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旋翼动态升力实验及理论分析

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EXPERIMENTAL AND THEORETICAL INVESTIGATION OF ROTOR DYNAMIC THRUST

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摘要

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摘要

建立了计入动力入流的旋翼动载荷分析模型, 在旋翼模型试验台上进行了悬停状态总距激振的铰接式旋翼动态升力实验研究, 理论计算与试验吻合很好。分析表明, 激振频率越小, 动力入流对悬停状态旋翼动升力影响越大; 静态总距越小, 动力入流的影响也越大。

关键词: 直升机 旋翼 载荷 悬停试验 动力入流

Abstract:

A new analytical model is developed to analyze rotor dynamic loads. A dynamic inflow model, verified by the experiment of rotor static loads, is included to take unsteady inflow into account. In this analytical model, separation of variables is used to analyze structural response. The flapping displacement of the blade is determined by the flapping generalized displacement and normalized mode shape. Blade bending moment is calculated by force integration method. On the basis of the comprehensive dynamic calibration of a test system, rotor model test stand/rotor balance, rotor dynamic thrust due to collective pitch oscillation is experimentally investigated in hover. During the sine oscillation of collective pitch, signals from the rotor balance are acquired. The dynamic thrust is obtained from the analysis of both the signals and the frequency response function of the test system. Correlation between the prediction of analytical model and the test data is good. From the comparison of calculation with dynamic inflow and quasi steady model, it is discovered that the influence of dynamic inflow on both magnitude and phase of dynamic thrust is significant in low oscillation frequency and low collective pitch.

Keywords: helicopters rotors loads hover test dynamic inflow

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