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基于优化算法的倾转旋翼准定常气动模型

Quasi-steady aerodynamic model of tilt rotor based on optimization algorithm

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英文关键词:tilt rotor quasi-steady blade element theory optimization aerodynamic performance flap

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中文摘要：

取消了传统直升机旋翼准定常气动模型中对飞行工况和桨叶形状的诸多假设和限制,建立了适合倾转旋翼特殊桨叶形状、桨毂构造以及飞行工况的准定常气动模型.桨叶气动载荷计算基于叶素理论进行数值积分,旋翼挥舞系数通过序列二次规划算法(SQP)进行数值优化求解,诱导速度分布采用Pitt-Peters动态入流模型的稳态形式.利用该方法计算了XV-15倾转旋翼机的旋翼在不同工况下的气动性能以及挥舞系数.计算结果与风洞实验数据吻合良好,误差在8%以内且计算效率高,单一工况求解耗时在5min以内,该方法可用于倾转旋翼机总体设计阶段的性能分析或建立其飞行动力学模型.

英文摘要：

There are many hypotheses and limitations about the flight condition and blade shape in the quasi-steady aerodynamic model of conventional helicopter rotor,and many of them were eliminated considering the special blade shape,hub structure and flight condition of tilt rotor.Aerodynamic loads were calculated through numerical integration based on the blade element theory,and flap coefficients of tilt rotor were solved through sequential quadratic programming (SQP) algorithm.Induced velocity distribution was adopted as the steady form of Pitt-Peters dynamic inflow model.The aerodynamic performance and flap coefficients of the rotor of XV-15 tilt rotor aircraft were predicted by this method.The theoretical results and wind tunnel tests data make good agreement with error less than 8% and this method has high calculation efficiency that one case can be solved within 5 minutes,therefore,this method is applicable for aerodynamic performance prediction in preliminary design of tilt rotor aircraft and suitable to set up its flight dynamics model.

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