HW8 due 11:30a Mon Dec 5

Asteroids control system

This problem deals with the asteroids control system (N)

$$\dot{x} = f(x,u),\ y = h(x,u)$$

with equilibrium

$$f(x_0,u_0) = 0$$

and associated linear control system (L)

$$\dot{\xi} = A\xi + B\mu,\ \eta = C\xi + D\mu$$

obtained with $A = D_x f(x_0,u_0)$, $B = D_u f(x_0,u_0)$, $C = D_x h(x_0,u_0)$, $D = D_u h(x_0,u_0)$.

a. Assess controllability of the asteroids control system (i.e. construct the controllability matrix and determine its rank).

b. Choose an initial condition and final condition (different from the initial condition), and use the Singular Value Decomposition of the controllability matrix to construct a control input that steers the initial condition to the final condition.

c. Assess observability of the asteroids control system (i.e. construct the observability matrix and determine its rank).

d. Simulate the system from an initial condition to a final condition (different from the initial condition), and use the Singular Value Decomposition of the observability matrix to construct the initial condition using the simulation's output.

Project control system

This problem deals with your project control system (N)

$$\dot{x} = f(x,u),\ y = h(x,u)$$

with equilibrium

$$f(x_0,u_0) = 0$$

and associated linear control system (L)

$$\dot{\xi} = A\xi + B\mu,\ \eta = C\xi + D\mu$$

obtained with $A = D_x f(x_0,u_0)$, $B = D_u f(x_0,u_0)$, $C = D_x h(x_0,u_0)$, $D = D_u h(x_0,u_0)$.

a. Assess controllability of your control system (i.e. construct the controllability matrix and determine its rank).

b. Modify your control system as needed to ensure it is controllable.

c. Choose an initial condition and final condition (different from the initial condition), and use the Singular Value Decomposition of the controllability matrix to construct a control input that steers the initial condition to the final condition.

d. Assess observability of the asteroids control system (i.e. construct the observability matrix and determine its rank).

e. Modify your control system as needed to ensure it is observable.

f. Simulate the system from an initial condition to a final condition (different from the initial condition), and use the Singular Value Decomposition of the observability matrix to construct the initial condition using the simulation's output.