

NONLINEAR AERODYNAMIC MODELING OF CASCADE FINS AND DELTA-WING AIRCRAFT MODEL

Rakesh Kumar

Ph.D Student

Department of Aerospace Engineering

Indian Institute of Technology Kanpur

Kanpur – 208 016, India

Email : rakpec@iitk.ac.in

Ajay Misra

Flight Lab Incharge

Department of Aerospace Engineering

Indian Institute of Technology Kanpur

Kanpur – 208 016, India

Email : majay@iitk.ac.in

A.K. Ghosh

Professor

Department of Aerospace Engineering

Indian Institute of Technology Kanpur

Kanpur – 208 016, India

Email : akg@iitk.ac.in

Abstract

The paper presents the modeling of the nonlinear longitudinal aerodynamics associated with the cascade fins and scale-down model of a delta-wing aircraft at high angles of attack. The Kirchhoff's steady-state stall model was used to model the stall characteristics and the Maximum Likelihood (ML) method was used to estimate the stall characteristic parameters. The cascade fin models with a rectangular and an airfoil (NACA-0012) cross-section were used to generate the variation of lift coefficient with angle of attack. The wind tunnel data pertaining to the cascade fin models were generated by varying the gap-to-chord ratios with and without end plates. The effect of end plates and the gap-to-chord ratio on the stall characteristics and the parameter estimation was analysed. The estimation results were compared to the reference results. In addition, the application of the Kirchhoff's steady-stall model to the scale-down model of a delta-wing aircraft has also been presented. The analysis pertaining to the cascade fins can be utilized as a basis for an initial design of cascade fins for guided missiles with desirable stall characteristics