Nor848A Acoustic camera

Wall Leakage Testing in the Lab with Acoustic Camera

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Problem

Facade insulation testing is usually performed by using a loudspeaker in the sending room, and record the sound pressure level (SPL) with microphones in both the sending and receiving room. The difference in SPL adjusted for the size of the dividing wall element will then give an estimate of the sound reduction quality of that element. However these measurements will not say anything on where any potential weaknesses, or cracks and gaps, exist in the wall element under inspection.

Measurements

An acoustic lab is set up with two reverberant rooms acting as sending and receiving room. In the sending room an impulse sound is used as the source. The Nor848A-10 1.0 m acoustic camera with 256 microphones was placed in the receiving room pointed at the wall element under inspection. It was thought that any weaknesses would be displayed as small sound sources on the wall element at the position of the weakness, as the SPL from these spots would be slightly louder.

One uncertainty was also how a very reverberant receiving room would influence the recordings, and if this method would only work in a receiving room with lots of absorption or close to anechoic.

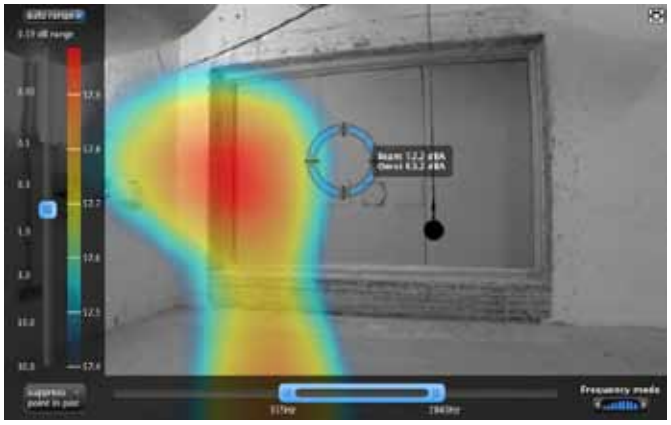
In the acoustic camera software it is possible to either look at a recording in live-mode view, which is the view when the recording is running, or to stop the recording at an arbitrary point in time to get a high-resolution plot. As seen in the picture below, the analysis was performed by stopping the recording just after an impulse sound had occured.

The coloring of sources is also influenced by the time weighting used, and the selected frequency band. As resolution for acoustic camera is also a function of frequency, where higher frequencies give better resolution, it is usually best to filter higher in frequency. For the results presented in this paper the default frequency filtering from 355 Hz to 2840 Hz was used, in addition to SLOW time weighting, which is the mean value over a second.

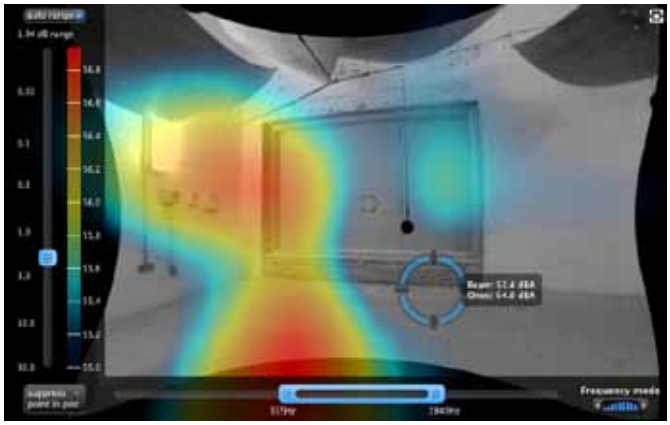
Results

When stopping the recording just after the impulse sound, and using the frequency filtering and time weighting as described above, the first image that appeared was the one seen below which indicated a weakness on the left hand side of the wall element.

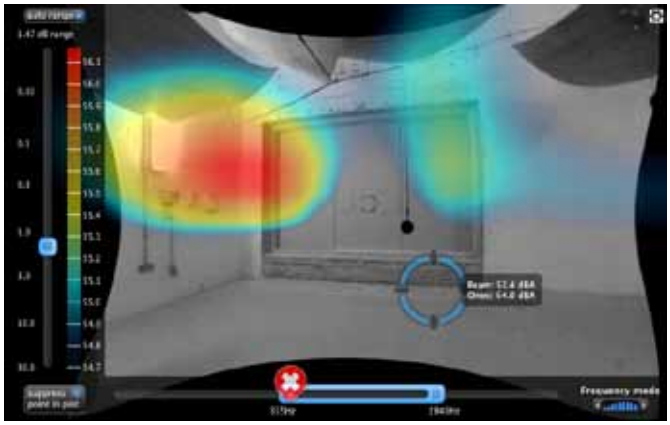
For this image however the dynamic range is set very low, so if we increase the dynamic range we are able to see more than just the strongest source in the room. Increasing the dynamic range produced the picture below where we can also see the reflection from the floor. Depending on where the measurement was stopped, the situation could also have been reversed, so that the reflection from the floor would be the strongest source, and the leakage from the wall would be the second strongest source and only appear after the dynamic range is adjusted.



