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

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CONCEPT FOR ON ORBIT SERVICEABLE SPACECRAFT BUILDING BLOCKS – STRUCTURAL DESIGN

Abstract

A resulting problem of the frequently high numbers of launched satellite missions is the accumulation of space debris. The number of non-operating systems is increasing continuously. One possibility to encounter this problem can be seen in the realization of On-Orbit-Servicing (OOS) missions. OOS is an approach to extend the lifetime of spacecrafts through the replacement of damaged components. Furthermore the upgrading of satellites with state-of-the-art systems becomes feasible.

Within the collaborative project iBOSS, founded by German Aerospace Center, a design concept for modular and serviceable spacecraft systems has been developed. This multi disciplinary project aims to subdivide common spacecraft systems on subsystem level into separated and individual building blocks that can be reconfigurated in space both for maintenance purposes as well as system upgrades. Furthermore the facility to extend existing systems by connecting additional building blocks enables in fact the installation of big unmanned multipurpose platforms in orbit.

A structural design has been developed that will enable the safe launch as well as in orbit reconfiguration scenarios for this modular spacecraft concept. This paper will describe the development process including drafts for different concepts and their assessment as well as the preliminary design of the structures.

The design process revealed that different concepts are generally feasible. One main decision is the distinction between structural and system blocks. Structural blocks will provide the stiffness and strength that is required especially during launch. They show a reduced degree of modularity. The system blocks are attached independently to the structural blocks and contain major system components and offer full degree of modularity. By means of an appropriate multifunctional interface different blocks can be connected in various configurations.

The design process as well as the assessment considers different aspects like weight, complexity, standardization and adaptivity of the structure. The preliminary design process focuses on problems like stability, load-introduction problems and thermo-mechanical aspects. Especially last-mentioned problems arise due to changing thermal boundary conditions. With regard to reconfiguration and rearrangement of different blocks, thermal deformations have to be kept in a small margin. Furthermore it is analyzed,

whether the directed material properties of CFRP for instance can be used to control the thermal behavior within the different boxes. Thermal conduction within the boxes as well as the transfer across structural boundaries like connectors is investigated.