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BASE FLOW FIELD, PRESSURE AND DRAG DURING ATMOSPHERIC REENTRY OF A RETRIEVABLE ORBITAL VEHICLE

Abstract

Orbital retrievable space vehicles go through a wide range of velocities ranging from hypersonic up to low subsonic during the reentry flight, crossing low and high densities layers of the Earth atmosphere. The SARA retrievable orbital vehicle is externally configured by a spherical nose followed by a cone and finalized with a cylindrical segment. The base of the vehicle is bluff shaped and certainly responsible for high base drag and the formation of a long and turbulent wake. After crossing the reentry flight phase, which is characterized by high velocities and high heating rates, the vehicle reaches low velocities, so that the recovery system, consisted of a series of parachutes located in the base region, can be act. Due to the low pressure acting on the base and in the wake flow, the extraction and deployment system should be designed to cross the whole wake so that the parachutes can be fully deployed and fulfilled. In the present work an analysis has been carried out which considers the compilation of aerodynamic data from wind tunnel tests, and from analytical and semi-empirical calculation procedures, with the aim to well establish the topology of the base flow field and the corresponding wake flow, in order to estimate base pressure and drag, as also velocity profiles and oscillation within the wake. Although the analysis covers the whole flight envelope during reentry, more attention is given for the moment short before the recovery system begins to act. The paper summarizes and comments the results obtained within this study and bring some recommendations which could be useful for the design and specification for the parachute deployment system for small retrievable space vehicles.