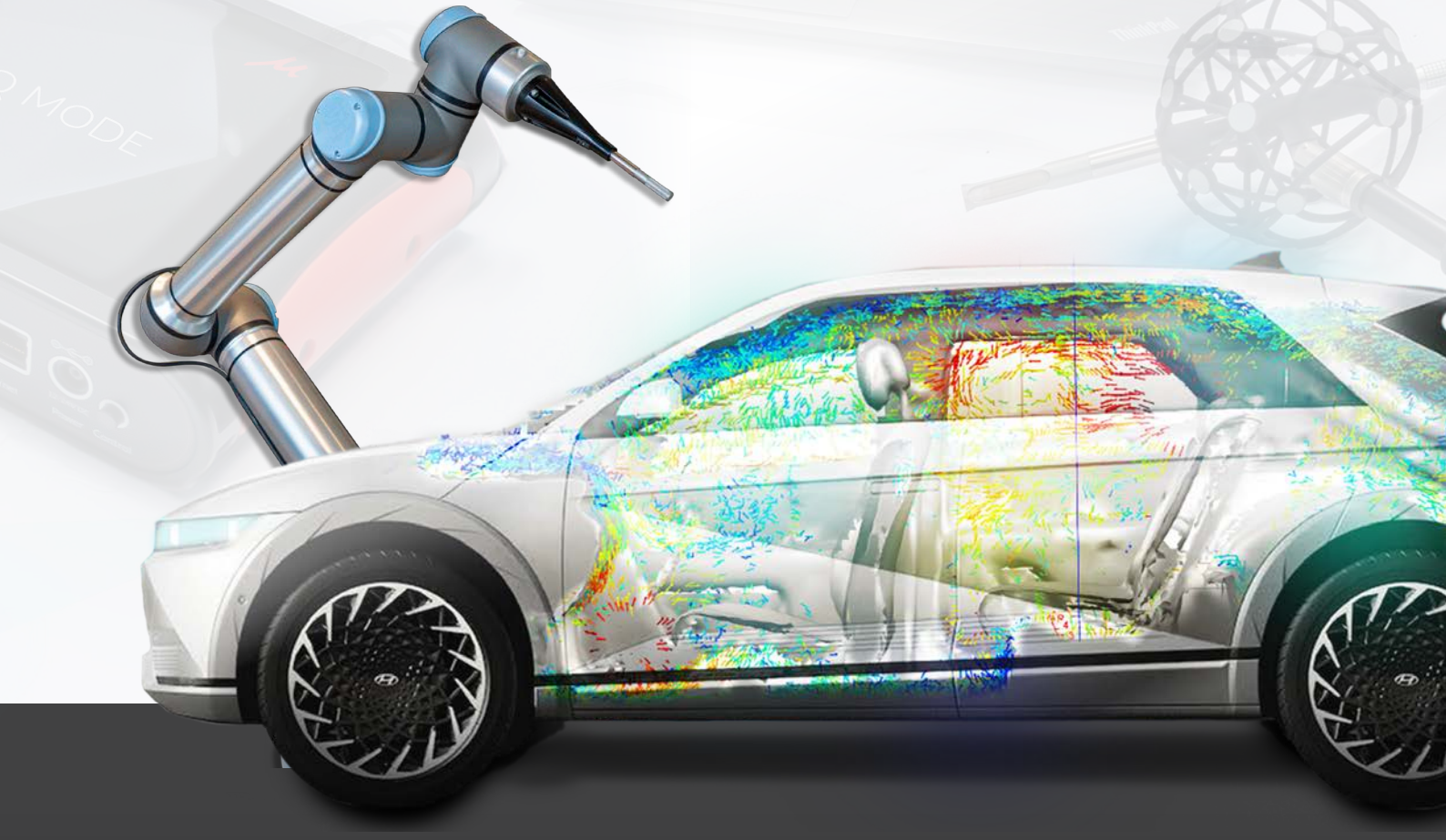
MICROFLOWN TECHNOLOGIES

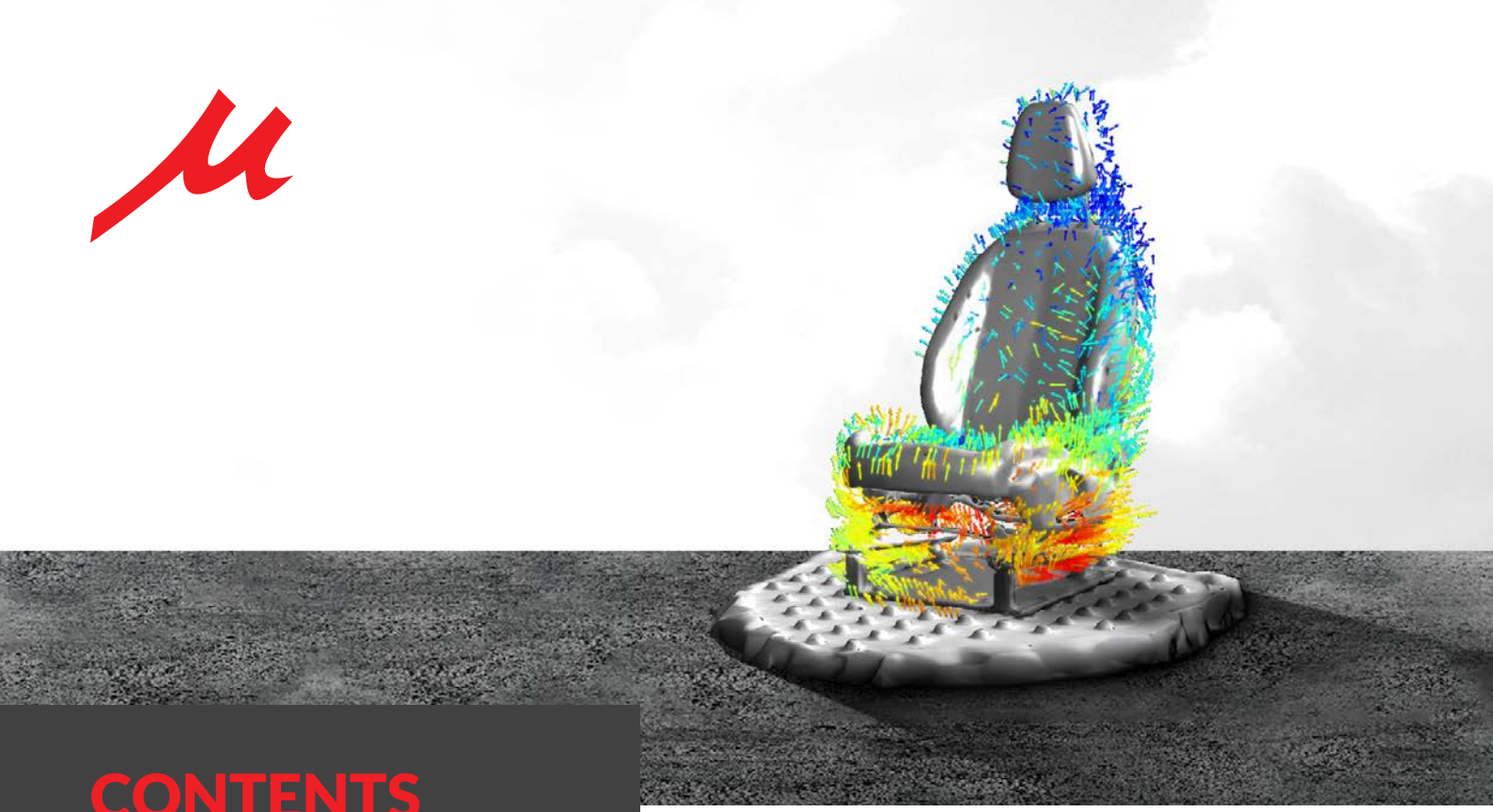
PRODUCT **BROCHURE**



SCAN&PAINT 3D

3D Characterization of Stationary Sound Fields

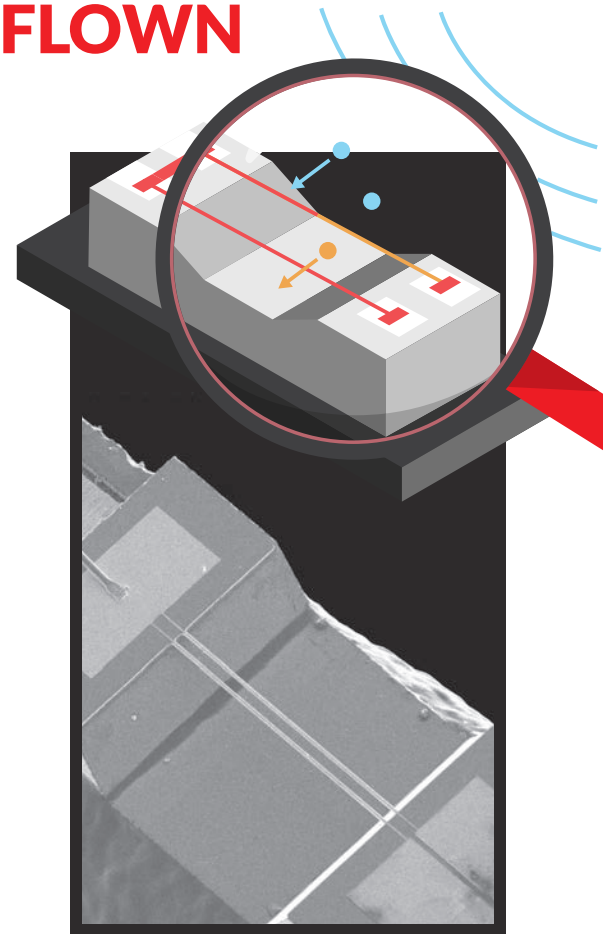
MICROFLOWN.COM



CONTENTS

THE CORE OF EVERY MICROFLOWN SOLUTION

Sensing acoustic particle velocity



THE FOUNDATION

At the heart of every Microflown solution is the acoustic particle velocity sensor, also known as a Microflown. This MEMS-based sensor directly measures acoustic particle velocity, giving access to a fundamental property of sound that traditional microphones do not capture.

Particle velocity describes the local oscillating motion within a sound field and is a vector quantity, containing both magnitude and direction. This makes it possible to analyse how sound propagates, where it originates, and how energy is distributed in space.

Manufactured on silicon wafers using cleanroom technology, the sensor consists of two ultra-thin platinum wires, each heated and acting as a temperature sensor. As sound waves pass, they disturb the temperature distribution asymmetrically, creating a resistance difference between the wires. This generates a signal proportional to the acoustic particle velocity, covering a wide frequency range.

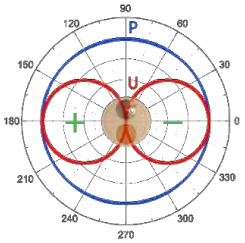
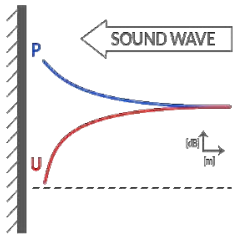
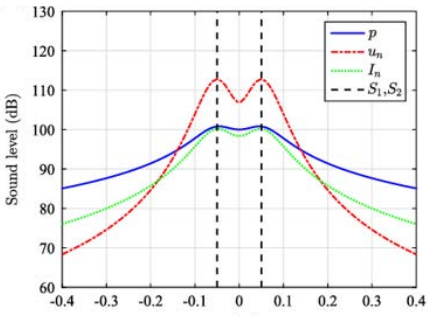
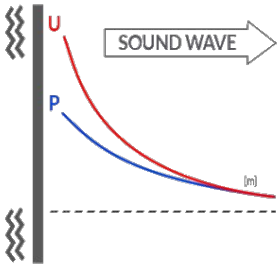


FIGURE OF EIGHT



NON VIBRATING SURFACE





VIBRATING SURFACE

Background noise reduction

