HELP

Overview

This program is a simulation application for the process control and simulation system WinErs, which can be used to practise and analyse the field of control engineering in vocational training.

The overview contains a list of different process pages, on which you can conduct various exercises and analyses. To reach the pages, click on the blue texts. You may also run through the individual pages by clicking on the "Next >>" button. Exit the program by clicking on the "End" button.

Furthermore, the practical course on control engineering has been designed, so that you can study the performance of the individual standard controllers P, I , PI and the PID controller by applying input jumps under item 1. Items 2 - 6 contain various processes or controlled systems, which can be used to examine the performance of controlled systems and control loops with different controllers. Apart from monitoring the process signals in the trend diagram, the signal curves are recorded, so that the performance of controlled systems, controllers and control loops can later be analysed and measured. For individual controlled systems, you can examine the response to setpoint changes and interference with the standard controllers P, I, PI, the PID controller and two-position controllers as well as a cascade control. The controller parameters are variable, so that the control loop response can be individually optimised.

Furthermore, the r.m.s. system deviation is issued for every control loop, and for the processes demonstrated in items 2 - 5, manual / automatic control can be selected. All the signal curves are recorded, so that they can later be analysed and measured.

1 Controller Response

1.1 Standard controllers

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

First, click on the "Start" button. The text "Apply jump" will be displayed next to the button. By clicking on the button, you will apply a step signal to the controller input. The input and output signals are displayed in the diagram. The signal values are automatically saved. By clicking on the "Analysis" button, you may later view them in a diagram, for example to verify the controller parameters. Here you have various methods of analysis. By clicking on the signal names, the Y scale is changed over. By clicking on the signal curves, the value of the active signal will be indicated; finally, by holding and dragging, the difference in value and time will be displayed. When you click on the buttons below, various analysis methods will be available, such as zoom, change time view, change value range, ruler function, methods to export the signal values into a text file, statistic analysing methods.

The controller parameters can be changed in the respectively marked edit fields.

Terminate the simulation by clicking on the "Stop" button; with the "Next >>" or the "<< Back" button you will get to Overview or to the next process images.

1.2 Three-position controller

Here you can study the function of a three-position controller.

First, click on the "Start" button. When clicking "<"the actual value decreases, when clicking ">" it increases. When clicking "Stop" the actual value stays constantly and with "Reset" resets the graphical view.

The controller parameters can be changed in the respectively marked edit fields.

Terminate the simulation by clicking on the "Stop" button; with the "Next >>" or the "<< Back" button you will get to Overview or to the next process images.

licking on the buttons "Next >>", "<< Back" and "Overview".

2 Temperature control

2.1 Uncontrolled System

This process consists a room, which is heated with an electrical heater.Bei dem Prozess handelt es sich um ein Zimmer, das von einer Elektroheizung geheizt wird. The exercise regarding control engineering is to control the temperature of the room by changing the heating power, so that it corresponds to a certain setpoint value. The heating power is the input variable, the inside temperature of the room is the output variable of the system. Outside temperature changes and window opening are disturbances.

Start the process simulation by clicking on the "Start" button. A defined initial state is automatically set. Try to manually correct the actual temperature value to the setpoint value by changing the heating power with the shift button or the up/down counter. The change in outside temperature or window opening causes an interference, which is to be controlled.

Terminate the simulation by clicking on the "Stop" button. Click on the "Next >>" or "<< Back" button to get to other process images.

2.2 Controlled System

Contrary to the last page uncontrolled system, the temperature is not controlled manually, but with a PI controller.

Start the process simulation by clicking on the "Start" button. Defined initial states are set automatically. A PI controller starts to reach the setpoint value by regulating the electrical heater output.

You may change the setpoint and the outside temperature and window opening with the respective shift buttons, the up/down counters or by entering values above the up/down counters.

Terminate the simulation by clicking on the "Stop" button. Click on the "Next >>" or "<< Back" button to get to other process images.

2.3 Examine Closed-Loop Control System

Here you can study the performance of the control loop responding to changes of the heater output and the outside temperature and window opening.

Start the process simulation by clicking on the "Start" button. The heater output and the outside temperature and window opening can be changed with the shift buttons or the display fields below the shift buttons or the bar displays.

The current values of the temperatures in the room and outside as well as the window opening are indicated in a diagram. The values of the signals are automatically saved, so that they can later be analysed in a diagram, e.g. to determine the time constant for the controlled system.

When clicking on "Analysis", the stored measured values are indicated in a timing diagram. Here you have various methods of analysis. By clicking on the signal names, the Y scale is changed over. By clicking on the signal curves, the value of the active signal will be indicated and by holding and dragging the difference in value and time will be displayed. When you click on the buttons below, various analysis methods will be available, such as zoom, change time view, change value range, ruler function, methods to export the signal values into a text file, statistic analysing methods

Terminate the simulation by clicking on the "Stop" button. The defined initial states are reset and you may get to other process images by clicking on the buttons "Next >>", "<< Back" and "Overview".

2.4 Closed-Loop Control with P Controller

Here you can study the performance of the control loop when the setpoint and the disturbance change. For this purpose, a P controller is used.

The block structure of the control loop can be viewed by clicking on the "Block structure" button.

Start the simulation by clicking on the "Start" button. The current values of the setpoint temperature, the actual temperature, the outside temperature and the window opening are indicated in the diagram. The setpoint and outside temperature, aswell as window opening (as disturbances) can be changed with the shift buttons or the display fields below the shift buttons or the bar displays. By clicking on the "Manual control" button, the controller is switched to manual operation. It is now possible to adjust the actuating signal with the shift button or by entering values in the display fields. By clicking on "Manual control" again, the controller is automatically reset to automatic operation.

