Practical Training of Control Engineering I

The Pratical Training of Control Engineering I is running under Windows 7/8/10. With setup the program will be installed and a program-group will be created.

Liquid Level Control / Control with Setpoint Delay

A container with inlet and outlet will be simulated as a controlled system. The size of the inlet or outlet can be adjusted with valves (by adjusting the shift buttons). The exercise on control engineering is to control the liquid level by changing the inlet, so that the level corresponds to a certain setpoint value. Therefore, the inlet constitutes the input variable, and the liquid level the output variable of the system. The outlet and varying admission pressure values for the inlet act as disturbances.

First examine the uncontrolled system. Try to manually correct the actual level to the setpoint level by changing the inlet or outlet.

Next examine the controlled system (Liquid Level). Contrary to the uncontrolled system, the closed-loop control process for the liquid level is not actuated manually, but with a PI controller. You may change the setpoint and the outlet via the respective shift buttons, the up/down counters or by entering values above the up/down counters. Clicking on the "Admission pressure variation" button causes interference to the outlet.

Finally study the performance of the control loop by changing setpoint, disturbance and control parameters. For this purpose you can use P-, I-, PI-, PID- and Two-Position Controller.

Temperature Control / Temperature Control with Time Delay

This process consists of a tank through which water is flowing continuously. The liquid level does not change. With the aid of an electrical heater, the temperature of the water in the tank is affected. The exercise regarding control engineering is to control the temperature of the water in the tank by changing the heater output, so that it corresponds to a certain setpoint value.

First examine the uncontrolled system. Try to manually correct the actual temperature value to the setpoint value by changing the heater output.

Next examine the controlled system (Temperature Control / Temperature Control with Time Delay). Contrary to the uncontrolled system (Temperature), the temperature is not controlled manually, but with a PI controller. You may change the setpoint and the inlet temperature.

Finally study the performance of the control loop by changing setpoint, disturbance and control parameters. For this purpose you can use P-, I-, PI-, PID- and Two-Position Controller.

When using the P-controller for the Temperature Control with Time Delay the setting rules acc. to Ziegler/Nichols will be maintained.

Mixing Container Cascade

The design of the system mainly consists of three mixing containers, each of which is equipped with an inlet and an outlet. The outlet of the first container is connected to the inlet of the second container, and the outlet of the second container to the inlet of the third container.

In this simulation example, a salt solution is mixed with water. The first container is filled with a mixture of water and salt solution. The individual flow rates can be varied with valves. The exercise on control engineering is to control the salt concentration in the third container, so that it corresponds to a certain setpoint value. Therefore, the flow rate of the salt solution constitutes the input variable, and the salt concentration of the liquid outlet from the third container is the output variable of the system. Varying flow rates of the water inlet and changing concentrations of the salt solution act as disturbances.

First examine the uncontrolled system. Try to manually correct the salt concentration to the setpoint value by changing the flow rate of the salt solution.

Next examine the controlled system (Mixing Container Cascade). Contrary to the uncontrolled system the salt concentration is not controlled manually, but with a PI controller. You may change the setpoint and the water inlet.

Finally study the performance of the control loop by changing setpoint, disturbance and control parameters. For this purpose you can use P-, I-, PI-, PID- and Two-Position Controller.

PTn-Controlled System

With this project, two methods of exercises can be carried out:

1) The analysis of the input/output response in various controlled systems

2) The examination of the response to setpoint changes and disturbances in control loops with various types of controllers and controlled systems

First-order to fifth-order Ptn elements are used for the controlled system. The parameters of these controlled systems are freely adjustable when you select "unknown system". A dead time can also be integrated in the systems.

If you select the option button in front of an unknown system, for the following exercises a Ptn-type system is used, whose order, parameters and dead time can only be changed with an access code.

When you select "Change system and parameters", a dialog window opens up asking for a password. When you have entered the correct password and clicked on "Set unknown system", a dialog window opens up, in which you can set the system (Pt1 - Pt5 with and without dead time) and the system parameters (gain and time constants). By selecting the respective items you may now examine the system or the control loop with the selected controller.

The password is 128.

Controller Response

Here you can study the response of standard controllers P, I, PI and PID controllers to input jumps.