

CHALLENGES IN SOLID BOOSTER SEPARATION DYNAMICS ANALYSIS FOR A WINGED BODY

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Abstract

The jettisoning of burnt solid rocket booster stage (HS9) from winged body configuration under hypersonic regime has been analyzed. The separation event takes place in the deceleration period of the vehicle i.e., aerodynamic drag is more dominating than the thrust generated by tail off phase of the solid booster. The separation environment in terms of dynamic pressure and Mach No are synthesized with all possibilities of HS9 stage performance and finalized the separation system requirement. The separation system realized should be able to take away separated HS9 stage sufficiently away from TDV stage as well as to avoid collision with TDV component such as rudder, hydraulic lines at the end of separation plane. A six-degree of freedom rigid body separation dynamics analysis has been carried out using the vehicle data and aerodynamic properties at the instant of separation. The aerodynamic coefficient data for HS9 stage is derived from wind tunnel test in Time March approach. The procedure for time march studies are described in detail in this paper. Also there are critical protrusions like hydraulic lines located around separation plane which are to be examined in detail during the pull out phase. It is to be ensured that separated HS9 stage does not collide with the protrusions at TDV aft end and vertical fin. This paper attempts to bring out the design and analysis efforts made during the separation of HS9 stage from winged body. Subsequently from the flight data analysis it is evidenced that the separation performance is normal and collision free.

Keywords: HS9 Stage, TDV Stage, Dynamics, Collision, Separation, Time March Approach, Protrusions