AA 549: Estimation and Kalman Filtering
Homework #6
Due: Sunday, May 16, 2021 @ 11:59 pm

For the following problems, feel free to write code that can perform multiple filters. Use some open-loop control $u(t)$ of your choice. Also, experiment with various covariance matrices. Try not to just copy my code. I know everything so I will know. No specific requirements on what plots you produce; the deliverable is to get the code running, but it's worth plotting some things to see the performance.

1. **Unscented Kalman Filter**

   Get the Unscented Kalman Filter working for the quadrotor model from last weeks homework.
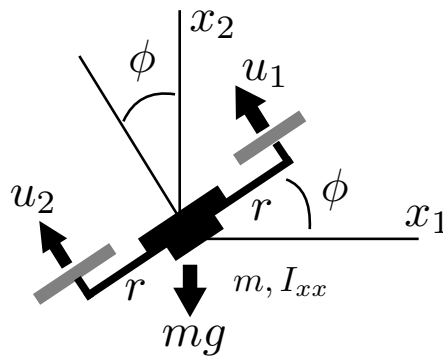
$$\ddot{x}_1 = -\frac{1}{m}(u_1 + u_2)\sin(\phi) + w_1, \qquad w_1 \sim \mathcal{N}(0, q_1)$$

$$\ddot{x}_2 = \frac{1}{m}(u_1 + u_2)\cos(\phi) - mg + w_2, \qquad w_2 \sim \mathcal{N}(0, q_2)$$

$$\ddot{\phi} = \frac{r}{I_{xx}}(u_1 - u_2) + w_3, \qquad w_3 \sim \mathcal{N}(0, q_3)$$

Measurement $\quad y = x + v, \qquad v \sim \mathcal{N}(0, R)$

with state vector $x = [x_1 \ \dot{x}_1 \ x_2 \ \dot{x}_2 \ \phi \ \dot{\phi}]^T \in \mathbb{R}^6$. Pick whatever values for m, r, and I_{xx} and some arbitrary control trajectory. Since you're randomly picking an open-loop control trajectory feel free to ignore the gravity term if it's making your quad fall too much.