HOW TO USE THIS LIBRARY

Jonathan Ospino P., Mauricio E. Sánchez, Argimiro R. Secchi.

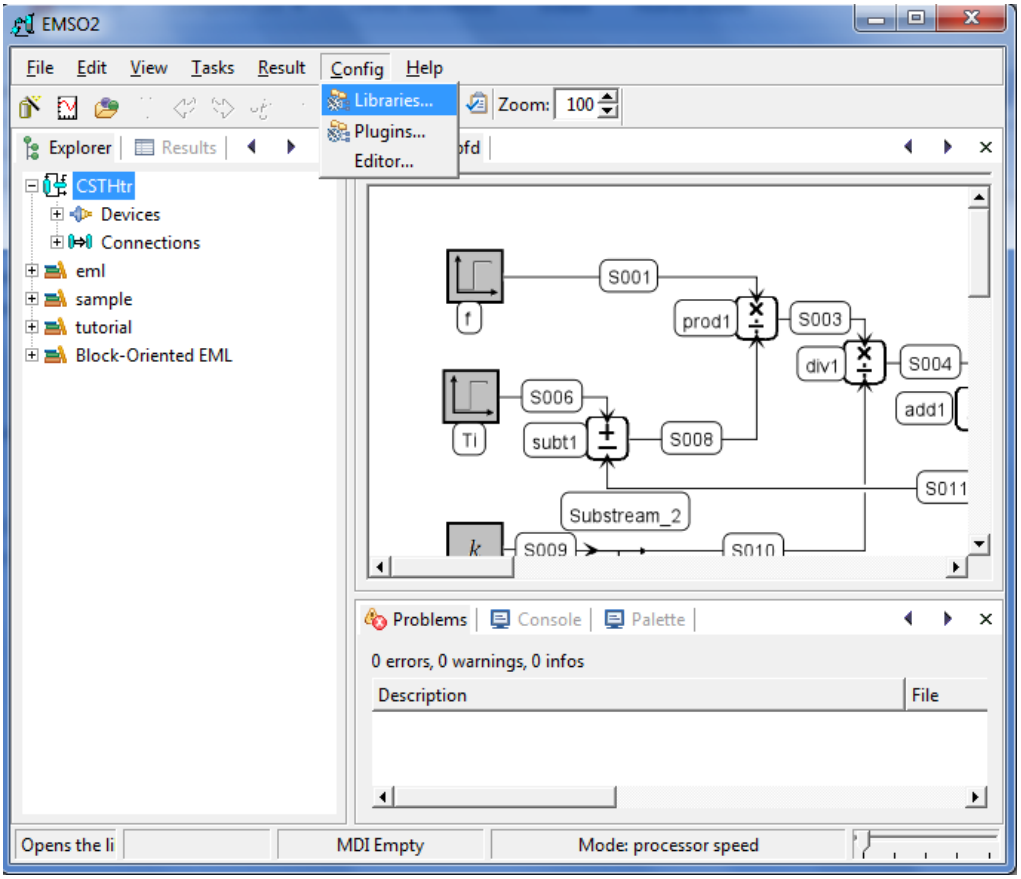
Brief Description

This library allows to the user create block-oriented models (*aka* block diagrams) by means of linking blocks of a set of basic computational blocks.

