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EXPERIENCE USING AN AUTOMATIC RENDEZVOUS / CAPTURE TEST FACILITY FOR GNC V&V IN A DYNAMIC ENVIRONMENT

Abstract

The purpose of this work is to describe the experience gained since autumn 2007 in a dynamic simulation facility (to mimic space manoeuvres in rendezvous / docking or formation flying scenarios) which has being developed by GMV, with support by INTA and located at this aerospace Institute. The paper outlines the technologies used for GNC subsystem verification and validation, for future use in rendezvous and docking. The relative trajectory and attitude of chaser and target vehicles are mimicked by robotic arms. Design details like specially featured rails and control cabinet floor mounting are explained. Teleoperation test took place in 2009 from GMV headquarters. Several ESA activities have already exploited the capability of the outlined test bench called "platform". During 2010 the contact dynamics tests, corresponding to the International Docking and Berthing Mechanism (IBDM) prototype, were performed successfully. After a period of building refurbishment works to restructure it for other INTA projects, the facility can now support simulations in darkening conditions. Since September 2011 capture and docking (with no contact) scenarios have been evaluated, using a Light Detection and Ranging (LIDAR) laboratory sensor, to verify and validate the ESA High Autonomy Rendezvous and Docking (HARVD) GNC design with air-to-air sensor stimulation and hardware in the loop. The next test campaign scheduled for the second quarter of 2012 is the "Online Reconfiguration Control System and Avionics Technologies" (ORCSAT) activity in the frame of ESA, Other potential users are "Project for On board Autonomy" (PROBA 3) mission which deals with formation flying and besides the ESA activity "Integrated GNC Solutions for Autonomous Mars Rendezvous and Capture" (i-GNC). Finally is described a Formation Flying Testbed in course of implementation at INTA, using the GPS and European Geostationary Navigation Overlay System (EGNOS) capabilities that permits closed-loop simulation of on-orbit service manoeuvres in low Earth orbit and allows development of relative navigation algorithms, based on Global Navigation Satellite System.