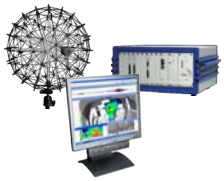
Application Note.
Interior Noise Measurements.

acoustic camera

System Characteristics



Array Sphere48
48 microphones
35 cm diameter
Carbon fiber structure
Dynamic of the microphones: 35 dB -130 dB
Recommended mapping frequencies: 1 kHz - 20 kHz
Typical measurement distance: 0,4 - 2 m

Data Recorder
192 kHz Sampling frequency
48 to 144 channels per 10 inch rack (24 channels per card)
Ethernet Interface → high transfer rate → 20 MByte/s, network-compatible
Digital card with 12 extra channels for recordings of RPM, rotation angle, reversal point, etc.
Integrated PC with Windows XP (embedded)

Software
NoiseImage3

Power Supply
Mobile power supply / battery pack

3D Measurements – Vehicle Interior
Interior Mapping of Peugeot 206

This application example demonstrates the application of the Acoustic Camera for the analysis of driving noise in the interior of a Peugeot 206. The car driver heard an unusual noise at a speed of 160 km/h for which he could not locate the source. This application note describes the identification and localization of the phenomenon using the Acoustic Camera.

Application area
Acoustic analysis of vehicle interiors during operation

Measurement task
Cavity mapping of Peugeot 206, localization of hissing sound at 160 km/h

Measurement object
Two-door Peugeot 2006

Measurement set up
The set up of the system took less then 10 minutes. For the power supply a transportable, high-capacity battery has been used which offers a continuous operation of more than 4 hours. After another 5 minutes the connection of the mobile power supply and the fitting of the array position into the 3D CAD model of the vehicle was finished and the system was ready to go. The microphone array Sphere48 was positioned between the two front seats for conducting the measurements.

Results
At first the driving noise at 130 km/h and at 175 km/h has been analyzed and checked against each other. The two analyses (figure 6 to 9) comprise A-weighted spectrograms and corresponding calculated Acoustic Photos 3D. Then, a point spectrogram is shown for the center of the acoustic hotspot.
In the analysis of the driving noise at 130 km/h there are no special frequency ranges dominant. Figure 7 shows an Acoustic Photo (dB(A)) with highly constant distribution of the noise scene inside the cavity with the sound pressure maximum of the source at 73.3 dB(A)).
During drive at the speed of 175 km/h the criticized hissing is audible. The overall sound pressure lies at 77.4 dB(A) and the hissing noise occurred at the frequency band from 2200 – 3000 Hz (marked with the blue frame in Figure 8 and 9) varying between 52 und 60 dB(A), being at least 17 dB lower than the overall sound pressure level. Figure 9 shows the resulting

Fig. 1 Measurement object Peugeut 206

Fig. 2 Setting-up

Fig. 3 Array position inside the cavity

Fig. 4 Set-up of the data recorder and mobile power supply in the trunk

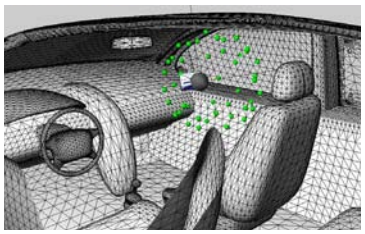


Fig. 5 Array position in the virtual cavity

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Acoustic Photo (dB(A)) still with a relatively even distribution of the noise field inside the cavity, but with an additional sound pressure level maximum in the middle of the wind shield.

For the analysis of the conspicuous frequency the band from 2200 to 3000 Hz was marked in the spectrogram and the associated Acoustic Photo has been calculated (Figure 10 and 11).

As a possible cause the wind shield wiper has been assumed and removed and the measurement has been repeated at 175 km/h without wiper.

As a result of this modification the hissing noise had vanished completely and is now not audible at any speed any more (tested up to 195 km/h). The corresponding frequency band is not conspicuous any more. During the last measurement without wiper an overall noise level of 76 dB(A) has been measured at a speed of 170km/h. Therefore, the wind shield wiper has been successfully clearly identified as the cause of the hissing noise (see figure 15 and 16).

