FINAL PROJECT FOR ELE 598J - 2006

PART I : CONTROL SYSTEMS ANALYSIS :

FOR YOUR SYSTEM DETERMINE THE FOLLOWINGS :

(i) Determine the Controllabilty and Observability using different criteria : Kalman, controller-Hessenberg and observer-Hessenberg forms, and eigenvalue criterion.

(ii) Plot step responses of both the uncontrolled and controlled systems by using MATLAB function ODE 23 and with the same chosen initial condition.

(iii) Determine stability of the system by using eigenvalue criterion Lyapunov criterion of stability.
In case your system is stable, determine controllabilty and Observability by computing controllability and Observability Gramminas. In case the system is not stable, perturb the system to make it a stable system and then perform the controllabilty and Observability Grammian tests.

(iv) Compute the H-2 Norm of the system.

PART II : CONTROL SYSTEMS DESIGN

(i) LQR DESIGN

Perform a LQR design of your system. (a) Find a stabilizing matrix K such that the system becomes stable (Use both CARE and Lyapunov Equations). (b) Compute the minimum value of the quadratic cost function. (c) Verify the stability and robustness properties of the LQR design as outlined Chapter 10 of the text book. (d) Compare the transient responses of the closed-loop system by both Lyapunov Method and the LQR design.

(ii) H-Infinity Control Design

Perform an State-Feedback H-Infinity Control Design of your system using results of Theorem 10.6.4 of the book. First put some "noise" in your input data to construct a stochastic system. (This requires a solution of an Algebraic Riccati Equation and computation of H-infinity norm of a transfer function).

(iii) Design of a Reduced-Order Observer

Suppose that only one state variable of your systems is known and you are required to estimate the other state variables. Design a reduced-order observer for your system by both pole-placement and Sylvester-Observer equation. Plot the graphs of comparison of both actual and estimated states in each case.

(iv) Kalman Filter Design

Design a Kalman Filter for your stochastic system and compare the graphs of actual and estimated systems.

(vi) Model Reduction

Reduce you model by an appropriate size by using Balanced Trunctaion. Compare responses of the orginal and the reduced-order model. Test the stability of the reduced order model. Verify the result on H-infinty Error Bound for the rduced-order model.