Particle velocity measurements are naturally less sensitive to surrounding noise because they combine two key advantages: directional sensitivity and vector behaviour. The Microflown sensor has a frequency-independent figure-of-eight directivity, allowing the most sensitive axis to be aimed toward the area of interest while rejecting sound arriving from other directions.

When measuring close to a rigid surface in a noisy environment, incoming and reflected sound waves travel in opposite directions. In terms of particle velocity, these opposite directions largely cancel each other, reducing the influence of surrounding sound fields. This helps isolate local sources and improves clarity in complex acoustic environments.

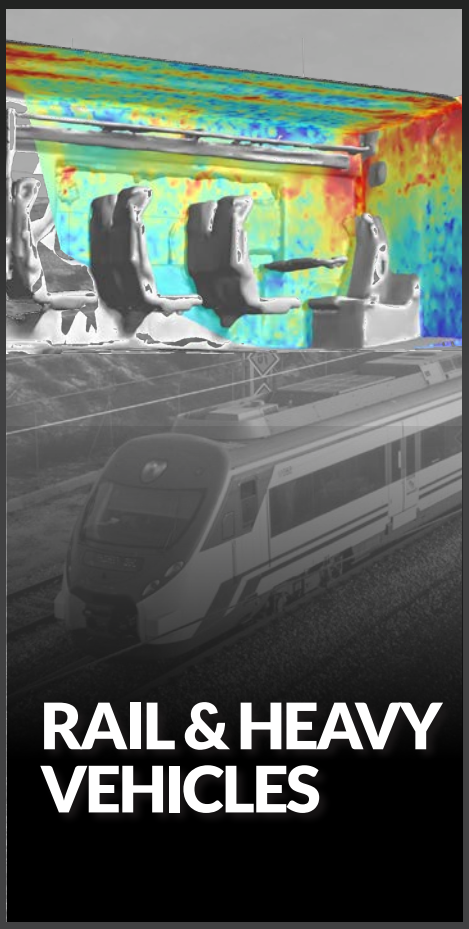
Enhanced spatial resolution

Close to a radiating source, particle velocity shows large level variations over very small distances. This is caused by near-field effects and the vector nature of this quantity.

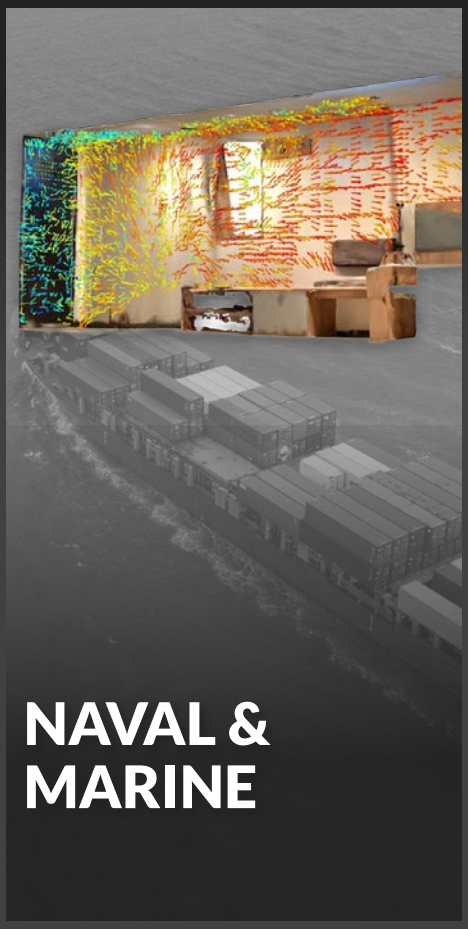
The strong spatial gradient make it easier to separate closely spaced sources and reveal local acoustic details that can be difficult to distinguish with pressure-based measurements alone.

Low-frequency performance

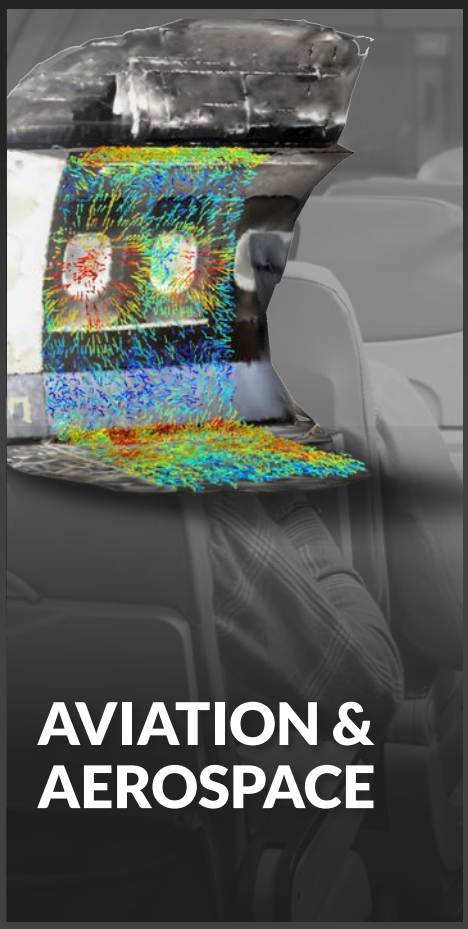
At low frequencies, near-field effects increase the particle velocity signal close to the source. This creates a stronger signal-to-noise ratio, making particle velocity especially valuable for troubleshooting low-frequency acoustic problems.



