

APPENDIX A: SPECIAL FEATURES

A.1 PROCESS PARAMETERS

As discussed in chapter 2, each case study is comprised of differential equations with pre-specified parameter's values. Some key process parameters, which are believed to have important effect on the process behavior, are made accessible for modification. To access these parameters, one can simply double click on the process flow sheet shown inside the yellow box in any given Simulink module. Figure A.1 shows an example of accessing the process parameters for the evaporator process.

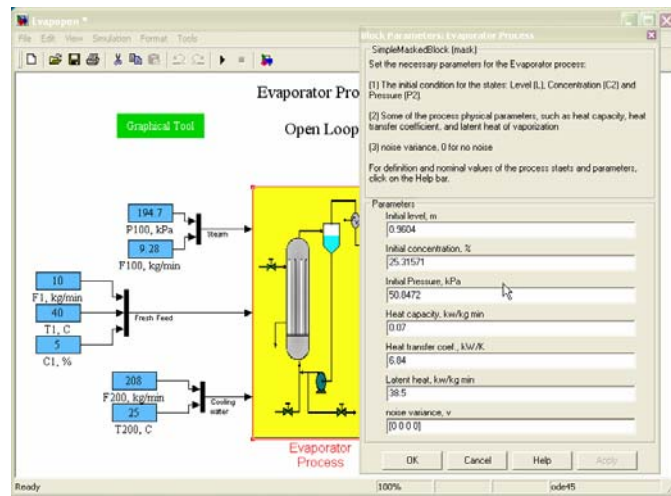


Fig. A.1 Accessing the process Parameter dialog Box

Specifically, the dialog box for the evaporator process contains that the initial value of the states, the heat capacity of the fluid, the overall heat transfer coefficient and the latent heat of the steam. The user can change the value of the designated process parameter directly. However, the user must run the simulation for open loop mode for enough long time to assure that the process reaches a new steady state. The new steady state values of the process states must be recorded in a separate sheet. The user should then access the process parameter box again and replace the initial value of the states with the newly obtained ones.

A.2 ADDING NOISE TO OUTPUT MEASUREMENT

All the simulation results shown in the manual depicted very smooth curves. Industrial practice indicates that output signals are always corrupted with noise. To add a realistic touch to the PCLAB simulations, a feature that allow the addition of measurement noise is adopted in this version of the software. As mentioned in the previous section, double clicking the yellow box in any Simulink module will open the process parameter dialog box, i.e. Fig. A.1. At the bottom of the parameter list appears the noise variance. The number of the noise variance equals the number of outputs. The order of the noise variance follows the order of the outputs appearance in the Simulink module. The user can specify the value of the noise *variance* which is supposed to be trivial compared to the variance of the measured output. Usually, noise is a random variable generated from mechanical and electrical sources. Since we are dealing with pure simulation, the noise is incorporated artificially to the data. Fig. A.2 shows the response of the product concentration in the evaporator process to 10kPa step change in the steam pressure. The left hand side plot depicts the response when no noise is preset while the right hand side plot shows the response with the measurement is corrupted by noise whose variance is 0.001.

