ADVANCED CONTROL II

Spring 2010

K. N. T. U.

Optimal Control of the Altitude of an Unmanned Surveillance Vehicle

Design a system for controlling the altitude of an unmanned surveillance vehicle. The entire state is measured and can be used to generate the throttle input. A constant altitude of zero feet is desired. Note that this can yield any desired height by appropriate definition of the zero altitude reference plane.

A block diagram for the vertical motion of the vehicle is given in the figure, where h(t) is the height of the vehicle, u(t) is the throttle input, and $\tau = 2$ is a time constant indicating that acceleration doesn't change instantaneously. Design the control system to minimize the coast:

$$J(x(t),u(t)) = \frac{1}{2}\int_0^{\infty} \{ \begin{bmatrix} h(t) & \dot{h}(t) & \ddot{h}(t) \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} h(t) \\ \dot{h}(t) \\ \ddot{h}(t) \end{bmatrix} + 2u^2 \} dt$$

Simulate the closed loop system with the initial height equal to 10 feet and the other state equal to zero, and plot the plane state and the control input. Generate the Nyquist plot for the system and find the stability margins.

Design additional controllers, simulate and plot as above for the following,

a. $Q = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}, R = 2000$	b. $Q = \begin{bmatrix} 10 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}, R = 2$	c. $Q = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 100 & 0 \\ 0 & 0 & 0 \end{bmatrix}, R = 2$

Comment on the effects of changing the coast function on the states, the control inputs, and the optimal feedback gains.

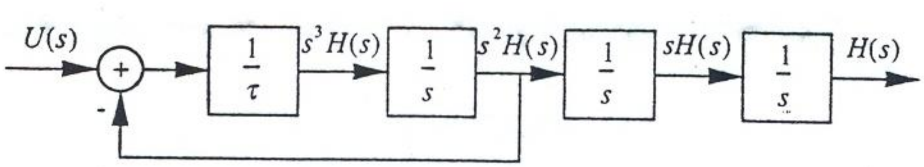

Fig. block diagram for the vertical motion of an unmanned surveillance vehicle