When you click on "Trend Stop", the current trend diagram is stopped. The calculation continues.

The system deviation box shows the integrated squared system deviation. When the setpoint value or the disturbance value changes, the system deviation is set to 0 and restarts to integrate.

The values for all the signals are automatically saved and can later be viewed and analysed in a diagram. When you click on "Analysis", a timing diagram containing the saved measured values opens up. Here you have several choices for an analysis. By clicking on the signal names, the Y scale is changed over. By clicking on the signal curves, the value of the active signal will be indicated and by holding and dragging the difference in value and time will be displayed. When you click on the buttons below, various analysis methods will be available, such as zoom, change time view, change value range, ruler function, methods to export the signal values into a text file, statistic analysing methods

When you click on the "Parameter" button, another window opens up in which you can change the controller parameters, the setpoint and the disturbances. The controller can also be switched from manual to automatic operation and vice versa, so that the actuating signal can be set manually.

Terminate the simulation by clicking on the "Stop" button. The defined initial states are reset and you may get to other process images by clicking on the buttons "Next >>", "<< Back" and "Overview".

2.5 Closed-Loop Control with I Controller

Here you can study the performance of the control loop when the setpoint and the disturbance change. For this purpose, a I controller is used.

The block structure of the control loop can be viewed by clicking on the "Block structure" button.

Start the simulation by clicking on the "Start" button. The current values of the setpoint temperature, the actual temperature, the outside temperature and the window opening are indicated in the diagram. The setpoint and outside temperature, aswell as window opening (as disturbances) can be changed with the shift buttons or the display fields below the shift buttons or the bar displays. By clicking on the "Manual control" button, the controller is switched to manual operation. It is now possible to adjust the actuating signal with the shift button or by entering values in the display fields. By clicking on "Manual control" again, the controller is automatically reset to automatic operation.

When you click on "Trend Stop", the current trend diagram is stopped. The calculation continues.

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When you click on the "Parameter" button, another window opens up in which you can change the controller parameters, the setpoint and the disturbances. The controller can also be switched from manual to automatic operation and vice versa, so that the actuating signal can be set manually.

Terminate the simulation by clicking on the "Stop" button. The defined initial states are reset and you may get to other process images by clicking on the buttons "Next >>", "<< Back" and "Overview".

2.6 Closed-Loop Control with PI Controller

Here you can study the performance of the control loop when the setpoint and the disturbance change. For this purpose, a PI controller is used.

The block structure of the control loop can be viewed by clicking on the "Block structure" button.

Start the simulation by clicking on the "Start" button. The current values of the setpoint temperature, the actual temperature, the outside temperature and the window opening are indicated in the diagram. The setpoint and outside temperature, aswell as window opening (as disturbances) can be changed with the shift buttons or the display fields below the shift buttons or the bar displays. By clicking on the "Manual control" button, the controller is switched to manual operation. It is now possible to adjust the actuating signal with the shift button or by entering values in the display fields. By clicking on "Manual control" again, the controller is automatically reset to automatic operation.

When you click on "Trend Stop", the current trend diagram is stopped. The calculation continues.

The system deviation box shows the integrated squared system deviation. When the setpoint value or the disturbance value changes, the system deviation is set to 0 and restarts to integrate.

The values for all the signals are automatically saved and can later be viewed and analysed in a diagram. When you click on "Analysis", a timing diagram containing the saved measured values opens up. Here you have several choices for an analysis. By clicking on the signal names, the Y scale is changed over. By clicking on the signal curves, the value of the active signal will be indicated and by holding and dragging the difference in value and time will be displayed. When you click on the buttons below, various analysis methods will be available, such as zoom, change time view, change value range, ruler function, methods to export the signal values into a text file, statistic analysing methods

When you click on the "Parameter" button, another window opens up in which you can change the controller parameters, the setpoint and the disturbances. The controller can also be switched from manual to automatic operation and vice versa, so that the actuating signal can be set manually.

Terminate the simulation by clicking on the "Stop" button. The defined initial states are reset and you may get to other process images by clicking on the buttons "Next >>", "<< Back" and "Overview".

2.7 Closed-Loop Control with PID Controller

Here you can study the performance of the control loop when the setpoint and the disturbance change. For this purpose, a PID controller is used.

The block structure of the control loop can be viewed by clicking on the "Block structure" button.

Start the simulation by clicking on the "Start" button. The current values of the setpoint temperature, the actual temperature, the outside temperature and the window opening are indicated in the diagram. The setpoint and outside temperature, aswell as window opening (as disturbances) can be changed with the shift buttons or the display fields below the shift buttons or the bar displays. By clicking on the "Manual control" button, the controller is switched to manual operation. It is now possible to adjust the actuating signal with the shift button or by entering values in the display fields. By clicking on "Manual control" again, the controller is automatically reset to automatic operation.

When you click on "Trend Stop", the current trend diagram is stopped. The calculation continues.

The system deviation box shows the integrated squared system deviation. When the setpoint value or the disturbance value changes, the system deviation is set to 0 and restarts to integrate.

The values for all the signals are automatically saved and can later be viewed and analysed in a diagram. When you click on "Analysis", a timing diagram containing the saved measured values opens up. Here you have several choices for an analysis. By clicking on the signal names, the Y scale is changed over. By clicking on the signal curves, the value of the active signal will be indicated and by holding and dragging the difference in value and time will be displayed. When you click on the buttons below, various analysis methods will be available, such as zoom, change time view, change value range, ruler function, methods to export the signal values into a text file, statistic analysing methods

When you click on the "Parameter" button, another window opens up in which you can change the controller parameters, the setpoint and the disturbances. The controller can also be switched from manual to automatic operation and vice versa, so that the actuating signal can be set manually.