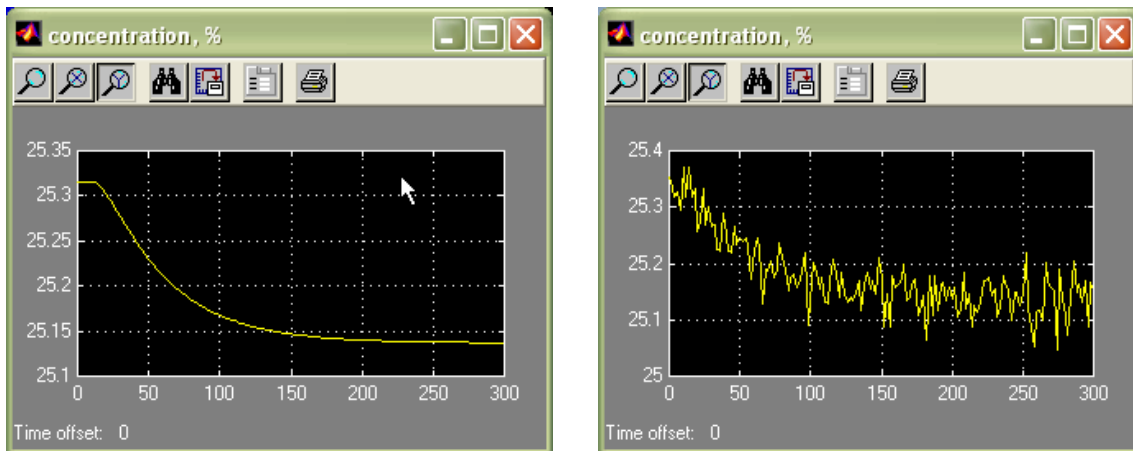


Fig. A.2 concentration response to step change in steam pressure

A.3 SIMULATION PARAMETER

All Simulink modules are simulated by pressing the start button as mentioned throughout the manual. In this case, the module will be simulated using default simulation parameters. To alter the simulation parameter, one can simply select *parameters* from the *simulation* menu as shown in Fig. A.3. This concept is also discussed in chapter 1 section 1.4.2. The user can adjust the simulation time, see Fig. A4. For example, if the simulation length is not enough to capture the full transient response, then the Stop time should be increased. Moreover, in some cases, the simulation may crash because the dynamic equations of the process are stiff or hard to integrate. In this case, the user should try different ODE solver. The current solver as it appears in Fig. A4 is Dormand-Prince. Pointing at the solver type box will reveal the available ODE solvers in a drop-down menu fashion. The user can also adjust the relative and absolute tolerance. In general reducing the tolerance will make the ODE easy to solve, but the resolution of the simulation plot will degrade. The user is also allowed to change the type of the solver from variable-step to fixed step.

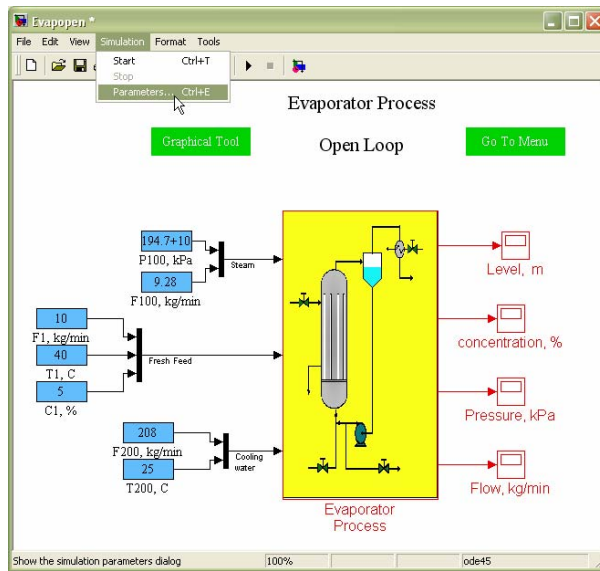


Fig. A3 Selecting the parameters option in the simulation menu item

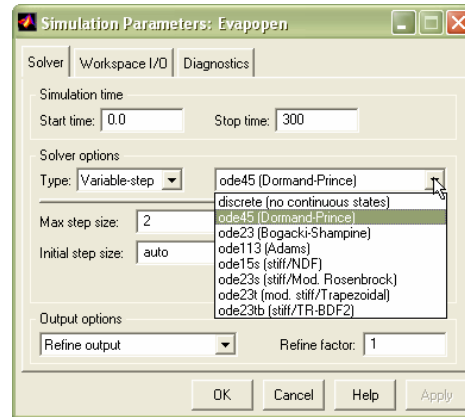
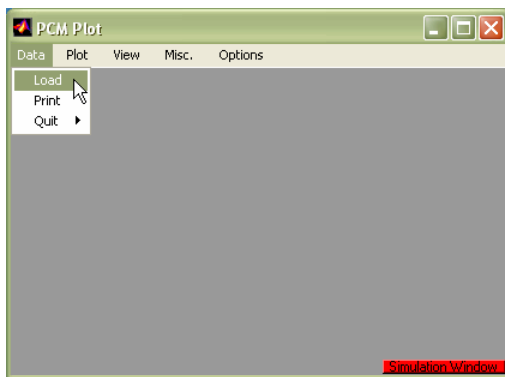


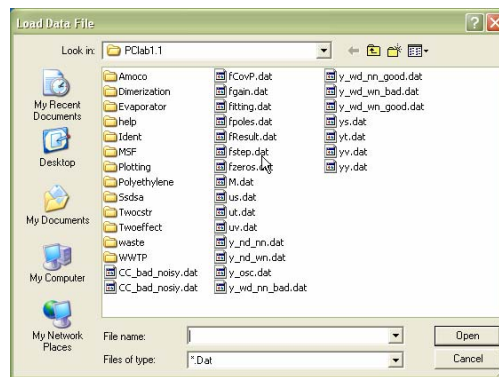
Fig. A4 the parameter adjustment dialog box

