WHITE PAPER

AI IN TEST AND MEASUREMENT

FROM DATA ACQUISITION TO INTELLIGENT TEST EXECUTION

DEWETRON

ABSTRACT

Test and measurement environments generate enormous amounts of measurement data, but most systems still rely on predefined limits and post-processing analysis. As a result, important deviations are often detected too late or not at all.

Artificial Intelligence (AI) introduces a new paradigm: instead of merely recording data, test systems can continuously interpret measurements, detect anomalies, validate test execution, and initiate corrective actions during the test itself.

This white paper looks at how AI can improve measurement and test environments, discusses an application example, and explains where DEWETRON fits in as the bridge between the two.

INTRODUCTION

Behind every test or measurement is a decision waiting to be made: is it within spec, is it trustworthy, is it ready? As systems grow more complex and test cycles grow longer, that decision increasingly depends on data no single person could fully review by eye, and the cost of getting it wrong, in time, materials, or reputation, keeps rising.

Current test environments already account for many such scenarios, threshold analysis being the standard example, but not every issue is caught this way, and some are only caught once the process has already run its course. This is exactly the kind of limitation AI is well suited to address: not by replacing sound engineering judgment or existing standards, but by adding a live layer of data interpretation and pattern awareness on top of them.

This article looks at that shift in three steps. It first examines the current state of automated test and measurement, and where current approaches structurally reach their limits. It then makes the business case for catching problems earlier, and explains what changes, technically and practically, once AI is brought into the live measurement loop. An e-mobility test bench example illustrates these ideas in a concrete setting, before the final sections describe DEWETRON‘s role in enabling this shift.

THE CURRENT STATE OF TEST & MEASUREMENT

Automated measurement processes are built around a well-established principle: define expected behavior in advance, measure continuously, and flag anything that crosses a defined limit. Data acquisition systems capture signals at high rates and high fidelity; software layers convert that raw data into engineering units, log it, and compare it against thresholds, tolerance bands, or pass/fail criteria set before the test begins.

This model is used across industries such as e-mobility, aerospace, automotive, and industrial manufacturing to validate performance, reliability, efficiency, and compliance. Test systems have grown more sophisticated, with synchronized acquisition across hundreds or thousands of channels, complex online calculations, and automated reporting. But the core logic has stayed the same: deterministic, auditable, easy to certify, and largely without any learning or adaptive component. Where automation has advanced further, it has mostly done so around the test (e.g., scheduling, sequencing, reporting) rather than in live interpretation of measurement data itself. Subtle patterns, like a signal drifting toward a limit or a profile quietly diverging from its own specification, are still typically caught only when an engineer reviews the data after the run.

CHALLENGES IN CONVENTIONAL TEST & MEASUREMENT WORKFLOWS

Limit checks excel at catching what they were explicitly built to catch: known conditions with known thresholds, defined in advance. Their limitations show up precisely where the problem is not a single value crossing a single line:

- Gradual drift: Issues that build up over hours or days, for example a slow rise in temperature, a creeping shift in a vibration signature, without ever breaching a fixed threshold until the underlying damage is already done.
- Deviation from the intended process, not the object being measured: A measurement can look flawless in isolation while the process producing it is wrong, for example a misconfigured parameter set, a corrupted profile, a hardware fault upstream. Values may stay within „normal“ ranges even though they no longer reflect what was meant to be measured.
- Setup and configuration errors: Errors introduced before acquisition starts, for example a sensor on the wrong channel, a mismatched sensor type, are often invisible to limit checks, since the recorded values can still look plausible on their own.

What these scenarios share is that they are failures of pattern, trend, or consistency with an expected reference. They are not failures of a single measured value and therefore lie outside the strengths of conventional rule-based monitoring systems.

CURRENT APPLICATIONS OF AI IN TEST & MEASUREMENT

AI and machine learning (ML) are already used in adjacent areas of test, validation, and industrial operations. Typical applications include anomaly detection in production testing, predictive maintenance based on long-term sensor behavior, automated fault classification, and advanced post-test analytics. All of it works with patterns and trends in continuous data rather than fixed limits, the same category of problems described above.

