Adaptive Process Control delivers bottom-line benefits

by Nirmala Arifin, Business Consulting Director, AspenTech Asia Pacific

Technology for refining and chemical companies to meet operational challenges.

Optimising plant operations and maximising the profitability of assets is essential for oil, gas and petrochemical companies to compete in today's market. The process industries encompass a wide range of complex challenges, including the need to maintain product quality, reduce energy consumption, maximise throughput and increase yield, whilst meeting safety and environmental standards. Advanced Process Control (APC) solutions help to successfully address these diverse production process issues. With the evolution of APC, innovative model-based predictive control techniques today deliver increased profits by reducing process variability and allow plants to be operated closer to their true constraints.

Evolution and innovation in APC

Over the last few decades, model-based predictive control has matured from a differentiating technology enjoyed by only the largest refining and bulk chemical entities to an essential technology for all continuous process companies. Driven by industry consolidation and market volatility, the applicability of APC has expanded to smaller and less complex processing units, with companies seeing greater benefit of APC through improved integration with other plant systems (eg DCS), significant cost reductions, greater ease of use, faster time-to-benefit, simpler maintainability and sustained value.

Experimentation with electronic instrumentation and control began in the late 1950s to early 1960s, soon replacing pneumatic transmitters and manual tuning practices. Consequently, some standardisation was achieved while instrumentation vendors advocated their own systems. Through collaborative efforts with major users, instrument and computer control systems software companies began to swiftly evolve. Through the 1970s, computing power expanded enormously and monitor displays gained in popularity as this era saw the emergence of the Distributed Control System (DCS) to improve functionality and flexibility. In early to mid-1980s, APC was seen as a strategic edge for major industrial companies. In-house teams drove the technology adoption, which became an accepted standard in refining and ethylene production, with deployment on major plants across the world. For more than 20 years, Aspen DMCplus has been the industry standard for advanced process control software. The application has been successfully applied on large and small units and is the most scalable commercial technology in the industry. By the early 2000s, technology innovation saw the development of industrial non-linear control and batch capabilities.

Where do we stand today?

APC has progressed over the years to allow the process industries to improve their operations, resulting in continuous management, control and optimisation of complex process interactions. Once a dynamic multivariable model is developed by an APC team and utilised with well-proven control software, the model can predict the future path of the process, comply with the operating boundaries and implement an optimal move plan to drive the plant to the desired targets. Essentially, APC comprises a supervisory control and optimisation layer above the basic level of regulatory control.

Today, APC eliminates the need for operators to repeatedly adjust PID controller set points manually. APC provides models that automate regulatory and constraint control, while optimising the process. Savings of up to 2% to 6 % of annual operating costs can be gained with payback often measured in months and almost always in less than one year. Moreover, APC can be used on all processes, especially processes that are difficult to control with single loop PID feedback controls. These processes can have long time-delays, changing conditions, complex heat integration, frequent or periodic upsets (such as dryer switches) or quality variables that are measured intermittently or offline.

With regard to batch processes, improvements in automation and regulatory control will help in the manufacturing of the product in a consistent way, resulting in reliable product quality and allowing operators to successfully manage varying conditions. By shortening batch times, companies can be flexible when operational requirements change.

With continuous process industries, APC can better coordinate the interactions that invariably occur in single loop control systems, reduce the process variability and allow the plants to run closer to their operating constraints. Advanced multivariable constrained control is a major advantage in helping to cut energy use, as well as raw materials and waste processing costs. It can also improve product yield as well as process safety and productivity.

Typical benefits of APC

- Reduced product quality variation by up to 75% through improved process inferentials, leading to better control and understanding of the process.

- Increased yield of high value products by 2% to 5%, due to reduction of losses due to quality issues.

- Increased throughput or production capacity, by up to 10%, through pushing the plant up against its true operating constraints. Agility gains, such as manufacturing flexibility, customer responsiveness, and reduction of working capital by processing to order.

