Soundscape 1&2
(Re)Creating a space using sound

An artistic research project at Stockholm University of the Arts
By Klas Dykhoff, Professor of film sound

Background

1. Most people who listen to music in their hi-fi systems probably have noticed that if you don’t listen from a position where the distance to the speakers is equal, the stereo image suffers. The ideal position is called "the sweet spot". When you listen to jazz or pop music recorded in multitrack, you get the impression that the mix gets narrower and the sound moves with you when you move sideways from this point. All the sounds appear to be coming from the loudspeaker closest to you. If you listen to a true stereo recording of for example a symphony orchestra in a concert hall, the spatial impression will get diminished as well.¹

2. When stereophonic sound was introduced in films in the 1950:s the Haas effect became a real problem. The spectators in a cinema are spread out sideways. Those who are seated at the far ends of the rows are sitting closer to the left or the right loudspeaker compared to those in the center. The former will get the impression that all the sounds are coming from one side, while the image on the screen occupy all of their field of vision. The film industry solved this dilemma by introducing a third channel with it’s own loudspeaker in the center of the screen. This was used for dialogue which left the left and right speakers for music and sound effects. The spatial effect of the sound was however still lost on the spectators sitting in the far ends of the rows. The surround sound formats from the 1970 - 1990:s hasn’t really succeeded in solving this dilemma, although they have brought a sense of depth in the mix, by enabling sounds to be placed behind the audience. Spectators sitting far back in the cinema will however get a very strange sound mix, where the surround sounds get too loud compared to what’s playing from the front speakers. For someone sitting in the outer seats, this problem becomes even worse. The most recent cinema audio formats, Barco Auro 3D and Dolby Atmos with up to 64 audio channels could solve this problem, but so far I haven’t heard them used in that way.

My idea

Is it possible to create a "place" using sound, a stereo field big enough for someone to move around in and so consistent that you don’t loose the spatial impression even as you approach one of the loudspeakers?

I revisited the early stereo experiments conducted by Alan Blumlein² in the early 1930s. His aim was to improve music recordings and to make film sound that could match the movements on sceen. I had other goals, but I could use his conclusions about stereophonic sounds and how the human hearing works.

Blumlein mainly used directional microphones and coincident stereo. (based on difference in intensity) This method is usually referred to as X/Y-stereo. I choose to use omidirectional mikes and stereo based on time (phase) difference, called A/B-stereo. I did however introduce a component of difference of intensity by spacing the microphones by several meters. The conventional way of recording AB- stereo is to use two omnidirectional microphones spaced at about 30 cm. This would roughly correspond to the distance between our ears. If you increase

¹ This phenomena is called the Haaseffect after Helmut Haas (1951). "Uber den Einfluss eines Einfachechos auf die Horsamkeit von Sprache," Acustica, 1, 49–58.

² (1903 - 1942) British inventor and pioneer in e.g. electronics and stereo recording.
the distance between the mikes, you run the risk of getting a recording with "a hole in the center." All the sounds will appear to come from the left or the right, with nothing in the middle. This is assuming that you play back your recording through a pair of loudspeakers spaced at considerably more than 30 cm, usually about 300 cm.

My idea was to place eight\(^3\) identical microphones in two rows of four. I spaced the mikes by four meters in every direction. The recordings were to be played back through eight loudspeakers placed in the same pattern. I thought that the time / phase differences between the microphones would be to my advantage if I replicated them in playback.

**The implementation**

I presented my hypothesis for Max Edkvist, service engineer at Stockholms konstnärliga högskola (Stockholm University of the Arts), who’s also a loudspeaker designer in his spare time. He believed in my idea, provided that I use omnidirectional loudspeakers\(^4\).

Since there are no such speakers commercially available that would fit in to my budget, he volunteered to design and build them for me. After some initial testing he realized that they need custom amplifiers as well\(^5\), so he build these too. Eventually almost all the technicians at Uniarts were involved in the build. I’m truly grateful for their help!

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\(^3\) My choice to use eight tracks is due to the fact that I had bought an eight track recorder. The smallest number of audio tracks for this exercise is four.

\(^4\) Max argued that if I use conventional loudspeakers that only beam sound in one direction, one would "hear the loudspeaker", meaning that one would localize the sound as coming from the loudspeakers. An omnidirectional loudspeaker diffuses the sound by reflecting it against the walls and the floor, thus eliminating this effect.

\(^5\) Each individual loudspeaker is made up from six small loudspeaker boxes, mounted in a cluster. Each of these six are pointing in different directions; up, down, left, right, forward and backward. If a loudspeakers is placed so that any of these six beam the sound into a wall or the ceiling, you would want to have control over the amount of reflected sound, according to Max. The easiest way to achieve this is by feeding each of the individual loudspeakers from it's own amplifier. That ment getting 6 X 8 amps.
The recordings

The first recordings were made in our garden. All the mikes were mounted at the same height, 180 cm and spaced at precisely 4 meters. To the left, outside the picture, is a small fountain. It would prove to be valuable when we played back the recordings.

Most sounds in this recordings come from relatively distant sources. There's some construction work going on behind the trees, birds are chirping and there are cars passing occasionally. The fountain is the only constant sound that's fairly close. When we played back the recordings in the sound stage at Uniarts, one could quite accurately point out where the fountain was, even when moving between the loudspeakers. When you approached the fountain sound you could get quite close, before its position dissolved and became indistinct. A truly strange experience.

Eight omidirectional microphones (Oktava MK 12) positioned 4 meters apart in two rows.

