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TECHNICAL PAPER

Order tracking analysis using maximum likelihood estimator in the presence of crossing orders and low-resolution tacho signal

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Abstract

Order tracking analysis aims to extract specific frequency components (orders) from the non-stationary vibrational and acoustic signals. The presence of crossing orders and/or close orders imposes additional challenges on the tracking process and requires a high-resolution speed signal to estimate the angular data with sufficient accuracy. In this work, the maximum likelihood (ML) estimator is employed to extract the specified orders from vibration signals. To deal with the artifacts of angular data obtained from the tacho signals, two techniques are employed. Firstly, the tacho signal is processed to obtain the speed as a function of time, which is obtained by using a cubic polynomial with bi-square robust fitting to eliminate the fluctuation of speed due to the end-of-cycle artifacts. Secondly, the angular data are used as an optimization parameter which is adjusted iteratively in the maximum likelihood estimator (MLE) solution. The proposed method is applied to synthesized, simulated and experimental vibration signals with close and crossing orders and passing through resonance conditions as well. The simulation and experimental investigations have shown that the proposed algorithms can effectively separate close and crossing orders with high accuracy.

Keywords Fault diagnosis · Order tracking analysis · Non-stationary analysis · Maximum likelihood estimator