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RANGE MANAGEMENT OF A VISION BASED RENDEZVOUS AND DOCKING NAVIGATION SENSOR

Abstract

The Vision Based Sensor (VBS) is a system capable of determining pose and position in between two spacecrafts flying in close formation, supporting rendezvous and docking maneuvers. The VBS system is based on a μ-Advanced Stellar Compass imaging platform using two Camera Head Units (CHU). One standard low light CHU capable of detecting stars, and one high light CHU with a fixed aperture and filter included enabling close range operations in between the two spacecrafts. Collectively, this setup enables the VBS system to work in three modes defined as follows:

- Far Range Mode: Where stars are detectable in the background in conjunction with the Target spacecraft.

- Intermediate Range Mode: Where the Target spacecraft appears to bright, disabling detection of stars, and no features of the Target spacecraft distinctly are visible.

- Short Range Mode: Where features of the Target spacecraft are visible.

Furthermore, the Short Range Mode consists of two sub-modes. In the first sub-mode the Target spacecraft operates cooperative providing clearly visible feature points, e.g. realized with Light Emitting Diodes (LEDs) placed in known positions on the structure. In the second sub-mode the Target spacecraft is in a non-cooperative state, where the pose and position determination is based on images of the spacecraft structure under the given light scenario.

The Far- and Intermediate Range modes will provide information about the pointing direction towards the Target spacecraft, whereas the Short Range Mode will provide both pose and position information of the Target spacecraft.

Based on the knowledge of the different modes and their capabilities in various scenarios a set of mode switching rules has been designed. Running the VBS system based on the designed set of rules provides autonomous mode switching and control, producing smooth transition in between each of the overlapping modes.

This article will describe the design of the mode transition rules and how the scenario analysis has been used in order to determine the ranges and the overlapping of the different modes, resulting in a stable VBS system providing high precision pointing- or pose and position information of a Target spacecraft.