Paper ID: 25846
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SYMPOSIUM ON BUILDING BLOCKS FOR FUTURE SPACE EXPLORATION AND DEVELOPMENT (D3)
Poster Session (P)

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CONCEPTUAL DESIGN, SIZING AND PRE-QUALIFICATION OF A MECHANICAL COUPLING INTERFACE FOR MODULAR SATELLITE BUS SYSTEMS

Abstract

The project intelligent Building Blocks for On-orbit Satellite Servicing (iBOSS2) focuses on the design and development of a modular satellite bus system. A building block concept is used to allow for maintenance and reconfiguration operations performed by means of autonomous robotic manipulation. A key technology within this concept is the development of suitable interfaces connecting the different blocks. This paper will give a detailed insight into the development process including the design phase and simulation with Finite Element and multi-body analysis as well as the implementation of optimization efforts.

The technical and mission specific boundary conditions generated a number of essential requirements which needed to be taken into consideration during the design process. Early in this project it was decided to use two dedicated types of mechanisms for the mechanical connection of building blocks during launch and orbital phase. The paper will concentrate on the mechanical interface used during the orbital phase as it is one of the key components to reach the desired level of modularity. One important requirement connected to the modularity is the use of an androgynous design which supports a maximum level of flexibility for orbital reconfiguration.

Based on an early breadboard model a second generation of the mechanical interface which uses a bayonet like principle was developed, build and tested. The results of a preliminary breadboard qualification testing campaign were used for further improvements and serve as a baseline to start the refinement process. A critical aspect discussed in this paper is the type of lubrication. The use of dry lubrication is intended and therefore different coatings are still under investigation which should offer a low coefficient of friction and withstand the harsh space environment.

Parallel to the testing campaign simulation models are developed to enhance the understanding of the mechanism and identify potential for improvement. The simulations include multi-body analysis to assess the influence of tribological effects and FE analysis to uncover weight saving potential and verify basic mechanical strength and stiffness. The availability of a full functional breadboard also allows a validation of the numeric models.