RAIL & HEAVY VEHICLES



NAVAL & MARINE



AVIATION & AEROSPACE

FROM COMPLEX SOUND FIELDS TO CLEAR INSIGHTS

Challenges Scan&Paint 3D helps solve

Complex acoustic problems are rarely limited to one surface, one direction, or one frequency band. Sound can radiate from multiple components, reflect inside confined spaces, interact with structures, or change depending on operating conditions. For engineers, this makes it difficult to understand where noise is generated, how it propagates, and which areas should be improved first.

In many cases, the device under testcannot be isolated in ideal environments such as anechoic chambers. Measurements often need to be performed under real operating conditions, where reflections and surrounding machinery are part of the problem itself.
Scan&Paint 3D is designed to excel at challenging environments.By measuring sound pressure and 3D particle velocity, it visualizes the complete sound field directly in its target environment. The result is a clear 3D representation of sound intensity, particle velocity, and sound pressure, helping engineers move from listening and guessing to to visualizing, quantifying and ranking.

KEY FEATURES

3D visualization of sound pressure, particle velocity, and sound intensity

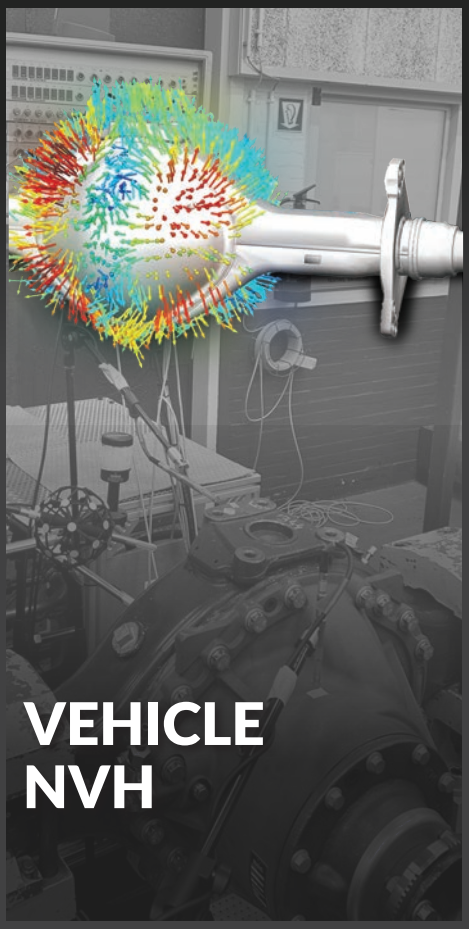
Broadband solution: 20 Hz – 10 kHz

High spatial resolution, including very small objects

Fast workflow: short setup, measure, and process time

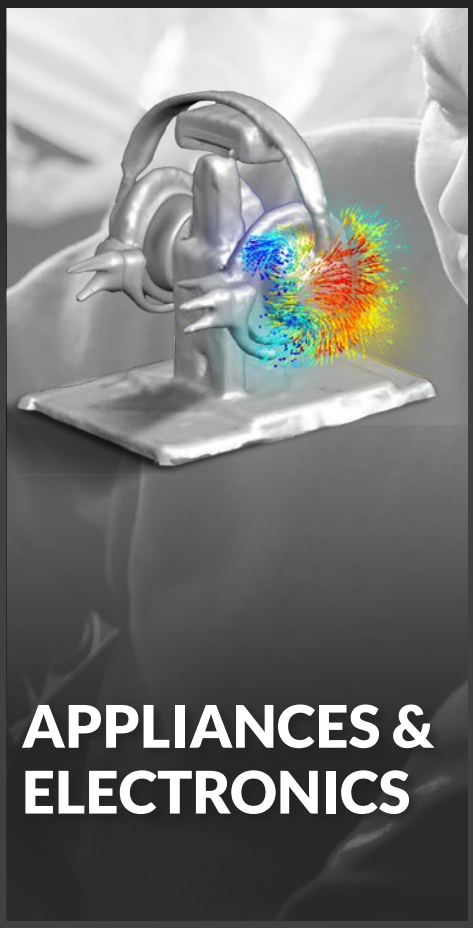
Real operating environments, No need for anechoic rooms

Extensive data export (.mp4, *.xlsx, *.nff (ACTRAN) or *.xdmf (ParaView)



VEHICLE NVH

POWER& ENERGY



APPLIANCES & ELECTRONICS

KEY APPLICATIONS

- Cabin interior acoustics
- Automotive NVH refinement
- Heavy-duty and ground vehicle noise
- Aircraft and rail cabin noise
- Component and subsystem validation
- HVAC acoustic radiation and ranking
- Compressor, pump, and energy machinery noise
- Large machinery and powertrain characterization
- White goods and appliance acoustics
- Battery, electronics, and appliance acoustics
- Acoustic leakage and installation troubleshooting
- Room and large-scale 3D visualization
- Product benchmarking and acoustic validation
- Hybrid acoustic modeling and simulation input

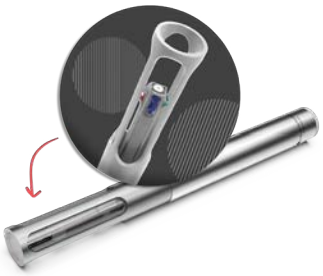
THE HARDWARE BEHIND THE MEASUREMENT

A flexible testing solution

Scan&Paint 3D is built around a flexible hardware platform designed to capture complex sound fields with precision and efficiency. Each component plays a specific role in the measurement process, from sensing acoustic behavior to tracking position and acquiring data.

Developed through years of application experience across automotive, aerospace, naval, and industrial environments, the system is optimized for real-world measurements. It enables accurate data acquisition in challenging conditions while remaining adaptable to different setups, workflows, and levels of complexity.

Together, these hardware elements work as one integrated measurement solution, while the system remains flexible enough to adapt to different applications and measurement environments.Camera options, DAQ configurations, accessories, and robotic scanning can be selected to match specific measurement needs.



Capturing acoustic vector data

A 3D sound intensity probe probe combines three orthogonally placed Microflown sensors with a sound pressure microphone in a compact ½ inch design. It measures sound pressure and the full 3D particle velocity vector at a single point.

This enables direct calculation of 3D sound intensity across a wide frequency range from 20 Hz to 10 kHz, providing insight into sound propagation, source location, and energy distribution.

Its small form factor makes it suitable for measurements close to complex geometries and small objects, supporting high spatial resolution in real operating environments.

Accurate 3d tracking

The Scan&Paint 3D system uses an optical tracking system to determine the position and orientation of the probe during measurements. A tracking camera emits infrared light, reflected by the tracking sphere, enabling real-time position tracking.

The probe is mounted in a remote handle for manual scanning. The tracking camera can be repositioned to capture the object from multiple angles, allowing complex geometries to be covered step by step.

Each measurement is automatically linked to its spatial position, resulting in a complete and accurate representation of the sound field.

Flexible data acquisition

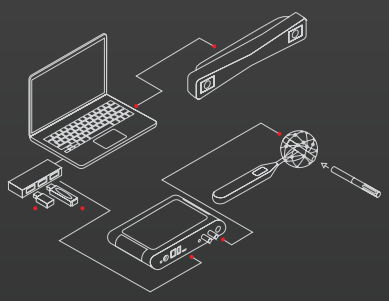
The DAQ frontend digitizes the acoustic signals from the 3D sound intensity probe and streams them to the Scan&Paint 3D software.

Depending on the application, the system can be configured with Voyager, Scout/MFPA, or compatible third-party hardware such as MeCalc, MCC Data Translation, and HEIM DATaRec devices.

Inside the software, acoustic data is combined with live 3D tracking data to visualize sound pressure, particle velocity, and sound intensity accurately in space.

