Autonomous Landing of a Quadrotor on a Moving Platform in Outdoor Environments

Chris Choi* Stanley Brown† and Steven L. Waslander‡

***Abstract*— The task of landing an aircraft on moving objects has been a topic of interest ever since humans took to the skies in the early twentieth century. Typically when attempting landing small, Micro UAVs such as quadrotors, the landing procedure is either done manually, or using GPS guidance to land on a stationary target. If landing on a moving target or in high wind conditions, a human operator is generally required. However this requires the human operator to have a clear line of site to both the target and the aircraft during all stages of the landing procedure. In recent years there have been several papers that propose a set of methods for landing on a slow moving platform in ideal conditions such as low wind and ideal GPS signals with little or no noise. Our contribution in this work is the demonstration of a set of algorithms that allow a quadrotor to perform a autonomous landing on a car travelling at over 20 meters per second while relying only on visual inertial data collected from and on-board gimbaled camera system. From this image data, along with on-board IMU readings, it is shown that both speed of the target and the quadrotor in the inertial frame can be directly estimated, and using this information a set of controllers and planners can be developed that allows for the quadrotor to perform a high speed landing manoeuvre in a variety of conditions. The robustness of our system is demonstrated by landing in without using GPS, poorly lit conditions, and with high winds.**

* M.A.Sc. Candidate, Mechanical and Mechatronics Engineering, University of Waterloo; c33choi@uwaterloo.ca

[2] M.A.Sc. Candidate, Mechanical and Mechatronics Engineering, University of Waterloo; s52brown@uwaterloo.ca

† Assistant Professor, Mechanical and Mechatronics Engineering, University of Waterloo; stevenw@uwaterloo.ca