

# Getting road load data right

From measurement to confident product design decisions

Kurt Munson

Brian Lovdahl

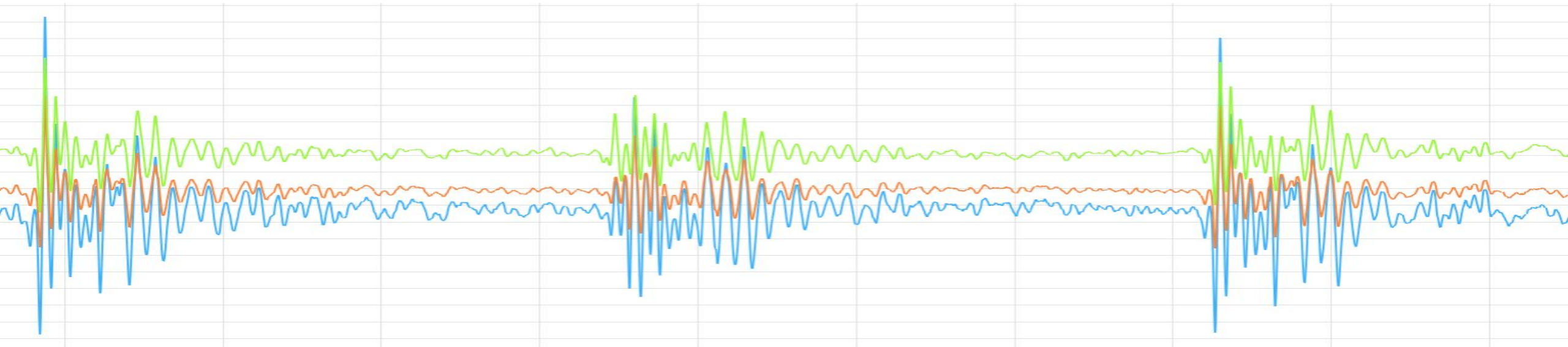
Kevin Horne



# Agenda

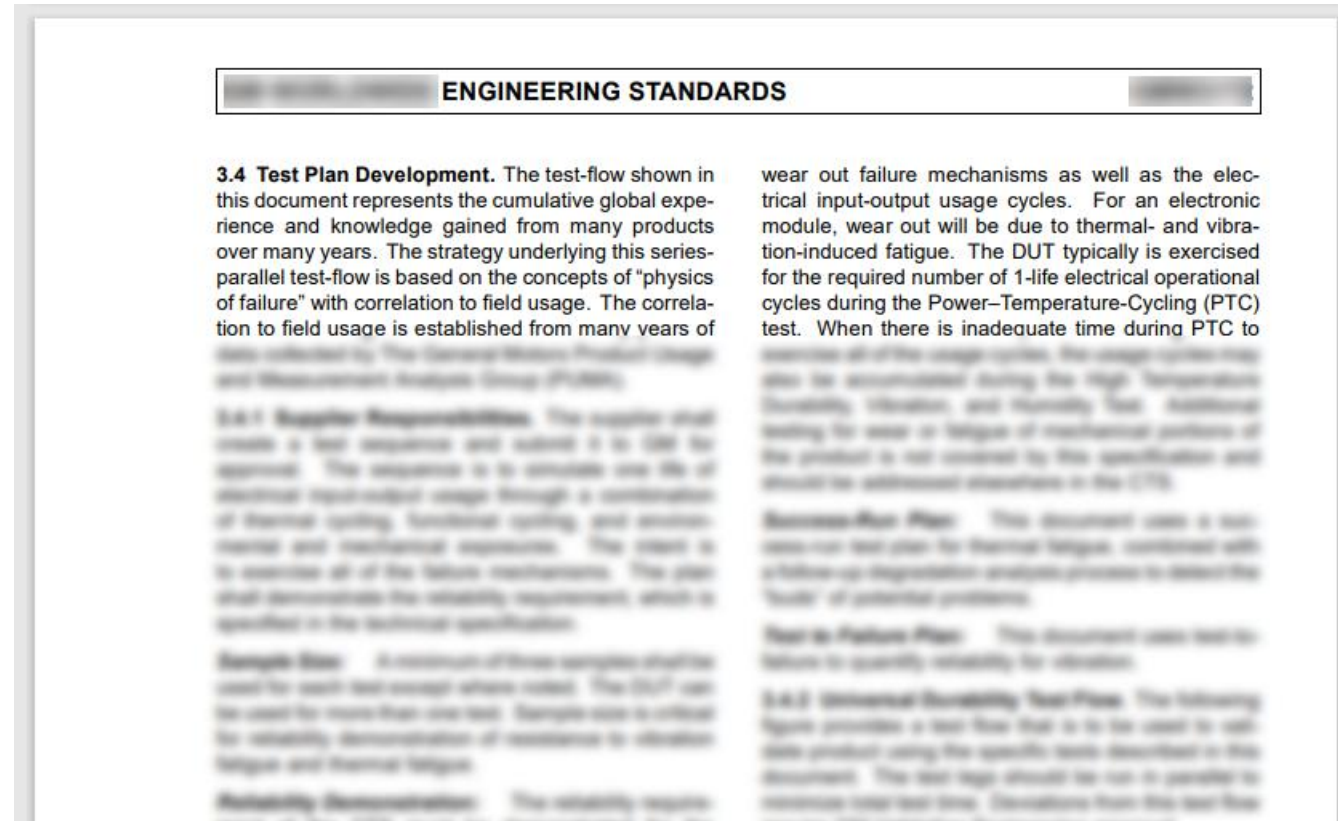
## **RLDA: road load data acquisition**

1. The challenge: how is the vehicle used?
2. The solution: an integrated sensor – DAQ – analysis workflow
3. The benefit: why does RLDA matter?
4. Summary



