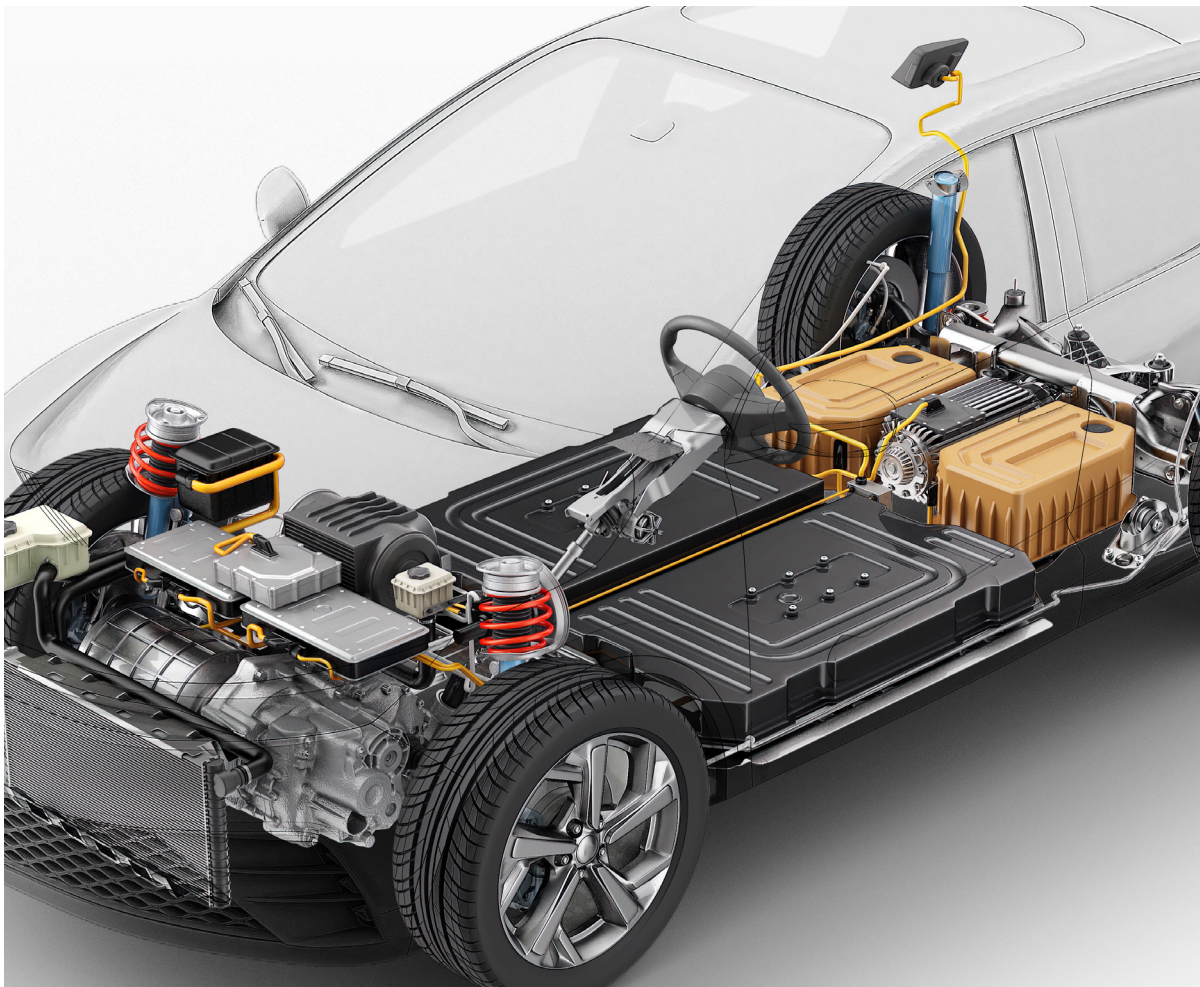


**MÜLLER-BBM**  
VibroAkustik Systeme



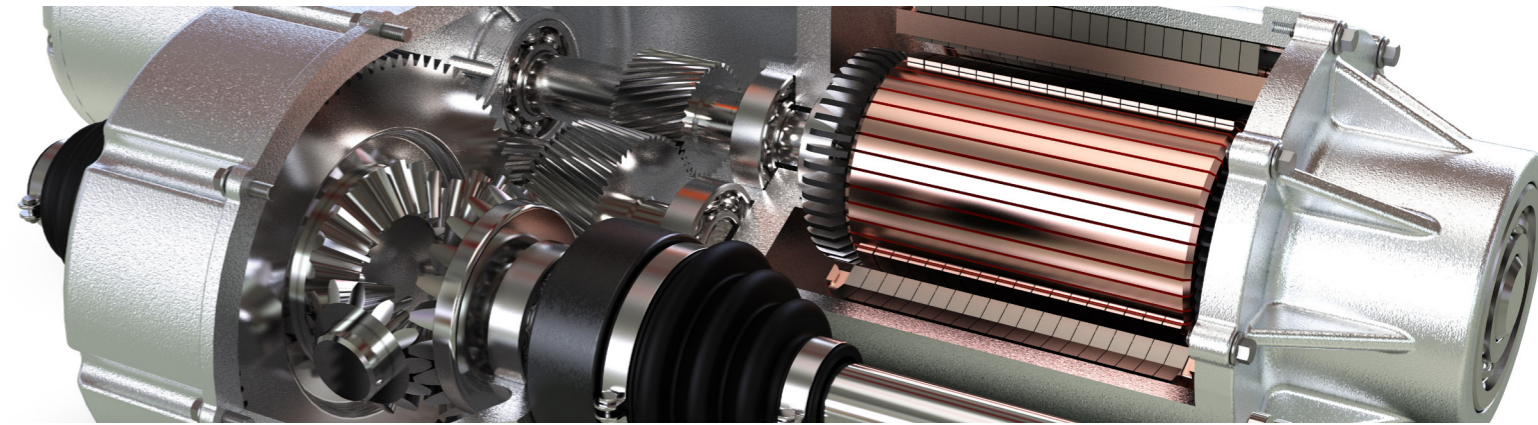
# NVH & E-Power

HOLISTIC DATA ACQUISITION AND ANALYSIS



**THE NEXT  
LEVEL  
OF ELECTRIC  
DRIVES  
ENGINEERING.**

## **An holistic approach**



Mastering the engineering of silent, high-performance electric motors will be one of the key factors to drive the future of e-mobility. A deep understanding of correlations between acoustics, performance, and reliability will ease their development.

