Introduction to Simulink

Please complete the tutorial on Simulink found at

`http://www.mathworks.com/access/helpdesk/help/pdf_doc/simulink/sl_gs.pdf`

. This will familiarize you with the basic operation of Simulink.

Introduction

The field of systems engineering is undergoing continuous advancement in the direction of doing more at the systems engineering level. One popular trend is that of model based engineering, where rather than building the actual system, a computer model of the system is built instead and properties of this model are checked against the requirements.

Simulink is a model-based design tool dynamic systems. It provides an interactive graphical environment and a set of block libraries that let you design, simulate and implement a variety of systems. Tools like Simulink are used to verify and validate system properties and requirements from a model rather than the implementation.

In this exercise, we will be using Simulink to model a very simple predator prey system. By doing this, you will familiarize yourself with building and modifying hierarchical graphical models with Simulink.

Predator Prey Model

You are asked to build a Simulink model that captures predator prey dynamics. Let $x(t)$ represent the number of prey and $y(t)$ represent the number of predators at time t.

There are two factors that affect the prey population, their natural tendency to reproduce at a birthrate b

$$bx(t)$$

and the fact that predators eat them in proportion to the product of their populations parameterized by p, the rate of predation

$$-px(t)y(t).$$

This results in the following formula for prey dynamics

$$\dot{x}(t) = bx(t) - px(t)y(t) \tag{1}$$

Predators are subject to their own population dynamics. Unlike prey, their numbers naturally tend to decrease at decay rate d

$$-dy(t).$$

However, their numbers increase when feeding on prey, in proportion to the product of the populations with ratio r

$$rx(t)y(t).$$

Resulting in the following formula for predator dynamics

$$\dot{y}(t) = -dy(t) + rx(t)y(t). \tag{2}$$

Using Simulink, model the dynamics of these populations.

Additional Questions

1. Using the scope tool, generate a plot of the populations over time.
2. Use the subsystem tool to create separate subsystems for the predator and prey populations.
3. Using the Unit Delay block, create a delay (rather than using $bx(t)$ and $-dy(t)$, use $bx(t-1)$ and $dy(t-1)$) to reflect the fact that the birth and decay rates are based on mature individuals. What happens? Thinking about what the model represents, can you modify it so that the results are sensible?