However, AI is still most commonly applied after measurements have been collected rather than during the test itself. In many environments, data is recorded first and analyzed later, limiting the ability to intervene while the test is running. Yet this is precisely where the greatest potential exists. Bringing AI-powered analysis into the live measurement workflow represents the next step in the evolution of test and measurement systems. Rather than simply recording what happened, future test environments will increasingly be able to understand what is happening while it is happening.

THE BUSINESS BENEFITS OF AI IN TEST & MEASUREMENT

Every gap described above has a cost attached that continues to grow the longer detection takes. A drift caught only once a hard limit is breached means the damage has often already happened. A flawed measurement process that runs to completion means an entire cycle of time, energy, and equipment wear was spent producing a result that has to be discarded and repeated.

The later a problem is found, the more expensive it becomes to fix — not just in direct cost, but in time on the test bench, personnel hours spent reviewing data after the fact, and wear on equipment and test objects that a faster catch would have avoided. Catching these patterns earlier, while a process is still running, delivers:

- Less wasted test time – problems are caught mid-run, not discovered only once a cycle has completed.
- Lower cost – fewer repeated runs, less scrapped material, less idle equipment time.
- Less manual review – engineers spend less time combing through completed datasets looking for what went wrong.
- Less wear – on both the equipment and the object under test, since faulty runs are interrupted rather than run to completion.

In short: earlier detection turns fixed costs of failure into avoidable ones.

HOW AI TRANSFORMS TEST & MEASUREMENT

Pattern and trend detection are well-established AI capabilities. What's missing today is architectural: applying them at the right moment, during a measurement process, rather than afterward on data already exported.

A live AI-connected loop looks different from a plain threshold check. Acquisition and live processing feed a stream of data into an AI environment that checks, validates, and interprets it as the process runs, producing a result that reflects not just whether a limit was crossed, but whether the process behaved as expected overall. This unlocks two levels of value:

- Earlier and more precise flags - such as drift trends, pattern deviations, or setup inconsistencies- surface while there is still time to act, along with a clearer picture of why a result failed rather than just that it did.
- Closed-loop response, where a system does not just flag an issue but reacts to it, adjusting a parameter, pausing, or aborting a run automatically.

Crucially, none of this requires replacing the measurement infrastructure already in place. It requires making its data available, live to an AI environment capable of interpreting it. This is precisely where the data acquisition layer comes in.

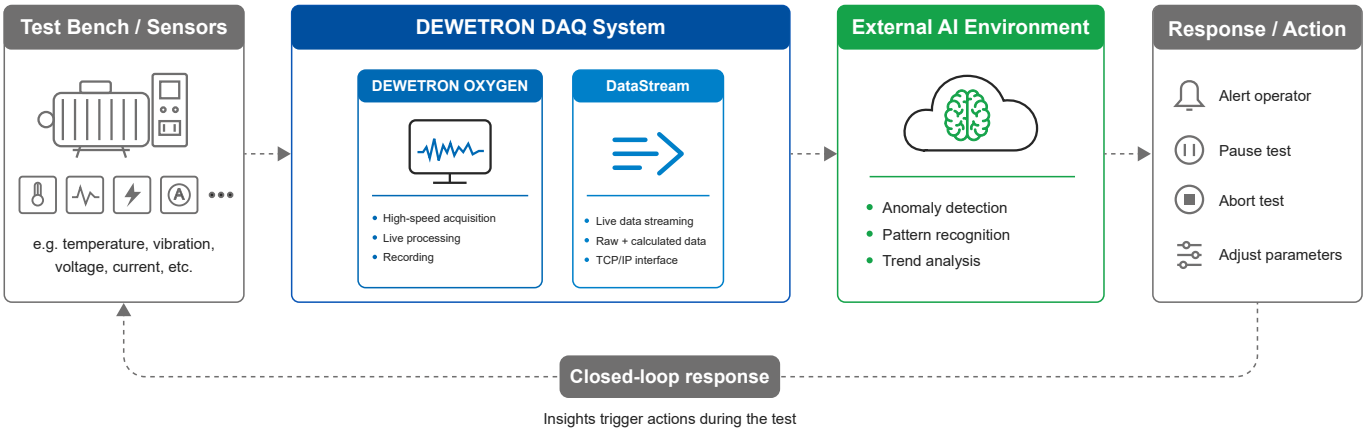


Fig. 1: DAQ Process with Support of AI

EXAMPLE APPLICATION: E-MOBILITY TEST BENCH

Let's put this into practice using a simple example. Consider a long-duration test bench validating an e-motor: a load profile runs for hours, sensors track parameters such as temperature, vibration, voltage, and current, and a threshold system watches for limit violations. Two scenarios from this kind of setup illustrate the difference between threshold-based and live AI-assisted monitoring.