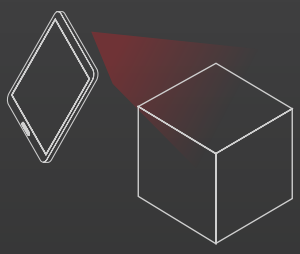
WORKFLOW

1



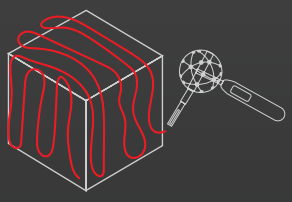
System setup
Connect the hardware components and launch the VELO Scan&Paint 3D application.

2



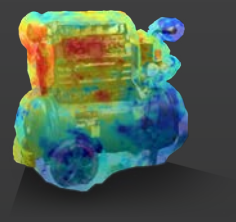
3D model input
Import a CAD model or capture the geometry directly using tools such as LiDAR or Structure Sensor, enabling a flexible setup without requiring a predefined model.

3



Capture
The surface of interest is scanned by manually moving the probe close to the device under test. During the scan, acoustic data and probe position are automatically synchronized, allowing multiple recordings to be combined into a single 3D project.

4



Processing
The captured data is processed in Scan&Paint 3D by defining a spatial resolution grid for the analysis. This converts the synchronized acoustic and position data into a 3D point cloud with detailed pressure, particle velocity, and sound intensity information

HARDWARE CONFIGURATIONS

Scan&Paint 3D is delivered as a complete, ready-to-use measurement system with al l required hardware. The configurations below represent commonly used setups for both portable and advanced measurements.

All setups are supplied in a rugged transport case with a custom-designed inlay, ensuring safe storage, easy handling, and reliable protection during transport and field use.

Scan&Paint 3D | VOYAGER configuration
Voyager DAQ
- Lanyard
- Sony WH-1000XM4 Headphones
- Tripod Adapter (1/4 to 3/8)
- Firmware Reset Ejector Pin
USP Regular
- Metal Probe Case
- Calibration Report
PST camera (Iris or Base HD)
CAMLINK tripod
Cables:
- 5 m LEMO 7pin male to male cable
- 3 m high-speed data USB-A to USB-C cable
- 2 m USB-A to Micro-B cable
Remote handle + Receiver
Tracking Sphere + Pointer
Pelicase 1650 + inlay
Sentinel HL Max | USB dongle
32 GB USB stick (Calibration report/manuals/software)
Manfrotto PIXI Mini Tripod Black

Scan&Paint 3D | Scout + MFPA configuration
Scout V2
MFPA-2
Scout/MFPA Stand
USP Regular
- Metal Probe Case
- Calibration Report
PST camera (Iris or Base HD)
CAMLINK tripod
Cables:
- 5 m LEMO 7pin male to male cable
- 3 m high-speed data USB-A to USB-B cable
- 20 cm BNC cables (x4)
Remote handle + Receiver
Tracking Sphere + Pointer
Pelicase 1650 + inlay
Sentinel HL Max | USB dongle
32GB USB stick (Calibration report/manuals/software)
Manfrotto PIXI Mini Tripod Black

CONFIGURATION FLEXIBILITY

DAQ

Scan&Paint 3D is available with two main DAQ configurations, allowing the system to be adapted to different application requirements. Voyager combines data acquisition and signal conditioning in one portable, battery-powered unit, making it ideal for mobile measurements and compact field setups.

The Scout+MFPA configuration separates signal conditioning and data acquisition. The MFPA powers and conditions the USP probe, while the Scout records the measurement channels, making this a strong modular option for lab-based setups or users who prefer a separated frontend workflow.

Tracking

Scan&Paint 3D can be configured with different tracking options depending on the object size, working distance, accessibility, and required repeatability. For manual measurements, the system uses an optical tracking camera to determine the live position and orientation of the probe during scanning.

PST Iris is the long-range optical tracking option, suited for larger objects and setups where the camera can be positioned further from the measurement area. PST Base HD is optimized for closer-range tracking and compact spaces, making it useful for confined environments such as vehicle interiors.

For automated and highly repeatable measurements, Scan&Paint 3D can also be configured with a Universal Robots cobot arm. With this setup, the robot streams the positioning data directly, removing the need for optical tracking. This is ideal for detailed benchmarking, validation work, dangerous environments, or situations where manual scanning is not feasible.

VOYAGER
Inputs: 4+2 AUX \(IEPE) **Outputs:** 1 headphones out
Battery powered : Yes
Best for: portability, simplified setup, and advanced analyses requiring extra input channels.

SCOUT + MFPA
Inputs: 4+1 TACHO **Outputs:** 1 line out + 1 Amplified
Battery powered : No
Best for: lab use, cost-conscious setups, and standard data analysis

PTS IRIS
Field of view: 65° (H) / 45° (V)
Tracking distance: 0.5 m up to 4 m
Tracking accuracy: 3 mm
Best for: longer working distances and cost-conscious setups and longer working distances

PTS BASE HD
Field of view: 75°(H) / 70° (V)
Tracking distance: 0.2 m up to 3 m
Tracking accuracy: 3 mm
Best for: compact spaces and close-range measurements

ROBOT SCANNER
Measurement reach: 0.85 m up to 1.75 m
Tracking accuracy: 0.01 mm
Best for: Dangerous environments

Accessories

Additional accessories can be added to Scan&Paint 3D to support challenging measurement conditions. The extension bar increases the reach of the USP probe for narrow or hard-to-reach areas, while the windscreen reduces flow-induced noise up to 15 m/s.

VOYAGER

ONE DAQ FOR ALL VELO APPLICATIONS

3D SOUND VISUALIZATION SOFTWARE

Scan&Paint 3D | VELO

VELO

VELO is the shared software platform behind Microflown testing solutions. It provides a consistent user experience across applications, while each module adds dedicated tools for processing, visualization, and analysis.

SCAN&PAINT 3D

The Scan&Paint 3D software module is the dedicated VELO environment for 3D acoustic mapping, source localization, and sound field analysis. It connects the measurement setup with the tools needed to capture, process, and visualize acoustic data directly on a 3D model.

The software is available in Lite, Standard, and Pro license levels, each offering a different set of tools depending on the required functionality, application case, and level of analysis.

SCAN&PAINT 3D SOFTWARE LICENSES

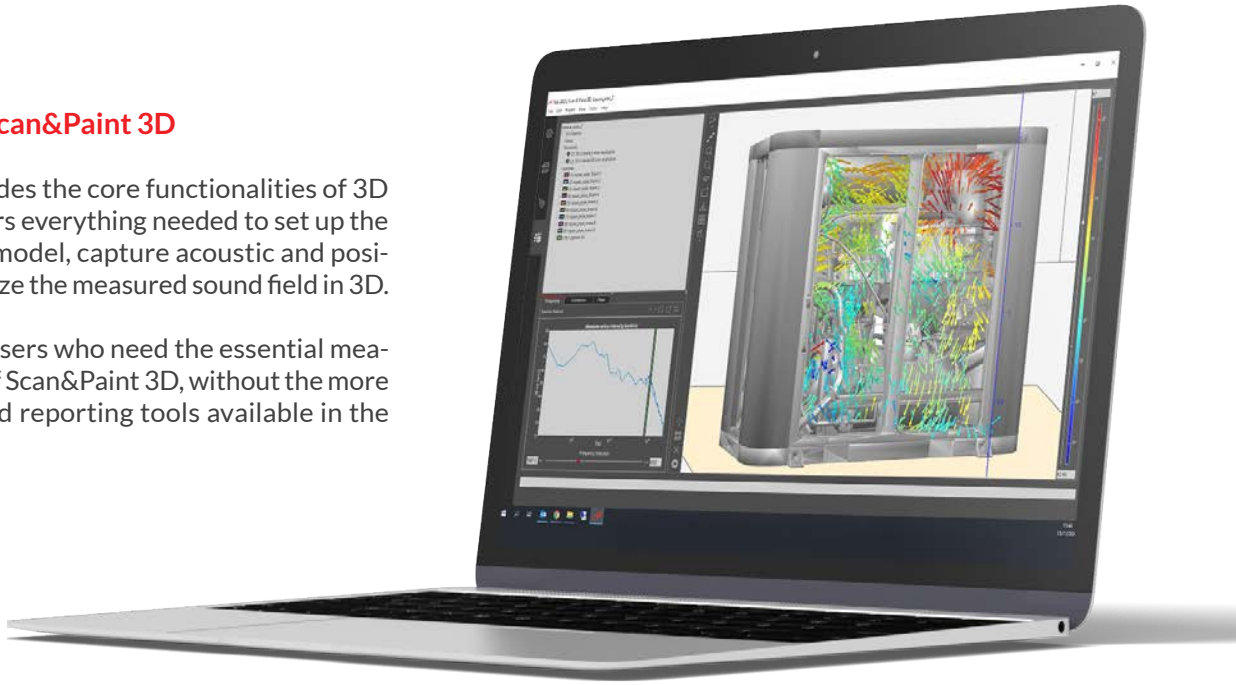
	Lite	Standard	Pro
• Data recording	✓	✓	✓
• 3D Tracker (incl. live tracking)	✓	✓	✓
• Support 3D objects texture mapping	✓	✓	✓
• Sound pressure, 3D Particle velocity, 3D sound intensity Mapping	✓	✓	✓
• Troubleshooting Tools (3D section selection, playback, spectra...)	✓	✓	✓
• Multi-view tools for result analysis and comparison	✓	✓	✓
• Colormaps based on planar sections	✓	✓	✓
• Range selection tab (histogram-based dynamic range filtering)	✓	✓	✓
• Dedicated playback tools (incl. filtering, tracking exclusion, impulse detection)		✓	✓
• Advanced colormap display (3D wrapping and spherical sections)		✓	✓
• Overall sound power estimation (cuboid-based)		✓	✓
• Multi-panel grouping, comparison and sound power ranking		✓	✓
• Full export options (incl. *.csv, *.mat, ParaView and ACTRAN)			✓
• Advanced troubleshooting, section time export, cross-processor			✓
• Reference sensor-based displays			✓
• Coherent intensity			✓
• Compatibility with Universal Robot scanner			✓
• Animated vector fields and colormaps			✓

