Model Predictive Control

Rockwell Automation Model Predictive Control delivers results.

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The Challenge

Today's manufacturing companies contend with intense global competition, reduced technical and operational resources, higher raw material and energy costs, stricter environmental regulations and growing customer demands. To stay competitive manufacturers are transitioning from product-driven to customer-centric operations.

Complex industrial processes make it challenging to be both market-driven and sustain profitable operations. Manufacturers must adjust their production methodology – introducing a greater variety of higher value products, more frequent changeovers and shorter production runs. They must ensure maximum uptime and more efficient transitions with less waste. In addition, manufacturers are facing stronger public demand to reduce their environmental impact and operate within strict emissions limits. Most importantly, manufacturers must find new ways to increase their agility in order to quickly respond to changing demand and profitably capitalize on new market opportunities.

Rockwell Automation Model Predictive Control delivers customer value.

Due to global competition, customers have more supply alternatives than ever before. The most successful manufacturers respond quickly to changing customer demands and minimize the impact of rising energy and material costs.

Is your company positioned to capitalize on growth while maximizing operational efficiency?

The Solution

Leveraging the Pavilion8® software platform, Rockwell Automation Model Predictive Control (MPC) technology is an intelligence layer on top of basic automation systems that continuously drives the plant to achieve multiple business objectives – cost reductions, decreased emissions, consistent quality and production increases – every production minute. Our MPC products are packaged to address the unique characteristics of today's processers and powers the industry-specific control and optimization solutions delivered by Rockwell Automation. Within these standard and a broad variety of custom industry solutions, our MPC technology continuously assesses current and predicted operational data, compares them to desired results and computes new control targets to reduce in-process variability, operate within equipment constraints and improve performance.

Robust process models are critical to any MPC-based solution. Rockwell Automation MPC products leverage flexible hybrid modeling capabilities that that enable models to incorporate all available knowledge about the process to deliver the most accurate, highest fidelity models possible. Rockwell Automation uniquely provides a single solution that can handle both nonlinear and linear processes simultaneously, driving to improved results across a wide range of process technologies.

To ensure that economic benefits are maintained, our MPC-based solutions include built-in controller performance metrics that continuously monitor key indicators such as utilization, time at constraints and deviation from target. These metrics allow product quality, production and efficiency to be measured directly against MPC utilization and performance to ensure maximum value is derived from a finely tuned control application.

Greater Model Accuracy

Features

- Hybrid modeling based on empirical data, first principles equations, operator knowledge or any comination thereof
- Soft Sensors® integrate with Model Predictive Control providing timely in-process measurements to increase accuracy of control actions
- Patented, Extrapolated Gain Constrained Neural Networks (EGCNN) to ensure model accuracy beyond the historic operating ranges

Benefits

- Expedites deployment by using all available information to create accurate models
- Minimizes need to adjust models as process range is extended
- Improves product quality through faster response to target changes or large process disturbances

Tighter Control Over a Wider Operating Range

Features

- Incorporates changing process dynamics (dead-time, time constants and gains) over wide process operating ranges
- Parametric model representation provides compact, computationally efficient controller model without sacrificing accuracy

Benefits

- Improves product quality and flexibility for new grade and product development
- Increases transition efficiency with less off-spec product
- Tightens control over a wider operating range

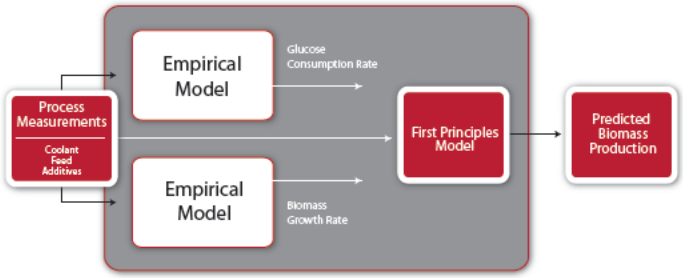
Maintain Controller Performance at Higher Levels

Features

- Controller replay capability maintains a contextual history of control actions and controller trajectories (improved trouble-shooting)
- Embedded controller performance metrics measure utilization, time at constraints and error from targets

