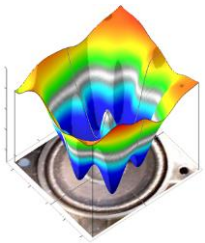
Acoustic Maps



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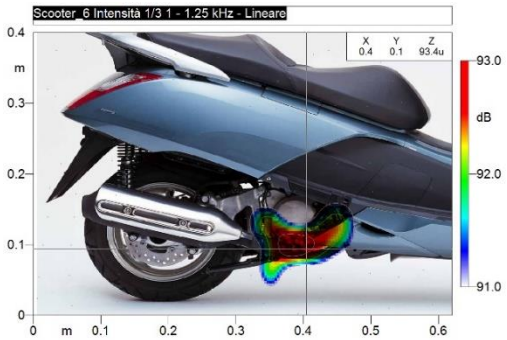
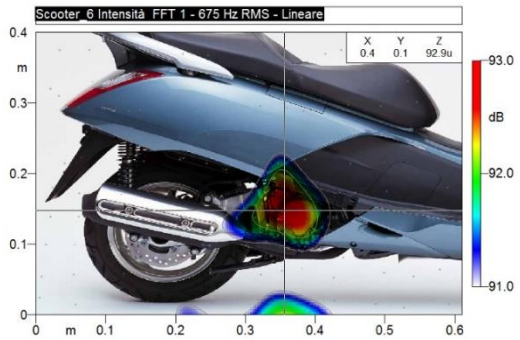
Premise

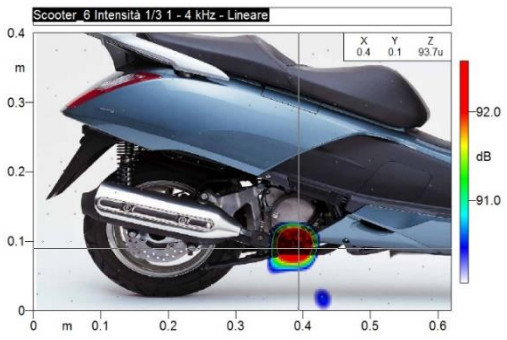
The mapping of the sound field in front of a sound source is the simplest and most intuitive solution to optimize any type of acoustic intervention.

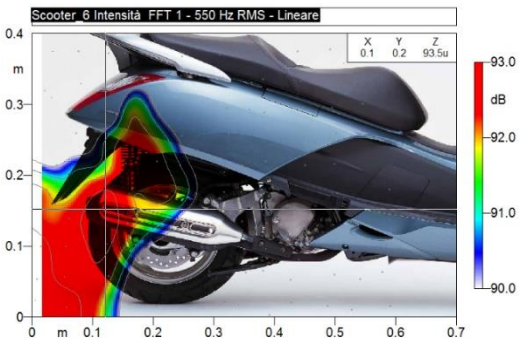
The acoustic mapping technique has been proposed for over 20 years as an option available in the NoiseWorks software. Recently this technique has been further developed and integrated into the 'Giotto' option of the SoundBook analysis system, allowing mapping of the sound field with semi-automatic procedures and execution times reduced to two, three minutes.

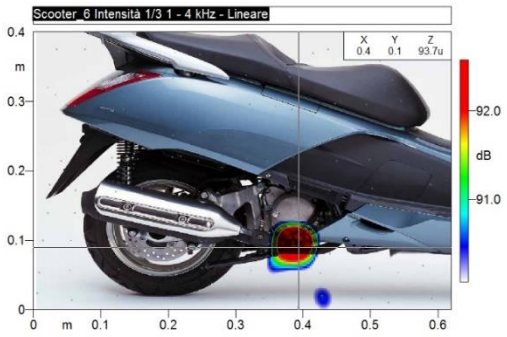
To better highlight the potential of these techniques, the relative results and the application sectors, a series of graphic examples accompanied by brief comments are reported in this document.

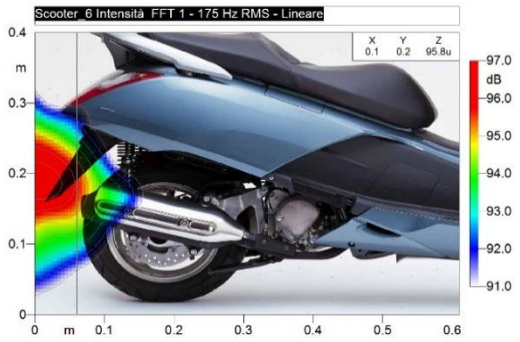


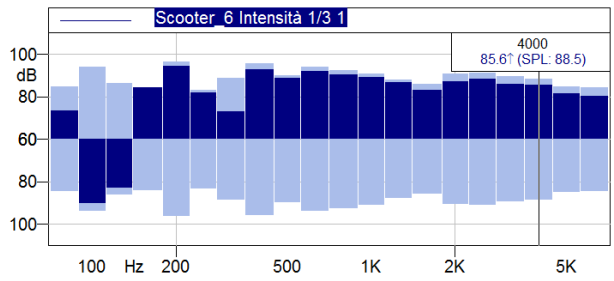


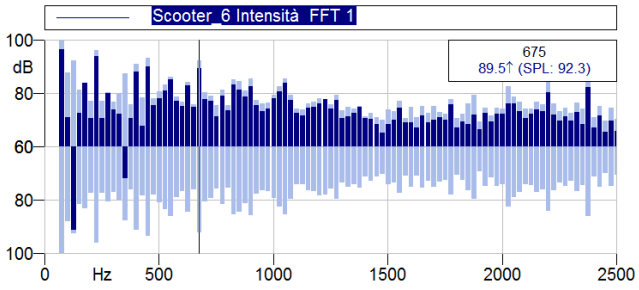












Motorcycle scooter mapping

Constant speed mapping of a scooter motorcycle on a dynamometer roller bench.

Measurement system: SoundBook with ‘Giotto’ option

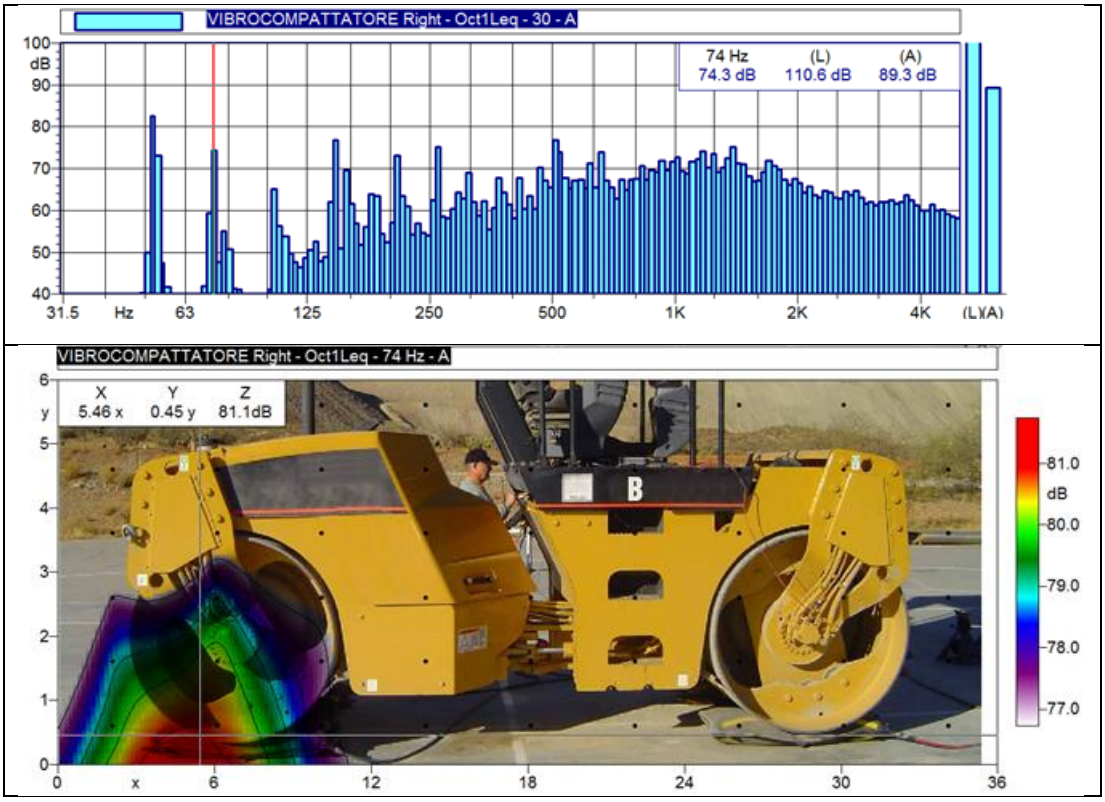
Method: Intensity level & sound pressure

Total measurement duration: 131 seconds

Number of measurement points acquired: 120

Analysis in 1/3 octave bands and FFT with 400 lines of resolution

Note: positioning the cursor on the individual bands of the acoustic intensity spectrum automatically updates the map corresponding to the selected frequency band.



Asphalt Compactor Mapping

Mapping of an asphalt compactor in operating conditions.

