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Aerodynamic Parameter Estimation from Flight Data Applying Extended and Unscented Kalman Filter

Girish Chowdhary and Ravindra Jategaonkar

DLR Institute of Flight Systems,
Lilienthalplatz 7, 38108 Braunschweig, Germany

Abstract

Aerodynamic parameter estimation is an integral part of aerospace system design and life cycle process. Recent advances in computational power have allowed the use of online parameter estimation techniques in varied applications such as reconfigurable or adaptive control, system health monitoring, and fault tolerant control. The combined problem of state and parameter identification leads to a nonlinear filtering problem; furthermore, many aerospace systems are characterized by nonlinear models as well as noisy and biased sensor measurements. Extended Kalman Filter (EKF) is a commonly used algorithm for recursive parameter identification due to its excellent filtering properties and is based on a first order approximation of the system dynamics. Recently, the Unscented Kalman Filter (UKF) has been proposed as a theoretically better alternative to the EKF in the field of nonlinear filtering and has received great attention in navigation, parameter estimation, and dual estimation problems. However, the use of UKF as a recursive parameter estimation tool for aerodynamic modeling is relatively unexplored. In this paper we compare the performance of three recursive parameter estimation algorithms for aerodynamic parameter estimation of two aircraft from real flight data. We consider the EKF, the simplified version of the UKF and the augmented version of the UKF. The aircraft under consideration are a fixed wing aircraft (HFB-320) and a rotary wing UAV (ARTIS). The results indicate that although the UKF shows a slight improvement in some cases, the performance of the three algorithms remains comparable.

For more details about this article, please contact:

Dr. Ravindra Jategaonkar
DLR Institute of Flight Systems
Lilienthalplatz 7
38108 Braunschweig, Germany

Phone: (+49) 531 295 2684
Fax: (+49) 531 295 2647
e-Mail: jategaonkar@dlr.de

AIAA - American Institute of Aeronautics and Astronautics
1801 Alexander Bell Drive
Reston, VA 20191-4344

Phone:703 264 7500
Fax: 703 264 7551