- Reduced energy consumption by up to 10% by maintaining operations within desired limits and not over-purifying products.

- All of these factors combined lead to an increase in reliability, by up to 4%.

Expanding capabilities in APC

In the past, many users of APC solutions suffered from steadily degrading benefits over time. Process changes, equipment ageing and changing economic conditions are just a few factors that drive the need to maintain controller models. Adaptive Process Control developed by AspenTech is a break-through in technology that eliminates the need to approach APC maintenance as a project and creates a continuous process of assessing model quality, collecting current data and generating new models as the behaviour of the plant changes over time. The software can detect, isolate and correct problems without increasing the burden on engineering staff.

There is a crucial difference between the traditional approach to controller maintenance (sustained value) and Adaptive Process Control. With sustained value, revamping the controller was done as a lengthy and costly project. Under Adaptive Process Control, however, the controller is modified over time in more of a continuous process. The update of the model occurs without the need to take the controller off-line and enables a company to reap the benefits of control and optimisation while the model is under maintenance. Model quality analysis, which continually runs and assesses the accuracy of the model, can detect when degradation of performance occurs. It can pinpoint a specific part of a controller, thereby helping engineers to determine the underlying cause of the degradation in performance.

Companies now have the ability to collect new model identification data using small perturbation background testing. The new model identification algorithm also supports the use of high degrees of closed loop data. This reduces the need for the aggressive step-testing methods traditionally used. As the new data are collected, they are monitored in real-time and, using AspenTech's new automated slicing technology, bad data are automatically removed, producing a clean data set for model identification. Adaptive modelling creates candidate models and those are automatically presented to the engineer for review. The engineer always has the final decision before the model is deployed. This entire process is monitored by an automated test agent and the engineer is notified in real-time of any problems that occur within the workflow.

The additional benefits of Adaptive Process Control are to squeeze out costs and increase benefits from making improvements to existing solutions by adopting new technology breakthroughs:

- Minimise erosion of benefits
- Return controllers to service faster after turnarounds
- Reduce controller maintenance costs by 25%
- Increase benefits by continually improving performance
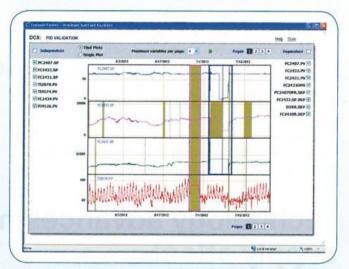- 10% to 20% increase in total APC benefits

Today, with Adaptive Process Control, non-expert engineers can do everything required to update the models, without the need to turn off the controller. They can also ensure that the controller exhibits robust behaviour during the periods between model updates, make maintenance a built-in and continuous part of

the process and eliminate the need to wait for turnarounds to revamp controllers. Crucially, the software permits the engineer to always be in the loop in terms of making decisions when new models would replace existing ones in on-line applications.
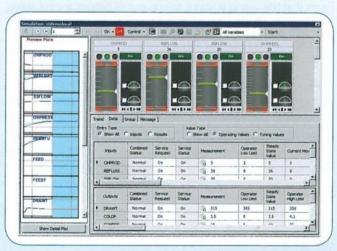
Conclusion

Since the early days of process automation, refining and chemical companies have experienced rapid increases in operational challenges. The game has become more complex. Traditional advanced process control and off-line, open-loop optimisation no longer deliver sufficient economic benefits because of the constantly changing conditions of today's plants. For companies to be competitive, economic benefits must be achieved through continuously improved process control techniques and innovations.

Adaptive Process Control provides a set of innovative, patented techniques for automatic adjustment of the controllers in real-time and elevates maintenance to a built-in and continuous part of the management process. For process industry companies operating today, the message is simple. APC software delivers sustainable measurable benefits and allows companies to operate their facilities with greater profitability, safety, cost-effectiveness, reliability and compliance with environmental regulations. APC delivers very significant built-in, bottom-line returns.

APC Online Model Adaption Dataset Viewer

APC Builder Simulation Version 8