

Lek Tuner (short description)

1 FUNCTIONS OF LEK TUNER

Program package PID Tuner consists of some modules which perform the following tasks:

- selection of OPC server and OPC points for input and output signals and controller parameters,
- selection of type of experiment (manual/automatic) and parameters of experiment,
- execution of experiment,
- data treatment,
- calculation of process model,
- calculation of I, P, PI, PID and cascade controller parameters, and
- automatic report generation.

OPC settings

Figure 1 shows the OPC window (tab “OPC”). Here we can define OPC input and output signals.

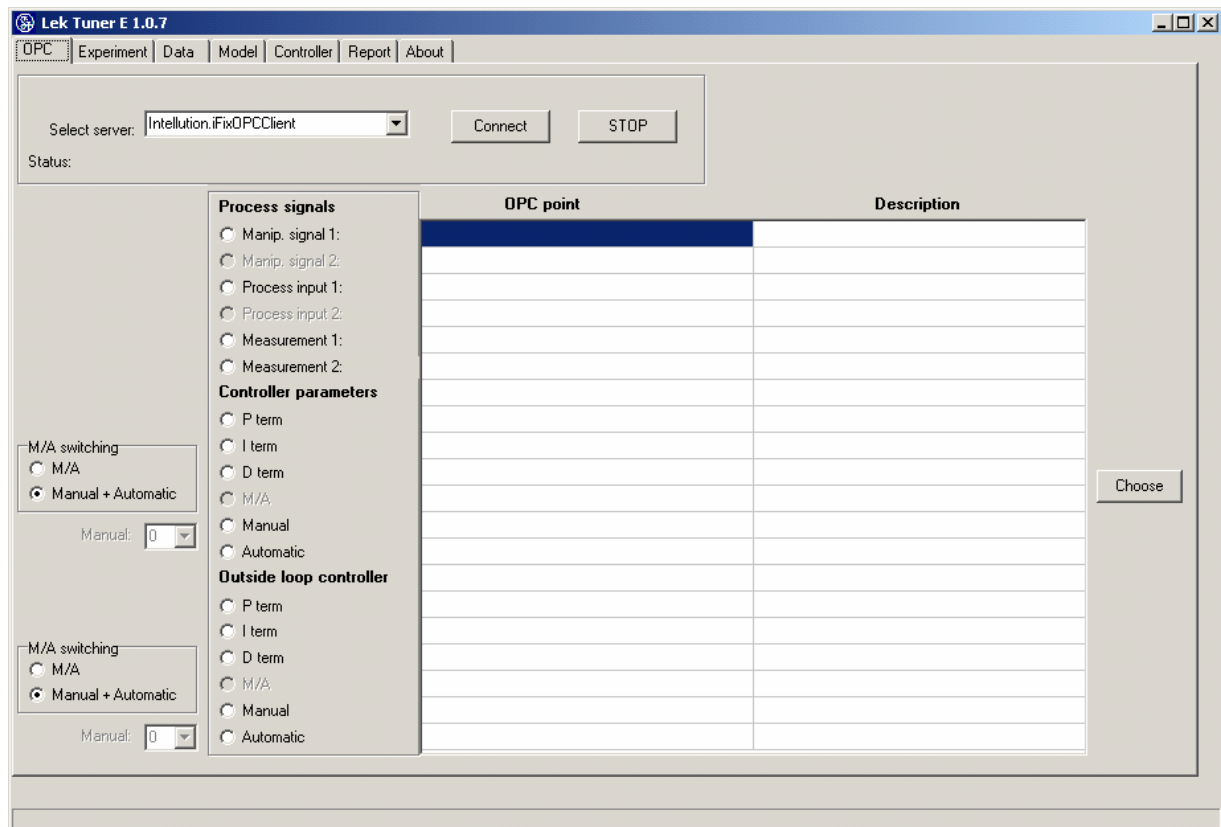


Figure 1. OPC settings

Note that other program modules (experiment, data treatment, process model, controller parameters and report) can be obtained by clicking corresponding tabs in the left upper part of the program window.

Setting parameters of experiment

Window for setting experiment parameters (Figure 2) is opened by clicking tab "Experiment" in the left-upper part of the program window.

