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SIMULATION ENVIRONMENT FOR TELEPRESENT ON-ORBIT SERVICING

Abstract

Telepresent On-Orbit Servicing offers satellite operators the ability of conducting inspection, repair, replenishment, upgrade or maneuvering of a client spacecraft in orbit by a servicer satellite. Compared to autonomous systems, advantages of telepresence are its high flexibility and the ability of the human operator to conduct real-time inspections of spacecraft and to adapt the servicing plan and procedures on-the-scene to the situation at hand. Using a communication link via geostationary data relay satellites, such as the European ARTEMIS, the feasibility of complex servicing operations with uninterrupted duration of at least 45 minutes using one single ground station has been established. This enables human operators to control robotic manipulators with haptic feedback on a servicer satellite, but also to use his sensory system, pattern recognition and decision-making abilities to reach out to space and to apply these to complex tasks as guidance, navigation and control, proximity operations and docking of two spacecraft in low and geostationary Earth orbits. When doing this, in addition to the roundtrip delay times unpreventable for relayed space communications, the operator faces the environment of space, the unintuitive and often unfamiliar kinematics and dynamics of the space environment and the lack of reference points. In order to cope with these problems, the Institute of Astronautics is researching methods and technologies to assist the human operator in orientation and navigation around the client spacecraft and in viewing and orienting his work site. To develop and verify such methods and technologies, a 6 degrees-of-freedom proximity operations and docking simulator is being developed, along with a camera manipulator that provides an independently steerable stereo camera view that will give the human operator additional views of the relative position of the two spacecraft and the work site. This paper describes the design and implementation of this simulation environment and gives an overlook of the research program to be conducted using this facility.