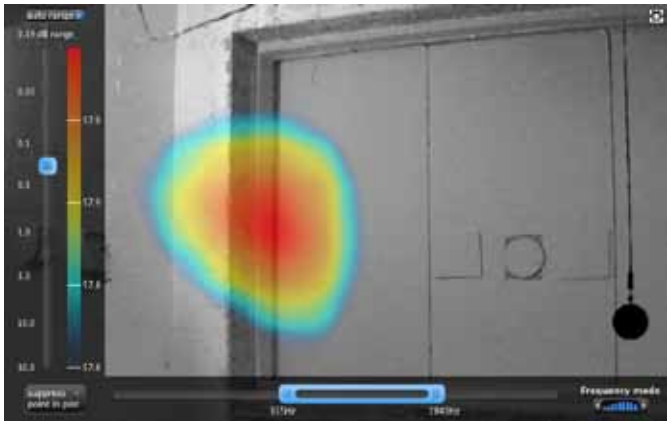
By further adjusting the dynamic range we are able to pick out the third strongest source and so on. Seen below is the image when increasing the dynamic range further, and we are now able to see a very faint third source on the right hand side of the wall element.

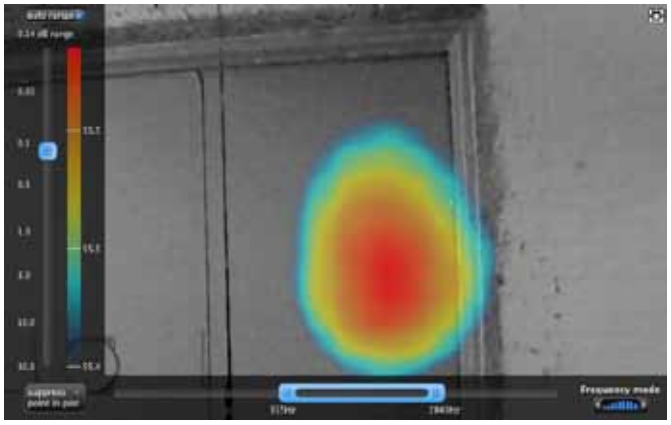


However the result is a bit obscured by the strong reflection from the floor. This could either be solved by adding some absorption materials in the receiving room such as a rug or similar, or zoom in in the image. But we also have the possibility to use the acoustic eraser in the software. The acoustic eraser removes a source in the image based on the position you place it. Seen in the image below, the acoustic eraser is seen as a red circle with a white cross on it. When placed on top of the position of the reflection, the reflection is removed from the image, and we can see the two sources from the wall element more clearly. Judging from this image it seems we have the strongest weakness on the left hand side of the wall, but also a second weakness on the right hand side that isn't as powerful as the first source.



Now it is possible to zoom in on the regions of interest to further increase the resolution. The images on the next page show the zoomed in results when looking at the left hand side and right hand side of the wall element.





For the results presented in this paper an impulse sound was used as noise source in the receiving room, and this worked well. However any type of source can be used, and often the best results are obtained when using a stationary white noise source in the sending room. In that case one is not dependent on stopping the recording at the correct time to obtain meaningful results, but could also do the analysis in the live-view mode. Also the virtual microphone, that enables the user to listen to the sound from only a specific direction, can be used in this situation to scan and hear along the edges or similarof the wall element. Often doing analysis by listening gives additional vital feedback that may not be obvious from the coloring alone.

The recordings in this paper were done with the acoustic camera connected directly to the MacBook also placed in the receiving room. Often in acoustic labs one would use a main control room where technicians can start and stop a measurement without having to physically be in the sending or receiving room. The transmission of data and communication between the acoustic camera and MacBook happens by ethernet cable over a fixed IP address. This means that it is also possible to use the LAN network of the lab to transmit data. In this case the MacBook could be located in the control room, and the camera in the receiving room with an arbitrary distance between them, as long as they are connected by cable on the same network.

Nor848A Acoustic camera

The Norsonic Nor848A acoustic cameras sets a new standard for acoustical cameras. The large number of microphones eliminates the problems of ghost-spots, compared to traditional acoustical cameras where the relatively low number of microphones increases the side lobe effect, resulting in the so called ghost- spot effect: You “measure” a non-existing source.

The Nor848A software is extremely intuitive and easy to use. Just after a few minutes of training, the user is able to operate the system and do real measurements. Three camera frontends are available, all varying in number of microphone sensors and size, where a larger array size ensures better resolution for lower frequencies: A 0.4 meter array holding 128 microphones, a 1.0 meter array holding 256 microphones and a 1.6 meter array with 384 microphones.

The digital microphone elements are protected behind a disc-shaped carbon fibre enclosure, and a dust and water repellent mesh is protecting the microphones from dust and moisture. The robust and sturdy construction also ensures that all microphones are kept in the correct position – important for field applications. The small distance between the microphones in the inner circle is important for low spatial aliasing at higher frequencies. The large number of microphones also contributes to the wide measurement range and the low self-noise. The signal in the selected direction is based on the weighted average of all microphones and is therefore far below the self-noise from a single microphone.

The system enables the user to perform noise analysis with a clear view of where the different noise sources are located in real time. The system is ready to measure in just a few minutes after entering the site. By moving the cursor in the picture you may analyze and listen to the sound in the selected directions while doing the measurements. This enables the user to identify the problem, whether it is an annoying sound, a leakage or other difficult noise problems in just a fraction of time compared to traditional methods.

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