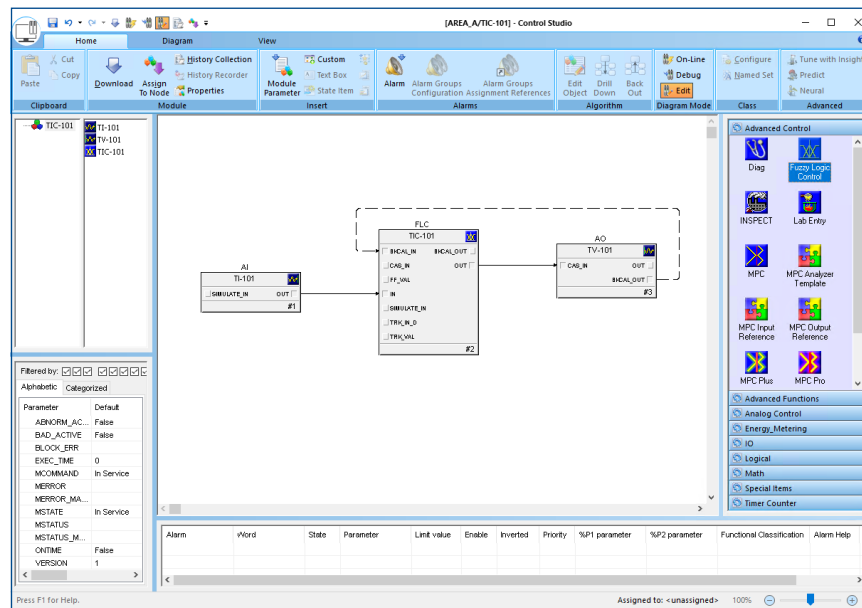# DeltaV™ Fuzzy

Fuzzy logic outperforms PID control of non-linear and noisy process loops.

- Beats traditional PID for tolerating noisy signals and non-linear process response

- Surpasses PID control for both setpoint and load changes

- Offers PID ease of use and configuration

- Easily tuned with DeltaV™ InSight

Introduction

The DeltaV™ Fuzzy function block offers a practical, field-proven substitute for PID control. The patented algorithm provides faster, tighter response and superior performance over traditional PID control on most loops. It is even capable of handling loops where manual control was once the only option.

In particular, process loops that can benefit from a non-linear control response are excellent candidates for fuzzy control. Since fuzzy logic provides fast response times with virtually no overshoot, it is excellent for loops that experience frequent setpoint changes or load disturbances. In addition, loops with noisy process signals have better stability and tighter control when fuzzy logic control is applied.

With DeltaV InSight software, you can easily tune DeltaV Fuzzy function blocks, for improved process quality, throughput, and efficiency.

Benefits

Beats PID for tolerating noisy signals and non-linear process response. Until now, the only way to manage noisy process signals was to filter out the noise resulting in sluggish control. The non-linear response curve makes fuzzy logic capable of handling noisy signals while maintaining stable responsive control. It even minimizes overshoot at the same time.

The fuzzy logic control function blocks supplied with DeltaV Fuzzy can improve performance on a wide range of process loops, even those difficult-to-control loops that require a non-linear control response curve. Fuzzy control handles them with ease.

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Surpasses PID control for both setpoint and load changes. Fuzzy logic recovers faster from error between setpoint and the process variable than even aggressively tuned PID loops. Since it returns the process to setpoint faster and with little-to-no overshoot, fuzzy control is excellent for loops where the setpoint changes often or for loops that experience frequent process load disturbance. Temperature and composition loops where overshoot can ruin the product also benefit from fuzzy logic control's response curve.

Offers PID ease of use and configuration. You don't have to learn how to adjust the "fuzzy rules". This is the big difference between DeltaV Fuzzy and traditional fuzzy loops. The DeltaV fuzzy logic control function block uses three easy-to-understand scaling factors, and the algorithm manages all the rules implementation for you.

