A Time-varying Energy Residual (TVER) Method for Fault Detection of a Planetary Gear Under Variable Speed Conditions

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ABSTRACT

In recent decades, many methods have been developed to detect faults in the gear system. In particular, techniques for fault detection of planetary gears have gained considerable attention because planetary gears are often exposed to harsh operating conditions, such as heavy loads or high speeds. However, many previous studies are limited to detection of the gear faults under a constant speed condition. In real-world settings, geared systems often operate under a variable speed condition. This study thus proposes a time-varying energy residual (TVER) method to detect faults in a planetary gear under a variable speed condition. In the proposed method, the wavelet transform is exploited to extract energy-related features that can express time-varying and faulty behaviors of the gear vibration signals in the time-frequency domain. Then, the Gaussian process is used with the wavelet coefficients to calculate energy residuals that represent the fault severities of transient signals. The effectiveness of the proposed method was demonstrated through a case study of simulated vibration signals of the planetary gear. From the case study, it can be concluded that the proposed TVER method can successfully differentiate a faulty gear from a normal one in a variable speed condition.