Norsonic Acoustic Camera

Measuring impact of traffic noise in apartment living room

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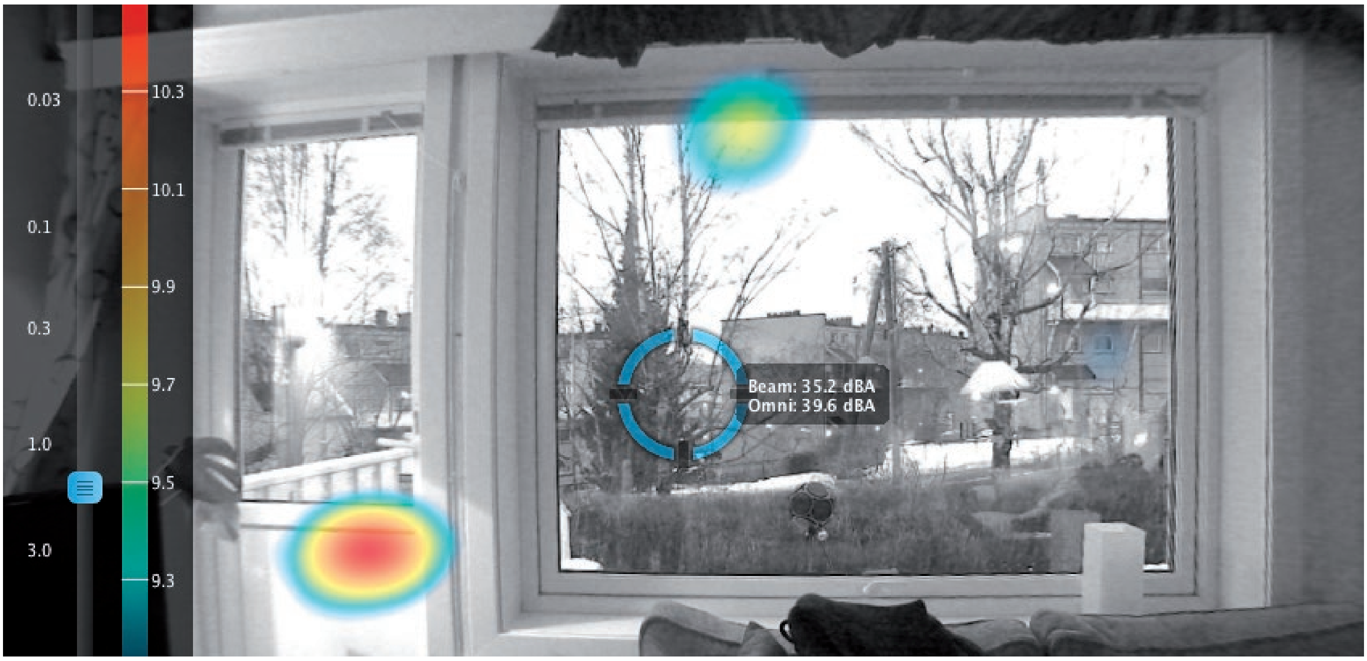


Measurements in apartment Oslo, Norway, February 2016

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

An apartment on the ground floor of a two story house in the city lies close to a busy road. The living room in the apartment is facing the road, and the inhabitants are bothered by traffic noise, especially in the morning and the afternoon, when the traffic is the heaviest.

Traffic noise could be clearly heard when standing in the living room. The facade facing the city street consists of a large window and a porch door. It was thought that the main contribution of noise came from these two parts, but it was difficult to verify if those assumptions were true, or exactly where any weaknesses in the structure might be located.