Measurement system: SoundBook with ‘Fractions of an octave’ option

Method: Sound pressure level

Total measurement duration: 40 minutes

Average per measurement point: 20 seconds

Number of measurement points acquired: 54 on a 9 x 6 measurement point grid

Analysis in 1/24 octave bands

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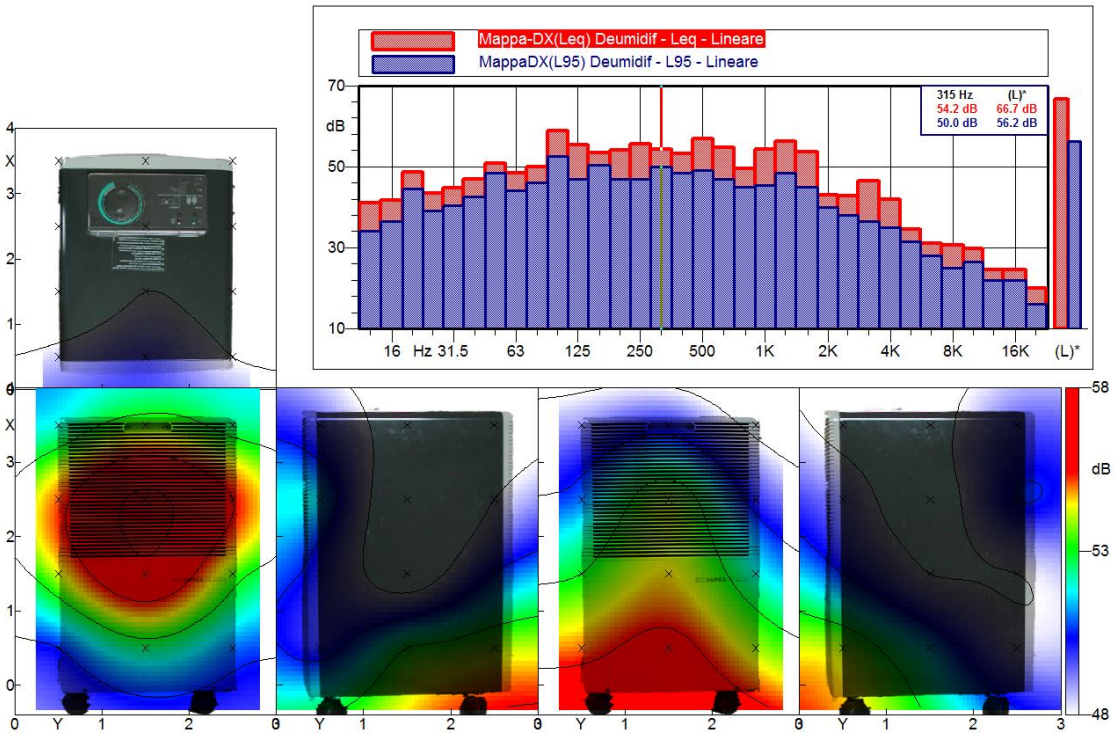


Dehumidifier Mapping for Home Environments

Mapping of a dehumidifier for domestic environments.

Measurement system: Larson Davis LD824 sound level meter

Method: Sound pressure level on selectable Ln percentiles

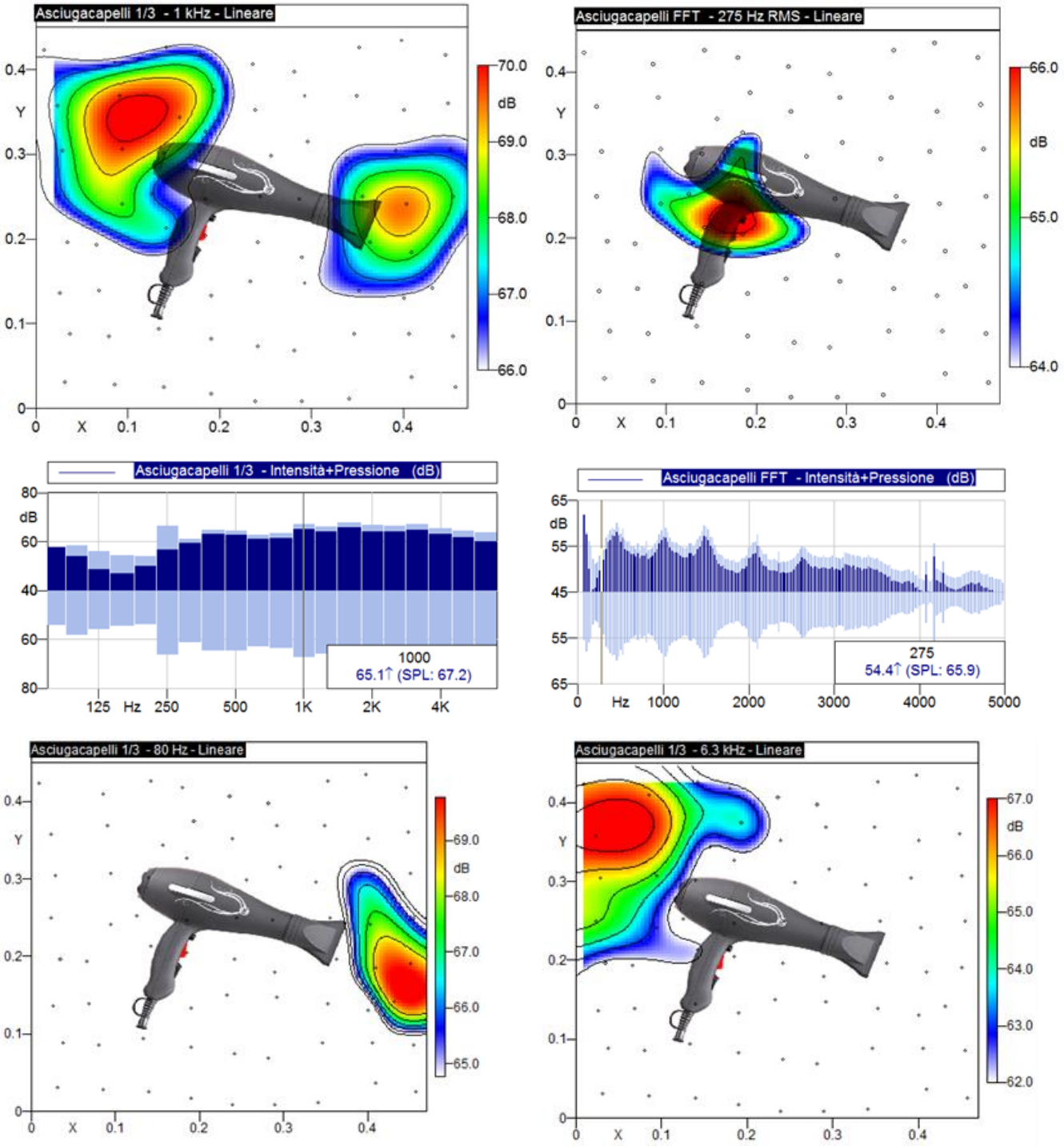
Total measurement duration: 35 minutes

Average per measurement point: 14 seconds

Number of measurement points acquired: 60 on a grid (4 x 3) for each of the 5 surfaces.

Analysis of Leq and Ln percentiles in 1/3 octave bands; calculation of the sound power Lw

Note: since the noise emission is continuous and constant, the use of the mapping as L95 percentile spectra allowed the automatic elimination of all the transient noises that were present in the measurement environment



Hair Dryer Mapping

Mapping of a hair dryer.

SoundBook with ‘Giotto’ option

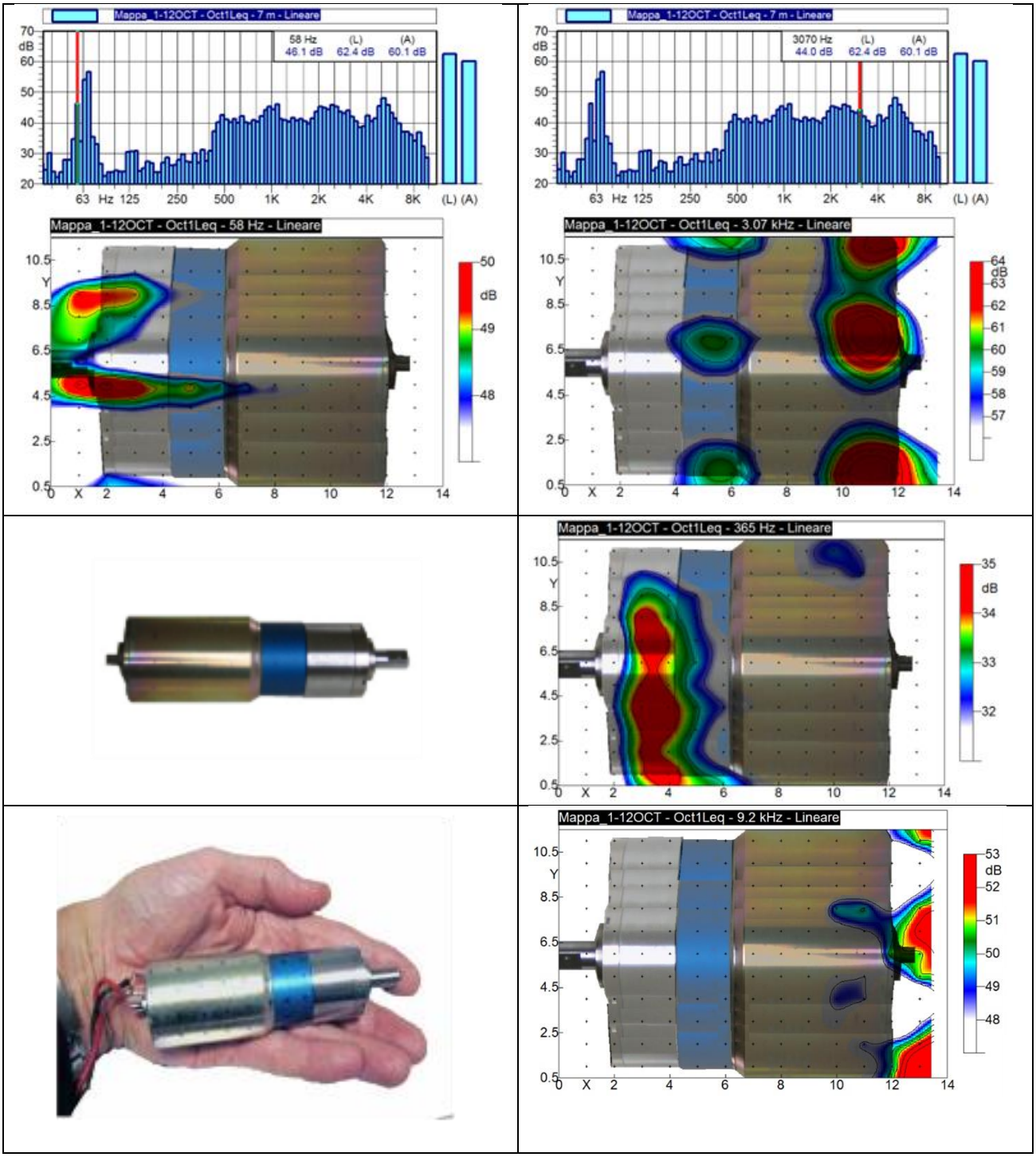
Method: Intensity level & sound pressure

Duration of measurement: 152 seconds

Number of measurement points acquired: 72 points.

