SPACE SYSTEMS SYMPOSIUM (D1)
Innovative and Visionary Space Systems Concepts (1)

Author: Mr. Detlef Reintsema
Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR), Germany, Detlef.Reintsema@dlr.de

Mr. Thomas Wolf
Germany, T.Wolf@dlr.de
Mr. Bernd Sommer
Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR), Germany, bernd.sommer@dlr.de

DEOS – GERMAN'S ROBOTIC AGENT CONCEPT TO SERVICE, SECURE AND DE-ORBIT MALFUNCTIONED SATELLITES FROM ORBIT

Abstract

Motivation

Nowadays hundreds of satellites populate the operational Earth orbits. Many of them will reach their end of life in the near future. Before running out of propellant satellites should leave their operational position and transfer onto a safe graveyard orbit or a safe and controlled re-entry trajectory where atmospheric drag causes its re-entry within a number of years. But many satellites can't de-orbit themselves because of a malfunction or lack of fuel. As long as maintenance or repair services can not be performed these satellites will block their positions and prevent further use.

Satellites out of service drift uncontrolled in space. In worse cases, they even start to rotate and enter into a tumbling motion. Flight path and orientation of such satellites are not longer predictable. Once out of control they become a hazard for other spacecrafts, for the International-Space-Station and even for the populated areas on Earth.

Maintaining and repairing of satellites can be a major step forward to prevent losing control. But the final step should be the safe disposal to avoid large scale damages and liability events. The German approach to service, secure and de-orbit malfunctioned satellites is based on a robotic agent concept, a sufficiently equipped servicing satellite with at least one manipulator on board.

DEOS Mission Goals

The main goal of German's technology mission DEOS (Deutsche-Orbitale-Servicing-Mission) is the inorbit verification of advanced unmanned satellite servicing techniques including rendezvous and berthing of a non-cooperative and tumbling satellite and its controlled de-orbiting. A comprehensive experimental program shall cover and investigate all essential situations and sequences of a satellite servicing mission including the approach, inspection and capture.

Capturing a non-cooperative satellite in space has not been demonstrated yet. Therefore, different operational approaches of grasping a tumbling satellite will be demonstrated to verify the stabilization and calibration of the interconnected spacecrafts. Furthermore, different control strategies and AOCS modes shall be investigated, especially to determine suitable maneuvers for soft docking and the subsequent stabilization of the compound. One major objective is to find the most robust method of grasping a satellite by means of a manipulator arm in a safe and secure manner. Typical maintenance operations performed on the client satellite by the manipulator shall investigate unmanned satellite servicing aspects.

The paper will present the overall mission concept, including the system concept, the experimental program, the communication concept, and the on-orbit servicing elements.