CN510 Assignment 1: Leaky Integrator

Due Tuesday Sept. 17, 2013

Leaky Integrator

Investigate a leaky integrator.

$$\frac{dx}{dt} = -Ax + I \tag{1}$$

Analytical Solution

Solve the equation above analytically. Provide all steps of the solution in the report. After you have obtained a general form solution, plot the resulting function for the following initial conditions and parameters during the first $T = 5$ time units:

- $I = 5$, $x_0 = 0$, $A = 1$;
- $I = 0$, $x_0 =$ whatever solution of the previous case gives you at $t = 5$, $A = 1$;
- $I = 5$, $x_0 = 0$, $A = 2$;
- $I = 0$, $x_0 =$ whatever solution of the previous case gives you at $t = 5$, $A = 2$;

For all these four cases calculate the equilibriun solution and compare how close it is to the actual solution at $t = 5$.

Rotter-Diesmann Solution

Set the $\Delta t = 0.05$. Using Rotter-Diesmann method iteratively (refer to lecture notes if needed) compute x at every time step from $t = 0$ to $t = 5$ for all four above cases. Plot the resulting solution points and look at the numerical precision with respect to analytical solution. Note that you will need to look at the numeric values, eyeballing the plots most likely will not show any difference between the two solutions. For extra credit you can do each run twice: for 32 bit and 64 bit floating point precision.

Additional Points to Discuss in the Report

- What effect does A have on the behavior of the system?
- For this report DO include your code for Rotter-Diesmann part. If you use LaTeX, you can use \begin{verbatim} and \end{verbatim} to surround the code fragments so that they are displayed properly in the resulting document.

Grading Rubric:

100 points	**Leaky integrator** from which
30 points	Well-formatted plot with readable labels and parameter meanings listed in the caption
40 points	Answers to all the questions above
30 points	Correct and complete analytical solution and equilibrium solution (not just the result, partial credit will be given for partially correct solution)