Originally appeared in HYDROCARBON PROCESSING® March 2003, pg 158. Posted with permission.

Y. ZAK FRIEDMAN, GUEST COLUMNIST

Zak@petrocontrol.com

APC, modeling and optimization insights

I have participated in the National Petrochemical and Refiners Association (NPRA) computer conference without fail for over a decade, and have seen it go through the ebb and flow of oil economics. In the aftermath of oil company layoffs, conference participation shifted to become vendor heavy. Then, the severe downturn of instrument manufacturers, software suppliers and advanced process control (APC) contractors shrunk attendance from 600 to around 200 people.

Several participants have expressed concern that these shifts would be detrimental to technical content, and it is true that many of the papers were overly commercial. However, there were a number of scientifically informative papers, as well as many high-caliber attendees, and that is what counts for the success of any conference.

Highlighted are the papers and topics that presented relevant and interesting information on APC, modeling and optimization.

Open-loop modeling. IT presenters have often claimed that once you spend money on IT, you immediately become a pacesetter, whatever that means. It was refreshing to listen to a number of examples of decision-support modeling applications that make money. Harpreet Gulati of Invensys gave an interesting paper in this category.[1] Simulations dealing with live inputs have to reconcile the model against plant data. Harpreet showed that the least-squares method does not necessarily give the best reconciliation results because large instrument errors distort the outcome. Better results are obtained by limiting the maximum deviation penalty.

Closed-loop optimization. In spite of bad press,[2, 3, 4] people continued to present papers about online optimization via the use of large steady-state models. I have noted problems with this methodology years ago,[2] and later suggested that the approach of using the LP part of the multivariable predictive controller (MVPC) as a Jacobian (partial derivative matrix) should work better.[5] At this conference, Citgo and Honeywell presented an interesting paper utilizing the method for optimizing an FCC unit.[6]

Inferential models. Inferential models are the Achilles heel of APC. APC moves the unit against constraints, but if we do not have the ability to control product qualities—constraint pushing becomes counterproductive. The industry has applied largely empirical methods to infer product properties with mixed, mostly negative results. The conference dealt with the quality control issue in two papers—Invensys' approach utilizing NMR analysis[7] and Petrocontrol's approach of first-principles inferential models.[8] Both papers deal with crude units with difficult crude switches and the conference provided a unique opportunity to compare the two approaches in terms of complexity, accuracy and price.

In addition to these two papers, there was an information exchange session on inference modeling. I may be biased, though, I think that at the end of the very informative discussion most people in the audience and on stage agreed that while empirical models are easier to develop, first-principle models are better and require less laboratory support.

A note about Emerson. Emerson deserves special mention because it seemed to be the only instrument vendor at the conference that demonstrated a vision and a plan. While I disagree with Emerson's controller failure statistics—presumably made to look bad to promote Emerson's smart sensors—I do agree that there is a need to detect control problems.

Detecting adverse events, for example pump cavitation or sticky valves, would permit taking corrective APC actions and would alleviate operator fear that the APC might take a wrong action, a leading cause of service factor losses.

Granted that Emerson is an innovative instrument vendor, one wonders whether the DCS is the right place to install complex logic. Putting goodies such as neural networks, multivariable predictive control and others into the DCS would make the DCS necessarily more cumbersome. Existing DCSs have certain advanced capabilities, but I have rarely seen anything beyond cascade or ratio applications working successfully. I would advise Emerson to try installing the sophisticated tools in a separate computer with a good DCS interface. HP

LITERATURE CITED

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The author is a principal consultant in advanced process control and online optimization with Petrocontrol. He specializes in the use of first-principles models for inferential process control and has developed a number of distillation and reactor models. Dr. Friedman's experience spans over 30 years in the hydrocarbon industry, working with Exxon Research and Engineering, KBC Advanced Technology and in the past 10 years with Petrocontrol. He holds a BS degree from the Israel Institute of Technology (Technion) and a PhD degree from Purdue University.