PREDICTIONS OF DYNAMIC DAMPING COEFFICIENTS OF BASIC FINNER BASED ON CFD

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Abstract: dynamic stability derivatives (such as pitch and roll damping) is important in aircraft design for evaluating dynamic stability of unguided aircrafts and maneuverability of guided aircrafts. The current state of the art requires the use of extensive wind tunnel experiments for determining such characteristics. methods that rely on CFD methods have gained attention during the recent years for unsteady aerodynamic calculations. While the unsteady Navier-Stokes solvers with appropriate turbulence models yield the most accurate results for such problems, with the development of CFD, multigrid, local time step, implicit methods etc. and with the development of computer sciences and parallel compute make predicting dynamic stability derivatives with Navier-Stokes solvers becoming possible.

A method to predict pitch and roll damping derivatives of aircraft geometries with fins using an unsteady RANS solver is presented. A three-dimensional structured RANS solver based on the arbitrary Lagrangian-Eulerian (ALE) formulation with a dynamically deforming mesh algorithm is used and validated with the wind tunnel and ballistic range data available in the literature. Roll and pitch damping derivatives are calculated from load history of the unsteady flow around the model. A standard research configuration, known as the Basic Finner, is studied under forced pitching and rolling conditions. Pitching and rolling motions with oscillation are analyzed at supersonic Mach numbers ranging from 1.5 to 2.5. Predicted results showed good agreement with the available wind tunnel data.

In this paper pitching and rolling dynamic stability derivatives of basic finner are predicted with unsteady RANS equations and k-w SST two equation turbulence models. And the result of prediction are fitted well with the experiment result. Comparisons with experiments showed that quite accurate results are obtained with this technique

1. Through the method developed in this paper the dynamic stability derivatives can be achieved with high precision

2. Multigrid and local time step and parallel computation are required to speed up prediction process. With those methods predicted dynamic stability derivatives can be used in the design circle.