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IAF SPACE SYSTEMS SYMPOSIUM (D1)
Innovative and Visionary Space Systems (1)

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SMALL SATELLITE MISSION DESIGN SUPPORTED BY TRADESPACE EXPLORATION WITH CONCURRENT ENGINEERING: SPACE RIDER OBSERVER CUBE CASE STUDY

Abstract

The current Space Agencies space transportation and space exploration programmes encompass the analysis and development of gap-filling activities towards future reliable interplanetary missions. Among appalling studies, a system performing on orbit inspections could represent an opportunity to increase both mission reliability and safety. For instance, a constant monitoring of the external conditions of a system could: 1) track down damages and geometry of components; 2) support maintenance activities; 3) characterize target dynamics and materials. Adjoined value would be given by the possibility of reusability of the system for inspection, enabling on-demand services to possible users. This paper presents the feasibility study performed by a consortium formed by Polytechnic of Torino and Tyvak international of an innovative small satellite mission, that would fly around and in formation with the European Space Agency Space Rider vehicle. The Space Rider is a new transportation system in development by Thales-Alenia Space for ESA. The small satellite mission subject of this paper is named Space Rider Observer Cube. This feasibility study has to achieve two main goals; to fly around the Space Rider vehicle and perform observations in visible, near infrared and thermal infrared wavelengths and to validate critical small satellite operations and technologies such as deployment and retrieval capabilities from and to the cargo bay of the Space Rider. The study is been carried out exploiting modern design methodology based on fast exploration of design alternatives, focusing on a value delivery approach. Tradespace exploration supported by genetic algorithms and multidisciplinary optimization are in specific adopted to speed up the flight vehicle trade-off and design process while guaranteeing the satisfaction and balance of stakeholder needs. Due to the novelty within the study a multi-physics concurrent engineering analysis has been carried out in order to properly design critical subsystems, defining technological roadmap and validating the feasibility of the selected point design. In this paper, the results obtained by the application of this design methodology are presented. Particular attention is given to trajectories selection, concept of operations, navigation strategies, payload design and multi-retrieval mechanism design. The proven feasibility of the mission concept and the drawn development roadmap might enable new applications of small satellites, proving the ability of on-demand systems while maintain the cost low and providing fast

delivery capabilities. Eventually, the paper highlights benefit and criticalities within the proposed mission concept and its drawback to the support of future space transportation and exploration.