EXPLORE SOFTWARE

IMPROVING PROCESS OPERATION USING THE POWER OF ADVANCED DATA ANALYSIS

EXPLORE is a powerful multivariate data analysis software that transforms existing data into valuable information and knowledge to help understand and improve process operation. Improvements can be achieved through process variability reduction, troubleshooting, process monitoring, soft sensors, and enhanced process control.

THE CHALLENGE FOR INDUSTRY

Production rates, product quality, and energy consumption are negatively impacted by process operation inefficiencies, equipment performance variability, as well as late detection and mismanagement of abnormal situations. The complexity of industrial processes and the interaction between a large number of variables make the operators' tasks difficult (especially in abnormal situations). Operators and engineers need to access relevant and accurate information, not only data, to better operate their processes. Analyzing large amounts of historical data can help develop decision-support tools to assist engineers and operators in carrying out their tasks more easily and efficiently.

THE EXPLORE SOLUTION

EXPLORE is composed of four modules that allow for logical step-by-step multivariate data analysis:

- Data Import and Pre-Processing;
- Global Analysis;
- Predictive Modeling; and
- Monitoring & Fault Detection.

EXPLORE uses several data cleaning and filtering methods, projection methods known as principal components analysis (PCA) and projection to latent structures (PLS), as well as Neural Networks (NN) to

EXPLORE main window

transform large amounts of data into intuitive plots that summarize essential information. PCA provides a concise overview of a dataset. It is notably very useful for recognizing patterns in data, outliers, trends, and groups. PLS is used to establish relationships between input and output variables, in order to create predictive models. NN are used for strongly nonlinear processes, where PLS is not accurate.
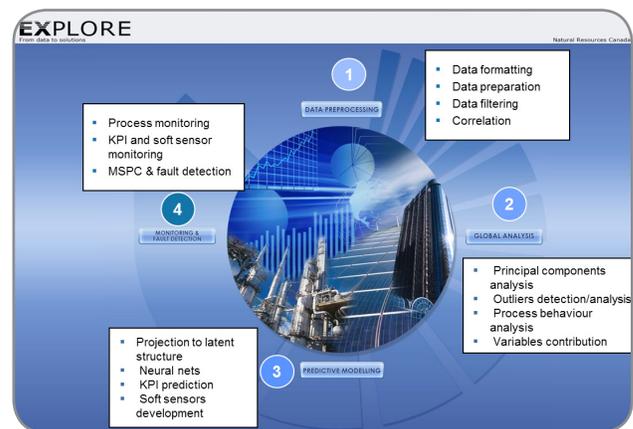
KEY FEATURES

EXPLORE has several features that notably help to:

- Import data from many different sources, such as Excel files, historians (e.g. OSISoft PI, Honeywell PHD), and SQL databases

- Easily clean and filter data

- Visualize data through many plotting, coloring, and labeling options

- Transform variables

- Handle missing data

- Identify dominant patterns in data (e.g. groups, trends, and outliers)

- Find relationships between process variables and conditions

- Troubleshoot process problems, using powerful multivariate latent variable plots

- Identify savings through process operation changes

- Simulate different operating scenarios

- Build predictive models and identify the variables that are most critical to quality and energy performance

- Forecast potential upsets and help reveal underlying causes

- Design better statistical process control, using advanced multivariate control charts

- Monitor process performance and quality, and detect faults online
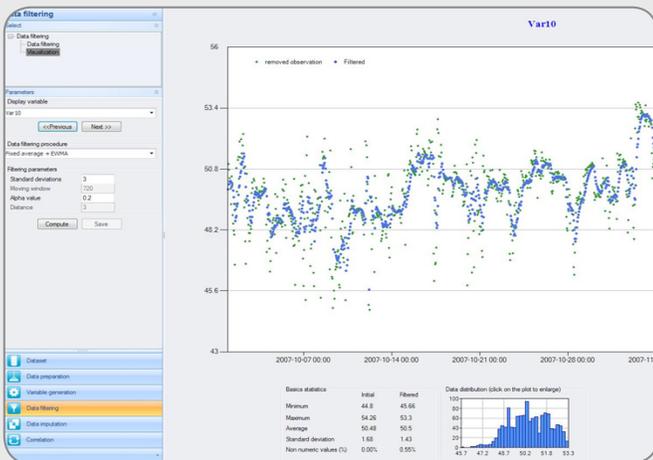
Basic statistics, plus various filtering methods for removing outliers, denoising, and linearizing data

