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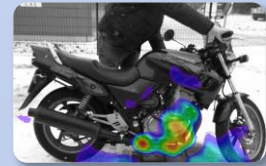
Noise Inspector - Acoustic Cameras Technical datasheet



USES AND APPLICATIONS

SEE SOUND AND VIBRATION

During the last years, new technologies for the visualization of sound sources – acoustic cameras – became extraordinary relevant in the industry and the environment field due to its practical and intuitive use. Acoustic design of a product is an important aspect of product development. Easy to use and obvious results give engineers a new sense – “See sound sources with your eyes”. This accelerates product development, quality control and environmental measurements enormously.



Therefore is developed the acoustic camera “Noise Inspector”. Powerful and flexible, the “Noise Inspector” improves continuously to give you the advantages of an accurate, fast and smart technology. With this system sound and vibration become visible in real-time. Furthermore the software is easy to use for non-acoustician and offers great functionality for professionals. The results are easy to interpret for everybody. Noise Inspector is an important tool to improve your product quality, minimize development time and to save your resources.



It can be adapted to your needs due its flexibility and modular approach. With one single system including a rich variety of arrays, the smooth transition between beamforming, holography and sound intensity measurements is possible, enabling to analyse a broad range of objects.

Everything is designed to have a very high performance. More advantages – less costs!

01dB has set up a partnership with the German company CAE Software and Systems to offer its customers the best solution for acoustic cameras.

FEATURES

Hardware

- Innovative arrays
- Integrated data acquisition system
- One system for near and far field
- 24 bit synchronous sampling
- Channels: 8 to 1000+
- High resolution results
- High resolution optical camera
- Battery operation
- Trigger and RPM channel
- Light weight and Small packaging dimensions
- Flexible and mobile

Software

- Real-time sound imaging for quick results
- Post processing for high accuracy results
- Powerful HD algorithms
- AVI, WAV and result export
- Localization from 40 Hz up to 20kHz depending on the configuration
- Dynamic range more than 40 dB possible
- Acoustic weightings filters
- LabVIEW- and Matlab interface
- Batch or manual processing
- Unique real 3D beamforming
- Intuitive and easy to use



APPLICATIONS

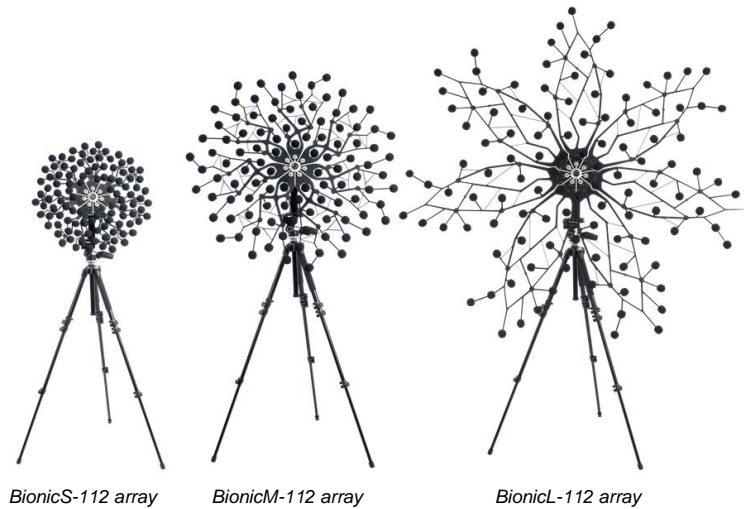
- Environmental acoustics
- Building acoustics
- Noise Leakage detection
- NVH
- Squeak and rattle
- Transient noise sources
- Stationary noise sources

NOISE INSPECTOR IS THE SOLUTION

The Noise Inspector solution is designed for quick setup to save time and start immediately with measurements. Therefore we designed a system which can be setup by only one person in about one minute. Immediately after setting up the hardware, the first acoustic pictures are only one mouse click away.

4 Important parts of acoustic cameras:

- Microphone array: we offer the best well-designed arrays.
- Data acquisition (analog or digital): 24 bit resolution, anti-aliasing filters and simultaneous sampling for each microphone. It is designed for all your applications.
- Camera: we use high definition digital cameras (USB or IP camera)
- Computation Software: Our software are made to be intuitive, easy to use and powerful



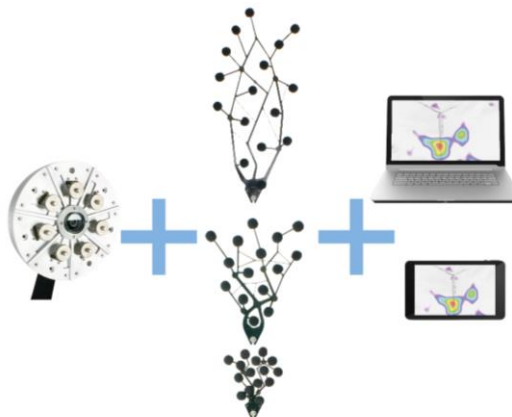
MODULAR CONCEPT

The unique Noise Inspector modular approach provides an optimal & high performance solution for every need.

Using the Smart Vision software (with a tablet-PC attached to the back of the camera, or a connected laptop), localizing sound sources is as easy as localizing thermal defects using a thermal camera.

And using the Noise Inspector software (with a Laptop-PC for instance), real-time and/or offline sound source localization is carried out with numerous additional and scalable functionalities: from standard to refined analysis to the most advanced investigations abilities.

The array can be selected according to the needs and to the kinds of noise to be analyzed. And in addition, it is possible to expand the acoustic camera with an additional array to open up new fields of application.

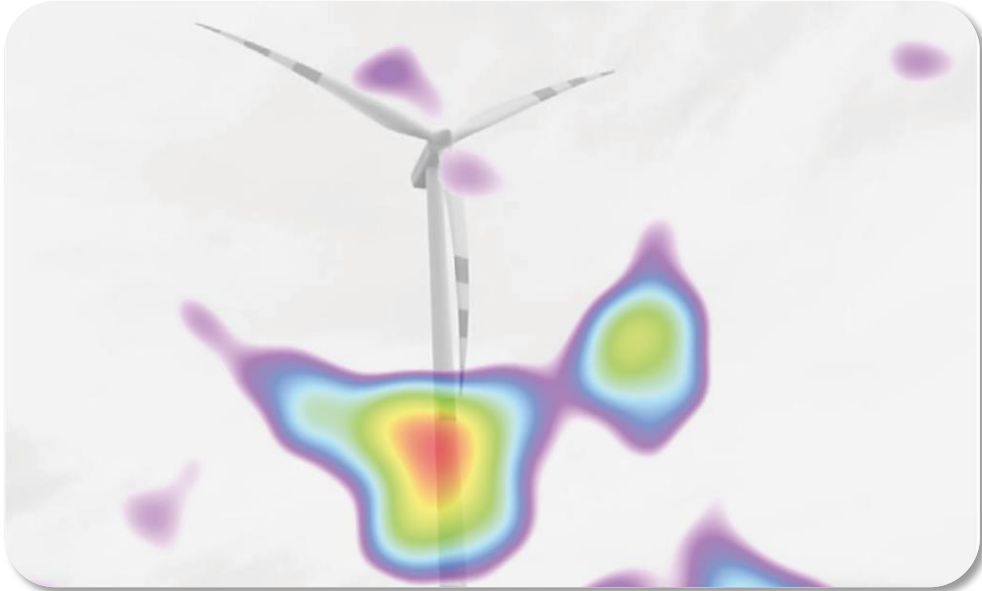


Assemble the array of your choice and use it with Smart Vision or Noise Inspector software