Analysis in 1/3 octave bands and FFT with 400 lines of resolution

Note: The hair dryer was fixed on a tripod placed 1.7 m from the ground; the scanning surface was 10 cm from the appliance; the measurement was performed in a normal environment, used as an office.



DC Micromotor Mapping

Mapping of a micromotor with reducer

OROS OR35 multichannel analyzer + N&VW software

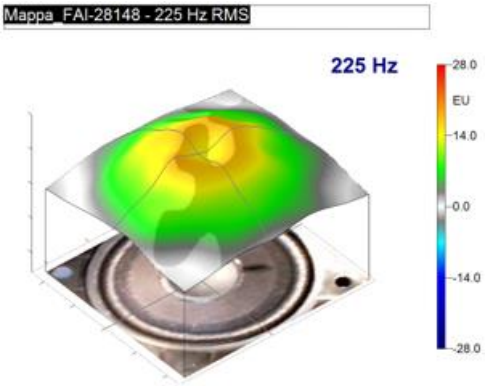
Method: Sound pressure level

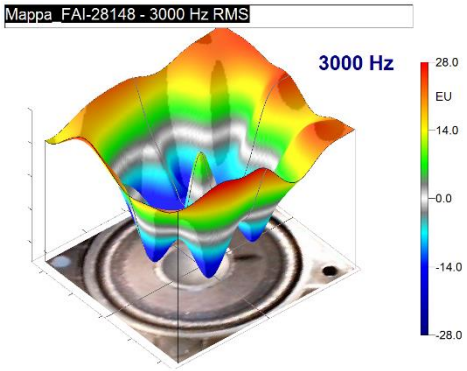
Duration of measurement: 1.5 hours

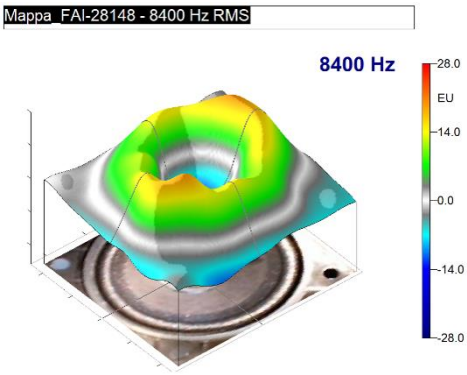
Number of measurement points acquired: 143 points (13 x 11) radial at 5 mm

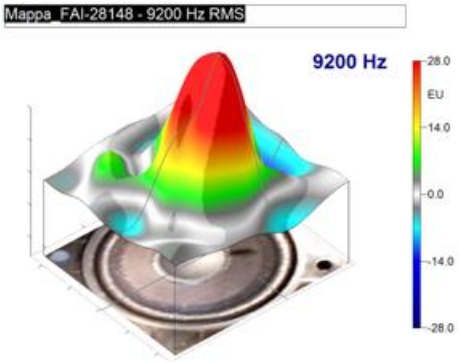
Analysis in 1/12 octave bands and FFT

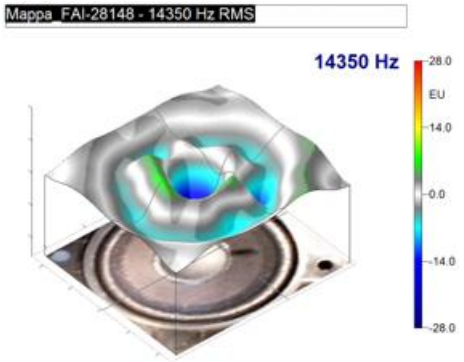
Note: The acquisition of each point was performed with the manual positioning of a 1/4" microphone on a grid of points arranged 5 mm from the cylindrical surface of the micromotor.











3.5" wideband speaker front mapping”

Mapping with wideband excitation of a 3.5” loudspeaker

Measurement system: SoundBook with ‘FRF’ option and N&VW with ‘Open-GL’ option

Method: FRF between excitation signal and response as sound pressure level

Average for each measurement point: 5 s

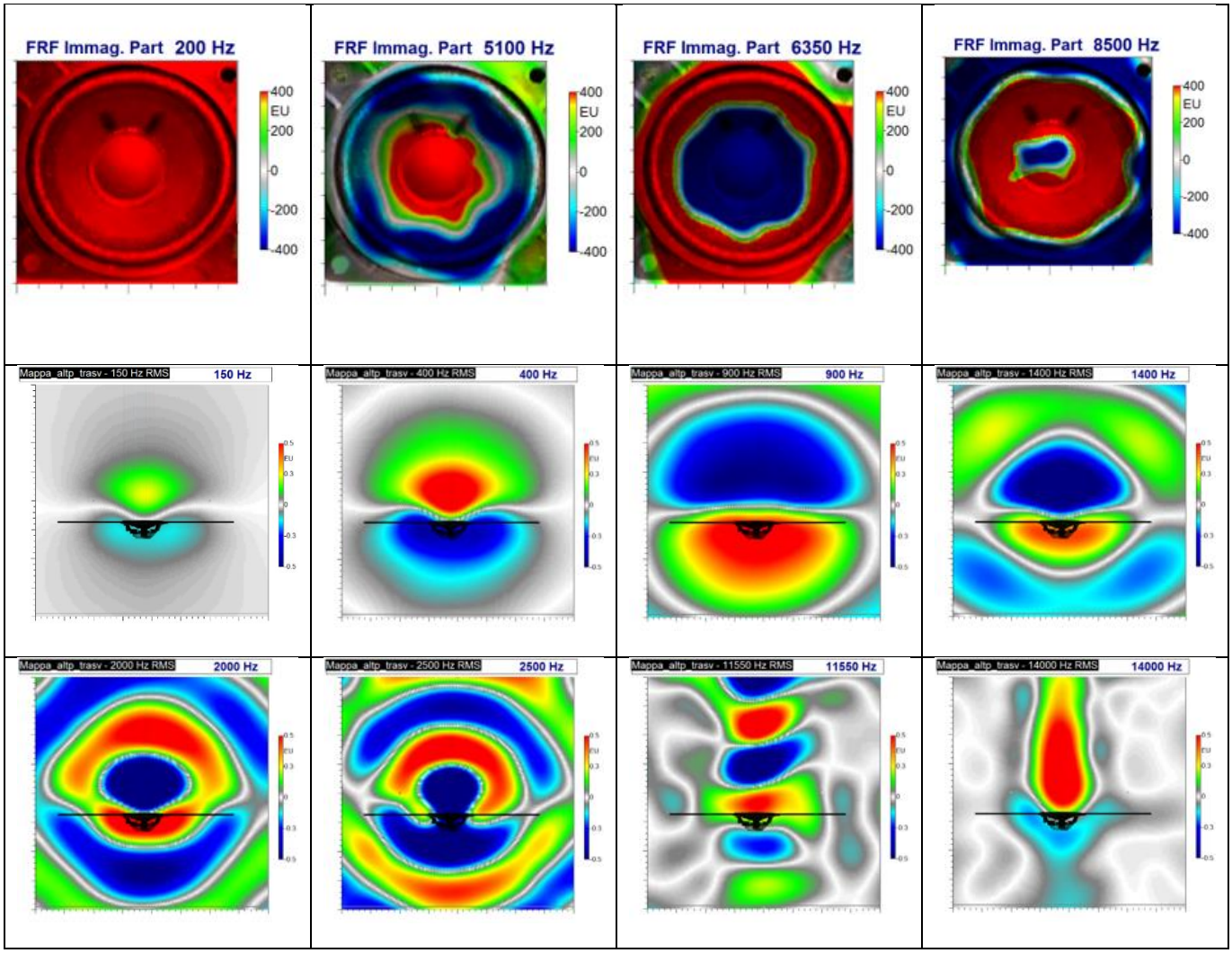
Total measurement duration: approximately 20 minutes

Number of measurement points acquired: 81 (5 x 16) 5 radial points every 22.5°

FFT analysis with FRF Frequency Response Function at 400 lines of resolution

Note: The acquisition of each point was performed with the manual positioning of a 1/4" microphone on a grid of 80 points arranged at 5 mm from the surface.

Mapping as an imaginary part of the FRF allows to highlight the emission modes of the loudspeaker membrane



