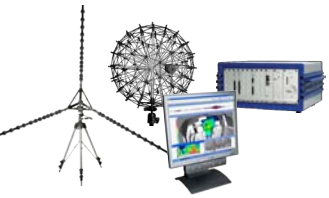
Application Note. Pass-by and Interior Measurements.

acoustic camera

System Characteristics



Array Star48 / Sphere48
48 / 48 microphones
3,40 m / 0,35 m diameter
Foldable, 3-arms structure / Carbon fiber structure
Dynamic of the microphones: 35 dB -130 dB / 35 dB -130 dB
Recommended mapping: 100 Hz – 7 kHz / 1 kHz - 20 kHz
Typical measurement distance: 5 – 500 m / 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 • Acoustic Photo 2D • Acoustic Photo 3D • Movie on Movie 2D

Power Supply
Mobile power supply / battery pack

2D Measurements – Train Pass-by

Visualization of running noise of a driving train and tank wagon

3D Measurements – Train Interior

Sound visualization of passenger wagon interior

Application Area

Acoustic analysis of train pass-by at about 120 km/h and interior operation noise

Measurement Task

Distinguishing between track and wheel noise during pass-by and finding conspicuous operation noise for the passenger inside the cabin

Measurement Object

Empty tank wagon and public transport train

Measuring Set-up

The scenes were measured with a Star48 and a Sphere48 Array. Both measurements were conducted with a mobile power supply and took less then 10 minutes. For the fitting of the array position into the 3D CAD model another 5 minutes where needed while the microphone array Sphere48 was positioned on a passenger seat.

Fig. 1 Measurement set up for train pass-by at 120 km/h

Results

Visualization of running noise of a driving train

A loco-hauled double-deck train on the line Berlin – Erkner was measured and analysed in order to localize noise emissions during pass-by (Fig. 1).
As expected the noise emission was concentrated distinctly in the region of the bogies (Fig. 2).

The velocity of the train lay between 100 and 120 km/h.
As the example illustrates it is within the realms of possibility for the Acoustic Camera to analyze scenarios with a high temporal resolution.

Fig. 2 Noise emission at the bogie

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Visualization of running noise of wagons

It was assumed that the running noise of the unloaded wagon (rolling, empty (!) tank wagon at the shunting hump, see Figure 4) is fundamentally radiated by the tank. Therefore, the emission image of the tank wagon was unexpected as well.

However, in the acoustic image not the tank unit but the wheel sets and bogies appeared to be the distinct source. They were conspicuous in all examined events as the acoustic images indicate demonstratively (see Figure 3). When considering the dynamic of about 8,5 dB(A) in the acoustic map the importance of this problem becomes obvious. It can be easily identified what region entails the most capability for noise reduction.

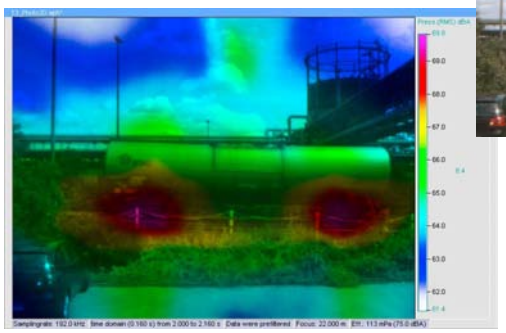

Fig. 3 Wheel emission at rolling tank wagon

Fig. 4 Unloaded tank wagon

Sound visualization of the wagon interior

The mapping procedure is also well applicable in interiors of standing and moving wagons. Here both 2D- and 3D-maping is available. The example displays a brake noise leakage in front of the seat as seen in Figure 5.

The presented examples show how a comparatively simple-to-manage analysis system is suitable for projects and measurements for traffic noise reduction. Easily communicable findings can be achieved in a short period of time while aiming at a better environmental quality in respect of noise exposure for all persons concerned.

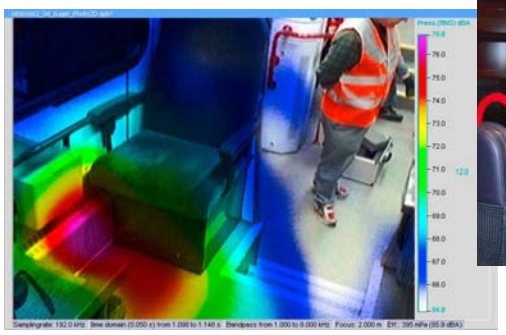

Fig. 5 Acoustic Photo 2D of emission from heater

Fig. 6 Set up inside train

Conclusion

Noise reduction in the field of train pass-by and customer satisfaction becomes more and more important. The case study reveals unequivocally the value of measurements conducted with the Acoustic Camera in the area of noise control both inside and outside of wagons and coaches of any kind. The autarkic utilization gives the analyst the chance to measure at any critical location in order to find acoustic hotspots fast and effectively.

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