# Why is RLDA important?

We need to meet these requirements



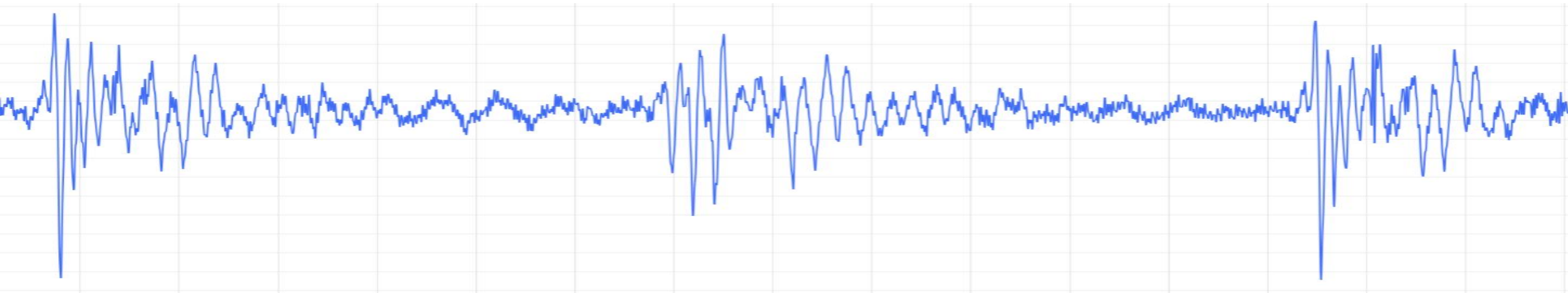
***‘Product must be free of visible cracks after 150,000 miles of use’***



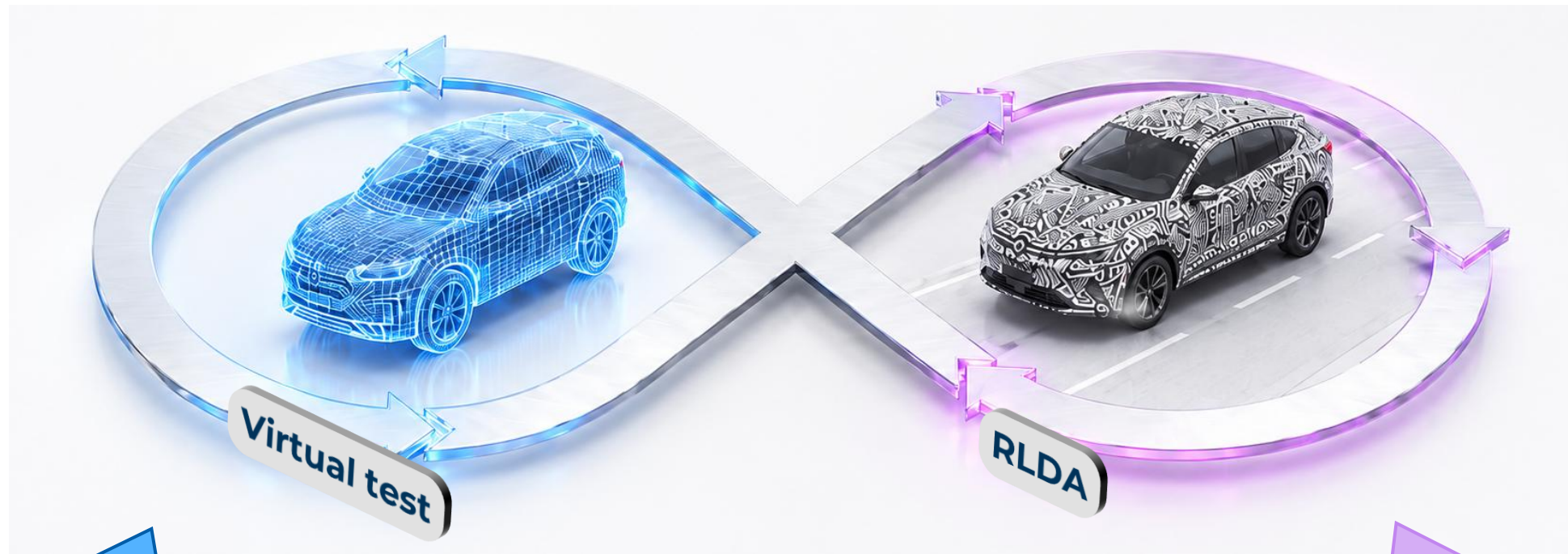
We don't want this to happen

# Why RLDA?

1. Understand and validate product performance
2. Verify and update design assumptions
3. Feed CAE simulation of motion, strength, durability, vibration, etc.
4. Define lab tests – real time, block cycle, and vibration tests
5. Correlate physical and virtual testing



# Virtual and physical testing in product development



Virtual testing with CAE-based simulation has become increasingly important

Physical testing and RLDA remains an important validation step

# The RLDA workflow

HBK has integrated tools for this entire workflow

1



## Physical Phenomenon

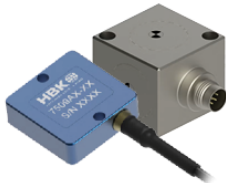
Real-world loads and conditions

2



## Sensor

Capture the physical response



3



## DAQ

Condition and digitize the signals



4



## Measured Data

High-fidelity time histories



5



## Data Validation

Ensure data quality and trustworthiness

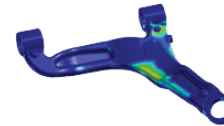


6



## Analysis

Extract insights and understand behaviour



7



## Actionable Answers

Turn insights into engineering decisions



8



## Product Improvement

Improve design, reduce risk, increase reliability



# The RLDA workflow

The test procedure

1



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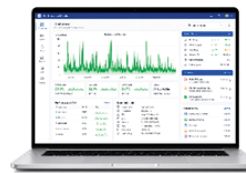


