

CALIFORNIA INSTITUTE OF TECHNOLOGY
Control and Dynamical Systems

CDS 210

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Fall 2008

Problem Set #M

Issued: 27 Oct 08
Due: 3 Nov 08

Note: In the upper left hand corner of the *second* page of your homework set, please put the number of hours that you spent on this homework set (including reading).

1. Åström and Murray, Exercise 7.3
2. Consider the one-dimensional heat-equation with dissipation:

$$\frac{\partial h}{\partial t} = k \frac{\partial^2 h}{\partial z^2} - \epsilon h$$

with forcing at $z = 0$ and measurement at $z = 1$. Using a central finite-difference, we can discretize this to give $\dot{x} = Ax$ where each row of the A -matrix has terms

$$k/\ell^2 [-1 \quad 2 \quad -1] - \epsilon [0 \quad 1 \quad 0]$$

The A -matrix is generated by the matlab code `heat_pde.m` on the course web-site. Compute the Reachability and Observability Gramians W_c and W_o . Is the system reachable and observable? Plot the most reachable and most observable directions. Considering the magnitudes of the eigenvalues of W_c and W_o , comment on the feasibility of designing a control system for these dynamics using this input and output.

3. Dullerud & Paganini, problem 2.9 part (b)
4. Dullerud & Paganini, problem 4.1