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NAVIGATION GUIDANCE AND CONTROL ALGORITHMS VALIDATION OF RENDEZVOUS AND
DOCKING USING ROBOTIC MANIPULATORS**Abstract**

Validation of NGC algorithms is complex and precise motion is required to demonstrate the RVD of two satellites. The facility uses two industrial robots of six DOF robotic systems. The dynamic motion system is also incorporating collision alert and safety limits of the environment. In this paper mainly, kinematics, Dynamics, constrained optimization of kinematics and dynamics, implementation of stereo vision techniques and validation of the aforementioned in a six DOF simulation environment are addressed. The trajectory constraints (state constraints) are considered to maintain sensor Field of View (FOV) from 18m to till docking and control constraints like thrust are considered in the nonlinear optimization problem. The constrained non-linear control system is designed using optimization techniques like pseudo spectral methods. Stereo camera based relative position and orientation estimation is implemented for navigation using Unscented Kalman Filter (UKF). To improve the precision and accuracy in relative position measurement, UKF is used in stereo vision and RANSAC method to estimate the relative position, relative velocity, relative attitude and relative attitude rates. In the validation process, the trajectory generated from the nonlinear relative dynamics and the performance of developed NGC algorithms has been demonstrated using kinematic and dynamic models along with the stereo vision in six DOF simulation environment.