1. Drift that a threshold misses. A signal such as temperature or vibration begins drifting slowly over the course of the run. No limit is breached; the classical threshold monitor stays silent. An AI system evaluating the same stream flags the trend early, while the underlying cause can still be investigated before any damage occurs.
2. A test that runs, but is wrong. The motor is meant to follow a specific cyclical load profile. Due to a configuration error, a slightly different profile runs instead. Every individual value still looks plausible, so no threshold ever triggers, but the test itself no longer matches its specification. An AI system comparing the live signal against the intended profile detects the mismatch within a few cycles, well before hours of test time are spent on an invalid run.

Both cases involve no limit violation and no fault in the device under test itself. In the first, the object being measured behaves unexpectedly; in the second, the test behaves unexpectedly. Neither would have been caught by threshold monitoring alone, and both would otherwise only have surfaced once an engineer reviewed the data afterward.

DEWETRON AS THE BRIDGE BETWEEN TEST & MEASUREMENT AND AI

By now, the benefits of integrating AI into a measurement environment are clear, and so is the underlying requirement: getting live measurement data out of the acquisition system and into an AI environment, fast and reliably. This is where DEWETRON comes in. DEWETRON does not build AI models; it builds the infrastructure that gets data to them. OXYGEN, DEWETRON's measurement software, handles acquisition, live processing, and streaming. What happens with the data afterward is the customer's choice: any AI provider, any model, run in the cloud or locally.

> DEWETRON does not provide the AI – it provides the reliable, high-quality measurement data that enables AI to deliver meaningful insights.

OXYGEN offers several interfaces for transferring data to other systems, including SCPI, CAN, XCP, EtherCAT, Profinet, OPC-UA, and more. For connecting to an AI environment specifically, one interface stands out: DataStream.

DataStream streams both raw signals and calculated data via TCP/IP at high speed to one or more receiving applications. Data is sent in binary format via packages, each containing one or multiple channels with one or multiple timestamped sample points. Further multiple parallel streaming instances are supported. Everything is configured via SCPI, and integration is straightforward thanks to public documentation and freely available example transmitter and receiver code in C and Python.

This makes DataStream perfectly suited to feeding an AI environment with large volumes of data in a short amount of time, while a process is still running. Notably, DataStream also works during post-processing, streaming from stored recordings, so the same interface and the same downstream AI pipeline can serve both live and retrospective analysis.

The result is a clear division of responsibility:

- OXYGEN serves as the measurement hub, handling comprehensive and accurate data acquisition;
- DataStream forms the bridge, delivering that data live and reliably;
- and the customer decides what intelligence sits on the other side.

Why DataStream is ideal for AI-driven test systems:

- Purpose-built for live streaming – built for reliably transmitting data to external environments
- High-speed TCP/IP transfer – built for large data volumes in short time windows
- Multiple parallel instances – several independently configurable streams and channel sets at once
- Raw + calculated data – streams both raw signals and computed values
- Fully SCPI-configurable – programmatic setup and control
- Live or post-hoc – same interface to stream from a running acquisition or from stored recordings
- Fast to integrate – public documentation and open example codes (C, Python)

BENEFITS OF SEPARATING AI FROM THE MEASUREMENT SYSTEM?

As mentioned in the previous section, keeping AI external to the data acquisition system, rather than embedding it into the measurement hardware, is a deliberate architectural choice. It brings a set of practical advantages that are worth making explicit.

No Impact on the Data Acquisition Performance

Running AI on separate infrastructure means the DEWETRON system stays fully dedicated to measurement, data recording, deterministic acquisition, and power calculations. AI workloads never compete with acquisition for compute or timing resources, so there is no risk of AI processing affecting measurement performance or accuracy.

Bring Your Own AI, Without Lock-In

Because DataStream simply delivers data, you are free to connect whatever AI environment fits their needs, from major cloud AI platforms to open-source frameworks, MATLAB-based tools, or proprietary in-house models, without changing anything about the DEWETRON setup. This protects existing AI investments and avoids vendor lock-in on either side of the bridge.