LITE

The foundation of Scan&Paint 3D

The Lite license provides the core functionalities of 3D workflow. It gives users everything needed to set up the system, align the 3D model, capture acoustic and positional data, and visualize the measured sound field in 3D.

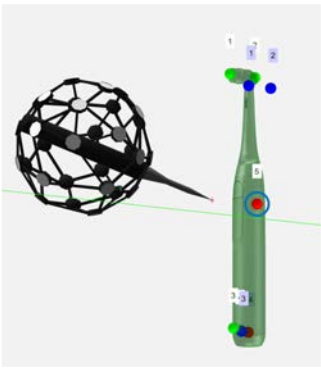
This level is built for users who need the essential measurement capability of Scan&Paint 3D, without the more advanced analysis and reporting tools available in the higher software tiers.



INTUITIVE SETUP

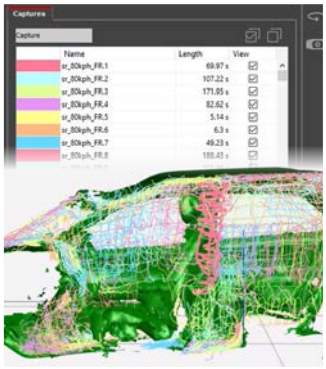
The Hardware Setup tab provides a shared VELO environment for preparing the measurement system before acquisition. It gives direct feedback on connected hardware, including the DAQ, probe, tracking system, and remote handle. Clear status indicators help confirm that all required components are detected and correctly configured.

AUTOMATIC 3D ALIGNMENT



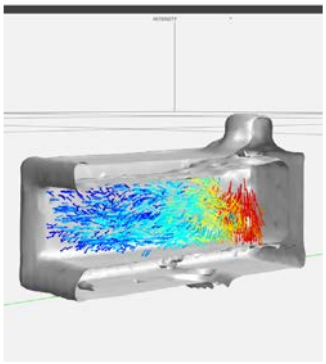
The user selects reference points on the 3D model and places the probe at the corresponding positions on the physical object. Based on these reference points, the software automatically calculates the camera position and aligns the model coordinates with the tracker coordinates.

CAPTURE CONTROL



The Capture tab shows all recorded scan traces, making it easy to verify whether the target area has been covered properly before processing. Multiple captures can be reviewed, selected, or excluded to build a clean dataset.

CORE 3D ANALYSIS



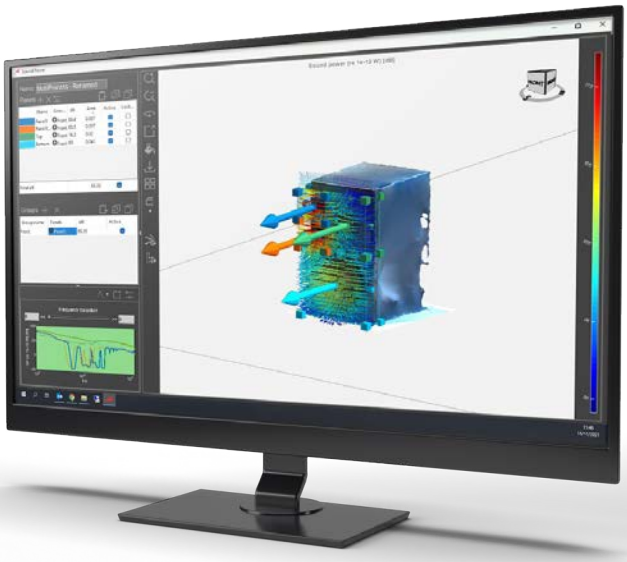
Results can be displayed as sound pressure, particle velocity, or 3D sound intensity. Multiple analysis tools allow users to inspect the measured field and understand where acoustic energy is generated and how it propagates.

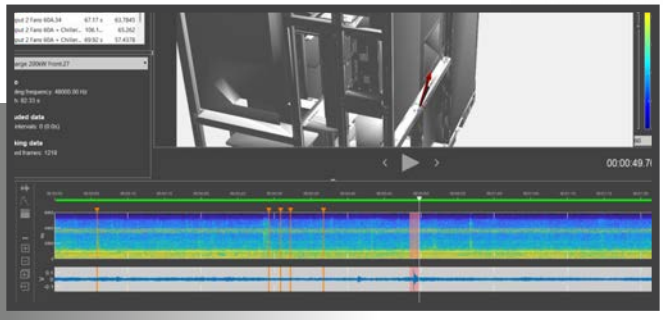
STANDARD

Expanded visualization and source quantification

The Standard license extends the Scan&Paint 3D workflow with additional tools for interpreting and quantifying the measured sound field. It helps users move beyond core 3D visualization by adding richer display options, playback tools, sound power estimation, and panel-based source ranking.

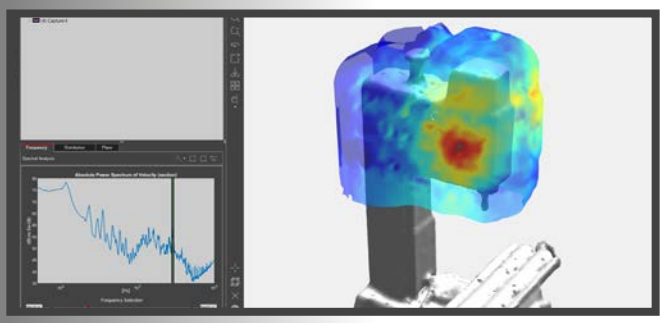
This tier is suited for troubleshooting, benchmarking, and product development where engineers need to understand which areas contribute most and their relative importance.





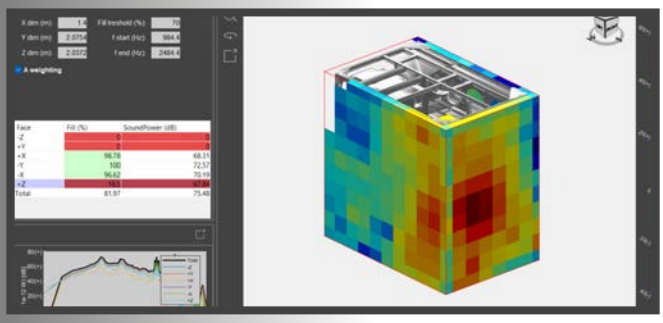
Dedicated playback tools

Dedicated playback tools allow users to inspect captured data before final processing. Filtering, tracking exclusion, and impulse detection help identify unwanted sections, measurement disturbances, or irregular events in the recorded data. This gives engineers more control over the dataset and helps ensure that the final result is based on clean and relevant measurement data.



