University of Colorado
Department of Computer Science

Numerical Computation   CSCI 3656
Spring 2016

Problem Set 13

Issued: 21 April 2016

Due: 28 April 2016

1. *[30 pts]* Modify your code from PS12 to solve the Lorenz equations using the *trapezoidal* method instead.

   Generate two 10,000-point-long trajectories using $h = 0.01$, one from the initial condition $[x, y, z]^T = [1, 1, 1]^T$ and the other from the initial condition $[x, y, z]^T = [1.01, 1.01, 1.01]^T$. Make time-domain plots of the x coordinates and state-space plots for both trajectories.

   Now explore the difference between forward Euler and trapezoidal by generating trajectories from $[x, y, z]^T = [1, 1, 1]^T$ for a range of different time steps (e.g., $h = 0.01$, $h = 0.001$, $h = 0.0001$) with these two solvers and make time-domain plots of their x coordinates. In these plots, keep the overall length the same—length in *time*, that is, not the number (N) of points. (Recall that h is a time interval.) You'll probably want to zoom in on the first second or so of the plot in order to focus this exploration.

   Comment on the similarities and differences between the results produced by these two solvers. Which are better, would you think? Why?

   Please turn in your plots, your thoughts, and a copy of your code.