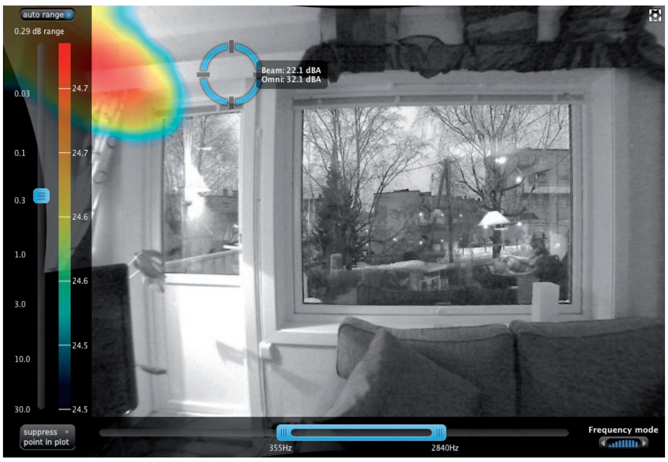
Measurements

The Norsonic Nor848A-10 1.0m acoustic camera with 256 microphones was used for the recordings. The camera was placed inside the living room pointing at the facade facing the street. The living room would hence act as the receiving room, and the outside as the sending room, much in the same sense as the procedure for sound insulation measurements. Weaknesses in the facade would then be possible to be seen as small noise sources in the structure. It was possible to use regular traffic as sound source, regardless whether the traffic was steady, or just a single vehicle from time to time.

In addition to using traffic as noise source, measurements were made by placing a omnidirectional loudspeaker emitting white noise on the outside of the facade. This created a more stationary sound field on the outside of the structure, and made detection of small cracks and gaps in the structure even easier.

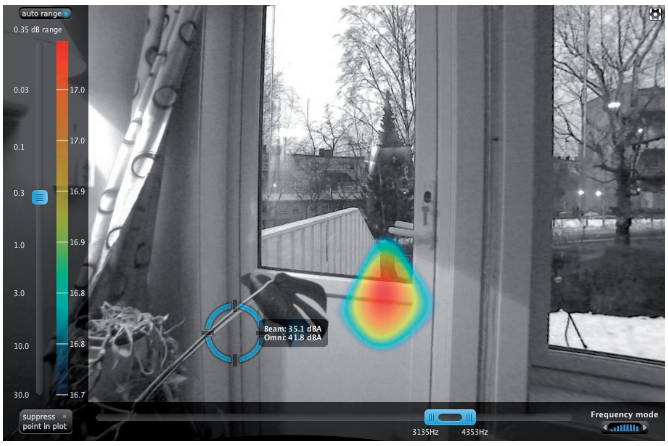
Results

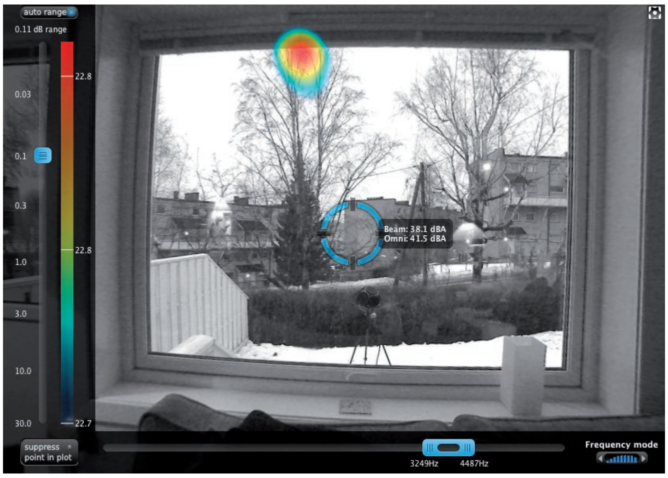
Initial recordings when using traffic as noise source displayed a single strongest facade weakness at the top left of the living room wall. This strongest source position was also confirmed when using the omnidirectional loudspeaker as noise source as seen from the images below, where the top image is traffic as noise source, and the bottom image is with noise from the loudspeaker. At this position a ventilation valve was installed, and most of the traffic noise came from this location.



Having determined that the intake valve was the main noise contributor, this spot was covered up with a pillow to remove it from the overall noise field, and try to locate secondary sources. By filtering on a relatively high frequency band around 3 - 4 kHz, it was possible to filter out only the noise being emitted by small gaps and cracks. This produced two new possible weaknesses, one on the porch door, and another on the air valve above the window as seen in the image below.

The next step was to look at those positions in more detail. The acoustic camera was then moved, first to cover the porch door, and secondly to look only at the large living room window. Again the frequency filtering stayed at the approximate same frequency limits. By looking at the coloring, and also listening to the points with the virtual microphone that enables the user to listen to sounds emitted from a single position, these two new noise positions were confirmed as seen from the two images below.





This same procedure with omnidirectional loudspeaker on the outside of the facade emitting white noise, and the acoustic camera on the inside filming an area of interest, could be used on other walls and windows as well. As seen below on a different window and wall, again the main source contribution is visualized as being the air valve above the window.

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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