Tooth-wise Fault Identification for a Planetary Gearbox Based on a Health Data Map

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ABSTRACT

Vibration-based fault diagnostics of a planetary gearbox is known to be challenging due to revolving planet gears. Signal transfer path between the planet gear of interest and the vibration sensor is periodically varying, and thus the vibration signal is modulated. To detect the faults in the planet gear, vibration signals are extracted using a window function when the signal transfer path is minimized. The extracted signals are transferred to the tooth domain of the planet gear of interest for further analysis. However, due to various uncertainties such as manufacturing and assembly tolerances that can significantly affect the vibration characteristics, vibration signals could have an unexpected modulation characteristics regardless of the signal transfer path. It means that the features from the faulty tooth of the gear can be discarded by the abuse of the window function during the extraction procedure. To overcome these challenges, this paper proposes an original idea of a tooth-wise fault identification for a planetary gearbox based on a health data map. In doing so, vibration signals are processed with time synchronous averaging (TSA) and auto-regressive minimum entropy deconvolution (AR-MED) filter that don't require the use of the window function. Vibration signals processed in time-domain must be aligned in the domains of a pair of gear teeth (i.e. ring-planet gear teeth pairs). Two-dimensional health data map can sketch the health data corresponding to every pairs of gear teeth to isolate the location of the faulty gear tooth. For demonstration of the proposed method, this paper presents case studies using an analytical model and a gearbox testbed.