Terminate the simulation by clicking on the "Stop" button. The defined initial states are reset and you may get to other process images by clicking on the buttons "Next >>", "<< Back" and "Overview".

3 Engine speed control

3.1 Uncontrolled System

This process is an engine, which´s rotational speed shall be adjusted using the voltage . Therefore, the voltage constitutes the input variable, and the rotational speed the output variable of the system. The load acts as disturbance.

Start the process simulation by clicking on the "Start" button. A defined initial state is automatically set. Try to manually correct the actual rotational speed to the setpoint by changing the voltage or the the load with the shift button, the up/down counters or by entering numeric values.

Terminate the simulation by clicking on the "Stop" button. Click on the "Next >>" or "<< Back" button to get to other process images.

3.2 Controlled System

Contrary to the last page uncontrolled system, the engine speed is not controlled manually, but with a PI controller.

Start the process simulation by clicking on the "Start" button. Defined initial states are set automatically. A PI controller starts to reach the setpoint value by regulating the engine voltage output.

You may change the setpoint and the load with the respective shift buttons, the up/down counters or by entering values above the up/down counters.

Terminate the simulation by clicking on the "Stop" button. Click on the "Next >>" or "<< Back" button to get to other process images.

3.3 Examine Closed-Loop Control System

Here you can study the response of the controlled system when the voltage and the load change.

Start the simulation by clicking on the "Start" button. The voltage and the load can be changed with the shift button or the display fields below the shift button or below the bar diagram.

When clicking on "Evaluation", the stored measured values are indicated in a timing diagram. Here you have various methods of analysis. By clicking on the signal names, the Y scale is changed over. By clicking on the signal curves, the value of the active signal will be indicated and by holding and dragging the difference in value and time will be displayed. When you click on the buttons below, various analysis methods will be available, such as zoom, change time view, change value range, ruler function, methods to export the signal values into a text file, statistic analysing methods.

Terminate the simulation by clicking on the "Stop" button. The defined initial states are reset and you may get to other process images by clicking on the buttons "Next >>", "<< Back" and "Overview".

3.4 Closed-Loop Control with P Controller

Here you can study the performance of the control loop when the setpoint and the disturbance change. For this purpose, a P controller is used.

The block structure of the control loop can be viewed by clicking on the "Block structure" button.

Start the simulation by clicking on the "Start" button. The current values of the setpoint, the actual value, the voltage and the load are indicated in the diagram. The setpoint and the laod (as a disturbance) can be changed with the shift buttons or the display fields below the shift buttons or the bar displays. By clicking on the "Manual control" button, the controller is switched to manual operation. It is now possible to adjust the actuating signal with the shift button or by entering values in the display fields. By clicking on "Manual control" again, the controller is automatically reset to automatic operation.

When you click on "Trend Stop", the current trend diagram is stopped. The calculation continues.

The system deviation box shows the integrated squared system deviation. When the setpoint value or the disturbance value changes, the system deviation is set to 0 and restarts to integrate.

The values for all the signals are automatically saved and can later be viewed and analysed in a diagram. When you click on "Analysis", a timing diagram containing the saved measured values opens up. Here you have several choices for an analysis. By clicking on the signal names, the Y scale is changed over. By clicking on the signal curves, the value of the active signal will be indicated and by holding and dragging the difference in value and time will be displayed. When you click on the buttons below, various analysis methods will be available, such as zoom, change time view, change value range, ruler function, methods to export the signal values into a text file, statistic analysing methods.

When you click on the "Parameter" button, another window opens up in which you can change the controller parameters, the setpoint and the disturbance. The controller can also be switched from manual to automatic operation and vice versa, so that the actuating signal can be set manually.

Terminate the simulation by clicking on the "Stop" button. The defined initial states are reset and you may get to other process images by clicking on the buttons "Next >>", "<< Back" and "Overview".

3.5 Closed-Loop Control with I Controller

Here you can study the performance of the control loop when the setpoint and the disturbance change. For this purpose, an I controller is used.

The block structure of the control loop can be viewed by clicking on the "Block structure" button.

Start the simulation by clicking on the "Start" button. The current values of the setpoint, the actual value, the voltage and the load are indicated in the diagram. The setpoint and the laod (as a disturbance) can be changed with the shift buttons or the display fields below the shift buttons or the bar displays. By clicking on the "Manual control" button, the controller is switched to manual operation. It is now possible to adjust the actuating signal with the shift button or by entering values in the display fields. By clicking on "Manual control" again, the controller is automatically reset to automatic operation.

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When you click on the "Parameter" button, another window opens up in which you can change the controller parameters, the setpoint and the disturbance. The controller can also be switched from manual to automatic operation and vice versa, so that the actuating signal can be set manually.

Terminate the simulation by clicking on the "Stop" button. The defined initial states are reset and you may get to other process images by clicking on the buttons "Next >>", "<< Back" and "Overview".

3.6 Closed-Loop Control with PI Controller

Here you can study the performance of the control loop when the setpoint and the disturbance change. For this purpose, a PI controller is used.

The block structure of the control loop can be viewed by clicking on the "Block structure" button.

Start the simulation by clicking on the "Start" button. The current values of the setpoint, the actual value, the voltage and the load are indicated in the diagram. The setpoint and the laod (as a disturbance) can be changed with the shift buttons or the display fields below the shift buttons or the bar displays. By clicking on the "Manual control" button, the controller is switched to manual operation. It is now possible to adjust the actuating signal with the shift button or by entering values in the display fields. By clicking on "Manual control" again, the controller is automatically reset to automatic operation.

