# Homework 5

## ECE6550 Linear Control Systems

Magnus Egerstedt

Due: December 1, 2011 (Dec. 8 for DL students)

## 1

Go to T-square under Resources/m-files and download the m-file `dist.m`. This is a model of a distillation process.

### a

Is the system completely controllable? Is the uncontrolled system stable?

### b

By picking weights, come up with a controller that makes the system behave "well". (This is vague - just like life as a control designer is...)

## 2

Using your favorite optimal control law in the previous question, find what the corresponding "optimal" closed-loop eigenvalues are.

### a

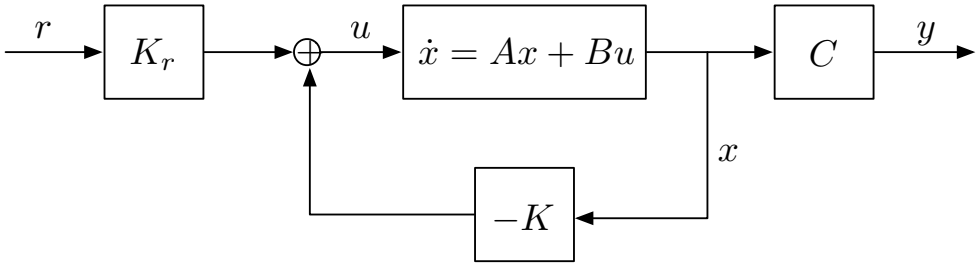
Use pole placement instead of optimal control in your code to make the closed-loop eigenvalues equal to the optimal eigenvalues above.

### b

Is the resulting $K$ the same as when you used optimal control in Question 1? If not, why not?

## 3

Consider the block-diagram below. Assume that $r, u, y$ are all scalars and that $K$ has stabilized the closed-loop system. If the reference signal $r$ is constant, what should $K_r$ be such that $\lim_{t\to\infty} y(t) = r$?




## 4

Consider the scalar system

$$\dot{x} = ax + bu,\ x, u \in \mathbb{R}.$$

For this system, write a matlab program that finds the optimal $u$ that minimizes

$$J(u) = \int_0^1 (qx^2(t) + ru^2(t))dt + x^2(1)k,$$

where $q, r, k > 0$. Plot and hand in your solution when $a = 1, b = 2, q = 1, r = 2, k = 0.5$, and $x(0) = 1$.

## 5

Go to

`http://www.cetl.gatech.edu/cios/digitalmeasures_student.htm`

and check out the course survey for ECE6550 – A for on-campus students, RCC for Savannah students, and Q for DL students. (The Course Instructor Opinion Survey will be available starting Monday Nov. 28.)

*How many questions were there?*