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ARCHITECTURE FOR AUTONOMOUS SATELLITE CAPTURE AND BERTHING

Abstract

On-orbit satellite servicing and refurbishment requires the capture and berthing of the client spacecraft by a robotic system. These mechanisms are often complex, multi-DOF robotic arms. Given possible communication delays or disruptions, these capture and berthing maneuvers would greatly benefit from automated algorithms to track and guide a serial manipulator to a target berthing mechanism without human input. This is a complex problem, involving tracking the client's location relative to the arm while simultaneously planning and executing joint trajectories for capture. In this paper, we first describe the state-space representation of a theoretical multi-DOF manipulator, including a method for marking obstacles such as singularities or hardware limitations. We then discuss a path planning algorithm to produce joint angle trajectories for a possibly changing goal in cartesian space. The algorithm includes support for discovering and remembering obstacles. We implement our algorithm and control strategy using the Robot Operating System (ROS), and demonstrate its performance on a simple, simulated robotic arm. Finally, using AprilTags and computer vision to produce cartesian goals, we demonstrate the algorithm's performance by using an 8-DOF manipulator to track and capture a simulated client in the University of Maryland's Neutral Buoyancy Research Facility.