When you click on "Trend Stop", the current trend diagram is stopped. The calculation continues.

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When you click on the "Parameter" button, another window opens up in which you can change the controller parameters, the setpoint and the disturbance. The controller can also be switched from manual to automatic operation and vice versa, so that the actuating signal can be set manually.

Terminate the simulation by clicking on the "Stop" button. The defined initial states are reset and you may get to other process images by clicking on the buttons "Next >>", "<< Back" and "Overview".

3.7 Closed-Loop Control with PID Controller

Here you can study the performance of the control loop when the setpoint and the disturbance change. For this purpose, a PID controller is used.

The block structure of the control loop can be viewed by clicking on the "Block structure" button.

Start the simulation by clicking on the "Start" button. The current values of the setpoint, the actual value, the voltage and the load are indicated in the diagram. The setpoint and the laod (as a disturbance) can be changed with the shift buttons or the display fields below the shift buttons or the bar displays. By clicking on the "Manual control" button, the controller is switched to manual operation. It is now possible to adjust the actuating signal with the shift button or by entering values in the display fields. By clicking on "Manual control" again, the controller is automatically reset to automatic operation.

When you click on "Trend Stop", the current trend diagram is stopped. The calculation continues.

The system deviation box shows the integrated squared system deviation. When the setpoint value or the disturbance value changes, the system deviation is set to 0 and restarts to integrate.

The values for all the signals are automatically saved and can later be viewed and analysed in a diagram. When you click on "Analysis", a timing diagram containing the saved measured values opens up. Here you have several choices for an analysis. By clicking on the signal names, the Y scale is changed over. By clicking on the signal curves, the value of the active signal will be indicated and by holding and dragging the difference in value and time will be displayed. When you click on the buttons below, various analysis methods will be available, such as zoom, change time view, change value range, ruler function, methods to export the signal values into a text file, statistic analysing methods.

When you click on the "Parameter" button, another window opens up in which you can change the controller parameters, the setpoint and the disturbance. The controller can also be switched from manual to automatic operation and vice versa, so that the actuating signal can be set manually.

Terminate the simulation by clicking on the "Stop" button. The defined initial states are reset and you may get to other process images by c

4 Flow rate control

4.1 Uncontrolled System

This process is a pipeline with a valve. Water is flowing through the pipeline with an adjusted pressure. The exercise regarding control engineering is to control the flow rate water by changing the valve position, so that it corresponds to a certain setpoint value. The valve position is the input variable, the flow rate is the output variable of the system. Pressure changes are a disturbance.

Start the process simulation by clicking on the "Start" button. A defined initial state is automatically set. Try to manually correct the flow rate to the setpoint value by changing the valve position with the shift button or the up/down counter. The change in the pressure causes an interference, which is to be controlled.

Terminate the simulation by clicking on the "Stop" button. Click on the "Next >>" or "<< Back" button to get to other process images.

4.2 Controlled System

Contrary to the last page Uncontrolled System, the flow rate is not controlled manually, but with a PI controller.

Start the process simulation by clicking on the "Start" button. Defined initial states are set automatically. A PI controller starts to reach the setpoint value by regulating the valve.

You may change the setpoint and the pressure with the respective shift buttons, the up/down counters or by entering values above the up/down counters.

Terminate the simulation by clicking on the "Stop" button. Click on the "Next >>" or "<< Back" button to get to other process images.

4.3 Examine Closed-Loop Control System

Here you can study the performance of the control loop responding to changes of the valve position and the pressure.

Start the process simulation by clicking on the "Start" button. The valve position and the pressure can be changed with the shift buttons or the display fields below the shift buttons or the bar displays.

The current values of the flow rate setpoint and actual value as well as the valve position and pressure are indicated in a diagram. The values of the signals are automatically saved, so that they can later be analysed in a diagram, e.g. to determine the time constant for the controlled system.

When clicking on "Analysis", the stored measured values are indicated in a timing diagram. Here you have various methods of analysis. By clicking on the signal names, the Y scale is changed over. By clicking on the signal curves, the value of the active signal will be indicated and by holding and dragging the difference in value and time will be displayed. When you click on the buttons below, various analysis methods will be available, such as zoom, change time view, change value range, ruler function, methods to export the signal values into a text file, statistic analysing methods

Terminate the simulation by clicking on the "Stop" button. The defined initial states are reset and you may get to other process images by clicking on the buttons "Next >>", "<< Back" and "Overview".

4.4 Closed-Loop Control with P Controller

Here you can study the performance of the control loop when the setpoint and the disturbance change. For this purpose, a P controller is used.

The block structure of the control loop can be viewed by clicking on the "Block structure" button.

Start the simulation by clicking on the "Start" button. The current values of the setpoint flow rate, the actual flow rate and the valve position and pressure temperature are indicated in the diagram. The setpoint and the disturbances can be changed with the shift buttons or the display fields below the shift buttons or the bar displays. By clicking on the "Manual control" button, the controller is switched to manual operation. It is now possible to adjust the actuating signal with the shift button or by entering values in the display fields. By clicking on "Manual control" again, the controller is automatically reset to automatic operation.

When you click on "Trend Stop", the current trend diagram is stopped. The calculation continues.

The system deviation box shows the integrated squared system deviation. When the setpoint value or the disturbance value changes, the system deviation is set to 0 and restarts to integrate.

