LOOP TUNING AND TROUBLESHOOTING

Course Overview

Course number: 4700

Course length: 4-5 days

NOTE: SESP Training Match and MPA discounting are not available for this course.

Having problems getting a PID loop to deliver the desired performance?

This process-oriented course begins with

- A review of the proportional, integral, and derivative modes of control from a process perspective
- The various combinations in which these modes are used
- The process considerations pertaining to the use of each mode

This discussion focuses on what contribution can be expected from the various modes of control, and how to approach tuning if trial-and-error tuning is the method of choice.

Tuning of loops can be complicated by certain characteristics within the process, within the final control element, or within the measurement device. Examples of these are presented, along with how to recognize when these characteristics are the source of a problem.

A comprehensive treatment of the options available for tuning loops is presented, including

- Trial-and-error tuning
- Conventional tuning techniques
- Automated/self tuning facilities
- Model-based tuning coupled with process testing

Cascade control is discussed in detail, with emphasis on mode selection and tuning.

The course concludes with an introduction to multivariable issues, with emphasis on how interaction within the process can lead to difficulties in loop tuning.

Course Benefits

High degree of automatic control, which is a prerequisite for improved product quality and/or all optimization endeavors

- Understand the role of each of the modes of control
- Apply the mode combination appropriate to the process
- Proficiently tune loops using trial-and-error, tuning techniques, or auto-tuners
- Recognize when process characteristics, measurement device deficiencies, or valve problems are impairing the performance of a loop
- Apply and tune cascade control configurations
- Recognize when loop interaction is leading to tuning problems

Course Delivery Options

- In-Center Instructor-Led Training
- On-Site Instructor-Led Training

Who Should Take This Course?

Those interested in the process (applications) aspects of process control as opposed to the systems (bits and bytes) aspects. This includes:

- Control personnel
- Instrument specialists
- Process engineers

This course is designed for those who are:

- Directly responsible for tuning loops
- Pursuing process improvements by enhancing the performance of the process controls

Prerequisite/Skill Requirements

Prerequisite Course(s)

- PID means proportional-integral-derivative. An understanding of what integrals and derivatives are will be assumed, but not a working knowledge. TDC-3000 solves the equations; there is no need for users to be able to do so.
- No prior exposure to Laplace transforms is required. The course includes a 15-minute introduction to Laplace transforms, the objective being to understand the various Laplace expressions in the TDC-3000 manuals

Required Skills and/or Experience

- None

Prerequisite/Skill Requirements Continued

Desirable Skills and/or Experience

- Familiarization with own plant's process control environment
- Some prior experience with loop tuning in a production facility is helpful but not absolutely necessary

Course Topics

You will learn how to….

- **The PID Controller.** Control modes; tuning coefficients; flow controllers as a special case; measures of loop performance.
- **Proportional Mode.** Regulators; proportional band; offset; bumpless transfer; PV tracking; effect of gain on response speed.
- **Reset (Integral) Mode.** PI control; elimination of offset; PI control implementations; effect of reset action on loop response; pitfalls of excess reset action; tuning PI controllers.
- **Derivative Mode.** Effect of derivative action on loop response; implementation of PID controller; PID responses; derivative in temperature loops; tuning PID controllers.
- **Relationship of Tuning to Process Characteristics.** Process gain (sensitivity); process operating line; linear vs. nonlinear processes; action of process and controller; process dynamics; time constants, integrating processes; dead time (transportation lag).
- **Measurement Devices and Final Control Elements.** Measurement device characteristics that impact control performance; control valve size and characteristics; valve positioners and smart valves; variable speed pumping.
- **Tuning Techniques.** Conventional tuning techniques; experiences with traditional tuning techniques; automatic tuning methods; process testing vs. normal operating data; model-based tuning; untunable controllers
- **Cascade Control.** Jacketed reactor example of cascade control; terminology; bumpless transfer; mode selection and tuning.
- **Ratio or Flow-to-Flow Control.** Applications of ratio control; controlled flow and wild flow; implementations; tuning ratio controllers.
- **Multivariable Issues.** Pairing controlled and manipulated variables; gains in multivariable processes; recognizing interaction as the source of loop tuning problems.

Process simulations are used throughout the presentations to illustrate the various points. The presentations are accompanied by practice sessions where the attendees use the simulations to

- Tune the proportional mode
- Tune a PI controller
- Tune a PID controller
- Effect of dead time on loop performance
- Effect of valve behavior on loop performance
- Apply a tuning technique
- Apply an automatic tuner
- Tune a cascade loop

Additional Training

To increase your knowledge and skills, there are additional courses available from Automation College.

For more information and registration, visit www.automationcollege.com.