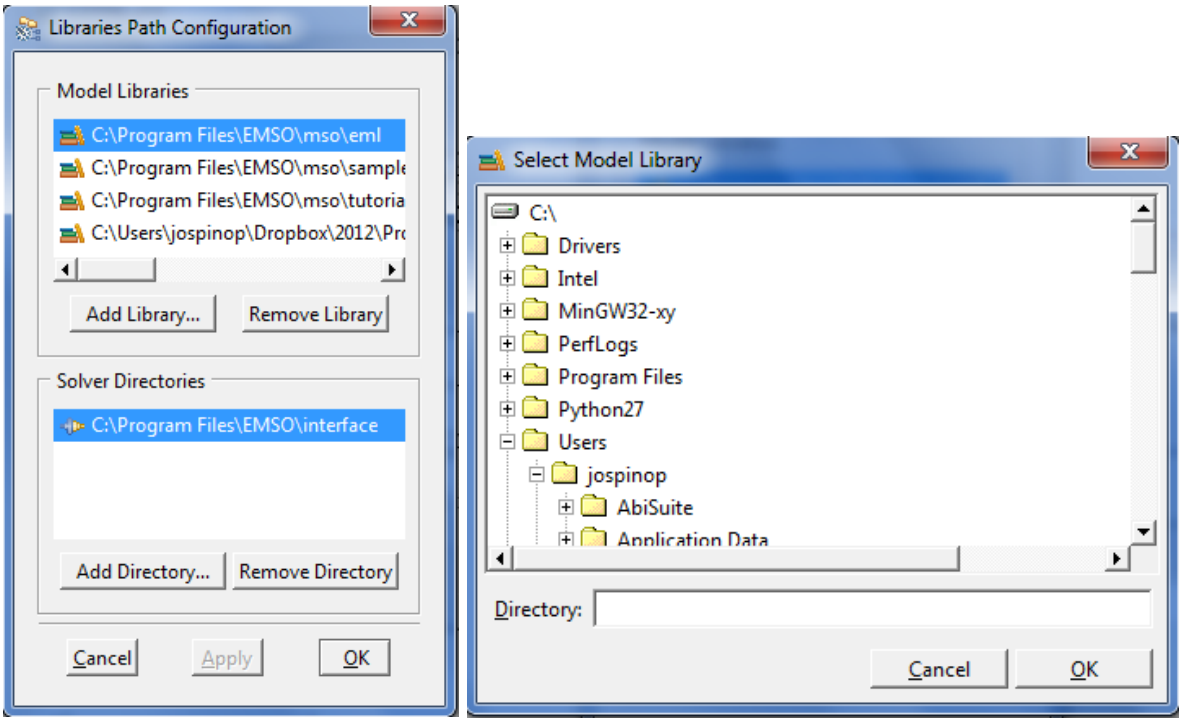
Installing the new library

If this library was downloaded from the internet repository of the ALSOC Project, you have to make the following instructions to get this library working in EMSO:

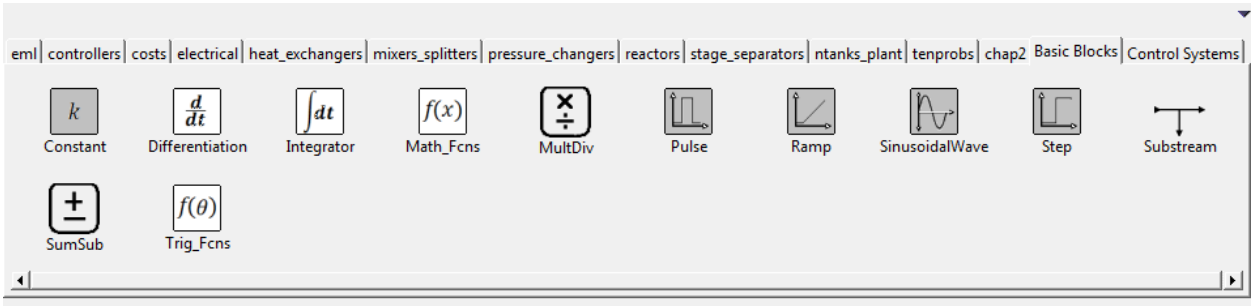
1. Open EMSO *Config* menu and click on *Libraries*…

