Advanced Process Control Applications

Developing optimum tuning for PID controllers requires an understanding of both the system dynamics and the process objectives. This is a straight-forward and inexpensive first step in process optimization. Optimum tuning *does not mean* that the controller will be effective at responding to all disturbances. An important insight is that the PID control performance is largely dictated by the process dynamics. Control loops with slow dynamics will usually require slow tuning. Attempting to speed up the PID controller beyond the inherent loop dynamics usually ends up increasing process variability. If the process dynamics are highly non-linear even more conservative tuning will be necessary – further limiting the overall performance.

For important control loops, if the process objectives cannot be achieved with a simple PID controller, a more sophisticated strategy needs to be considered. Cascade, ratio, feed-forward and decoupling strategies can often deliver the required performance improvement. The focus of this 4 day advanced process control course is on recognizing opportunities for advanced strategies and successful implementation. Approximately 50% of the course is devoted to a series of simulation labs that illustrate the concepts presented in the lectures.

Day 1

8:00 – 12:00 **Review**
Lambda tuning, PID control performance
Time series analysis, characterizing variability
Techniques to calculate the cost of variability
Control Strategy Design – General concepts

1:00 – 4:30 **Cascade Control**
Concepts / Applications
Detailed design, avoiding pitfalls
Seminar - Mill examples
Lab – Implementing a Cascade Strategy

Day 2

8:00 – 12:00 **Feedforward Control**
Concepts / Applications
Detailed design, avoiding pitfalls
Seminar - Mill examples
Lab - Tuning the Feedforward controller / investigating the impact of non-linear dynamics

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1:00 – 4:30	**Setpoint Feedforward** Concepts / Applications **Ratio Control** Concepts / Applications Detailed design, avoiding pitfalls Seminar - Mill examples **Lab** – Investigating ratio control strategy options

Day 3

8:00 – 10:00	**Loop Interaction / Decoupling** Concepts / Applications Detailed design, avoiding pitfalls Seminar - Mill examples
10:00-12:00	**Deadtime compensators** Applications / Benefits **Lab** – Tuning a Smith Predictor / Impact of model errors
1:00 – 4:30	**Extending the Control Range** Concepts – Split Ranging, Mid Ranging, Override control Detailed design, avoiding pitfalls Seminar - Mill examples **Lab** – Split Range Controller design

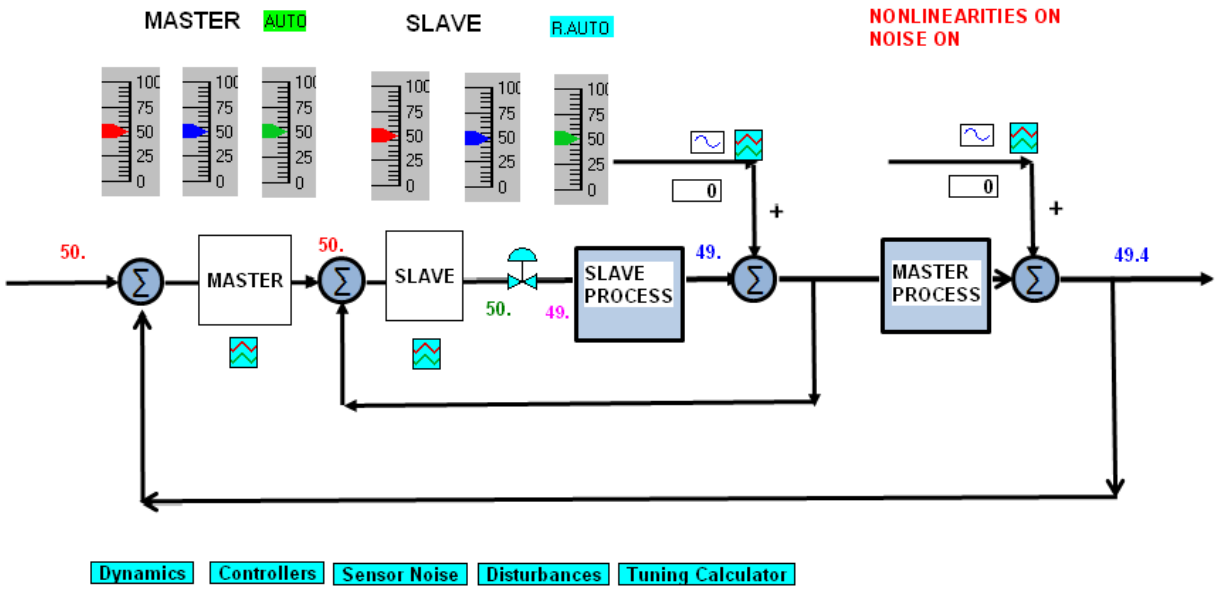
Day 4

8:00 – 10:00	**Dealing with Non-linearity** Process / Output Characterization, Adaptive Tuning Detailed design **Lab** – pH control
10:00 – 12:00	**Multi-Variable Controllers** Concepts / Applications
2:00 - 3:00	Troubleshooting advanced control strategies **Lab – Advanced problem sets**
3:00 – 4:00	Wrap Up / Discussion

Lab Description

A series of control strategy design simulations are used for the course labs. The control strategies are configurable, allowing exploration of design and tuning options. In each lab load disturbances can be injected into the system, allowing the student to evaluate the regulatory capability of the advanced strategy. The impact of non-linearities on the performance of the advanced control strategy will be evaluated.

ProNamics Cascade Control Simulator



ProNamics Feedforward Controller Lab