Top 3 Misconceptions of Manual PID Controller Tuning

When the PID controller was first introduced manual tuning was the only game in town. As tuning software entered the market it consistently failed to address common challenges associated with industrial control. Those lapses provided the rational for a generation of practitioners to continue tuning PID loops by manual methods. Recent innovations now make software the clear and superior option. But benefitting from tuning software requires practitioners to move beyond those historical misconceptions.
**REJECTED:**

Top 3 Misperceptions of Manual PID Controller Tuning

**Steady the process.** Easier said than done, but it can be settled for the most part by limiting variability of other interacting control loops. **Bump the process.** Noise in the process makes it difficult to determine how big a step is really needed. Assuming there are no safety constraints it’s often better to err on the side of a larger CO change. **Model the dynamics.** Estimating process parameters is more often guesswork than math since details in the trended data are rarely obvious. **Compute tuning parameters.** Converting values to tunings isn’t ideal. The correlation math is advanced and setting the controller’s responsiveness is as much a guess as each of the previous steps. **Test and repeat.** When tuning a single controller involves multiple tests like this, there’s got to be a better way.

The PID controller was first introduced to industrial manufacturing by the Taylor Instrument Co in 1940. At the time manual tuning was the only game in town. Early iterations of the controller were pneumatic and they were adjusted more often than not with the turn of a screwdriver. As can be imaged, such a process would be inexact and limit the ability of practitioners to maintain effective control.

In 1959 Bailey Meter Co. introduced the first solid-state electronic PID controller — one that supported the direct input of numeric values. Process data became available to practitioners in the form of graphic trends from strip chart recorders. The paper-based output simplified the analysis of data associated with manual bump tests. As the PID controller established itself in industrial applications an array of methods for performing such step tests, modeling the dynamics, and calculating controller tuning parameters became established. Even so, approaches for computing tuning parameters such as the Zeigler-Nichols method involved complex mathematics and made little sense to the average practitioner.

PID controller tuning software first became available with the advent of the computer. Software promised a simpler procedure and optimized controller performance through improved modeling of the associated process dynamics. In practice, however, controller tuning software failed to deliver on its promise due to an inability to accurately model noisy, oscillatory process data. Even today many practitioners remain skeptical of tuning software. How can they be blamed? Manual tuning is free and it’s been proven effective even when a screwdriver was involved. Besides, software can’t do any better.

Only there truly is a cost involved with manual tuning. What’s more, innovations in process modeling make software the superior option for tuning complex industrial PID control loops and optimizing plant performance.
The top three (3) reasons offered by practitioners who choose to manually tune their facility’s PID controllers are largely based on long-standing misconceptions. Many of these views have unfortunately been perpetuated through word of mouth and the trade press. As economic drivers force process manufacturers to improve production control and optimize throughput by all means necessary, however, it is worth reconsidering the benefits that PID tuning software now afford.

Following are the top reasons for manual tuning along with a contrarian viewpoint:

**Reason #1: I’ve been doing it this way forever**

Manual controller tuning is no longer consistent with the demands of today’s ultra-competitive and highly automated environment. As a method, manual tuning is widely referred to as “poke and hope” for good reason. At its core manual tuning is a trial and error approach that regularly involves unnecessary guesswork and needless repetition to achieve only moderate improvements in control of complex production control loops. Here’s why a new approach is needed:

- Oscillations hamper the ability to achieve steady-state
- Noise obscures relevant details in graphically trended data
- Correlations offer limited options for loop responsiveness
- Use of default PID settings/random values remains common
- Veteran staff retiring, younger staff lack experience/intuition

**Reason #2: I’m saving money by not buying software**

As the expression goes: Nothing is free. That is especially true in the realm of process manufacturing as everything has a cost. Each bump test negatively impacts production. In order to manually test and model a process’ dynamics it’s often necessary to move it away from Set Point numerous times while simultaneously keeping other, interacting loops unnaturally steady. Those ‘savings’ are actually costing you dearly:

- Numerous tests required to fine tune a loop’s performance
- Each test consumes costly inputs, impacts production output
- Prolonged use of limited and valuable human capital
- Manual correlation calculations and adjustments prone to error
- Inability to simulate loop response and optimize performance

**Reason #3: Software can’t do any better anyway**

Software has come a long way particularly since 2009 when innovations in process modeling eliminated the steady-state testing requirement. Unlike the manual approach, select software solutions equipped with non-steady-state modeling can now accommodate variability that is typical in industrial process data. Advanced features – both graphic and numeric – simulate performance and equip users with valuable insight that limits the need for additional testing. Software actually can do better – much better:

- Supports open-/closed-loop data, integrating/non-integrating processes
- Accurately models dynamics of noisy, oscillatory processes
- Graphically simulates the responsiveness of all PID forms
- Statistics reveal performance characteristics prior to implementation
- More robust tunings for controlling a wider range of dynamics
Success Story: Misconceptions Fall in the Face of Financial Benefits

Bigelow-Liptak has been supplying world-class engineering, equipment and materials for high temperature processes since the 1950s. Just like their customers, Bigelow-Liptak understands that time is money and lengthy commissioning comes with a clear cost to the company’s bottom-line.

Commissioning temperature-based control systems can be difficult and time-intensive as the dynamics are typically slow and often involve extensive Dead-Time. Bigelow-Liptak’s more complex batch processes had a history of taking many days - sometimes weeks – to commission and optimize tuning parameters for a single controller. When presented with a project in central China, the company sought to control the time and cost of tuning each of the system’s PIDs.

Manual PID Controller Tuning Challenges:

The challenges of tuning PID control loops manually are squarely rooted in economics and they can be summarized as follows:

- Time Involved with Performing Each Bump Test
- Cost of Staff Involved in Commissioning Projects
- Complexities of Multi-Zone, Interacting Systems
- Negative Impact of Trial-and-Error Loop Tuning
- Valuable Production Inputs, Environmental Liability

Commissioning time allocated to tuning the system’s interacting PID controllers was a significant concern for the project team. The process was known to be exceptionally slow, requiring a minimum of 24 hours to set-up, initiate and complete a modest 20 degree bump test. The multi-zone, cascading process architecture presented challenges in terms of establishing accurate models of the system’s dynamics and of assigning tuning parameters that would deliver effective control to the customer. In particular the degree of acceptable overshoot for the process material was less than 4 degrees Celsius. Any appreciable overshoot beyond tolerance levels would lead to the use of additional and costly catalyst. In the event that a batch was completely rejected a more severe situation would result as its contents would become an environmental liability for the customer.

“Optimizing controller performance was a breeze with LOOP-PRO. A single bump test was all that we needed to accurately model the complex dynamics of each control loop. The software’s graphics made it easy to finely tune parameters for optimal responsiveness and control. It easily reduced the time we budgeted for tuning by over 80%. It’s a truly remarkable product.”

Engineer Manager

LOOP-PRO™ is the only PID controller tuning software that accurately models oscillatory and noisy data associated with the full range of industrial control loops. Using the software the Bigelow-Liptak engineering team was able to model and tune PID controllers with a single bump test, essentially eliminating days of commissioning with each loop. The software’s graphic tools empowered the engineers to tailor loops easily for appropriate responsiveness and optimal control. Payback for the software came in just three (3) days, and the project was both a technical and a financial success.

Contact Us Today and Learn About Our Industrial Grade Controller Tuning Solutions

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