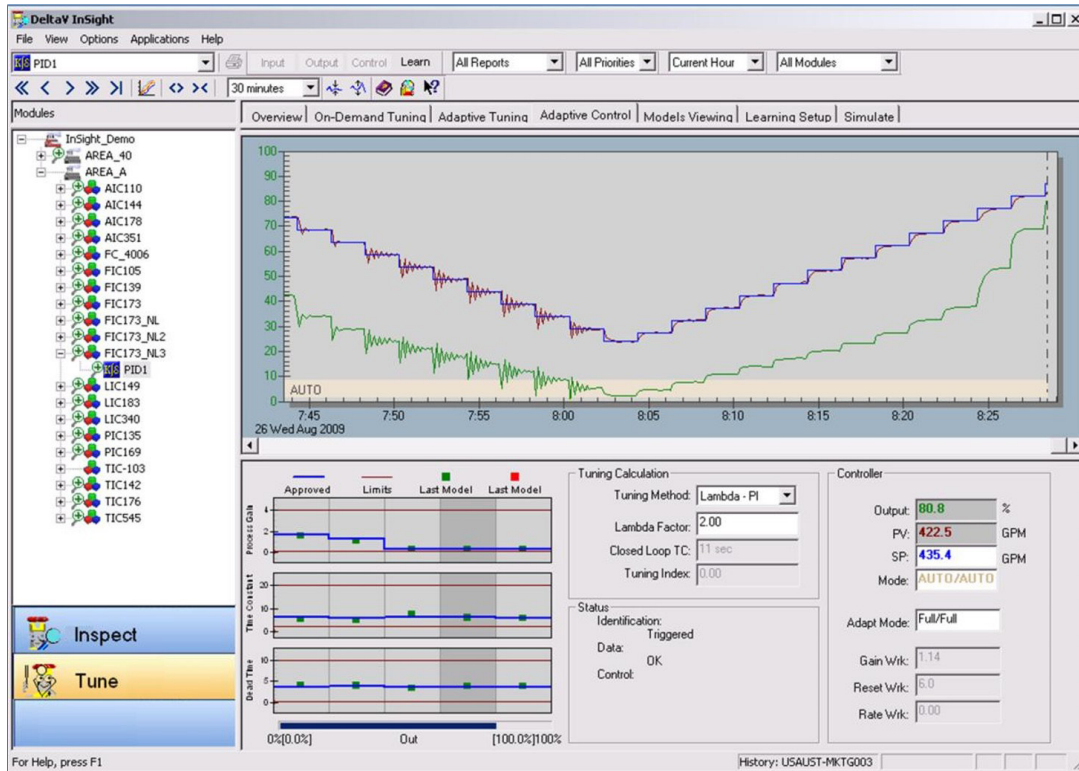# DeltaV™ Adapt
Continuous Closed Loop Adaptive Control

DeltaV™ Adapt provides continuous adaptive control for any DeltaV PID control loop.

- Better control for non-linear processes

- Adaptive tuning with no process disruption

- Fast response to changing conditions

- Easy to use with any PID control loop

Introduction

One day the control works great; the next day (or night) you receive a phone call about a critical loop that has gone unstable. Unfortunately, most control engineers have experienced non-linear processes that cause problems for traditional PID control. With DeltaV™ Adapt, you may never have to re-tune that problem loop again.

All process variables and control valves are non-linear to some degree. Many non-linearities are inherent in the process; resulting from changing product specifications, production rates, or other operating conditions. As a result, many loops have to be detuned (backed off from maximum performance) to provide stable control during all process conditions.

DeltaV Adapt continuously adjusts PID tuning for optimal control as process conditions change. In addition to calculating new tuning, DeltaV Adapt also remembers the best tuning from the last time it was controlling in the same operating region. And best of all, DeltaV Adapt can be applied to any PID loop in the control system – without control configuration changes.

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DeltaV Adapt is available as an add-on product for DeltaV InSight, a control performance monitoring and tuning product. DeltaV InSight includes embedded process learning to calculate process models without disruptive plant tests. With DeltaV Adapt, you can now use these process models for continuous closed loop adaptive control for any PID function block.

