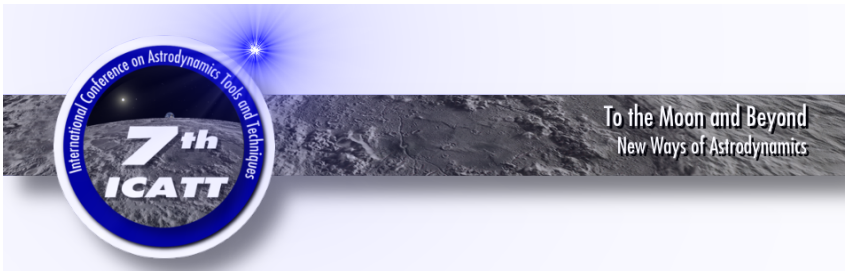

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RICADOS - Rendezvous, Inspection, CApturing and Detumbling by Orbital Servicing

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Safe de-orbiting and increasing the life-time of satellites by on-orbit servicing (OOS) will be of high importance in future spaceflight. The rendezvous and docking/berthing (RvD/B) phase is one of the most complex and critical parts of on-orbit servicing and debris removal missions. Several missions and developments have been started like the Restore-L mission of NASA, the RSGS (Robotic Servicing of Geosynchronous Satellites) program of DARPA, the Mission Extension Vehicle (MEV) of Orbital ATK and the ESA Clean Space Initiative (e.Deorbit). Robotic servicing will be of importance also in human spaceflight since rendezvous and docking technology generally plays a major role in all assembly, service and maintenance tasks.
All these missions require robust and reliable guidance, navigation and control (GNC) systems for rendezvous and robotic systems for berthing and maintenance tasks. In a recently started project called RICADOS (= Rendezvous, Inspection, CApturing and Detumbling by Orbital Servicing) the German Aerospace Center (DLR) develops a new on-board inspection, rendezvous and robotic system as well as a ground segment for on-orbit servicing including telepresence capability.
The paper presents the current status of the project and the end-to-end testing environment: The space segment is simulated using two robotic hardware-in-the-loop test facilities at the German Aerospace Center: the European Proximity Operations Simulator (EPOS 2.0) at DLR-German Space Operations Center, where the inspection and rendezvous is tested and demonstrated, and the OOS-Simulator (OOS-Sim) at DLR-Robotics and Mechatronics Center, where the capturing and detumbling are performed. The robots' motion is generated by a numerical satellite simulator in software based on orbit and attitude dynamics for service and target satellite, simulation of actuators and of the satellites' environment. The communication path from space to ground and vice-versa is simulated such that different scenarios can be tested: Different channel parameters such as telemetry and tele-command data loss, jitter and delay can be chosen for realistic tests. The ground segment is established as for a real on-orbit servicing mission with dedicated consoles (standard satellite console, rendezvous console and robotic console). In a multi-mission control room, which is used for real missions at the same time, the operators can train and collect experience how to run a real on-orbit servicing mission including the robotic capture via telepresence.
The paper also presents a first reference scenario based on DLR's satellite strategy: DLR will launch several compact satellites like Eu:CROPIS in Low Earth Orbit in the next years. The reference scenario of RICADOS foresees a service satellite with rendezvous and berthing payload which is able to perform service tasks for a fleet of compact satellites in neighboring orbits. This paper describes the entire RICADOS-concept for the selected reference scenario, from inspection and rendezvous towards final capturing and detumbling of the target satellite, the ground contact concept for the mission, and presents results of the latest simulations and tests.

Summary

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