

Adaptive room acoustic design

Master Thesis: Adaptive room acoustic design

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Popular science summary

During this master thesis an adaptable acoustic panel was developed to change the acoustic properties of a room.

The design thinking methodology was followed to go from some simple sketches to a functional prototype. After an initial research about acoustics, the requirements for the panel and its functionalities were defined, then an ideation process took place in order to gather several concepts. After a selection process one of them was further developed into a physical prototype. Finally, to check the behaviour of the panel a set of measurements were performed.

Different activities demand different characteristics of the space where they are carried out. This is pretty evident with lighting, there's a need for a lot of light when a group of art students gathers to paint in a class. But they need darkness in order to watch a movie projected on a wall. In this example a simple switch can easily change the environment conditions. Furthermore, light modulators exist so the lightning can be more precisely adjusted, for a dinner or reading. The goal of this master thesis is to do the same thing with sound. Developing an acoustic panel that can redirect the sound that stays too long in the room towards the ceiling, where it can be absorbed by an absorptive ceiling.

When sound stays in a room for too long it can make speech harder to understand. Nevertheless, if it disappears too soon the speaker could have trouble getting information to the listeners. A group of toddlers playing in a classroom generates a lot of noise, in this environment the clarity of the teacher's speech is not that important and therefore the acoustic treatment needed is a lot of sound absorption. Nevertheless, when the teacher is teaching the kids, they need to clearly hear the information from every position in the room. There's a risk

that with too much absorption in the room the children seated farther from the teacher won't hear the teacher correctly, making the learning process more difficult.

The panel was conceived to be mounted on the walls of multipurpose rooms, such as a High School classes or a coworking office space. This way, the sound behaviour inside the room can be adapted to fit the requirements of the activities.

The device consists of a box with a plastic fabric on the outside and moving bars on the inside. When they change their position, they modify the shape of the fabric. The thick material acts as a mirror for the sound. To change the acoustic properties of the room the panel redirects the sound in different angles. This makes it bounce around more or less around the room. To test the functionality of the prototype some measurements were carried out and it was proven that the prototype could in fact redirect the sound as intended and that that created a noticeable change in the room acoustics.

After completing this project several things can be learned:

- The device can indeed change the time the sound stays in the room
- The changes it creates are noticeable, even more so for the extreme configurations
- It's an expensive and complex system that would need to be simplified to be turned into a manufacturable product
- This was a steppingstone in the integration of automation in the field of acoustics
- The prototype will be further used to explore its capabilities