

CDA6530: Performance Models of Computers and Networks (Fall 2010)

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

(assigned 10/21; due: 10/30 midnight, late submission deadline: 11/02 midnight)

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.

Submission: please submit this project assignment via webcourse. You should attach a Winzip file containing a document (such as word) containing experiment figures and simulink model figures, and a simulink model file (.mdl), and a matlab script file (.m file), so that I can test by myself.

1. 2nd-order mass-spring-damper system.

You are requested to solve the ODE: $m\ddot{x} + c\dot{x} + kx = f(t)$

With initial conditions: $x(0) = 0, \dot{x}(0) = 0, \ddot{x}(0) = 0$ and parameters $m = 0.25, c = 0.5, k = 1$. The input $f(t)$ is a step function with magnitude 3.

The experiment output can use a “scope” figure to represent.

2. Two-factor worm propagation model (Zou’s CCS’02 paper)

As you learned the simple worm propagation model simulation, here you are requested to simulate the two-factor worm propagation model, which is:

$$\left\{ \begin{array}{l} dS(t)/dt = -\beta(t)S(t)I(t) - dQ(t)/dt \\ dR(t)/dt = \gamma I(t) \\ dQ(t)/dt = \mu S(t)J(t) \\ \beta(t) = \beta_0 [1 - I(t)/N]^\eta \\ N = S(t) + I(t) + R(t) + Q(t) \\ I(0) = I_0 \ll N; S(0) = N - I_0; R(0) = Q(0) = 0; \end{array} \right.$$

Where $J(t) = I(t) + R(t)$

The simulation parameters are: $N=1,000,000, I_0 = 1, \eta = 3, \gamma = 0.05, \mu = 0.06/N, \beta_0 = 0.8/N$.

This model is introduced in the page 8 of the paper:

<http://www.cs.ucf.edu/~czou/research/codered.pdf>

You are requested to draw the $J(t), I(t), Q(t)$ by using `plot()` command in workspace (similar to the figure 7 in the paper). That means you have to save the simulation results into workspace variable and then plot them out.

In your submission, please provide the model .mdl file and also the matlab script file (in which you call the simulink model and plot the results).