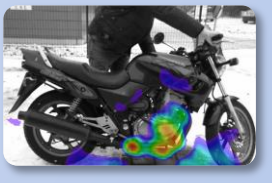
Noise Inspector - Acoustic Cameras
Technical datasheet

ENVIRO SOLTECH
☎:+964 781 100 6216
:+964 773 642 9559
✉: info@envirosoltech.com
: www.envirosoltech.com

01dB
Powered by CAE Software and Systems

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.

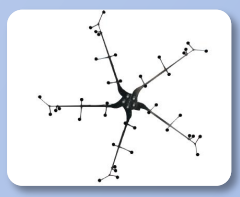
Therefore is developed the acoustic camera “Noise Inspector”. Powerful and flexible, the “Noise Inspector” improves continuously to give you the advantages of an accurate, fast and smart technology. With this system sound and vibration becomes visible in real-time. Furthermore the software is easy to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

It can be adapted to your needs due its flexibility in array design, number of microphones and state of the art algorithms. 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
- 24 bit synchronous sampling
- Channels: 8 to 1000
- High resolution results
- High resolution optical camera
- Battery operation
- Trigger and RPM channel
- Light weight
- 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

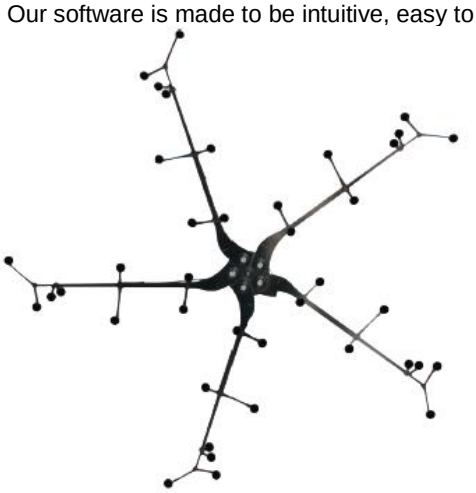
- Environmental acoustics
- Building acoustics
- Noise Leakage detection
- NVH
- Squeak and rattle
- Transient noise sources
- Stationary noise sources

NOISE INSPECTOR IS THE SOLUTION

The Noise Inspector 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:

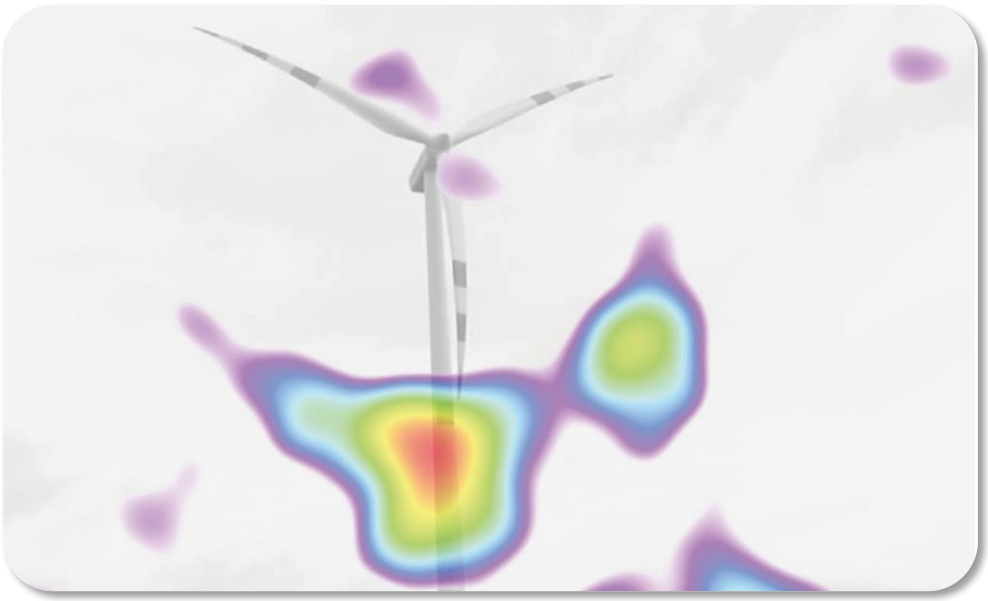
- Microphone array: we offer the best well-designed arrays.
- Data acquisition (analog or digital): 24 bit resolution, anti-aliasing filters and simultaneous sampling for each microphone. It is designed for all your applications.
- Camera: we use high definition digital cameras (USB or IP camera)
- Computation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



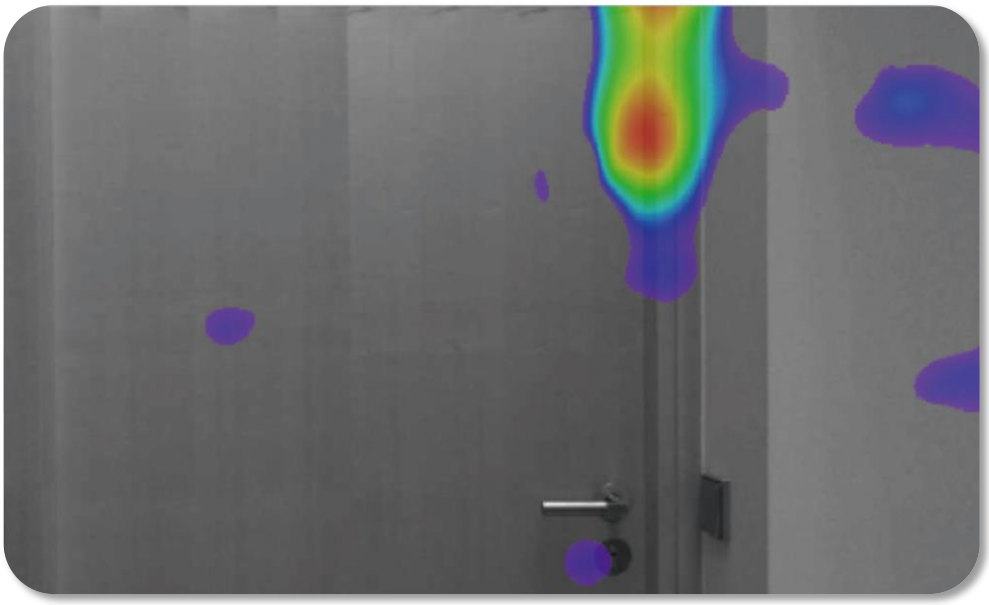
ENDLESS APPLICATIONS FOR ACOUSTIC CAMERAS