PCA results identifying different regimes of operation and variables with high contribution

BENEFITS

- Simplified operator duties

- Improved process knowledge

- Improved process operation stability

- Higher equipment runtime

- Improved productivity: 2 to 10%

- Energy savings: 5 to 15%

- Reduced use of raw materials: 1 to 5%

- Improved quality: 20 to 50%
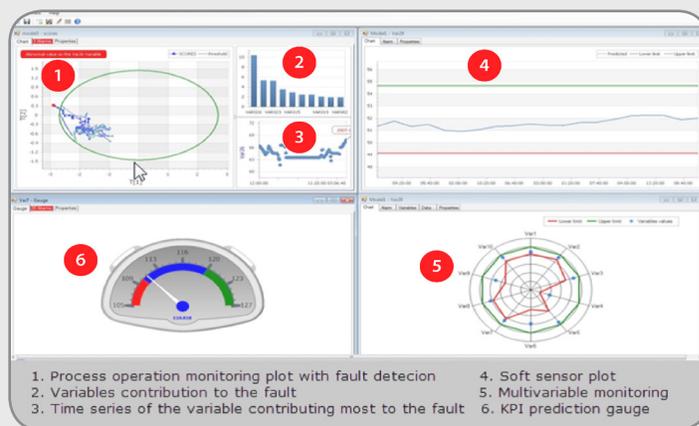
ADVANTAGES

- Low-cost solution: No/low capital cost

- User-friendly, Windows-based

- No need to be physically installed in the control room or connected to plant controls

- Easy to update and account for process and/or operational changes

Predictive models using PLS and neural network methods

1. Process operation monitoring plot with fault detecion
2. Variables contribution to the fault
3. Time series of the variable contributing most to the fault
4. Soft sensor plot
5. Multivariable monitoring
6. KPI prediction gauge

EXPLORE view, showing online process operation

EXAMPLES OF INDUSTRIAL APPLICATIONS

- Active Energy Management (integration into an Energy Management System) to automatically diagnose inefficiencies

- Reduction of variability (e.g. quality and specific energy)

- Predictive models of performance indicators for evaporators, boilers, dryers, etc.

- Detection of fouling and clogging (e.g. exchangers, boilers, and evaporators)

- Cleaning and maintenance cycle planning for different equipment (e.g. evaporators, heat exchangers, and boilers)

- Supports Six Sigma (data-mining driven DMAIC procedure)

- Soft sensors for continuous estimation, monitoring, and control of product quality and emissions (e.g. SOx and NOx)

- Quality optimization through changes to operation parameters

- Throughput maximization

- Supervision of existing control systems (decision support for operators)

- Diagnosis and correction of process abnormalities (faults) for boilers and vaporators, among others

CanmetENERGY
Leadership in ecoInnovation

For more information on **EXPLORE**, please contact us: **Explore@canada.ca**

CanmetENERGY's Systems Analysis Software
To allow effective transfer to industry, CanmetENERGY is developing innovative software solutions that reflect the most recent advancements from our research activities.

COGEN, for maximizing revenues from cogeneration systems
INTEGRATION, for optimizing heat recovery in industrial facilities
EXPLORE, for improving process operation, using the power of advanced data analysis
I-BIOREF, for evaluating the economic viability and environmental impacts of biorefinery technologies

For more information, please visit our website or contact us: www.nrcan.gc.ca | 1-450-652-4621