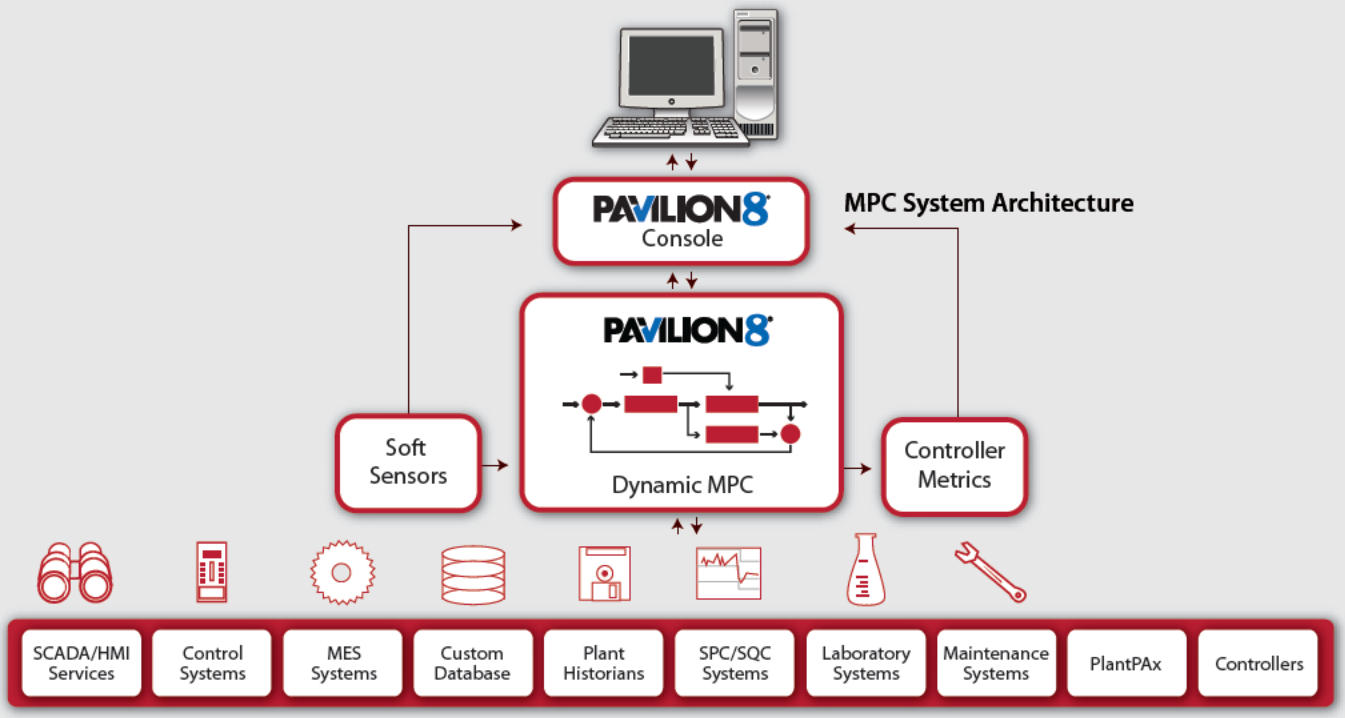
Benefits

- Allows quick identification and resolution of model mismatch or tuning parameter errors for improved controller performance
- Assesses historical controller performance
- Achieves predictable, sustainable performance through continuous controller monitoring



Hybrid Model Used in Fermentation Application

Rockwell Automation Model Predictive Control uses multivariable models and current plant measurements to determine future control actions that will result in operations that satisfy processing limits, while driving to improved performance. These dynamic, predictive models differentiate MPC from other types of Advanced Process Control (APC) technologies.



