Dynamic Stability Analysis Using CFD Methods

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Abstract

These notes review recent results using Computational Fluid Dynamics to perform dynamic analyses aimed at both calculating and evaluating aerodynamic coefficients for maneuvering aircraft. The methods mirror the most common experimental methods for obtaining dynamic data: rotary-balance, forced-oscillation, free-oscillation, and free-flight. Computed results using the Cart3D automated, inviscid analysis package, and the Overflow Reynolds-averaged Navier-Stokes solver are included. A non-linear, frequency-domain approach to simulating forced-oscillation motions of slender bodies is also reviewed. Validation examples for missiles, aircraft, idealized shapes, and atmospheric-entry capsules are presented and discussed. A case-study analysis of the Genesis Sample-return capsule demonstrates the capabilities of simulation-based methods for both obtaining and evaluating dynamic coefficients with complex flow physics.

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