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Innovative Systems toward Future Architectures (1)

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SYSTEM DESIGN STUDIES FOR THE EUROPEAN ADVANCED REUSABLE SATELLITE (EARS) ARCHITECTURE

Abstract

Nowadays, a tremendous expansion of space activities is occurring. This trend provides notable benefits, but also poses serious issues regarding sustainability. Actually, a very large number of satellites equates to a lot of resources used and wasted, together with the potential for the generation of a significant amount of debris. The EARS (European Advanced Reusable Satellite) project, funded by the European Commission in the frame of the Horizon Europe program, aims to tackle this challenge by developing a reusable small satellite platform. Moreover, since the beginning, the conceived spacecraft will allow to perform missions that need to recover the payload, like microgravity experiments, in-orbit manufacturing of special materials or substances to be then used on Earth like crystals, semiconductors, pharmaceutical items, and many others. The logic behind the concept is to keep everything as simple as possible and, at the same time, attain the required performance and allow for modularity and flexibility. To achieve this goal, the idea foresees taking a small satellite platform and adding a recovery-propulsion module on the bottom side and an inflatable heatshield on the other upper side. The satellite will perform a controlled de-orbit thanks to a steerable propulsion system, deploy an inflatable heatshield and re-enter the atmosphere in a ballistic trajectory. The satellite will then be retrieved in mid-air by a helicopter and returned to the support facility for post-flight check. Finally, after refurbishment and re-qualification, the system can be intended for another mission cycle. The spacecraft concept is conceived to be developed by means of a step-by-step approach, starting from a simpler, lower performing, single-use version to be later upgraded in order to improve the payload and other capabilities, together with increasing the number of mission cycles, decreasing refurbishment work and reduce time between consecutive flights. The system design studies have proven the effectiveness of the proposed architecture, identifying off-the-shelf solutions for many components and critical but not exotic technologies to be developed. The preliminary sizing for all subsystems has been performed. The results demonstrate the feasibility of the original concept and design solutions, highlighting however some aspects that need careful attention during further developments, in particular the weight optimization of the whole platform and its subsystems, and the study of the interactions with the external ambient during re-entry/descent by the platform and its external parts behind the heatshield wake.