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

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REAL-TIME EVALUATION OF ATTITUDE CONSTRAINS DURING SPACE ROBOT OPERATIONS

Abstract

This paper defines and analyzes problems in complying with operative constrains during telepresent space robot missions and proposes methods to support the ground operator during teleoperation.

A multitude of possible scenarios, like on-orbit servicing of an uncooperative spacecraft with indefinite knowledge of its current state, call for telepresent real-time operation of space robots. Such operations imply unpredictable, interactive control of the space robot and hence significantly restrain the applicability of classical mission planning. Especially the direct or indirect effect of platform maneuvers or reactions from actuator motion on the space robot's attitude and dynamic state is considered to be critical. As a result from the unplanned change in attitude of angular velocity of the space robot's base, several operative constrains like communication antenna pointing might be violated, leading to signal losses, instrument damage or even loss of the spacecraft.

A real-time space robotics simulator was developed in order to identify these problems and to test and evaluate the proposed concepts and solutions. This simulator is based on multi-body dynamics and relative kinematics models implemented in MATLAB/Simulink. A highly generic approach allows adapting the simulation to different scenario and spacecraft configurations. In addition, realistic visualization and real-time simulation capabilities allow Operator-in-the-Loop tests to evaluate the closed loop performance of different operator support concepts. The simulator architecture, identified operative constrains and simulation results are presented and discussed.