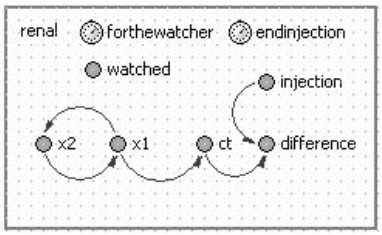
An Object-oriented Solution to ARGESIM Comparison "C15 Clearance Identification" with AnyLogic and Identification with OptQuest

F. Judex, F. Breitenecker; Tu Vienna;'
efelo@fsmat.at

Simulator: AnyLogic is able to handle continuous, discrete and hybrid models. It is based on JAVA and therefore object-oriented. It offers drag-and-drop dialogues for the basic parts of the model's structure as well as for animation. Everything needed is created as an instance of the ActiveObject class, starting with the 'root' class, which represents the model to state variables (appearing on the left-hand side of an ODE), with statecharts and animation.



Model: A basic class represents the model, with all relevant variables (equations of compartments; see left).

The injection (input) is modelled using a timer, which on expiry changes the value of f(t) from D/τ zero.

Task a: Simulation of the System. As AnyLogic is object orientated, several instances of the same model can be placed in the 'root' conveniently, allowing simulation with several sets of parameters in one replication.

Furthermore we add another timer and a state variable to acquire the exact values of the concentration one minute after the injection: c(1.5) = 320.9, c(4) = 302.579 and c(240) = 145.261. Finally another pair of state variables allows a plot of the difference of injection and c(t).

Task b: Identification. AnyLogic offers an optimisation toolbox based on OptTek's OptQuest optimisation engine, which uses genetic algorithms (at present – April 2003 – not well documented and only available via a graphical user interface. To get the data for the cost function (least square deviation between measured and computed concentration), we use still another timer, which on expiry gets the current value of $x_1(t_i)$ and restarts itself with the time between the current and the next point of the dataset at t_{i+1}.

The resulting values after 500 iterations are k01=0.00464 E-5, k12=0.0641 E-4, k21=0.0538 E-4, v1=7.177 E-2). Figure 2 shows the result, comparing measures and modelled concentration.

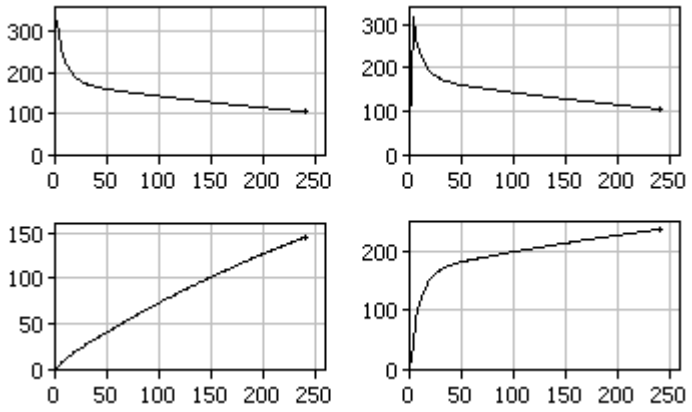


Figure 1: x1 for τ=0.5 (upper left), τ=3 (upper right)τ=240 (lower left) and difference injection / for τ=0.5 (lower right)

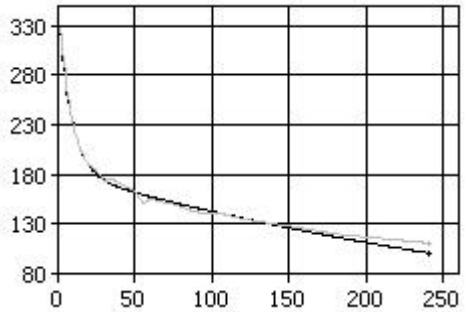


Figure 2: Expimental data (grey) and solution of the identification problem (black)

Task c: Error Estimation. As mentioned above, AnyLogic's optimisation toolbox is only available via a GUI and has no features for multiple optimisation runs or data input/output. Every run has to be started manually.

The perturbed data were obtained with a small MATLAB program and transferred into and out of the model using cut-and-paste and finally evaluated using SPSS.

Considering this time consuming process, the identification was only performed 50 times with the following results:

Variable	k_{01}	k_{21}	k_{12}	v_1
Mean	$4.587 \cdot 10^{-3}$	$5.129 \cdot 10^{-2}$	$6.293 \cdot 10^{-2}$	7.2296
Std Dev	$3.096 \cdot 10^{-4}$	$4.275 \cdot 10^{-3}$	$5.036 \cdot 10^{-3}$	0.1554

Table 1: Results of the error estimation

C15 Classification: Fully Numerical Approach
Simulator: AnyLogic V. 4.5 (2003)