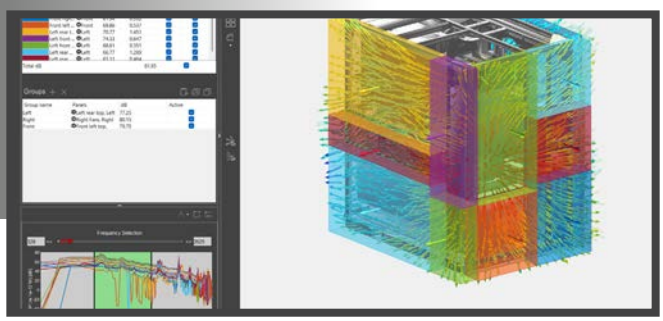
Advanced colormap display

Advanced colormap tools make it easier to visualize acoustic results over complex 3D geometries. With 3D wrapping and spherical sections, the sound field can be displayed around the object instead of only through isolated vectors or planes. This creates a clearer overview of how sound is distributed around the structure at a control distance and helps communicate results more intuitively.



Overall sound power estimation

Cuboid-based sound power estimation, adds a quantitative layer to the 3D visualization. Users can define an enclosing volume around the object and calculate the acoustic contribution within that volume. This helps compare the overall acoustic output more objectively and supports better decisions when evaluating design changes or countermeasures.



Panel grouping and sound power ranking

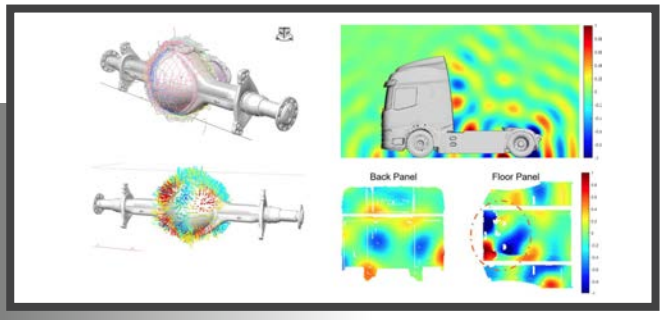
With multi-panel grouping and ranking, users can divide the test object into relevant sections and compare their contribution to the total sound radiation. This makes it easier to identify which panels, components, or regions contribute most, helping engineers prioritize damping, redesign, or further investigation based on measured acoustic impact.

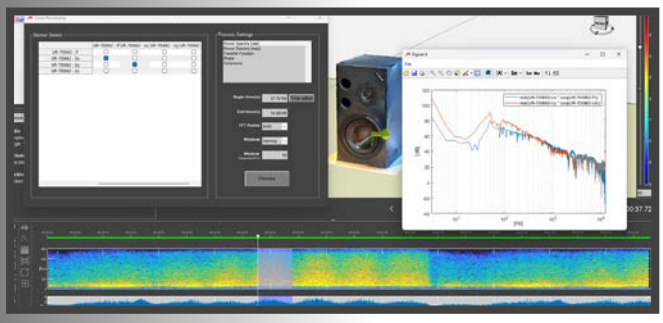
PRO

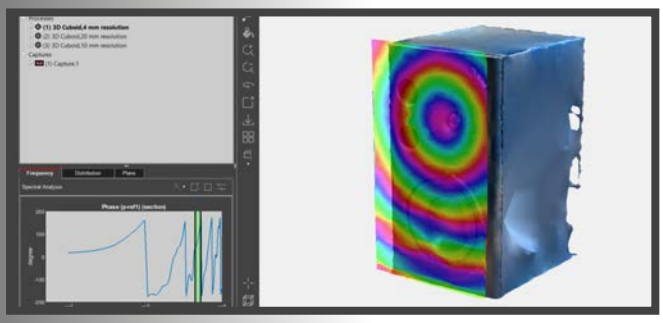
Advanced export, automation, and deep analysis

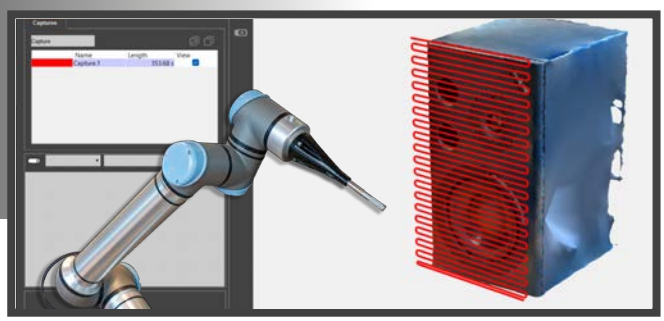
The Pro license unlocks the most complete Scan&Paint 3D functionality. It is designed for users who need to take measurement data beyond standard visualization, into external analysis, simulation environments, automated scanning, or deeper acoustic investigation.

This tier is best suited for advanced NVH teams, research environments, validation work, and applications where repeatability, data export, and detailed interpretation are critical.









Full export options

The Pro tier enables extended export for reporting, simulation, and external analysis, including formats such as .csv, .mat, .mp4, .xdmf, (ParaView) and .nff,(ACTRAN) . This allows measured 3D acoustic data to be used beyond VELO in hybrid acoustic modelling, numerical simulations, and custom processing algorithms.

Advanced troubleshooting tools

Advanced troubleshooting tools support deeper inspection of specific events, sections, or frequency ranges. With section time export, cross-processor support, and extended filtering options, users gain more control when cleaning, comparing, or investigating measurement data.

Reference-based and coherent analysis

Reference sensor-based displays and coherent intensity help separate relevant source behaviour from unrelated background contributions or evaluate their spatial phase response. This is useful in complex environments with multiple sources, reflections, or challenging operating conditions.

Animated vector fields and colormaps

Animated results display how sound propagation, direction, and magnitude vary in relation to a reference signal, such as a microphone, accelerometer, or voltage input. By converting static results into animations, they help reveal interactions between correlated sources, structural vibration, and acoustic radiation patterns.

Robot scanner compatibility

The Pro tier supports Universal Robot cobot arms. for automated and repeatable Scan&Paint 3D data acquisition. This is valuable for use cases. where manual scanning is difficult, unsafe, or not feasible.

CASE STUDY: LARGE COMPRESSOR

Reducing noise emissions from Lontra's LP2 compressor

The LP2 is the first fully packaged blower manufactured by Lontra using its patented Blade Compressor technology. Operating up to 1 barG and delivering up to 2600 m³/h of air at 2500 rpm, the LP2 produces one discharge per revolution, resulting in dominant low-frequency noise components. This created a complex acoustic challenge where the source behaviour had to be understood both inside and outside the enclosure.

GOALS

Lontra wanted a rigorous measurement approach to identify dominant noise sources and reduce the overall sound power level of the LP2 compressor. The system needed to work in-situ, in a normal measurement environment, while resolving low-frequency behaviour even below 50 Hz.

WHY USE SCAN&PAINT 3D?

