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Fault Diagnosis of Rolling Bearings Based on Optimized VMD-CYCBD Method Under Variable Speed Conditions

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Abstract : Aiming at the problem that the early fault signal of rolling bearings is weak and difficult to extract due to strong noise interference under variable speed conditions, a method for extracting the fault feature of rolling bearings under variable speed conditions which combines variational mode decomposition (VMD) and maximum second-order cyclo-stationarity blind deconvolution (CYCBD) was proposed. Firstly, computed order tracking (COT) is used to convert non-stationary vibration signals under variable speed conditions into angular stationary signals. Secondly, the optimal modal component is based on the VMD algorithm, which has been optimized by the Sine-cosine and Cauchy mutation sparrow search algorithm (SCSSA). The CYCBD parameters were optimized by using the composite index of harmonic significance and envelope kurtosis as the fitness function of SCSSA, and the features of the selected optimal modal components were enhanced based on the optimized CYCBD algorithm. Finally, the deconvolution signal is analyzed by order envelope spectrum to extract fault features. Simulation and experimental results show that the method can effectively identify the weak fault characteristics of rolling bearings submerged by strong noise under variable speed conditions.

Keywords : rolling element bearing, early weak fault, variable speed condition, variational mode decomposition, maximum second-order cyclo-stationarity blind deconvolution
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