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Microgravity Experiments from Sub-Orbital to Orbital Platforms (3)

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DEPLOYABLE AEROBRAKING EARTH ENTRY SYSTEMS FOR RECOVERABLE MICROGRAVITY EXPERIMENTS

Abstract

Deployable aerobrakes for Earth re-entry capsules may offer many advantages in the near future, including the opportunity to recover on Earth scientific payloads from the Space with reduced risks and costs with respect to conventional systems. Such capsules can be accommodated in the selected launcher in folded configuration (optimizing the available volume) and, when foreseen by the mission profile, the aerobrake can be deployed in order to increase the surface exposed to the hypersonic flow and therefore to reduce the ballistic parameter. The reference surface increment offers as main advantages the opportunity to perform an aerodynamic de-orbit of the system without the need of a dedicated propulsive subsystem and an atmospheric re-entry with reduced aerothermal and mechanical loads. This also makes possible the use of relatively lightweight and cheap thermal protection system materials (like the ceramic fabrics successfully tested in hypersonic plasma wind tunnels). Furthermore, the deployable surface can be modulated for the aerodynamic control of the de-orbit trajectory in order to correctly target the capsule towards the selected landing site for post-flight analyses and operations. The main objective of the work is to present a number of feasible mission profiles for air-launched and vertically-launched platforms to/from Low Earth Orbit. In addition, also sub-orbital trajectories for technological demonstrators are presented. These scenarios can be useful to experimentally verify the system applicability for microgravity experiments before the design of orbital missions. The main outcomes of the study include the preliminary definition of the analyzed missions and of the corresponding deployment mechanism, but also the aerodynamic and aerothermodynamic study of the system in different flight regimes, from rarefied to continuum.