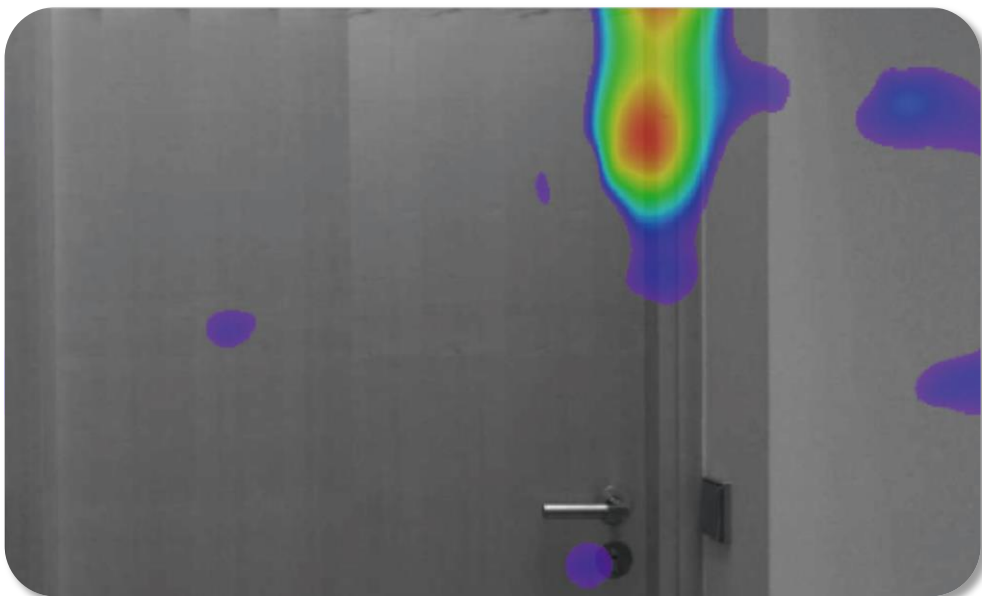
ENDLESS APPLICATIONS FOR ACOUSTIC CAMERAS

Our Noise Inspector is optimized to deliver best performance and most accurate results for every possible application. Depending on the used array, the system is suitable for very low to very high frequencies.

