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直升机桨距主动控制对旋翼性能的影响

Effect of active blade pitch control on helicopter rotor performance

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中文关键词： 旋翼性能 气动特性 飞行力学 动态入流 主动控制

英文关键词:rotor performance aerodynamic characteristic flight dynamics dynamic inflow active control

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中文摘要：

为摸索直升机桨距主动控制对旋翼性能的影响规律并揭示其机理，首先建立能够考虑2阶谐波桨距控制影响的旋翼气动力模型，进一步建立相应的直升机飞行动力学模型，将旋翼需用功率作为性能评估的依据，在全机配平状态下开展2阶谐波桨距控制对旋翼性能的影响研究.对于样例直升机，前进比为0.2时，施加任何2阶谐波桨距控制均使旋翼需用功率增加；前进比为0.35时，施加幅值为1.5°、初相位为90°的2阶谐波桨距控制使旋翼需用功率降低约5%.通过分析样例直升机桨盘平面迎角分布和阻力系数分布，总结出利用2阶谐波桨距控制提升旋翼性能的物理本质： 当直升机处于高速、大载荷飞行状态时，施加适当的2阶谐波桨距控制可以改善桨盘平面迎角分布，推迟后行边桨叶失速，从而降低旋翼需用功率，有效提升旋翼性能.

英文摘要：

In order to find out the influence rule and the essence of the effect of active blade pitch control on helicopter rotor performance, a rotor aerodynamic model was built firstly in consideration of the impact of second order harmonic blade pitch control, and then corresponding helicopter flight dynamic model was established. Rotor power was taken as the evaluation basis to investigate the effect of second order harmonic blade pitch control on rotor performance in trimming conditions. For the sample helicopter, the rotor power obtained with any second order harmonic blade pitch control increases when advance ratio is 0.2; 5% rotor power reduction can be achieved by second order harmonic blade pitch control with amplitude of 1.5° and initial phase of 90° when advance ratio is 0.35. By analyzing the distribution of angle of attack and drag coefficient on rotor disc of sample helicopter, the essence of using second order harmonic blade pitch control to improve rotor performance was summarized: in the high speed and high load status, an appropriate second order harmonic blade pitch control can improve the distribution of angle of attack on rotor disc, and delay the occurrence of retreating blade stall, thus decreasing the rotor power eventually and improving the rotor performance effectively.

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