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Ensure data quality and trustworthiness

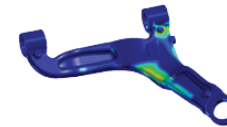


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# The RLDA workflow

Sensors to measured data

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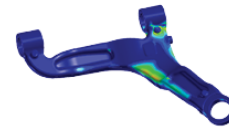


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# Augmenting the traditional RLDA data set

Beyond strain, forces, and displacement

- GPS and CAN
  - Association of events
- Video
  - Data validation tool – incidents
- Inertial Measurement Units (IMU)
  - Precise frame orientation at time of event
  - The MicroStrain [MV7-AR](#) is a rugged, CAN based IMU

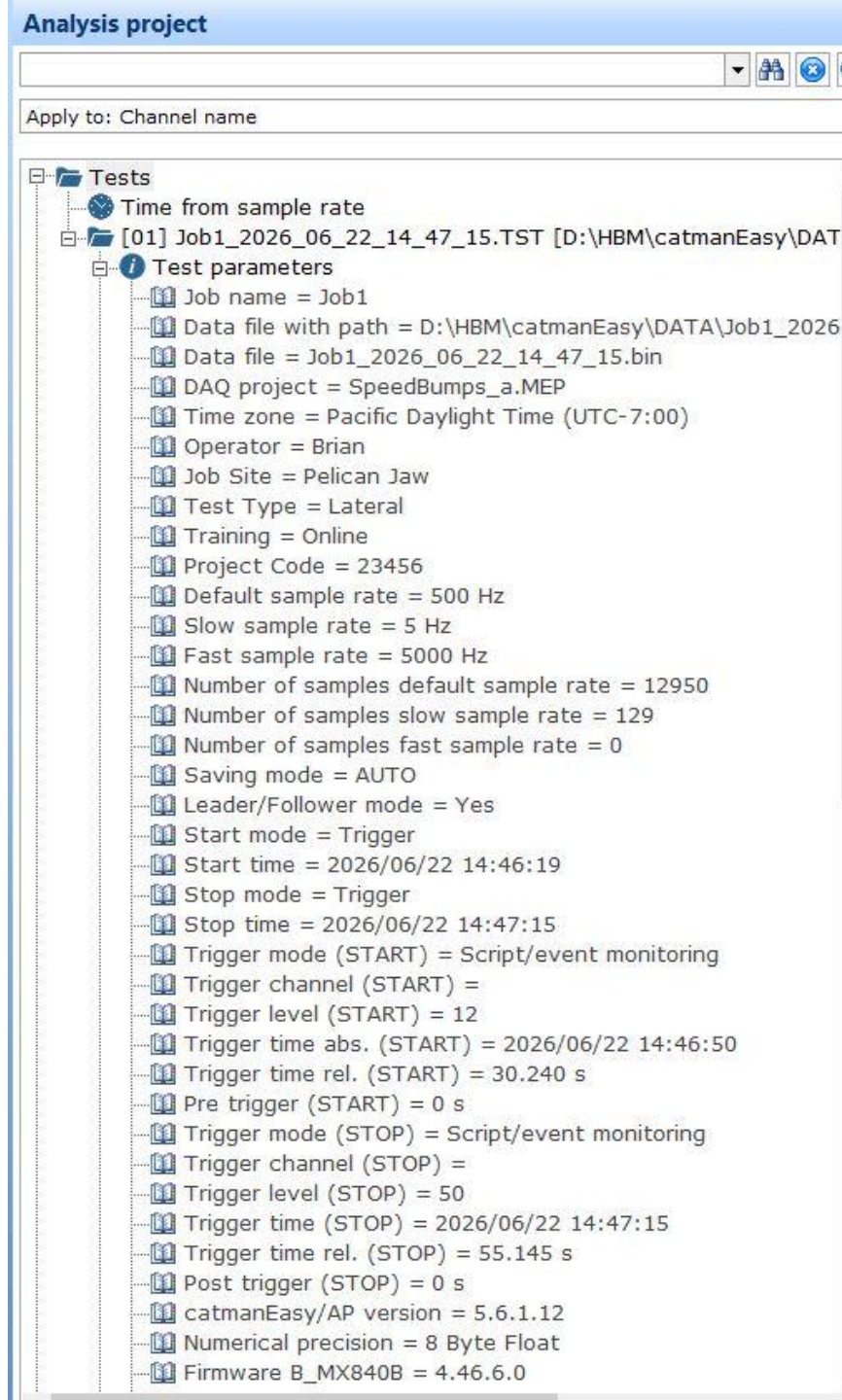


# Traceability and metadata

Documenting your setup

Catman data acquisition software – HBK's computer aided test manager.

