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俯仰跟踪任务中的驾驶员神经网络模型辨识

谭文倩[1], A.V. Efremov[2], 屈香菊[1]

1. 北京航空航天大学 航空科学与工程学院2. 莫斯科航空学院 飞行力学与控制系

Identification of Pilot Neural Network Model in Pitch Tracking

Tan Wenqian[1], A.V. Efremov[2], Qu Xiangju[1]

1. School of Aeronautic Science and Engineering, Beijing University of Aeronautics and Astronautics 2. Flight Dynamics and Control Department, Moscow Aviation Institute

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摘要 在飞机设计中,应用驾驶员数学模型预测飞机飞行品质是避免人机系统出现不良耦合的重要途径之一。为了提高飞行品质的预测精度,采用人工神经网络(NN)方法进行驾驶员模型辨识,着重研究该模型对不同飞机被控对象的适应能力。首先,详细分析了驾驶员完成俯仰跟踪任务的操纵行为特点,提出适用于该驾驶员行为描述的神经网络模型结构形式。然后,根据对不同被控对象进行俯仰跟踪实时仿真实验的结果,对神经网络模型参数进行识别。最后,对模型辨识结果进行了精度评价。研究结果表明,该辨识方法适用于研究具有不同增益、不同短周期振荡频率飞机被控对象的驾驶员操纵行为特性。

关键词： 人机系统　驾驶员模型　数学模型　神经网络　飞行品质

Abstract： In the process of aircraft design, a mathematical model of pilot control behavior characteristics is usually used to predict aircraft flying qualities. This is one of the important methods to avoid adverse aircraft-pilot coupling. In order to improve the precision of predicting flying qualities, artificial neural networks (NN) are used to identify the pilot model. This study emphasizes the applicability of the NN model to different aircraft controlled elements. Firstly, pilot control behavior characteristics in the pitch tracking task are analyzed in detail, based on which the structure of a pilot NN model is proposed. Then, pilot-aided experiments are exe-cuted using a special workstation builting for a set of different aircraft controlled elements. The parameters of the pilot NN model are identified by experimental results. Finally, the precision of identification is assessed. The results obtained verify the applicability of this identifying method to aircraft controlled elements with different amplifications and different short period mode natural frequencies.

Keywords： aircraft-pilot system　pilot model　mathematical model　neural network　flying quality

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