Aspen Apollo™
Non-Linear Advanced Control Solution for Polymers

Aspen Apollo provides true non-linear advanced control for the polymers industry, providing significant advantages over competing products.

The Challenge: Push Your Plant to its True Operating Capability

In the polymers industry, processes exhibit significantly different characteristics from one operating region to another. These differences, referred to technically as non-linearities, are not addressed by traditional advanced process control (APC) solutions. Traditional solutions can be extended to address some aspects of non-linearities, but these extended solutions have shortcomings – either requiring a range of controller tuning recipes that are costly to set up and maintain, sub-optimal control due to gain adapted models, and/or reverting to linear control outside a very narrow operating region. The challenge is to provide a control solution that resolves all these issues; in other words, a controller that is valid across a wide range of operating conditions, including unfamiliar operating scenarios, is driven by a single set of tuning values, and can calculate an optimal move plan based on accurate modeling of non-linear gains across the entire operating space.

The Opportunity: Optimal and Flexible Manufacturing Operations

The correct advanced control solution provides the opportunity to reduce variability in quality, maximize on-spec product, and minimize loss of production during product transitions, thereby allowing more optimal manufacturing operations and greater agility to respond to market demand. To fully realize this objective, however, the controller must perform reliably across a wide range of operating conditions, and not be restricted to a small set of possible grade changes.

Aspen Apollo 6.0
Integration into Aspen Manufacturing Suite 6

- Common install with the rest of the AMS products.
- Common data collection utility.
- Common web viewer that allows multiple Aspen Apollo, DMCPPlus®, and Aspen SmartStep™ controllers to be viewed on the same web pages.

Modeling and Control Engine Capabilities

- Constraint ranking. Targets and limits for different variables can be ranked so that under conditions of infeasibility, the optimizer will give up on lower ranked constraints first.
- Variable dead time support designed for multiple reactors in series where dead time changes may be triggered by line rate changes.
- Gain constrained dynamics.
- Run controller at different frequency from collected data.

Usability Improvements

- Ability to load a run file while controller is running.
- Ability to load a run file into the simulator.
- Support for calculations in the simulator.
Our Promise

Aspen Apollo provides a practical control solution to the highly non-linear processes present in the Polymer industry. Due to unique structure and accuracy of Apollo’s models, and the fact that a true non-linear optimization problem is being solved, this solution can be used reliably across a large operating range to maximize production of on-spec material.

Why AspenTech?

Aspen Technology, Inc., provides industry-leading software and implementation services that enable process companies to increase efficiency and profitability. AspenTech’s manufacturing/supply chain product line allows companies to increase margins in their plants and supply chains, by managing customer demand, optimizing production, and streamlining the delivery of finished products. Its engineering product line is used to design and improve plants and processes, maximizing returns throughout an asset's operating life. These two offerings are combined to create solutions for enterprise operations management (EOM), integrated enterprise-wide systems that provide process manufacturers with the capability to dramatically improve their operating performance.

Over 1,500 leading companies already rely on AspenTech’s software, including 46 of the world’s leading chemical companies and 23 of the world’s largest refiners.
The Solution: Aspen Apollo

Aspen Apollo is the world’s first commercial general purpose model-based controller that performs a full non-linear steady-state and path optimization at every control execution – without the need for any model suppression mechanisms.

Aspen Apollo is a true non-linear controller that, together with Aspen Grade Transition Manager™ and Aspen IQ™, provides a complete solution for polymer manufacturing control. Key differentiators are:

- **Reliability** – The patent pending Bounded Derivative Network (BDN) technology in Apollo provides models that have accurate predictions and globally reliable gains.
- **Modeling Capability** – Apollo models capture the non-linear dynamics that are inherent in polymer processes.
- **Control Capability** – Globally reliable models allow fully non-linear steady-state and move plan optimization – the move plan is constructed knowing the full non-linear effects of the move plan across the future horizon.
- **Consistency** – The steady-state optimization, the move plan optimization, and the inferentials can all use the same global State-Space-BDN model. Single model solution allows for better replication.
- **Maintainability** – Consistent models, analytic extrapolation properties, a single global set of tuning, and no need for gain scheduling make Apollo significantly more maintainable than alternative solutions.
- **Transition Capability** – Safe and rational gain predictions allow Apollo to control and optimize product grade transitions. Grade Transition Manager automates transition preparation, recipe management, start-ups and general sequencing.