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



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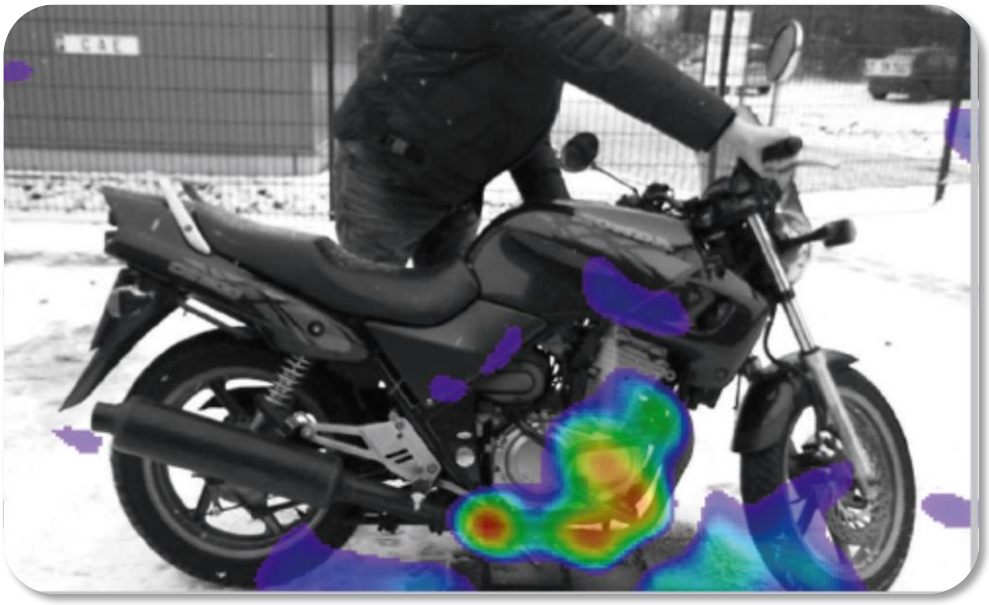
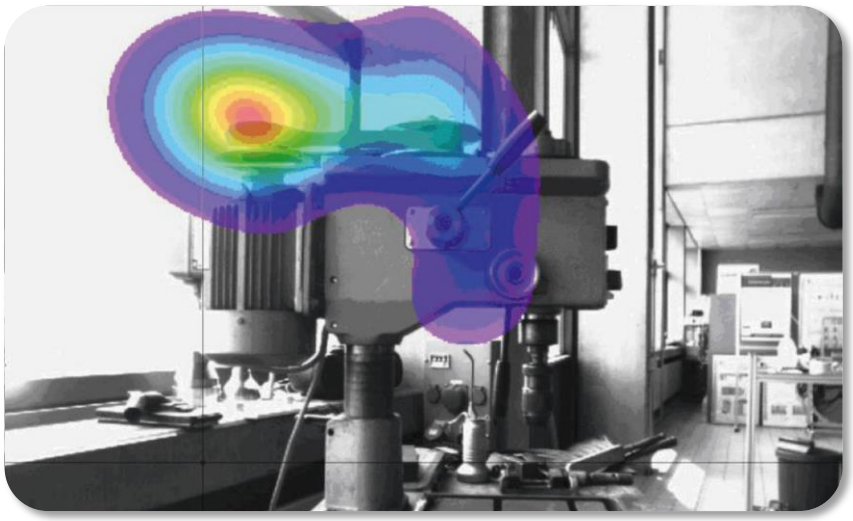
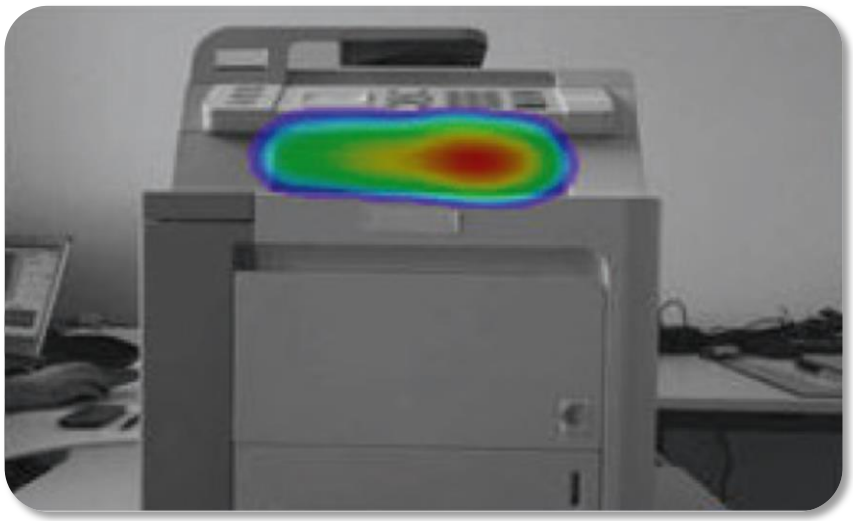
MOTORCYCLE NOISE