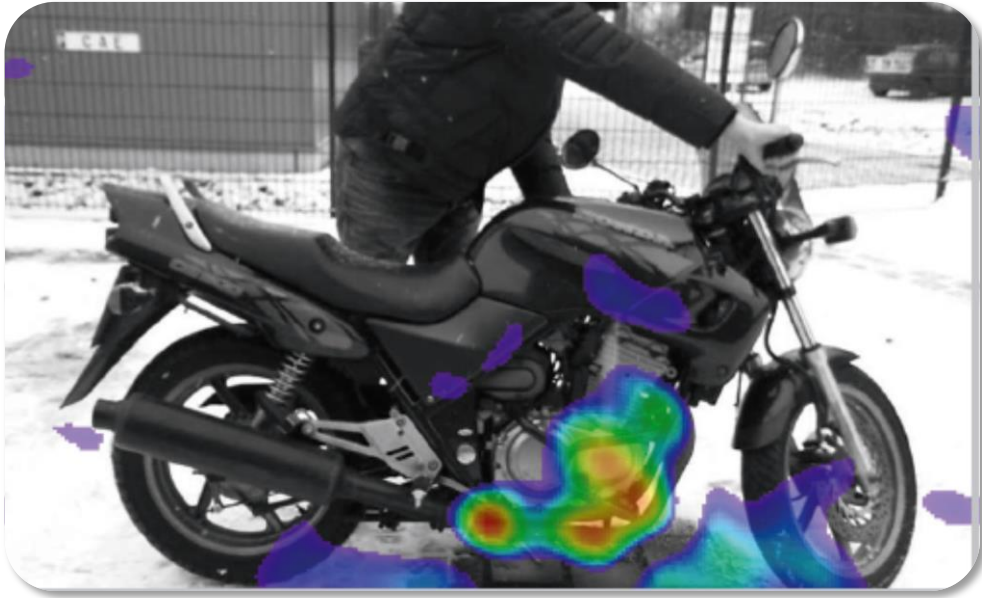
AIRBONE NOISE OF WING TIP



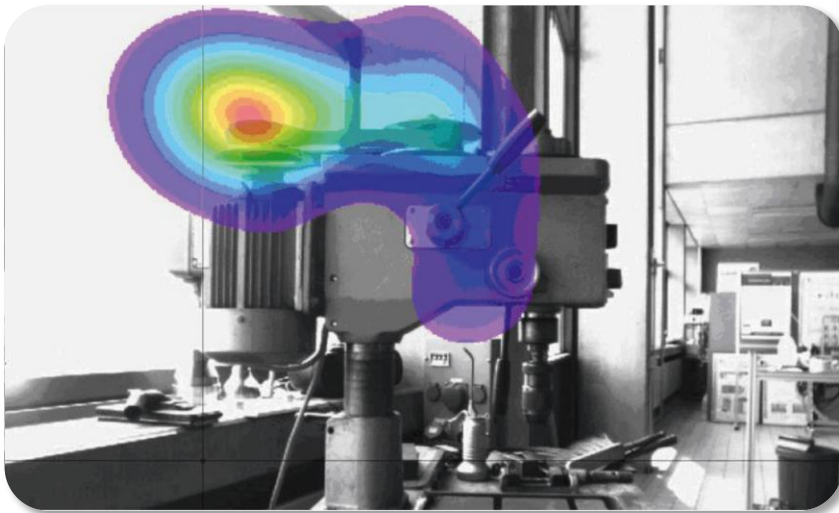
BUILDING LEAKAGE DETECTION



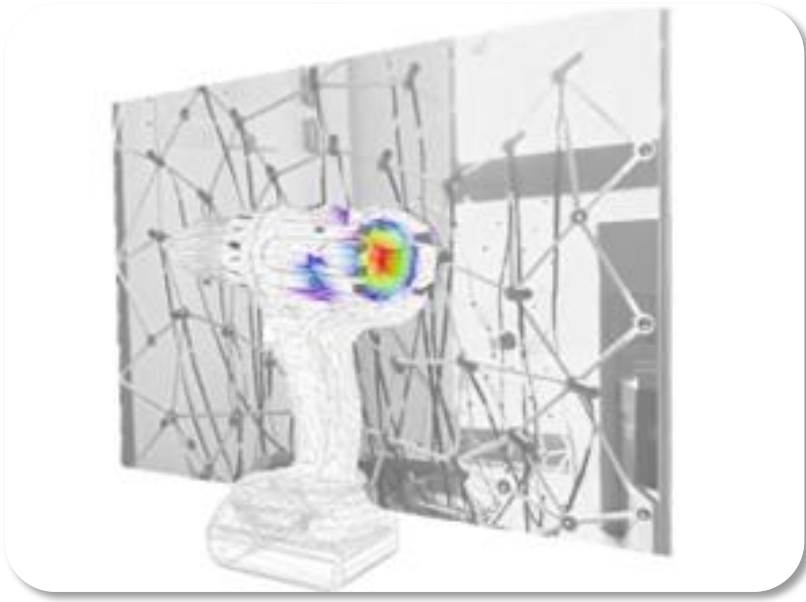
MOTORCYCLE NOISE



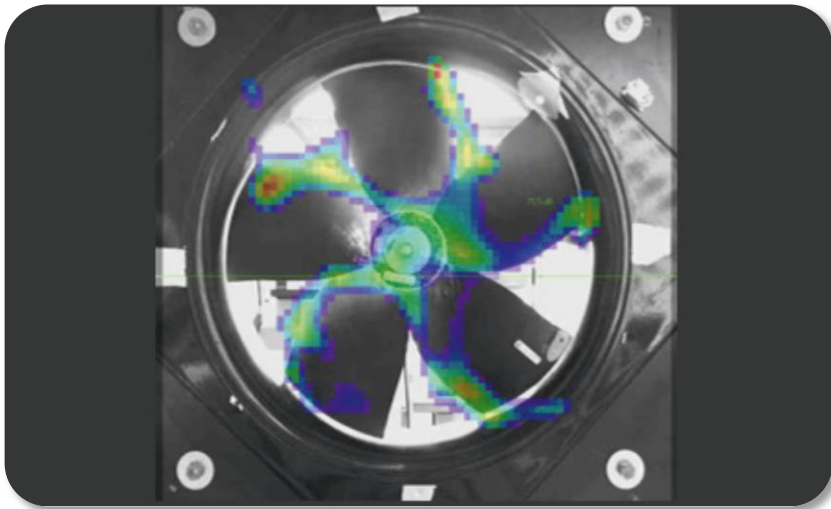
FRICTION NOISE OF A BELT DRIVE



DRILL NOISE



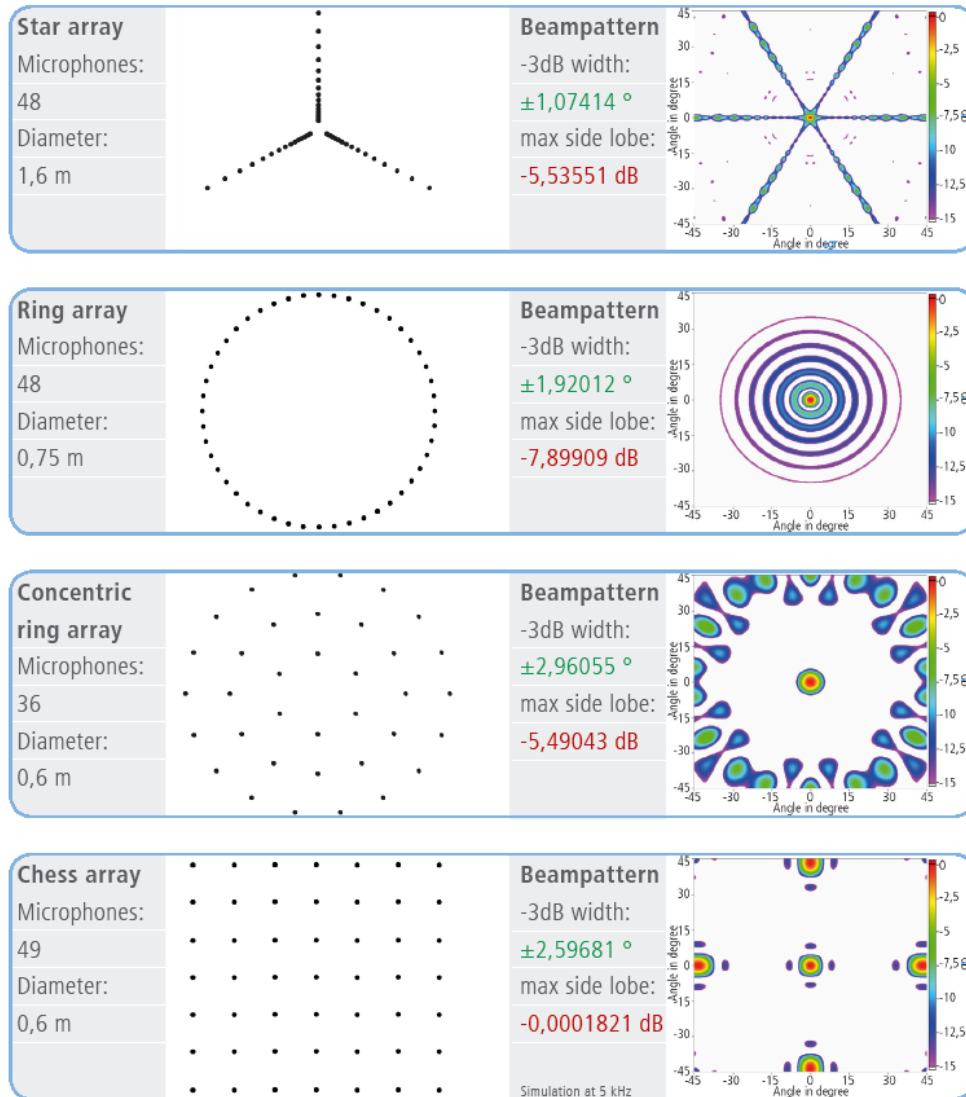
FAN NOISE



THE BEST ARRAY TECHNOLOGY

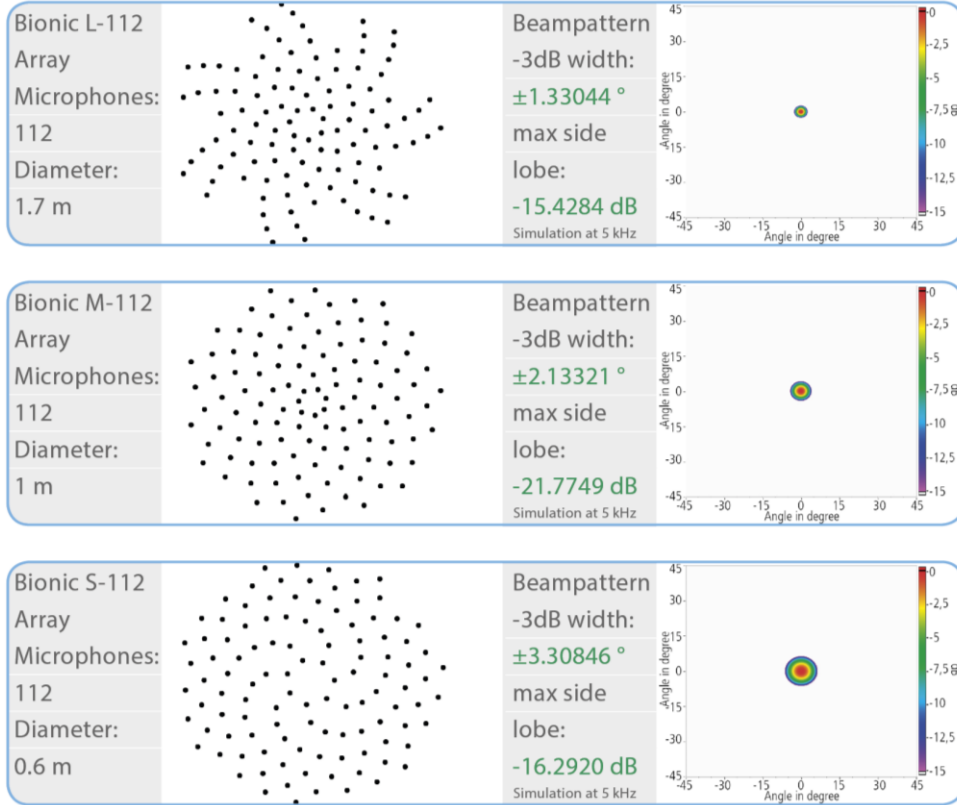
COMMON ARRAYS

The array design is an important physical property to deliver very high resolution results. Therefore a lot of engineering know-how is put into the shape of the arrays. Standard designs give results with poor resolution and/or poor dynamic range:



LEADING ARRAY TECHNOLOGY

As the influence of the array designs are that significant, we created a portfolio of good microphone distributions (see below). Also it is absolutely possible to create customized array designs to fulfil the customers' needs.



SMART VISION SOFTWARE – SMART STAND ALONE OPERATION

By using a tablet the acoustic camera can be turned into a very smart and mobile system. It is mounted on the backside and plugged into the acoustic camera. Acoustic pictures are directly displayed on the tablet in real-time. The simple software interface allows the user to start immediately acoustic investigations.



