SPACE OPERATIONS SYMPOSIUM (B6)
New Operations Concepts (2)

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ON-ORBIT SERVICING MISSIONS AT DLR / GSOC

Abstract

DLR's history of On-Orbit Servicing (OOS) goes back to 1987 when TV-Sat 1 was launched. Unfortunately the failure of one solar panel to deploy curtailed operations severely. After several attempts to repair the spacecraft from ground it was finally placed in a graveyard orbit in 1989. This failure triggered the idea of a rescue satellite with TV-Sat 1 as an early candidate for OOS. Settelmeyer et al. (1998) presented the concept of an Experimental Servicing Satellite (ESS) including the design of a capturing tool for the apogee engines of geostationary satellites (patented by DLR).

The focus of DLR's present OOS projects DEOS and OLEV is to capture non-cooperative and/or not specially prepared client spacecraft. The primary goals of DEOS (DEutsche Orbitale Servicing Mission) are (1) to demonstrate the capture of a tumbling and non-cooperative client satellite in low earth orbit and (2) a controlled de-orbiting of the mated system. OLEV (Operation Lifetime Extension Vehicle) is a purely commercial project managed by a European consortium including a strong DLR participation. The business case of OLEV is to build an orbital "tug boat" which is able to dock on high value, geostationary communication satellites and to take over Attitude and Orbit Control in order to extend the clients lifetime after its fuel has been depleted. A second goal is to use OLEV for fleet management purposes.

Both missions DEOS and OLEV pose several challenges to spacecraft operations: 1. Teleoperation: Capturing a tumbling client as well as RvD operations set requirements far beyond the capabilities of standard communication architecture. 2. Communication: Shading and interference during proximity operations might prevent the continuity of the communication link. 3. Navigation: A gap between absolute navigation (e.g. ranging) and purely geometrical relative navigation (e.g. stereo camera) has to be bridged by an alternative method. 4. Verification: Approach navigation, capture and docking algorithms should be thoroughly tested on ground first.

DLR /GSOC's concepts and solutions to the above challenges will be discussed in this paper. An innovative communication concept is presented, enabling direct transfer of video signals with minimal delay time and jitter as well as a multipath and multimission TMTC communication link to a worldwide network of ground stations. Additionally, we discuss methods of vision based navigation for the gap between absolute and geometric navigation. Finally, we describe an integrated system test including GSOC's new European Proximity Operation System (EPOS).