Multiple Test parameters can be embedded into data files at time of testing



# Traceability table

Assign channels from Test Data

catmanAP V6.0.1 Analysis project: <C:\Users\Lovdah\Documents\HBM.....atmanEasy\RLDA\_PostProcess.OFP>

File Test Explorer Visualization Dataviewer Computations Export

New Copy Lock Zoom out Zoom in Paste Full screen mode Delete Update Panel/page Visualization objects Computations Report

Stats Simple Min/Max Traceability X

|                      | AngularRate_PitchRate | AngularRate_RollRate | AngularRate_YawRate  | AccelerationSensor_Vertical | Bend Beam              | Air Temp             |
|----------------------|-----------------------|----------------------|----------------------|-----------------------------|------------------------|----------------------|
| Channel comment      | MV7-AR - s/n 214731   |                      |                      |                             | T-rosette on beam      |                      |
| Samples              | 11825                 | 11825                | 11825                | 11825                       | 11825                  | 11825                |
| Sample rate          | 500 Hz                | 500 Hz               | 500 Hz               | 500 Hz                      | 500 Hz                 | 500 Hz               |
| T0                   | 6/17/2026 4:36:19 PM  | 6/17/2026 4:36:19 PM | 6/17/2026 4:36:19 PM | 6/17/2026 4:36:19 PM        | 6/17/2026 4:36:19 PM   | 6/17/2026 4:36:19 PM |
| Unit                 | deg/s                 | deg/s                | deg/s                | m/s^2                       | µm/m                   | °C                   |
| Sensor               | AngularRate_PitchRate | AngularRate_RollRate | AngularRate_YawRate  | AccelerationSensor_Vertical | SG half bridge 350 Ohm | Thermocouple Type J  |
| Sensor-ID            | 217066210_7_2531      | 217066210_6_5818     | 217066210_5_1893     | 149958114_4_6581            | DMS_2_350              | Thermo_J             |
| Calibration date     | Not defined           | Not defined          | Not defined          | Not defined                 | Not defined            | Not defined          |
| Expiration of        | Not defined           | Not defined          | Not defined          | Not defined                 | Not defined            | Not defined          |
| Amplifier            | MX840B-R              | MX840B-R             | MX840B-R             | MX840B-R                    | MX840B-R               | MX840B-R             |
| Serial no. amplifier | 9E5007BD6             | 9E5007BD6            | 9E5007BD6            | 9E5007BD6                   | 9E5007BD6              | 9E5007BD6            |
| Connector plate      | NA                    | NA                   | NA                   | NA                          | NA                     | NA                   |
| Serial no. connector | NA                    | NA                   | NA                   | NA                          | NA                     | NA                   |
| Transducer type      | Unknown               | Unknown              | Unknown              | Unknown                     | SG half bridge         | Thermocouple Type J  |
| Excitation voltage   | NA                    | NA                   | NA                   | NA                          | 2.5 V excitation       | NA                   |
| Carrier frequency    | NA                    | NA                   | NA                   | NA                          | 4800 Hz                | NA                   |
| Filter               | NA                    | NA                   | NA                   | NA                          | Bessel lowpass 50 Hz   | Bessel lowpass 50 Hz |
| Zero balance         | NA                    | NA                   | NA                   | NA                          | 390.7709 µm/m          | 0 °C                 |
| Scaling              |                       |                      |                      |                             | Strain gage            |                      |
| Electr. measuring    |                       |                      |                      |                             | 5.000 mV/V             |                      |
| Phys. measuring      |                       |                      |                      |                             | 7616 µm/m              |                      |
|                      |                       |                      |                      |                             | Gage factor = 2.02     |                      |
|                      |                       |                      |                      |                             | Bridge factor = 1.3    |                      |

# Introducing...

Centralized, expandable, vehicle DAQ



## Fusion RX

New-generation Fusion RX DAQ system is the perfect solution for rugged mobile testing in commercial, industrial, and military vehicles - when you need reliable road load and durability data.

[Fusion RX](#)