MÜLLER-BBM VibroAkustik Systeme and DEWETRON provide a one-of-a-kind integrated testing solution for e-Power and NVH where electric parameters and efficiency data can be directly combined and opposed with NVH data.

# PASSION FOR TECHNOLOGY

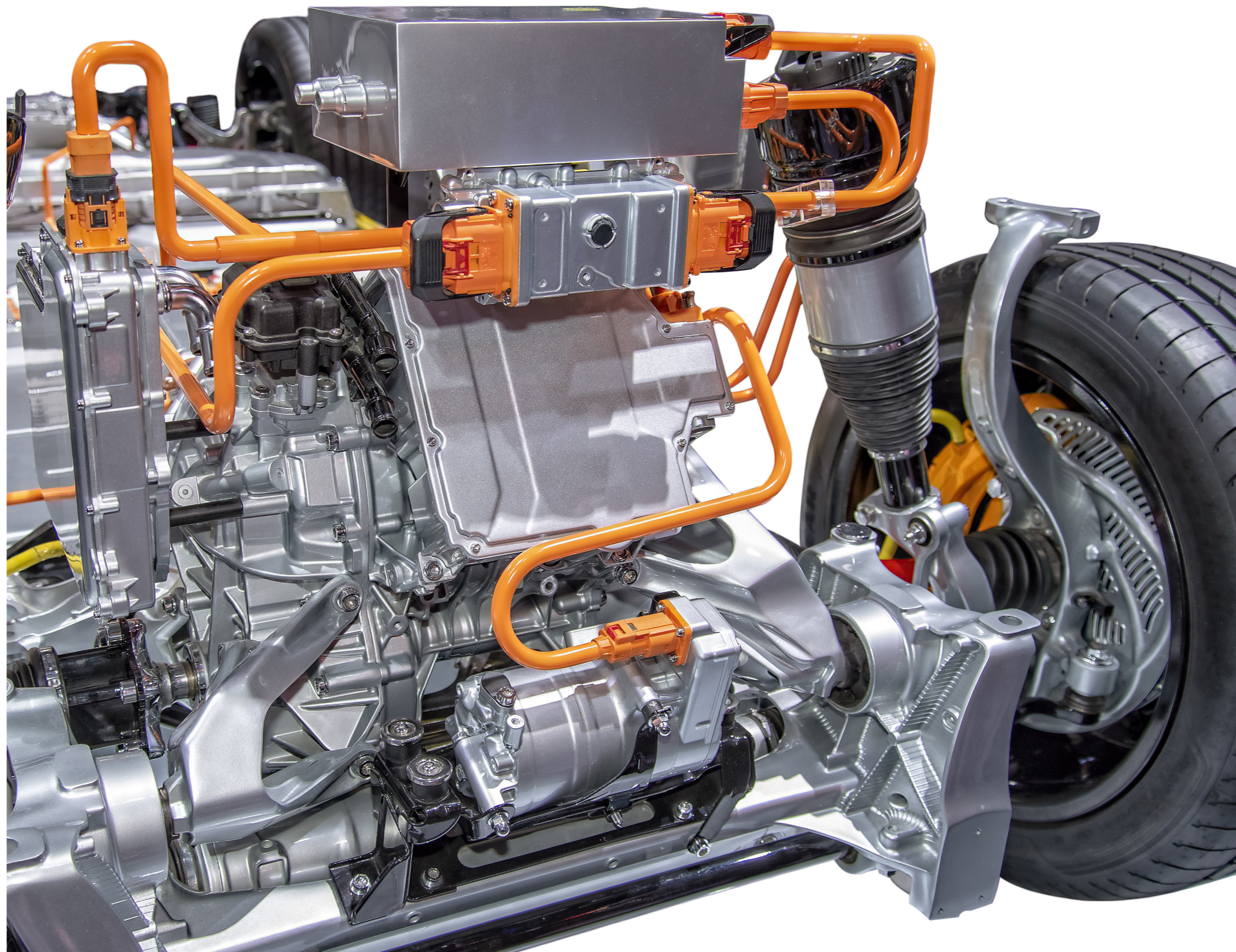
With our broad product portfolio, we create custom-fit solutions for your engineering and testing.

When designing an electric motor, there are several targets challenging each other, e.g., performance, dynamics, efficiency and acoustics.

To solve the conflicting targets and define the perfect motor application, a deep understanding of interactions and influencing factors is crucial. A comprehensive acquisition of power and NVH data will be the base for a targeted development of active components on the testbench.

