PRACTICAL
ADVANCED PROCESS CONTROL
FOR ENGINEERS AND TECHNICIANS

YOU WILL LEARN HOW TO:

- Understand the essentials of Advanced Process Control (APC)
- Grasp the key differences between the various technologies
- Perform simple APC design strategies and implementations
- Be able to perform PID control
- Troubleshoot simple APC problems
- Identify processes suited to APC

WHO SHOULD ATTEND:

- Instrumentation and Control Engineers
- Process Control Engineers
- Senior Technicians
- Automation Engineers
- System Integrators
- Electrical Engineers
- Chemical Engineers
- Chemical Plant Technologists
- Process Engineers

Petra Training Group

The Workshop

In today's environment, the processing, refining and petrochemical business is becoming more and more competitive and every plant manager is looking for the best quality products at minimum operating and investment costs. The traditional PID loop is used frequently for much of the process control requirements of a typical plant. However there are many drawbacks in using these, including excessive dead time which can make the PID loop very difficult (or indeed impossible) to apply.

Advanced Process Control (APC) is thus essential today in the modern plant. Small differences in process parameters can have large effects on profitability; get it right and profits continue to grow; get it wrong and there are major losses. Many applications of APC have pay back times well below one year. APC does require a detailed knowledge of the plant to design a working system and continual follow up along the life of the plant to ensure it is working optimally. Considerable attention also needs to be given to the interface to the operators to ensure that they can apply these new technologies effectively as well.

Practical Sessions

This is a practical, hands-on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

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The Program

JUSTIFICATION OF ADVANCED CONTROL

- Advanced vs classical control
- Advanced on-line control vs statistical process control
- Comparison of pay back time on real examples

Practical Exercise

FUNDAMENTALS OF PROCESS CONTROL

- Processes, controllers and tuning
- PID Controllers - P, I and D modes of operation
- Load disturbances and offset
- Speed, stability and robustness
- Gain, dead time and time constants
- Process noise and feedback controllers

Practical Exercise

FUNDAMENTALS OF TUNING PID LOOPS

- Open and closed loop tuning
- Ziegler Nichols
- Fine tuning for different process types
- Lambda tuning
- Ten different rules compared
- Cascade systems
- Feedforward control and dead time
- Models and disturbances

Practical Exercise

INTERNAL MODEL CONTROL (IMC)

- Open loop model in parallel with the process
- Control system in two blocks
- Equivalence with a classical controller
- Disturbances rejection and control
- IMC and delays and feed forward

Practical Exercise

MODEL PREDICTIVE CONTROL (MPC)

- Single input/output vs multivariable control
- Example on a binary column causality graph
- Constraints and planning ahead
- Different models

Practical Exercise

MPC: MODEL REPRESENTATIONS

- State space and transfer function representation
- Impulse response representation

Practical Exercise

MPC: MODEL IDENTIFICATION

- Identification - what and how?
- Black and grey box models
- Causality graph of the unit

Practical Exercise

MPC: OBSERVERS

- Overall formulation and purpose
- Study of Kalman algorithm

Practical Exercise

MPC: CONTROL

- Overall formulation
- Hard constraints on manipulated variables
- Set values and soft constraints on control variables
- The notion of horizon

Practical Exercise

REFERENCE MODELS

- Handling setpoints on controlled variables
- Measured and unmeasured disturbances rejection
- Handling soft constraints on controlled variables
- Rejection of disturbances

Practical Exercise

CONTROL FORMULATION PROBLEM

- Quadratic criterion vs geometric control
- Importance of the horizon length
- Use of the weight matrix
- Handling output constraints along the horizon
- Projection of measured and unmeasured disturbances along the horizon
- Final quadratic problem formulation and resolution
- Off-line pre-processing
- On-line calculations

Practical Exercise

MPC STEADY STATE OPTIMISATION

- Degrees of freedom and rationale for optimisation
- Economic output submitted to setpoint
- Slogans to maximise or minimise
- Bridge from optimisation to control
- Reachable targets for economic variables
- Interpretation of the horizon for economic variables
- Change of the control formulation problem

Practical Exercise

APPLICATION OF THE THEORY TO THE CONTROL OF TWO DIFFERENT UNITS ON A PROCESS SIMULATOR

- Complete application (identification, controller design, control and optimisation)

Practical Exercise