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When you click on the "Parameter" button, another window opens up in which you can change the controller parameters, the setpoint and the disturbancee. The controller can also be switched from manual to automatic operation and vice versa, so that the actuating signal can be set manually.

Terminate the simulation by clicking on the "Stop" button. The defined initial states are reset and you may get to other process images by clicking on the buttons "Next >>", "<< Back" and "Overview".

4.5 Closed-Loop Control with I Controller

Here you can study the performance of the control loop when the setpoint and the disturbance change. For this purpose, a I controller is used.

The block structure of the control loop can be viewed by clicking on the "Block structure" button.

Start the simulation by clicking on the "Start" button. The current values of the setpoint flow rate, the actual flow rate and the valve position and pressure temperature are indicated in the diagram. The setpoint and the disturbances can be changed with the shift buttons or the display fields below the shift buttons or the bar displays. By clicking on the "Manual control" button, the controller is switched to manual operation. It is now possible to adjust the actuating signal with the shift button or by entering values in the display fields. By clicking on "Manual control" again, the controller is automatically reset to automatic operation.

When you click on "Trend Stop", the current trend diagram is stopped. The calculation continues.

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Terminate the simulation by clicking on the "Stop" button. The defined initial states are reset and you may get to other process images by clicking on the buttons "Next >>", "<< Back" and "Overview".

4.6 Closed-Loop Control with PI Controller

Here you can study the performance of the control loop when the setpoint and the disturbance change. For this purpose, a PI controller is used.

The block structure of the control loop can be viewed by clicking on the "Block structure" button.

Start the simulation by clicking on the "Start" button. The current values of the setpoint flow rate, the actual flow rate and the valve position and pressure temperature are indicated in the diagram. The setpoint and the disturbances can be changed with the shift buttons or the display fields below the shift buttons or the bar displays. By clicking on the "Manual control" button, the controller is switched to manual operation. It is now possible to adjust the actuating signal with the shift button or by entering values in the display fields. By clicking on "Manual control" again, the controller is automatically reset to automatic operation.

When you click on "Trend Stop", the current trend diagram is stopped. The calculation continues.

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When you click on the "Parameter" button, another window opens up in which you can change the controller parameters, the setpoint and the disturbancee. The controller can also be switched from manual to automatic operation and vice versa, so that the actuating signal can be set manually.

Terminate the simulation by clicking on the "Stop" button. The defined initial states are reset and you may get to other process images by clicking on the buttons "Next >>", "<< Back" and "Overview".

4.7 Closed-Loop Control with PID Controller

Here you can study the performance of the control loop when the setpoint and the disturbance change. For this purpose, a PID controller is used.

The block structure of the control loop can be viewed by clicking on the "Block structure" button.

Start the simulation by clicking on the "Start" button. The current values of the setpoint flow rate, the actual flow rate and the valve position and pressure temperature are indicated in the diagram. The setpoint and the disturbances can be changed with the shift buttons or the display fields below the shift buttons or the bar displays. By clicking on the "Manual control" button, the controller is switched to manual operation. It is now possible to adjust the actuating signal with the shift button or by entering values in the display fields. By clicking on "Manual control" again, the controller is automatically reset to automatic operation.

When you click on "Trend Stop", the current trend diagram is stopped. The calculation continues.

The system deviation box shows the integrated squared system deviation. When the setpoint value or the disturbance value changes, the system deviation is set to 0 and restarts to integrate.

The values for all the signals are automatically saved and can later be viewed and analysed in a diagram. When you click on "Analysis", a timing diagram containing the saved measured values opens up. Here you have several choices for an analysis. By clicking on the signal names, the Y scale is changed over. By clicking on the signal curves, the value of the active signal will be indicated and by holding and dragging the difference in value and time will be displayed. When you click on the buttons below, various analysis methods will be available, such as zoom, change time view, change value range, ruler function, methods to export the signal values into a text file, statistic analysing methods

When you click on the "Parameter" button, another window opens up in which you can change the controller parameters, the setpoint and the disturbancee. The controller can also be switched from manual to automatic operation and vice versa, so that the actuating signal can be set manually.

Terminate the simulation by clicking on the "Stop" button. The defined initial states are reset and you may get to other process images by clicking on the buttons "Next >>", "<< Back" and "Overview".

5 Liquid Level Control

5.1 Uncontrolled System

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 closing or opening the valve, 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 inlet acts as a disturbance.

The valve is controlled with an engine which is runned with a three-position controller. The valve can open, close or stay in the same position. The three-position controller gives the orders "open" and "close". The setpoint valve position is the setpoint of the three-position controller. The actual valve position follows the setpoint with a time delay, when opening or closing the valve.

In the initial state the valve is closed and the inlet is 0. To change the liquid level, the inlet must be set to value greater than 0.

Start the process simulation by clicking on the "Start" button. A defined initial state is automatically set. Try to manually correct the actual level to the setpoint level by changing the valve setpoint. The three-position controller starts the engine, that opens or closes the valve. Is the desired valve position reached the engine stops and valve remains in the same position.

Terminate the simulation by clicking on the "Stop" button. Click on the "Next >>" or "<< Back" button to get to other process images.

5.2 Controlled System

Contrary to the last page Uncontrolled System, the closed-loop control process for the liquid level is not actuated manually, but with a PI controller.

The valve is controlled with an engine which is runned with a three-position controller. The valve can open, close or stay in the same position. The three-position controller gives the orders "open" and "close". The setpoint valve position is the setpoint of the three-position controller. The actual valve position follows the setpoint with a time delay, when opening or closing the valve.

In the initial state the valve is closed and the inlet is 0. To change the liquid level, the inlet must be set to value greater than 0.