Reuse Existing Models and AI Workflows

Because the AI environment is separate from the data acquisition hardware, you are not limited to models trained specifically for that hardware. Predictive maintenance models, fault classifiers, digital twins, or battery models that already exist and are already trained can be applied directly, without a retraining cycle tied to the measurement system itself.

Independent Scalability and Evolution

AI resources can scale independently of the measurement hardware: the same AI service can support one test bench or a hundred, and a cloud-based deployment can grow with demand without any change to the DAQ side. The reverse holds too, AI models can be updated, retrained, or replaced as they improve, while the measurement hardware remains untouched. Neither side forces an upgrade cycle on the other.

CONCLUSION & OUTLOOK

Threshold-based monitoring has served automated measurement well for decades, but it was never built to catch drift, pattern deviation, or setup errors that never breach a fixed limit. AI closes that gap, not by replacing the measurement infrastructure already in place, but by adding a live analytical layer. Instead of discovering issues after a process has been completed, patterns are caught while the test is still running, enabling earlier intervention and more informed decisions. The e-mobility example illustrated what this looks like in practice, and the underlying principle applies well beyond any single use case, to any environment where measurement data is generated continuously and a delayed answer has a cost attached.

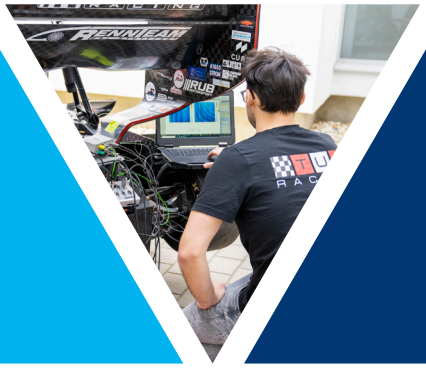
DEWETRON's role in this shift is deliberately narrow: OXYGEN and DataStream deliver measurement data live and reliably, so that your AI environment - whatever it is and wherever it runs - has the information needed to act on it. As AI capabilities continue to evolve rapidly, the choice of AI framework, model, deployment strategy, or provider remains entirely with you. Whether intelligence is implemented on-premises, at the edge, or in the cloud, DEWETRON provides the data foundation required to enable it.

That evolution points in a clear direction. The nearer-term step is better analysis: earlier, more precise flags and clearer root-cause detection. The step beyond that is closed-loop response, where a measurement system does not just report a deviation but reacts to it, automatically and in real time. Getting there does not require new acquisition hardware or a new measurement philosophy. It requires exactly what DataStream already provides: a live, reliable connection between the test bench and an intelligence that is asked to interpret it.

AUTHOR

Rafael Goldgruber

Rafael Goldgruber holds a Master's degree in Physics from the University of Graz, specializing in astrophysics and data analysis. Before joining DEWETRON, Rafael worked on various scienceresearch projects in Austria and Spain, gaining valuable experience in the field. Since 2022, he has been part of DEWETRON, where he serves as an Application Engineer. In this role, Rafael contributes his expertise to the development of advanced measurement systems, leveraging his background in physics and data analysis to support the company's projects and initiatives.



ABOUT DEWETRON

DEWETRON is a manufacturer of precision test and measurement systems and part of the globally operating Anritsu Group. Our reliable measurement data help customers worldwide make processes more predictable, efficient, and safer.

Our strength lies in customized measurement solutions: ready to use right away while remaining flexible to adapt to dynamic testing requirements in the energy, automotive, transportation, and aerospace industries.

More than 35 years of experience and innovation have made DEWETRON a trusted partner in the global test and measurement market.

More than 25,000 DEWETRON measurement systems and over 400,000 measurement channels are in continuous use at leading companies worldwide.

DEWETRON's quality is certified according to ISO 9001 and ISO 14001.
The high integrity of the measurement data is guaranteed by our own accredited calibration lab according to ISO 17025.

THE MEASURABLE DIFFERENCE.

Get to know our
GLOBAL OFFICES

DEWETRON

HEADQUARTERS
DEWETRON GmbH
Parkring 4, 8074 Grambach
AUSTRIA

+43 (0) 316 3070-0
info@dewetron.com
www.dewetron.com