

New lab mimics the sound of any room

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Neo Kaplanis in the soundlab in Aalborg, Denmark. Credit: Aalborg University

Researchers at Aalborg University, in conjunction with Bang & Olufsen in Denmark, have developed a sound laboratory that can reproduce the acoustics of any environment from cars to concert halls. One goal is better design of sound systems for cars.

In the basement beneath Aalborg University are 40 small speakers and three subwoofers placed around a narrow walkway with just enough

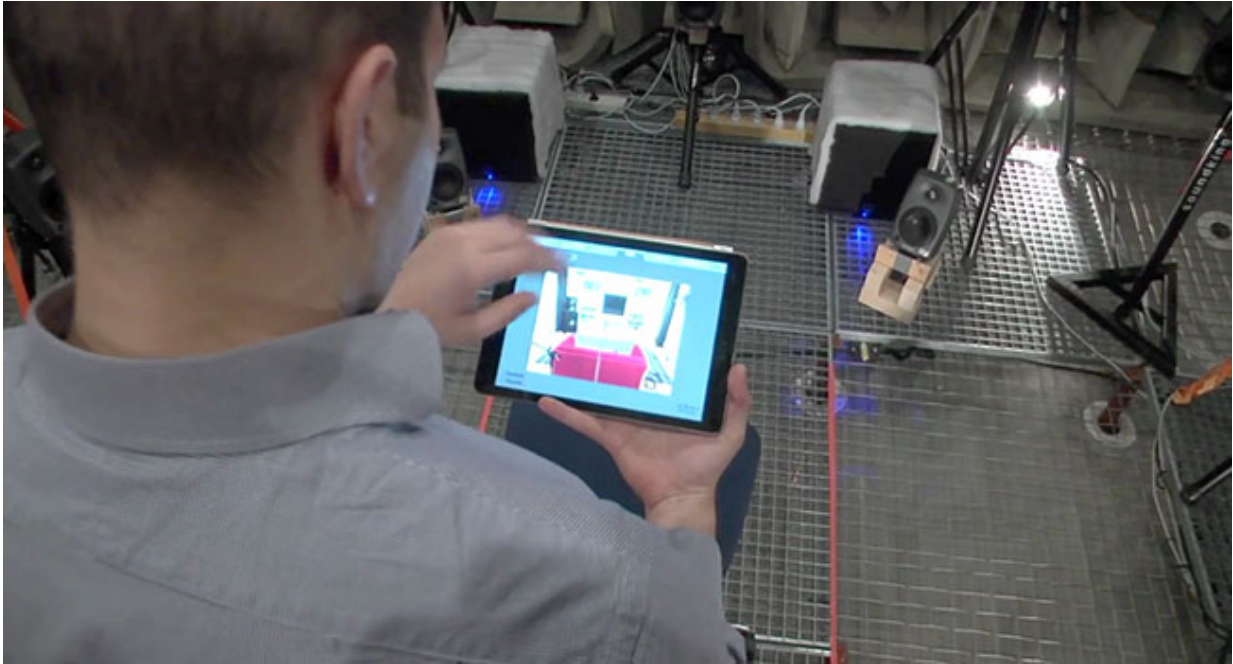
room for a chair. The space is an anechoic chamber where the walls, ceiling and floor are covered with thick, pointed, foam plates that absorb sound that hits the walls.

The 43 speakers are set up so that along with a newly developed recording system and an advanced computer program they can reproduce the exact acoustic conditions from any other room. If you put a CD in the drive or start an audio file on a computer, it will sound entirely as it would in the space the laboratory is simulating.

Artificial head

The sound lab is the latest addition to the accurate reproduction of acoustic conditions. Years ago, Aalborg University along with Brüel & Kjær, Delta Akustik and Bang & Olufsen developed an artificial head with built-in microphones that could record how the human ear perceives sounds coming from different places. The artificial head was later developed to turn to each side and accurately map how the acoustics of a room affect sound when you move.

By reproducing the sound in a pair of headphones with a head-tracker, you can make it sound as if you are in the room. The perceived acoustics are very close to those of the real room and thus you can simulate how speakers and sound systems will work in different rooms.



Setting up the lab. Credit: Aalborg University

Not the same with headphones

Recordings with artificial head technology have been used for a number of years to reproduce various acoustic conditions, but the problem has always been that we do not ordinarily experience the sounds of our surroundings through a pair of headphones on a daily basis. In order to more accurately reproduce an acoustic environment, you can enhance the experience considerably by using a loudspeaker setup in an anechoic environment to create a precise spatial illusion. The idea and the system were originally developed by [researchers](#) at Aalto University in Finland for studies on sound in concert halls. The system at AAU is an advancement aimed at smaller spaces such as living rooms and automotive interiors.

"With headphones on, it often feels as if all sound is quite close to or inside the head. You do not have the feeling that something comes from farther away – the spatial element is very difficult to recreate," explains PhD student Neo Kaplanis who developed the new sound reproduction system at AAU.

"The same goes for the experience of a powerful bass. It's not something we just hear with our ears; it's something that can be felt in the entire body. You simply cannot reproduce it with a pair of headphones."

However, in the accurately positioned array of speakers in the new sound lab, you can. By using recordings made with the appropriate recording method we can recreate the sound of any room.

"If you wear a blindfold or turn off all the lights in the lab, your ears make you believe that you're in a completely different place; in fact that's how we run the experiments," says Neo Kaplanis.

Better sound in the car

Right now the lab is set up to reproduce the acoustic space in a car, and with good reason. The university's partner, Bang & Olufsen, was until recently one of the world's leading manufacturers of Hi-Fi audio for luxury cars. The automotive department was recently sold to American speaker manufacturer Harman, but their development department is now in Struer, right next to B&O's headquarters.

When you develop a sound system for a brand new car, it takes a very long time because you test the car with many different speaker systems that have to be changed along the way. It is a long and costly affair, but because the entire production of new cars is top-secret, audio system manufacturers typically only have a prototype of the car available for a few days.

"With the new system we will be able to map the car's acoustic conditions, send the car back to the factory, and then adapt and adjust the audio system with measurements in the lab. It makes it possible to develop much higher quality sound," says Søren Bech, Director of Research at Bang & Olufsen, who divides his time between the Struer company and a professorship at AAU's Department of Electronic Systems.

The possibilities in the sound lab are not limited to the best speaker solutions for luxury cars. With the new system, in principle we can reproduce the sound from all kinds of spaces, from concert halls to living rooms – to buildings that are still on the drawing board. The setup will thus be an important tool in future research/development projects.

Facts

- Sound systems are an important selling point in luxury cars. In partnership with Bang & Olufsen, automotive manufacturer Audi has mapped the acoustic conditions in most of the model series. Potential buyers can put on a pair of headphones and virtual reality glasses and click through interiors – and sound environments – in the different cars.
- A scientific paper from the researchers presented at the Audio Engineering Society's 60th International Conference in Belgium earlier this year describes the design and implementation of a method to perceptually assess the acoustical properties of a car interior and the subsequent sound reproduction properties of automotive audio systems. Read more:
[vbn.aau.dk/da/publications/a-m ... e-5678443656ef\).html](http://vbn.aau.dk/da/publications/a-m ... e-5678443656ef).html)

More information: Room simulation sound-examples from SoundLab AAU: soundcloud.com/user-621419667/ ... ets/room-simulations

Provided by Aalborg University

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