Nor848A Acoustic camera

Using Acoustic Camera Inside Caravan Car to Find Squeak and Rattle Noise

Jørgen Grythe, Norsonic AS

Measurements in caravan car Lier, Norway, October 2015

Problem

When driving a caravan car, the driver could hear annoying noises from behind the driver's cab in the living compartment. Even though the noises could be heard clearly, it was very difficult to discover the exact location and cause of the various annoying sounds due to overwhelming background noise.

When the car was standing still with the engine running, no extra noises could be heard, but especially two distinctive sounds that were different from ordinary engine and wheel noise were heard when the caravan was driving. The first sound had the characteristics of a loose screw sliding back and forth on a hard surface, so whenever the vehicle was turning, what sounded like a small piece of metal rolling from one side to the other on a hard surface could be heard. This was only heard when the caravan was in a turn, and not when driving straight. The second noise sounded like squeaking and creaking of wood, which made sense since a lot of the interior consisted of wood. This sound also appeared when the caravan was driving straight, and not only when turning. Since there were several pieces of the interior that consisted of wood, including the floor, it was not know what specific piece of interior made the noise. Based on previous listening experiments when the car was driving, it was thought that the indoor fridge which was positioned next to the entrance door might be root of of both noises.

Measurements

The Norsonic Nor848A-10 1.0m acoustic camera with 256 microphones was used for the recordings. The camera was plugged into an external battery pack for easy transportation and mobility. Although the 40 cm Nor848A-0.4 acoustic camera would have been more mobile, at the time of the measurements it was unavailable. Nevertheless there was more than enough room in the caravan car to use the Nor848A-10.

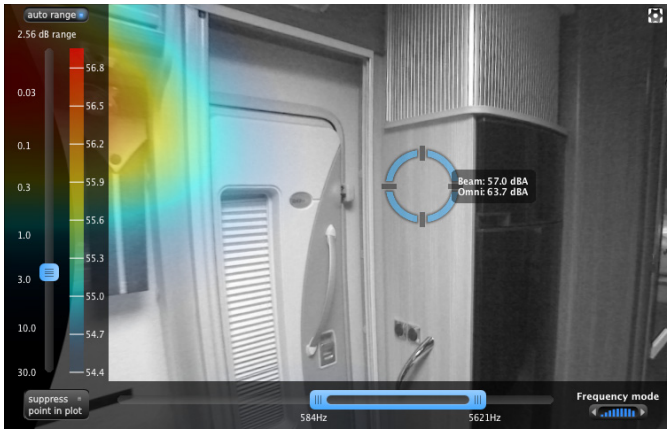
The measurements were done with one person driving the caravan, and another placing the camera dish on a table and performing the measurements. As the array dish itself weighs in at only 11 kg, it was easy to control it with one arm, and starting and stopping a measurement in the software on the MacBook with the other arm. No tripod was used or needed for the measurements.

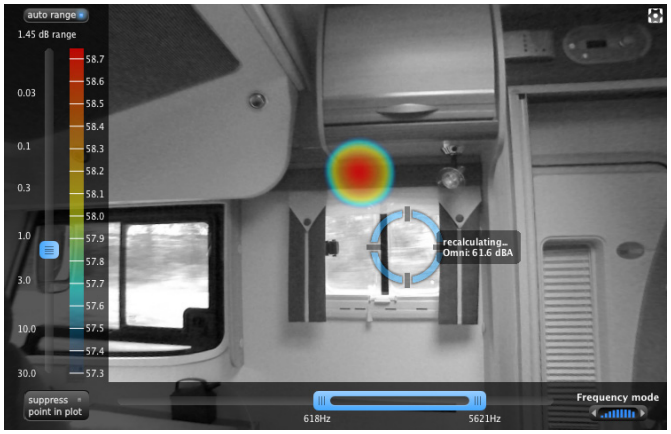
Results

Initially the camera was pointed towards the fridge in the center of the living compartment of the caravan and measurements were made as this was thought to be the origin of the sources, In addition to looking at the coloring of the sources, it was also very useful to use the virtual

