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# Part 2—What happened to simple useful APC techniques?

This is the second part of my interview with Greg Martin about simple control techniques, unjustifiably retired. In this part we address single-input, single-output (SISO) predictors and simple engineering calculations.

**Zak:** *SISO or multi-input, single-output (MISO) dynamic predictors can be used for comparing analyzer readings versus inference models. When a reliable analyzer exists I apply a bias correction for the inferential model to compensate for the analyzer delay. Have you seen dynamic predictors being used for that or other purposes?*

**Greg:** I have packaged SISO predictive controllers where there is a single manipulated variable (MV), a single control variable (CV) plus several disturbance variables (DVs). These controllers use parametric step response models, have a reference trajectory for the CV and move size-weighting tuning for the MV. The advantage of such a controller is that on small applications it is much easier to implement than a commercial MVPC.

**Zak:** *What are typical applications?*

**Greg:** Analyzer loops and slow temperature response loops. Since it is a classical predictor, it is most suited for applications where the dead-time is significant, let's say more than 50% of the time constant.

**Zak:** *Is the package implemented in the DCS?*

**Greg:** It is only a few dozen lines of code, and can easily fit into the microprocessor applications of modern DCS systems.

**Zak:** *Many of our readers are familiar with MVPC technology, but can you please elaborate on how the prediction and control are achieved?*

**Greg:** The predictor controller, which I call "DPC," the "D" standing for "distributed", applies parametric dynamic response models, taking into account MV, as well as DV moves to calculate predictions of future CV behavior. Then the controller calculates the next MV move necessary to nudge the CV into a desired response pattern.

**Zak:** *Is it difficult for a control engineer to code such a package? Can you elaborate on how it makes its calculations?*

**Greg:** Sure, DPC is not a formal package or product. Engineers familiar with the workings of MVPC can implement it if they follow some simple concepts. First, consider the move calculation as the left inverse (least squares) used in the original DMC package, which is public domain. Then take advantage of the fact that for one MV and for one move ahead the inverse is achieved by a simple division. There is some bookkeeping involved with the starting point for the reference trajectory and calculating dynamic responses, but it is straight forward. Only the model parameters and prediction errors need to be stored, all the rest is recalculated at every control interval. That is why DPC takes minimum storage.

**Zak:** Let's leave this very interesting field and move to other simple techniques. You have mentioned process engineering calculations, which I would consider a part of almost any application, with or without MVPC, but to my disappointment I do not see them being used extensively. Are you of the opinion that they should be applied or abandoned?

**Greg:** Engineering calculations should be used as CVs or MVs because they tend to linearize the control models, improving control performance. I have often used DCS MVs with the necessary engineering calculation built in, for example heat duty or ratio controllers. Many MVPC practitioners object to any MV complexity, but that fear is a carry-over from the early days of awkward communications between MVPC and DCS MVs, causing MVPC wind-up. Today it is easy to apply complex MVs without adverse consequences.

By the way, speaking about ratio control, it is often desirable to apply certain controllers outside the MVPC. Specifically, I would comment about stripping steam ratio controllers on fractionator sidestreams. The effect of stripping steam on product properties is quite nonlinear and MVPCs are unlikely to correctly address the nonlinearity. It would be better and simpler in most cases to avoid stripping steam MVs and just set DCS ratio controllers to control the desired stripping steam ratio.

One final comment, I do not wish to create the impression that MVPCs are not necessary. When you have multiple constraints on a unit, MVPC is the most effective control methodology, but the use of simple engineering calculations enhance, as well as simplify, the MVPC application. For simpler control problems MVPCs can become cumbersome and practicing APC engineers should apply the simpler techniques. That would reduce the demand on their time and make the plant work better. HP

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