Simulink

Lab Notes #13

What is it?

Simulink is a GUI (graphical user interface) programming environment intended for modeling and simulation work.

It is fully integrated into MATLAB.

It contains special toolboxes for basic Math, Control Systems, Digital Signal Processing, Instrument Control.

This means (generally speaking) that you can model any LTI system in it and even some nonlinear ones!

Linear System Example

Consider the system

$$\ddot{x} + \dot{x} + x = u(t) \qquad t > 0$$

Perhaps we'd like to know the response to this function in the time domain. We can implement this second order system in Simulink easily in either the time domain or the s-domain. Note that the Laplace Transform of the above DE is

$$s^2 X(s) + s X(s) + X(s) = 1$$

Time Domain Model $\ddot{x} + \dot{x} + x = u(t)$

Can be rewritten as

 $x = u(t) - (\ddot{x} + \dot{x})$



S-Domain Model Rearranging the Laplace Transform of our DE

$$X(s) = \frac{1}{s^2} - \left(\frac{1}{s^2}X(s) + \frac{1}{s}X(s)\right)$$



Both models give the same result! (they should)



Nonlinear System of Differential Equations

$$\frac{dx}{dt} = -y - z$$
$$\frac{dy}{dt} = x + ay$$
$$\frac{dz}{dt} = b + z(x - c)$$

This system is called the Rössler system of differential equations. It is studied because it is a simple system which exhibits chaotic behavior. Typical interesting parameter values are a = 0.2 = b and c = 5.7

Rossler System-Time Domain



Rossler System s-domain









Parametric Plot



It's Chaotic!

No Lab Report!