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UNSTEADY NUMERICAL SIMULATION AND ATTITUDE CONTROL ON SEPARATION TRAJECTORIES OF MISSILE EJECTED FROM AIRCRAFT

Abstract

One of the most challenging problems in aerospace engineering is the analysis of the separation trajectories by which a missile ejected from an aircraft. The attitudes of some static unstable missile are divergent quickly due to aerodynamic interference by the aircraft. Therefore, it is disadvantageous to missile's separation from aircraft safely. the attitude control strategy must be applied to avoid the possible collision with the aircraft.

A method based on dynamic mesh technique is developed to simulate the separation trajectories with attitude control law. The FLUENT commercial code is used to solve the 6 degree-of-freedom (DOF) dynamics equation and the kinematics equation of the missile in a very rigorous manner. In order to take into account the attitude control strategy, the User-Defined-Function (UDF) is introduced to calculate the aerodynamic effect of rudder using the free-stream results originated from calculation or wind tunnel test. Different from the spring analogy method, it is highly efficient and low in computational cost without the calculation of rudder deflection and the modification of the geometry in the unsteady simulation, especially for the conceptual design or analysis.

The comparison computing of the trajectories of a wing/pylon/finned-store configuration with three different attitude control laws is carried out with this method. The computational results show that when attitude control strategy has been introduced, the attitudes of missile during the separation from aircraft are effectively controlled, and the security of missile ejected from aircraft is greatly improved. On the other hand, it has a practical significance in the engineering for the security analysis of missile ejected from aircraft, the identification of safe separation zones and the assessment of attitude control law.