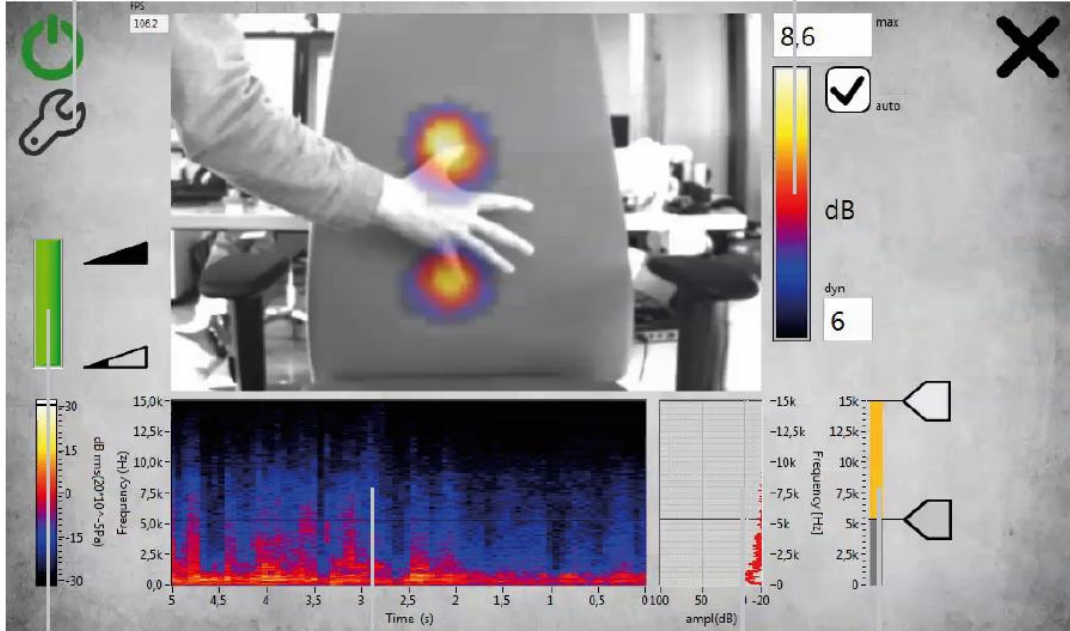
FEATURES

- Up to 100 acoustic pictures per second over a selectable frequency range
- Up to 60 optical pictures per second
- Real-time processing with high definition acoustic pictures
- No analysis hardware (PC/Notebook) needed
- No cable needed
- Optimized array shape for high dynamic range
- Online local sound listening
- Save acoustic pictures and acoustic videos
- Playback of local sound
- Easy-to-use
- Ultramobile
- Flexible
- Robust
- Runnable on Windows tablets, PCs and Notebooks

SMART VISION – PERFECT FOR NEWCOMERS

On/Off and Setup of Beamforming

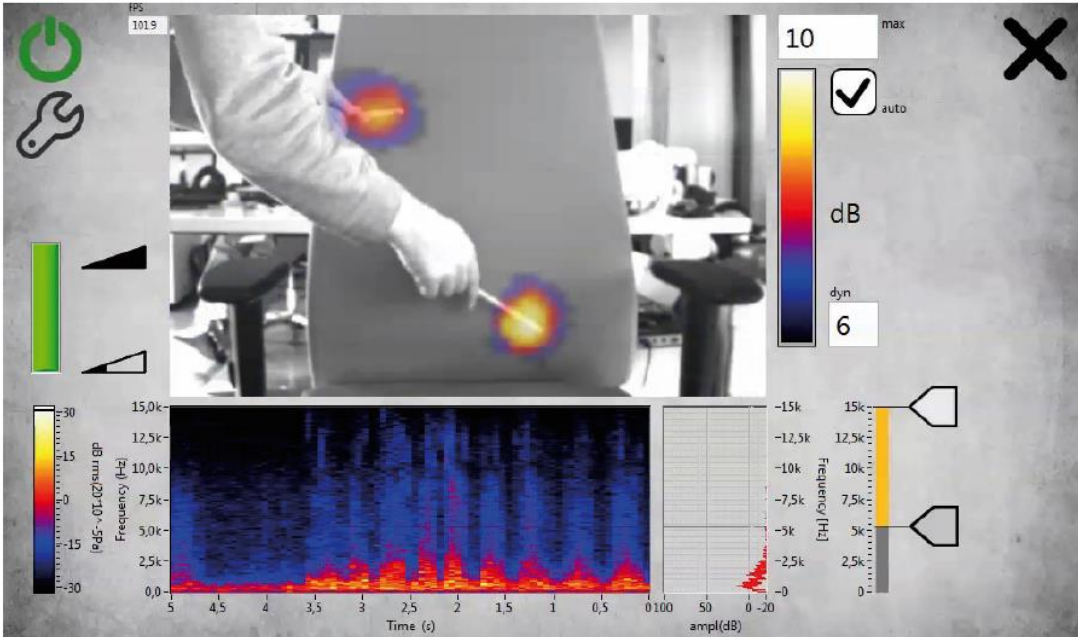
Maximum Soundpressurelevel and setup for dynamic range



Volume of local sound

Time-frequency graph

Frequency graph
Frequencyrange sliders for beamforming



Friction noise of two pens on the backrest of an office chair.

NOISE INSPECTOR SOFTWARE – EXCELLENCE MAKES THE DIFFERENCE

The Noise Inspector software is a turn key solution to visualize sound sources. Acoustic pictures and movies show the user fast and directly where the noise is coming from.