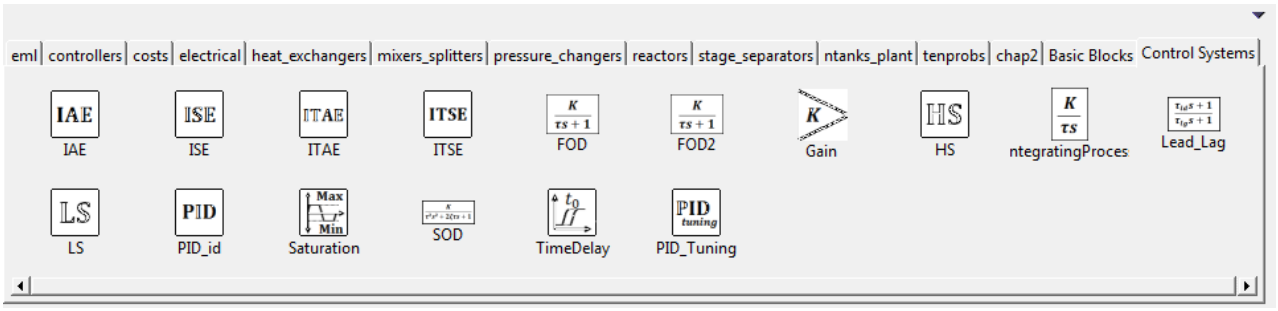


2. Once done that, click on the *Add library…* button and look for the folder directory which contains the models in the emerging window.



3. Press the *OK* button in both windows and restart EMSO (in some computers is necessary).
4. Now you can use the block-oriented library in EMSO, just click on the *Pallete* tab and select the categories *Basic Blocks* and *Control Systems*:





Building your first block diagram

Let's suppose you want to solve the following initial value problem using EMSO:

Integrate the moderately stiff problem[1]

$$y'' = -\frac{19}{4}y - 10y' \qquad y(0) = -9 \qquad y'(0) = 0$$

From $x = 0$ to 10 and plot the results.

Solution

1. For solving the problem is required to express the second-order differential equation as a system of differential equations of first order. By setting, $y = y_0$ and $y' = y_1$, the equivalent first-order differential equations are:

$$y_0' = y_1 \qquad y_0(0) = -9$$

$$y_1' = -\frac{19}{4}y_0 - 10y_1 \qquad y_1(0) = 0$$

2. Once done that, open EMSO and create a new *Diagram* by clicking on the *New File..* icon ( ). Assign it a name and click in the *OK* button.

3. In the emerging window, click on the *Options* tab and set the *Start time*, *Step time*[2] and *End time* for the simulation in 0, 0.1, and 10, respectively. With respect to the units, use the default value (seconds).

4. Now we can build our block diagram for solving the problem. Let's start by inserting one *SumSub* block, two *Integrator* blocks, two *Gain* blocks, and one *Substream* block of the *Basic blocks* tab of the *EMSO Pallete*. Rename them and organize them as in Fig. 1.

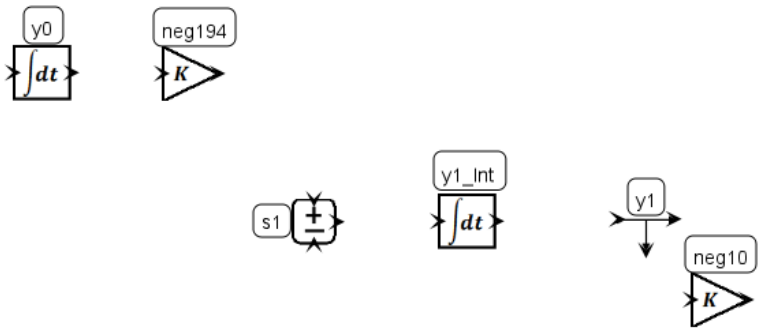


Figure 1. Initial array of the blocks

[1] Problem taken from *Kiusalaas, J. Numerical Methods in Engineering with Python. Cambridge University Press. 2005*

[2] The step time configured in here does not correspond to the solver step. This step time is for reporting results and plotting purposes only.

5. Set the initial values of the integrators, by double-clicking on the blocks *y0* and *y1_int*. According to the problem statement, the initial values must be *-9* and *0,* respectively.