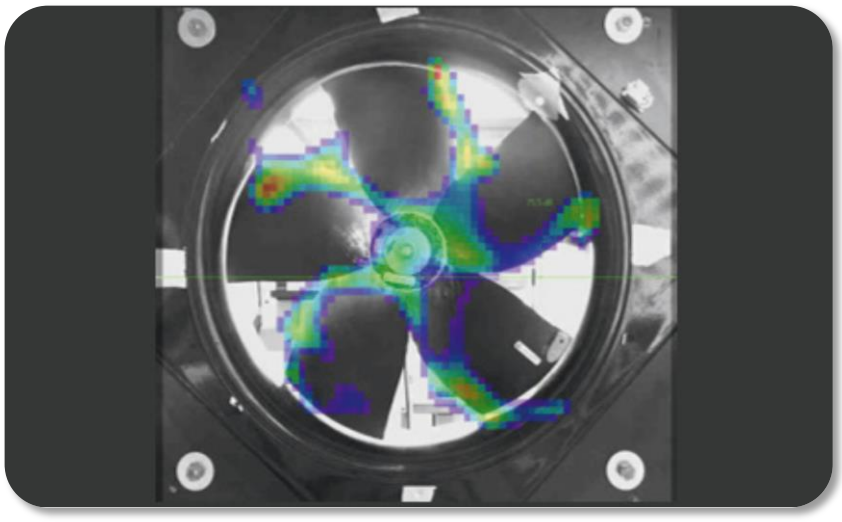
FRICTION NOISE OF A BELT DRIVE



PRINTER NOISE



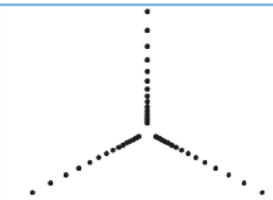
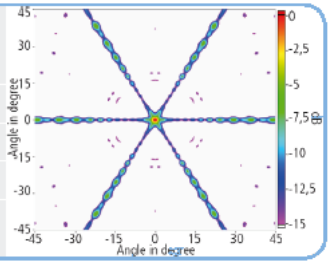
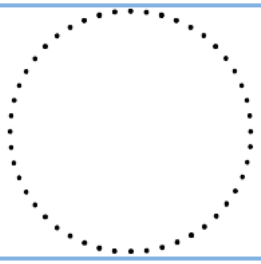
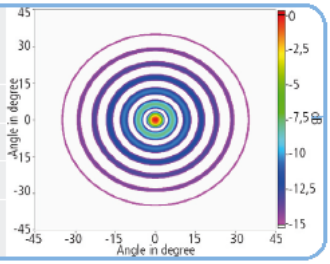
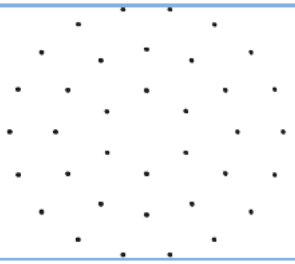
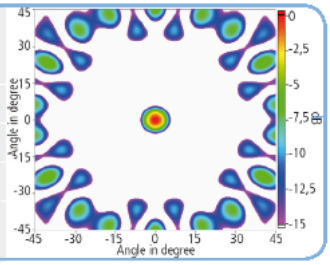
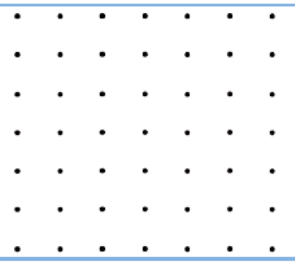
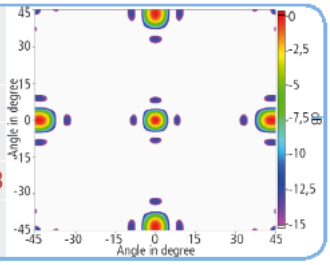
FAN NOISE



THE BEST ARRAY TECHNOLOGY

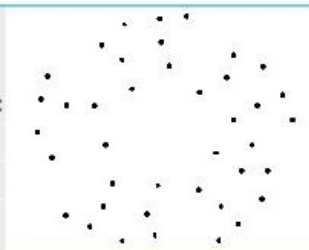
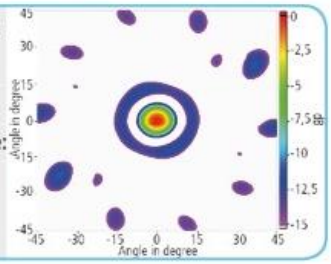
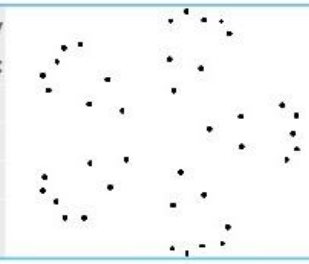
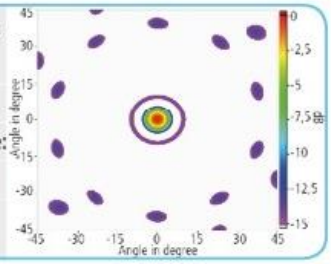
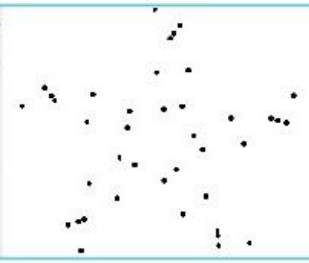
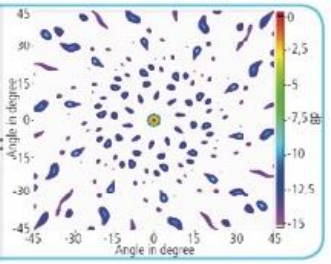
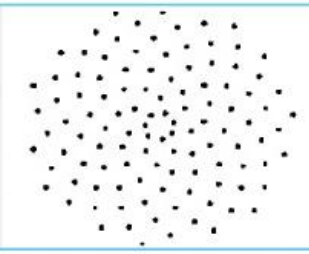
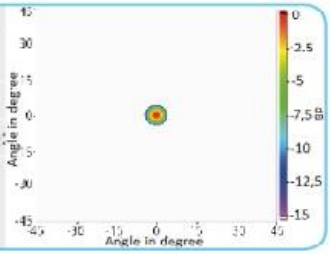
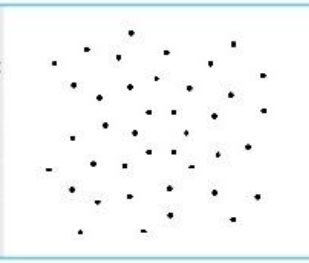
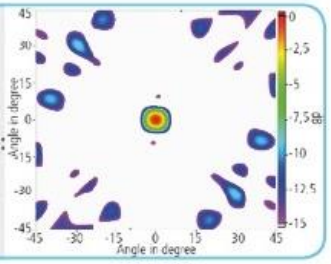
COMMON ARRAYS

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.