The user friendly interface guides the user through the whole process from data acquisition through analysis to reporting. We implemented in the software many well-known and new algorithms for getting detailed pictures. A comprehensive reporting tool allows the user to quickly generate documentation and visualization of the results.

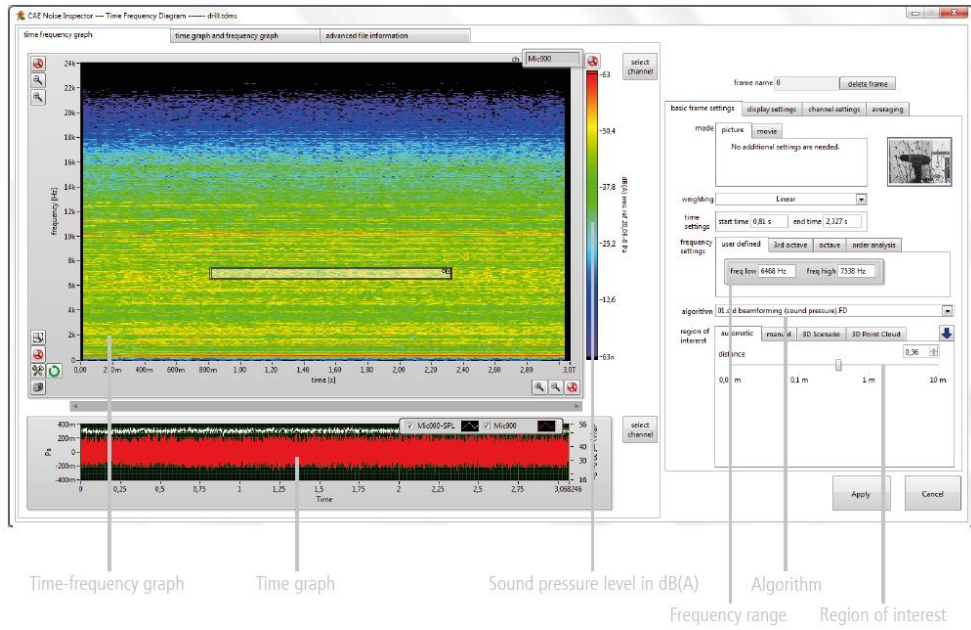
The Noise Inspector Software is not a closed software solution. The export possibility allows the usage of the results and measurements on different software platforms. The raw data files and the result files are stored on the hard disc in the TDMS-file format from National Instruments and can be read in external software easily.

The open LabVIEW and Matlab interface provides a simple way for our customers to develop their own algorithms and to integrate these into the Noise Inspector, which is often used for research properties.

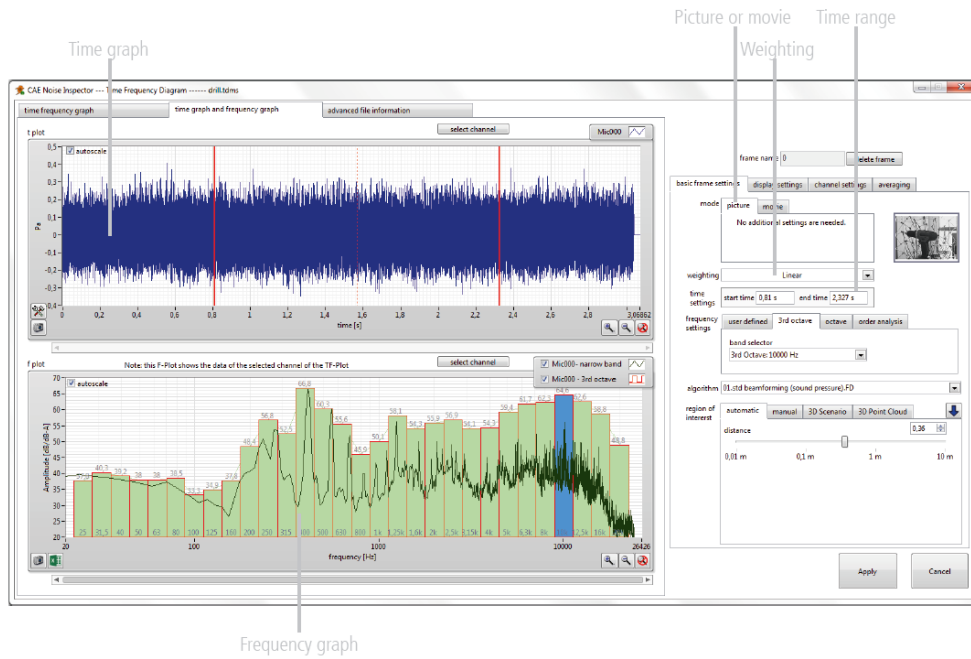
MAIN INTERFACE OF THE NOISE INSPECTOR SOFTWARE



PRE-ANALYSIS IN TIME-FREQUENCY DOMAIN



PRE-ANALYSIS IN TIME AND FREQUENCY DOMAIN



WIDE SELECTION OF ALGORITHMS

The Noise Inspector software comes with the largest range of algorithms available on the market. You can choose between standard beamforming and high resolution beamforming algorithms for far field measurements.

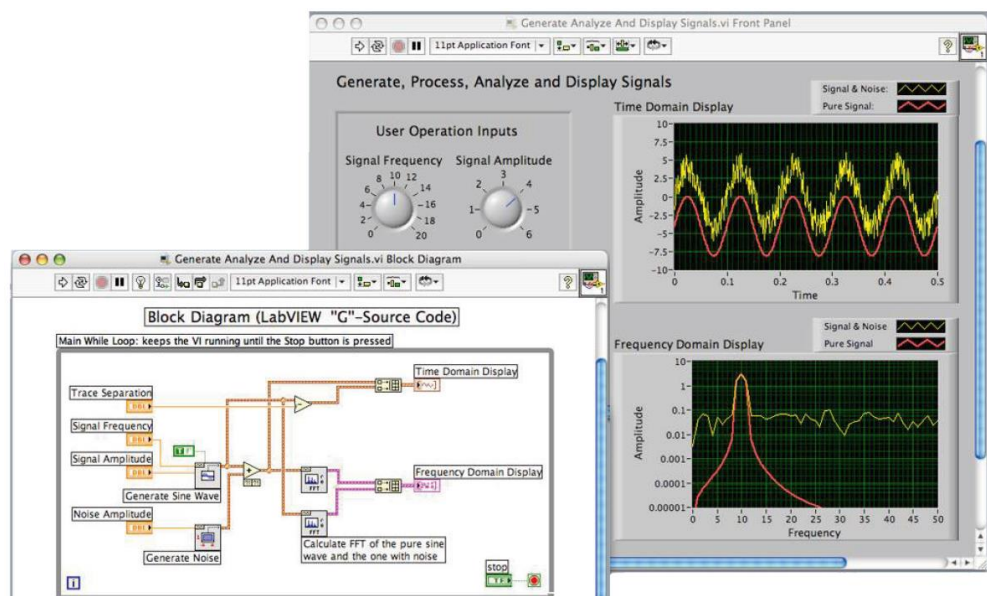
If you are facing lower frequency sources the Noise Inspector can be used for acoustic holography measurements or intensity mapping tasks (with specific intensity arrays), as well the user is able to design own analysis algorithms and implement them via the LabVIEW interface for plugins.