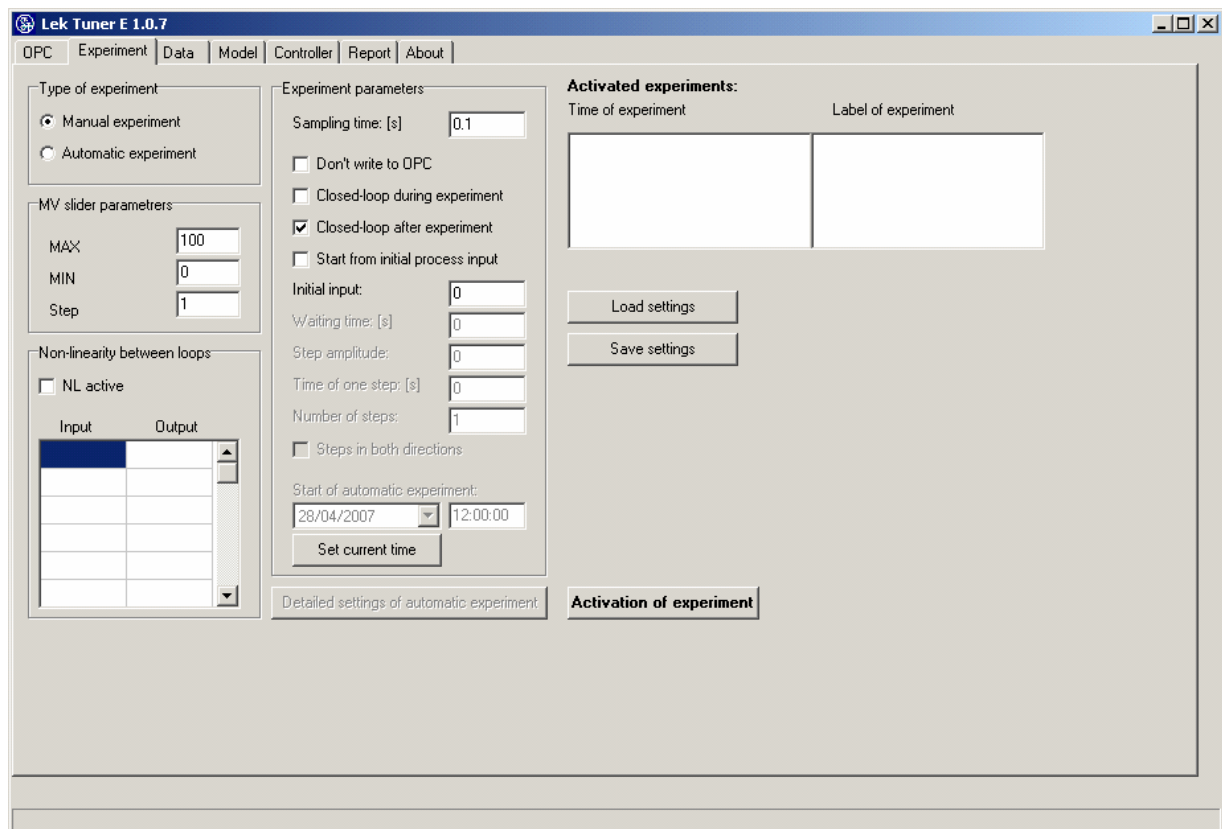


Figure 2. Setting of experiment parameters

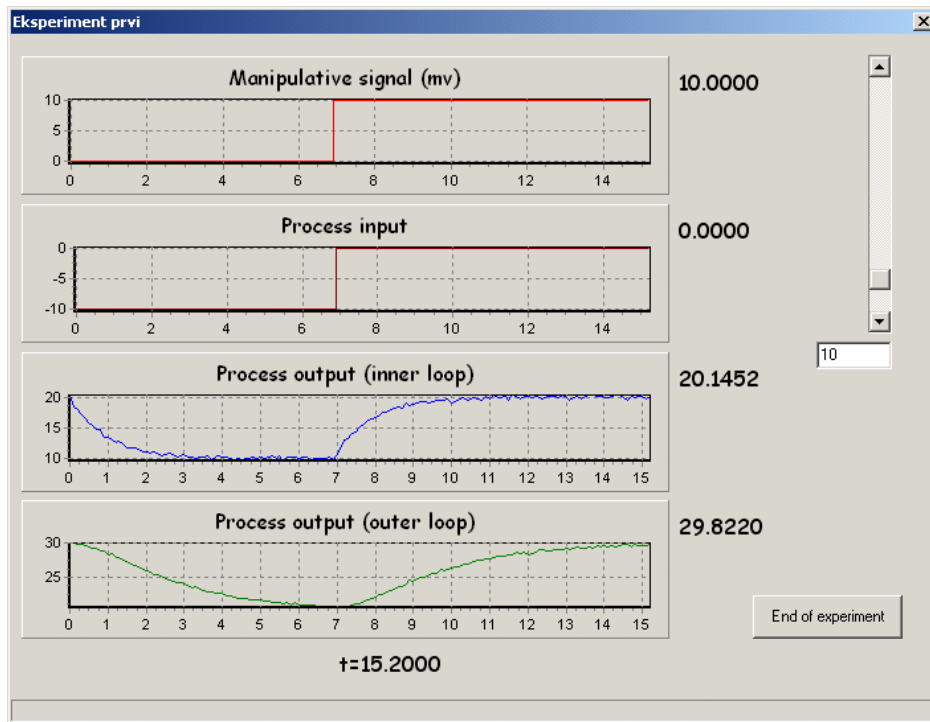
The following parameters can be set:

- selection of type of experiment (manual or automatic),
- selection of sampling time, experiment duration, amplitude of process input signal, time of experiment, etc., and
- more detailed settings of automatic experiment (slider limitations, etc.)

Execution of experiment

The experiment (manual or automatic) is started by clicking button “Activation of experiment”. When the experiment is started, a new window (Figure 3) is opened. The most important functions of experiment window are the following:

- drawing input and output signals, and
- modifying manipulative signal for changing steady-state of the process (by changing slider position).



Slika 3. Experiment window

Data treatment

Window for data treatment (Figure 4) is opened after the experiment is terminated (by clicking button "End of experiment" or if time of automatic experiment passed) or by clicking tab "Data". All the measurements are shown in graphs. Here, the measured data can be truncated and filtered. If the actuator has amplitude and velocity limitations, they can be taken into account for the calculation of process model parameters.

The most important functions of Data treatment window are:

- truncation of the measured data,
- data filtering with limitation, and
- data analysis.

More detailed measurements and histograms graphs can be obtained by double-clicking or right-clicking the measurement graph (Figures 5 and 6), while maximum, minimum and standard deviation values are shown on the right side.

