Abstract

The majority of current aircraft maintenance procedures employ time-based maintenance for their aircraft, inevitably creating an inherent error in the general maintenance process that causes unnecessary expenses and jeopardizes passenger safety. Condition-Based Maintenance (CBM) employs structural health monitoring to actively monitor the condition of components and alert operators when the part must be replaced, allowing for the safest and most cost-effective approach to rotorcraft maintenance. This study evaluated the suitability of piezoelectric vibration data loggers as the primary sensing device for an aircraft and rotorcraft CBM system. The performance of the data loggers was initially tested in a simulated environment monitoring bearing structural health. The second phase of this study evaluated the effectiveness of the data loggers in the real-life aeronautical environment of a Cessna 172, recording key phases of flight such as engine start, takeoff, and landing. Fourier analysis in the time and frequency domain using Fast Fourier Transform (FFT) and Power Spectral Density (PSD) methods was done to model vibration data and the condition of the subject. Results demonstrated that the data loggers successfully detected the various manners of failure of both types of bearings. Several significant trends were found in the frequency domain data that accurately represented the performance of the aircraft and condition of the bearings. The demonstrated feasibility of the vibration data loggers in both simulations and real-life environments for aeronautical health monitoring is a great advancement in the development of aircraft CBM.