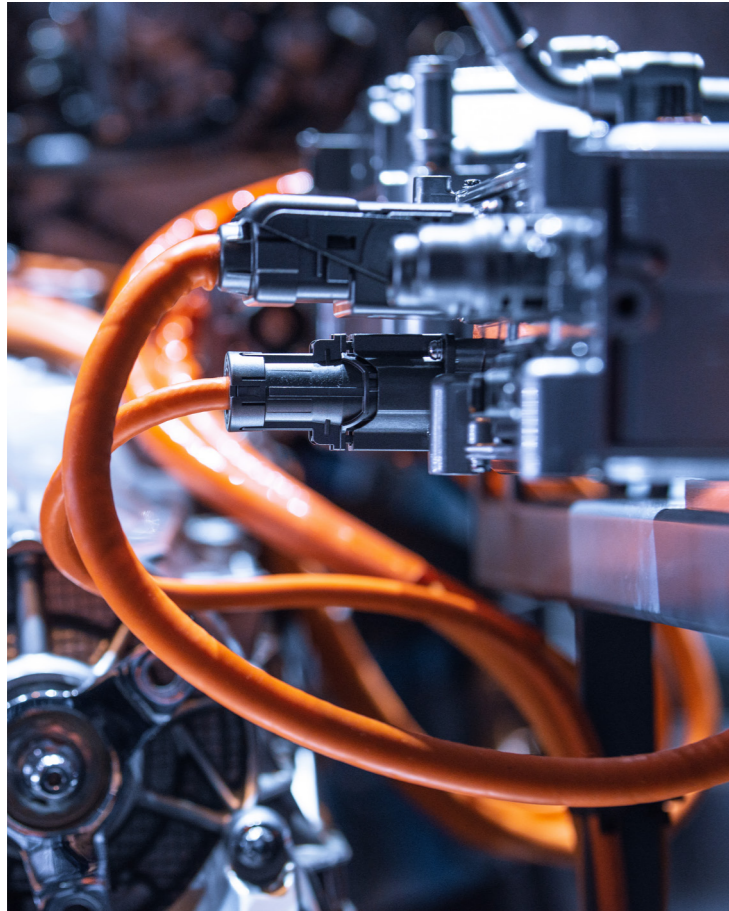
This includes not only the optimization of acoustics and power during testing by a correlation of NVH and power data, but also the entire NVH system analysis with PTP-synchronized data of various data sources.

Having all data at hand allows for an interdisciplinary engineering approach and significantly reduces development times.



Efficiency starts with sustainable engineering and testing. Performance optimization and acoustic design go hand in hand.

# IN-THE-LOOP-TESTING

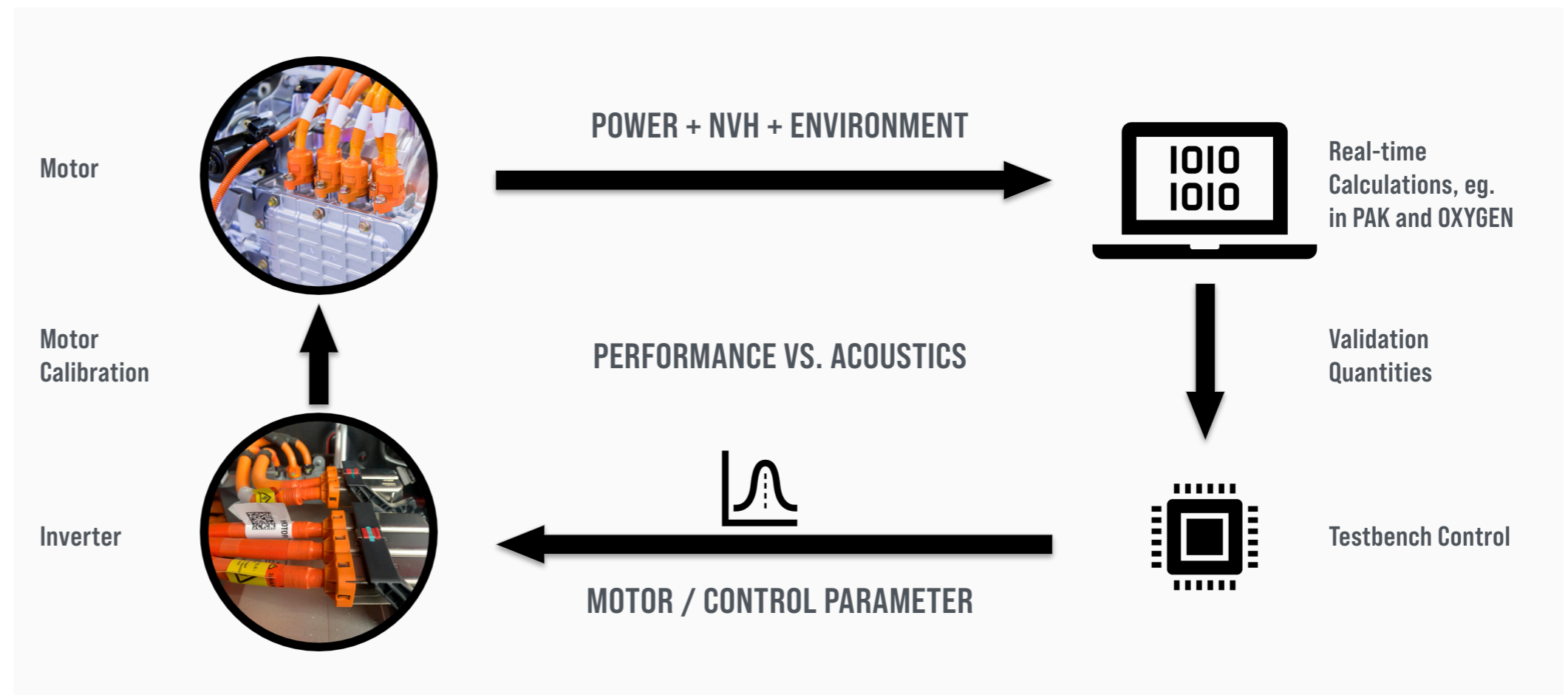


## ONE SETUP. INTEGRATED TESTING

Driven by innovation and efficiency, we move engineering and testing ahead. Our mission is to contribute to a better engineering by enabling sustainable testing ecosystems and smart data networks.

Users save time, resources, and costs through a comprehensive data acquisition, analysis, and management. NVH and e-Power quantities are time-synchronously acquired, processed and evaluated by our system solution based on the PAK live.hub.

