When tuning strategies reach their limits

New tool provides stable control – also under unfavourable conditions

First published in fluid, Germany, 4-2004, pages 52-53
(Translation of the text by PMA)

Symbolic representation of the self-tuning tool "PMATune" for all PMA controllers with front interface port.

Photo: Courtesy of PMA

Originally developed at the Technical University of Pilsen in West Bohemia, the self-tuning procedure was adapted exclusively by PMA in Kassel, Germany, for its controller range. The main advantages: On-site savings in time and costs during commissioning.

A nightmare situation for control engineers: The plant is ready to go, and during commissioning it turns out that: The sensors have been installed in an unfavourable position – the delay times are much longer than expected – the process does not line out using the classical PID optimization method – there is no short-term solution without enormous costs – constructional changes are out of the question.

"But now", claims the measurement & control company PMA, "there is an alternative that can even be applied by persons without years of experience." Its name is PMATune.

According to PMA, the procedure is as simple as this: Connect a laptop to the front port of the PMA controller, get the process into a stable condition (manual operation), and start the self-tuning function.

Starting with the loop identification phase through to the determination of optimum control parameters, the software package ensures secure and reliable control: Without overshoot or hunting of the process variable – stable line-out at the setpoint.

No overshoot, no oscillation

To put it more precisely: For process loops up to the 3rd order, PMA's established automatic self-tuning procedures are unbeatable. Previously however, loops with a ratio <10 between dead time and recovery time (Tg/Tu) were considered as difficult to control, and a ratio <3 was deemed uncontrollable.

These conditions are encountered mainly in higher-order (above 3rd order) control loops, and in loops with dominant dead time, as found in thermal processes, furnaces, casting plants, pressure and flow control loops, etc.

The associated control problems cannot be solved with conventional proprietary algorithms or classical tuning methods derived from textbooks (Ziegler/Nichols or Chien/Hrones/Reswick).

All automatic self-tuning procedures are designed for easily controllable loops (up to the 3rd order). Therefore, the previous approach to the above problems involved measures such as relocation of sensors, the implementation of interlinked control loops (master/slave solutions) or the use of 'expert systems' such as model-based predictive control (MBPC).

Now, with the tool “PMATune”, the personnel on site (e.g. the control engineer during commissioning or the plant operator) have a PC-based tool that determines precise control parameters in the shortest time for a wide range of control loop structures. The defined parameters ensure stable control, whereby loop variations are also tolerated.

For the tuning procedure, it is irrelevant whether the loop is self-regulating or not, or if the controller output is 2-point, 3-point (heating/cooling), stepping (with or without position feedback) or continuous. The only condition is that the PMA controller has a front interface, i.e. all controllers of the BluePort range (KS XX-1 series), the KS 94 / KS 98 family, and the KS 800 / KS 816 multi-loop controllers.

Coarse selection of bandwidth for required control dynamics

The user simply makes a coarse selection of the bandwidth for the required control dynamics – i.e. *slow* (non-periodic, with less than five percent overshoot), *normal* (with less than ten percent overshoot) or *fast* (with up to 20 or 25 percent overshoot). Subsequently, the software uses the connected controller to initiate a step response of the process, and then determines the ideal control parameters.

Hereby, even slight drifting of the process variable has no effect on the tuning procedure. The new parameter settings are transferred to the controller at the push of a button. If necessary, the user can perform additional fine tuning by reducing the proportional gain *Kp*.

Summary: For control loops that cannot be optimized using the standard automatic self-tuning function of PMA controllers, it is possible to determine PID parameters that result immediately in a stable process. There is no need for tedious trial-and-error attempts. Valuable time is gained to consider possible restructuring of the loop or modifications of the control concept. However, there is one limitation: The procedure is not suitable for oscillating processes or processes with non-minimal phases.