

基于小波和双谱分析的湍流相干结构辨识 Identification of Turbulent Coherent Structures Based on Wavelet and Bi-spectrum Analysis

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关键词: 湍流信号 相干结构 双谱 小波分析 含能尺度

摘要: 为了从湍流信号中获取更多关于相干结构的定量信息, 提出了一种基于小波和双谱分析的辨识相干结构的方法。该方法通过双谱和互相关分析合理地得到了包含相干结构信息的大涡信号, 利用小波变换有效地提取出表征湍流多尺度相干结构的信号成份。建立了基于小波分析辨识湍流含能尺度的能量最大准则, 以沟槽壁面减阻机理实验的湍流数据分析为例, 验证了该方法的合理性和可靠性。 It is very important to develop a more effective and objective method to get more quantified information of coherent structures from the turbulent signal. Based on wavelet and bi-spectrum analysis, a reasonable method was put forward. The large eddy signal including the information of coherent structures was extracted by the bi-spectrum and cross correlation analysis, and multi-scale coherent structures were detected by the wavelet transform. Besides, by using wavelet analysis, a new identification criterion of energy-containing scale was established. The reliability and rationality of the method was verified by an example with the sample data from the experiment on the mechanism of rib-lets drag reduction. Furthermore, this research has also led to the conclusion that the multi-scale characteristics of coherent structures can be gotten by the above method.

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