Inferential Modeling Platform for Sensor Validation (IMP-SV)

IMP-SV Features

IMP-SV is a native Windows, client-server software package for the off-line development and on-line deployment of sensor validation strategies. The software product includes distinct off-line (IMP- SV Model Builder) and on-line (IMP-SV Real-Time Server) software. It features:

Number of Sensors Monitored

- Up to 200 Sensors Simultaneously Monitored

Modeling Technologies

- K-Nearest Neighbor

Statistical Process Analysis

- PCA
- SPC
- MvSPC

IMP-SV Environments

IMP-SV Model Builder

- Data Import
- Data Processing
- Automatic Outlier Removal
- Data sets and Input Selection Wizards
- Automatic Multiple Model Development
- Model Assessment and Comparison
- Model Explorer
- SPC and MvSPC Development

IMP-SV Real-Time Server

- Model Deployment
- Control System OPC Connection
- LIMS Interface (ODBC, OPC)
- Quality Monitor
- Process Performance Monitor
- Maintenance Trigger
- Off-Line “What-If” Analysis
- Snapshot stored model capability

The Inferential Modeling Platform for Sensor Validation (IMP-SV) is a software package capable of identifying and—in certain instances—replacing measurements from failed sensors.

Based on a field-proven Inferential Modeling Platform (IMP) software environment, IMP-SV is designed to distinguish good plant data values from bad ones. It accomplishes this by creating a set of predicted values.

For each sensor to be monitored, a model is built based on past recorded sensor output readings.

IMP-SV uses the model to provide dynamic alarm limits for detecting measurement abnormalities and instrument drift. Alarm limits for a given sensor are set by placing user-specified bounds above and below the sensor‘s output values.

Sensor readings that register outside the alarm limits are flagged as needing attention by an operator or engineer.

IMP-SV MODELING FUNCTIONS

IMP-SV modeling functions are based on advanced pattern recognition algorithms able to compute reliable predictions from topological considerations and to satisfy the severe requirements imposed by the need to have a large number of MISO models running in real-time.

During real-time execution, the output values can be seen as predictions of how the plant should behave. These output values are highly fault-tolerant because defective plant parameters in the input record do not markedly bias the accuracy of the computed results.

IMP-SV MODEL BUILDER

The IMP-SV approach to inferential calculation is to create a platform for process engineers where all the functionalities are available, easy to use, and arranged for the best workflow.

A major concern when working with data-driven technologies is that data may be misleading because of outliers or unnecessary signals. IMP-SV addresses this with many built-in functions for data processing, including:

- Data import from different sources
- Data handling (data set merging and splitting, data editing, calculated tags, etc.)
- Automatic outlier removal
- Multi-chart (2D and 3D) visualization facility
- “Bulls-eye” chart visualization

As an example, the best selection of model inputs can be identified by means of powerful, built-in wizards or through use of a dedicated scripting language.

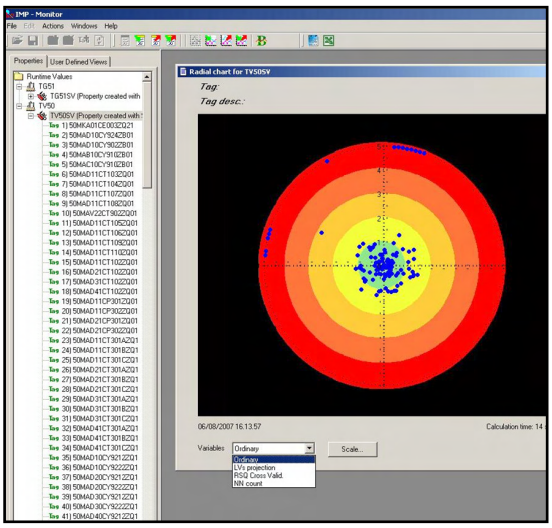

Figure 1. IMP-SV monitor depicting a “Bulls-eye” chart.

Once a model has been built and validated, it can be used on-line through IMP-SV on-line facilities for delivering timely and accurate predictions. Additionally, it can be exploited off-line for “what-if” analysis and sensitivity studies by means of a built-in Model Explorer utility.

