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RELATIVE POSITION AND RELATIVE ATTITUDE ESTIMATION USING A CAMERA FOR RENDEZVOUS AND DOCKING EXPERIMENT

Abstract

Rendezvous and Docking (RVD)missions have been played a major significant role for space exploration from the Apollo program to the present day International Space Station (ISS) autonomous space rendezvous and docking applications. There has been a growing interest in RVD missions for orbital debris removal, on-orbit assembly, on-orbit refueling and on-orbit servicing and repair missions etc. 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. In this paper, in order to validate the onboard Navigation Guidance and Control (NGC) algorithms, Rendezvous and Docking simulator was developed using robotic system and demonstratedusingRendezvous and Docking camera on chaser satellite and LED's in the target satellite. The relative attitude and position determination has been derived from the vector observations and using the quest algorithm. The relativeattitude and positionestimation is carried outusing the unscented Kalman filter. The relative position control is carried out with multi-pulse glide slope algorithm. The relative attitude control has been carried with PID controller with reaction wheel as actuators. The proposed algorithm has been tested in the robotic based relative motion Environment. The relative attitude and Relative position dynamics models was developed with Dual quaternions method to achieve high numerical accuracy. Validation of the NGC algorithm and performance with 6 DOF simulations successfully was carried out in Robotic Simulation Laboratory.