悬停状态下小型共轴直升机操纵响应特性分析

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Control response analysis of small coaxial helicopter in hovering state

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摘要 从在研共轴双旋翼直升机的工程实际出发,建立了悬停状态下旋翼非定常气动特性的计算模型.引入Leishman-Beddoes指数函数的半经验公式,建立了二维翼型非定常气动模型;引入干扰因子到动态入流模型,建立了反映共轴双旋翼直升机上下旋翼气动干扰的诱导速度模型;从桨叶的挥舞动力学模型出发,利用四阶Runge-Kutta算法求解桨叶刚性挥舞角的数值解.通过计算分析,得到了悬停状态,总距突增时上下旋翼升力和扭矩的动态响应特性,并分析比较了半差动和全差动航向控制方式的操纵响应差别,为共轴式直升机机动特性的研究作了必要的准备.

关键词: 共轴式直升机   旋翼非定常   动态入流   动态响应

Abstract: Based on the engineering reality, a calculation model of the rotor unsteady aerodynamics of the small coaxial helicopter in hovering state was set up. An airfoil unsteady aerodynamic model was established by introducing a set of Leishman-Beddoes semi-empirical indicial response formula. The induced velocity of the aerodynamic interaction between upper and lower rotors of a coaxial helicopter was set up by bringing in an interferential factor in the dynamic inflow model, the Runge-Kutta method was used to obtain the numerical solution of the rigid blade flapping angle. According to the calculation and analysis, the thrust and torque response to a rapid collective pitch increase in hovering state was gotten, and the course response differences between the semi-differential and full-differential direction control modes was compared.The results would be a necessary preparation for the research of coxial helicopter-s maneuvering flight.

Keywords: small-scale coaxial helicopter   rotor unsteady   dynamic inflow   dynamic response

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