Homework 2, Linear Systems, Fall 2007

- When turn in your homework, please write down: 作業次別, 姓名, 學號, 系級, 日期
- Assigned: 10/23/06, Due on 11/6/06

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1 (The RLRC circuit) — 30 points

Consider the RLRC circuit discussed in Problem 1 of HW1, and use the values: $R_1 = 2, R_2 = 10, L = 0.5, C = 1$.

1a Find the analytical solution of the system, that is, $\mathbf{x}(t) = ?$.

1b Given the initial conditions $\mathbf{x}(0) = [0, 0]^\top$, and the input, $u(t) = 1$, find the numerical soltion of the system by using (1) direct computation, (2) the STEP function, (3) the ODE45 funtion. Show the result by plotting the values of state versus time and discuss what are shown in the plots.

1c Given the different initial conditions $\mathbf{x}(0) = [1, -1]^\top$, and the input, $u(t) = a * \sin(b * t)$, find the numerical soltion of the system by using (1) direct computation, (2) the ODE45 funtion. You need to try different values of a and b. Show the result by plotting the values of state versus time and discuss the result shown in the plots.

2 (The bicycle-rider system) — 10 points

Consider the bicycle-rider system in Problem 6 of HW1, and the following specifications are used for the system.

Weight of vehicle	$m_v g$	136.0	N
Weight of human	$m_h g$	9.11	N
Height of center of gravity of vehicle	h_v	0.334	m
Height of center of gravity of human	h_h	0.465	m
Moment of inertia of vehicle	I_v	2.25	kgm^2
Moment of inertia of human	I_h	0.201	kgm^2
Wheel base	L	0.665	m
Longitudinal distance	L_r	0.313	m
Rider's distance	h	0.08	m
Forward speed	V	1	m/s
Length	l	0.7	m
	B_1	$1/L$	
	B_2	L_r/L	

Assume that the inputs are constant or sinusoidal functions, that is, $u_i = a_i$ or $u_i = a_i * \sin(b_i t + c_i)$.
You may choose different values of a_i, b_i, c_i and try to simulate the system. Plot the numerical result and explain your plots.

3 (The Vehicle system) — 10 points

Consider the four state-space models obtained in the Midterm exam. Numerically show that the four models are algebraically equilivant and find the corresponding equivalence transformation matrix.