Benefits

Better control for non-linear processes. Properly tuned loops can decrease process variability and increase profits through improved product quality, throughput, and equipment availability. DeltaV Adapt continuously updates tuning parameters for any PID loop for optimal control of non-linear or changing process conditions.

Adaptive tuning with no process disruption. DeltaV Adapt provides optimal tuning based on past changes the operator makes during normal day-to-day operations. No additional plant tests are required.

Fast response to changing process conditions. DeltaV Adapt will quickly adjust tuning for different operating conditions because it remembers the best tuning for each region of operation. Most adaptive controllers have to relearn the process when operating conditions change, even when they've seen similar conditions many times before.

Easy to use with any PID control loop. DeltaV Adapt is embedded in the DeltaV control system to improve both ease-of-use and calculation performance. It's easy to use because there is NO additional software to install, NO additional configuration required, NO data integration, and NO new databases or user workstations. Adapt software comes pre-installed on every DeltaV system, uses the standard DeltaV configuration and process historian database, and runs in existing workstation and controller nodes. DeltaV Adapt also runs with existing PID controllers, which means no configuration changes or module downloads are required to implement adaptive control.

Product Description

Adapt provides closed loop adaptive control for DeltaV resident PID function blocks, and is available as an add-on to DeltaV InSight, a control performance monitoring and loop tuning product. (See DeltaV InSight product data sheet for more information.)

DeltaV Adapt incorporates a new and enhanced model-based approach to on-line adaptive control; utilizing DeltaV's embedded process learning which identifies process models from normal day-to-day operation.

DeltaV Adapt uses these process models to calculate optimal tuning, and remembers the best tuning for different regions of operation. This model-based approach provides fast adaptation during changing conditions, and provides users with familiar tuning rules for defining desired control performance. And best of all, the embedded process learning and adaptive control can be implemented on any DeltaV resident PID block without control configuration changes.

Embedded Process Learning

DeltaV uses learning algorithms embedded in the controller to calculate process models and diagnostics for every control loop in the system. DeltaV calculates process models based on process changes made by the operator or automated procedures such as batch control sequences. Whenever there is a change in the setpoint (or output when controller is in manual), DeltaV captures the process input and output data and performs an efficient calculation to identify process dynamics. These process models are stored in a database for engineers to evaluate and analyze for potential process non-linearities. These process models also provide the basis for DeltaV adaptive control.

Process learning is easily enabled from DeltaV Explorer or DeltaV InSight for individual control modules or entire controller nodes. No control configuration changes or module downloads are required to enable process learning.

Model Analysis

A model analysis display in DeltaV InSight enables control engineers to inspect the process models calculated for each control loop. Using this tool, an engineer can evaluate performance over time and identify potential process non-linearities and degradations caused by such factors as fouling of catalysts, heat transfer surfaces, and sensors. The model analysis includes X-Y plots of the model parameters vs. time, quality, PV, OUT, or other process variables. The models are also easily copied and pasted into Microsoft Excel for additional data analysis.
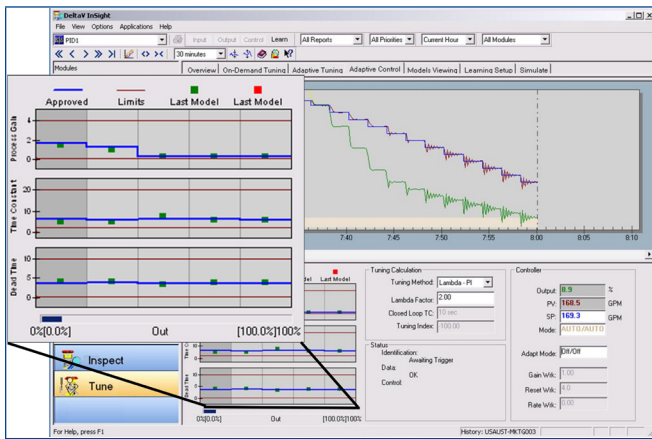
Identify tuning in up to 5 regions of operation.

