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MULTIFUNCTIONAL INTERFACE FOR MODULAR SATELLITE SYSTEMS WITH ROBOTIC SERVICING CAPABILITIES

Abstract

The project "intelligent Building Blocks for On-orbit Satellite Servicing" (iBOSS) focuses on the design and development of a modular satellite bus system. A cube-based concept is used to allow for maintenance, repowering and reconfiguration operations performed by means of autonomous robotic manipulation. The project aims to be applied from small to mid-sized satellites which can be used in all relevant earth orbits and for multiple purposes and applications. However, it is also envisioned to expand the idea to larger spacecraft such as orbital platforms, warehouses and planetary exploration spacecraft. Each spacecraft consists of a number cube shaped building blocks which contain the payload and different systems of the bus and a load-carrying central structure. In order to build a fully operational satellite all modules are interconnected with a multifunctional interface that can also be used as an end effector for robotic systems. This paper will outline the functionality, design process and testing of the multifunctional interface which is developed as one of the main features of the project. The interface mechanism combines the transfer of mechanical loads, electrical energy, heat and data. However, the focus of this paper will be the design and sizing of the electrical part of the mechanism and the ongoing improvements on the mechanical part. The mechanism was conceived to coincide with the cube-based approach used in iBOSS and the aim was to allow for a maximum of flexibility regrading robotic reconfiguration activities. This forced the development of a mechanism with unique characteristics such as an androgynous coupling design and corresponding guiding elements, a high level of redundancy, 90-degree rotational symmetry and a compact buildup. The guide elements are implemented as a set of movable pins to cope with positioning inaccuracies and to support mechanical load transfer. The electrical part of the interface is implemented using the same pins as contacts. In-between pin and socket a canted coil spring is mounted as current transferring element. With the special geometry of coil springs it is possible to create a relatively high number of contact points enabling a high power transmitting capability within very limited building space. As part of a breadboard testing campaign to verify the calculated values a test has been set up, which showed a very good performance. Besides the results of the breadboard test also the result of a qualification campaign of the complete mechanism is part of this paper.