# Fusion RX

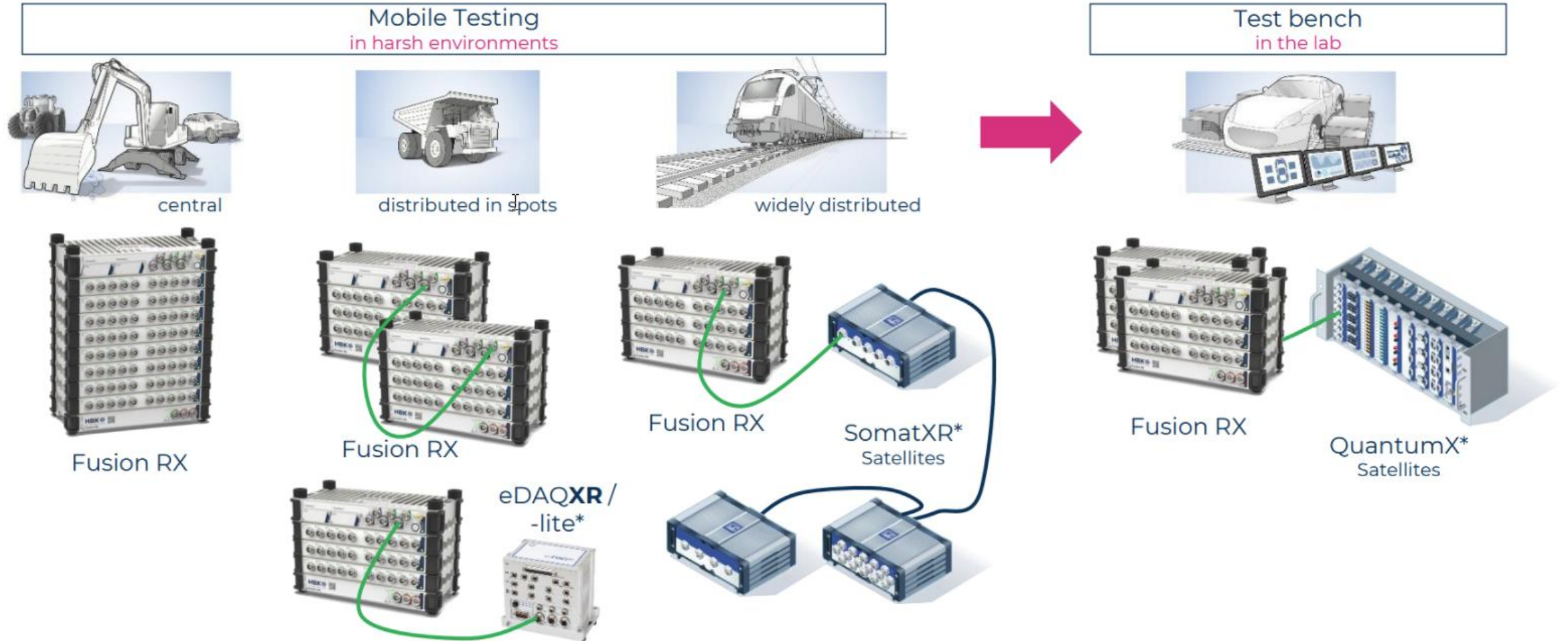
Centralize, Rugged, mobile DAQ



- Processor layer with CAN FD, GPS, Ethernet & EtherCAT interfaces
- 10 to 80 channels per stack with Universal layer – now!
- 2x Cartridge Slots – SSD, WiFi, 5G, CAN, Analog Out, Counter, video
- Saves data locally in .SIE file format

# Topology

One data set – regardless of channel count!



# Test setup in catman

Technical Empathy

- Sensor Database entries

  - Transducer setup – Accelerometer & Strain Gage

- CAN database imported as .dbc

- Test parameters in unattended mode

# Data validation

Is this data correct and useful?

1



## Physical Phenomenon

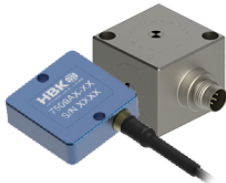
Real-world loads and conditions

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## Measured Data

High-fidelity time histories

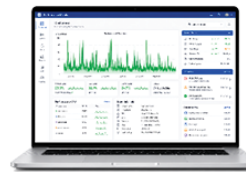


5



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Ensure data quality and trustworthiness

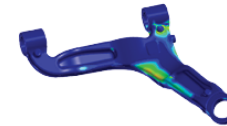


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Improve design, reduce risk, increase reliability



# Data validation

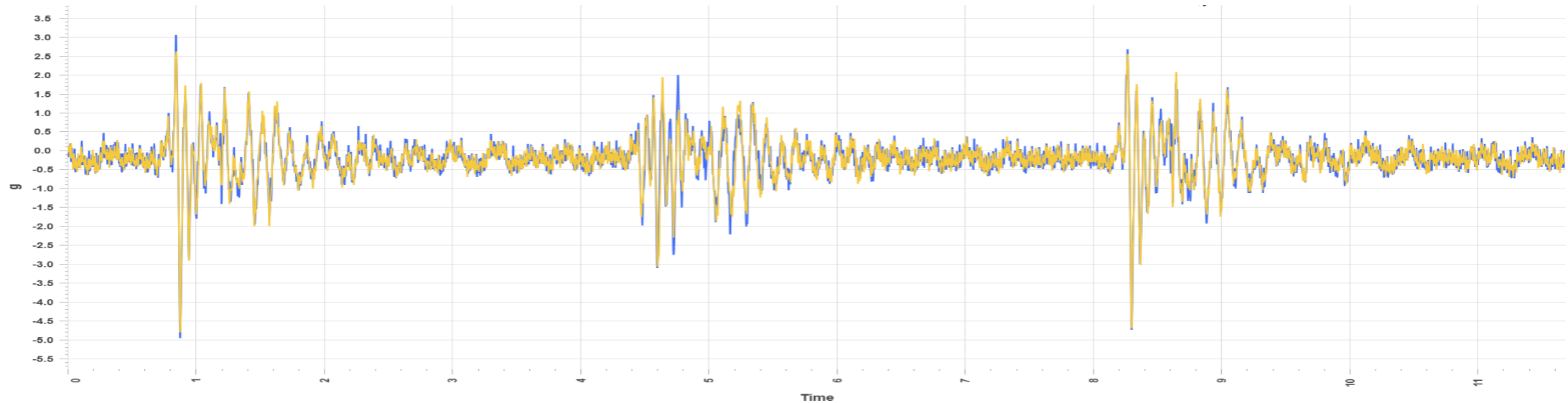
Are the sensors working?

Does the measurement make physical sense?

Was the test procedure followed correctly?

