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Visual Servoing for Quadrotor UAV Target Tracking: Effects of Target Information Sharing

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Abstract : This research presents simulation and experimental work in the visual servoing of a quadrotor Unmanned Aerial Vehicle (UAV) to stabilize overtop of a moving target. Most previous work in the field assumes static or slow-moving, unpredictable targets. In this experiment, the target is assumed to be a friendly ground robot moving freely on a horizontal plane, which shares information with the UAV. This information includes velocity and acceleration information of the ground target to aid the quadrotor in its tracking task. The quadrotor is assumed to have a downward-facing camera which is fixed to the frame of the quadrotor. Only onboard sensing for the quadrotor is utilized for the experiment, with a VICON motion capture system in place used only to measure ground truth and evaluate the performance of the controller. The experimental platform consists of an ArDrone 2.0 and a Create Roomba, communicating using Robot Operating System (ROS). The addition of the target's information is demonstrated to help the quadrotor in its tracking task using simulations of the dynamic model of a quadrotor in Matlab Simulink. A nested PID control loop is utilized for inner-loop control the quadrotor, similar to previous works at the Flight Systems and Controls Laboratory (FSC) at the University of Toronto Institute for Aerospace Studies (UTIAS). Experiments are performed with ground truth provided by an indoor motion capture system, and the results are analyzed. It is demonstrated that a velocity controller which incorporates the additional information is able to perform better than the controllers which do not have access to the target's information.

Keywords : quadrotor, target tracking, unmanned aerial vehicle, UAV, UAS, visual servoing
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