ALGORITHMS FROM 40 HZ

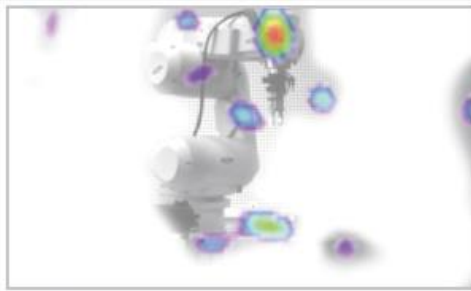
- SONAH (with the BionicS-112 array or BionicM-112 array) – Statistically Optimized Near field Acoustic Holography
- Intensity (with specific intensity arrays) – Online Intensity, Intensity mapping method, 3D intensity mapping (3D vectors)

ALGORITHMS FROM 500 HZ

- Standard Beamforming - very fast and robust
- EVOB (EigenValue Optimized Beamforming)
- Deconvolution algorithms
 - CLEAN SC
 - MUSIC (Multiple Signal Classification)
 - CAPON
 - DAMAS (Deconvolution Approach for the Mapping of Acoustic Sources)
 - Orthogonal Beamforming
 - And others
- Real 3D beamforming - object is inside of the microphone array
- Rotating beamforming - for fast rotating parts e.g. fans
- “user” - interface for your own methods



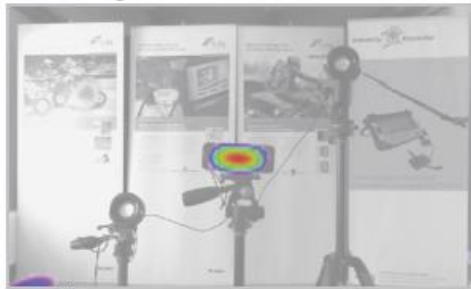
ADVANCED HD ALGORITHMS



Beamforming



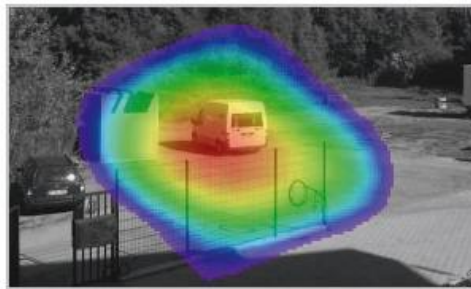
EVOB (EigenValue Optimized Beamforming)



Beamforming



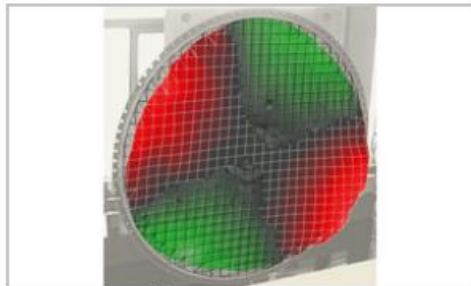
MUSIC



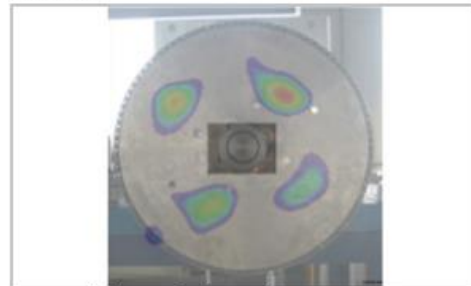
Beamforming



Clean SC



Laser scanning vibrometry



Acoustic holography (SONAH)

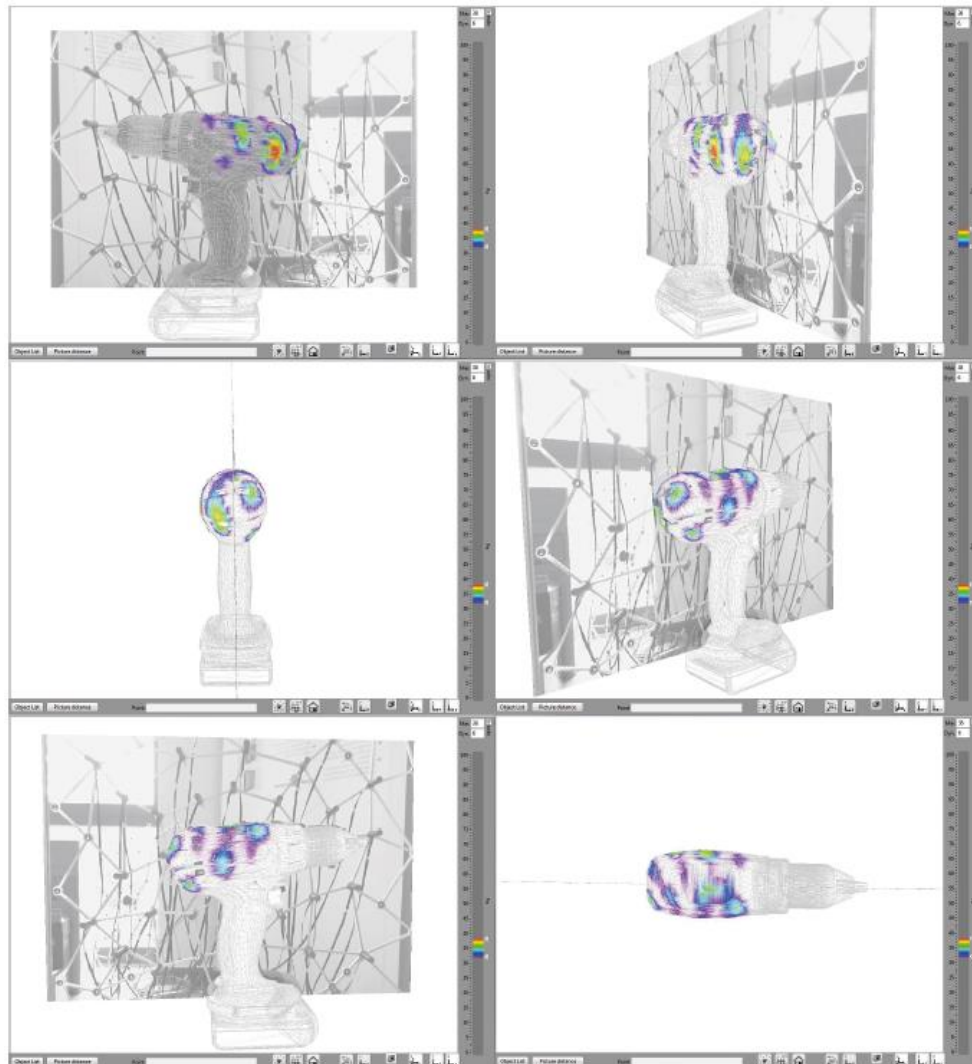
UNIQUE REAL3D BEAMFORMING

The Noise Inspector solution offers worldwide unique 3D beamforming.

The object is surrounded by microphone arrays and is therefore measured from all sides. The results are real 3D measurement results which are projected on the 3D model.