IMP-SV REAL-TIME SERVER

The IMP-SV on-line environment provides a deployment platform for developed models and statistical evaluation. Real-time estimation is performed by direct connection to the plant’s DCS or PLC through OPC, using an IMP-SV built-in OPC client.

The environment features an open client-server architecture that allows the deployment of models built with the IMP-SV Model Builder, additionally, the IMP-SV Real-Time Server allows the implementation of calculations (through a scripting language) and custom, proprietary models through the use of DLLs.

The IMP-SV Real-Time Server allows the use of multiple IMP-SV monitor modules to monitor and command IMP applications.

The configuration of the IMP-SV Real-Time Server is accomplished through the use of a dedicated IMP-SV configurator module.

Advanced visualization techniques allow the user to clearly spot which sensors need attention using a “Bulls-eye” chart such as the one featured in Figure 1.

IMP-SV provides a cost-effect alternative to traditional data validation methods by monitoring a substantial number of sensors to help ensure a high degree of accuracy for the plant information stream.

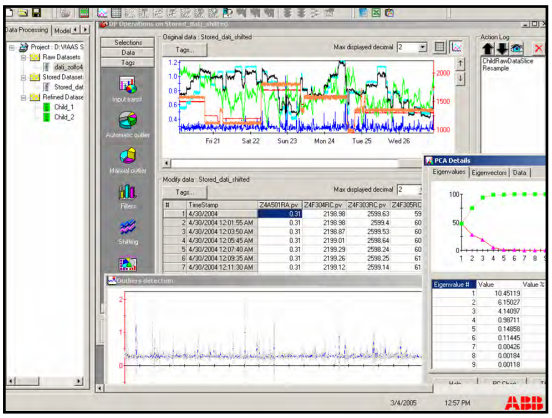

Figure 2. IMP-SV data processing workspace example.

Each point in the bulls-eye plot represents the deviation of the measured value from the calculated value, converted to a common basis (normalized with the deviation threshold).

The further a single point is from the center, the greater the deviation between the measured and calculated value.

The IMP-SV Real-Time Server is able to incrementally update, improve and extend the validity of the stored models by means of a Snapshot Saving feature. When a user recognizes that a process is in an interesting or questionable situation, they can add all the sensor readouts as an additional record (a snapshot) to the general database. In this way, the application will grow both in extension and in robustness without requiring any additional effort.

IMP-SV TARGET APPLICATION

Sensor validation is a critical factor in preventing and managing abnormal or even emergency situations. Its inherent ability to provide early warnings about sensor malfunctions or equipment degradation grants more response time for corrective action. IMP-SV has been designed to be fully compliant with this undertaking. An IMP-SV data processing workspace is shown in Figure 2.

IMP-SV provides essential functions for process plant monitoring and diagnostics projects, including:

- Identification and qualification of shifts in plant performance
- Early detection of failing devices and/or equipment
- Temporary back-up for out-of-order sensors
- Data validation for critical decision/planning tools (ERP, MES, Real-Time Optimizer, etc.)

Given the flexibility of IMP-SV, its application is well suited for the process industry sector ranging from petrochemical to power plants, and from pulp & paper units to refineries.

THE NEED FOR ACCURACY

Over the last 15 years, information technologies and advanced control techniques have had an enormous impact on process plant operation, changing forever the way process plants are run. The result has been a dramatic improvement in plant performance.

The foundation of this approach is based on having a timely and accurate flow of information from the plant with which production can be maintained and efficiencies initiated.

However, this approach is potentially problematic if the data coming from the plant are not reliable. Given the high number of sensors placed in any modern industrial facility raises the potential that a certain number of instruments are failing or are at some level of performance degradation.

Traditional data validation methods have been based on the concept of redundancy. Two out of three logic (2oo3) is actually implemented only on a very small subset of the installed sensors, their cost preventing their application further restricting critical measurements.

IMP-SV provides a cost-effect alternative to traditional data validation methods by monitoring a substantial number of sensors to help ensure a high degree of accuracy for the plant information stream.

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