The main hall at Stockholm central station. The microphones are spaced in roughly in the right way, but this proved not to be critical in this recording.
The second recording session was made in the large hall of the main Stockholm railway station. It was difficult to keep precise distances between the mikes here, because I’d promised the railway authorities not to hinder the travelers in any way. I captured a lot of voices from people moving in every direction, as well as footsteps and the sound of trollies being pulled across the stone paved floors in my recording. This gives a strong sense of presence. The combination of moving sounds and stationary ones, like the escalators, pa-announcements and sounds from shops and cafés all contribute to this. When played back one can actually sense the height of the hall, especially when there are pa-announcements. The pa-speakers are mounted high above the floor, and the sound echoes in the huge space.

One of the technicians at Uniarts came up with the idea to measure the platform in the subway station close to our campus. He found out that the platform and the main hall of our D-house were almost exactly the same length. He suggested that I recorded the platform, not with the microphones in two rows, but rather in one long row, and then played it back in our main hall. I thought that it was an interesting experiment, but it turned out that it’s very difficult to get in touch with the subway company to get permission for it. After having waited unsuccessfully for several month I went there without permission with lavaliere (miniature) microphones and radio transmitters, that I stuck to the wall using gaffer tape. It was by no means an ideal solution, but it allowed me to make the recordings quite discreetly, with no microphone stands and no cables on the floor.

Presenting my work in progress at Uniarts research days 2018. (Photo by Anders Bohman)

The main hall at Uniarts transformed into a subway station and a pedestrian tunnel. The placement of the speakers was determined by them not blocking doors or staircases, not by how the recordings were made. The sonic illusion still was very powerful!
Unfortunately the high voltage that feeds the subway trains caused interference with the radio transmissions, but still, after a few hours of careful sound editing I had five minutes of usable recording. The result, when played back, exceeded every expectation. It was a stereo field that was almost 80 meters wide. No matter where you stood in the main hall you got a clear view of people moving and trains arriving and leaving. This result was achieved despite the fact that I couldn’t place the mikes at an even distance while recording, and I couldn’t replicate the distances with the loudspeaker while playing back.

PhD candidate Carolina Jinde suggested another recording in a very long pedestrian tunnel in Stockholm. (Tunnelgatan) We went there with the BA students in film sound and recorded the space. We got the sound of footsteps and voices moving past our microphone array in our recordings. The soundscape there is really not that different from what we would get if we recorded the natural sounds at our college. However, when we played it back in the main hall at Uniarts we noticed how the natural soundscape and the recording blended together quite seamlessly. Especially when played back at night, when the hall was almost empty, the effect was interesting and slightly scary. It wasn’t as spectacular as the subway recording, but still very powerful. You could actually walk along an imaginary friend for 80 meters.

Conclusions:

After having worked in film sound for forty years I already knew that sound can create a powerful illusion of a space. The question is if this is only a consequence of the "audio-visual contract" as described by Michel Chion\(^6\), or if it works in the non mediated world as well? A cinema audience is prepared to be tricked, or seduced, they have even payed for that. The same applies for someone visiting an art gallery to take part of a piece of sound art. In everyday life however, things are different. Nevertheless our perception of a space and a situation appears to a large extent to be dependent on what we hear, even if it's contradicted by what we see and by our preconception.

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\(^6\) Michel Chion, french composer an film sound theorist (AudioVision 1994)

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PhD-candidate Carolina Jinde and the BA-students in film sound preparing a recording in a pedestrian tunnel. We used lavaliers and radio transmitters to avoid cables and mike stands in the narrow passage.
When I tried the recording of the subway station in our main hall, students and staff came running out of their offices to see if there was actually a train passing through the building. I had forgotten to issue a proper warning about my test...

When I played back the recording during our research days, I observed spectators moving to different positions in the hall, to get different perspectives. It is in deed an interesting thing to have your senses fool you!

One explanation to the powerful illusion may be that the soundscapes are in full scale. They are recordings of big spaces played back in another big space. The main hall has the same length as the subway station, and the recording of the Central railway station with it’s high ceiling creates an illusion that the space expands beyond the loudspeakers, in three dimensions.

The voices, footsteps and the trains give us information about what’s happening around us. The way those sounds reverberate gives us information about the space, the size of it, and its acoustic properties.

The answer to my original question is undoubtedly yes. It is in deed possible to create a "place" using sound, a stereo field big enough to move around in and so consistent that you don’t loose it as you approach one of the loudspeakers.

So how can we use this knowledge?

One could try this recording technique to record background sounds for films that will be screened in Barco Auro or Dolby Atmos. And it’s obviously a way to create interesting sound installations that allows the audience to move while listening.

For me it has raised another possibility.

By transforming a familiar space, we can begin questioning who we are in different situations. I’m not the same person when I’m walking the corridors in our college building as I am walking on a beach while on vacation. So if I hear the sounds from that beach walk in the corridors of my workplace, will that change the way I feel and act?

I made an experiment in our staff canteen. Now during the Corona restrictions it’s an empty place where you often find yourself totally alone while having lunch.

So I made a soundscape, using sound effects from my library, that turned one end of the canteen into a posh restaurant, with a piano player, discreet voices and other sounds referring to fine dining. At the other end I put a lively english pub ambience, and in the kitchenette i put the sound of a german fine dining restaurant kitchen.

The transformation of the place was quite remarkable. As you enter you pass through the german kitchen, and then you can choose if you prefer to be one of the guests in the fancy restaurant or to join the cheerful crowd in the pub. Where ever you choose to sit, you still hear sounds from the other spaces. This is where this project is going to take me next. To change familiar places in order challenge our self image and our feeling of belonging or being a stranger in a space.

All photos are by the author unless otherwise stated.