Easily tuned with DeltaV InSight. In addition, unlike traditional fuzzy controllers, the DeltaV fuzzy logic control blocks can be tuned using DeltaV InSight. All this makes implementing and maintaining fuzzy logic control loops very easy, even for the first-time user.

Product Description

Until today, the PID controller has been the workhorse of the process industry. It is robust and easy to implement. Now, there is the DeltaV fuzzy logic control function block. DeltaV Fuzzy control is just as robust and easy to implement, and it surpasses PID performance.

Fuzzy logic control loops are as easy to implement and tune as PID, but you get better control response than aggressively tuned and over-damped PID loops. Fuzzy logic provides no overshoot like an over-damped PID loop, but it simultaneously responds faster than an aggressively tuned PID loop. You get the advantages of both.

Tests on DeltaV Fuzzy have shown loop performance improvement of 30-40% over traditional PID. These improvements come from large reductions in overshoot and decreased settling or response time. You don't need to understand fuzzy logic rules to utilize DeltaV Fuzzy. You simply configure scaling factors, similar to proportional, integral, and derivative factors on a traditional PID loop, and the rules are set automatically in the controller. Furthermore, the optional DeltaV InSight product is capable of tuning fuzzy loops by adjusting these scaling factors.

Fuzzy logic takes more aggressive control action on large control errors (PV not equal to SP) than small ones. It also takes aggressive action to eliminate oscillatory behavior.

This is accomplished by balancing high gain response on large errors with strong damping when the loop becomes oscillatory: the result—tighter, more precise control. The figures below compare the fuzzy logic response curve to PID control with various tuning settings. A first-order process model with dead time was used to compare fuzzy logic control performance to traditional PID control.

The following figure shows the response curve for a PID loop tuned for aggressive response. This almost always results in significant overshoot. The fuzzy logic response was equally aggressive but did not overshoot.
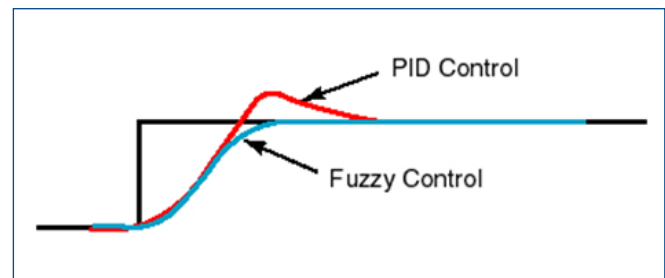
PID tuned with overshoot allowed.

In the next figure, the PID loop was tuned for no overshoot. The resulting slower response is far less effective than the fuzzy logic loop.
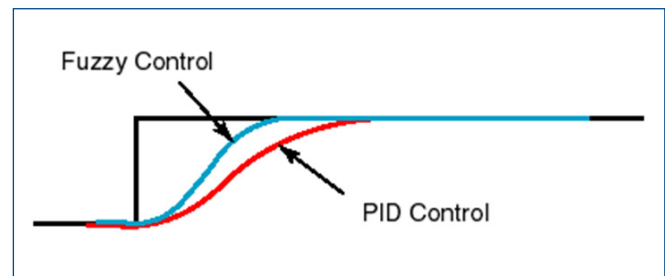
PID tuned for no overshoot.

To overcome the challenge of fuzzy rule determination (tuning), DeltaV Fuzzy function blocks are designed to work in conjunction with DeltaV InSight. Sold separately, it guides you through the tuning procedure.

During tuning, a patented relay oscillation technology is used by the fuzzy function blocks to identify the process dynamics. DeltaV InSight then recommends scaling factors to optimize the fuzzy loop.

Use of DeltaV Fuzzy function blocks is available on any DeltaV system with a Control license.

Ordering Information

Description	Model Number
DeltaV Fuzzy	Included with Control license

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 or DeltaV InSight Basic.** Required for automatic tuning of fuzzy logic control blocks starting with v9.3.

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