A.4 GRAPHICAL TOOL

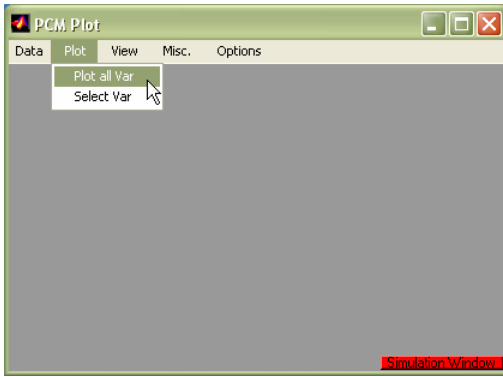
All Simulink modules comprising the case studies allow for visualization of the transient response through the Scope box. However, the Scope shows only the result of the current simulation. Relying solely on the Scope capability, the user can not compare the result of different simulations in one screen. For this reason, we have added the graphical tool to allow the user to plot his results in a single screen. The graphical tool can be activated from any Simulink module by clicking the green box entitled “graphical tool”. By doing so, the following window pop up:



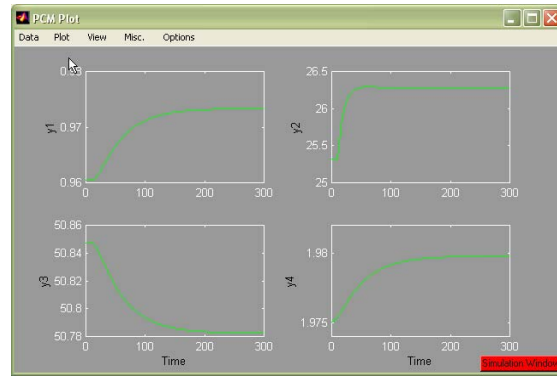
(a)



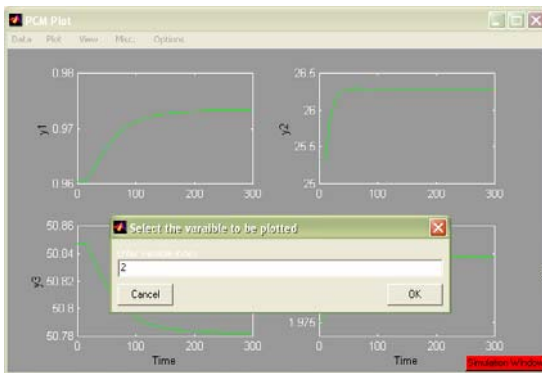
(b)



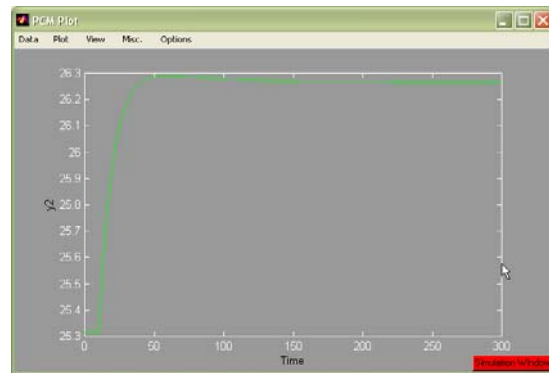
(c)



(d)



(e)



(f)

Fig. A5 Plotting Forum Options

Before starting the drawing, one should save his data containing the results of different simulation in a single matrix. The data matrix should have the sampling points in the first column. The following subsequent columns should contain the results for diverse simulations. After creation of the data file, the user starts uploading the data file by choosing *load* from the *Data* menu item, see Fig. A5a. By doing so, a new dialog box called “Load Data file” appears as in Fig. A5b pointing at the current PCLAB home directory. The user can select and load the desired data file or navigate through other directories for his desired data file. Next, the user can select “plot all var” as in Fig. A5c, which in turn draws all the data stored in the loaded file as shown in Fig. A5d. Alternatively, one can chose “plot selected var” which brings up the window shown in Fig. A5e. By inserting the number 2 to select the third column of the loaded data file, the plotting forum will be filled out by the response of the corresponding data signal.

If one tends to plot all results in a single box, then he should use the “plot selected var” option. Every time the user selects a specific variable index, it will be plotted in the screen on top of the previous plot. Repeating this procedure will draw all variables in a single plotting box. The menu toolbar of the plotting forum has additional options such changing the axis scale, changing the foreground and background colors, adding labels, clearing the forum and a pointer. The latter can be used to point at a specific point of the plot and grip its local value.