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EFFECT OF FOREBODY CONFIGURATION ON NONSLENDER DELTA WING ROCK

Abstract

Delta wing and sharp/ conical camber forebody profile is commonly used in reusable spacecraft configuration to obtain a balanced aerodynamic performance at wide range of flight speeds. Numerical simulation of forebody/wing rolling accompanied by vortex-vortex disturbance at large angle of attack might help recognize the physical mechanism of nonlinear roll motion and configuration shapes suitable for suppressing roll oscillations.

Delta wing/forebody roll motion always produces abundant vortical flow patterns. A coupled computation method consist of RANS equations and Euler equations of rigid-body dynamics is established to predict the nonlinear rock characteristic. The rigid grid rotation method conforms well to geometric conservation law. Large scale multi-processors parallel calculation technique is adopt to reduce computation period.

The computation result of amplitude of roll angle and reduced frequency of a 65 degree pure delta wing rock at a given angle of attack accord with the experiment result. Then a 80 degree sharp forebody and a conical camber forebody are placed forward the delta wing apex respectively and simulated. Comparison of their rock characteristic reveals that the forebody-wing interaction obviously affects the critical state and reduced frequency. The aerodynamic spring mechanism of forebody/wing rock is also discussed by analyzing the unsteady flowfield structure.