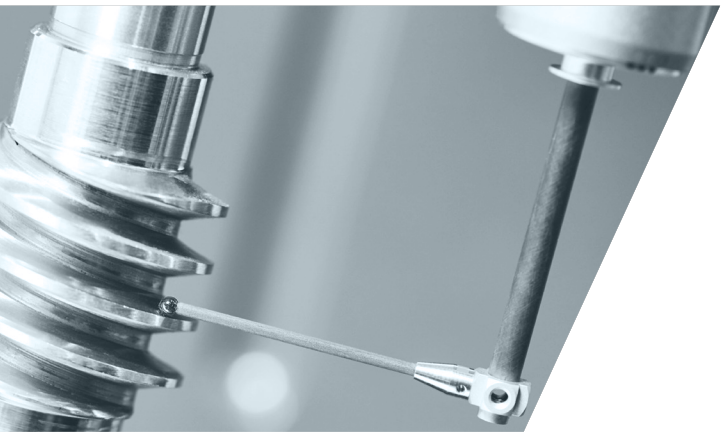
PerfectPattern

AI Sensors

Create software sensors
fast and unsupervized

Powered by PerfectPattern´s AI technology platform PYTHIA

Software Sensors
made quick and easy



Many companies do not yet benefit from the huge advantages of software sensors. Because until now, building software sensors was slow, expensive, and required a lot of data science expertise. This changes with AI Sensors.

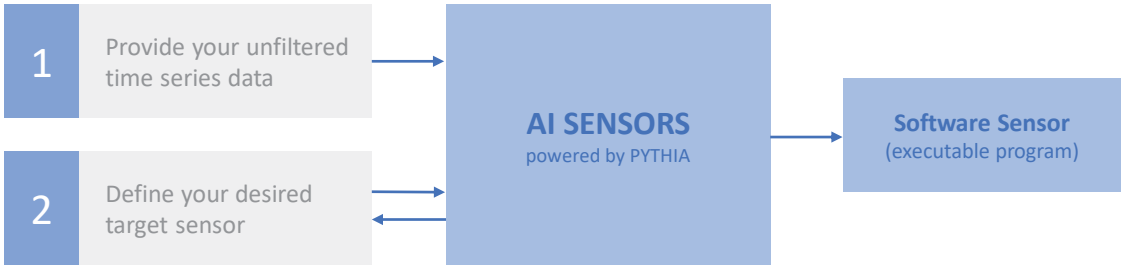
With AI Sensors you can create software sensors much faster, easier and with much less data than before. And the best part: You don't need much mathematical or data science expertise to do so. Because AI Sensors does the work for you.

Getting started:

1. **Provide the data for building/training the sensor**
   The time series data can be unfiltered and asynchronous. It can be a few megabytes, but also several gigabytes. The data can represent any number of signals – just a few, but also thousands of different signals.

2. **Define your request and generate the sensor**
   Your request describes the target software sensor, that you are about to build. This request might be straight forward like "generate a sensor for signal S", or more complex. Either way, the request must comply with the provided data. The sensor then is built automatically by AI Sensors.

3. **Integrate your sensor**
   Once created, your software sensor will be provided as an executable program. In order to be used efficiently, it has to be connected to the live signal data sources. You should also define, how often you want your sensor value to be updated.



Contact us!

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A breakthrough in building software sensors

Unsupervized generation of software sensors
The core of every software sensor is a model for calculating the desired sensor value from the input signals. AI Sensors generates these models without the need of human supervision or intervention. Working on asynchronous and unfiltered data, AI Sensors builds those models very quickly and based on relatively small amounts of training data (e.g. compared to Artificial Neural Networks).

No data cleaning, no parameter tuning
AI Sensors makes manual data preparation almost obsolete. Tasks like data synchronization and cleaning, removal of anomalies or adding sensor values for missing timestamps are completely covered by AI Sensors in an automated manner. Also, manual parameter tuning is not required.

Great performance, easy to maintain
Even in complex scenarios with learning data from thousands of physical sensors, including historical data, AI Sensors computes a new software sensor model **within one hour**. Also software sensor updates therefore can be easily performed.

Advanced techniques for finding signal relations
AI Sensors makes use of very advanced techniques such as modelling signals by stochastic differential equations (SDE), tuning of hyperparameters, clustering data and distance correlations. This way AI Sensors finds even the most complex relationships between signals. It also is fully deterministic: Identical input will always generate the same output.

Define your target sensor
Your request can be very basic like "generate a sensor for signal S", or more complex since S can also represent a function over time of multiple signals, as well as a forecast of statistical values. Anyway, if the data you provide complies with your request and allows the generation of a model, AI Sensors will do so. The result is a software sensor provided as an easy to use, executable program to be used in various environments.

Measurements within milliseconds
The execution time of the target sensor is typically just a few milliseconds. Such a software sensor can be used in closed-loop and real-time scenarios, for example to control and optimize complex production lines.

Prediction including root causes
Considering sensor signal response times, AI Sensors also models time series. This allows to predict e.g. a future signal progression including root causes, which influence the forecast of the software sensor signal.