MPC System Architecture

Hybrid Modeling – Key to Robust Process Models

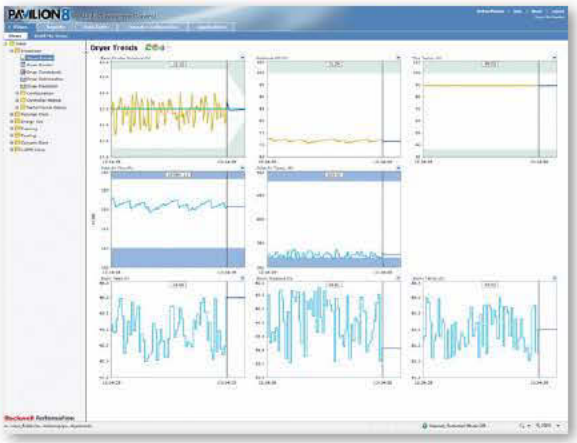
Robust process models are critical to any MPC-based solution; they define how the control solution should respond to changing process targets and disturbances. Based on innovative hybrid modeling techniques, Rockwell Automation MPC technology produces accurate, high-fidelity process models, offering an unparalleled ability to handle the full spectrum of simple to complex industrial processes.

MPC models may be fundamental, empirical or a combination of both. In practice, pure fundamental models can require hundreds of equations to be solved in an iterative manner each execution cycle. This requirement limits the control application's size and speed. When little or no first principles knowledge is available, empirical models can be derived using only historical process data. These models are extremely accurate over the operating range represented by the historical data, but they may not perform as well when extrapolated beyond this range.

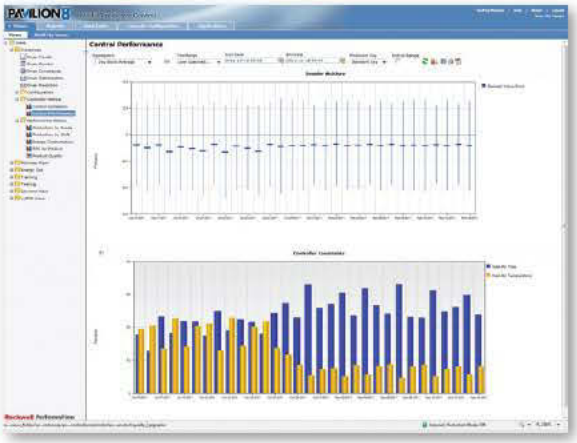
A hybrid modeling approach combines the best of both techniques. With this type of model, MPC-based solutions use process knowledge in the form of a mathematical equation or known constraints in model development. Rockwell Automation MPC technology combines empirical modeling techniques (such as neural networks), process data and first-principles equations to give manufacturers more robust, accurate models across the entire range of operations. Rockwell Automation hybrid modeling approach offers a parametric representation of a process that allows for fast control execution even in highly complex manufacturing environments, without sacrificing accuracy.

Dynamic MPC Drives Operational Excellence Across Full Product Portfolio

In today's customer-driven environment, manufacturers are increasing product portfolios and embracing mass customization. As a result, manufacturers are grappling with more product transitions and in-process variability. Unlike solutions that require different technologies to solve different phases of production, Rockwell Automation flexible MPC products can tackle a broader product spectrum. Built on an integrated, comprehensive control architecture, Pavilion8 dynamic MPC uniquely provides a single, parametric controller architecture that can handle the full range of industrial processes – from simple to very complex (4 to 100x variables), linear and nonlinear, as well as fixed or variable dynamics. The controller includes dynamic and steady state optimization to ensure any number of objectives and constraints are met at every execution, including hard limits, soft or 'fuzzy' constraints, desired value targets, maximization or minimization of selected variables and rate of change constraints. The MPC technology implementation provides flexibility to adjust production schedules to meet new orders, regardless of what is currently being produced. With context sensitive built-in help, warnings and error-checking and user assistant tools (like MPC tuning support) these flexible, powerful algorithms are more accessible than ever.



Pavilion8's browser –based user interface provides easy access to monitor all aspects of the MPC solution



Built-in controller KPIs provide easy to understand views of control utilization, time at constraints, model error, and other key metrics to determine effectiveness of the control

Additional metrics for production, quality, energy usage, and other factors can be easily configured to provide continuous measurements of the benefits derived from the application.

Rockwell Automation, Inc. (NYSE:ROK), the world's largest company dedicated to industrial automation, makes its customers more productive and the world more sustainable. Throughout the world, our flagship Allen-Bradley® and Rockwell Software® product brands are recognized for innovation and excellence.

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