Norsonic Acoustic Camera

Filming sound leakages in highly reflective office environment

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Measurements in office complex, Lier, Norway, April 2016

These recordings were made with the Nor848A-10 1.0 m acoustic camera system with 256 microphones, now replaced with Nor848B acoustic camera system.

Problem

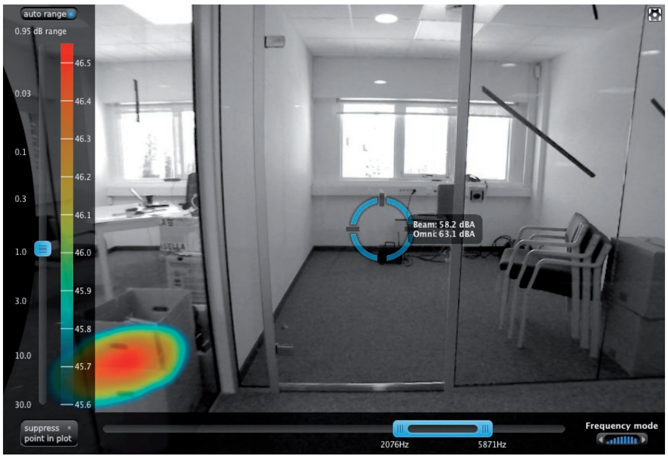
A newly built office complex is designed with glass facades between the offices and the hallway. The glass facades include a glass door. Although the glass structures themselves have a sufficient sound reduction value, the sound insulation between office and hallway was measured at 19 dB, which was far below the sound insulation criteria for offices given in the regulations. It was therefore important to find out where any weaknesses were introduced in the overall structure.

Measurements

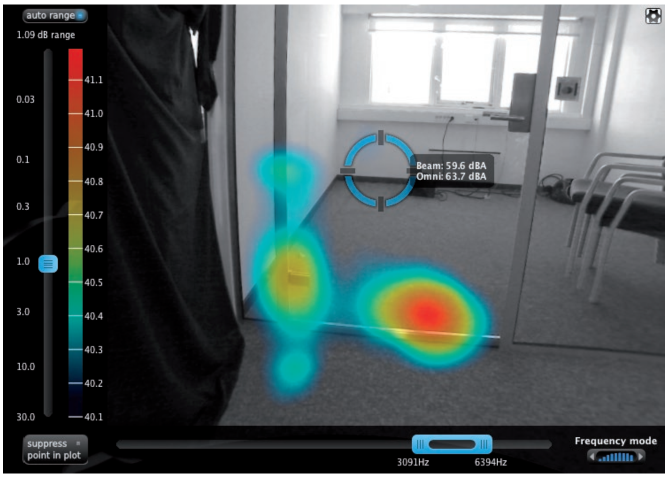
A common way to detect cracks and gaps in barriers is by placing an omnidirectional loudspeaker emitting white noise in the sending room, and use the acoustic camera in the receiving room pointing at the structure of interest. For this situation the Norsonic Nor848A-10 1.0m acoustic camera with 256 microphones was placed on the outside of the glass facade filming directly at it. Gaps and cracks in the structure should then be detectable by being visualised as small noise sources in the structure.

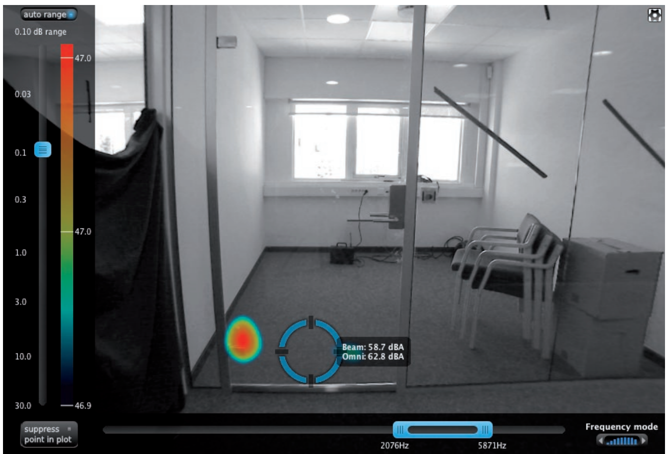
Results

The first results from the initial recordings proved disappointing. Although it was possible to hear clear differences by using the virtual microphone, which enables the user to listen to specific points in the image, the coloring of sources was only seen on a glass facade standing perpendicular to the wall of interest, as seen on the left side in the image above. Clearly this was a strong acoustic reflection and not the main source itself.