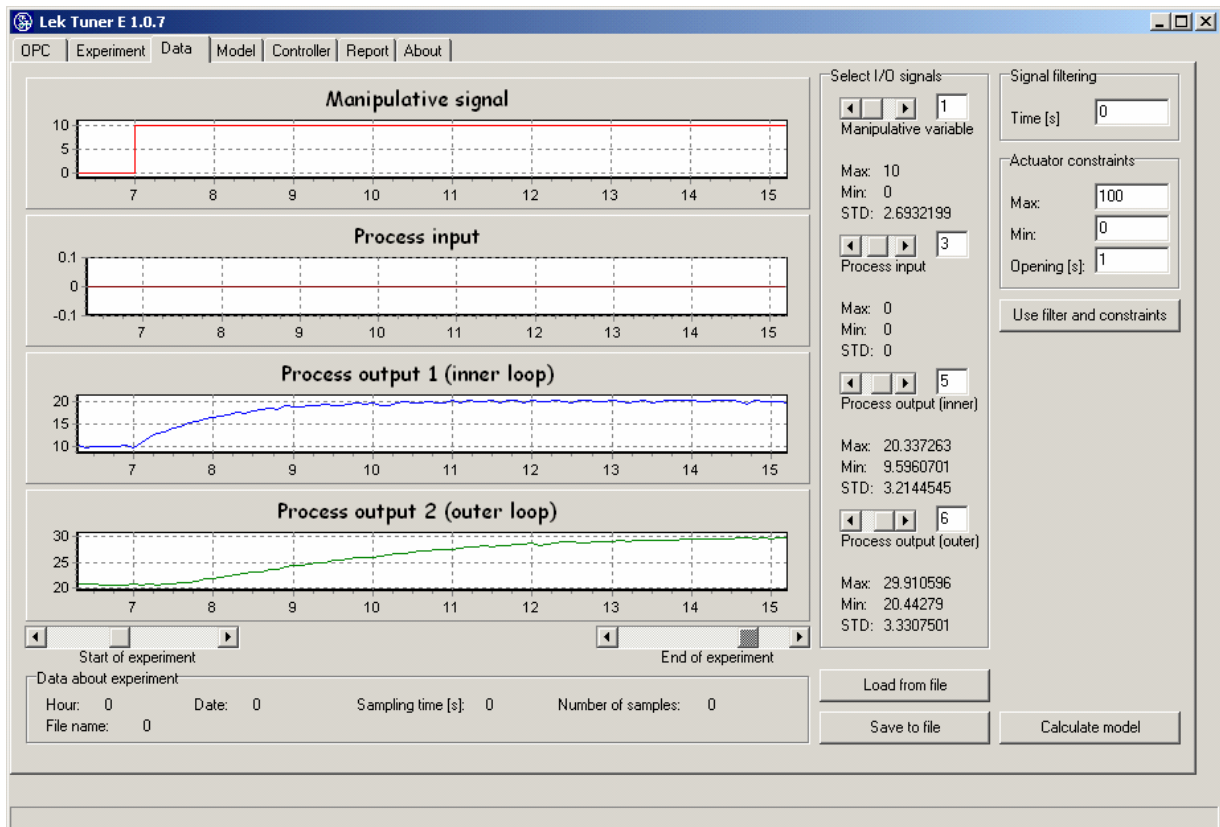


Figure 4. Data treatment window

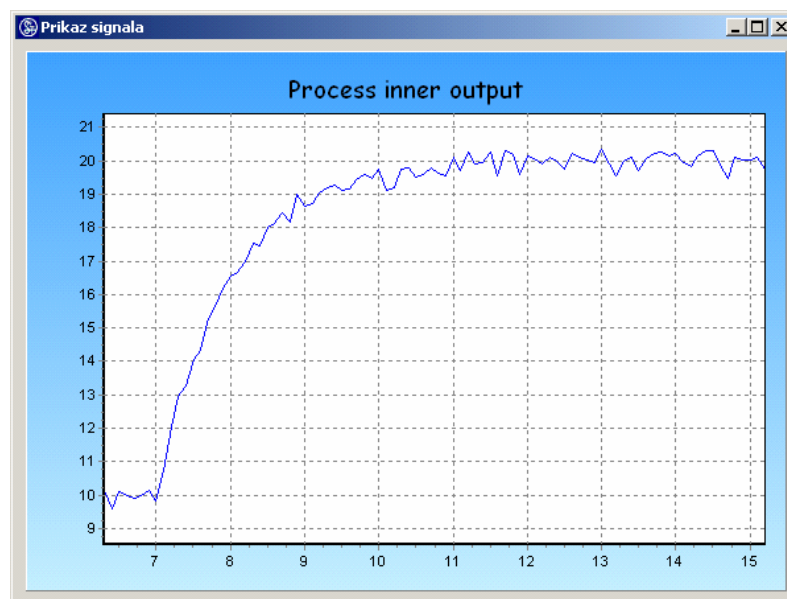


Figure 5. Detailed view of the measured signal (double-clicking signal graph).

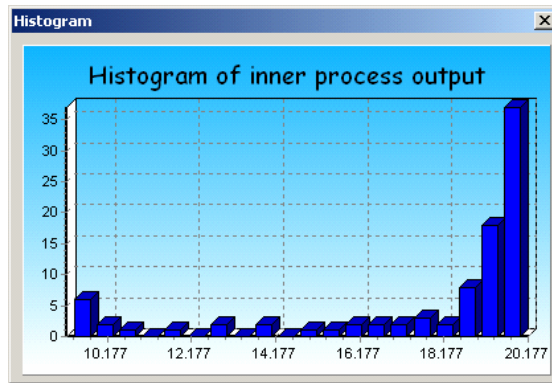


Figure 6. Histogram of the measured signal (right-clicking signal graph).

Process model

A window “Model” (Figure 7) is opened by clicking the button “Calculate model” in window “Data”. The most important functions are the following:

- graphical representation of the measurement and the model, and
- display of process model parameters (manual modification is possible).