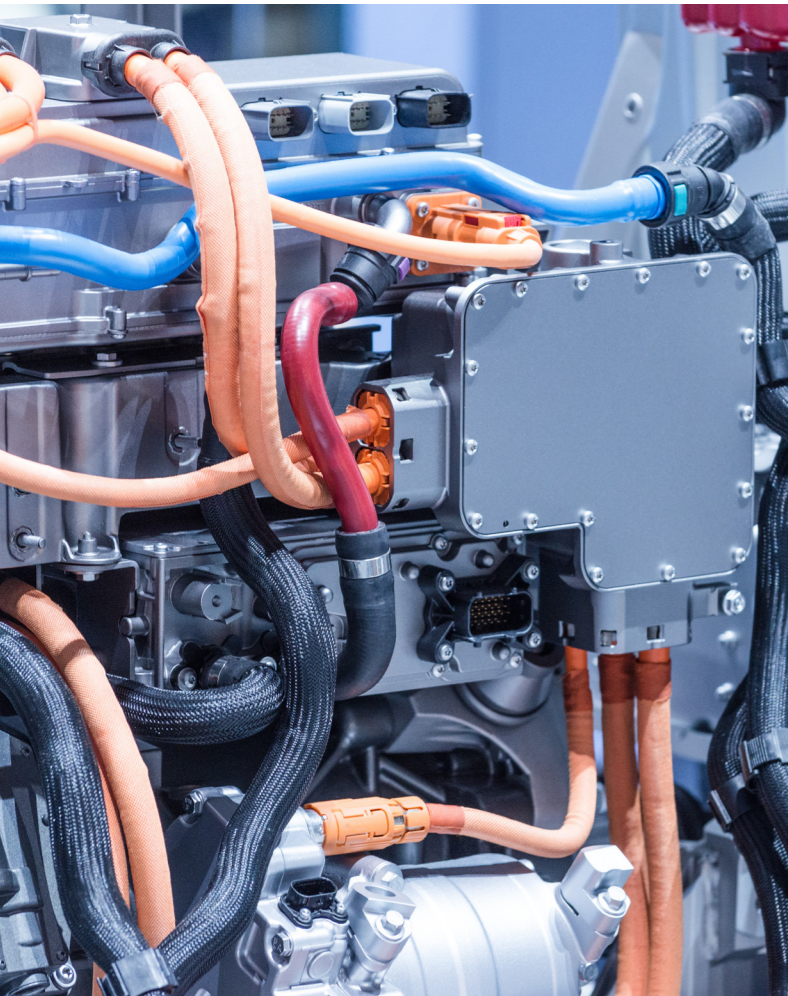
Integrated data acquisition and analysis: Measured power and NVH data is used to improve the adjustment of the motor in real time.