Start the simulation by clicking on the "Start" button. A PI controller controls the liquid level until the setpoint is reached. To change the liquid level, a corresponding inlet must be set.

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.

Terminate the simulation by clicking on the "Stop" button. The defined initial states are reset and you may get to other process images by clicking on the buttons "Next >>", "<< Back" and "Overview".

5.3 Examine Closed-Loop Control System

Here you can study the response of the controlled system when changing the valve position or the inlet.

The valve is controlled with an engine which is runned with a three-position controller. The valve can open, close or stay in the same position. The three-position controller gives the orders "open" and "close". The setpoint valve position is the setpoint of the three-position controller. The actual valve position follows the setpoint with a time delay, when opening or closing the valve.

In the initial state the valve is closed and the inlet is 0. To change the liquid level, the inlet must be set to value greater than 0.

Start the simulation by clicking on the "Start" button. The inlet can be changed with the shift button or the display fields below the shift button or below the bar diagram. The valve position is influenced by the three-position controller, when changing the valve setpoint.

The values for the liquid level, the inlet and the set point valve position are graphically indicated in a diagram. The signal values are automatically stored, so that they can later be analysed in a timing diagram, e.g. to determine the time constant for the controlled system.

When clicking on "Analysis", the stored measured values are indicated in a timing diagram. Here you have various methods of analysis. By clicking on the signal names, the Y scale is changed over. By clicking on the signal curves, the value of the active signal will be indicated and by holding and dragging the difference in value and time will be displayed. When you click on the buttons below, various analysis methods will be available, such as zoom, change time view, change value range, ruler function, methods to export the signal values into a text file, statistic analysing methods.

Terminate the simulation by clicking on the "Stop" button. The defined initial states are reset and you may get to other process images by clicking on the buttons "Next >>", "<< Back" and "Overview".

5.4 Closed-Loop Control with P Controller

Here you can study the performance of the control loop when the setpoint and the disturbance change. For this purpose, a P controller is used.

The block structure of the control loop can be viewed by clicking on the "Block structure" button.

The valve is controlled with an engine which is runned with a three-position controller. The valve can open, close or stay in the same position. The three-position controller gives the orders "open" and "close". The setpoint valve position is the setpoint of the three-position controller. The actual valve position follows the setpoint with a time delay, when opening or closing the valve.

In the initial state the valve is closed and the inlet is 0. To change the liquid level, the inlet must be set to value greater than 0.

Start the simulation by clicking on the "Start" button. The current values of the setpoint, the actual value, the inlet and the valve position are indicated in the diagram. The setpoint and the disturbance can be changed with the shift buttons or the display fields below the shift buttons or the bar displays. It is now possible to adjust the actuating signal (the valve position) with the shift button or by entering values in the display fields. By clicking on "Manual control" again, the controller is automatically reset to automatic operation.

When you click on "Trend Stop", the current trend diagram is stopped. The calculation continues.

The system deviation box shows the integrated squared system deviation. When the setpoint value or the disturbance value changes, the system deviation is set to 0 and restarts to integrate.

The values for all the signals are automatically saved and can later be viewed and analysed in a diagram. When you click on "Analysis", a timing diagram containing the saved measured values opens up. Here you have several choices for an analysis. By clicking on the signal names, the Y scale is changed over. By clicking on the signal curves, the value of the active signal will be indicated and by holding and dragging the difference in value and time will be displayed. When you click on the buttons below, various analysis methods will be available, such as zoom, change time view, change value range, ruler function, methods to export the signal values into a text file, statistic analysing methods.

When you click on the "Parameter" button, another window opens up in which you can change the controller parameters, the setpoint liquid level and the inlet. The controller can also be switched from manual to automatic operation and vice versa, so that the actuating signal can be set manually.

Terminate the simulation by clicking on the "Stop" button. The defined initial states are reset and you may get to other process images by clicking on the buttons "Next >>", "<< Back" and "Overview".

5.5 Closed-Loop Control with I Controller

Here you can study the performance of the control loop when the setpoint and the disturbance change. For this purpose, an I controller is used.

The block structure of the control loop can be viewed by clicking on the "Block structure" button.

The valve is controlled with an engine which is runned with a three-position controller. The valve can open, close or stay in the same position. The three-position controller gives the orders "open" and "close". The setpoint valve position is the setpoint of the three-position controller. The actual valve position follows the setpoint with a time delay, when opening or closing the valve.

In the initial state the valve is closed and the inlet is 0. To change the liquid level, the inlet must be set to value greater than 0.

Start the simulation by clicking on the "Start" button. The current values of the setpoint, the actual value, the inlet and the valve position are indicated in the diagram. The setpoint and the disturbance can be changed with the shift buttons or the display fields below the shift buttons or the bar displays. It is now possible to adjust the actuating signal (the valve position) with the shift button or by entering values in the display fields. By clicking on "Manual control" again, the controller is automatically reset to automatic operation.

When you click on "Trend Stop", the current trend diagram is stopped. The calculation continues.

The system deviation box shows the integrated squared system deviation. When the setpoint value or the disturbance value changes, the system deviation is set to 0 and restarts to integrate.

The values for all the signals are automatically saved and can later be viewed and analysed in a diagram. When you click on "Analysis", a timing diagram containing the saved measured values opens up. Here you have several choices for an analysis. By clicking on the signal names, the Y scale is changed over. By clicking on the signal curves, the value of the active signal will be indicated and by holding and dragging the difference in value and time will be displayed. When you click on the buttons below, various analysis methods will be available, such as zoom, change time view, change value range, ruler function, methods to export the signal values into a text file, statistic analysing methods.

