and predicted data. **t**he main topics studied where engine health monitoring, deep learning (DL) for anomaly detection, and aviation software simulation. Additional topics included backpropagation, dropout, RNN and LSTM to include the mathematical formulations and historical line in the development of algorithms used in this work.

REVIEW 4:

Title Of The Paper :

Predictive Maintenance of the Aircraft Engine Bleed Air System Component

Name Of The Author:

Savitha Ramasamy,Richard Han ,Nelson Low

Problem Description:

This paper presents a predictive maintenance solution of an aircraft engine bleed air system component using ma-chine learning approaches on aircraft Quick Access Recorder (QAR) data. The solution involves: (a) pre-processing QAR data for obtaining a subset of parameters relevant to the bleed air system component, (b) generating features from the parameter subset that are clearly discriminative of the health status of the component, (c) deriving the health status of the component based on airlines maintenance records and observed QAR signals, (d) training a machine learning classifier that learns the relationship between the generated features and the health status. We train the model on QAR

data obtained over a two-month period pivoted on all the failures in the aircraft fleet. Performance results show that the model is capable of accurate component health prediction with very low false alarm rate and high overall accuracy (above 90%).

REVIEW 5:

Title Of The Paper :

Aircraft Engine Reliability Analysis using Machine Learning Algorithms.

Name Of The Author:

Deepankar Singh; Mithilesh Kumar; K.V. Arya; Sunil Kumar

Problem Description:

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 XGBoost gives the best prediction accuracy in terms of root mean square error. The proposed LightGBM-based classifier further enhances the maintenance prediction based on the health state of the aircraft engine. Thus, the proposed analysis shows that XGBoost and LightGBM is a better choice for predicting the RUL, and for classifying the health state of the aircraft engine.

PAPER REFERENCE:

- Adams, S., .Meekins, R., Beling, P. A., Farinholt, K., Brown, N., Polter, S., & Dong, Q. (2017). A comparison of feature selection and feature extraction techniques for condition monitoring of a hydraulic actuator. Annual Conference of the Prognostics and Health Management Society, 2017.
- ASF-230, O. (2004, April). Ac 120-82 - flight operational quality assurance (Tech. Rep.). Federal Aviation Administration.