Introduction

We created support infrastructure that can help speed up the development of UAV technology. The majority of UAVs today are controlled with PID control schemes which are hard to tune perfectly. Aircraft radio communication becomes an issue at large distances due to data loss over transmission and requires high power to compensate. Additionally flight video capturing is not perfectly performed by humans. Our infrastructure aims to alleviate these problems.

Aircraft Tracking

In order to precisely aim an antenna, camera, or any other device at the aircraft, we implemented a tracking system. Specifically, a two degree of freedom pan-tilt system was used. Using telemetry data downlinked from the aircraft, a location and velocity based PID control scheme was then devised to control the tracker. A video camera was placed onto the system during testing to confirm directional accuracy.

Testing

Initial testing was performed using a commercial flight simulator emulating the aircraft's flight characteristics. Further results were obtained using an Avistar UAV trainer aircraft equipped with an Intel Edison for in flight navigation and data processing.

Automated PID Tuning

In order to identify the system for future analysis, several unit steps were applied to the aircraft's elevators and ailerons. This produced an impulse response that was characterized by applying several different model approximations in Matlab, such as State Space Representation and Transfer Function Representation. From this data we were able to apply traditional PID tuning algorithms to our analyzed system to produce an optimally tuned system. Since this approach can be used for any system we can characterize, it allows for a rapid, accurate, and general ability to tune aircraft controls.

Conclusion

We were able to develop a procedure to automatically tune the PID constants of our aircraft to ensure a stable flight as well as a general model that can be applied to any single aircraft without taking days to manually tune.

Furthermore, we made significant improvements to the ground station infrastructure by making a modular system that can accommodate directional antennas for long range tracking. This system is now seamlessly integrated into the simulation environment so that future testing can be done much more quickly and thoroughly.

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