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HIGH PRESISION RENDEZOUS DOCKING NAVIGATION GUIDANCE AND CONTROL DEMONSTARTION USING 13 DEGRESS OF FREEDOM ROBOTIC ARM ON TRACKING SYSTEM

Abstract

Space docking Experiment (SPADEX)mission is a first of its kind in ISRO's space program with its unique technology to demonstrate the low impact docking activity in space between two small satellites of 150kg.As the docking mission requires very stringent relative attitude and relatives position accuracies at the terminal point, the docking mission has to be demonstrated on ground in a state of the art real time dynamic simulation setup using Dual Robotic Arm based Rendezvous docking system. Kinematics motion and dynamics motion of the robotic system is modelled using Dual Quaternion where the relative position and orientation are solved simultaneously. This scheme greatly helped in cutting down the volume of algebra and simulations have become straight forward and robust. Obstacle avoidance problem is solved using Receding Horizon Model Prediction Control (RHMPC) optimization algorithm where environment constraints are modelled as path constraints. Local minimum problem was solved and convexity has been ensued using hyper plane rotation by linearizing the non-linear obstacles as spheres and ellipsoids. Effectively, constrained optimization problem has been solved in an integrated Navigation Guidance and Control (NGC) environment for trajectory optimization problem. The performance of NGC is demonstrated in a state of the art simulation laboratory "Rendezvous Simulation Laboratory". This is a 13 degrees of Freedom simulation lab and rendezvous simulations have been carried out and performance of NGC has been demonstrated. This paper briefly describes about the simulation strategy and implementation of algorithms and performance demonstration of NGC.