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模型直升机悬停状态下飞行力学模型辨识

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Identification of Flight Dynamics Model of Model scale Helicopter in Hover Condition

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摘要

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摘要 直升机飞行力学模型的准确性对于直升机的控制系统设计具有非常重要的影响。采用常规的建模方法往往很难获得准确的飞行力学模型。为满足飞行控制系统设计的需要,提出了一种直升机飞行力学模型的系统辨识建模方法。该方法将机理建模方法与辨识建模方法相结合,首先利用状态子空间法获得直升机的近似飞行力学模型,再将机理建模提供的先验知识与子空间法辨识得到的模型相融合,限定主要参数,采用误差预报法进一步寻优得到较准确的直升机飞行力学模型。通过飞行试验,成功地辨识得到了悬停状态下模型直升机状态空间方程表达的线性化飞行力学模型。所得的辨识结果能够准确预测出模型直升机的响应,可以应用于飞行控制系统设计当中。

关键词: 飞行力学 系统辨识 状态子空间 直升机 误差预报法

Abstract: The accuracy of helicopter flight dynamics model is essential for helicopter control system design. But the model obtained using traditional modeling method is deficient. In order to meet the demand of helicopter control system design, a method for modeling helicopter flight dynamics is presented. This method combines mechanism modeling method and system identification modeling method. Firstly, an approximate model is developed by using subspace state space system identification method. Combining with the prior knowledge offered by mechanism modeling, many parameters are decided. Then, the remaining parameters are identified by using prediction error method, and an advanced model with constraint of prior knowledge is obtained. In the following flight test, a state space presented linearized flight dynamics model of a model scale helicopter at hover condition is successfully identified. The result shows that the identified model can predict the response of helicopter accurately, and can be a candidate model for helicopter control system design.

Keywords: flight dynamics system identification subspace method helicopter prediction error method

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