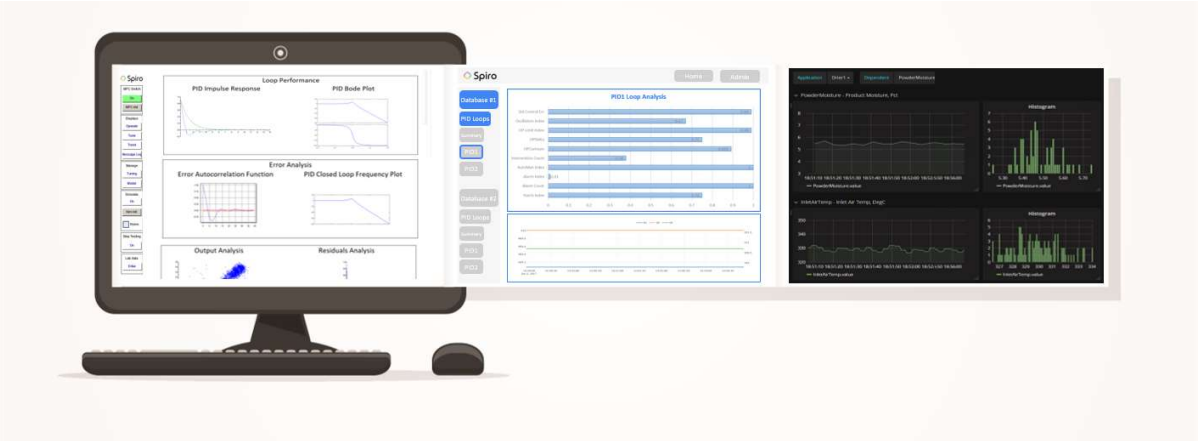
Spiro PID

PID loop monitoring and diagnostics

Overview

Spiro PID is an application that delivers continuous measurement and visualization of PID control loop performance, valve/actuator anomalies, and sensor performance. By understanding the cause of poorly performing control loops, users can make significant improvements to process efficiency. Key features include:

- ✓ A data historian capability to collect, monitor and visualise PID loop data for control loop performance analysis.
- ✓ Data analytics and performance metrics that can be used by the control engineer to monitor loop performance.
- ✓ Visual tools that identify poorly performing loops and can be used to diagnose the most likely causes of the degraded performance.
- ✓ Ability to extract data for off-line analysis.
- ✓ Tools in Octave for model identification and PID loop tuning parameter optimisation.