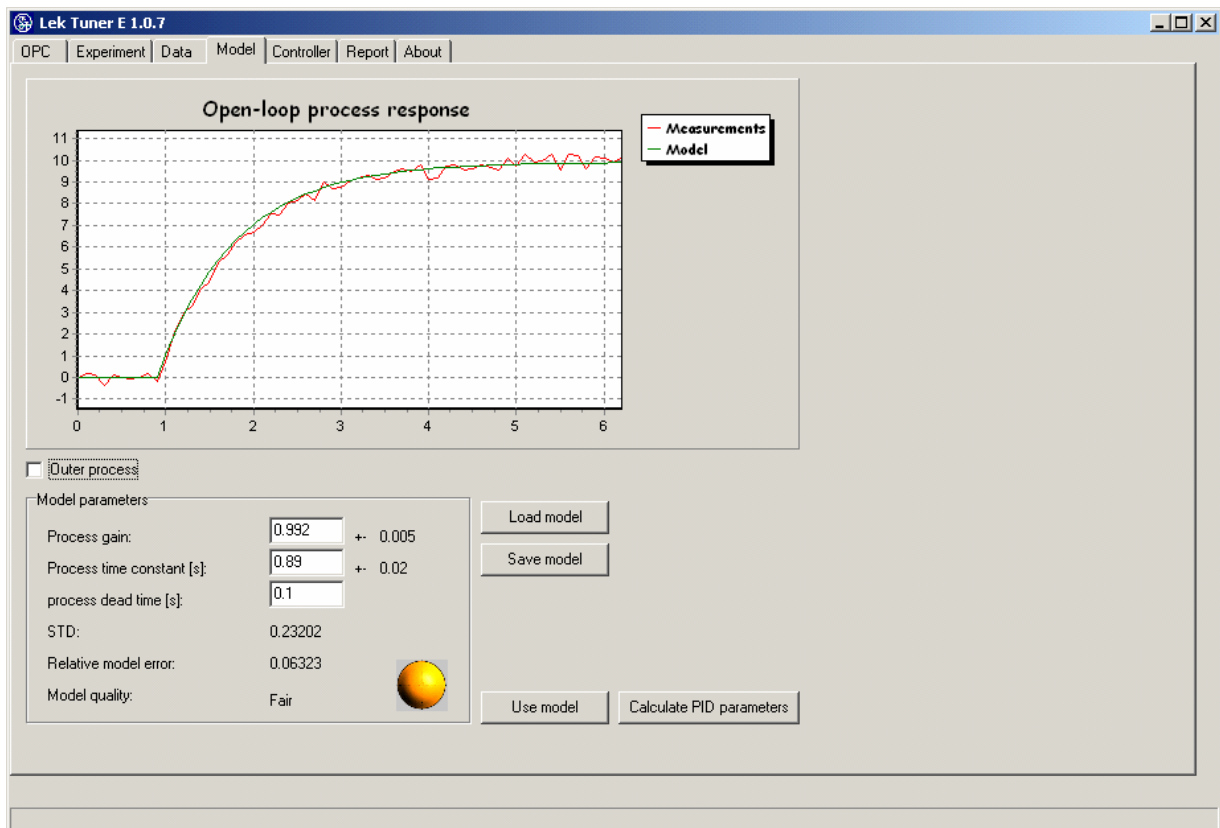


Figure 7. Process model window

PID controller parameters

Controller parameters can be obtained by clicking button “Calculation of PID parameters” (or clicking tab “Controller” if they have been previously calculated). Window “Controller” is shown in Figure 8.

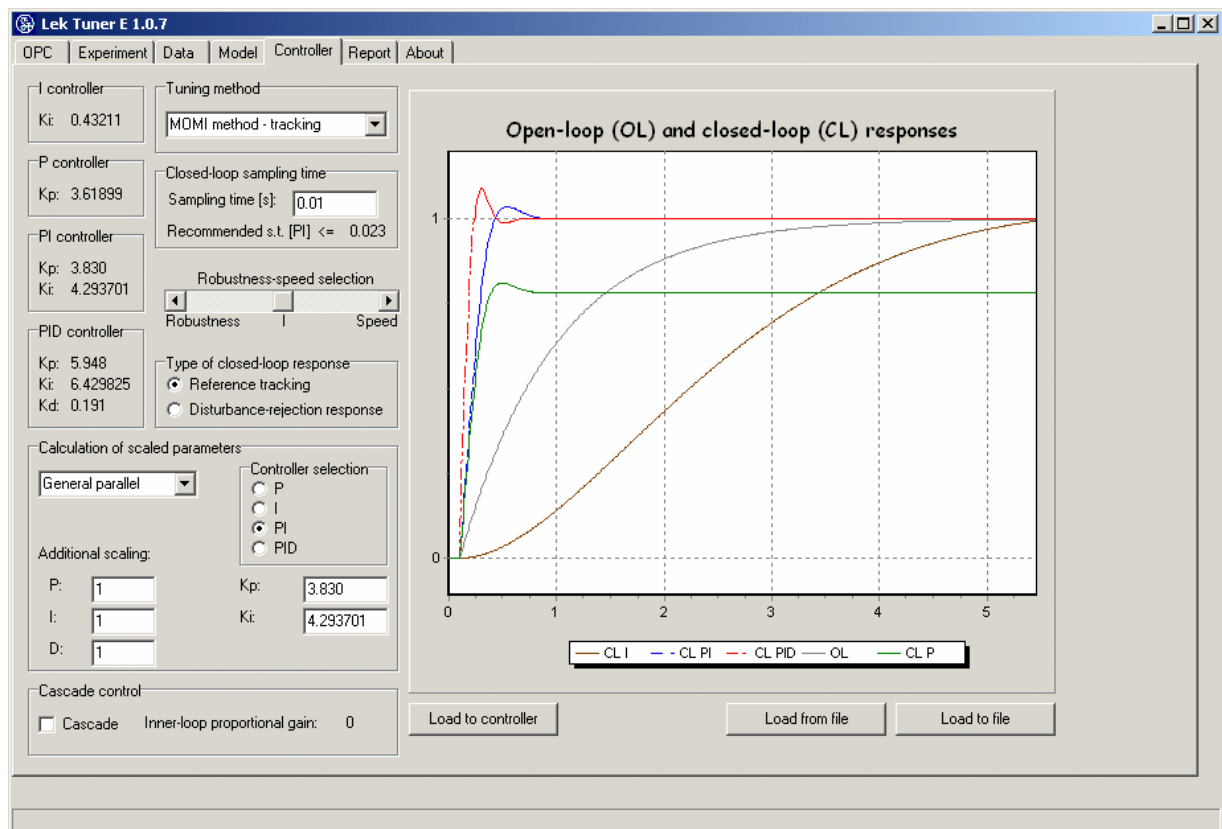


Figure 8. Controller parameters window

The most important functions of controller parameters window are:

- selection of tuning method,
- selection of degree of robustness,
- selection of sampling time,
- selection of tracking/disturbance rejection tuning,
- display of controller parameters, and
- graphical view of the anticipated closed-loop response.

Report generation

Window Report generation can be obtained by clicking tab "Report" (Figure 9). Here we can choose parameters for automatic report generation (Microsoft Word file).

