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Abstract
In the thesis, the singularity exponent analysis is proposed and derived from a wavelet-based enveloping function. According to the singularity exponent of the vibration signal, the defect of a mechanical system is studied. Because of the occurrence of amplitude modulation in the vibration signal of mechanical system, a wavelet-based enveloping function is applied to demodulate the vibration signal. The wavelet-based enveloping function has three parameters to adjust the function characteristics, which are the high-cutoff frequency, the low-cutoff frequency and the scale. The passband of wavelet-based enveloping function can be arbitrarily designated by simply setting the parameters of high-cutoff frequency and the low-cutoff frequency, and could also provide the convenience in the singularity analysis. For determining the interval of vibration signal to calculate the singularity exponent of the vibration signal, a theoretical study is proposed to reduce the requirement of computation. Accordingly, a global singularity exponent could be derived from calculating the singularity exponents of the vibration signal and would be an explicit index for the defect diagnosis of a mechanical system. When applied in the analysis of vibration signal for a bearing system, the global singularity exponent is capable of diagnosing of the bearing defects. The proposed method is implemented in a TMS320C32 DSP interface card in the diagnosis of bearing defect to apply the singularity analysis with the wavelet-based envelope function. Thus, the singularity exponents derived from the wavelet-based enveloping function could be applied in the remote diagnosis of a mechanical system through the internet.
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