Originally appeared in HYDROCARBON PROCESSING® August 1998, pg 17 & 19. Posted with permission.

Y. Zak Friedman, Guest Columnist

More about closed-loop optimization

Editor's note: In the March '98 "HP In Control" editorial[1], I named several controversial issues and requested readers' input. Dr. Friedman is responding to perhaps the most controversial question: Does real-time closed-loop optimization work?

I was one of the first "whistle blowers" on this issue. In 1995, after seeing companies spending millions on closed-loop optimization with dubious benefits, I wrote a paper explaining why such applications are difficult.[2] I received flak from colleagues and vendors who complained that I was destroying the business. This caught me by surprise. There is much solid control technology in existence, and selling "vaporware" cannot be in anyone's long-term interest.

We should all be aware of the history of advanced control. It naively started out with real-time optimization and failed miserably. That failure hindered advanced control development for over a decade. More recently, certain vendor companies who consistently sold nonworking optimization schemes have lost reputation and market share even for their working technology.

An example of the flak I received is a July '97 editorial by my friend Dr. Pierre Latour.[3] Pierre's criticism is not in the content of what he says, but in the tone of calling my assessment "bemoaning." After that he goes on to acknowledge that real-time optimization does not work, though his conclusion was that contracts between vendor and operating company are flawed. If only contracts were based on percentage of profit, as opposed to fixed price, Pierre would guarantee a profit of $0.50/bbl.

In his editorial, Pierre refers to two of my articles[2,4] to support his view. One of these is about closed-loop optimization; the other discusses mostly advanced process control (APC). Pierre lumps all control and monitoring tools under one name: CIM. In so doing, the distinction among tools and the ability to judge which ones work and which do not can be lost. In referencing my work, he did not differentiate between "APC" and "closed-loop optimization." These are two entirely different technologies with very different success rates.

APC is a different story. APC has been with us for three decades. It is a collection of techniques to control the plant at or near constraints, while keeping product qualities at targets. APC tools have changed over time. While there are arguments as to which ones work best, there is no doubt that most can be configured to work well. My articles dealing with APC failures[4,5] have concluded that these problems can be addressed by certain management practices, aiming to improve the quality and maintainability of control engineering work.

APC could optimize the plant minute-by-minute, except it needs instructions from the operator as to which constraints are to be held and what the optimal product qualities are. Closed-loop optimization aims to determine these constraints and targets automatically via the use of rigorous unit simulation. This sounds good, though presently there are many failures and few—if any—working applications. One could overlook past failures in the hope that some useful technology might emerge. Still, closed-loop optimization is an entirely new tool, new approach and new untested level of complexity. We would be justified separating it out as "uncharted territory."

My article identified a number of difficulties standing in the way of successful closed-loop optimization:[2]

- There is a lack of procedures for estimating intermediate product prices. A unit cannot be optimized in isolation unless its product economics are known.
- Inability to define unit feed makes it impossible to predict the products.
- The use of steady-state simulation models in a dynamic environment prohibits re-setting new optimized constraints and targets in small steps. Present real-time optimizers use steady-state models and wait several hours between runs. Applying only a small increment of the solution after each run would take too long.
- Effective optimization requires detailed, accurate models and complex simulations.

Another problem. I would like to now add another problem to the list: shortage of people. In the current management environment of "streamlining," plants are badly short of engineers, and only have hope of maintaining the simplest applications. Consider the priorities of any control engineer:

1. Identify and chase instrument problems such as sticky valves, incorrect control structures, etc.
2. Tune basic (DCS) control loops in the unit.
3. Maintain APC applications: identify and tune dynamic models, come up with working inferential calculations, add new constraints when needed, etc.
4. Create APC checking logic to deal with erroneous instruments or abnormal situations, which call for abnormal control strategies.

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5. Train operators. Solve any operator-misunderstanding problem.

6. Implement new APC applications (by in- house personnel), or supervise vendors implementing new applications.

7. In any spare time, deal with online optimization applications.

In the current reality people normally accomplish tasks 1 and 2. Control engineers understand that for APC applications to work, the DCS controllers must be well-tuned. Then they struggle to do justice to tasks 3, 4 and 5, and often there is no time left after that. Supporting new APC applications of task 6 is a problem. Task 7 is Utopia.

To make matters worse, real-time optimization is labor-intensive and requires skills that are in high demand elsewhere in the plant. Until more skilled engineers are available, I have given up leaning on clients to resurrect closed-loop optimization applications. I consider it enormous success when a plant has APC applications on most units, and all of them run well.

LITERATURE CITED

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