

论文

EMD与能量算子解调在提升机齿轮箱故障诊断中的应用

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摘要:

提升机齿轮减速箱一旦发生故障, 其振动信号表现出强烈的非平稳性, 表现为复杂的调制现象, 因强烈的噪声干扰, 给故障特征提取带来了困难。介绍了基于经验模态分解(Empirical Mode Decomposition, EMD)与Teager-Kaiser能量算子(Teager-Kaiser Energy Operator, TKEO)解调相结合的提升机齿轮箱故障诊断方法, 该方法结合了EMD自适应滤波和Teager-Kaiser能量算子非线性故障特征提取的优点。EMD方法可将齿轮箱振动信号分解成若干个局部频率从高到低不同频段的IMFs (Intrinsic Mode Functions), 各个IMF突出了原始信号的某些局部特征, 再对相对高频段且含有齿轮啮合频率及谐频的IMFs进行能量算子解调, 成功提取了提升机齿轮箱中间轴旋转频率fr2的故障特征频率, 诊断出了提升机齿轮箱中间轴上齿轮Z2和Z3的点蚀故障。分析结果表明, 该方法能有效诊断出提升机齿轮箱的故障。

关键词: 提升机齿轮箱; 故障诊断; EMD; 能量算子解调

Application of fault diagnosis method based on EMD and energy operator demodulation to hoist gearbox

Abstract:

Once the hoist gearbox failure, its vibration signal exhibits strong non-stationarity and complex modulation performance, it is very difficult to extract the fault feature for strong noise interference. In this paper, a fault diagnosis approach for hoist gearbox, based on the empirical mode decomposition (EMD) and Teager-Kaiser energy operator (TKEO) demodulation, was introduced. The method combines the advantages of EMD adaptive filtering and nonlinear fault feature extraction of Teager-Kaiser energy operator. By EMD method, the vibration signal of hoist gearbox was decomposed into several intrinsic mode functions (IMFs) with local frequency from high to low frequency, every IMF highlights some local features of the original signal. Then, the energy operator demodulation method was applied to demodulate some IMFs including gear meshing frequencies and its harmonic frequencies corresponding to high frequency bands, the fault characteristic frequency fr2 of the middle shaft rotating frequency was extracted, and the pitting failure of gear Z2, Z3 of hoist gearbox was diagnosed. The analysis result shows that the approach based on EMD and energy operator demodulation is very effective for the fault diagnosis of hoist gearbox.

Keywords: hoist gearbox; fault diagnosis; empirical mode decomposition (EMD); energy operator demodulation

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