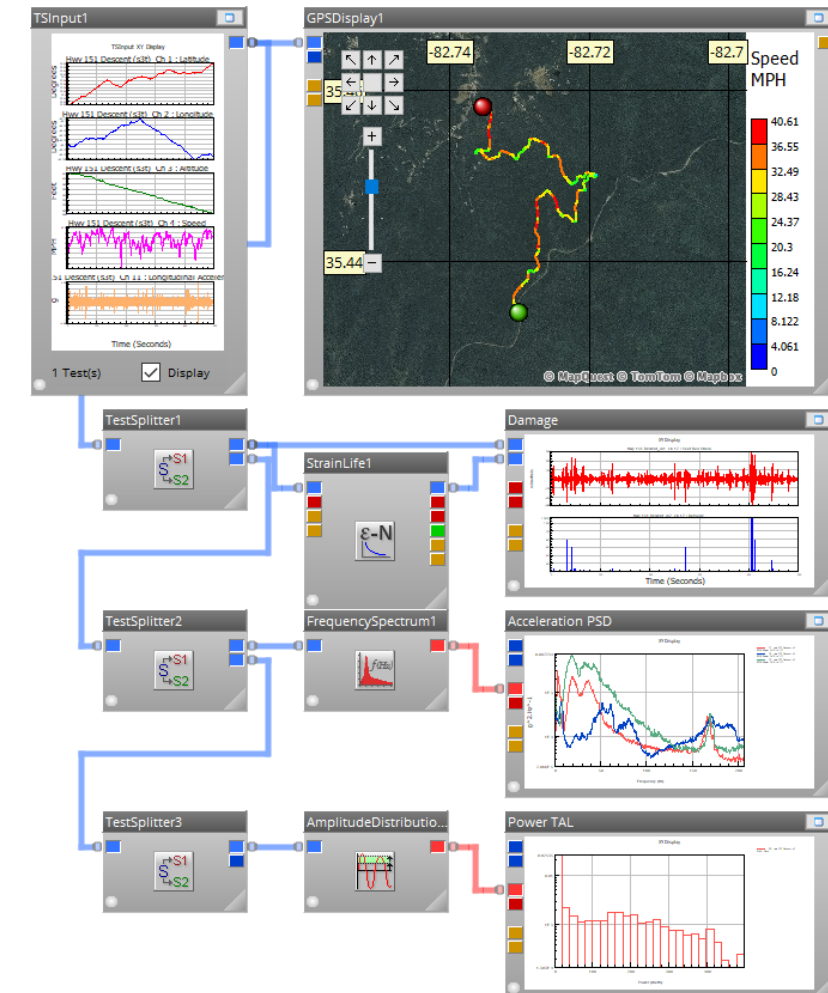
Can we trust this data to be representative?

Are we done measuring?

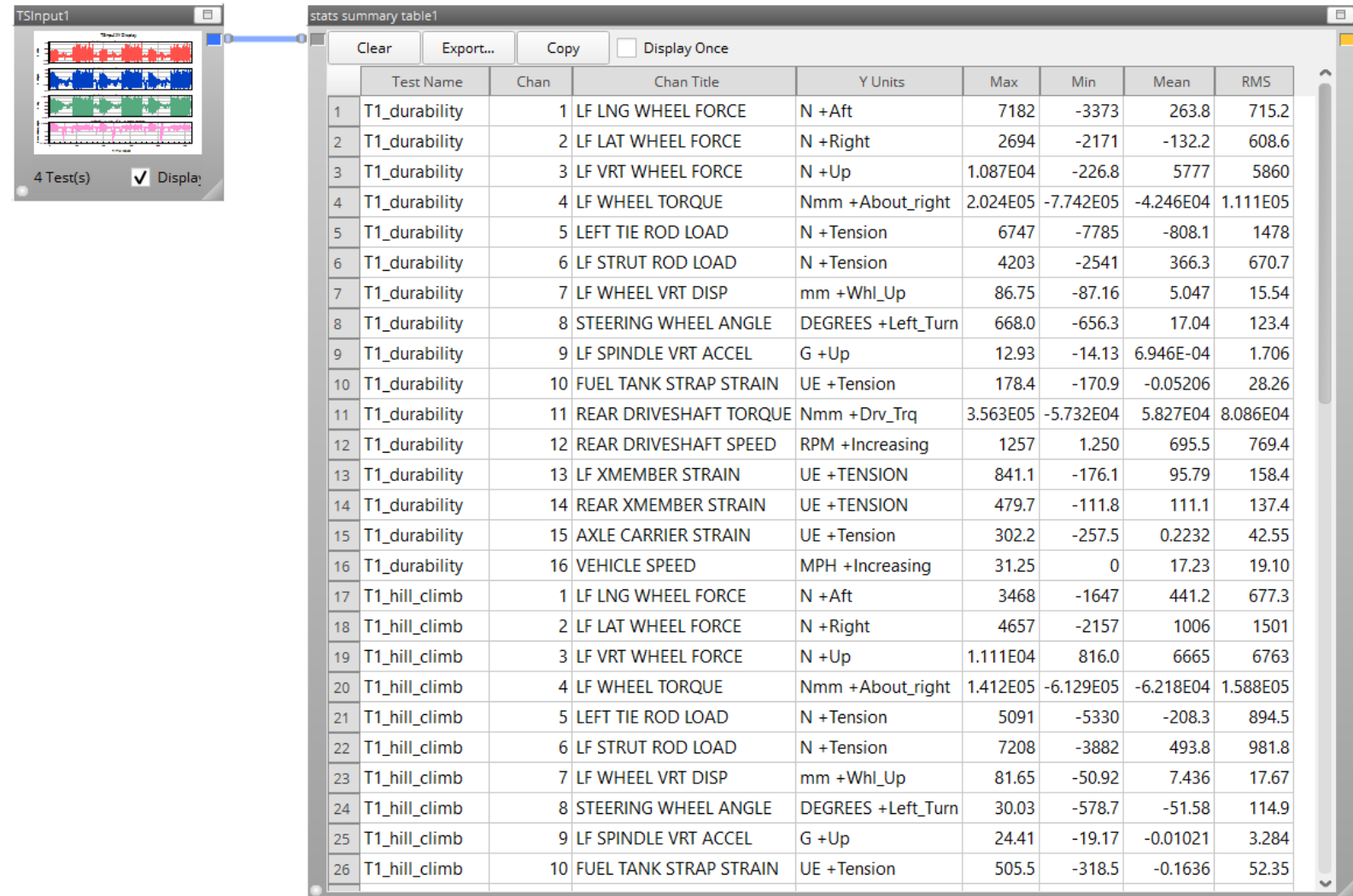


# Test data processing and durability analysis

- Intuitive, graphical interface for standardized analysis of measured data
- Pre-defined processes for performing time, frequency, durability, and statistical analysis
- Read 40+ time series file formats from many sources
- Accelerate durability and vibration tests
- Analyze gigabytes of multi-channel data and streamline reporting
- Single environment for correlating test and CAE data
- Extend capabilities with Python scripting and MATLAB



# Data validation demo using nCode GlyphWorks



# Data analysis

Do we meet engineering specs?  
How do we ensure durability and reliability?

