Machine Learning Application on Aircraft Fatigue Stress Predictions

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Machine learning applications are rapidly gaining momentum and already offer significant benefits in many areas of industry; from traffic predictions and flow of goods to fighting cancer, the world is turning increasingly to intelligent algorithms to overcome its most persistent challenges. With an ever-growing demand for air travel and an increasingly competitive market, it has now become a priority for commercial aircraft manufacturers to join the digital revolution.

The fundamental requirement for tailored aircraft maintenance solutions providing fully optimised scheduling without compromise to safety is knowledge of real-world aircraft usage. By harvesting fleet-wide aircraft usage parameters (e.g. 'big data' flight-by-flight recordings, meteorological conditions, etc), and exploiting them with the application of validated machine learning algorithms, highly accurate predictions of the internal loading conditions of a structure become possible based on measured and recorded aircraft parameters (e.g. speed, altitude, flight-configurations, accelerations etc). The major benefit of such data analytics is the possibility to recreate the real loading sequence as experienced by the structure. To fully validate any conclusions from machine learning, it must be recognised that other information will need to be considered in the context of the analysis, e.g. additional in-service data, full scale test results, theoretical analyses, etc.

The significance of the potential capabilities held by machine learning applications to predict aircraft structure internal load distribution is a major enabler for linking and comparison of practical aircraft usage against that of any average fleet or initial assumptions; the unlocking of such potential offers game-changing benefits in civil aviation.

The main input needed to make relevant and reliable predictions is a comprehensive dataset. Generally speaking, this and most other parts of the puzzle are already available; the main challenge for machine learning will be to integrate these parts harmoniously, obtaining new predictive capabilities by enhancing analytical power.