

## Simulate Rate Equation Kernel

### *Abstract.*

This kernel can be used to implement a generic biochemical rate equation. It is assumed that the product  $y(t)$  increases at a rate proportional to some time-dependent expression  $\alpha(t)$  while its degradation rate is proportional to its current level. The rate of change in  $y(t)$  is represented by the following ordinary differential equation:

$$\frac{dy(t)}{dt} = k_g \cdot \alpha(t) - k_{\text{deg}} \cdot y(t)$$

where  $k_g$  is the growth rate constant, and  $k_{\text{deg}}$  is the degradation rate constant.

This kernel provides services for easily instantiating models of processes that may be represented this differential equation.

This kernel may be used to model a variety of processes involving the synthesis of some molecular species (e.g.,  $y(t)$  may represent cAMP concentration if  $\alpha(t)$  represent adenylyl cyclase activity). By defining  $\alpha(t)$  as a function of other signaling processes (such as the activity of an enzyme or the concentration of other molecular species) and by passing  $y(t)$  as an input to other kernels, complex networks involving the synthesis of many molecular species can be modeled.