1



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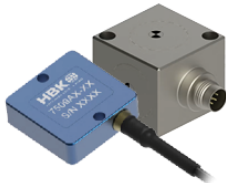
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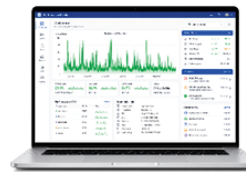


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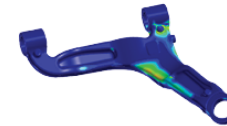


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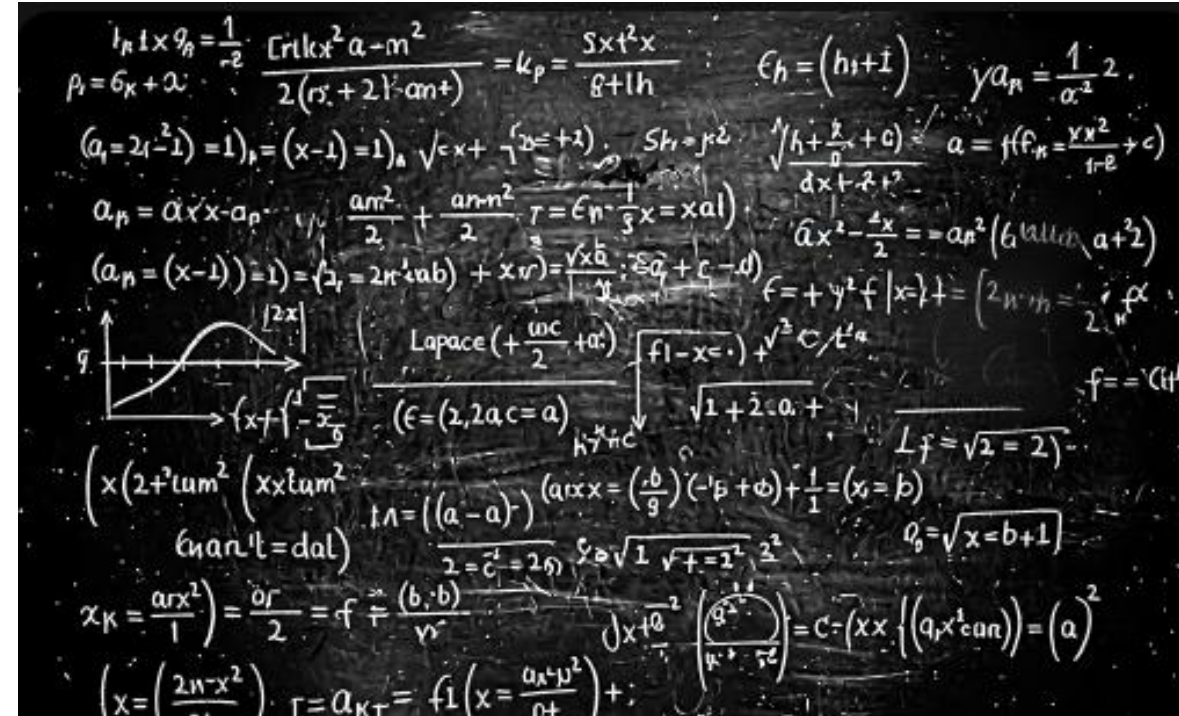
## Convert time series data into actionable insights