Synchronous data acquisition

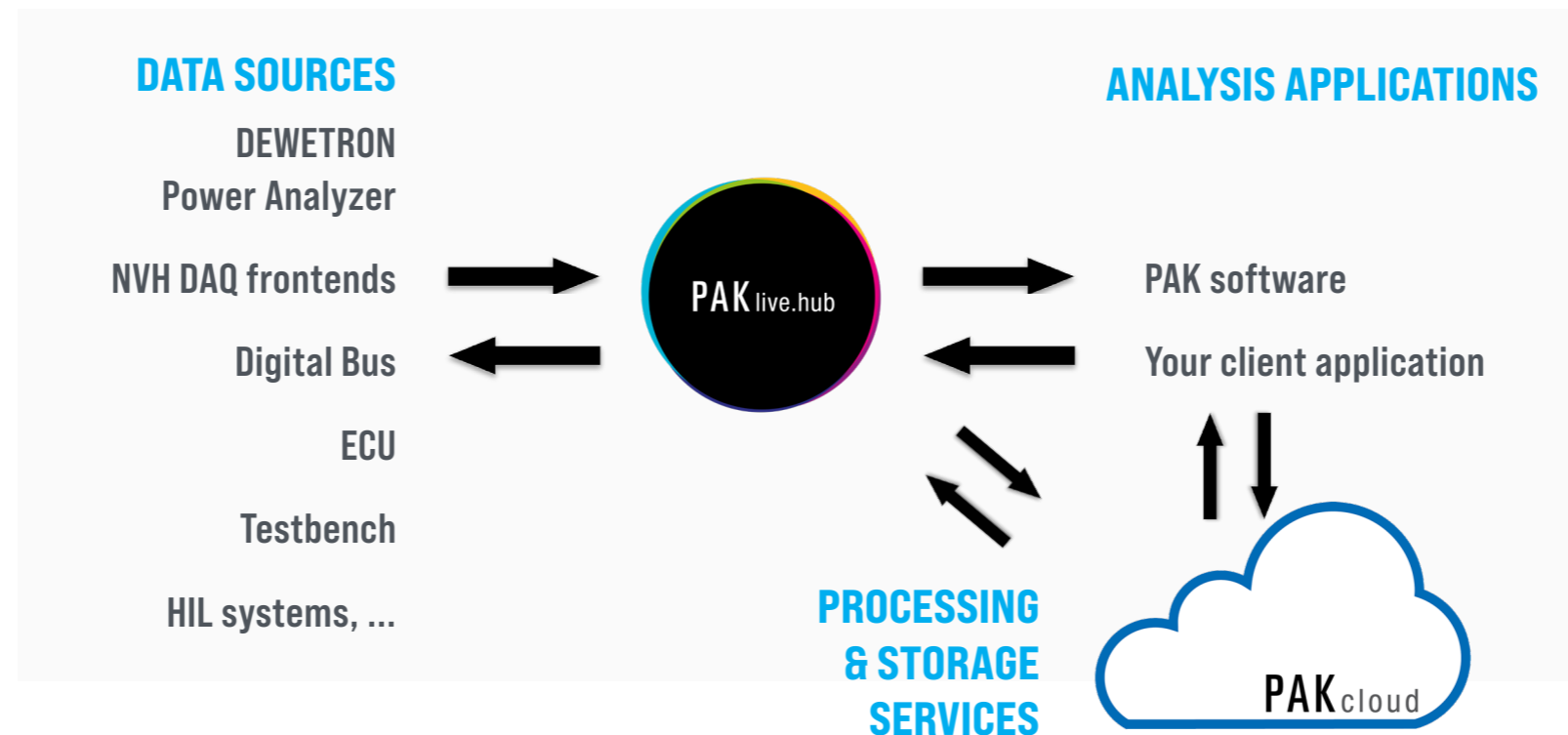
Correlation of NVH and performance data

Simultaneous optimization of e-NVH & e-Power characteristics



# THE ECOSYSTEM AREA HAS ARRIVED

## CONNECTED DATA



The benefits of data ecosystems extend far beyond the boundaries of the individual testing task and have the potential to impact the entire engineering and data value chain.

## HIGHER FUNCTIONALITY

PAK live.hub is a data I/O handler interacting with various data sources, e.g. DEWETRON power analyzers and DAQ frontends, and state-of-the-art testing applications, e.g., from VIBES Technology for dynamic substructuring and from Müller-BBM for NVH engineering. Also partnering with leading providers for Hardware-in-the-loop (HIL) systems is seamlessly possible.

The PAK family software is designed to record and analyze all power, NVH, ECU, bus, testbench, and HIL system data simultaneously.

With its open architecture, PAK live.hub masters a network of expert tools that are used to best solve each task. We call it smart live.networks.



# THE MEASURABLE DIFFERENCE

Performing with highest efficiency is key for all data acquisition. DEWETRON's power analyzer and DAQ frontends stand for maximized performance aligned with highest flexibility.

## MULTI-POWER ACQUISITION

DEWETRON's mixed signal power analyzer allow the analysis of even polyphase motors with up to 16 different power phases and various parameters.

The dynamic range is accompanied with a tremendous accuracy. Acquisition rates up to 10 MS/s @ 18-bit A/D conversion as well as the best linearity guarantee a continuous raw data storage with the highest dynamic performance in the whole input range - up to  $1000 V_{RMS}$  ( $2000 V_{PEAK}$ ) and up to  $20 A_{RMS}$  ( $40 A_{PEAK}$ ) direct current measurements in safety category IV - with the highest possible accuracy for all your dynamic applications.

An integrated current transducer supply enables the direct connection of the sensors to the power analyzer.

Users are able to precisely capture electrical parameters, mechanical parameters, and environmental parameters.

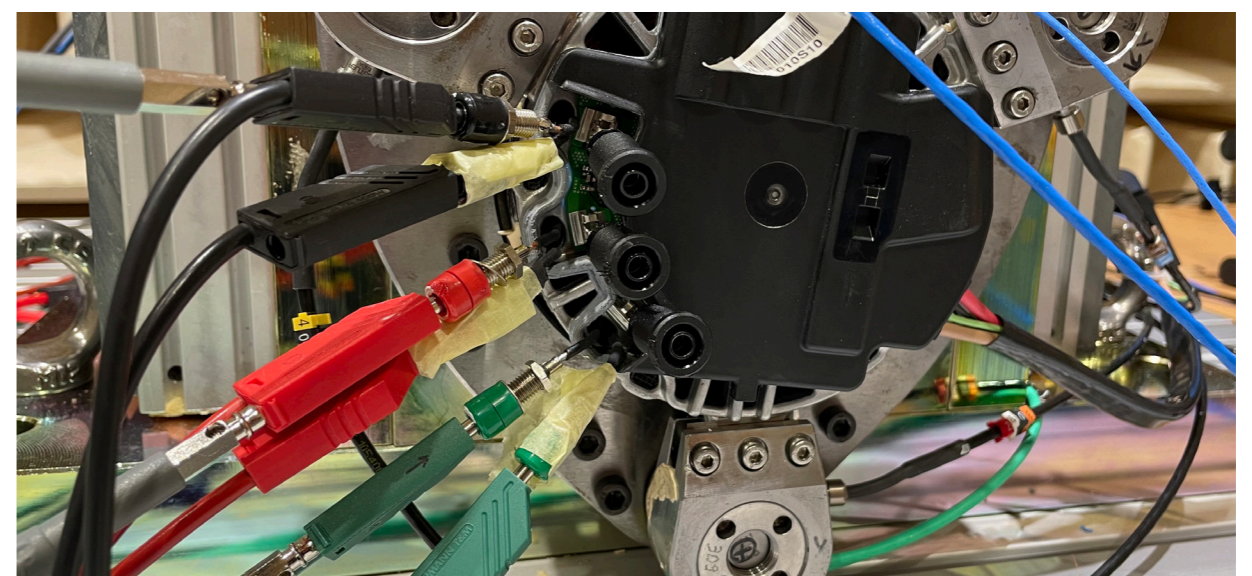
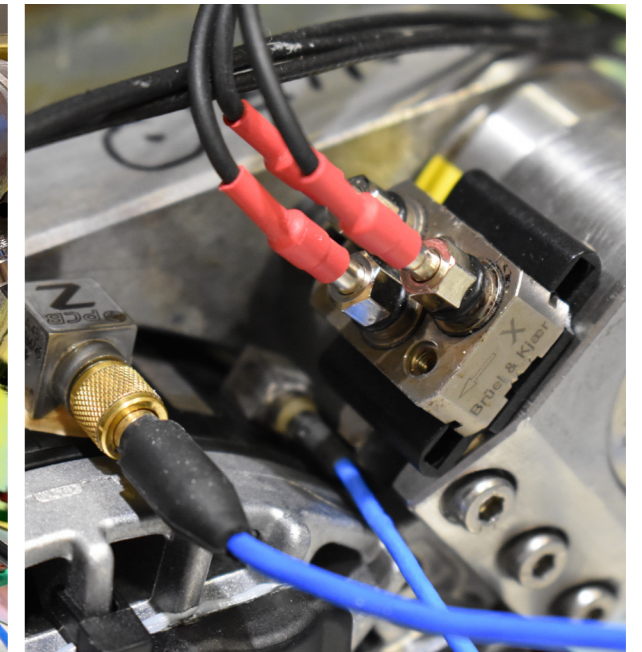
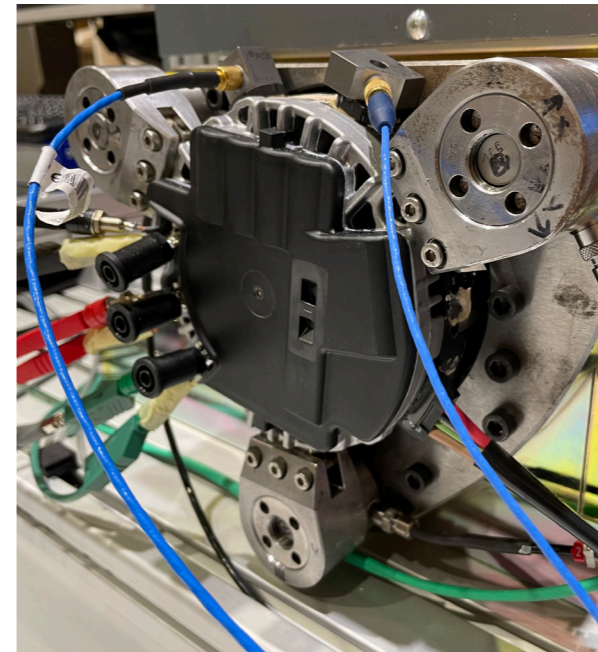
## SYNCHRONOUS DATA STREAM