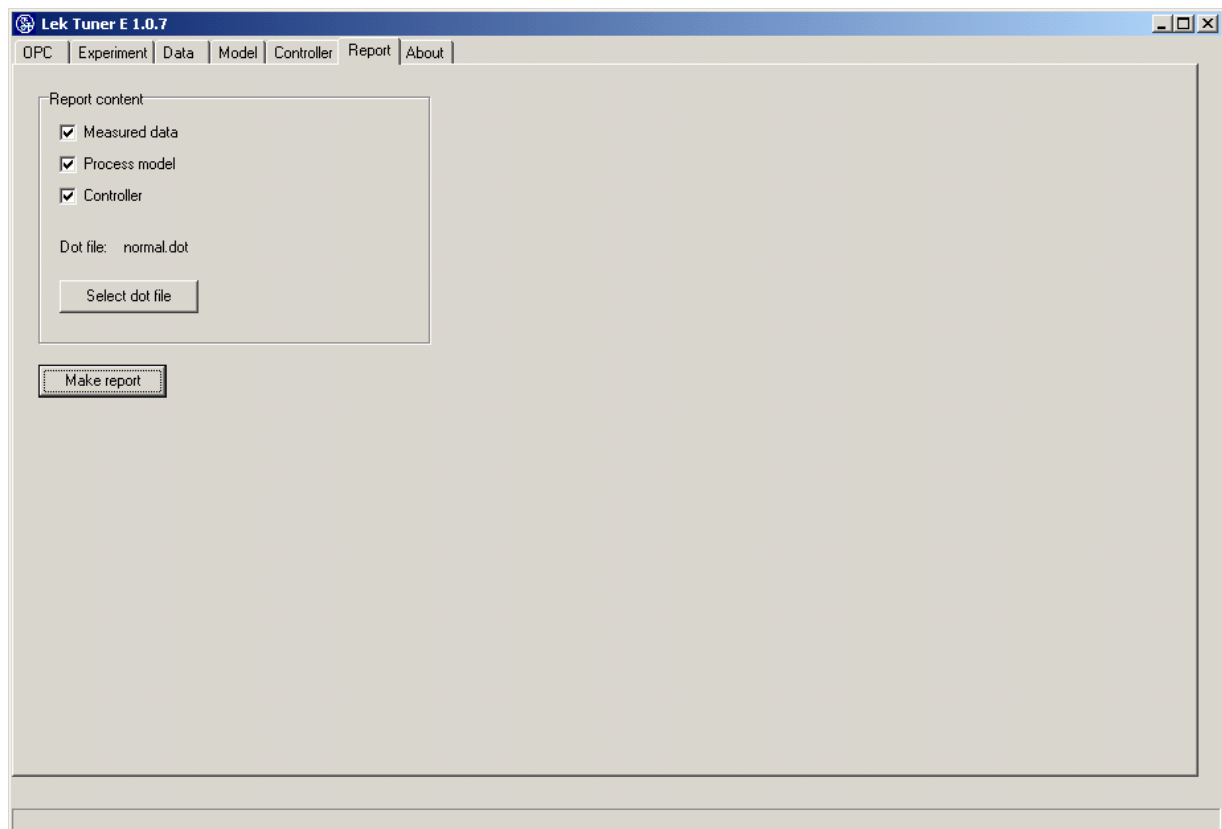


Figure 9. Report generation window

2 PRACTICAL EXAMPLE

After start of the program, we first select an OPC server in OPC window (Figure 1). After selection of the server, button connect has to be pressed. Then input and output signals should be selected (Figure 10). Note that manipulative signal is any signal which drives the process from one to another steady-state (it might be either manual controller signal or controller reference signal). The window “OPC”, when some OPC signals are entered, is shown in Figure 11. The rest of parameters are required only for loading calculated controller parameters into PID controllers.

Then we press tab “Experiment” and enter experiment parameters, as shown in Figure 12. First we choose manual experiment (1). Sampling time (3) is chosen so as to be at least 10-20 times shorter than process main time constant. A checkbox “Close-loop after experiment” (4) is checked so that LEK Tuner switches controller into the closed-loop configuration when experiment is finished. Experiment is executed by pressing button “Activation of Experiment” (5).

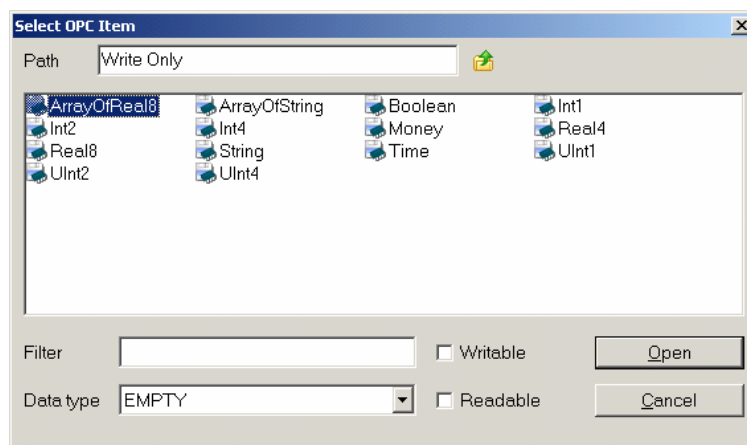


Figure 10. OPC window.

