Homework #5

1 Problem 1

For the following linear system

$$r(t) = \dot{e}(t) + \alpha \cdot e(t)$$

where α denotes some positive constant, prove the following properties

- If $r(t) \to 0$ exp. fast, then $e(t)$, $\dot{e}(t) \to 0$ exp. fast;
- If $r(t) \to 0$, then $e(t)$, $\dot{e}(t) \to 0$;
- If $r(t)$ is GUUB, then $e(t)$, $\dot{e}(t)$ is also GUUB.

2 Problem 2

For the following nonlinear system

$$\ddot{x} = ax^3 + bxe^{-t} + \frac{c\ln(|x|+1)}{\dot{x}^2+2} + (x^2 + \cos^2 x)u$$

where a, b, $c > 0$ denote known positive constants, design a nonlinear control to drive x to the desired trajectory

$$x_d = 10\sin(t)$$

exponentially fast.

- Show that your controller achieves the desired control performance;
- Demonstrate that all the signals during closed-loop operation remain bounded, and there is no singularity presented with your controller.

3 Problem 3

For the following system

$$\begin{cases} \dot{x} = x\cos(x) + x^2 - y \\ \dot{y} = u \end{cases}$$

where x and y represent the system state, u is the control input. Design the control u to drive x to zero asymptotically fast.

4 Due Date

November 22, 2004.