Star array Microphones: 48 Diameter: 1,6 m		**Beampattern** -3dB width: ±1,07414 ° max side lobe: -5,53551 dB	
Ring array Microphones: 48 Diameter: 0,75 m		**Beampattern** -3dB width: ±1,92012 ° max side lobe: -7,89909 dB	
Concentric ring array Microphones: 36 Diameter: 0,6 m		**Beampattern** -3dB width: ±2,96055 ° max side lobe: -5,49043 dB	
Chess array Microphones: 49 Diameter: 0,6 m		**Beampattern** -3dB width: ±2,59681 ° max side lobe: -0,0001821 dB Simulation at 5 kHz	

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.

Bionic XS Array Microphones: 40 Diameter: 0,45 m		Beampattern -3dB width: ±4,01958 ° max side lobe: -11,2164 dB Simulation at 5kHz	
Bionic S Array Microphones: 40 Diameter: 0,6 m		Beampattern -3dB width: ±3,02449 ° max side lobe: -13,2983 dB Simulation at 5kHz	
Bionic L Array Microphones: 40 Diameter: 1,6 m		Beampattern -3dB width: ±1,30365 ° max side lobe: -9,61437 dB Simulation at 5kHz	
Bionic M Array Microphones: 112 Diameter: 1 m		Beampattern -3dB width: ±2,13321 ° max side lobe: -21,7749 dB Simulation at 5kHz	
Spider Array Microphones: 40 Diameter: 0,65 m		Beampattern -3dB width: ±3,00837 ° max side lobe: -9,10779 dB Simulation at 5kHz	

EXCELLENT SOFTWARE MAKES THE DIFFERENCE

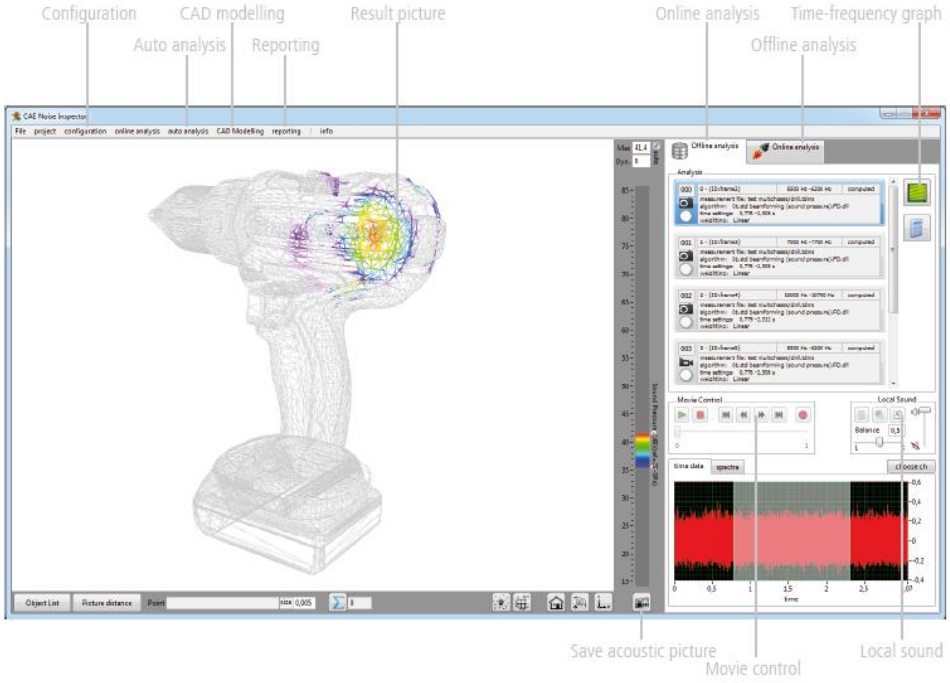
The Noise Inspector software is a turn key solution to visualize sound sources. Acoustic pictures and movies show the user fast and directly where the noise is coming from.

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.