When you click on the "Parameter" button, another window opens up in which you can change the controller parameters, the setpoint liquid level and the inlet. The controller can also be switched from manual to automatic operation and vice versa, so that the actuating signal can be set manually.

Terminate the simulation by clicking on the "Stop" button. The defined initial states are reset and you may get to other process images by clicking on the buttons "Next >>", "<< Back" and "Overview".

5.6 Closed-Loop Control with PI Controller

Here you can study the performance of the control loop when the setpoint and the disturbance change. For this purpose, a PI controller is used.

The block structure of the control loop can be viewed by clicking on the "Block structure" button.

The valve is controlled with an engine which is runned with a three-position controller. The valve can open, close or stay in the same position. The three-position controller gives the orders "open" and "close". The setpoint valve position is the setpoint of the three-position controller. The actual valve position follows the setpoint with a time delay, when opening or closing the valve.

In the initial state the valve is closed and the inlet is 0. To change the liquid level, the inlet must be set to value greater than 0.

Start the simulation by clicking on the "Start" button. The current values of the setpoint, the actual value, the inlet and the valve position are indicated in the diagram. The setpoint and the disturbance can be changed with the shift buttons or the display fields below the shift buttons or the bar displays. It is now possible to adjust the actuating signal (the valve position) with the shift button or by entering values in the display fields. By clicking on "Manual control" again, the controller is automatically reset to automatic operation.

When you click on "Trend Stop", the current trend diagram is stopped. The calculation continues.

The system deviation box shows the integrated squared system deviation. When the setpoint value or the disturbance value changes, the system deviation is set to 0 and restarts to integrate.

The values for all the signals are automatically saved and can later be viewed and analysed in a diagram. When you click on "Analysis", a timing diagram containing the saved measured values opens up. Here you have several choices for an analysis. By clicking on the signal names, the Y scale is changed over. By clicking on the signal curves, the value of the active signal will be indicated and by holding and dragging the difference in value and time will be displayed. When you click on the buttons below, various analysis methods will be available, such as zoom, change time view, change value range, ruler function, methods to export the signal values into a text file, statistic analysing methods.

When you click on the "Parameter" button, another window opens up in which you can change the controller parameters, the setpoint liquid level and the inlet. The controller can also be switched from manual to automatic operation and vice versa, so that the actuating signal can be set manually.

Terminate the simulation by clicking on the "Stop" button. The defined initial states are reset and you may get to other process images by clicking on the buttons "Next >>", "<< Back" and "Overview".

5.7 Closed-Loop Control with PID Controller

Here you can study the performance of the control loop when the setpoint and the disturbance change. For this purpose, a PID controller is used.

The block structure of the control loop can be viewed by clicking on the "Block structure" button.

The valve is controlled with an engine which is runned with a three-position controller. The valve can open, close or stay in the same position. The three-position controller gives the orders "open" and "close". The setpoint valve position is the setpoint of the three-position controller. The actual valve position follows the setpoint with a time delay, when opening or closing the valve.

In the initial state the valve is closed and the inlet is 0. To change the liquid level, the inlet must be set to value greater than 0.

Start the simulation by clicking on the "Start" button. The current values of the setpoint, the actual value, the inlet and the valve position are indicated in the diagram. The setpoint and the disturbance can be changed with the shift buttons or the display fields below the shift buttons or the bar displays. It is now possible to adjust the actuating signal (the valve position) with the shift button or by entering values in the display fields. By clicking on "Manual control" again, the controller is automatically reset to automatic operation.

When you click on "Trend Stop", the current trend diagram is stopped. The calculation continues.

The system deviation box shows the integrated squared system deviation. When the setpoint value or the disturbance value changes, the system deviation is set to 0 and restarts to integrate.

The values for all the signals are automatically saved and can later be viewed and analysed in a diagram. When you click on "Analysis", a timing diagram containing the saved measured values opens up. Here you have several choices for an analysis. By clicking on the signal names, the Y scale is changed over. By clicking on the signal curves, the value of the active signal will be indicated and by holding and dragging the difference in value and time will be displayed. When you click on the buttons below, various analysis methods will be available, such as zoom, change time view, change value range, ruler function, methods to export the signal values into a text file, statistic analysing methods.

When you click on the "Parameter" button, another window opens up in which you can change the controller parameters, the setpoint liquid level and the inlet. The controller can also be switched from manual to automatic operation and vice versa, so that the actuating signal can be set manually.

Terminate the simulation by clicking on the "Stop" button. The defined initial states are reset and you may get to other process images by clicking on the buttons "Next >>", "<< Back" and "Overview".

5.8 Closed-Loop Control with Three-Position Controller

Here you can study the performance of the control loop when the setpoint and the disturbance change. For this purpose, a three-position controller is used.

The block structure of the control loop can be viewed by clicking on the "Block structure" button.

The valve is controlled with an engine which is runned with a three-position controller. The valve can open, close or stay in the same position. The three-position controller gives the orders "open" and "close". The setpoint valve position is the setpoint of the three-position controller. The actual valve position follows the setpoint with a time delay, when opening or closing the valve.

In the initial state the valve is closed and the inlet is 0. To change the liquid level, the inlet must be set to value greater than 0.

Start the simulation by clicking on the "Start" button. The current values of the setpoint, the actual value, the inlet and the valve position are indicated in the diagram. The setpoint and the disturbance can be changed with the shift buttons or the display fields below the shift buttons or the bar displays. It is now possible to adjust the actuating signal (the valve position) with the shift button or by entering values in the display fields. By clicking on "Manual control" again, the controller is automatically reset to automatic operation.

