

AIRCRAFT PARAMETER ESTIMATION USING GAUSSIAN SUM FILTER WITH LYAPUNOV STABILITY ANALYSIS

Sara Mohan George
Assistant Professor
Dept of Electronics and Communication
Engineering
Ramaiah Institute of Technology
MSR Nagar, MSRIT Post
Bangalore-560 054, India
and
Doctoral Student
Visvesvaraya Technological University
Nagarabhavi, Bangalore-560 091, India

S. S. Selvi
Professor and Former Head
Dept of Electronics and Communication
Engineering
Ramaiah Institute of Technology
MSR Nagar, MSRIT Post
Bangalore-560 054, India

J. R. Raol
Independent Consultant in Estimation, Data Fusion, and Control
Former Senior Scientist and Head, FMCD, NAL-CSIR and
Emeritus Professor
Department of Electronics and Communication
Ramaiah Institute of Technology, MSR Nagar, MSRIT Post
Bangalore-560 054, India
Email : raoljr@gmail.com

Abstract

The use of Gaussian Sum Filter (GSF) as a state/parameter estimation tool for aerodynamic modelling is relatively unexplored in the literature. In this paper GSF has been employed for aircraft parameter estimation. The stability analysis of GSF has also been discussed using the normalized Lyapunov energy functional and the conditions for the convergence of the GSF are derived by using the proposed nonlinear observer which is a novel approach. An approach to prune the weights of GSF based on Pearson coefficient is considered. The performances of the three recursive parameter estimation algorithms: Extended Kalman Filter (EKF), the simplified version of the GSF and the improved version of the GSF are evaluated for aircraft parameter estimation using simulated flight data in the MATLAB implementations. The numerical results show that pruning the weights reduces the computational load by nearly 75%, and still provides good performance compared to the conventional GSF.

Keywords: Aircraft Parameter Estimation, Gaussian Sum Filter, Weight Pruning, Lyapunov Function, Stability Analysis