Thesis Project Portfolio

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

(Technical Report)

Analysis of the Difficulties of Integrating Commercial UAVs into the National Airspace

(STS Research Paper)

An Undergraduate Thesis

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Miller Caldwell Garrett

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Department of Engineering Systems and Environment

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Sociotechnical Synthesis
(Executive Summary)

Over the past 20 years, the applications of unmanned aerial vehicle (UAV) technology have rapidly grown from limited research and military operations, to novel public, recreational, and commercial uses. The versatility of these vehicles for aerial photography, surveying, and even UAV-based delivery, contained in a relatively simple and cheap system, has resulted in broad areas of potential applications. Both my technical and STS research focused on the process of integrating UAV systems into society through technical and regulatory means. My technical project developed a control system to help UAVs recover from in-flight collisions, mitigating the danger to people and property on the ground. My STS research focused on exploring the societal and technical requirements for viable commercial UAV systems of the future.

While the fundamental hardware and software behind UAVs have existed for many years, some technical aspects that are key to societal integration are only just being developed. Because many of these elements are related to the safety of the vehicle, my team developed a general control system that attempts to recover a UAV in mid-air following a collision during flight. As opposed to typical see-and-avoid strategies which try to avoid a collision, our system assumes that all precautions have failed and a collision has already occurred. Our system detects that a collision has occurred, estimates the approximate direction and location of the collision, and enters a recovery mode that attempts to stabilize the vehicle. With this type of system integrated into most UAVs, we can greatly reduce the likelihood that a collision results in the loss of the vehicle or danger to people and objects on the ground.

Through my STS research, I investigated the regulatory requirements for large-scale, commercial UAV systems to emerge in coming years. Protecting the safety and privacy of the

public, as well as gaining the public's trust in this technology, will be the paramount tasks of companies and regulators involved in this process. Effective implementation of these systems will be contingent upon regulations developed by the Federal Aviation Administration (FAA), as shown by the history of aviation regulation. Through this analysis of aviation history, I show how specific events have led to the current regulatory landscape surrounding UAVs, and how the FAA needs to make significant progress on new regulation to properly support these systems.

My technical and STS projects work together to demonstrate how the sociotechnical system surrounding UAVs is far more complex than just the technology behind the vehicles. My group's technical work is one piece of research that may be combined with other projects to protect and benefit the public. Research and innovations in UAV technology are rapidly solving many problems related to safety and privacy, but this will not be sufficient without complimentary innovation in social and political realms. My research highlights how the FAA must keep the safety and privacy of the public in mind while striving to achieve the maximum benefits of these systems.