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EXPERIMENTAL ASSESSMENT OF I3DS PERFORMANCES: A SUITE OF SENSORS FOR ON-ORBIT RENDEZVOUS

Abstract

The Integrated 3D Sensors (I3DS) project was led from November 2016 to January 2019 to design, manufacture, integrate and validate a suite of sensors for orbital and planetary applications. The main objective of this project was to provide a multi-purpose suite of sensors with a standardised interface to the platform in order to ease their integration in future space rendezvous missions.

The current paper aims at presenting the experimental results obtained on the orbital validation use-case consisting of static station keeping at different distances from a telecommunication spacecraft, and also an inspection and rendezvous with this target. A selection of I3DS sensors has been chosen and then integrated within a mechanical housing to be validated on the ROBotic orbital FacilitY (ROBY) test bench of Thales Alenia Space in France (Cannes). This robotic test bench is made of two industrial robots reproducing the behaviour of two vehicles approaching for rendezvous in order to perform Software-In-the-Loop (SIL) and Hardware-In-the-Loop (HIL) experiments.

In this paper, the different experiments in open loop are presented along with the resulting sensor performances, and how these latter fit into the real mission requirements. Apart from the station keeping configuration used to characterize the overall performances, two main phases of the rendezvous are considered with an Ellipse of inspection to observe the target and predict its relative behaviour, whilst the second one is a straight line approach performed in forced motion for the capture phase. During these different phases, specific subsets of the sensors are activated, their data are processed and used to feed back the control loop. Therefore, the performance assessment consists in the 3D sensors measurements accuracy compared to the ground truth data acquired during the experiments and based on the robot positions and attitudes.

These experiments covers the validation of the following sensors: a stereo camera and a LIDAR providing 3D point clouds, a High-Resolution camera to detect Aruco markers on the target, a pattern projector to extract a 3D point cloud from the camera images, and a contact unit to measure the force/torque applied on the target by the chaser.

This project brings together the following companies throughout Europe: Thales Alenia Space, SINTEF(Norway), TERMA(Denmark), cosine(Netherlands), PIAP Space(Poland), HERTZ Systems(Poland)

and Cranfield University(UK).

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