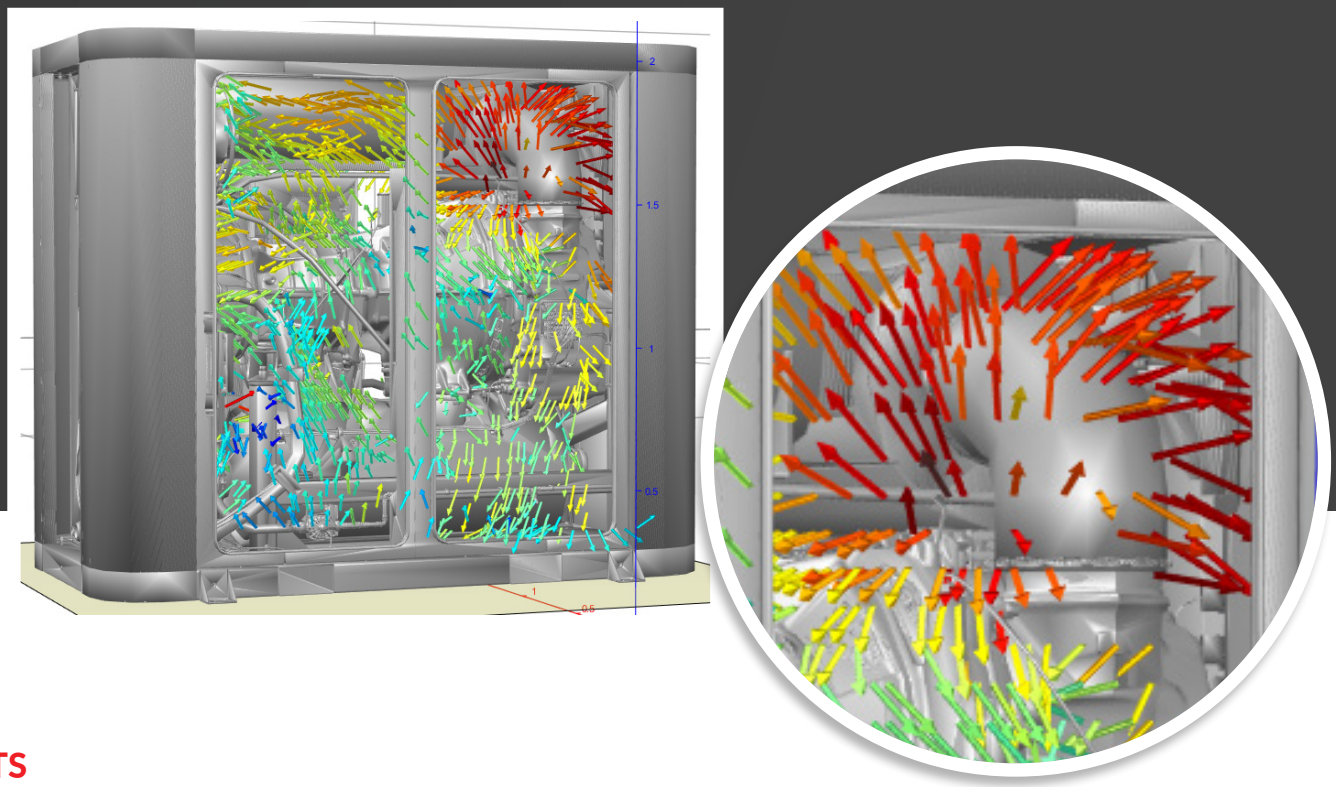
Scan&Paint 3D allowed Lontra to visualize and quantify the 3D sound field around the compressor enclosure. By directly measuring particle velocity and sound intensity, the system could identify sources inside the enclosure, rank their contribution, and target improvements with minimal design changes.

A key advantage was the ability to resolve low-frequency noise below 50 Hz and calculate sound power in relatively small test cells, avoiding the need for costly dedicated acoustic facilitie

METHOD

A pre-production LP2 unit was scanned with Scan&Paint 3D to locate where sound was emitted from the enclosure. First, the outside of the closed enclosure was measured to identify dominant radiation areas. The enclosure was then opened and scanned internally to locate the sources responsible for these emissions.

Because of the size of the LP2 package, the exterior scan required around 16 individual trajectories and multiple camera positions. All trajectories were combined in VELO into one processed dataset, creating a complete 3D representation of the acoustic field.



RESULTS

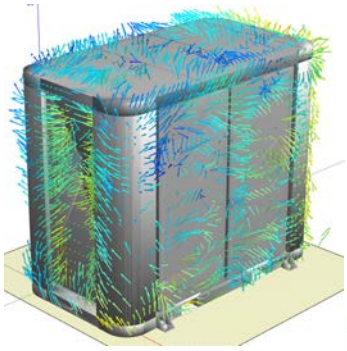
The results were used to inform design changes, which were implemented into a subsequent enclosure:

- Redesigned inlet silencer to better attenuate the fundamental tone, and hence reduce excitation of the rear panel
- Softer anti-vibration mounts to reduce vibration transmission between front and rear panels
- Stiffening of front and rear panels
- Improved outlet pipe cover
- Better quality control for enclosure panel assembly

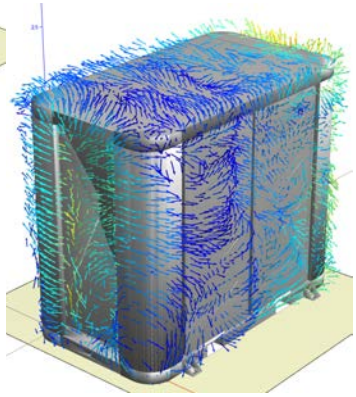
CONCLUSION

Using just a single set of acoustic scans, Lontra was able to reduce the A-weighted sound power of the enclosure by over 3dB by identifying a key vibration transmission path inside the enclosure. Furthermore, this improvement was achieved with minimal cost additions to the enclosure, and little previous acoustic data or experience of the Microflown Velo software, which is a great first result for Lontra.

It is also clear that there are still improve ments to be made, and that by using Microflown equipment we will be able identify, prioritise, and address them in a more efficient and cost-effective manner.



Before



After

CASE STUDY: CABIN INTERIOR NOISE

Acoustic performance enhancement of a Hyundai electric vehicle interior

The vibro-acoustic properties of a car cabin play a key role in the perception of vehicle quality. One of the main NVH goals of most car manufacturers is to enhance acoustic performance while meeting demanding weight and cost targets. Traditional applied experimental techniques have strong limitations, especially testing a complete vehicle is mostly unfeasible, requiring an independent evaluation of each subsystem.

A CONTINUED TECHNICAL COLLABORATION

Microflown and Hyundai have worked together across multiple EV NVH research projects, using 3D sound intensity measurements to better understand how acoustic energy is generated, transmitted, and perceived inside vehicle interiors.

This collaboration has supported the development of advanced methods for identifying key radiation areas, ranking panel contributions, and improving acoustic packages while balancing weight and cost targets. By combining Scan&Paint 3D measurements with acoustic transfer functions,

GOAL

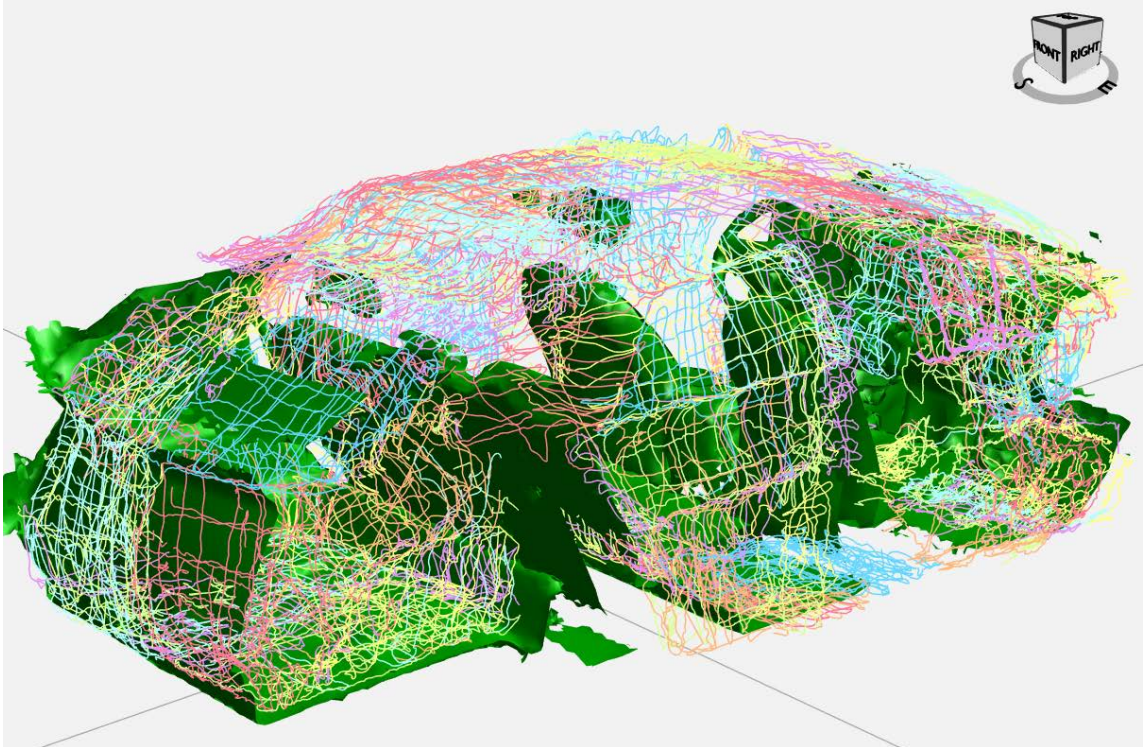
Apply a novel methodology to enhance acoustic performance while meeting demanding weight and cost targets.