6. Set the values of the blocks *neg10* and *neg194* to *-10* and *-4.75*, respectively.

7. Link the blocks as in Figure 2.

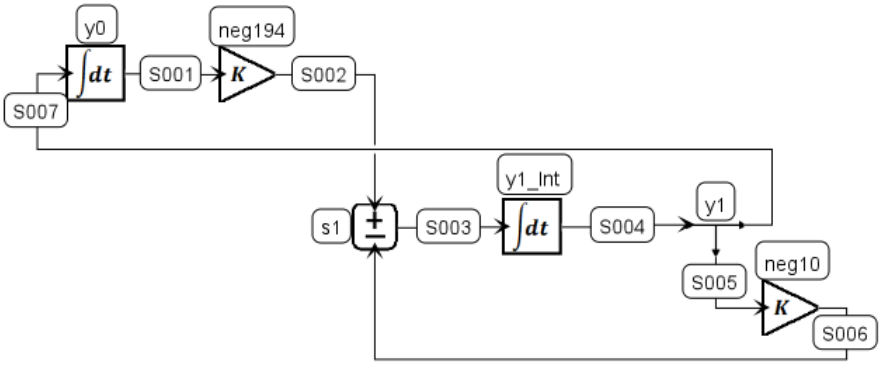


Figure 2. Final block diagram for solving the problem.

8. Now we are ready to start the simulation. Check that the diagram icon ( ) is selected in the *Explorer* and hit the *Run* button ( ) for running the simulation.

9. Once the simulation is finished (check the *Console* tab), go to *Results* ( ), expand item *y0* (by hitting the '+' sign), and double-click on the item *Out*. If there is not plot window opened, EMSO will ask you whether you want to plot the selected variable, click on *Yes*. It will show you the plot corresponding to *y0*. Do the analogous procedure for the item *y1*. You can change the names in the legend of the plot, by right-clicking inside the plot window and selecting *Properties…* Figure 3 shows the results obtained for the simulation with the legend of the plot changed.

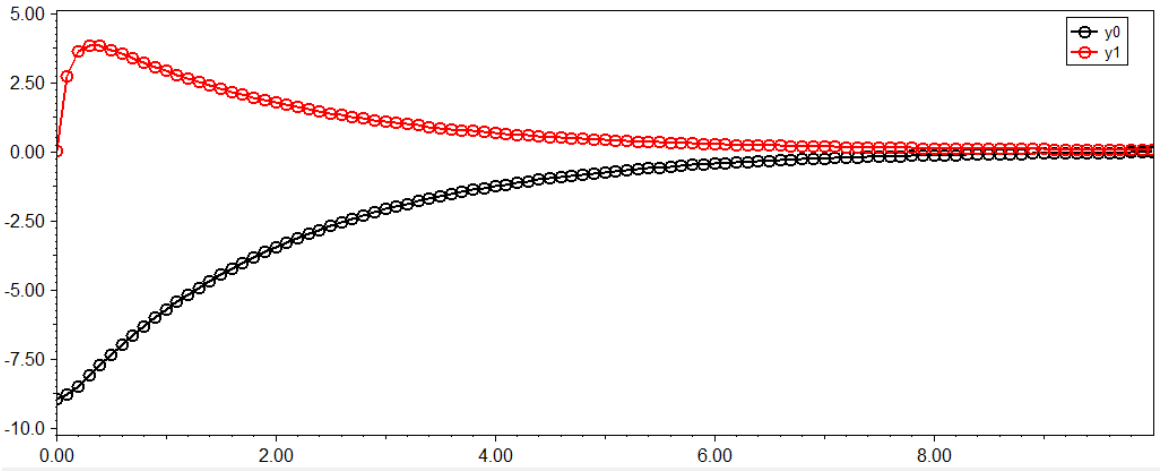


Figure 3. Results of the simulation.