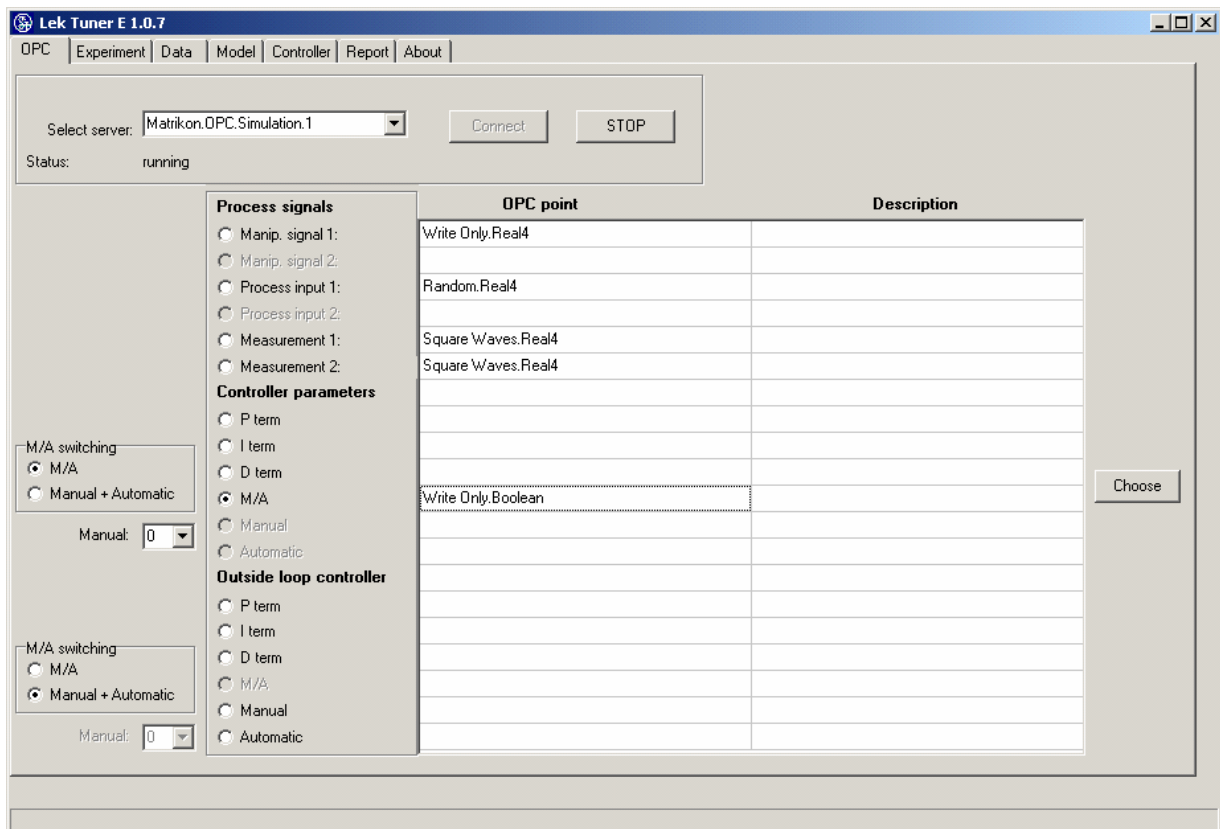


Figure 11. OPC window after selecting signals.

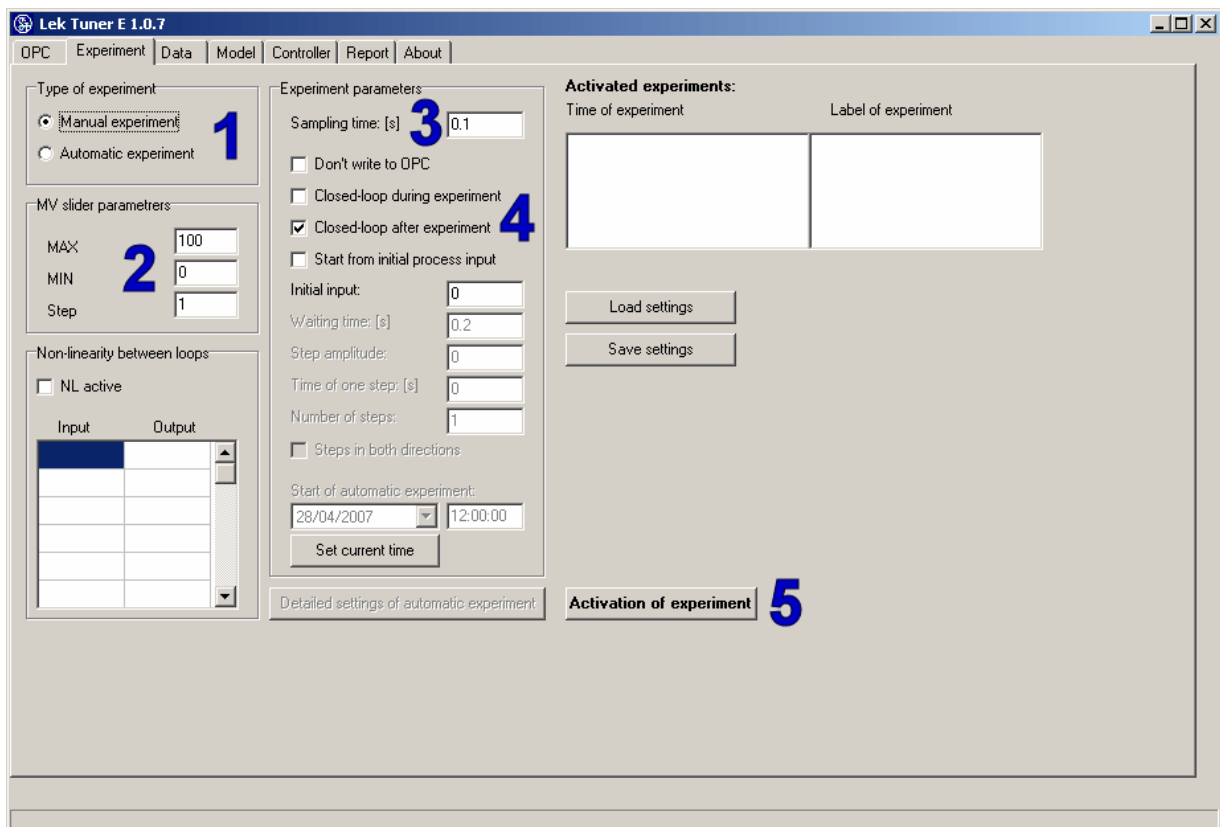


Figure 12. Window experiment data after entering parameters.

First configuration data is saved, then experiment is performed. Window “Experiment” opens (Figure 13). Process steady-state point can be modified by adjusting slider position (1). The slider changes the value of manipulative variable. Slider limits are previously set in window “Experiment” (Figure 12, (2)). Experiment is terminated by pressing button “End of experiment” (2).