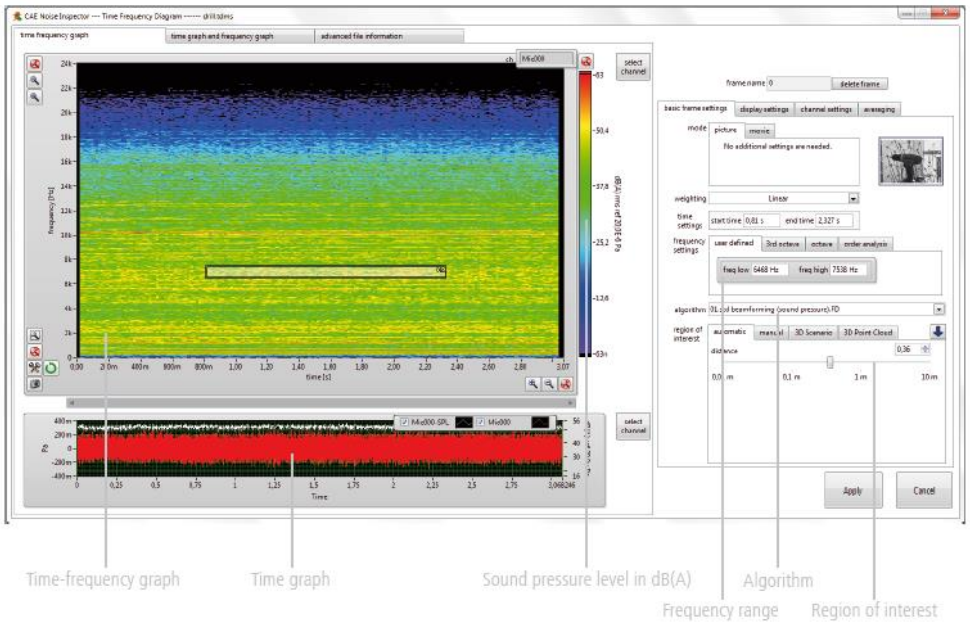
The Noise Inspector Software is not a closed software solution. The export possibility allows the usage of the results and measurements on different software platforms. The raw data files and the result files are stored on the hard disc in the TDMS-file format from National Instruments and can be read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

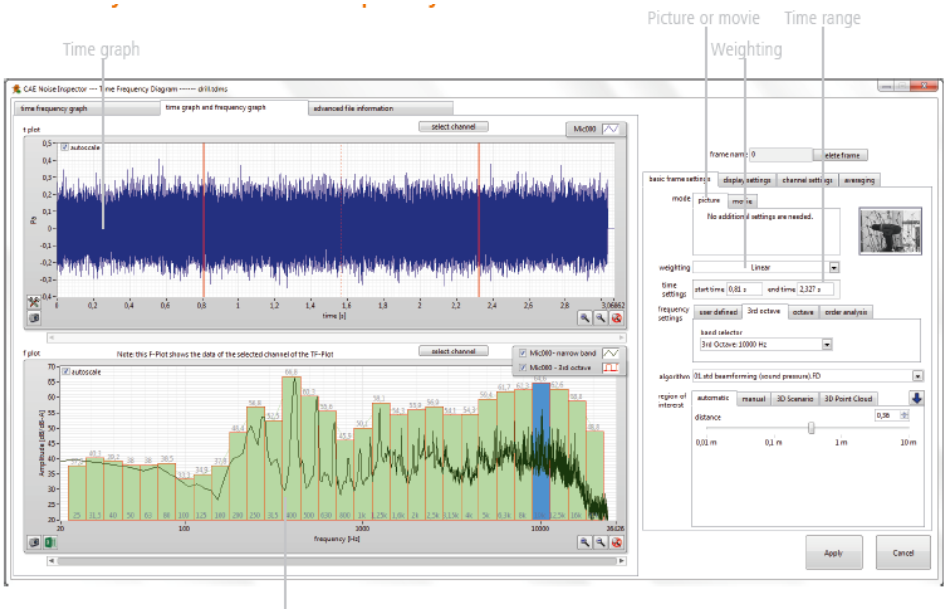
MAIN INTERFACE OF THE NOISE INSPECTOR



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.

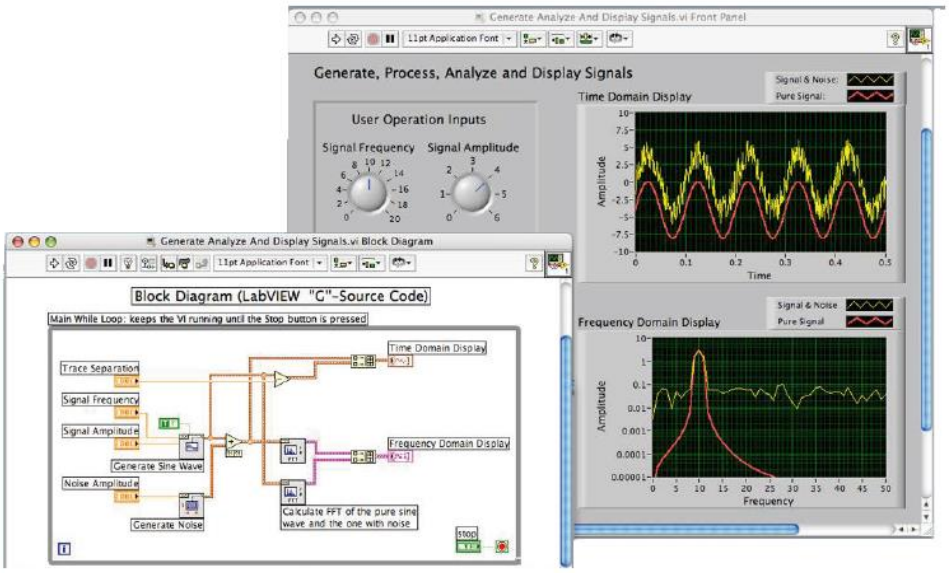
If you are facing lower frequency sources the Noise Inspector can be used for acoustic holography measurements (with the Spider array or Bionic M array) or intensity mapping tasks (with specific intensity arrays), as well the user is able to design own analysis algorithms and implement them via the LabVIEW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

ALGORTITHMS FROM 40 HZ

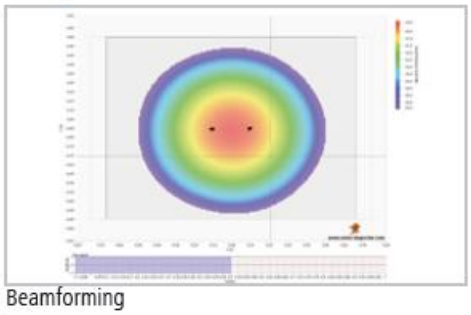
- SONAH (with the Spider array) – Statistically Optimized Near field Acoustic Holography
- Intensity (with specific intensity arrays) – Online Intensity, Intensity mapping method, 3D intensity mapping (3D vectors)

