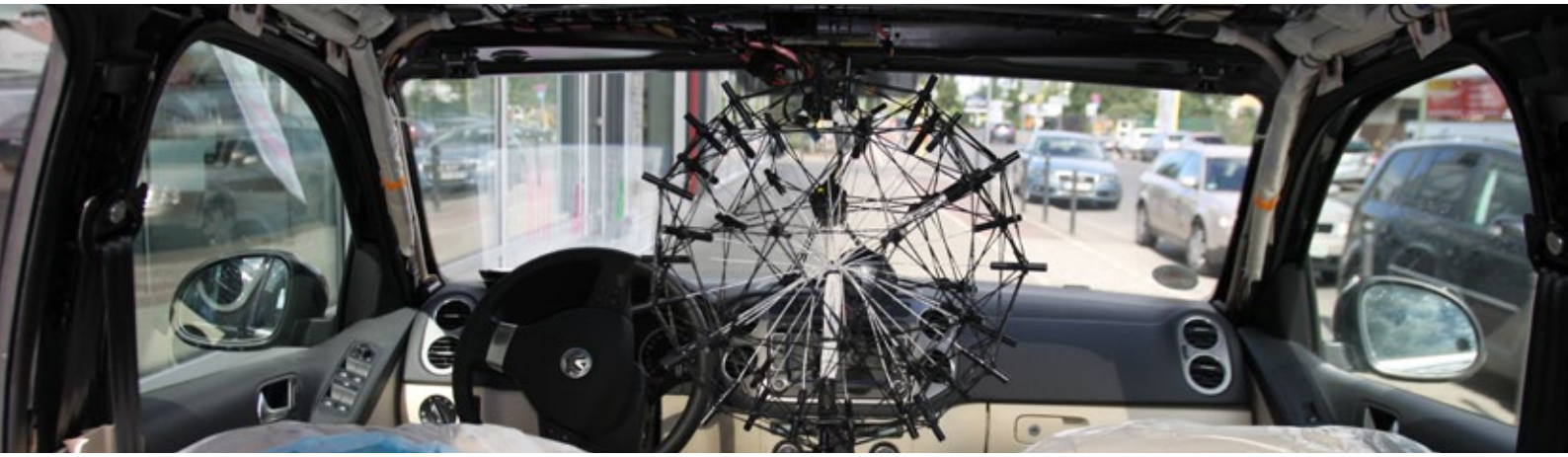
Vehicle Interior Measurements

The Acoustic Camera as an Effective Tool for the NVH Analysis of Vehicles



CHALLENGE

A car vendor in Berlin needed help with NVH analysis. When customers brought in their recently purchased cars because of a disturbing squeak and rattle noise while driving, their engineers were not able to locate the source of noise.

SOLUTION

The Acoustic Camera as a mobile system allows on road testing while driving. By performing real 3D beamforming measurements inside the vehicle, all directions are taken into account. The noise sources can then be accurately mapped on CAD models of the vehicle. The acoustic field is not influenced by the hardware, as the microphone array is almost transparent. Because of its light-weight construction, safe test-drives are possible without any danger for the driver. Several cars can be tested within a few hours because of the fast and easy set-up. The Acoustic Camera enables reliable sound source localization in the car interior instead of the biased interpretation of engineers.

BENEFITS

- Fast and easy set-up
- One measurement position covers the full vehicle interior
- Nearly no influence of the acoustic field
- Mobile system for testing while driving
- Precise localization and 3D analysis

MEASUREMENT

Measurement object	VW Tiguan, VW EOS, VW Golf
Microphone array	Sphere48 AC Pro
Software NoiseImage 4	Acoustic Photo 2D Acoustic Photo 3D Recorder Interface Spectral Analysis Advanced Algorithms Project Manager
Data acquisition	Data recorder mcdRec

For the measurement, the microphone array and the data recorder were positioned inside the cabin of each car. The mobile power supply was set up in the trunk of the car. All measurements were conducted while driving on the road to capture real-life conditions. Afterwards, CAD models of the vehicles were integrated into the channel data and each cabin was analyzed three-dimensionally with the software NoiseImage.

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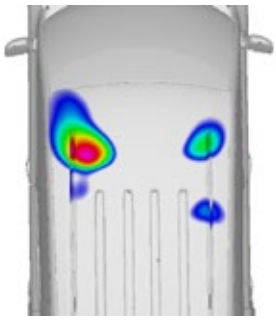
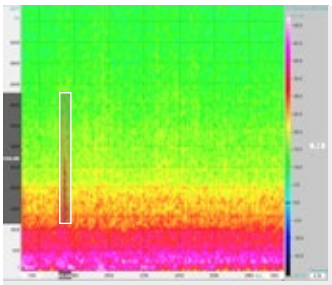
RESULTS

During the test drives, a wide variety of sounds was identified. Including “normal” sounds like the engine noise, the noise of the turning wheels on the street and other systems like the power train. By selecting the correct events in the correct frequencies and times, the analysis results are independent of these surrounding noise sources.

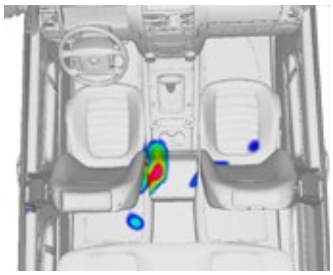
In the spectogram view, the squeak and rattling noises are clearly visible. With NoiseImage, the relevant times and frequencies can easily be localized on the 3D models of the vehicles. Furthermore, the CLEAN-SC algorithm is applied to increase the dynamic range and improve the spatial resolution of the noise sources.

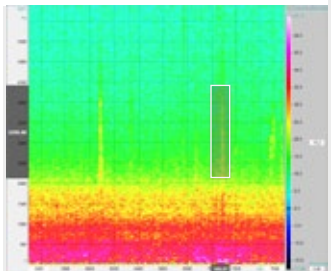




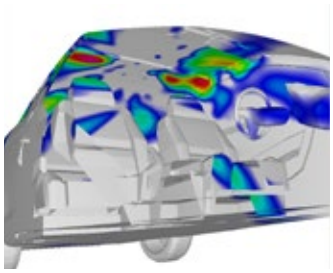
VW TIGUAN

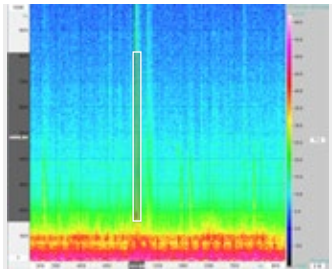
- Acoustic hotspots located at the roof of the car
- Crack appeared regularly at maximum sound pressure level of 39.9 dB(A)





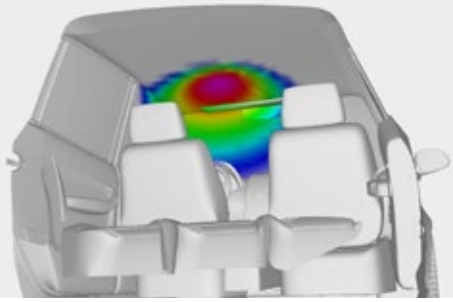
- Second source localized under the seat
- Spectrogram: Frequency range of the source is marked from 1.7 to 5.7 kHz at a maximum level of 33.1 dB(A)





VW EOS

- A squeal in C-pillar of the electric roof was located emitting noise at 1.8 to 9.8 kHz.
- The channel data and the spectrogram with marked frequency band and associated Acoustic Photo 3D show several sources on the roof top.



VW GOLF

- Unusual squeaking noise located above the driver seat at peak level of 68.1 dB(A)
- Acoustic hotspot is shown on the CAD model of the car

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