SPACE SYSTEMS SYMPOSIUM (D1)
Cooperative and Robotic Space Systems (6)

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MODEL-BASED LOCALIZATION AND SEGMENTATION OF MODULAR SATELLITES USING 3D LIDAR POINT CLOUDS

Abstract

This paper addresses the challenge to generate an accurate satellite segmentation based on current sensor data and localize this sensor on a space manipulator at the same time. The simultaneous localization and segmentation problem is a challenge for On-Orbit-Servicing within the iBOSS concept. The iBOSS concept consists of multiple small cubes containing different hardware, which can be connected like building blocks via interfaces. The core idea behind it is, to perform servicing and maintenance on broken or outdated systems, and adapt a satellite without decommissioning it. However, this concept comprises multiple new challenges, e.g. it is required to develop techniques to gather current information about the state and status of the satellite. Some of these challenges are the detection of malformations due to impacts or thermal displacement, or to provide visual guidance while exchanging individual building blocks. For this purpose it is existential to obtain a detailed representation i.e. a segmentation of the present satellite. Further it is necessary to identify the individual blocks and connection interfaces for servicing tasks. In order to generate a representation containing the desired level of detail, a rotating laser scanner will be utilized. The scanner obtains a 3D representation of the environment, commonly referred to as a point cloud which is composed of several hundreds of thousands of scanning points. Each of these points contains the 3D position and the intensity of the object from which the laser beam was reflected. However, the scan from one point of view might not suffice for obtaining a complete segmentation of the satellite. Therefore multiple scans from different perspectives are recorded, which are subsequently merged into one large point cloud. After obtaining this 3D representation, each individual cube needs to be identified within the point cloud. This can be done by using its previously known geometry since each iBOSS cube inherits the exact same base structure. However, in order to efficiently use the representation for the previously mentioned services it is necessary to refine the obtained model, by extracting the locations of the interfaces within the point cloud. This becomes possible by utilizing the intensity values of the laser scanner, since the surface of the interfaces shows a quite different reflectance signature, than those of the building blocks.