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基于EMD样本熵-LLTSA的故障特征提取方法

Method of fault feature extraction based on EMD sample entropy and LLTSA

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中文关键词: [经验模态分解](#) [样本熵](#) [流形学习](#) [特征提取](#) [支持向量机](#)

英文关键词: [EMD\(empirical mode decomposition\)](#) [sample entropy](#) [manifold learning](#) [feature extraction](#) [SVM\(support vector machine\)](#)

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中文摘要:

针对振动信号的非线性、非平稳性以及微弱故障特征难以提取的问题, 提出了一种基于经验模态分解(EMD)、样本熵和流形学习的故障特征提取方法. 该方法将EMD、样本熵和流形学习相结合. 首先, 利用EMD的自适应多分辨率的特点计算分解得到的IMF(固有模态函数)信号的样本熵, 初步提取滚动轴承状态特征值; 然后利用流形学习方法对初步提取的滚动轴承状态特征进行进一步的提取; 最后利用支持向量机(SVM)对该特征提取方法进行分类评估, 并将该方法运用在滚动轴承故障诊断实验中, 实验证明该特征提取方法与基于小波包样本熵的故障诊断方法相比具有很好的聚类性能, 且对于SVM的分类结果可达100%, 在降低了特征数据的复杂度的同时, 增强了故障模式识别的分类性能, 具有一定的优越性.

英文摘要:

A fault feature extraction method based on the empirical mode decomposition (EMD), sample entropy and manifold learning was presented to account for a range of issues of the vibration signal, e.g. Nonlinearities, non-stationary and weak fault features hard to extract. The proposed method combined the EMD, sample entropy and manifold learning techniques. Firstly, on the basis of the property of adaptive multi-resolution for the EMD technique, the sample entropy of the IMF (intrinsic mode function) signal reconstructed by using the EMD was calculated, and the state features of the rolling bearing were preliminarily extracted. Secondly, the extraction performance of the state features was further implemented by using the manifold learning technique. Finally, the SVM(support vector machine) was employed to classify and to evaluate the feature extraction method. Moreover, the proposed method was applied to the experiment of the rolling bearing fault diagnosis. The experimental results show that the proposed fault feature extraction method has more robust clustering performance than the fault diagnosis method based on the sample entropy of wavelet packets. Furthermore, a relatively high precision, namely, 100% of classification result for the SVM, can be obtained. The proposed method not only decreases the complexity of the feature data, but also enhances the classification performance of fault diagnosis and pattern recognition, thus bringing about certain superiority.

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