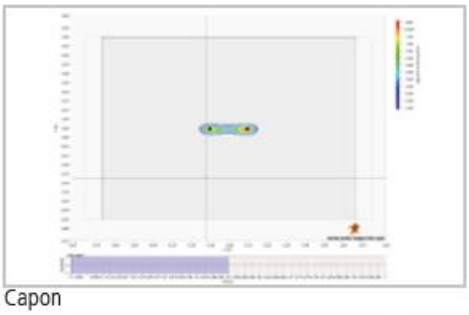
ALGORTITHMS FROM 500 HZ

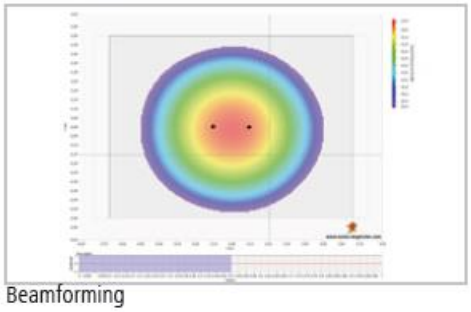
- Standard Beamforming - very fast and robust
- Deconvolution algorithms
  - CLEAN SC
  - MUSIC (Multiple Signal Classification)
  - CAPON
  - DAMAS (Deconvolution Approach for the Mapping of Acoustic Sources)
  - Orthogonal Beamforming
  - And others
- Real 3D beamforming - object is inside of the microphone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

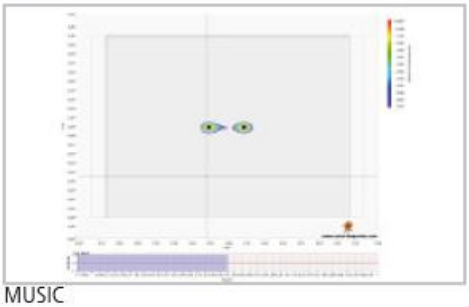


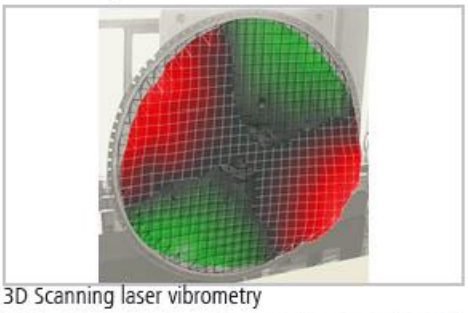
ADVANCED HD ALGORITHMS

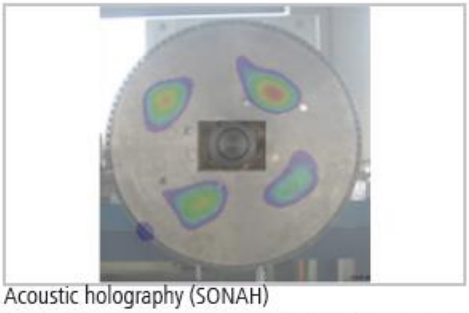

Beamforming

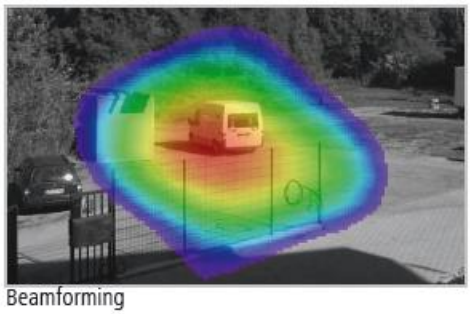

Capon


Beamforming


MUSIC


3D Scanning laser vibrometry


Acoustic holography (SONAH)


