Advancements in Aviation Maintenance: From CBM+ Strategies to Predicting RUL of Avionic Electronic Equipment

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In the aviation field, maintenance methodologies have evolved from Corrective Maintenance, Preventive Maintenance to the more advanced Predictive Maintenance. In the past, when a fault occurred about a specific equipment, the equipment was checked for abnormalities. Repair or replacement was carried out. The current paradigm of Predictive Maintenance is termed Condition Based Maintenance plus (CBM+), recognized as a state-of-the-art strategy in aviation maintenance. CBM+ processes consists of six activities: Capture Data, Transmit Data, Store Data, Analyze Data, Implement Change, and Track & Improve. These processes form a Continuous Feedback Loop, fostering continuous improvement. CBM+ has many advantages such as accident prevention, cost reduction, and operational efficiency improvement because of predicting the Remaining Useful Life(RUL) and future condition of equipment. Our research focuses on the challenge of predicting the RUL of avionic electronic equipment. Before forecasting the final RUL, we mapped the temporal aviation electronic equipment flight data and Maintenance Fault List(MFL) data. The flight data consists of 94 sorties, including maneuver-related data such as Altitude, Mach, AOA, and sensor data like Fan Inlet Temperature and Turbine Exit Temperature. Our study has the following significance. First, the construction of flight data and MFL data to successfully complete one loop of CBM+'s process is a remarkable achievement in the aviation field, characterized by low openness and stringent security requirements. Second, the research has revealed that not every fault listed leads to a meaningful maintenance action. Third, identification of equipment prone to frequent faults during rapid maneuvers has been achieved. The future challenge is leveraging AI models to learn the relationship between flight data and faults, and subsequently predicting RUL using additional maintenance and replacement data to be acquired.