Hand-In Exercise 3: State Space Control of Flying Drone

Name 1 (Username 1), Name 2 (Username 2), ...

1 System Analysis

1.1 State Space Model

Provide a derivation of a state space model of the system. Use Figure 1 and (1).

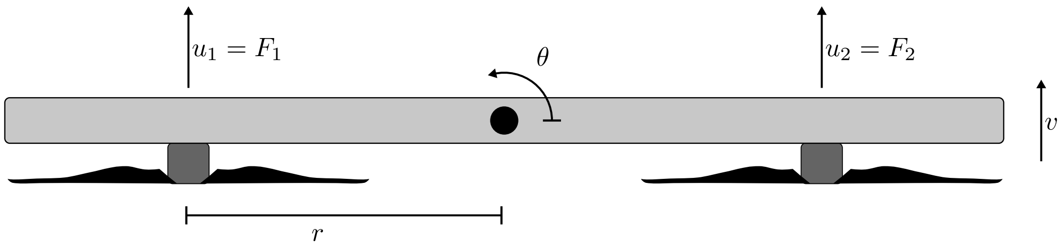

Figure 1: Diagram of flying drone that is controlled via two propellers, which apply forces F_1 and F_2 to the drone.

$$\begin{aligned} J\ddot{\theta} &= r(u_2 - u_1) - b_1\dot{\theta} - b_2 v \\ m\dot{v} &= u_1 + u_2 - b_3 v \end{aligned} \tag{1}$$

Text

$$\begin{aligned} \dot{x} &= \text{Insert equation} \\ y &= \text{Insert equation} \end{aligned}$$

where explain all parameters

1.2 Observability and Controlability

Determine controlability and observability of the system.

Write the two matrices

$$\begin{aligned} \mathcal{O} &= \text{Insert equation} \\ \mathcal{C} &= \text{Insert equation} \end{aligned}$$

provide conclusion on based on matrices

2 Controller Design

2.1 Integral Control

Design an integral control for the system using pole placement. The control should ensure that the system has a 5 % settling time of 1 s.

The following control law is an integral control that ensures a 5 % settling time of 1 s

$$u = \text{Insert equation}$$

2.2 Performance Evaluation

Evaluate the performance of the system by changing the reference to the system from $(p, \theta) = (0, 0)$ to $(p, \theta) = (1, \pi/8)$. You should plot both u, y, and the state x in Figure 2.

Plot of u, y, and the state x

Figure 2: Insert caption.

3 Observer Design

3.1 Pole Selection

Determine appropriate locations for observer poles.

3.2 Observer Design

Design a full-order observer for the system using pole placement.

4 Simulation

Simulate the observer-based controller by changing the reference to the system from $(p, \theta) = (0, 0)$ to $(p, \theta) = (1, \pi/8)$ and ensure that the initial condition of the system and the observer are different. You should plot both u, y, and the state x in Figure 3.

Plot of u, y, and the state x

Figure 3: Insert caption.