CDA6530: Performance Models of Computers and Networks (Fall 2015)

Project 2: Using Matlab Simulink to derive numerical solution for differential equations

(Due: Oct. 11th midnight via webCourse)

You have learned matlab simulink from the example of the simple worm propagation modeling in class. Now you are asked to derive the numerical solutions for more complicated differential equations.

If you cannot access Matlab Simulink, you can use an equivalent free software 'Xcos' (similar to Simulink), which comes with the free software package 'Scilab' (similar to Matlab). The website is:
http://www.scilab.org/products/scilab

Submission: please submit this project assignment via webcourse. You should attach a zip file containing:
1). A report file (such as word file) containing experiment figures and simulink model figures, and
2). Simulink model files (.mdl), and matlab script file (.m file in which you call the simulink model and plot the results), so that I can test by myself.

If you use 'Xcos', please explicitly show how the teacher can test your simulation model.

1. 2nd-order damped, forced oscillator system.

You are requested to solve the Ordinary Differential Equation:

$$\frac{d^2x}{dt^2} + 3\frac{dx}{dt} + 4x = 5\cos(2t)$$

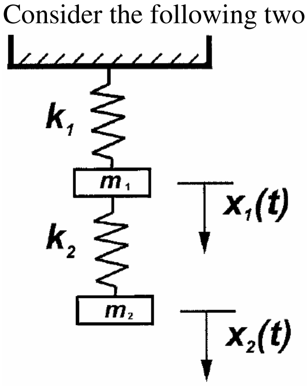
With initial conditions:

$$x(0) = 0 \quad \text{and} \quad \frac{dx}{dt}(0) = 0$$

Run the simulation for **10 unit time**. You need to plot the *x(t)* curve to show its dynamics.

2. Two coupled spring with Damping

Consider the following two coupled spring with damping system:



Where $x_1(t)$, $x_2(t)$ represent the positions of the two block m_1 and m_2. k_1 and k_2 denote the Hooke's constants (you can think them as the strength metric of springs). Suppose the two springs have frictions, with the damping coefficient of δ_1 and δ_2, respectively. The differential equations governing the system's dynamics are:

$$m_1\ddot{x}_1 = -\delta_1\dot{x}_1 - k_1x_1 - k_2(x_1 - x_2)$$

$$m_2\ddot{x}_2 = -\delta_2\dot{x}_2 - k_2(x_2 - x_1)$$

Now we assume the two blocks have weight $m_1 = m_2 = 1$. The four constants have values of: $k_1 = 0.4$, $k_2 = 1.808$, damping coefficient $\delta_1 = 0.1$ and $\delta_2 = 0.2$.

The initial condition is: $(x_1(0), \dot{x}_1(0), x_2(0), \dot{x}_2(0)) = (1, 1/2, 2, 1/2)$

Plot the dynamics of position variables $x_1(t)$ and $x_2(t)$ on two graphs from t=0 to t=50, respectively.