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Upper Stages, Space Transfer, Entry & Landing Systems (3)

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PROJECT BOOMERANG: INNOVATIVE ARCHITECTURE OF A LIGHTWEIGHT AND MODULAR RECOVERY SYSTEM FOR LAUNCHER UPPER STAGE.

Abstract

The purpose of this project is to develop the architecture and design of an innovative lightweight and modular recovery system for launcher upper stage, coming down from low earth orbit. The aim of the proposed concept is to allows reutilization of launcher upper stage in order to minimize launch costs and reduce time between launch. Recovering of first stages has been demonstrated in the last years but concerning upper stages it is a harder task, mainly because it involves more energy to dissipate.

The system is based on several aerodynamic deployable elements, triggered along flight path. Main advantages of this concept are the mass and volume needed by the different devices involved, and also the possibility of the design to be modular and scalable to fit on various launchers.

After the primary mission of the upper stage achieved, the first subsystem to deploy is an inflatable heat shield on the top of the structure, stocked under the satellite adapter. It is composed of multiple pressurized torus assembled in a conical shape and covered with a special thermal blanket. This device allows upper stage to slow down and protect it from extreme thermal load. Further in the flight, a ballute is deployed from the back, it consists of a large inflatable structure with a toroidal shape attached with several cables to the structure. This device gives us capabilities to continue to reduce speed and to control flight trajectory thanks to actuators modifying its orientation. During final phase of the flight, trajectory control is operated via a parafoil to guide precisely the upper stage to the landing zone. To reduce mass, there is no dedicated landing system aboard and this function is achieved by a large, suspended net and dampening systems on the ground.

This presentation is focused on how to dimension correctly the architecture's elements regarding environmental and technical constraints. To achieve this goal, a good comprehension of chemical, thermal and aerodynamic phenomenon during reentry is necessary. After digital analysis and simulation, a downscale demonstrator will be developed and tested in different facilities, and also in realistic conditions in upper atmosphere.

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