3.5” Wideband Speaker Cross Mapping

Wideband excitation mapping of a 3.5” loudspeaker

Measurement system: SoundBook with ‘FRF’ option and N&VW with ‘Open-GL’ option

Method: FRF between excitation signal and response as sound pressure level

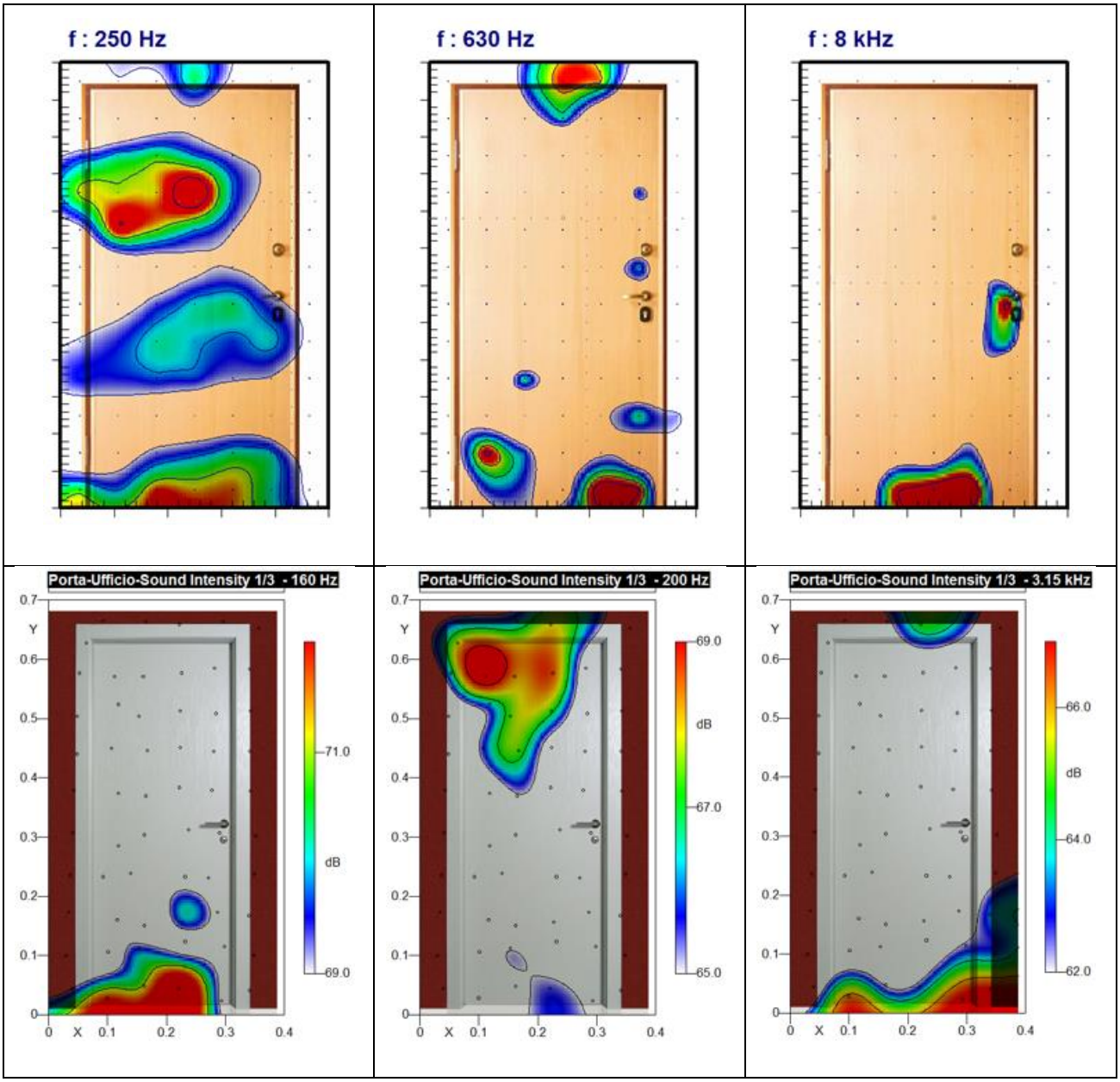
Average for each measurement point: 5 s

Total measurement duration: approximately 15 minutes

Number of measurement points acquired: 152 (with 8-microphone array in line)

FFT analysis with FRF Frequency Response Function at 400 lines of resolution

Note: The loudspeaker was mounted in the center of a 350 x 350 mm square baffle.



Internal door mapping

Mapping of two internal ports.

SoundBook with ‘Giotto’ option

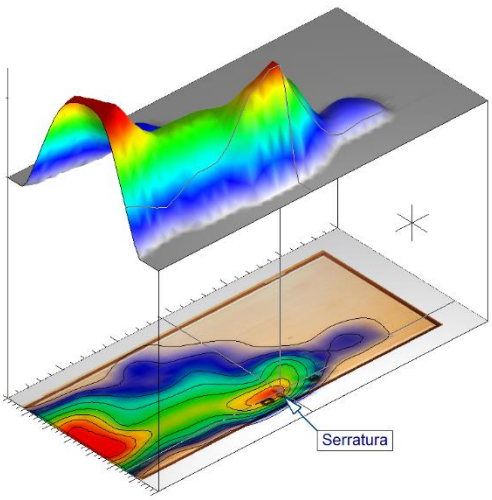
Method: Intensity level & sound pressure

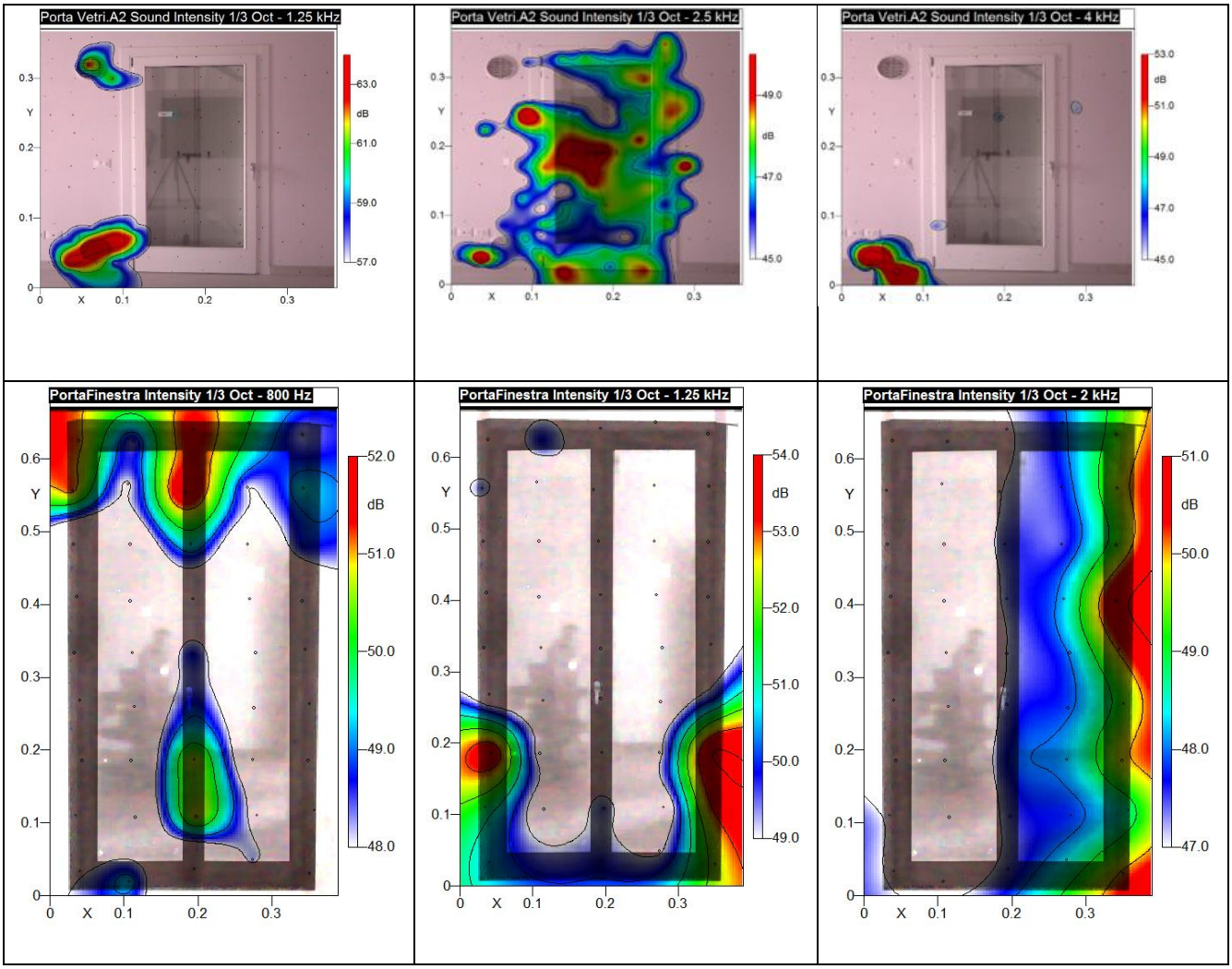
Duration of measurement: 158 seconds

Number of measurement points acquired: 60 points

Analysis in 1/3 octave bands

Note: The mapping refers to two different ports, the first mapped as sound pressure level, the second as sound intensity





French window mapping

Mapping of two French windows.

SoundBook with ‘Giotto’ option

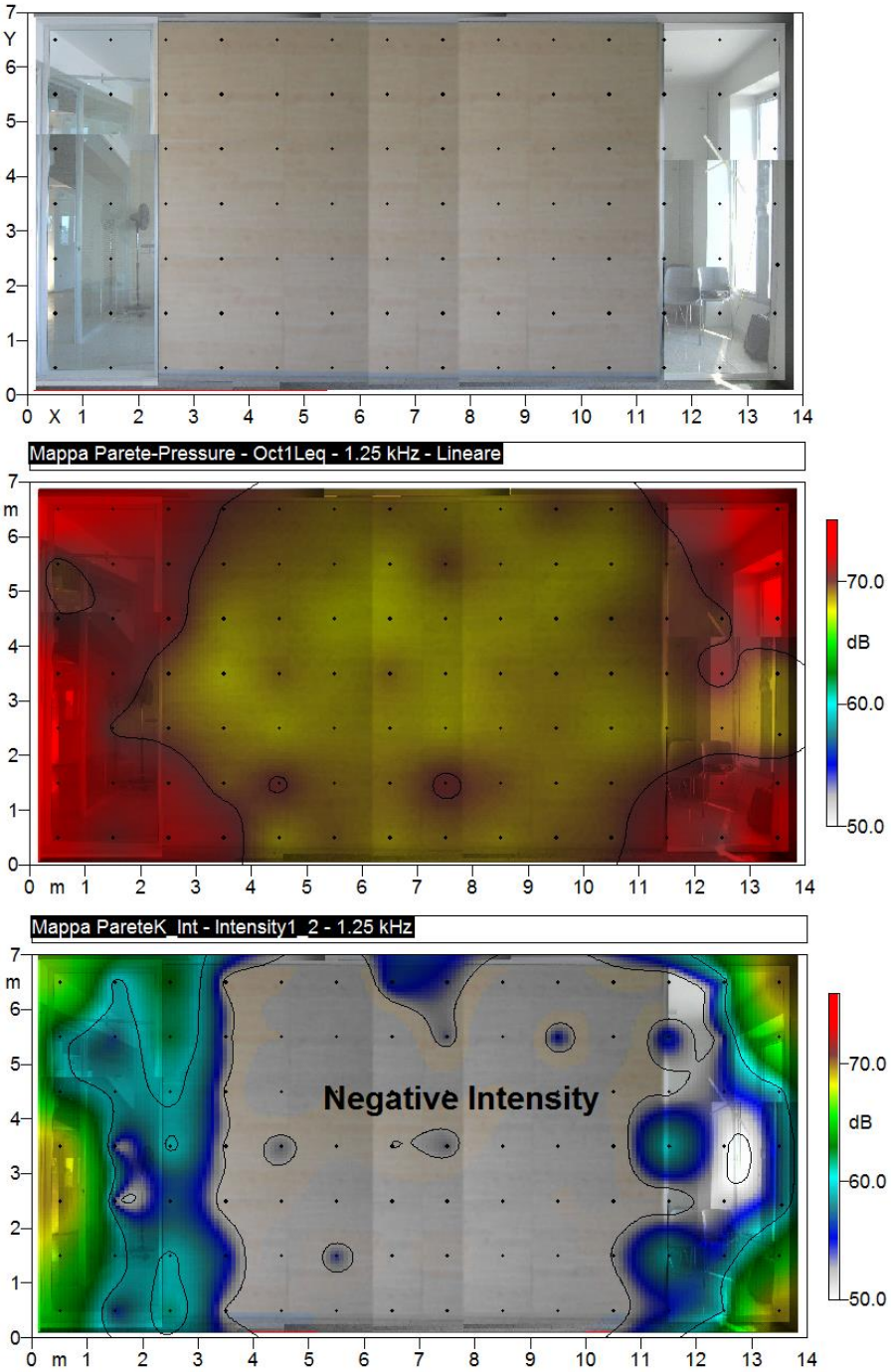
Method: Intensity level & sound pressure

Duration of measurement: 480 seconds (1), 130 seconds (2)

Number of measurement points acquired: 196 points (1), 45 points (2).

