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Small Fixed-Wing UAV Physical Based Modeling, Simulation, and Validation

Authors : Ebrahim H. Kapeel, Ehab Safwat, Hossam Hendy, Ahmed M. Kamel, Yehia Z. Elhalwagy

Abstract : Motivated by the problem of the availability of high-fidelity flight simulation models for small unmanned aerial vehicles (UAVs). This paper focuses on the geometric-mass inertia modeling and the actuation system modeling for the small fixed-wing UAVs. The UAV geometric parameters for the body, wing, horizontal and vertical tail are physically measured. Pendulum experiment with high-grade sensors and data analysis using MATLAB is used to estimate the airplane moment of inertia (MOI) model. Finally, UAV's actuation system is modeled by estimating each servo transfer function by using the system identification, which uses experimental measurement for input and output angles through using field-programmable gate array (FPGA). Experimental results for the designed models are given to illustrate the effectiveness of the methodology. It also gives a very promising result to finalize the open-loop flight simulation model through modeling the propulsion system and the aerodynamic system.

Keywords : unmanned aerial vehicle, geometric-mass inertia model, system identification, Simulink
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