Beamforming


Clean SC

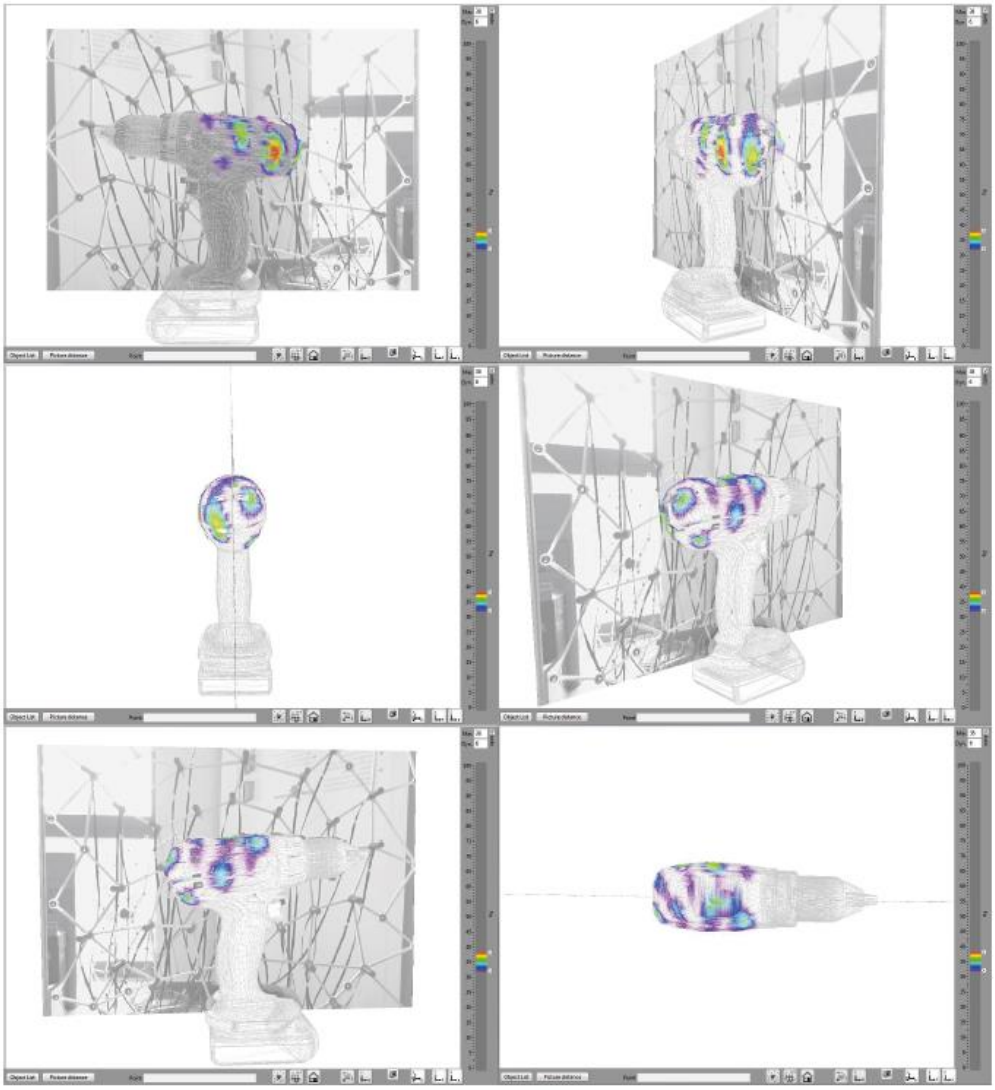
UNIQUE REAL3D BEAMFORMING

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.



THE POWERFUL DIGITAL FRONTEND

The powerful I²S-frontend is robust and light weight. The on-board 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 or measure the RPM of a rotating system simultaneously. Therefore the frontend has a trigger channel and an RPM channel integrated.

The Frontend streams the acquired data of the microphones through high speed Ethernet in real time to the host computer.

For the Bionic XS and Bionic M arrays, the data frontend is directly integrated into the camera body.

MAIN FEATURES

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

PACKAGES

OVERALL SPECIFICATIONS

All Acoustic Camera packages contain:

- One antenna with microphones, with associated Frontend (integrated or external)
- One Noise Inspector Software Main Package (only Beamforming, only 2D) with dongle

AVAILABLE KITS

	CAM3002000 40ch Noise Inspector Spider	CAM3005000 80ch Noise Inspector Spider	CAM3009000 40ch Noise Inspector Bionic XS	CAM3003000 40ch Noise Inspector Bionic S	CAM3010000 112ch Noise Inspector Bionic M	CAM3004000 40ch Noise Inspector Bionic L
Number of I²S Front-End	1	2	integrated	1	integrated	1
Hardware Option: Multichassis functionality	○	●	x	○	○	○
Hardware Option: Trigger and Tacho	○	●	○	○	○	○
Hardware Option: battery for I²S	○	○	○	○	○	○
Noise Inspector Software Main Package (only Beamforming, only 2D)	●	●	●	●	●	●
Software Option: High Resolution Algorithms (partial set)	●	●	○**	●	●	●
Software Option: High Resolution Algorithms (complete set)			○			
Software Option: 3D Beamforming	○	○	○	○	○	○
Software Option: Order Analysis	○	○	○	○	○	○
Spider Array with 40 microphones	●	○	○	○	○	○
Spider Array with 80 microphones	○	●*	○	○	○	○
Bionic Array XS with 40 microphones	○	○	●	○	○	○
Bionic Array S with 40 microphones	○	○	○	●	○	○
Bionic Array M with 112 microphones	○	○	○	○	●	○
Bionic Array L with 40 microphones	○	○	○	○	○	●

● *Included* ○ *Option* *x Not possible* ○** *Recommended*

●* *The CAM3005000 kit contains 2 "40 microphones spider arrays"*

ADDITIONAL 3D ARRAYS

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

For instance:

- splitting of one Spider array into several arrays
- assembly of several Bionic M arrays or several Spider arrays
- Customized 3D arrays
- Complete room 3D array

TECHNICAL SPECIFICATIONS

I²S-FRONTEND

Digital data acquisition
Channels: 40
Sample rate: 48 kHz
Resolution: 24 bits
Synchronous sampling

Weight and dimensions
Length: 230mn
Width: 185 mm
Height: 58 mm
Weight: 2kg

Power
Power supply: 9-30V DC
Power consumption: < 5W
Battery option: Yes

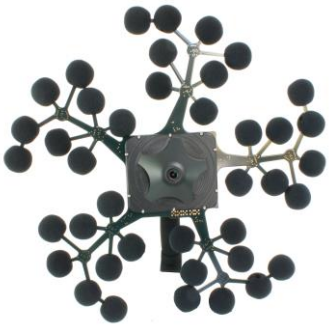
BIONIC ARRAY XS

Main Features
Integrated design
Data frontend integrated in the body
High resolution
High dynamic range
Very small package volume
Designed for farfield measurement (Beamforming)
40° Resolution at 1300Hz
Handheld

MEMS-Microphones
Number: 40
Resolution: 24 bits
Sample rate: 48kHz
Interface: I²S
Dynamic range:33-120 dB
Frequency range: 20Hz-20kHz

Weight and dimensions
Material: Composite material
Diameter: 450mm
Weight (excl. Tripod): 1.7 kg
Whole system packaging: case 79.4 x 61.5 x 44.4 cm

Accessories
Aluminium Tripod



BIONIC ARRAY S

Main Features
Integrated design
High resolution
High dynamic range
Very small package volume
Designed for farfield measurement (Beamforming)
40° Resolution at 1000Hz

MEMS-Microphones
Number: 40
Resolution: 24 bits
Sample rate: 48kHz
Interface: I²S
Dynamic range:33-120 dB
Frequency range: 20Hz-20kHz

Weight and dimensions
Material: Composite material
Diameter: 600mm
Weight (excl. Tripod): 1 kg
Whole system packaging: case 79.5 x 52 x 39.4. cm

