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”COMO3#2 - Wavelet-based high order spectrum for local damage diagnosis of gears under different operating conditions”

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Gears play an important role in transmission systems, allowing for high performance in terms of load capacity and efficiency. Common gear faults such as cracked teeth and pitted teeth, can occur as a result of contact fatigue, excessive load, or sudden impact. Starting from an initial stage, their steady growth can lead to irreparable damage and unexpected breakdowns that result in economic losses. Therefore, local tooth damage diagnosis of gears using advanced monitoring techniques is extremely important for the normal operation of drivelines and transmissions. The presence of local tooth damage on gear tooth produces transient impact in the vibration signals, which exhibit non-stationary and non-linear characteristics. Taking into account its ability to characterize the phase coupling between signal components caused by non-linearity, wavelet-based high order spectrum (e.g. wavelet bispectrum/bicoherence) is considered to be effective to attain reliable fault-related features. Among others, wavelet bicoherence technology has been successfully applied to detect the artificially created gear faults under steady speed and load. However, in case the operating condition changes, the effectiveness of this method in detecting gear faults is still unclear. Additionally, there is no mature idea of selecting informative bifrequency bands and extracting instantaneous diagnostic features after applying wavelet bicoherence. This may constraint the widespread application of wavelet-based high order spectrum in gear fault diagnosis. This paper presents a novel strategy for selecting informative bifrequency bands and extracting instantaneous diagnostic features in the time-bifrequency domain. The performance of the proposed methodology is evaluated and extended to cases involving healthy and faulty gears operating under different speeds and loads. To validate the effectiveness of the methodology, a publicly available dataset is utilized, which includes gears with various crack severity as well as different speed and load operating conditions.

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