Addressing control using wireless transmitters

The slow sample rate and delay that are characteristics of wireless measurement present new technical challenges in implementing control in some applications. A new approach is required to achieve effective control using a wireless measurement. *Terry Blevins* explains.

Many of the control techniques and guidelines established during the development of single loop digital controllers in the mid 1970s are based on providing a capability that mimics an electronic analogue controller. Guidelines established for setting the control execution period were designed to ensure that the control response and behaviour duplicated those provided by an analogue controller. To minimise any delay introduced into the control loop by I/O access, the field measurements were highly oversampled in the controller. With the introduction of battery powered wireless transmitters, such update rates are impractical.

The underlying intellectual property of the PIDPlus algorithm has been donated to the FieldComm Group to help advance the capability of WirelessHART.

When a wireless measurement transmitter is used in a control application, the battery in the wireless transmitter would be quickly depleted if the update rate were based on the same oversampling used by a distributed control system (DCS). The impact that communication update rate has on battery life is shown in Figure 1 for different types of wireless measurement transmitters.

To achieve a battery life in the range of between five and seven years the wireless transmitter communication update rate needs to be configured to transmit a new measurement value every eight seconds or slower.

So, it is necessary to re-examine how control should be structured for use with wireless measurements. A new approach, known as PIDPlus, makes it possible to control using wireless measurements while delivering control performance that is comparable to that achieved using traditional wired transmitters and wired final control elements. The modifications in PID introduced by PIDPlus are designed to address loss of communication and enable control using slow measurement updates, non-periodic measurement updates.

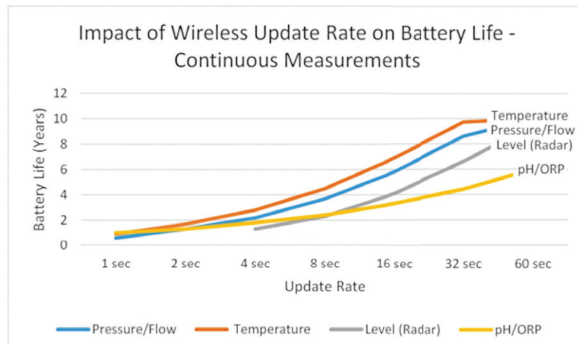

Figure 1: Impact of update rate on battery life

PIDPlus for wireless control

Within the process industry the PID design is based on the assumption that a new measurement value is available with each execution and that the PID control is executed on a periodic basis. When the measurement is not updated as fast as the PID execution rate then the calculated reset action may not be appropriate. To provide the best control using slow non-periodic measurement updates, the PID may be restructured to reflect the expected process response since the last measurement update as the reset contribution. When the reset contribution of the PID is implemented using positive feedback network the modifications required for PIDPlus behaviour are illustrated in Figure 2.

When structured in this manner the reset calculation automatically compensates for setpoint changes that are made between measurement updates or changes in output introduced by feedforward action.

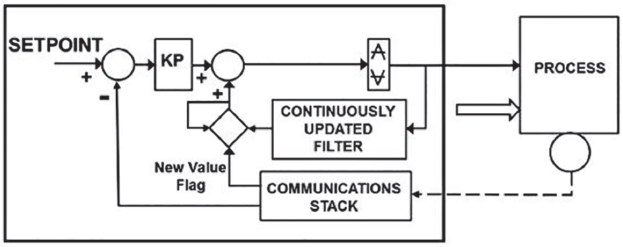

Figure 2: PIDPlus implementation for PI control.

For those processes that require derivative action, the derivative contribution should be recomputed and updated only when a new measurement is received. The elapsed time since the last new measurement was communicated is used in the derivative calculation.

In an application where PIDPlus is used in wireless control, the control execution rate is set much faster than the wireless measurement update rate. The PIDPlus tuning is based strictly on the process dynamics. No change in PID tuning is required for slow or varying update rates or for variations in measurement communications.

Wireless control performance

Extensive testing of wireless control using PIDPlus has been conducted and in these tests, closed loop flow control was evaluated using both wireless and wired flow measurement The primary objective of these tests was to measure and quantify the deviation of the control parameter from setpoint as a measure of control performance. The response to setpoint changes using a wired valve and wireless transmitter with communication update rate set to eight seconds is shown in Figure 3.

A similar well-behaved control response was observed when an unmeasured disturbance was introduced into the flow process.

The underlying intellectual property of the PIDPlus algorithm was donated to the FieldComm Group late in 2014 to provide another step to help advance the capability of *Wireless*HART toward reliable real-time control.

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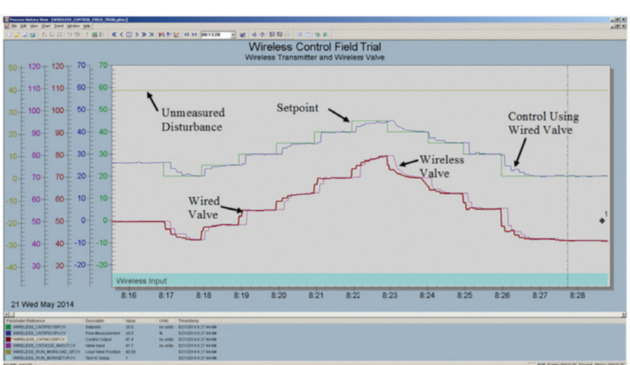

Figure 3: Setpoint change response, wireless transmitter and wired valve.

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