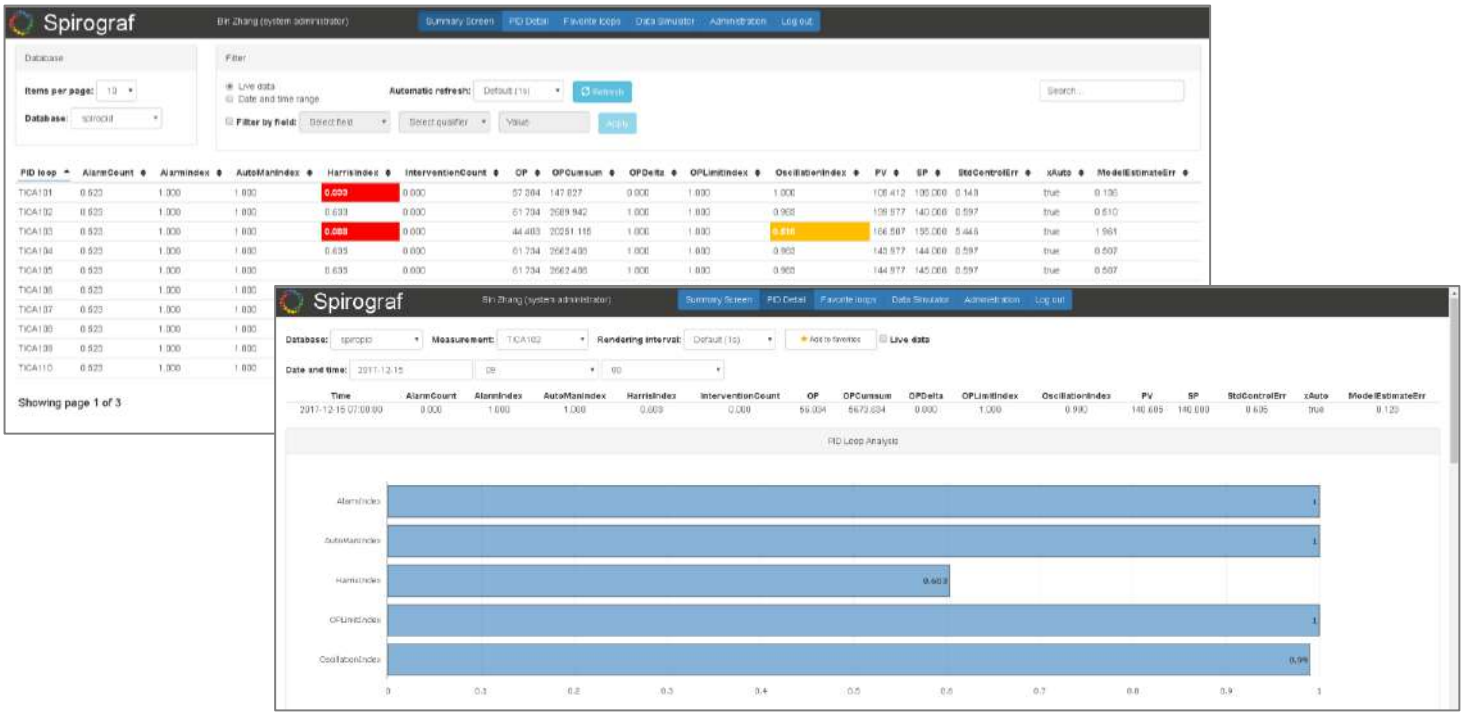


Benefits of using Spiro PID

- Quickly identify and correct PID performance problems.
- Prioritizes loop performance issues: All indices have a normalized value between 0 and 1 where values closer to 1 indicate desirable performance.
- Simplify the task of identifying optimal tuning parameters.

Performance metrics

Numerous performance metrics and statistics are provided, with results presented in intuitive charts and indices.



Visuals provided include:

- PID Loop Summary Display: Table showing metric values for all PID loops, where each column can be sorted and users can search & filter rows (e.g. filter to only show temperature loops).
- PID Loop Data Plot: Plot of PV, SP, OP. Highlight data where loop is in Manual.
- PID Loop Analysis Summary: A set of scaled bar graphs showing the value of each performance metric on a range of 0-1.
- PID Loop PV vs OP: This can be used as a visual indication of process non-linearity, and to display control valve issues such as basklash, hysterisis, dead band, and stiction.
- PID Impulse Response: The plot provides a direct measure of how well the PID is performing in rejecting disturbances or tracking SP changes. The plot shows characteristics such as overshoot, damping ratio, settling time, oscillations.
- PID Closed Loop Bode Plot: Shows the closed loop frequency response as an alternative way to evaluate how well the PID is performing in rejecting disturbances or tracking SP changes.
- PID Error Autocorrelation Function (ACF) Plot: The plot provides an approximation of how close the controller is to ideal, minimum variance.
- PID Closed Loop Frequency Plot: Shows the range of frequencies over which the controller is deviating significantly from minimum variance.
- ARX Model Residual Autocorrelation Plot: Used to evaluate the arx model.
- Output Distribution: Allows the user to understand if the control element is saturated.