Accessories
Aluminium Tripod

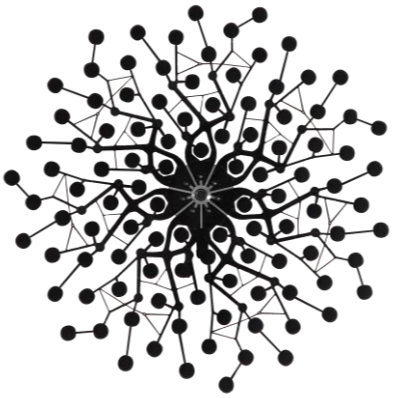
BIONIC ARRAY M

Main Features
Integrated design
Data frontend integrated in the body
High resolution and dynamic range
Analysis Dynamic Range: up to 40dB
Very small package volume
Designed for Far field analysis (Beamforming),
and Near field analysis (Holography) (from 40 Hz)
40° Resolution at 600Hz with Beamforming
Handheld

MEMS-Microphones
Number: 112
Resolution: 24 bits
Sample rate: 48kHz
Interface: I²S
Dynamic range:33-120 dB
Frequency range: 20Hz-20kHz

Weight and dimensions
Material: Composite material
Diameter: 1000mm
Weight (excl. Tripod): 3.3 kg
Whole system packaging: case 95.2 x 68.9 x 36.5 cm

Accessories
Aluminium Tripod



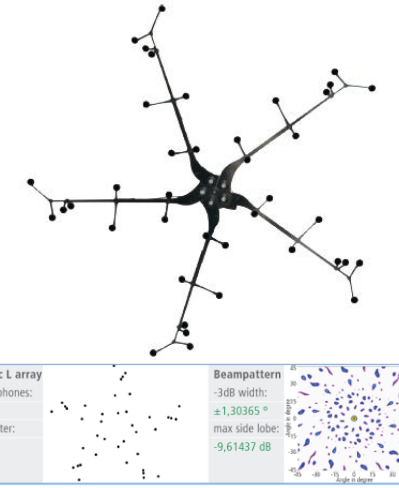
BIONIC ARRAY L

Main Features
Integrated design
High resolution
High dynamic range
Small package volume
Designed for farfield measurement (Beamforming)
40° Resolution at 350Hz

MEMS-Microphones
Number: 40
Resolution: 24 bits
Sample rate: 48kHz
Interface: I²S
Dynamic range:33-120 dB
Frequency range: 20Hz-20kHz

Weight and dimensions
Material: Composite material
Diameter: 1600mm
Weight (excl. Tripod): 3.5 kg
Whole system packaging: case 95.2 x 68.9 x 36.5 cm

Accessories
Aluminium Tripod



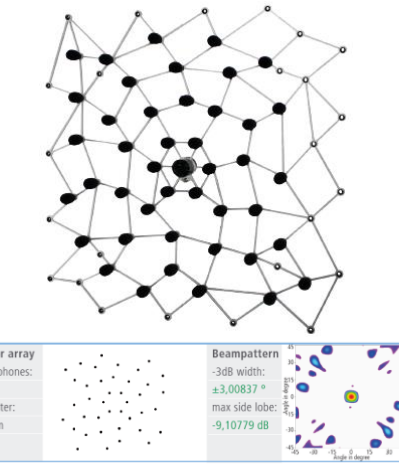
SPIDER ARRAY

Main Features
Designed for Far field analysis (Beamforming),
and Near field analysis (Holography) (from 40 Hz)
40° Resolution at 750Hz (Beamforming)
Easy to use
Expandable array size
Expandable amount of channels
Changeable microphone positions

MEMS-Microphones
Number: 40 (expandable)
Resolution: 24 bits
Sample rate: 48kHz
Interface: I²S
Dynamic range:33-120 dB
Frequency range: 20Hz-20kHz

Weight and dimensions
Material: Aluminium
Standard size: 800x800 mm (expandable)
Weight (excl. Tripod): 2.6 kg

Accessories
Aluminium Tripod



3D ARRAYS

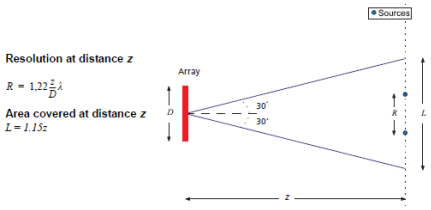
Main Features
3D Beamforming
3D results on 3D objects
One measurement for the complete acoustic emission in 3D
Stationary and non stationary processes
Array size: small cube or complete room
Acoustic photos and videos

MEMS-Microphones
Number: 80-400

Weight and dimensions
Customization-based principle
Possible starting with 1 single Spider array (by splitting the 40mics on several plans)
Possible assembly of several Bionic M arrays
(or several Spider arrays with aluminium frame)
Size: Variable
Weight: 10.5kg for the picture example

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

*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.

ARRAYS COMPARISON TABLE

	Spider Array 40mics	Spider Array 80mics	Bionic Array XS 40mics	Bionic Array S 40mics	Bionic Array M 112mics	Bionic Array L 40mics
Beamforming 2D / Far-field measurements	●	●	●	●	●	●
Beamforming with High Resolution Algorithms / Far-field measurements	●	●	○	●	●	●
3D Beamforming	○	○	○	○	○	○
Order Analysis	○	○	○	○	○	○
Acoustic holography (SONAH) / Nearfield measurements	●	●	x	x	●	x

● *Included* ○ *Option* *x Not possible*

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- to protect personnel, sites and vehicles in military theaters of operation
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200 Chemin des Ormeaux
69578 LIMONEST – FRANCE
Tel. +33 (0)4 72 52 48 00

www.acoemgroup.com

Asia
Tel. + 66 (2) 7112 293 – Fax : + 66 (2) 7112 293

South America
Tel. + 55 (11) 5089 6460 – Fax : + 55 (11) 5089 6454