- Complete vehicle 3D scanning and broadband, high spatial resolution sound field mapping
- Noise ranking of vehicles sections, so called panel contributions
- Design and improve the acoustic package of a commercial electric vehicle

METHOD

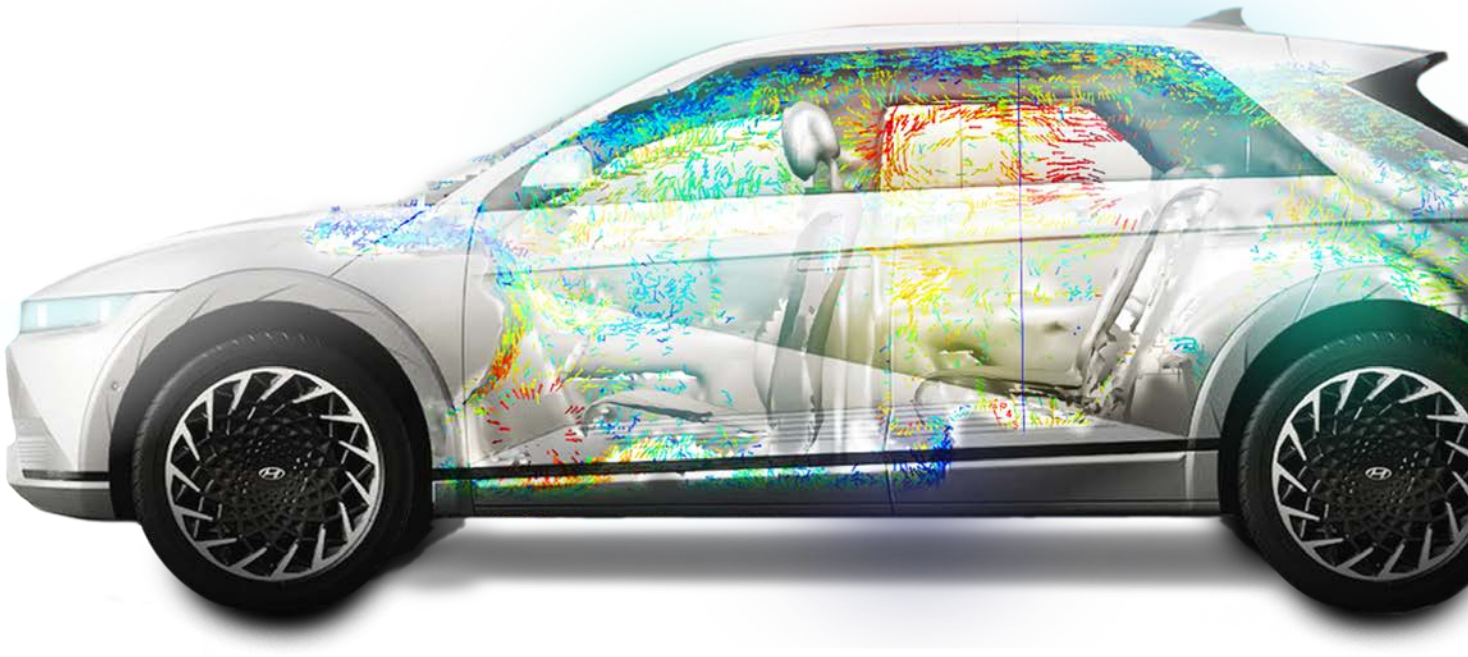
The visualization of sound intensity in a 3D space enables to get an intuitive and comprehensive understanding of sound radiation mechanisms as well as the interaction between problematic elements. By 3D scanning, it was already possible to identify two critical bands with very different behavior. The trunk has the highest acoustic emission for lower frequencies, whereas the C pillar, B pillar, and rear passenger windows seem to dominate the medium frequency range.

Secondly, a ranking of the main sections of the car interior was presented, showing that the combination of reciprocally measured acoustic transfer functions with 3D sound intensity measurements can reveal the main problematic areas for multiple operational conditions and/or frequency bands. This information was used to apply an effective acoustic treatment in order to reduce the noise perceived by the vehicle's passengers.

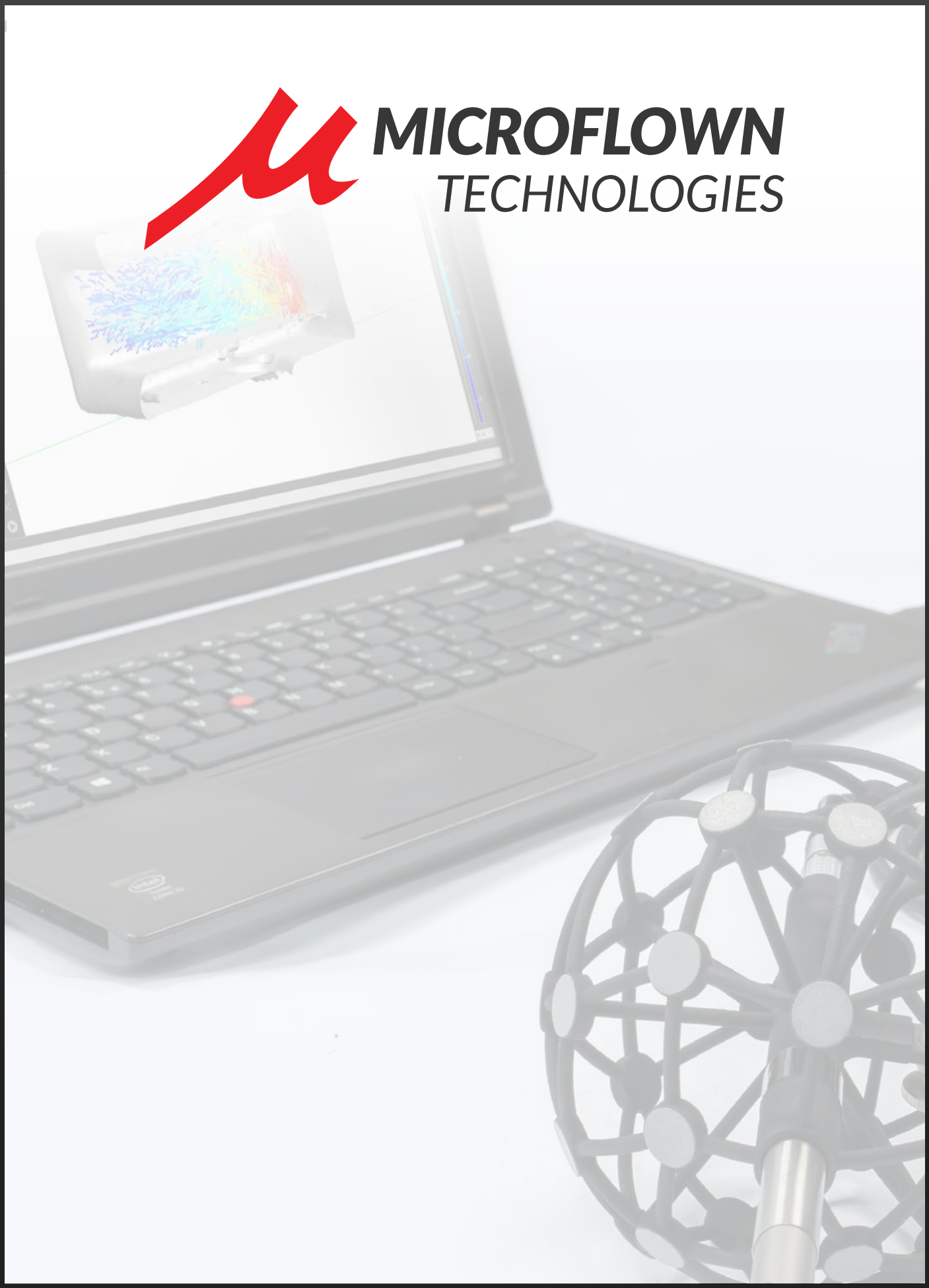


INTRODUCTION OF A NOVEL TECHNIQUE

- Easy identification of the problematic area in terms of noise emission
- Broadband, high spatial resolution visualization of the sound field to intuitively identity main sources
- Significantly decrease of required time to obtain results compared to traditional techniques
- Ranking of the panels based on their sound pressure contribution to a defined reference position
- Knowledge and information over the perceived noise by the vehicle's passenger for applying proper and effective damping treatment



MICROFLOWN TECHNOLOGIES



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