Advantages deriving from cutting-edge deployment method

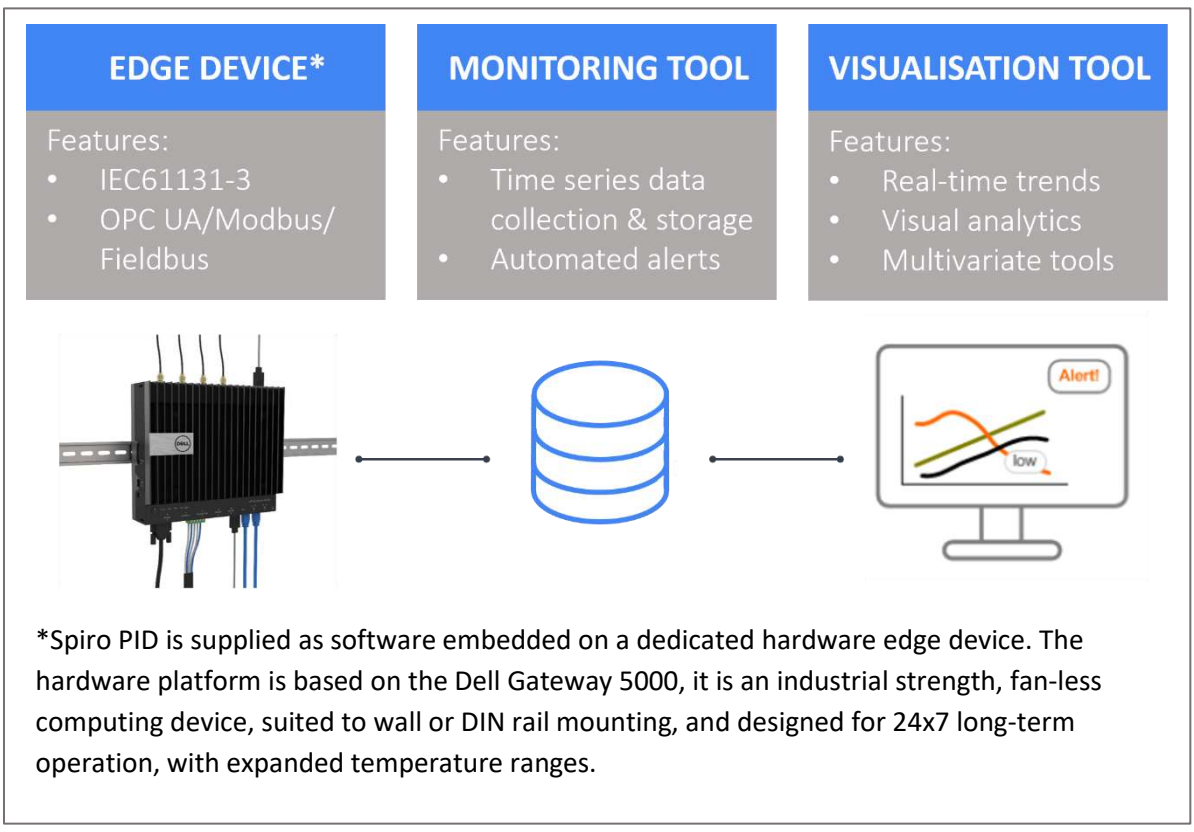
The traditional approach to comparable analytics is to route all measurement data to a central facility with large scale computing services. Our approach is different, we move the analytic function to the data, rather than the data to the analytic function. During day-to-day operation, running the analytics against live data is best done close to the data source. This approach offers significant benefits in the manufacturing environment as it has a lighter network footprint; only data that absolutely needs to be transferred to the central location is carried.

Edge device - Spiro PID is deployed as an application on an edge device, this is a rugged computing device that enables real-time evaluation of sensor data from industrial processes and equipment. A choice of communication protocols are supported including OPC-UA, Modbus, MQTT and various Fieldbus protocols. This allows easy integration with all control systems for streamlined data acquisition.

The PID loops are configured using a simple Wizard and the configured application then collects process data from the data source, calculates the PID loop performance metrics and pushes the results to the centralised monitor tool.

Monitoring Tool - The monitoring tool includes a high performance real-time database the collects and stores the loop performance data. This allows any historical performance or tuning data to be retrieved for comparison, analysis, process modelling etc.

Visualisation Tool - The visualisation tool is a web-server that allows authenticated web clients to retrieve and analyse loop performance data.



*Spiro PID is supplied as software embedded on a dedicated hardware edge device. The hardware platform is based on the Dell Gateway 5000, it is an industrial strength, fan-less computing device, suited to wall or DIN rail mounting, and designed for 24x7 long-term operation, with expanded temperature ranges.

Reasons for installing Spiro PID

Identifying improperly tuned PID control loops and instrumentation issues is critical to optimizing plant performance, yet:

- 70% of PID controllers are operating in automatic mode, 80% of which are operating sub-optimally!
- 65% of controllers are poorly tuned or de-tuned to mask control-related problems.
- 20% of control systems are not properly configured to meet the control system objectives.

Differentiators

- Solution easily integrates into any industrial control or data network. All major industrial data ingestion protocols are supported including OPC-UA, Modbus, and Fieldbus.
- Capability to run analytics at the edge while hosting the visualisation and monitoring functions either on premises or at cloud level.
- All performance metric calculations are implemented in standard IEC61131-3 code and executed in real-time.
- Performance calculations are based on a proprietary recursive closed-loop identification algorithm.
- Forgetting factor method is used in place of data windowing.
- All counters (e.g. Alarm count) are calculated on a per hour basis.
- Loops are assigned to configuration groups based on their dynamic response times.
- No additional configuration is required, the default parameters work out of the box.