For adaptive control, models may be grouped into five different operating regions. These regions can be defined by OUT or PV range, or from other process variables in the system. From the model analysis display, a control engineer can easily plot models, define region boundaries, approve models for each region, and set limits to constrain the model identification and tuning parameters.

Adaptive Tuning

DeltaV adaptive tuning is available for all PID blocks that have embedded process learning enabled. Each time a new model is identified; adaptive tuning provides optimal tuning parameters based on the desired tuning criteria. Before these new models are used for tuning, they are validated using identification quality metrics that take into account factors such as signal/noise ratio, model error, convergence, and variability. Tuning parameters are automatically calculated for validated models based on Lambda or IMC tuning rules. A tuning index

provides the predicted % change in variability for the new tuning parameters and is used to indicate when a loop should be retuned. These adaptive tuning calculations are used for both advisory tuning recommendations and for closed loop adaptive control.

For maximum flexibility, DeltaV Adapt enables PID blocks to operate in one of three adaptive control modes:

- Full Adaptive Mode – Continuously adjusts tuning parameters based on the last good model calculated for each operating region.

- Partial Adaptive Mode – Adjusts tuning parameters only when operating regions change, and only using process models that have been approved for each region.

- Learn Only Mode – Process learning and adaptive tuning recommendations are calculated for each operating region but no tuning parameter changes are written to the on-line PID block.

Improvements in Reliability and Robustness

Emerson's approach to adaptive control provides several key advantages which improve reliability and robustness.

- Diagnostics from smart devices are utilized so that no process models or tuning parameters will be calculated using faulty devices.

- Process models and tuning are only calculated from known trigger events; that is, setpoint changes or output changes when loop is in Manual mode. DeltaV adaptive control does not rely on pattern recognition, and will not induce oscillations to help learn process dynamics.

- Model identification is based on an iterative search algorithm that starts with the last good model and imposes limits on how much the model can change per trigger event. New models are not based on a single set of process data which may result in erroneous results. Furthermore, model quality is calculated using a number of factors including signal- to-noise ratio, quality of fit, convergence of search, and variability of prior model calculations. Only high- quality models are utilized for adaptive control.

- Tuning calculations are predictable based on process models using well know tuning rules.

Licensing

DeltaV Adapt is licensed per PID block. Adapt licenses for PID blocks may be ordered, assigned to the ProPlus workstation and accumulated in the DeltaV system database. This total number of Adapt licenses is then decremented whenever you assign an Adapt license to a PID function block. The licenses may be assigned to any PID block within the DeltaV system. Adapt licenses are sold in quantities of 1, 10, and 100 as described below.

Ordering Information (Perpetual License - v14 and Earlier Systems or Systems with Existing Perpetual Licenses)

Description	Model Number
DeltaV Adapt for 1 function block	VE3155F0001
DeltaV Adapt for 10 function blocks	VE3155F0010
DeltaV Adapt for 100 function blocks	VE3155F0100

Ordering Information (Subscription License - DeltaV v15.LTS and Later Systems)

Description	Model Number
DeltaV Adapt Subscription License; xxx Function Block(s)	VE3155SwS0xxx_YyFYzz

The model numbers above are for initial subscription term lengths only; renewal model numbers are available with a "-R" at the end of the model number string

*w represents the length of the subscription term in years (1, 3, or 5).

*xxx represents the license capacity (001, 010, or 100 Adapt Function Blocks).

*y represents the specific year of the subscription term (1, 2, 3, 4, or 5).

*zz represents a two-digit indicator of the year of purchase (e.g. 23).

Related Products

- **DeltaV InSight**. Control performance monitoring and loop tuning application embedded in DeltaV. Identifies control problems and improves control performance with automatic process learning, loop diagnostics, on-demand and adaptive tuning, and automatic report generation.

Prerequisites

- DeltaV InSight is a required prerequisite for DeltaV Adapt. DeltaV InSight is licensed for system-wide unlimited client connections. A full InSight license is required (VE9140Sxxxxx). InSight Basic (VE2134BASIC) is not adequate for use with DeltaV Adapt. See DeltaV InSight product data sheet for ordering information.

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