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Tesis: "TELEOPERATION AND CONTROL OF AN AERIAL MANIPULATOR USING A VIRTUAL REALITY SYSTEM"

Resumen:

The present work is about the simulation of an aerial manipulator with a 2DoF robotic arm. First, the Unmanned Aerial Vehicle (UAV) and robotic arm's mathematical modeling is obtained. The UAV model equations consider a force and torque as unknown parameters that need to be compensated by the controllable inputs which are the UAV thrust force and torque.

The manipulator's modeling is made through the Newton-Euler algorithm and leads to a Lagrangian expression form. This form is useful to program the manipulators controller and dynamics. The torque and force are estimated and compensated in the UAV model equations.

To estimate the force and torque nonlinear observers are employed. A geometric controller on the Special Euclidean group (SE(3)) is designed for angular velocity considering angular velocity errors that are proven to converge to zero using the Lyapunov direct method. Also, a position controller is designed to compute the thrust force produced by the rotors so the UAV tracks the desired position. A Proportional-Derivative (PD) joint controller is designed to compute the manipulator joint torques to track a desired angular position. Also, manipulator controller stability has been proven using the Lyapunov method. Finally, the controller simulation results show the controller stability. The position controller tracks the desired position in the z axis direction and the angular velocity error converges to zero like the torque and force estimation errors, even with aggressive rotations. The aerial vehicle is simulated in MATLAB and the controller is programmed in MATLAB-SIMULINK. A final simulation is made by plotting a representation of the UAV with the real measured parameters to simulate a real-time flight with the obtained values. A future work is presented where a rotation error will be considered so the UAV tracks a desired x,y position from the desired rotation. Also a publication related to this work is annexed as a complementary backup.