Roadmap & collaboration

Spiro PID is an early stage product that we are continuously looking to improve on. What is set out in this document is just the start.

Spiro PID roadmap

Functionality	Functionality description	Status
PID performance metrics with web based visualisation & reporting	This constitutes the first release of Spiro PID, providing continuous measurement and visualisation of the performance of PID control loops throughout a plant. For each PID loop a user can drill down to a more detailed visual display to better understand loop performance.	Implemented
Closed loop model identification and PID loop tuning	This update will provide the essential tools for control loop optimization, all within the same web based platform as the Control Loop Performance Monitoring functionality.	Scheduled release **Q1 2018**
Self-service analytics tool set	To help users achieve a deeper understanding of their process operations and process capability, we will provide a range of interactive graphical tools for statistical analysis of process data.	Scheduled release **Q1 2018**
PID Loop diagnostics expert using machine learning	This is a tool that uses machine learning techniques to analyse control loop performance data and provide diagnostics for control loop related faults (such as sensor faults, actuator faults, tuning errors, and design errors).	Scheduled release **Q3 2018**
PID Loop Tuning Expert using machine learning	Tool for automated tuning of previously unseen PID loops.	Scheduled release **Q4 2018**

FREQUENTLY ASKED QUESTIONS

TOPIC: SOLUTION ARCHITECTURE

Question. Is it essential to use an edge device to run Spiro PID? For example, in a situation where I have a server on site, can Spiro PID be deployed on my existing hardware?

Answer. We support a variety of different architectures and can supply Spiro PID without the edge device to be installed on a local server. Indeed, in some instances this may indeed be the more logical route. The key advantage of using the edge device is the connectivity opportunities it affords.

Question. I have an existing data historian, I would prefer to use that to provide the PID data as this database resides on the business network. Is this a possibility with Spiro PID?

Answer. We can provide connectivity to an existing data historian that supports OPC-UA or REST based such as OSI PI.

Question. Regarding the communication standards supported, will they be backwards compatible?

Answer. Yes. Further to a choice of new communication protocols including OPC-UA, MQTT and various Fieldbus protocols, we also support OPC-DA, and Modbus. This allows easy integration with all control systems for streamlined data acquisition.

TOPIC: THE ANALYTICS PERFORMED

Question. We require the performance metrics to be calculated continuously so that we can identify any changes in loop performance. Are the performance metrics calculated continuously or on demand?

Answer. Performance metrics are calculated on a continuous basis, enabling you to configure alerts to notify you when loop performance deteriorates.

Question. When performance metrics alert me to a poorly performing loop, what additional details are provided to help diagnose the problem?

Answer. For each PID loop a user can drill down to a more detailed visual display to better understand loop performance. The key in our approach has been, rather than overload a user with a huge array of numbers, to focus on a key set of forensics tools that can enable a user to isolate the root-cause of a problem.

There are a number of Control Loop Performance Monitoring tools available, each with their advantages and disadvantages. However, a key motivation for developing Spiro PID is we see significant opportunity to improve on the forensic, prescriptive, and predictive capabilities of CLPM technology.

This is an area of continual improvement and focus with Spiro PID, as indicated in the Spiro PID roadmap displayed below.

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Question. One of our important plant KPIs is to monitor the number of loops that are operating in manual mode. Does Spiro PID report this?

Answer. From a user perspective it is important to know how many PID loops in a plant are in manual mode and what percentage of time are they in manual. Both performance metrics are reported on within Spiro PID. Other performance metrics will continue to be reported when a PID loop is in manual, although some may not be of relevance if this is the case.

TOPIC: HISTORIAN & REAL-TIME DATABASE

Question. Does Spiro PID come with a data historian?

Answer. Yes. The Spiro PID plant historian archives all process variables and performance assessments as well as all inputs and tuning constants. The data retention time is configurable by the user.

Questions. What are the capabilities of the real-time database?

Answer. Our high performance real-time database has the flexibility to collect additional supporting process data. The historian supports data visualisation tools, analysis of data can be done through a SQL like query language.