When you click on "Trend Stop", the current trend diagram is stopped. The calculation continues.

The system deviation box shows the integrated squared system deviation. When the setpoint value or the disturbance value changes, the system deviation is set to 0 and restarts to integrate.

The values for all the signals are automatically saved and can later be viewed and analysed in a diagram. When you click on "Analysis", a timing diagram containing the saved measured values opens up. Here you have several choices for an analysis. By clicking on the signal names, the Y scale is changed over. By clicking on the signal curves, the value of the active signal will be indicated and by holding and dragging the difference in value and time will be displayed. When you click on the buttons below, various analysis methods will be available, such as zoom, change time view, change value range, ruler function, methods to export the signal values into a text file, statistic analysing methods.

When you click on the "Parameter" button, another window opens up in which you can change the controller parameters, the setpoint liquid level and the inlet. The controller can also be switched from manual to automatic operation and vice versa, so that the actuating signal can be set manually.

Terminate the simulation by clicking on the "Stop" button. The defined initial states are reset and you may get to other process images by clicking on the buttons "Next >>", "<< Back" and "Overview".

6 Climate Room Control

6.1 Uncontrolled System

This process contains a cooling chamber in which the temperature is influenced with cold or warm supply air. The exercise on control engineering is to control the temperature by closing or opening the valves to the heat exchanger, so that it corresponds to a certain setpoint value. Therefore, the inlet air temperature constitutes the input variable, and the temperature in the chamber is the output variable of the system. The inlet air temperature acts as a disturbance.

Start the process simulation by clicking on the "Start" button. A defined initial state is automatically set. Try to manually correct the actual temperature to the setpoint temperature by changing the inlet air temperature.

Terminate the simulation by clicking on the "Stop" button. Click on the "Next >>" or "<< Back" button to get to other process images.

6.2 Controlled System

Contrary to the last page Uncontrolled System, the closed-loop control process for the temperature is not actuated manually, but with a three-position controller.

Start the simulation by clicking on the "Start" button. A three-position controller controls starts controlling by opening and closing the valves.

You may change the setpoint and the inlet temperature via the respective shift buttons, the up/down counters or by entering values above the up/down counters.

Terminate the simulation by clicking on the "Stop" button. The defined initial states are reset and you may get to other process images by clicking on the buttons "Next >>", "<< Back" and "Overview".

6.3 Examine Closed-Loop Control System

Here you can study the performance of the control loop responding to heating, cooling and the change of inlet air temperature.

Start the process simulation by clicking on the "Start" button. The valves are served with the buttons next to the valves or or with the buttons "heating" or "cooling". The inlet air temperature can be changed with the shift buttons or the display fields below the shift buttons or the bar displays.

The current values of inlet air temperature setpoint temperature are indicated in a diagram. The values of the signals are automatically saved, so that they can later be analysed in a diagram, e.g. to determine the time constant for the controlled system.

When clicking on "Analysis", the stored measured values are indicated in a timing diagram. Here you have various methods of analysis. By clicking on the signal names, the Y scale is changed over. By clicking on the signal curves, the value of the active signal will be indicated and by holding and dragging the difference in value and time will be displayed. When you click on the buttons below, various analysis methods will be available, such as zoom, change time view, change value range, ruler function, methods to export the signal values into a text file, statistic analysing methods

Terminate the simulation by clicking on the "Stop" button. The defined initial states are reset and you may get to other process images by clicking on the buttons "Next >>", "<< Back" and "Overview".

6.4 Closed-Loop Control with Three-Position Controller

Here you can study the performance of the control loop when the setpoint and the disturbance change. For this purpose, a three-position controller is used.

The block structure of the control loop can be viewed by clicking on the "Block structure" button.

The valve is controlled with an engine which is runned with a three-position controller. The valve can open, close or stay in the same position. The three-position controller gives the orders "open" and "close". The setpoint valve position is the setpoint of the three-position controller. The actual valve position follows the setpoint with a time delay, when opening or closing the valve.

In the initial state the valve is closed and the inlet is 0. To change the liquid level, the inlet must be set to value greater than 0.

Start the simulation by clicking on the "Start" button. The current values of the setpoint, the actual value, the inlet and the valve position are indicated in the diagram. The setpoint and the disturbance can be changed with the shift buttons or the display fields below the shift buttons or the bar displays. It is now possible to adjust the actuating signal (the valve position) with the shift button or by entering values in the display fields. By clicking on "Manual control" again, the controller is automatically reset to automatic operation.

When you click on "Trend Stop", the current trend diagram is stopped. The calculation continues.

The system deviation box shows the integrated squared system deviation. When the setpoint value or the disturbance value changes, the system deviation is set to 0 and restarts to integrate.

The values for all the signals are automatically saved and can later be viewed and analysed in a diagram. When you click on "Analysis", a timing diagram containing the saved measured values opens up. Here you have several choices for an analysis. By clicking on the signal names, the Y scale is changed over. By clicking on the signal curves, the value of the active signal will be indicated and by holding and dragging the difference in value and time will be displayed. When you click on the buttons below, various analysis methods will be available, such as zoom, change time view, change value range, ruler function, methods to export the signal values into a text file, statistic analysing methods.

When you click on the "Parameter" button, another window opens up in which you can change the controller parameters, the setpoint liquid level and the inlet. The controller can also be switched from manual to automatic operation and vice versa, so that the actuating signal can be set manually.

Terminate the simulation by clicking on the "Stop" button. The defined initial states are reset and you may get to other process images by clicking on the buttons "Next >>", "<< Back" and "Overview".