EE798T Course Project
Automatic Antenna Tracking System

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1 Introduction

The problem statement is to design a ground station antenna tracking system that dynamically points a directed antenna at a moving UAV. Assuming that the drone is friendly, the antenna would also be receiving the kinematics of the UAV from some of the packets that it receives.

2 Methodology

2.1 Control Strategy for the Antenna

1. Introduce more advanced and optimal control algorithms for individual axis control.
2. Couple both controllers to get a faster response by changing both angles simultaneously.
3. Develop a method to predict the response time given the current orientation (ϕ, θ) and the desired orientation (ϕ^r, θ^r), say Δt_a.
4. Analyse the path traced by the antenna top over the sphere S_a.

2.2 Prediction for Correct Reference Angles

We would need to do the following:

1. Setup the scripts that intimate kinematics data as IP packets between the onboard computer and the antenna controller.
2. Work out an optimal model based on current and past kinematics of the UAV that would predict the pose at $t + \Delta t$, let $P(t)$, which can be directly translated to antenna orientation $P_a(t)$.
3. To maximise directed tracing, introduce waypoints instead of allowing the antenna control to directly go to $P_a(t + \Delta t_p)$.
4. Decide the scheme of choosing waypoints on the sphere S_a, described above.
5. Simulate a UAV with its pose being broadcasted on a computer and tune the above
6. Demonstrate a UAV localized by the motion capture setup. This would be a test environment where we would know the ground truth of the orientation of antenna as well as kinematics of the drone.
7. Demonstrate a UAV localized outdoors using GPS and with no ground truth.

3 Timeline

04 Mar - 09 Mar	Get familiar with current antenna control and motion capture system, demonstrate the current status in-flight and benchmark the timings
11 Mar - 16 Mar	Create control algorithms as in section 2.1
18 Mar - 23 Mar	Setup connection scripts between onboard and antenna controller. Simulate a virtual UAV and broadcast it's pose within MoCap.
01 Apr - 06 Apr	Test within MoCap using actual drone's pose and communication
08 Apr - 13 Apr	Test outdoors with only GPS pose estimates
15 Apr - 20 Apr	Buffer period

4 Hardware

We would require the access to the antenna, as well as access to the Qualysis motion capture system for getting a testing environment that provides feedback of antenna orientation and UAV pose estimates that could be treated as ground truth.

We would also require a UAV with an onboard computer and connection module for the antenna.