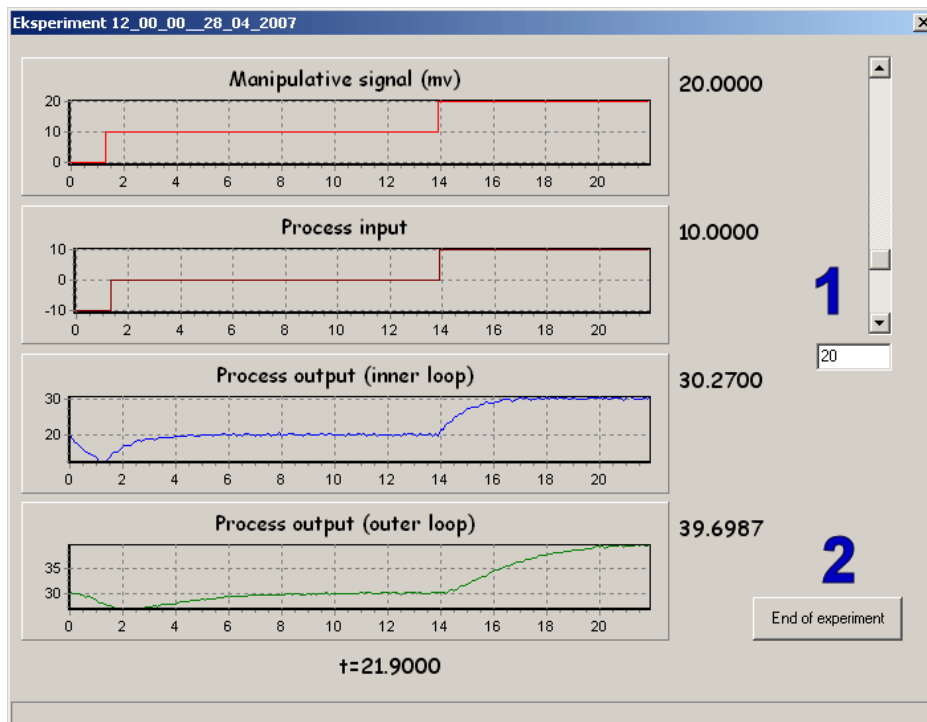


Figure 13. Window experiment during run of experiment.

Window “Data” (Figure 14) is opened automatically after termination of experiment. Here actuator limits can be set (1) and used (2) if they were met during the experiment. Data is trimmed by using slider for selecting begin and end of experiment (3). Note that start should be set before change of manipulative variable. The process model is calculated by pressing button “Calculate Model” (5).

Window (tab) “Model” appears (Figure 15), where the measurement and the process model response are shown on the same graph. Calculation of controller parameters is initiated by pressing button “Calculate PID parameters” (3).

In window “Controller” (Figure 16) there are several parameters available. First we have to choose appropriate closed-loop sampling time (1). A tuning method can be selected in a field “Tuning method” (2). Closed-loop responses can be additionally adjusted with slider “Robustness-speed” (3). Closed loop tracking or disturbance-rejection response can be selected as well (4).

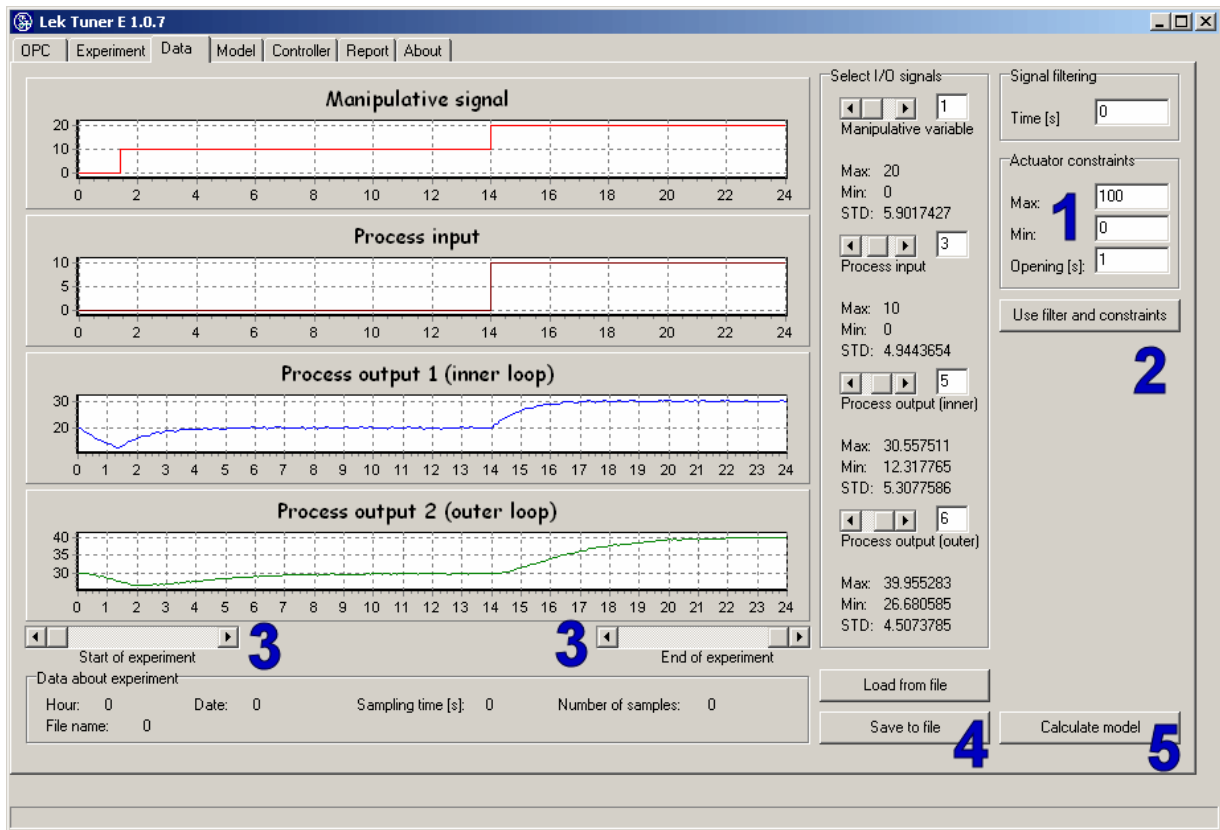


Figure 14. Window “Data” after termination of experiment.

