

the following question: Since we perceive sounds as coming from individual sources that merge and interact with the acoustic space around us, would it be possible to achieve a similar experience by using radio waves in the electromagnetic space? Sound is spatial not only because it traverses and reflects in the three-dimensional space around us; it is also spatial because we perceive it as a temporal phenomenon that takes place in that space.

Radio is often used to transmit individual signals from one point to one or more other points. To establish these communication channels, we use modulation principals such as AM, FM and GSM. Individual transmitters broadcast via their own frequencies, and with a receiver we tune into a specific frequency while filtering away the others.

I wondered what would happen if, instead of using modulation, we directly addressed a certain frequency range within the electromagnetic spectrum by shifting the sound up in frequency. I also wanted to know what would happen if multiple transmitters were to transmit in that same range. I was expecting that the transmitted signals would “mix” in the electromagnetic space much like acoustic sounds mix in the acoustic space. This would be a spatial approach to radio based on a field of transmitters with receiver(s) moving through it.

The loudness of acoustic sound sources decays as distance from them increases because their radiated energy gets spread over a bigger surface in space. Electromagnetic waves behave similarly, but using regular, carrier-based transmission techniques compensates for or avoids this effect. My resulting work, *Radioscape* (Fig. 1), however, does not use a carrier wave. Any received signal within the chosen frequency range becomes audible. The individual strengths of the received signals directly correspond to their loudness. The closer the receiver gets to a transmitter, the louder its signal becomes, and vice versa.

While sound travels at a speed of about 340 m per second, radio waves travel at the speed of light: 300,000 km per second. We perceive an acoustic sound reflecting in space both as a timbral and a temporal phenomenon. Radio waves also reflect in space, but since they are that much faster than sound, we would need enormously large spaces to be able to perceive their reflections as independent from the sources.

RADIOSCAPE: INTO ELECTROMAGNETIC SPACE

Edwin van der Heide (artist, lecturer, researcher), Eerste Pijnackerstraat 91A, 3035GN Rotterdam, the Netherlands.
E-mail: <edwin@evdh.net>. Website: <www.evdh.net>.

ABSTRACT

The author describes his use of radio waves in public spaces to create interactive sonic compositions in his project, *Radioscape*.

A call for artworks from an area in the Japanese countryside brought me to

The wavelength of a wave depends on its frequency and traveling speed. *Radioscape* uses a relatively long wavelength (175 m = 1.7 MHz) to avoid standing wave patterns coming from, for example, reflections between buildings in a street. At this wavelength, buildings are not only reflectors: They start to become conductors and resonators for the transmitted signals. As a result, the physical environment gets excited by, and responds to, the transmitted radio waves.

In developing this work I learned about different antenna principles. A vertical antenna has an omni-directional sensitivity pattern and relates to the “electric” component of the electromagnetic field. A coil or loop antenna is only sensitive from the sides and relates to the electromagnetic field’s

magnetic component. These two directivity patterns, I realized, correspond to the patterns of two microphones: the omnidirectional and the figure-eight. The mid-side (m-s) stereo recording technique uses exactly these two microphones, and I started to wonder whether it would be possible to realize a stereo receiver with this antenna setup. It would not be a receiver that receives a signal broadcasted in stereo, but a receiver that creates a stereo image resulting from the positions of the individual transmitters. A transmitter on the left of the antenna would be heard on the left, and a transmitter on the right would be heard on the right. Rotating and moving the receiver would change the stereo image directly.

In *Radioscape*, each transmitter transmits its own layer of the meta-composi-

tion. They change slowly and eventually repeat after 4–10 min. The changes within a layer are the slowest. The next level of change is the interaction that occurs when one does not walk but merely moves the receiver. By doing so, one reorients oneself in the field of received signals and finds new perspectives in the environment. The third and last level of change is the result of walking, getting closer to certain transmitters while moving away from others. Certain signals will become audible or louder while other signals decrease or disappear. Listening alters one’s focus and way of interacting. Navigating the city generates a unique sonic order, combinations and timing within the composition.

The *Radioscape* receiver is handheld. Moving the receiver enables one to explore the surrounding space. The scale and the speed of change match the space that the participant’s hand and arm movements describe. The space thus becomes almost tangible, allowing the participant to explore and remember positions and transitions. It is intuitive to navigate and reveals itself easily, while complex enough to require ongoing exploration.

Radioscape takes place in public space. My preferred locations are areas within a city that are diverse and easy to walk in and have streets close to each other so that the participants must frequently choose their directions.

The resonating buildings are an interesting example of a situation in which the real world interacts with an added environment. The transmitted signals do not merely form a parallel reality: The physical space and the electromagnetic space directly influence one another.

When I began to develop *Radioscape*, I was not yet aware of Max Neuhaus’s *Drive in Music*. His statement regarding placing sound in space instead of in time is an important one and applies well to *Radioscape*. It is interesting to see how *Radioscape* builds further upon this early work.

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Edwin van der Heide is an artist and researcher in the field of sound, space and interaction. He extends the terms composition and musical language into spatial, interactive and interdisciplinary directions. His work comprises installations, performances and environments. The audience is often positioned in the middle of the work and challenged to actively explore, interact and relate themselves to the artwork.

Fig. 1. *Radioscape* in the city center, Amsterdam, 2004. (Photo © Studio of Edwin van der Heide)