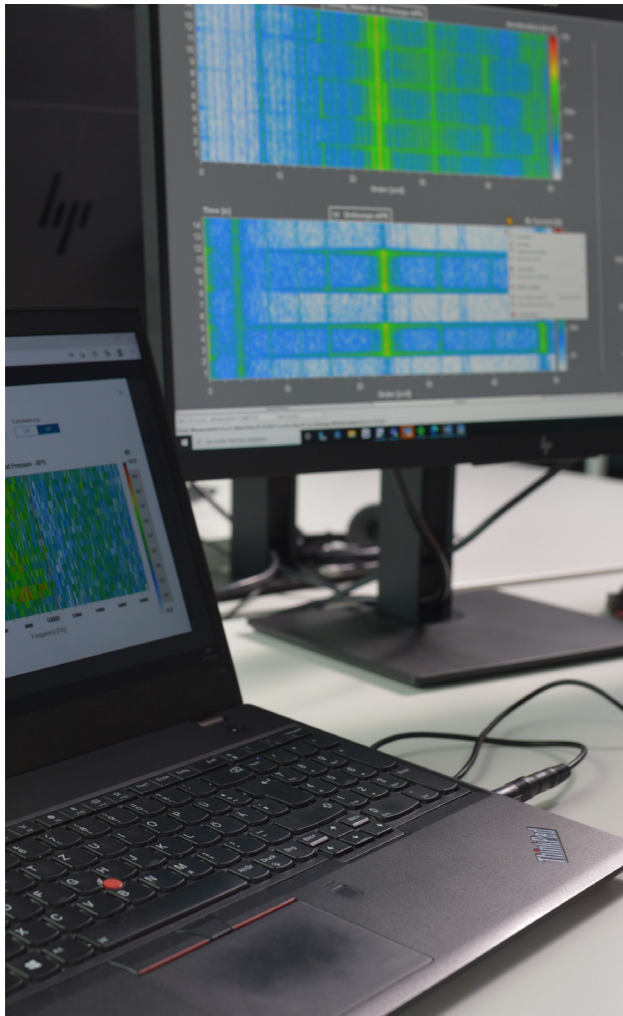
Perfect signal synchronization via PTP provides the most reliable data integrity. The power analyzer is connected with the PAK live.hub that handles data streams from multiple sources while various applications can access the data on demand.

Via OXYGEN, dynamic data and power analyses, such as cycle-by-cycle calc. or active/reactive/apparent power total & fundamental as well as energy, are being transmitted to PAK software totally synchronized to signals from other sources. Channel settings and data recording can be made via PAK.

## POWERFUL DATA ANALYSIS

The power and NVH data is analyzed online. PAK's powerful graphical capabilities enable a direct visualization of acquired quantities and spectral evaluations.





Whether it is e-mobility, NVH, strength or ride comfort – PAK has the solution for your needs.