Analysis in 1/3 octave bands

Note: The mapping refers to two different types of French windows, the first set up in the laboratory together with two silenced ventilation holes, the second always in the laboratory but in the double-leaf version.



Mapping of office partition wall

Mapping of a partition wall between offices.

SoundBook with ‘Intensity’ option

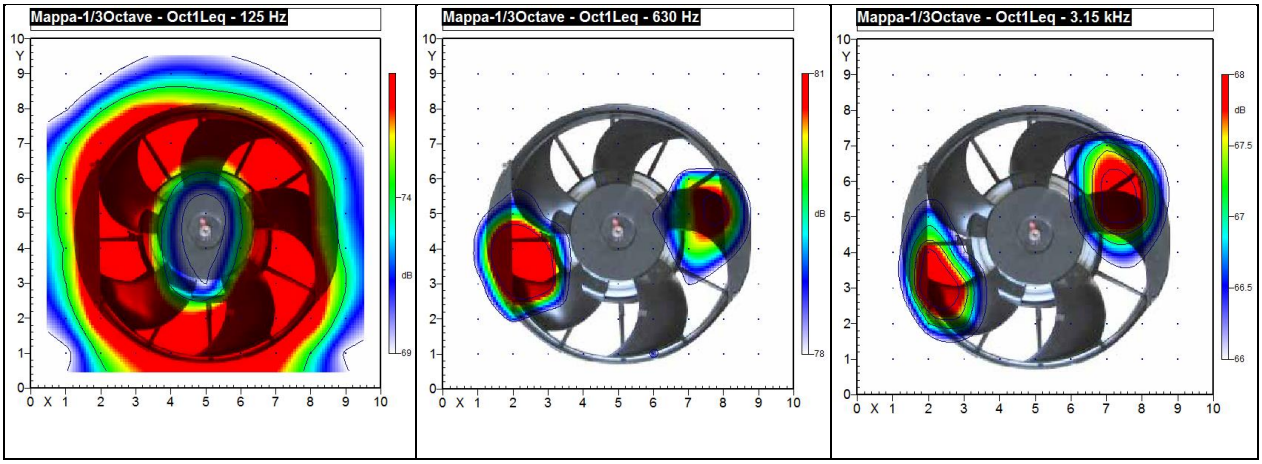
Method: Intensity level & sound pressure acquisition for discrete points

Duration of measurement: 45 minutes

Number of measurement points acquired: 98 points

Analysis in 1/3 octave bands

Note: The intensity mapping highlights in grey the part of the negative flow originating predominantly from the flanking propagation; the pressure level mapping instead shows the uniformity of the sound field created by the empty and extremely reverberant room.



Axial fan and electric motor mapping

Mapping of a DC axial fan and an electric motor for washing machines.

Oros OR36 with N&VW ‘Maps’ option

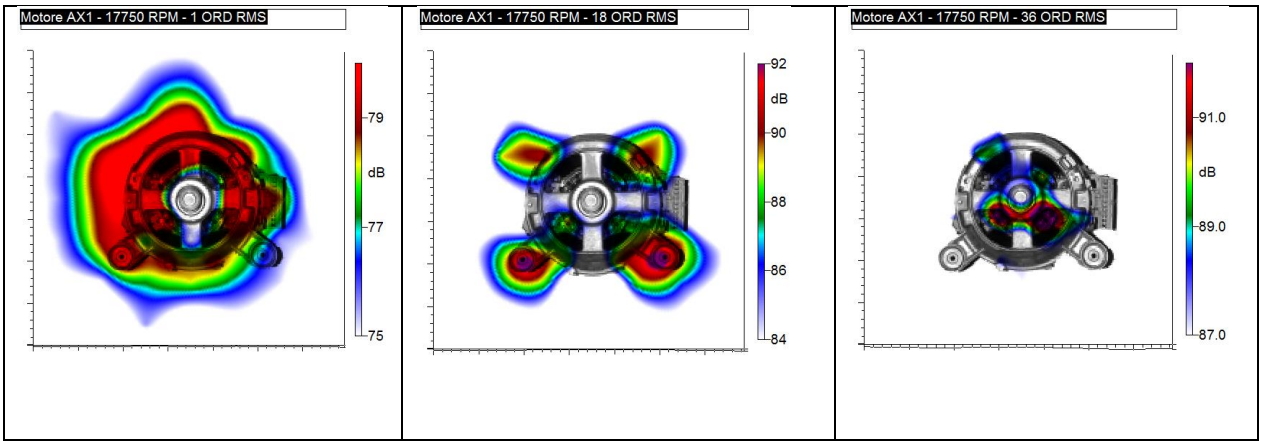
Method: Sound pressure level

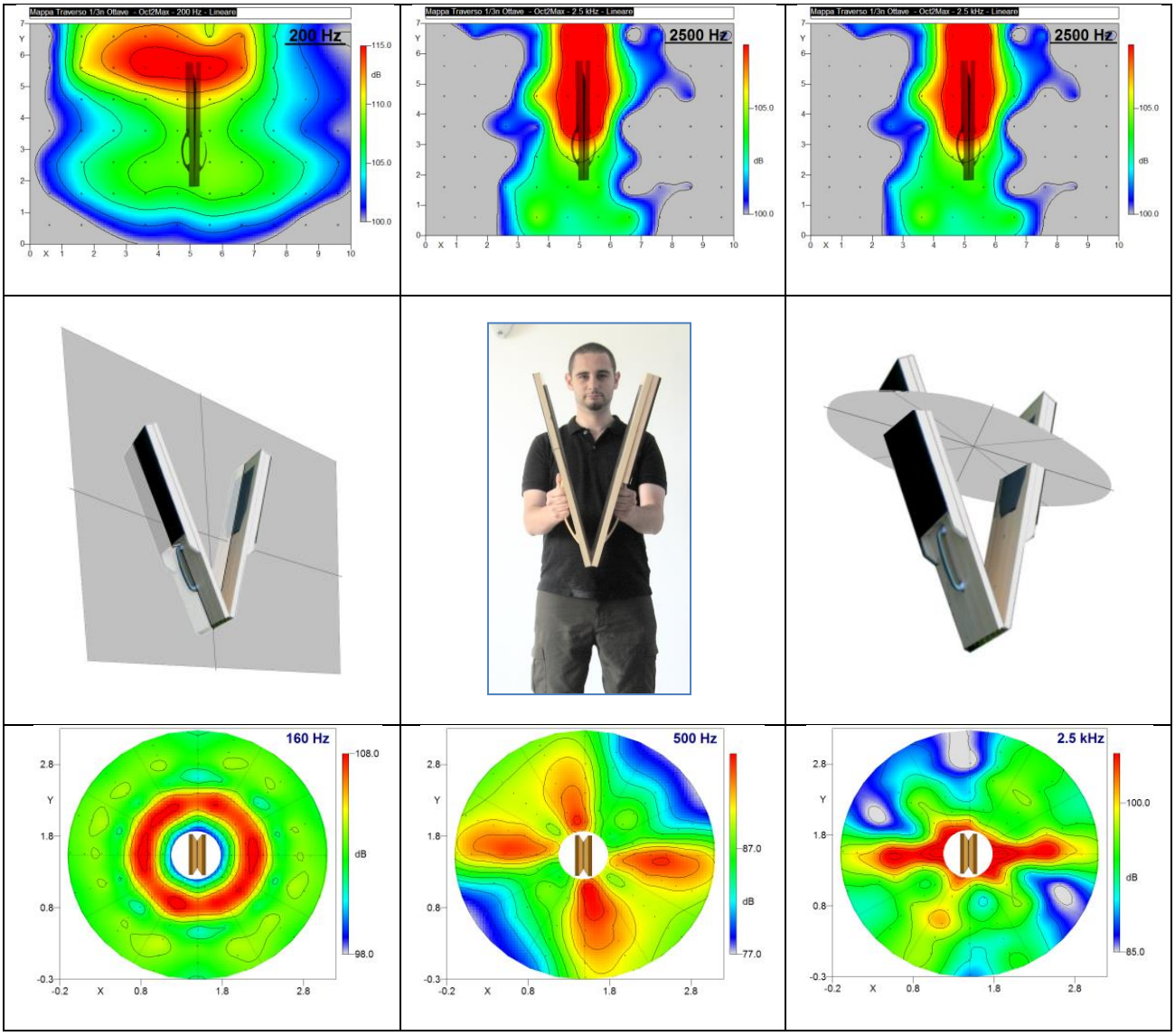
Duration of measurement: 18 minutes (1), 15 minutes (2)

Number of measurement points acquired: 81 points (1), 65 points (2).

Analysis in 1/3 octave bands (1), harmonic order analysis (2)

Note: Mappings performed at constant rotation speed





Clapper Mapping

Mapping of the sound impulse generated by the clapper.