AI Sensors is powered by PerfectPattern´s groundbreaking AI technology platform PYTHIA, providing significant advantages over conventional methods of data analysis.

What is PYTHIA

PYTHIA is a platform product for pattern recognition, time series prediction and anomaly detection in real-time data streams. By combining methods from deep learning, stochastic calculus, infinite dimensional geometry and quantum field theory, it independently finds even the most hidden patterns – if the information is in the data, PYTHIA will find it. The system learns how to predict and control any desired variable.

More information about PYTHIA is available at
https://perfectpattern.de/en/technology/pythia

Scan me!

Methodology

The following table compares the methodology of PYTHIA step-by-step with typical data analysis (others).

PYTHIA	Others
Unsupervized data synchronization	Data synchronization by data scientists
Unsupervized anomaly detection for data cleaning	Data cleaning by data scientist
Unsupervized extraction of relationships including response times	Extraction of relationships including response times by data scientist and domain expert
Automated creation of model of time series	Root cause analysis and creation of model of time series by data scientist
Prediction of target quantity based on delay SDEs	Prediction of target quantity by data scientist
Learning of impact on expectation of target quantity	Creation of model to affect root causes by data scientist

A new way of pattern recognition

The following tables compares pattern recognition of PYTHIA with Artificial Neuronal Networks (ANN).

	PYTHIA	ANN
Amount of data needed	small	huge
Training	global	local
Calculation speed	fast	fast
Overfitting	no	tends to
Tweaking	no	a lot
Transparency	full	not clear why it works

Software Sensors in a nutshell

A software sensor, sometimes referred to as "soft sensor" or "virtual sensor", provides an indirect measurement by computation of a measurand. It´s based upon results from real physical sensors. A software sensor is typically used where deploying a physical sensor isn't possible or is too expensive.

The value measured by a software sensor does not have to correspond to a physical value. It instead represents a characteristic value or parameter, a certain tendency or any abstract value, such as quality measures, output volumes, machine wear levels and more. Software sensor solutions are therefore mostly used to estimate product properties or process conditions, for instance.

For that purpose, the software sensor uses internal models to calculate or intelligently estimate the desired value(s) based on the inputs from multiple physical sensors. Eventually it also uses additional information, e.g. from an MIS system.

Most of the effort setting up software sensors lies in the learning phase and generation of these models. This work is typically performed by data scientists.

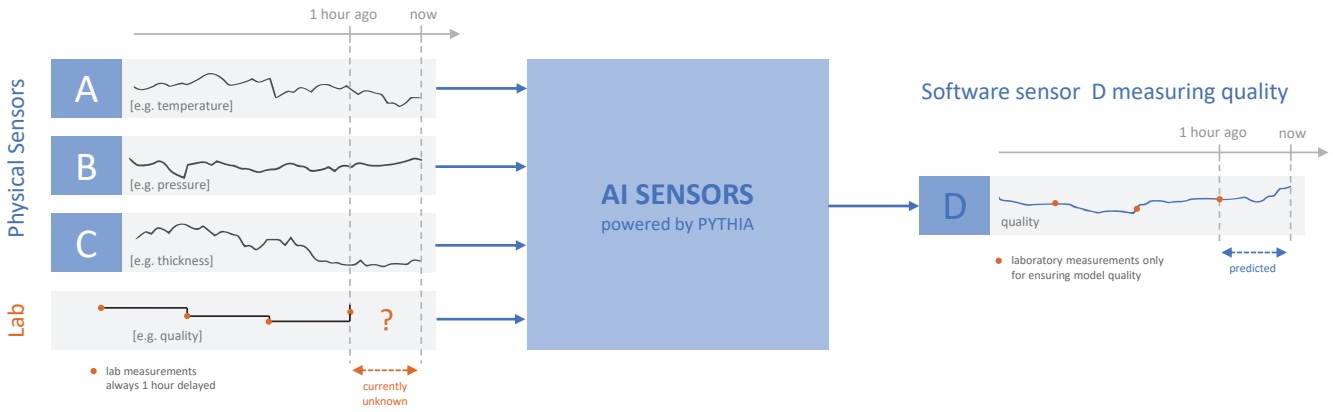
Advantages of soft sensors

- A software sensor can quantify the impact of a certain measure (machine wear, for instance) on another target measure (such as output volume and output quality).
- A software sensor can be easily adopted to changes in the system environment. A repeated learning process of the models will be often sufficient for this adaption.

Despite these obvious advantages, many companies do not yet make use of software sensor. Building the underlying data models typically requires very large amounts of data and takes a long time. In addition, it requires manual intervention and deep involvement of data scientists with domain expertise. This made the generation of software sensors slow and expensive – until now.

AI Sensors overcomes these obstacles

Based on PerfectPattern´s groundbreaking AI technology platform PYTHIA, software sensors can now be generated much faster, with much less data and fully automated.



Here is an application example for a software sensor: The quality of a product can only be determined one hour in retrospective by lab measurements. The physical sensors, however, do measurements online and live. By creating a software sensor measuring the quality, this value now can also be measured live, based on the other sensors outcome. Lab measurements are only necessary to ensure the quality of the software sensor.

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