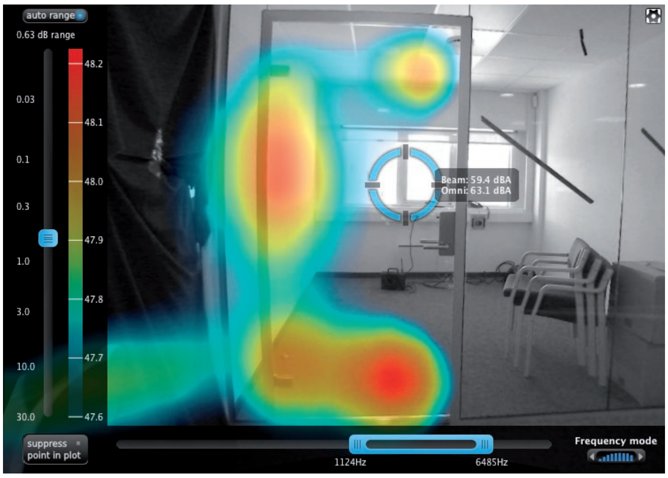
Since the recording environment was highly reflective, a good approach was to try to dampen the influence from surrounding structures. By using a piece of cloth to cover parts of the reflective wall, the acoustic reflection was absorbed enough so that the sources of interest could be visualised as seen in the image below. Now various weak points in connection with the door frame became apparent. Sources were seen between the door and the floor, and especially around one of the door hinges.

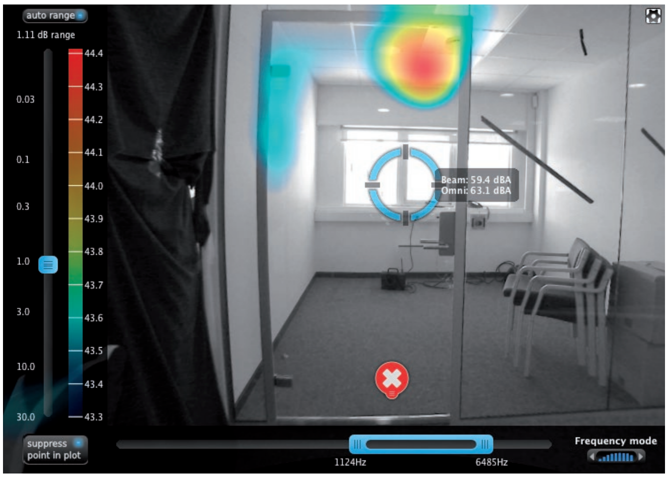




By studying the hinge in detail, one could easily see how the rubber seals weren't completely sealed off around the hinge, but left a small gap as seen in the image below. This gap allowed noise to leak through.

In addition to the main weaknesses being the door hinge and the seal between the door and the floor, also the top right corner of the door wasn't closed tightly enough, so that noise leaked through here as well. This weakness could be clearly heard with the virtual microphone. Since it was weaker than the two main sources, it was better visualised in the image by using the acoustic eraser to try to remove the main sources from the visualisation as seen in the images below.





By closer inspection one could see how the rubber strip around the door edge wasn't completely sealed shut in this position as seen from the image below.

Nor848B Acoustic camera

The Norsonic acoustic camera is a module based approach to acoustic camera that gives the user both portability and great resolution for a wide range of measurement situations. The array dish is based on a hexagon shape, given it both its name, and the ability to combine several tiles into larger systems.

Acoustic beamforming arrays, commonly known as acoustic cameras, enable the user to visualise different sound sources at different frequencies and source strengths. The resolution and ability to resolve sound sources spaced closely apart, and at lower frequencies, is mainly decided by overall size and number of microphones of the equipment being used. Although image manipulation and deconvolution techniques on the beamformed results might give added resolution, in practise the properties of the array still influence the results. This size versus resolution criteria is the crux of the acoustic camera market. Users want something that is small, light weight, and portable, while at the same time having excellent resolution, and the ability to go low in frequency. This has been an impossible demand for a single system – until now.

Hextile - lightweight and portable

With a single Hextile, the user has a small, portable and lightweight acoustic camera that can be used for a wide range of measurement situations. The Hextile is a USB based acoustic camera, with a single USB cable for both power and data transfer – no extra battery cable needed. The array is made from robust and lightweight aluminium, has 128 MEMS microphones, and is less than 3 kg in weight while having a maximum diameter of 46 cm. The low frequency limit for the Hextile is 410 Hz.

Multitile - great solution

For users that require better resolution both in lower frequencies and overall, three single Hextiles can be combined to a larger Multitile system, consisting of 384 microphones with a maximum diameter of 96 cm. The low frequency limit for the Multitile is 220 Hz.

Multitile (LF mode) - low frequency measurements

For special low frequency applications below 1 kHz, it is also possible to utilise the Multitile in the low frequency configuration as the Multitile (LF mode). By placing the individual Hextiles further away, the maximum diameter of the complete array system is increased to 1.46 m, making it ideal for low frequency measurements. The Multitile (LF mode) is for low frequency measurements below 1 kHz, with a lowest frequency limit of 120 Hz.

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