Measurement system: SoundBook with ‘FRF’ option

Method: Transfer Function with sound pressure level

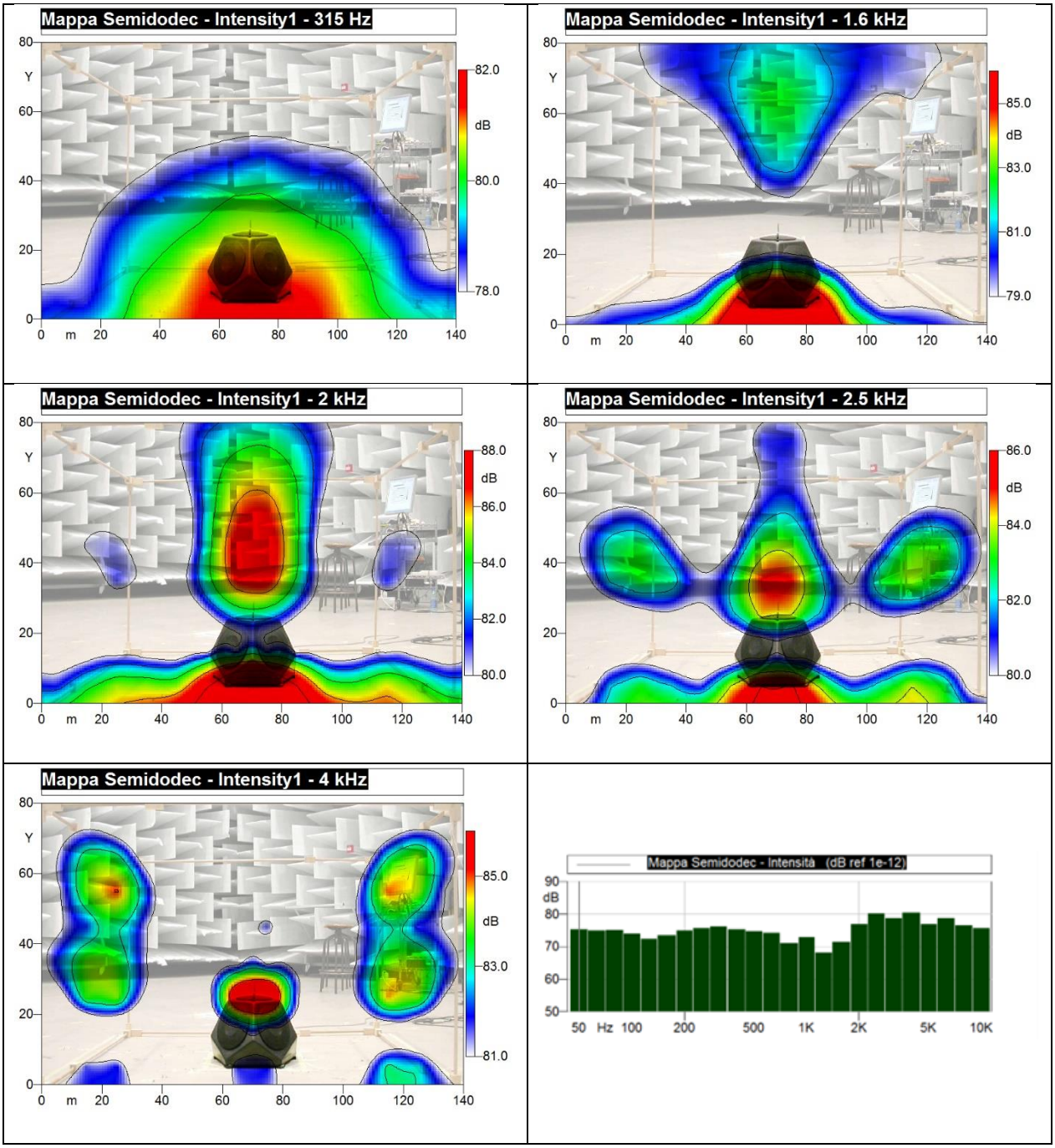
Total measurement duration: 18 minutes

Average per measurement point: 5 impulses

Number of measurement points acquired: 70 on a 7 x 10 measurement point grid

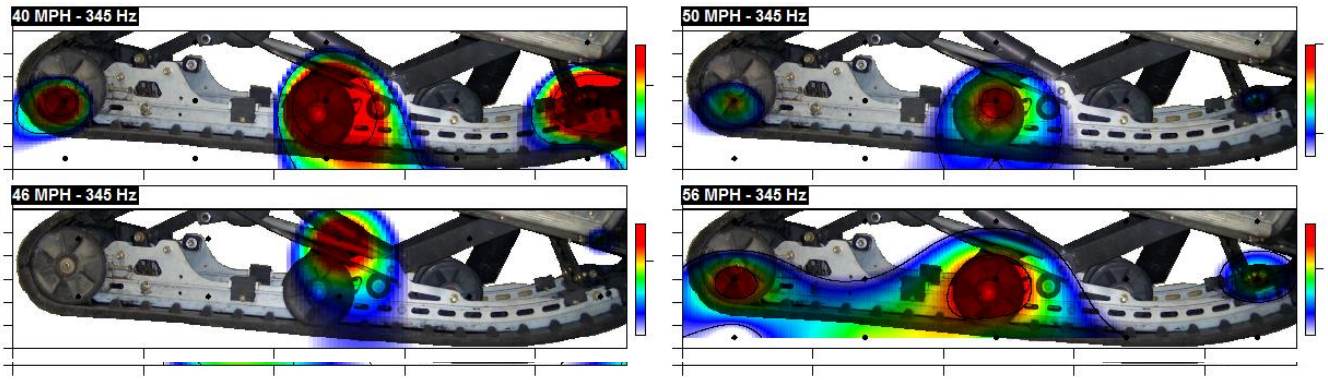
Analysis in 1/3 octave bands

Note: The mapping is performed using a linear array with 7 microphones and detecting the transfer functions between an accelerometer positioned on the clapper and the individual microphones that are positioned along the pre-established measurement grid.



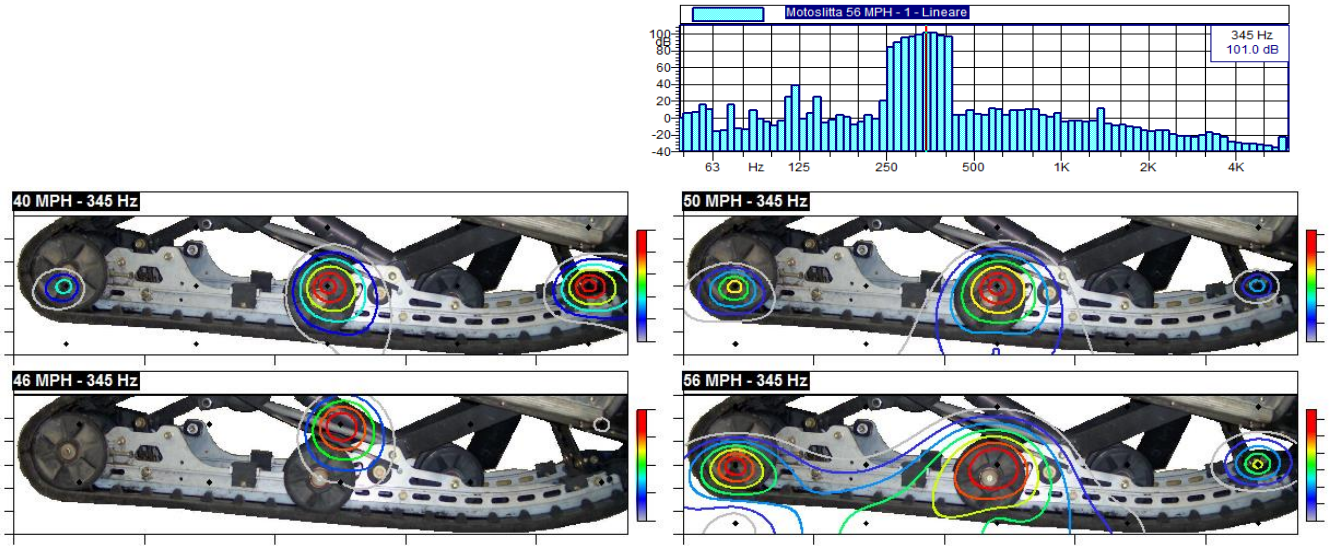
Semidodecahedral Source Mapping in Anechoic Chamber