Only one measurement shows the complete acoustic emission of the measured object. There is no limit in the microphone array size - from a small cube of 800 mm x 800 mm x 800 mm up to a complete anechoic chamber.

Results are in high resolution in all dimensions.



DIGITAL REAL-TIME INTEGRATED HARDWARE

The powerful data acquisition hardware is integrated into the acoustic camera hub and is robust and lightweight. The onboard real-time processor and FPGA guarantee the highest accuracy of the measured data. By synchronizing frontends the system can be extended to more than 1000 channels. Furthermore it can record the RPM of a rotating system. A trigger channel can be used to start the measurement with an external signal.

The frontend streams the acquired data of the microphones and the camera through high speed Ethernet in real-time to the host computer.



Features

- Lightweight
- Robust
- Expandable
- Trigger channel
- RPM channel
- Battery option
- Fanless
- Synchronized multi chassis applications
- Up to more than 1000 microphone channels

Hub-Frontend	
Channels	112
Sample rate	48 kHz
Resolution	24 bits
Simultaneous sampling	Yes
Interface to PC	Ethernet
Fanless	Yes
Additional inputs	Trigger, Tacho (RPM)
Battery option	Yes
Power supply	12 V DC
Power consumption	< 14 W
Dimension	180 x 180 x 100mm
Weight	2,2 kg

PACKAGES

OVERALL SPECIFICATIONS

All Acoustic Camera packages contain one complete system (microphone array + acquisition system).

AVAILABLE KITS

	CAM3013000 BionicXS-56 Smart Vision (coming soon)	CAM3014000 BionicS-112 Smart Vision	CAM3015000 BionicM-112 Smart Vision	CAM3020000 BionicS-112 Noise Inspector Standard	CAM3021000 BionicM-112 Noise Inspector Standard	CAM3022000 BionicL-112 Noise Inspector Standard	CAM3018000 BionicS-112 Noise Inspector Premium	CAM3010000 BionicM-112 Noise Inspector Premium	CAM3019000 BionicL-112 Noise Inspector Premium
BionicXS-56ch Array – 0.45m diameter (coming soon)	●	○	○	○	○	○	○	○	○
BionicS-112 Array – 0.6m diameter	○	●	○	●	○	○	●	○	○
BionicM-112 Array – 1m diameter	○	○	●	○	●	○	○	●	○
BionicL-112 Array – 1.7m diameter	○*	○*	○*	○	○	●	○	○	●
Accessories: Complete set of windshields	○	○	○	○	○	○	●	●	●
Accessories: Flight Case	○	○	○	○	○	○	●	●	●
Smart Vision Software	●	●	●	●	●	●	●	●	●
Tablet Kit (incl. Windows 10 Tablet)	●	●	●	○	○	○	○	○	○
Noise Inspector Software Main Package	X	○	○	●	●	●	●	●	●
Software Option: High Resolution Algorithms (complete set)	X	○*	○*	○	○	○	●	●	●
Software Option: High Resolution Algorithm (1pc)	X	○*	○*	○	○	○	X	X	X
Software Option: Rotating Beamforming	X	○*	○*	○	○	○	○	○	○
Software Option: 3D Beamforming	X	○*	○*	○	○	○	○	○	○
Software Option: Order Analysis	X	○*	○*	○	○	○	○	○	○
Software Option: Multichassis functionality	X	○*	○*	○	○	○	○	○	○
Extension package: Intensity Array with I ² S frontend	○*	○*	○*	○	○	○	○	○	○
Extension package: Acoustic Compass with I ² S frontend	○*	○*	○*	○	○	○	○	○	○

● Included ○ Option x Not possible ○* Noise Inspector Software necessary

ADDITIONAL 3D ARRAYS

Additionally to the standard packages, 3D arrays can be offered, on a customization principle.

For instance:

- Assembly of several BionicS-112 arrays or several BionicM-112 arrays
- Customized 3D arrays
- Complete room 3D array

TECHNICAL SPECIFICATIONS

BIONIC S-112 ARRAY



Features

- Far field analysis (beamforming)
- Near field analysis (holography)
- Fully integrated design (no frontend necessary)
- High dynamic range and resolution
- Very small package volume
- 40° resolution at 1000 Hz with beamforming
- From 40 Hz with holography
- Handheld

Application

- NVH
- Squeak and rattle
- Noise leakage detection
- Environmental and building acoustics
- Engine noise
- Automotive (interieur)
- Product development
- For transient and stationary noise sources

Bionic S-112 Array

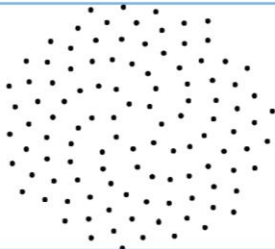
Array Size	Diameter 600 mm
Array Material	Composite Material
Weight (excl. Tripod)	3.1 kg
Microphones	112
Sample Rate	48 kHz
Mic. Frequency Range	10 Hz to 24 kHz
Operating Range	< 33 dB to 120 dB
Analysis Dynamic Range	up to 40 dB
Measurement distance	0.2 m to ∞
Resolution	24-Bit
Interface	Ethernet
Operating Temperature	-40 °C to +60 °C
Operating Humidity	Non Condensing

Bionic S-112

Array

Microphones:
112

Diameter:
0.6 m



Beampattern

-3dB width:

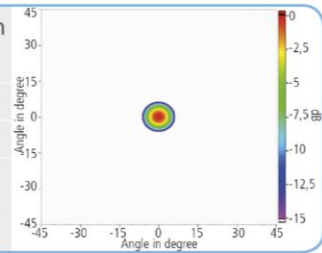
$\pm 3.30846^\circ$

max side

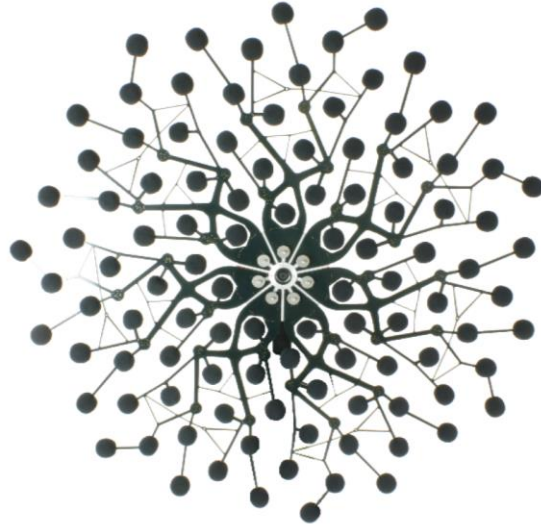
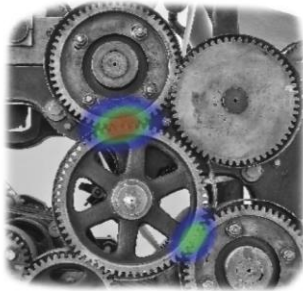
lobe:

-16.2920 dB

Simulation at 5 kHz



BIONIC M-112 ARRAY



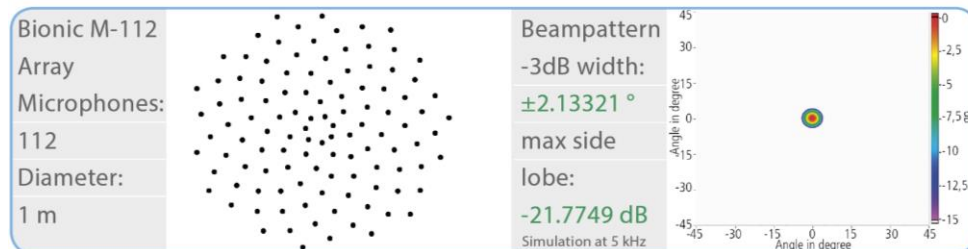
Features

- Far field analysis (beamforming)
- Near field analysis (holography)
- Fully integrated design (no frontend necessary)
- High dynamic range and resolution
- Very small package volume
- 40° Resolution at 600 Hz with beamforming
- From 40 Hz with holography
- Handheld

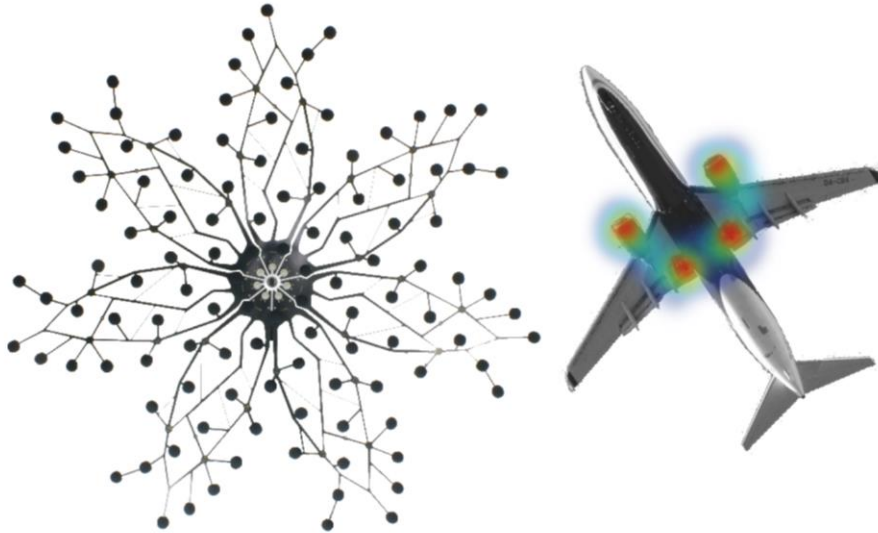
Application

- NVH
- Squeak and rattle
- Noise leakage detection
- Environmental and building acoustics
- Engine noise
- Automotive (exterieur)
- Machine acoustics
- For transient and stationary noise sources

Bionic M-112 Array	
Array Size	Diameter 1000 mm
Array Material	Composite Material
Weight (excl. Tripod)	3.3 kg
Microphones	112
Sample Rate	48 kHz
Mic. Frequency Range	10 Hz to 24 kHz
Operating Range	< 33 dB to 120 dB
Analysis Dynamic Range	up to 40 dB
Measurement distance	0.2 m to ∞
Resolution	24-Bit
Interface	Ethernet
Operating Temperature	-40 °C to +60 °C
Operating Humidity	Non Condensing



BIONIC L-112 ARRAY



Features

- Far field analysis (beamforming)
- Fully integrated design (no frontend necessary)
- High dynamic range and resolution
- Very small package volume
- 40° resolution at 350 Hz with beamforming
- Handheld

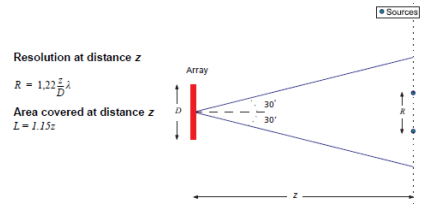
Application

- NVH
- Machine acoustics
- Noise leakage detection
- Environmental and building acoustics
- Wind energy
- Wind tunnel
- For transient and stationary noise sources

Bionic L-112 Array	
Array Size	Diameter 1700 mm
Array Material	Composite Material
Weight (excl. Tripod)	3.5 kg
Microphones	112
Sample Rate	48 kHz
Mic. Frequency Range	10 Hz to 24 kHz
Operating Range	< 33 dB to 120 dB
Analysis Dynamic Range	up to 40 dB
Measurement distance	0.8 m to ∞
Resolution	24-Bit
Interface	Ethernet
Operating Temperature	-40 °C to +60 °C
Operating Humidity	Non Condensing

<p>Bionic L-112 Array Microphones: 112 Diameter: 1.7 m</p>		<p>Beampattern -3dB width: ±1.3044 ° max side lobe: -15.4284 dB Simulation at 5 kHz</p>	
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Note: the **40° Resolution** frequency value given here above for each array comes from the classical formula for Beamforming:



It corresponds to a worst case scenario when identical noise sources have to be separated. This value is given to help comparison of arrays. In practical situations, with non-identical sources, this value is generally lowered down. And the Noise Inspector HD algorithms also allow improving drastically the low frequency results.

3D ARRAYS



Example of 3D array based on an assembly of 3 Spider arrays.

Features

- 3D beamforming
- 3D results on 3D objects
- One measurement for the complete acoustic emission in 3D
- Array size: small cube or complete room or combine our standard arrays to a 3D array
- Acoustic photos and videos

Application

- NVH
- Squeak and rattle
- Machinery acoustic
- Product development
- Wind tunnel
- Noise leakage detection
- Test stand
- For transient and stationary noise sources

3D Array	
Array Size from	0.8m x 0.8m x 0.8m
Array Material	Aluminium
Weight	10 kg
Microphones	40 and more
Sample Rate	48 kHz
Mic. Frequency Range	10 Hz to 24 kHz
Operating Range	< 33 dB to 120 dB
Analysis Dynamic Range	up to 40 dB
Measurement distance	Inside of array
Resolution	24-Bit
Interface	Ethernet
Operating Temperature	-40 °C to +60 °C
Operating Humidity	Non Condensing

I²S-FRONTEND

For Intensity arrays and/or 3D Spider-based arrays:



Features

- Light weight
- Robust
- Expandable
- Trigger channel
- RPM channel
- Battery option
- Fanless
- Synchronized multi chassis applications
- Up to more than 1000 microphone channels

I²S-Frontend

Channels	40
Sample rate	48 kHz
Resolution	24 bits
Simultaneous sampling	Yes
Interface to PC	Ethernet
Fanless	Yes
Additional inputs	Trigger, Tacho (RPM)
Battery option	Yes
Power supply	12 V DC
Power consumption	< 7W
Dimension	230 x 185 x 58 mm
Weight	2 kg

ACOEM

Smart monitoring, diagnosis & solutions

In today's complex and increasingly fast-moving world, it is essential to keep risks under control. **ACOEM** helps customers in the industrial, environmental and defense sectors make the right decisions and take the right actions:

- to ensure the productivity and reliability of industrial machines
- to prevent noise and vibration pollution
- to protect personnel, sites and vehicles in military theaters of operation
- to contribute to the development of effective, robust & noiseless products

All around the world, **ACOEM's** 400 employees are at the forefront of innovation in monitoring, maintenance and engineering through **01dB**, **ONEPROD**, **FIXTURLASER** and **METRAVIB**.

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