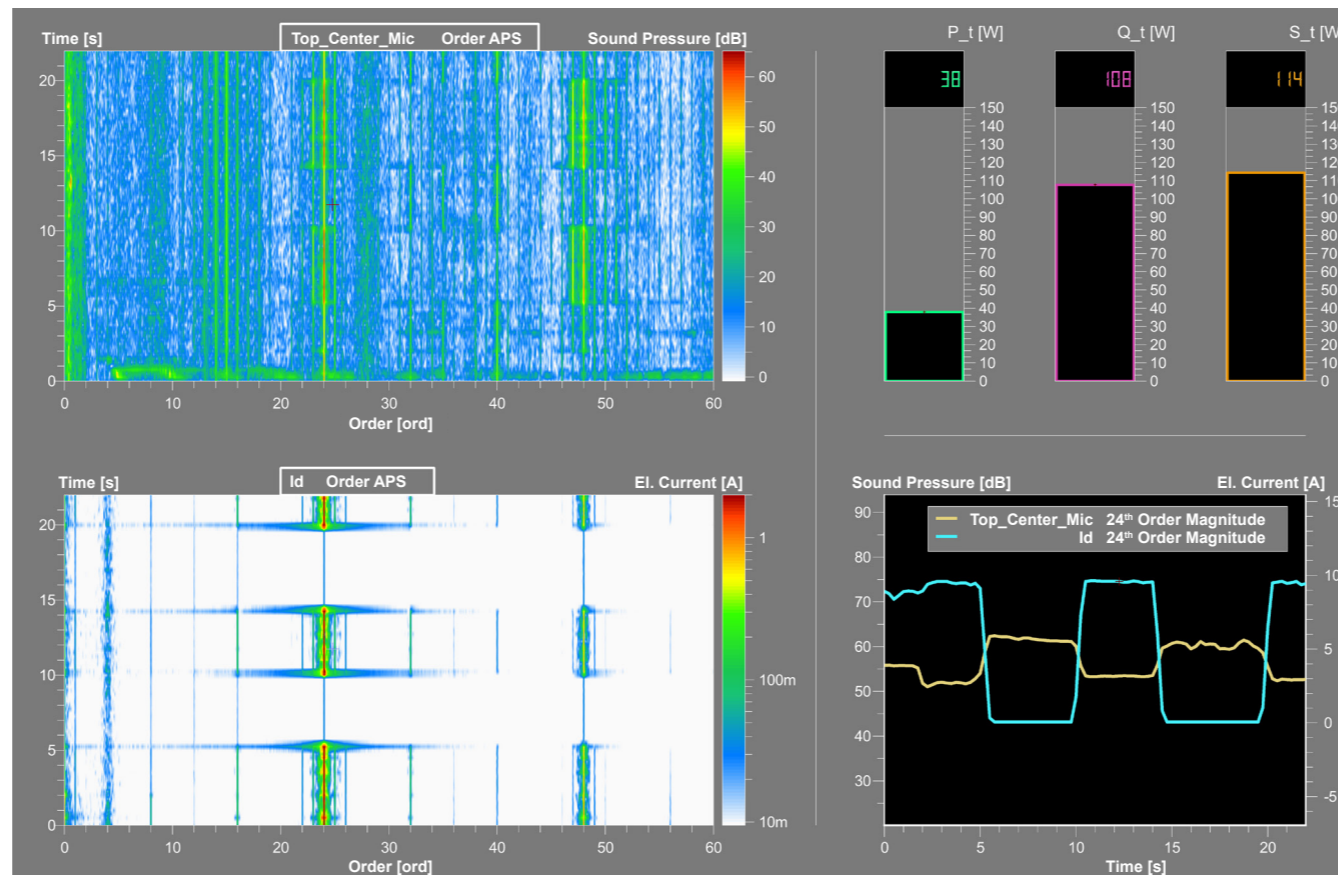
PAK includes high-precision data acquisition from various data sources, immediate result visualization and data storage in the ASAM ODS ATF/X standard data format.

PAK perfectly matches for process-oriented work in highly standardized, laboratory tasks, mobile measurements, and troubleshooting (e.g. fingerprints).

To acquire power and NVH data with DEWETRON power analyzer or DAQ units, there are several ways possible.

On the one hand, the measurement settings are made via DEWETRON's OXYGEN software, including activation of special calculation channels for power. All signals from OXYGEN can be streamed, displayed, processed, and stored by PAK. In addition, customers can use PAK live settings.

On the other hand, the configuration for the hardware and channels is directly performed from PAK via the PAK live setting interface.



PAK is the NVH suite to master for example harmonic current injection, rotor-positioning, or specific motor controlling.

# COMPREHENSIVE DATA ANALYSIS

With PAK software, you will have all data together in one measurement to be analyzed online and offline.

PAK software includes a wide range of analyses to determine the acoustic signature and the performance characteristics of electric motors, such as

Frequency / order analysis for PWM fans, incl. determination of torque-ripple, electric duty cycle, electrical & mechanical power,

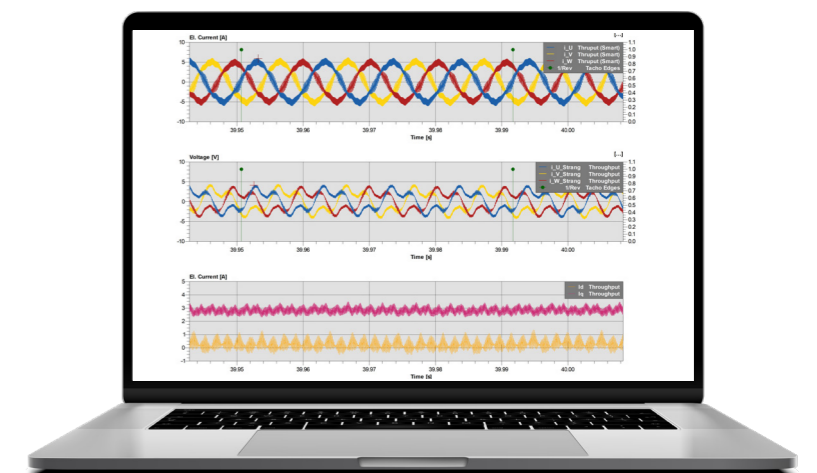
Structural & rotational analysis e.g., for motor housing modes,

Angle-based analysis referring to the e-duty-cycle,

Grid displays for engine performance parameters

Sound design & psychoacoustic indices, d/q Transformation (Clarke / Park transformation),

and much more.



# ADVANCED E-MOBILITY

Interdisciplinary testing is an effective way to answer engineering challenges even more faster.

## EFFICIENCY MATTERS

Power and NVH specialists can work in one test field and have all data available in real-time. Thus, a simultaneous optimization of e-NVH and e-power characteristics at test benches is possible.

