Planet Bearing Fault Detection using Unified Change Detection Approach

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Abstract: In the last few years, there were a couple of fatal helicopter crashes which were caused by failures of planet gears/bearings in the main transmission gearbox. It is crucial to equip helicopter HUMS with capabilities of detecting such faults. Recently, we developed a unified approach to detecting and trending changes caused by mechanical faults in rotating machinery. The method is very effective and robust in detecting and trending various types of mechanical faults in aircraft propulsion systems, such as gear tooth cracking, bearing spalling, planet gearbox carrier plate cracking, vane pump faults and mechanical looseness etc. The strength of this approach is its capability of detecting unexpected or unknown fault types and isolating the fault to the component level. Many of the validation work were based on analysing the F135 engine vibration data supplied by the Joint Strike Fighter Program Office (JPO) and the F135 engine manufacturer (Pratt & Whitney). In this paper, we will present some results of applying the unified change detection approach to detecting and trending the naturally generated and propagated damage in the planet bearing of a Bell-206 main rotor gearbox (4-planet model). Using the synchronously resampled vibration data, change signals are generated in comparing the current-state signal to the healthy-state signal. Preliminary results have shown that the unified approach can detect and trend the changes caused by the planet bearing damage. In the near future, we plan to conduct a test to generate and propagate a radial crack in the outer race of the planet bearing (which is also the body of the planet gear) of the Bell-206 main gearbox from a seeded notch, and apply the unified approach to monitor the crack propagation process.

Keywords: fault detection, planet bearing, planet gear, unified change detection.