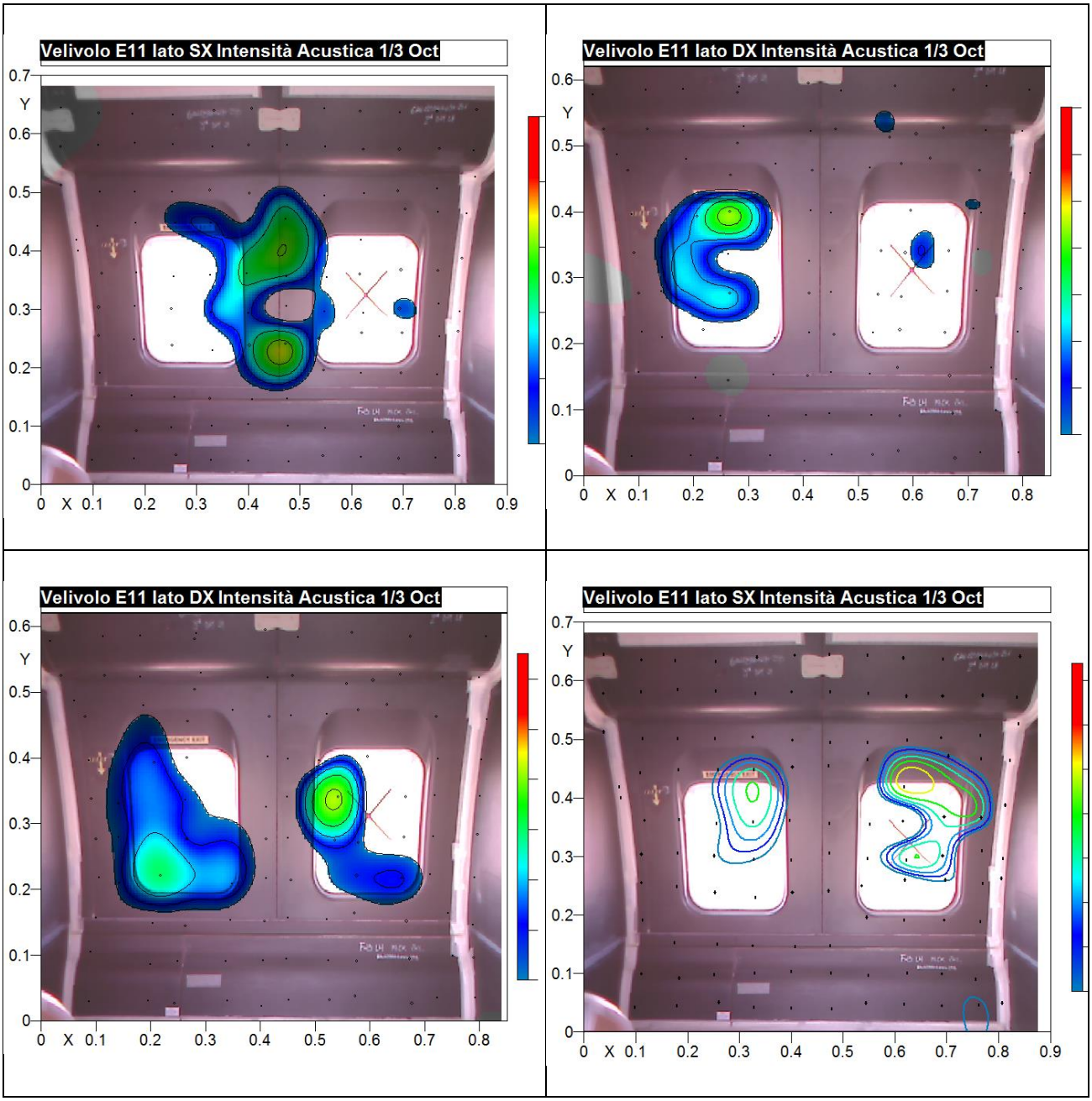
Mapping of acoustic intensity levels on a semidodecahedral source.
Measurement system: SoundBook with ‘Acoustic Intensity’ option
Method: acoustic intensity level in 1/3 octave
Total measurement duration: 4 hours
Average per measurement point: 15 seconds
Number of measurement points acquired: 112 measurement points
Acoustic intensity analysis in 1/3 octave bands



Snowmobile Traction Mapping

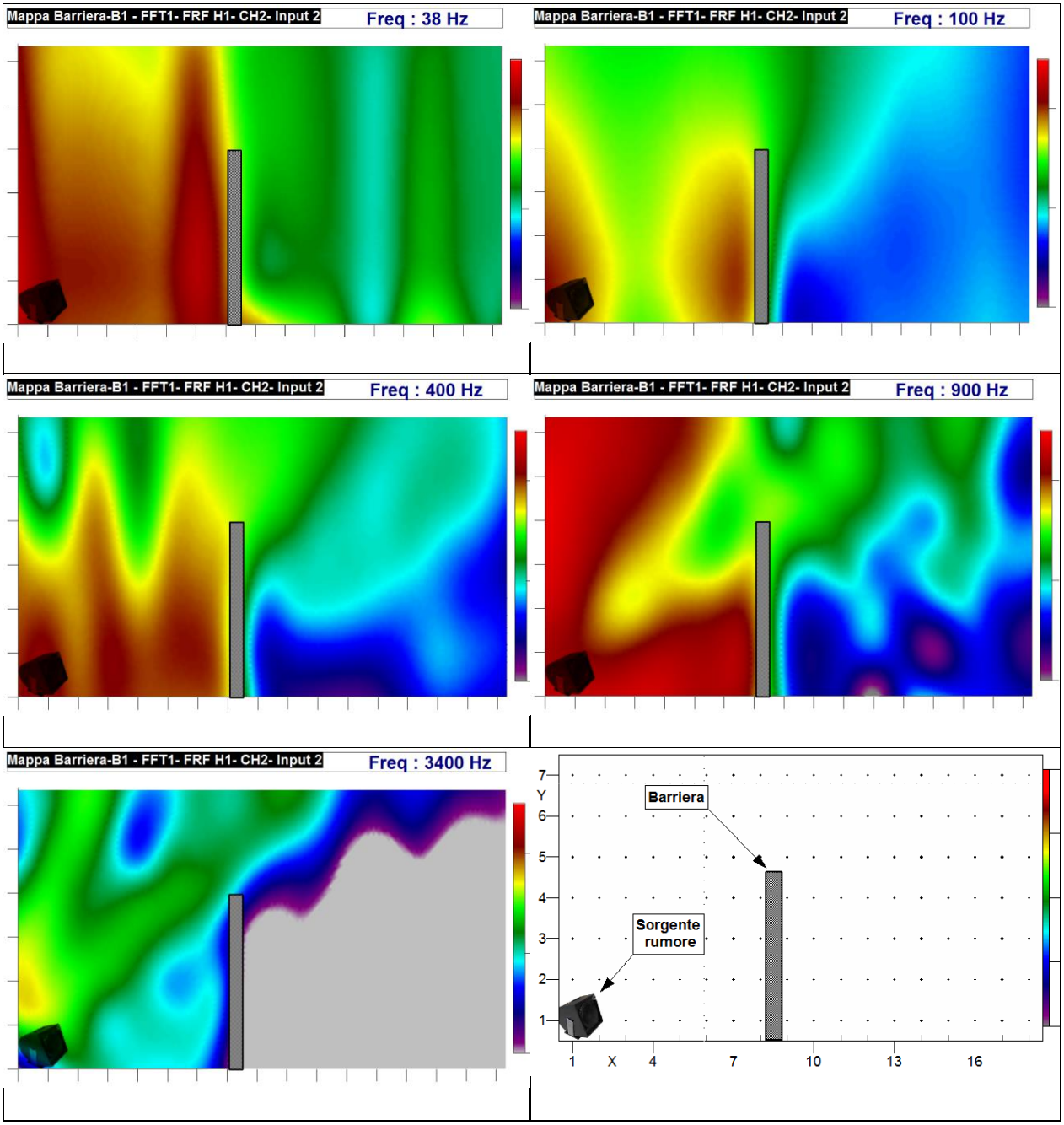
Mapping of a snowmobile at various speeds.
Measurement system: SoundBook with ‘Fractions of an octave’ option
Method: Sound pressure level
Total measurement duration: 35 minutes
Averaging per measurement point: acceleration ramp
Number of measurement points acquired: 18 on a 3 x 6 measurement point grid
Analysis in 1/24 octave bands





Mapping on aircraft in flight

Noise level mapping on aircraft in flight
Measurement system: SoundBook with ‘Giotto’ option
Method: 1/3 octave noise level and 400-line FFT
Total measurement duration: 210 seconds
Number of measurement points acquired: 113 measurement points
Analysis in 1/3 octave bands and FFT in parallel



Noise Barrier Mapping

Mapping with pink noise excitation of a partially absorbing noise barrier.

Measurement system: SoundBook with ‘FRF’ option and N&VW with ‘Open-GL’ option

Method: FRF module between excitation signal and response as sound pressure level

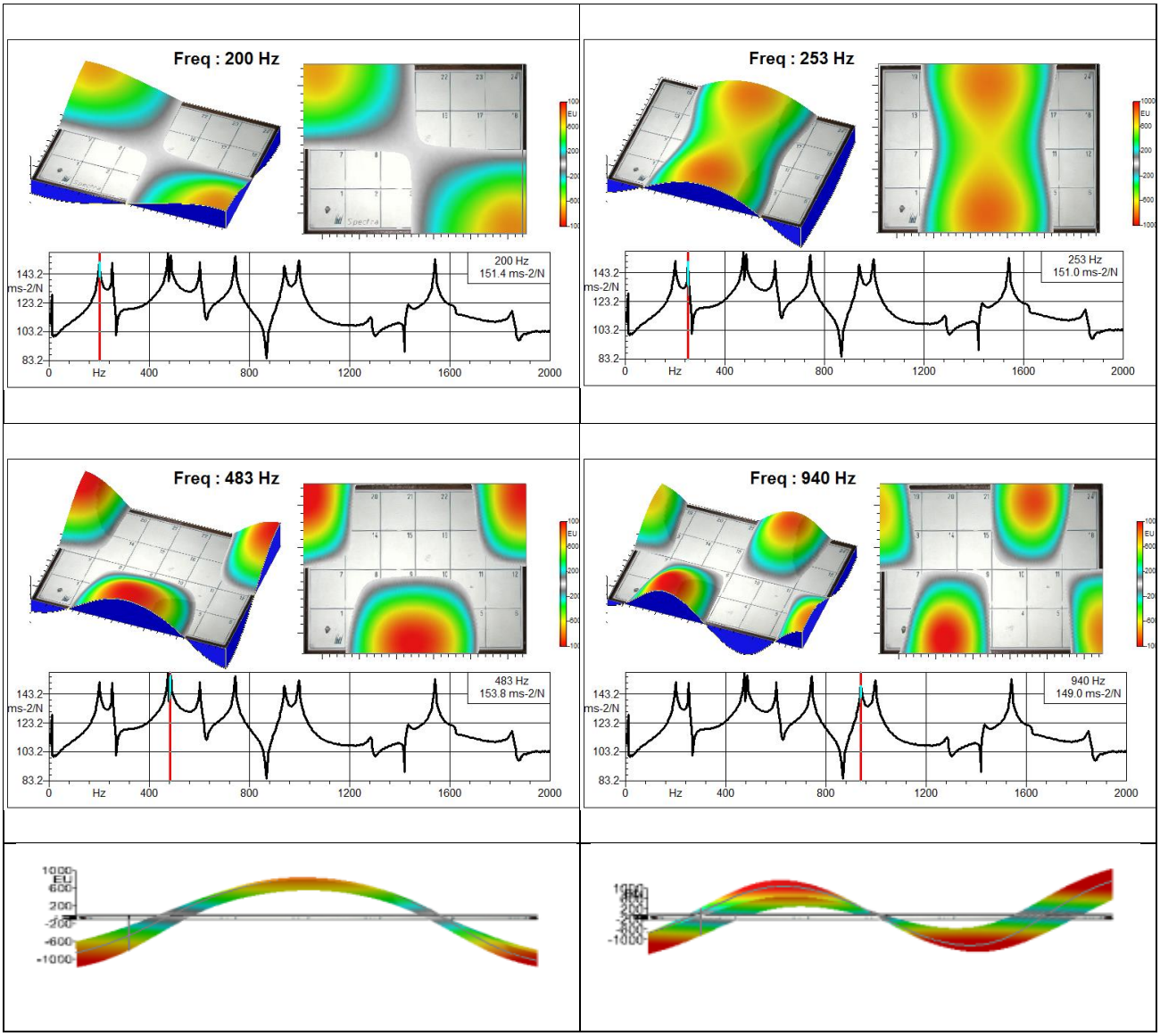
Average for each measurement point: 5 s

Total measurement duration: approximately 40 minutes

Number of measurement points acquired: 126 (7 x 18)

FFT analysis with FRF Frequency Response Function at 400 lines of resolution

Note: The position of the noise sound source was on the road level at 8 m from the barrier



Deformity mapping of an aluminum plate

Impact excitation mapping of an aluminum plate.