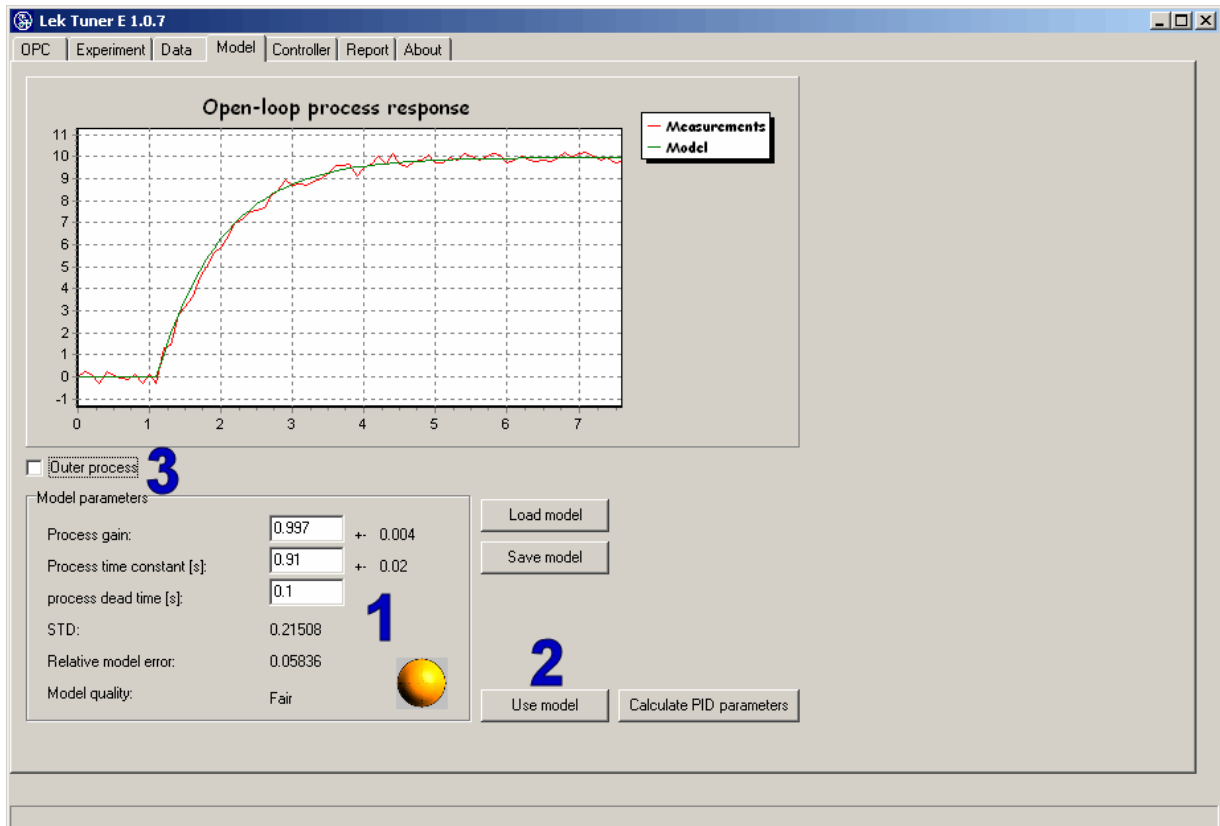


Figure 15. View of window “Model”.

Report generation (as Microsoft Word file) can be selected by clicking button “Save report” in tab “Report” (see Figure 9). Report shows measured signals, histograms, process model, anticipated closed-loop responses and calculated P, I, PI and PID controller parameters.

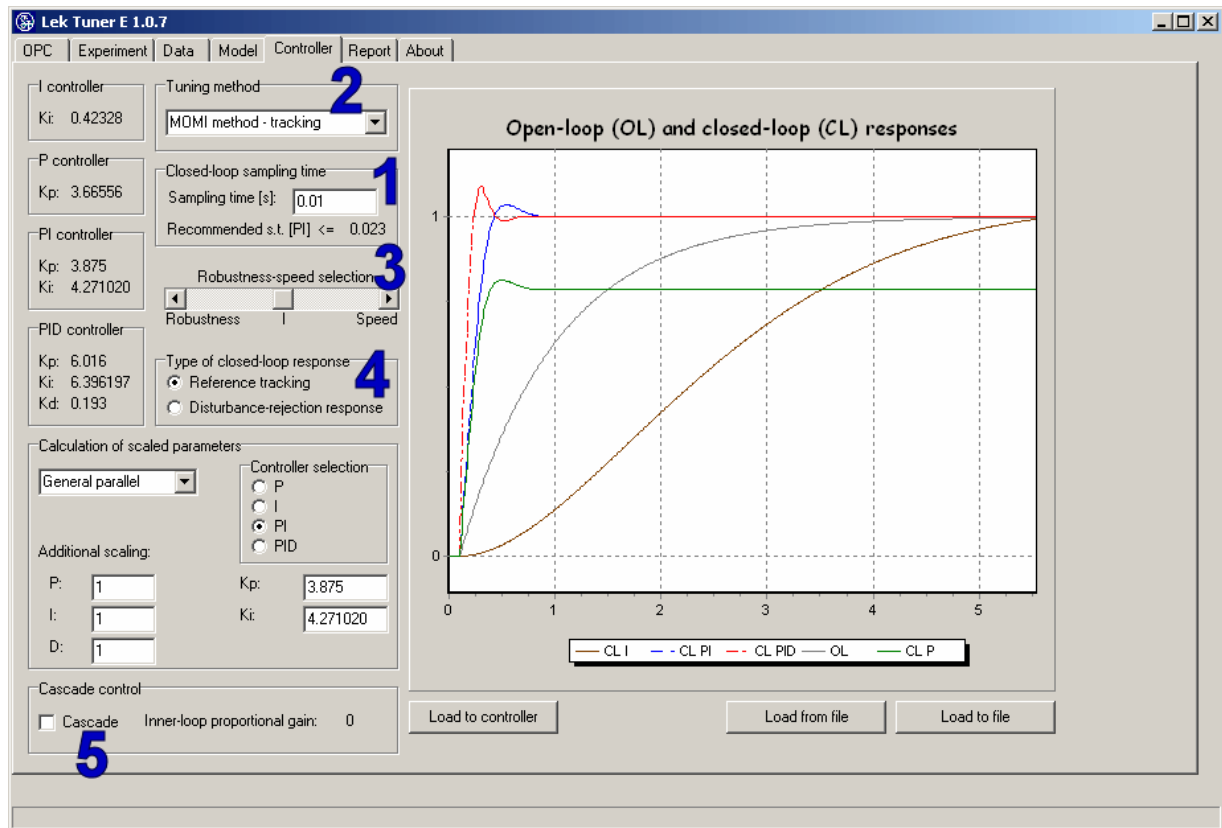


Figure 16. Window »controller«.

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