基于小波变换技术的内燃机燃烧噪声特征提取

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关键词： 内燃机 燃烧噪声 特征提取 小波变换

摘 要： 以某六缸柴油机为研究对象，采集不同工况下的噪声信号，对其进行小波包逐层分解和系数重构，提取各频带信号，将与发动机燃烧过程有关的频带信号进行合成重构，得到燃烧激励引起的噪声信号，并对其进行连续复小波变换，计算三维小波能量谱，进一步分析各缸燃烧状态，提取内燃机燃烧过程相关的特征信息。分析结果表明，2200 r/min满负荷时，燃烧激励产生噪声信号能量主要分布在20.480～24.576 kHz的高频带内，燃烧噪声所占比重较小；650 r/min怠速时，燃烧激励产生噪声信号能量主要集中在1024～2521 Hz的中低频带内，燃烧噪声所占比重较大。 Taking a six cylinder diesel engine as the example, noise signals were recorded in different working conditions. Based on the wavelet packet decomposition and coefficient reconstruction of the recorded noise signals, signals in various frequency bands were extracted. Subband signals relevant to the engine combustion process were combined and reconstructed, and noise signals resulted from the combustion excitation were obtained. Moreover, the continuous complex wavelet transform was adopted to analyze the reconstructed signal. The three-dimensional wavelet power spectrum was also calculated to investigate the combustion condition of each cylinder and extract the related information. The analysis results show that the signal energy of combustion noise accounting for small proportion mainly distributes in the high frequency region of 20.480～24.576 kHz, when engine works at the speed of 2200 r/min with full load. At the idle condition of 650 r/min, combustion noise signal energy is mainly concentrated in the medium and low frequency band of 1024～2521 Hz, and has a larger contribution to engine noise.

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