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A MODEL-BASED APPROACH TO THE PRELIMINARY DESIGN OF A SPACE TUG AIMED AT EARLY REQUIREMENT'S VERIFICATION

Abstract

The paper deals with the design of a space tug involved in on-orbit satellite servicing missions through a Model Based approach. The space tug reference mission is dened in STRONG (Systems Technology and Research National Global Operations) program, inserted in space exploration and access to space frame supported by Italian Ministry of Research and University (MIUR). The space tug is a spacecraft able to transfer payloads from Low Earth Orbit (LEO) to higher operational orbits, thus allowing the reduction of subsystems complexity of the target spacecraft and a considerable optimization of its payload/platform ratio. Recently, space agencies are showing an increasing interest in space tug systems concept for the large range of future applications. After dening the mission architecture and Concept of Operation (ConOps), the work focuses on the application of a tool based on the integration of Model Based System Engineering (MBSE) elements in order to achieve an eective classication, traceability and veriability of requirements among the various phases of the design process, combining the main features of specic tools and software, such as portability and exibility, and the advantages of Model Based approach. In fact, the tool is aimed at guaranteeing an optimized data exchange among environments conceived for requirements management, design and simulation, allowing a coherent re-use of the information collected through specic analysis for others focused on dierent topics. The overall approach is based on the capabilities of the software, such as DOORS, Rhapsody, Capella, Matlab/Simulink, to maintain traceability of requirements during the hando of the models, supporting requirements verication and allowing the realization of the multi-V approach. Indeed, it is demonstrated how this accurate management simplies the planning and execution of the verication activities, because the requirements verication can be performed through in the loop simulation and test in any phase of the product life cycle. The paper shows the capabilities of integrated tools chain applied to the case study. The detail of the requirements of the space tug is provided highlighting how they derive from the mission scenario, the mission architecture, the ConOps and the functional analysis. Moreover, the recursive process of requirements denition and rening is properly managed, demonstrating how the proposed sequence of tools can help the verications phases, saving time and money.