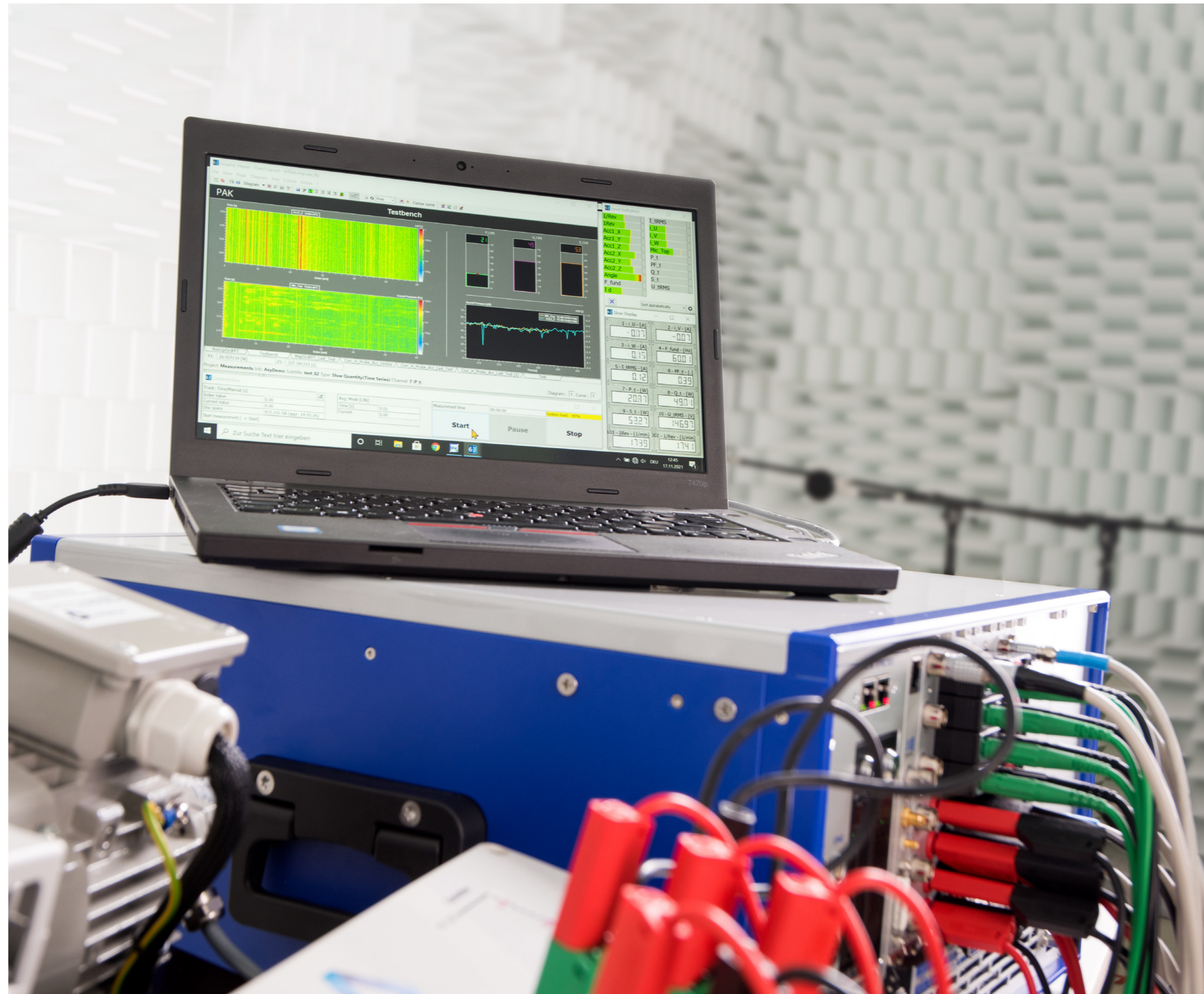
The raising NVH awareness during the ECU adjustment helps to avoid troubleshooting later on as the direct feedback of setting changes is displayed online without additional post-processing. Through the direct consideration of airborne and structure-borne sound within the vehicle, an online simulation of vehicle responses is possible, allowing for an enhanced testing efficiency through the optimized use of resources.

## EARLY PREDICTIONS

Having NVH and electrical data at hand, allows to make early predictions. Imbalances of current in amplitude or phase help to determine rotational ununiformities due to rotor eccentricities, wear & tear, or fatigue which may influence start-/stop-cycles, acoustics, and motor performance. Order spectra of d/q-transformed current and sound pressure, vibration, or torque are directly correlated.

The infrastructure of smart live networks allows to execute online analyses onsite and to transfer these results directly to the motor control for further processing.

By means of active manipulation of orders through current control, it is possible to deliver feedback immediately to the testbench and to vary parameter online. Motor modifications are visible and measurable in performance and acoustics in real time. This saves time and accelerates the development process.





# GET in touch

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#### ABOUT US

MÜLLER-BBM VibroAkustik Systeme is a global solution provider for the acquisition and analysis of physical data as well as data management. Our credo is openness, which we actively master by continuously integrating standards, such as ASAM ODS, CAN, EtherCAT®, IENA, iDDS or openMDM®, and collaborating with innovative technology partners. This openness is the foundation of our open platform architecture PAK, enabling ecosystems to emerge around physical data – through the tailored integration of data sources and applications.



## DEWETRON

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#### ABOUT US

DEWETRON is the manufacturer of high-precision test and measurement equipment. As the key player in the electrical & mechanical power analysis sector, DEWETRON develops high-performance hardware in the megasample range. This is particularly relevant to fulfill the high demands of NVH analyses. With the highly intuitive data analysis software OXYGEN, DEWETRON enables the simultaneous calculation of up to 16 different power phases.