Fig. 12, 13 and 14 Removal of the wind shield wiper and fixing with duct tape

Conclusion

The Acoustic Camera allows the user 3-dimensonal analyses of cavities/interiors. The autarkic utilization of hardware and software at any place permits to conduct analyses of complex noise structures during drive mode. Both sources types - impulse and stationary noise - can be located even in low frequency ranges. For the example of the Peugeot 206 it is diagnosed that the analysis with the Acoustic Camera is fast, distinct and efficient. The manufacturer can now take action in order to remove the disturbing noise of the wind shield wiper for the client.

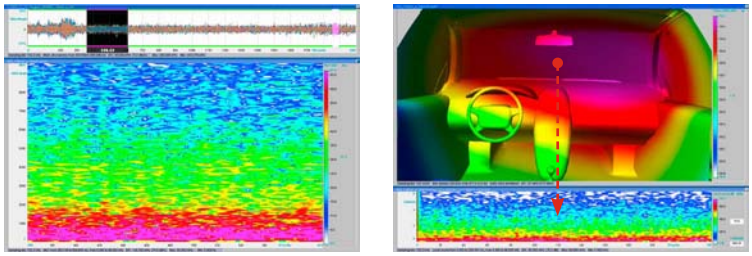

Fig. 6 and 7 Test at 130 km/h, channel data and spectrogram and the associated Acoustic Photo (dB(A)) with the corresponding point spectrogram in the middle of the wind shield

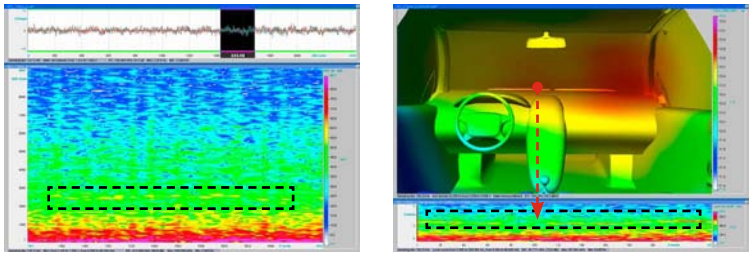

Fig. 8 and 9 Test at 175 km/h, channel data and spectrogram with the associated Acoustic Photo (dB(A)) and the point spectrogram in the middle of the wind shield below

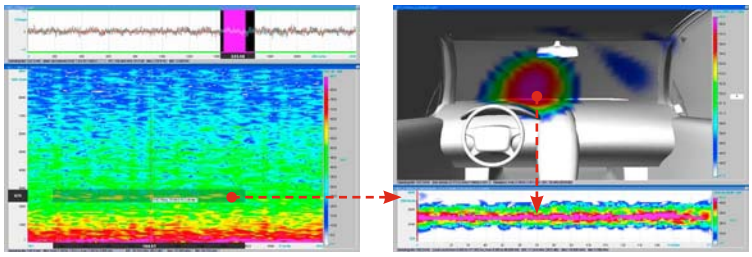

Fig. 10 and 11 Test at 175 km/h, channel data and marked area in the spectrogram and the associated Acoustic Photo (dB(A)) with a map dynamic of 10 dB and the point spectrogram in the middle of the wind shield below

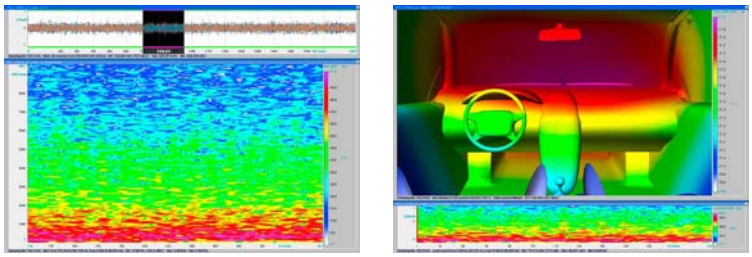

Fig. 15 and 16 Test at 170 km/h, channel data and marked region in the spectrogram as well as associated Acoustic Photo (dB(A) with a map dynamic of 10 dB and the point spectrogram of the middle of the wind shield below

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