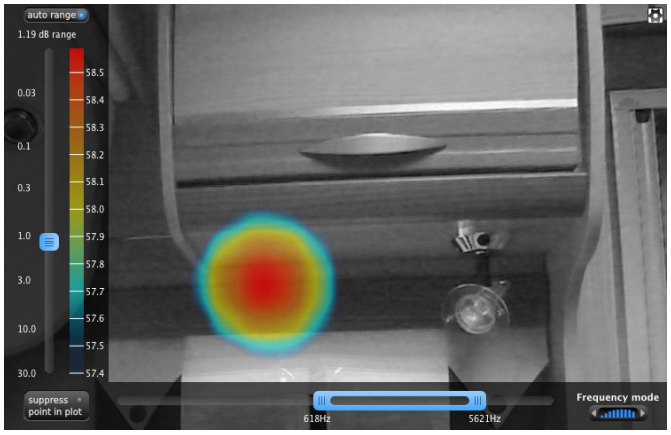
microphone to listen to the sound field from a specific direction. In addition it worked very well to enable the band pass filter when listening in order to filter out background noise such as engine noise and wheel noise.

Seen in the image below is the inital result when filming at the fridge in the living compartment of the caravan with the caravan driving and turning, and when the distinct metal rolling sound was heard. As seen from the image there was no indication whatsoever that the sound originated from the fridge in the middle of the picture. Instead the coloring indicated that the sound originated from a different location. Also listening with the virtual microphone could more or less rule out the possibility that the fridge was the source origin. Instead the camera was positioned to aim to the left of the fridge where the coloring indicated a source.

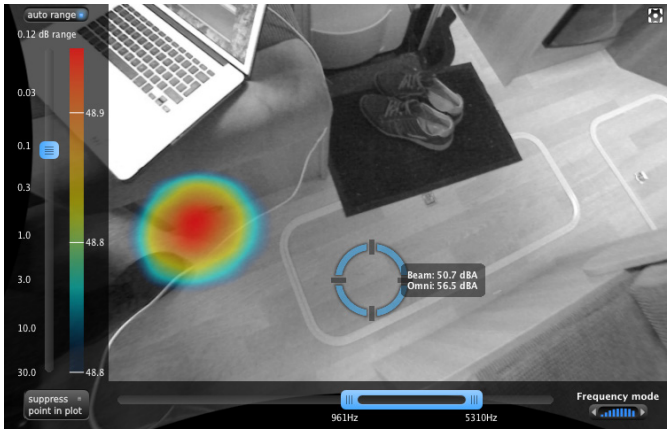




The position of the true source was seen more or less instantly to be inside a cabinet positioned on the wall of the car. This true source location was also confirmed when listening with the virtual microphone on a recording, and even when holding the ear into the cabinet when driving.



Finding the second noise source proved to be a trivial case after the fridge had already been ruled out as the source. Since most of the interior floor was wooden, is was thought that the creaking might originate from here, and this was the first position the camera was aimed at. Both coloring and listening with the virtual microphone confirmed this.



Normally using acoustic cameras in the interior of cars will often provide poor results, due to high background noise, and a very reverbant noise field. This means that sounds and signals will arrive multiple times at the array at different times, thus making it very difficult to determine the true source location. In this case study it is demonstrated how ordinary beamforming can provide accurate results even in such a situation. This could be thanks to the added space of the interior compartment of the caravan van, in addition to various soft furniture and so on that may help in reducing reverberation effects. In addition the Nor848A-10 1.0 m camera was used that has higher resolution than smaller cameras, in addition to excellent side lobe level suppression.

In addition to being able to locate the various sources correctly by looking at the coloring, also using the virtual microphone in combination with the band pass filter to filter out background noise proved valuable.

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.

Norsonic
P.O.Box 24, N-3421 Lierskogen, Norway
Tel.: +47 3285 8900 Fax.: +47 3285 2208
info@norsonic.com www.norsonic.com

Distributor: