PREDICTIVE MAINTENANCE AND PERFORMANCE OPTIMIZATION FOR JET ENGINES BASED ON ROLLS-ROYCE ENGINE MANUFACTURER AND SERVICES WITHIN THE AEROSPACE SECTOR

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5.1 Summary

This study aims to bring forth predictive maintenance system for jet engines by utilizing extensive sets of engine performance data and sensor information to the full potential for predicting possible engine malfunction, enhance maintenance plans to increase engine effectiveness. From the analysis, it can be concluded that the predictive analysis following Rolls Royce approach are vital in foresee the RUL for jet engine.

Through the use of CMAPPS turbofan jet engine data from NASA together with the 21 sensors for EDA and feature engineering by applying first two machine learning model which are Linear regression and SVR, we can determine and compare the RUL for the 100 units of jet engines. The sensor's features that are having high correlation with the RUL of the jet engines also has been successfully identified.

To summarize based on initial insights, jet engine can achieve the maximum cycles time is the range 190 and 210 before the High Pressure Compressor failure. The greatest engine performance is at first 50% or up to second quartiles and the trend goes down going through the next third and fourth quartile. As a result, this discovery offers insightful information to apply data-driven strategy to predict potential failures in advanced facilitate by manufacturers and service providers improve the predictive maintenance services for aerospace manufacturer and services sector.

5.2 Future Works

Few gaps have been identified as the outcome of this research and these shall be addressed as improvements in the future. This study suggested a few suggestions and insights that could be useful for potential researchers to further explore the research scope on the predictive maintenance of jet engine for engine health monitoring topic within the aerospace sector.

There are few aspects that can be taken into count for expanding the research further. First and foremost, sensor data can be altered by scaling the data with certain the range given by applying method of MinMaxScaler to transform the sensor features.
At the same moment, the machine learning model used are only 2 out of 6 model listed and 4 more model shall be applied to continue the research. While running the model, it is advisable to train and test at least 5-10 times for 5 figures dataset to be able to view the clearer output pattern before deciding the RUL besides plotting the visualization for each sensor output to view the trend and further evaluate the finding.

On the contrary, the classification on RUL could be done by group it into 3 classes which are 'No risk, Moderated risk and Risk zone". This is believed to be beneficial for improving the predictive maintenance schedule. In succession, there are 2 more set of data listed in the study which are Aviation Data from ICAO/FAA aircraft engine emissions databank and IoT simulated sensor dataset hence these data shall undergo phase 3 to 6 dataset to explore more about the validation purpose involving testing fault detection performance by using simulated engine data, besides fault detection accuracy and latency reduction as primary performance metrics.

Subsequently, it would be beneficial to have multi-sensor fusion whereby exploration in algorithms needed to combine vibration, acoustic and thermal data for the purpose of enhancing fault detection accuracy. On this occasion, data from the engine emission databank could be used to investigate the predictive maintenance's role in improving fuel efficiency and lowering the carbon emission. In summation, actionable insights are useful for dashboard designing with the sole purpose of providing ultimate understanding in between maintenance teams and the decision-makers for further improving predictive maintenance schedules.