Measurement system: SoundBook with ‘FRF’ option and N&VW with ‘Open-GL’ option

Method: FRF imaginary part between excitation signal (force) and acceleration response

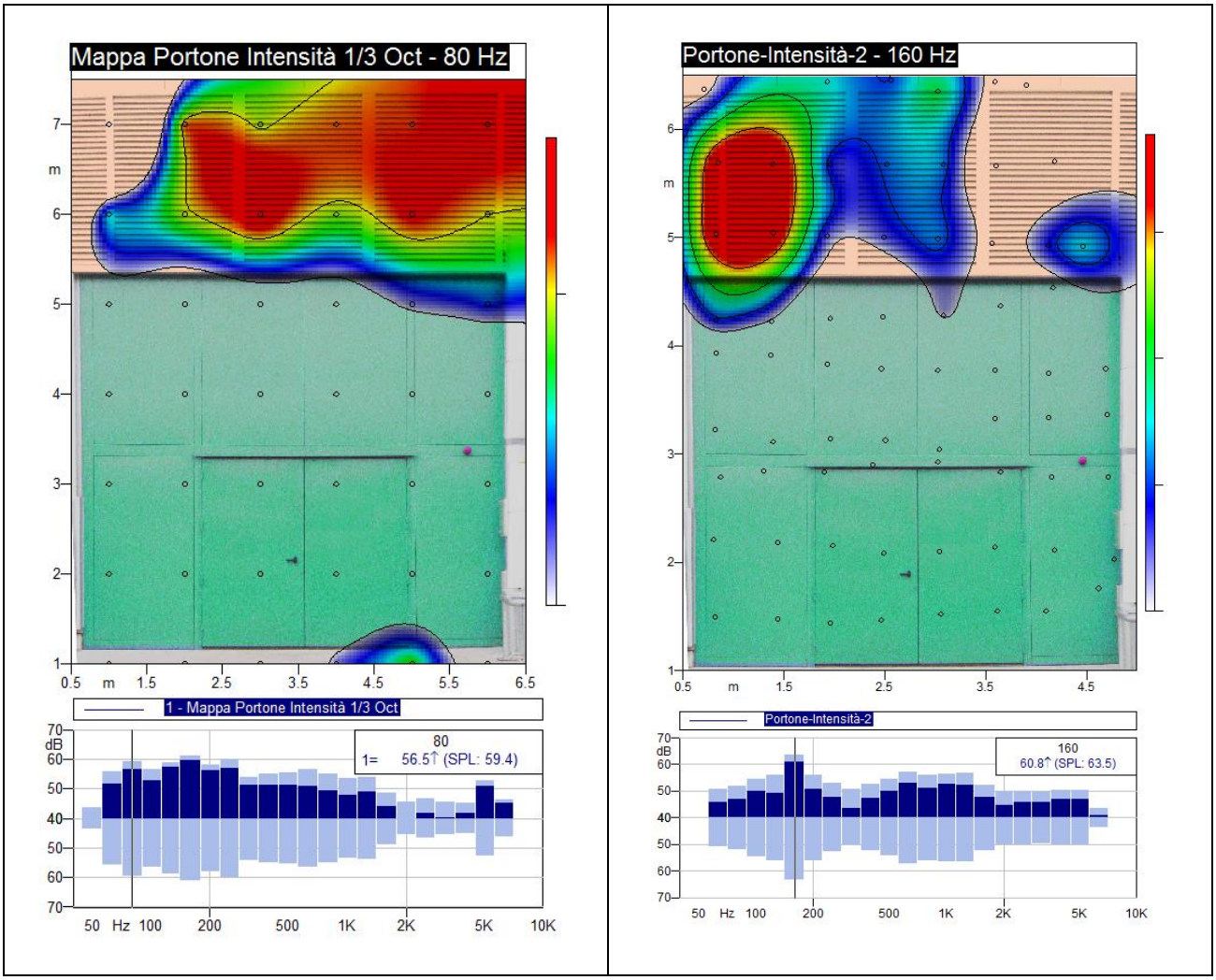
Average for each measurement point: 4 impacts

Total measurement duration: approximately 5 minutes

Number of measurement points acquired: 24

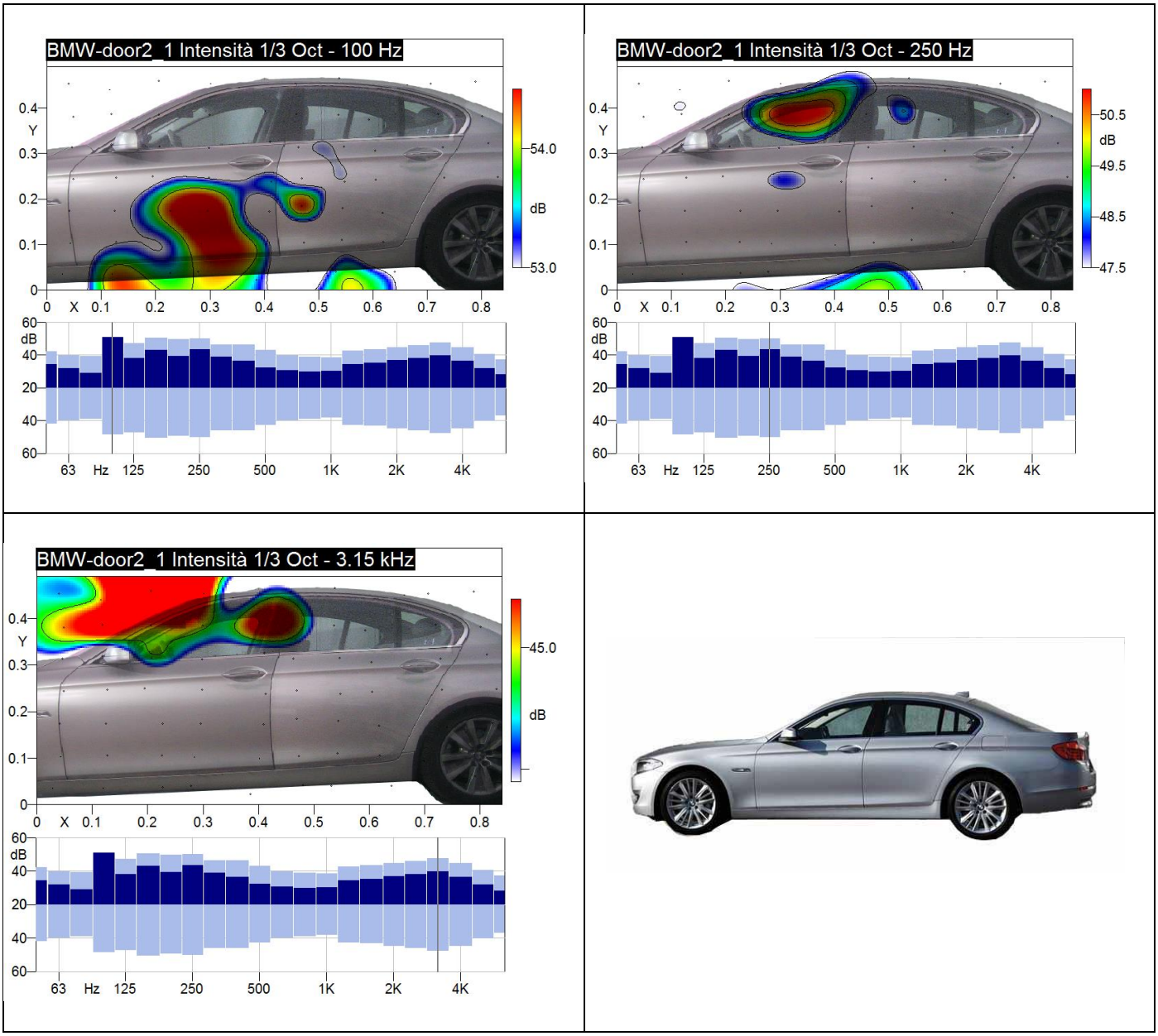
FFT analysis with FRF Frequency Response Function at 800 lines of resolution

Note: The imaginary part of the FRF Transfer Function is mapped between the force detected by the transducer inserted in the hammer, during the impact excitation, provided in each of the 24 points and the acceleration measured by an accelerometer positioned at point 1, bottom left



Mapping on soundproof wall

Sound intensity and pressure level mapping on a soundproof wall
Measurement system: SoundBook with ‘Giotto’ option
Method: sound intensity level in 1/3 octave and in FFT 400 lines
Total measurement duration: 340 seconds
Number of measurement points acquired: 42 measurement points
Analysis in 1/3 octave bands and FFT in parallel



Mapping on the left side of the car

Mapping of intensity and sound pressure levels on the left side of a car

Measurement system: SoundBook with ‘Giotto’ option

Method: sound intensity level in 1/3 octave and in FFT 400 lines

Total measurement duration: 192 seconds

Number of measurement points acquired: 70 measurement points

Analysis in 1/3 octave bands and FFT in parallel

Note: The omnidirectional sound source with pink noise generator was placed inside the car on the passenger seat