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考虑舵机动力学的舵系统颤振特性分析

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Flutter analysis for rudder considering actuator’ s dynamics

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摘要 飞行器舵面的颤振特性与舵机动态特性有很大关系.提出了2种考虑舵机复刚度颤振分析的工程分析方法,第1种方法思想是对舵面和舵机的耦合系统(下文称舵系统)模型在各种来流速度下进行状态矩阵的稳定性判断,称为时域方法;第2种方法是将舵机复刚度特性包含在频域颤振方程中,使用改进的*V-g*法求解该方程得到舵系统颤振特性,称为频域方法.通过对舵系统模型算例的数值计算验证了方法的可行性;发现传统的按扭转频率进行舵机刚度等效的舵面颤振工程计算方法的结果相对于该方法有较大差别.说明当舵机动力学特性较差时,在舵面颤振分析中考虑舵机复刚度特性是很有必要的.

关键词： 颤振 舵面 舵机 复刚度

Abstract： Missile rudder-s flutter characteristics are influenced by the actuator-s impedance. Two new methods which can analyze the rudder-s flutter stabilities were used respectively in time domain and frequency domain. Stability judgement of the state matrix was required in the time domain method. Actuator-s impedance characteristics had to be included by the flutter equation which can only be solved by the improved *k* method when the frequency domain method was used. The two methods- validity was checked by numerical calculation of a rudder model with an actuator. Traditional way of predicting flutter boundary was also used to analyze the rudder, and the flutter velocity/frequency were different from the new methods- results. It indicates that considering actuator-s dynamic characteristics while doing a rudder-s flutter analysis is very important.

Keywords： flutter rudder actuator impedance

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