## How does it perform?

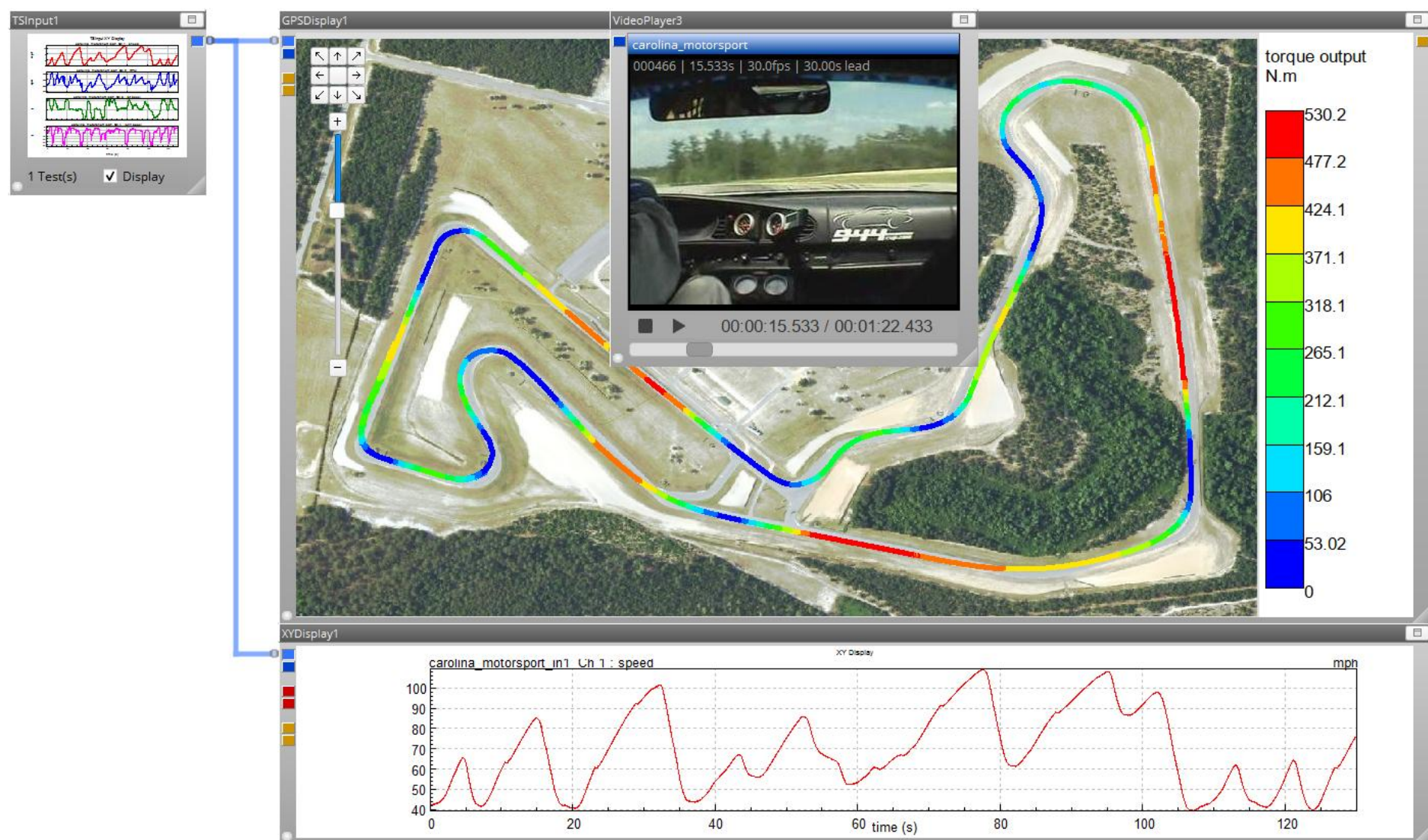
# How long will it last?

# How does it vibrate?

# Why does it perform the way it does?



# Data analysis demo with nCode GlyphWorks



# Aqira: test data management



Increase the value of historical RLDA data



Save time through improved searching



Run server-side analyses – either interactively or using apps



Better, faster insights from huge amounts of data



Avoid losing corporate IP, free up experts to add more value

Aqira

DriveSim Data Search | Select Search Parameters

Search for Channels

Search for Sessions

## Choose Data Parameters to Search for Data

For Session Searches: Select one or more of Platform, Scenario and Tire Model.

Data will be found where all parameters are true

Select Platform

DiM400

Select Scenario

vi\_provingground

Select Tire Model

Select

Select

cti

pac2002

pac2003

ridesuite

not defined

For Channel Searches: Select one or more of Platform, Scenario, Tire Model and Channel.

Data will be found where all parameters are true

Select Channel

Select

# Product validation

Does this product meet the specification?

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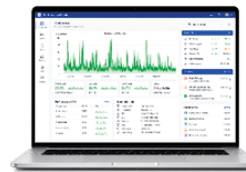


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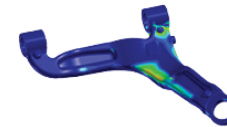


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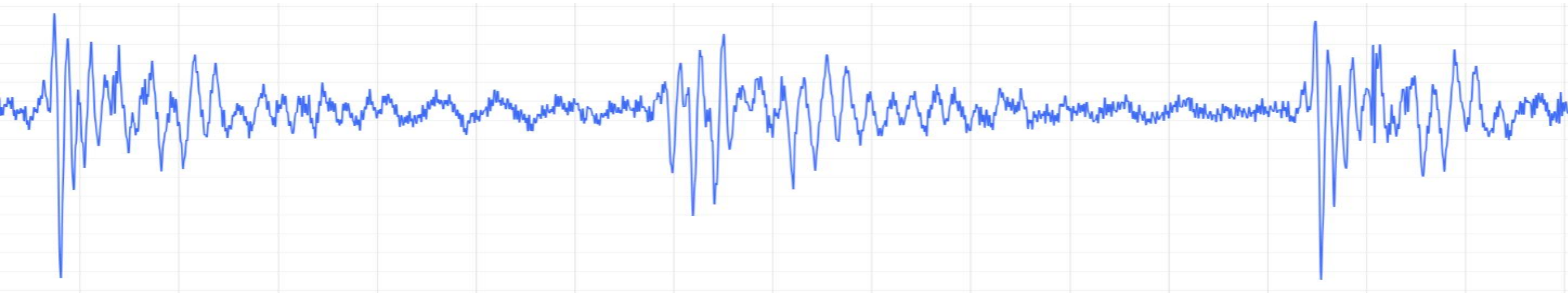
## Product Improvement

Improve design, reduce risk, increase reliability



# RLDA's business value

1. Understand and validate product performance
2. Verify and update design assumptions
3. Feed CAE simulation of motion, strength, durability, vibration, etc.
4. Define lab tests – real time, block cycle, vibration tests
5. Correlate physical and virtual testing



# The RLDA workflow

HBK has integrated tools for this entire workflow

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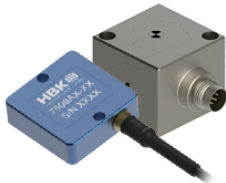
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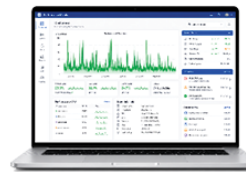


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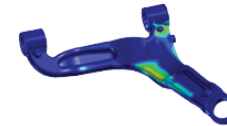


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# Getting road load data right

QUESTIONS, ANSWERS, AND DISCUSSION

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