

PID Control: May It Rest in Peace

Technology is obsolete in the age of digital networks

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PID (proportional + integral + derivative) control has been the foundation of building control for several generations, but with the emergence of digital networks, the drawbacks of PID control are becoming more apparent, especially as our industry becomes more concerned with energy efficiency.

PID control has persisted as long as it has largely because of a lack of competition (i.e., an alternative that can be universally applied when modulating control is required). That is changing, however, with the recent development of methods of control that take advantage of network integration to improve performance and efficiency. The time has come, then, to bid farewell to PID and focus on new, more-efficient means of control.

DRAWBACKS OF PID CONTROL

PID control's most serious drawback is inefficient operation. Application rules dictate that for effective PID operation, valves and dampers must be undersized so that a substantial pressure drop occurs across them under all operating conditions. When applied to chilled- or heating-water distribution systems, this recommended valve pressure drop can be as much as double the pumping power required. This loss is magnified because PID control moves variable-speed pumps and fans away from their "natural

curves" (the curve of the pump's or fan's highest efficiency at various speeds), thus reducing operating efficiency while adding substantially higher operating-pressure requirements. As much as three-fourths of annual power consumption in some distribution systems can be attributed solely to PID-control losses.

The problems of PID control do not end with inefficient operation:

- Because PID loops operate in isolation from each other, they cannot assure that all loads will be satisfied at any given time.

- PID control can be costly to implement and support. The goal for any distribution system employing PID control is to have the pressure differential across supply and return headers at each load be constant as flow in the system changes. To accomplish this, designers often oversize distribution mains or employ reverse return-piping configurations. These pressure-leveling techniques add costs.

- PID control is a headache for operations staffs because to operate effectively, it requires frequent valve- and damper-position readjustment (1- to 5-sec reposition intervals often are recommended). This nearly continuous repositioning shortens actuator life, adds to maintenance costs, and makes control stability an ongoing issue.

"INTERDEPENDENT" NETWORK CONTROL

All of these problems can be mitigated or eliminated by replacing "independent" PID control with "interdependent" network control.

Historically, PID control loops have operated independently of other equipment to maintain a stable pressure or temperature condition that is employed for control by the next system down the line. Network-enabled interdependent control combines these subsystems and operates them as a single system. In addition to automatically optimizing operation, effective network control avoids the costly and energy-wasting decoupling required for local PID control.

The integrated network control of

HVAC systems is not unlike the control approach employed in the information-technology (IT) world to manage Internet services in an office network. Think of the loads in a distribution system as clients and the pump or fan as a server interconnected through a network. The direct-digital-control system acts as a resource manager, processing client requests and directing the server accordingly. Each load is satisfied while resource expense is minimized.

There are several important advantages of applying IT resource-management strategies for HVAC systems. Among them are lower costs, simpler configurations, more-efficient and effective operation, reduced maintenance, and greater long-term stability and reliability. In implementing these strategies as a replacement for PID control in a distribution system, the pressure/temperature-setpoint control of subsystems is replaced with energy-optimized control based on the Equal Marginal Performance Principle (see the author's feature article "Ultra-Efficient Cooling With Demand-Based Control," December 2001).

Designers understand that the purpose of an HVAC system is not to maintain distribution pressures or temperatures, but to keep all of the people in a building comfortable as efficiently as possible. A network control system designed to connect every occupied zone directly to comfort-resource systems can do a far better job of maintaining comfortable conditions in all zones with less energy than can a system in which these components are isolated and operated independently. Achieving such a system, however, requires a significant change in operating strategies.

In August, Thomas Hartman, PE, will outline some demand-based-control operating strategies and provide some tips for setting up effective network controls for typical distribution systems.

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