Thesis Portfolio

Fly-Crash-Recover: A Sensor-based Reactive Framework for Online Collision Recovery of UAVs

(Technical Report)

An Analysis and Recommendation of the Implementation of Automated Cheat Detection Systems on Honor-Based Academic Societies

(STS Research Paper)

An Undergraduate Thesis

Presented to the Faculty of the School of Engineering and Applied Science
University of Virginia • Charlottesville, Virginia

In Fulfillment of the Requirements for the Degree
Bachelor of Science, School of Engineering

Anders Christoffersen
Spring, 2020

Department of Electrical and Computer Engineering

Table of Contents

Sociotechnical Synthesis

With a technical component focused on quadrotor recovery methods and an STS portion focused on the development and implementation of automated cheat detection systems, the two parts of this portfolio may seem largely disconnected. The quadrotor recovery technical work stemmed from the prevalence of quadrotor systems in both the hobby and industry fields. These systems are often expensive and sensitive, therefore crashing or falling to the ground can impact not only the results of the activity, but may also cause financial damage. Investigating the types of crashes experienced by quadrotor systems and the design of impact recognition and recovery strategies is therefore of interest. The development of automated cheat detection systems and their implementation is a largely unrelated topic, but one I had personal interest in due to the constant shifts in academic environments and the nature of honor at universities. With the 2020 COVID-19 coronavirus pandemic and the subsequent online focus of many universities, how universities and students maintain fair relationships and ensure the integrity of the academic process became of even higher importance and interest.

My Capstone project, Fly, Crash, Recover, focused on the development of impact recovery methods for quadrotor unmanned aerial vehicles (UAVs). The first half of the project centered around gaining familiarity with the Robot Operating System (ROS) which is a robotics oriented operating system built on top of Linux and provides interfaces to many popular platforms, including the DJI Tello and Bitcraze Crazieflie platforms used in this project. Using ROS also allows the impact recognition and recovery strategies to be easily ported to other platforms not used in this project. Initial tests were performed with the two quadrotors to gather crash data for analysis to determine what impacts looked like to the quadrotors. This data is used to determine when to change controller states to recovery processes, which were designed in the

second portion of the project. By combining recognition of impacts with recovery strategies designed to change the quadrotors trajectories away from the obstacles the system is able to impact, recover, and recalculate a trajectory to the end target that avoids the obstacle.

As universities continue to develop their curriculums in the ever-increasing digital age, the problem of honor and academic integrity develops with it. As many courses include online components or have shifted entirely online, the resources available to students and faculty change just as their interactions do. While many universities including UVA have strong histories of academic honor, higher enrollment numbers and the nature of assignments has led to an increase in automated cheat detection systems in use. These systems allow almost instant comparison of submitted work against other submissions and are not restricted to that year or university only. I focus my STS research on how the implementation of these systems affects student-student and other interactions at universities, focusing specifically on the School of Engineering and Applied Science at the University of Virginia, and research sources from studies at other universities around the United States. The impacts of these systems on student work and relationships with course material, professors, and other students is a critical part of academia at universities that choose to implement these systems and a topic of personal interest as well. Interviews with several faculty at UVA's Engineering and Applied Science school were performed to examine the current state and impression of these automated systems, and unsurprisingly, results were mixed. Understanding how these systems benefit majority online introductory courses while remaining unused for high level STS courses for example provides some insight into how these systems can be catered to specific needs, but remain dependent on the relationships between students, faculty and their work. Understanding of these differences

and requirements, as well as course policies and enforcement thereof is an important part of understanding the impacts and best ways to use automated cheat detection systems.

Beyond the normal coursework of my program I found it interesting to work simultaneously on a technical and more social oriented engineering project. The two bear almost no resemblance to each other, but there is value in both and they are both research oriented projects, something I had not had much opportunity to do while in my undergraduate program. The research focus provided new ways of using my education in computer engineering, and analyzing and solving real world problems that had not been tackled before. The STS portion was the first longer project involving engineering principles to a social project that I have been involved with, and I found the perspectives needed to understand the problem more varied than normal when doing technical engineering analysis. While interesting and something I would be open to doing more of in the future, the technical work involved with the quadrotor systems and ROS was a topic I had some exposure to previously, but not at the level in the Capstone project. This project directly influenced my intended path forwards in engineering and was surprisingly easy to engage with despite the technical nature of the project.