Product Description

Apollo provides a set of desktop tools for model development, analysis, and simulation, an on-line system for controller implementation, and a web-based engineering and operations interface.

**Aspen Desktop**

Comprised of an integrated suite of three programs.

- **Apollo Model** – Desktop application that provides a step-by-step workflow leading you from data to a deployable controller model. Apollo Model includes modeling and analysis tools, as well as a rich simulation environment that can be used for initial controller tuning and importing and simulating tuning changes made in the field.
- **Powertools Apollo Model** – Advanced modeling environment and the primary data analysis and model building environment for Apollo applications. This modeling environment is available as a specially licensed option in the Aspen IQmodel Powertools product. Models built in this environment are exported to Apollo Model for simulation and for creation of a controller run file.
- **Apollo Config** – Tool for configuring Apollo I/O connections, and for setting up custom calculations.

**Apollo Online**

- **Apollo Control** – The model-based controller engine used to keep a process at optimally determined set points, or to optimally transition from one operating region to another.
- **Apollo Client Control Program** – A program provides the interface between the Controller and your Process Control System (PCS). This uses a standard, supported, network-aware multiple-device connection layer that works consistently with a large set of DCS and process information management systems. Each interface is a standard, fully supported product-quality software package.
- **Apollo Manage** – A program that manages the start-up and shutdown of the controllers and client control programs.
- **Apollo View** – An engineering viewer that runs on the controller box. It provides a graphical view of the running controller. It also allows an engineer to modify operating constraints and controller tuning parameters.
Production Control Web Server

Based on Microsoft’s Internet Information Server (IIS), PCWS provides standard operator and engineering displays with the following features:

- **Works right out of the box** – No custom displays required; no need to know HTML.
- **Lower cost of ownership** – No need to install any AspenTech software on the client PC. Only Internet Explorer is required.
- **Role-based security** – Allows you to control which users can access which controllers. Integrates with either Aspen Local Security or Aspen Framework Security.
- **Multiple access levels** – None, Read-only, Operator-change, Engineering-change, and Administrator.
- **Intuitive user interface** – A standard web interface means easy point and click access to controller data. If you know how to surf the Web, you know how to use the PCWS interface.
- **Integrated plots** – Standard views include future move and prediction plots.
- **Multiple controller overview** – See the current state of many controllers at once, even if they are running on multiple host computers.
- **Faceplate view** – See the status of all the variables in a controller at once, with color-coded status information, high/low limits, and current process values.
- **Customizable** – Display variables in configurable groups; select which parameters to display; reorder table rows and columns; sort/filter variables by status or by active constraint.

The Aspen Apollo Advantage

Aspen Apollo has the following key features:

- **Data Management** – Loading of data files, data cutting capabilities, data conditioning and interpolation.
- **Dead time and Dynamics** – Independent dead time alignment for each pair of relationships. General state space identification and parametric dynamics supported. Manually set low-order dynamics supported. Variable dead times are also supported and the controller can be bumplessly switched from one dead time set to another online.
- **Guaranteed Gain and Extrapolation** – Bounded Derivative networks guarantee gains will be within specified bounds. Models extrapolate sensibly outside data in existing operating regions. These allow the controller to be used across all operating regions. Constraints can also be imposed on the dynamic step responses.
- **Interactive Graphical Simulation Environment** – Simulate open loop and closed loop performance. Validate controller tuning including move plan, optimization, and unmeasured disturbance rejection.
- **Consistent Models** – Steady-state optimization and move plan optimization use consistent models, so controller optimally moves the process to targets it knows it can achieve.
- **Unmeasured Disturbance Rejection** – Configurable Extended Kalman Filter update mechanism used for unmeasured disturbance rejection.
- **No Complex Tuning Recipes** – Powerful approximators and true non-linear path optimization eliminate need for gain adaptation, transforms, or multiple tuning recipes.
- **Flexible Tuning** – Flexible tuning allows individual manipulated and controlled variables to be tuned with different levels of aggressiveness, and supports widely differing dynamics within the same controller.
- **Constraint Ranking** – Powerful ranked constraint handling. Important limit constraints and quality constraints can be placed ahead of less important constraints. Economic or Ideal Resting Values can be imposed on all MVs and CVs.
- **I/O management** – Connect and exchange data with multiple I/O devices. Uses a standard network-aware multi-device connection layer which works consistently with a large set of DCS and Process Information Management Systems.
- **Web Viewer** – Browser based viewing of online controller with role based security.