
FOLLOWING THE ELEPHANT-NOSED FISH: MAKING THINGS MORE COMPLICATED AS A FORM OF RESISTANCE

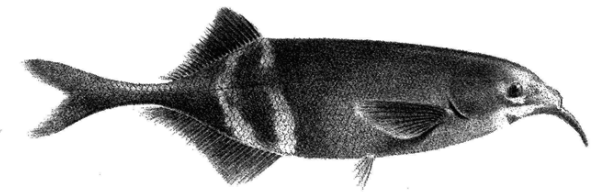
Shintaro Miyazaki and Susanna Hertrich

Compared to the more common design practices research in design – or design research – as a child of the post-war 1960s has always already been linked to more processual aspects of design influenced by cybernetics, system dynamics, and system thinking. Since then a continuous vanishing and diminution of the material aspects in design are noticeable. Certain aspects of design became increasingly ungraspable, invisible and unperceivable as Lucius Burckhardt famously noted in the early 1980s. This has been the case, especially with the rise of service design or user experience design in the 1990s. More recent re-iterations of this radical expansion of design (Colomina and Wigley 2016; Milev 2013) are once again steering its attention towards media technological realms located somewhere in-between interfaces, networks, systems, infrastructures, users, programmable machinery, smart materials, and organisms. Confronting this strand with transformative and socially responsible design as recently propagated by design researchers such as Wolfgang Jonas, Jesko Fezer or Friedrich von Borries (Jonas, Zerwas, and Von Anselm 2015; Fezer and Studio Experimentelles Design 2016; von Borries 2016) is one of many approaches within the emerging field of new experimental research in design (NERD). Our focus is on adaptive-dynamic (Jonas 1994), signal-based and intangible aspects of designed environments, which are nevertheless still highly material-critical. How can we combine this focus with an attempt of designing playful, and at the same time scholarly advanced approaches, that enable a sustainable transformation of our knowledge and our ways of living in an increasingly automated, highly-complicated and technology-driven world? Especially since we are ‘condemned to being the designers of ourselves’ (Groys 2008)? How can people like you and me open-up new ways of acting and re-designing against protected modes (Kittler 1997) of closed media designs in the age of smart cities, homes, and cars that are planned to be invisible?

We will tackle these questions by referring to ‘Sensorium of Animals’¹, an ongoing research project (2016–2018) funded by the Swiss National Science Foundation (SNSF). This practice-based research project is inspired by the more-than-human (Abram 1997) sensorial ecology and biology of the elephant-nosed fish – a species that is capable of electrolocation and -reception, sensorial abilities which allow these fish to sense their electromagnetic environment (Fig. 1). ‘Sensorium of Animals’ explores ways to sense our high-tech electromagnetic environments,

1 *Gnathonemus petersii*
(Peters' elephantnose
fish)

Source: Proceedings
of the Zoological Society
of London (vol. 1864,
plate II), Wikimedia
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especially those serving as infrastructures of our ‘digital’ and wireless devices.² While we also prototype tactile interfaces, that could be worn on our arms, shoulders or upper body our solution-oriented prototyping and media experimentation is at the same time expanded and synthesised with historical contextualisation and fictional world-designing (Fig. 2). This threefold approach creates and unfolds an enriched spectrum of designerly and theoretical propositions, as well as narrations and speculations. It operates as a conceptual device to make things appear more complicated and complex than they seem to be. Our works will find their way into an exhibition, and publications, both in print and web-based formats.

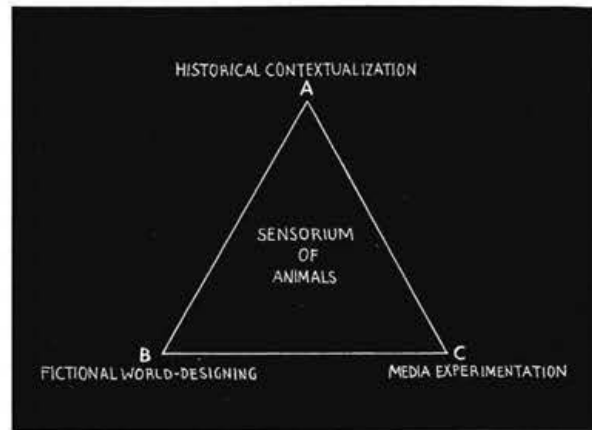
We hypothesise that increasing the complexity of our reflections and knowledge about the protected designs of our critical infrastructures in smart cities, homes, and cars, might open-up new entry points and create possibilities to intervene, re-design and self-determine how we want to use and live with these highly invasive information technologies. Making things more complicated and difficult is also a form of resistance towards overly profit oriented forms of research mostly capitalizing the reduction of complexity leading to more calculable and thus economically valuable forms of design.

Historical contextualisation

Historical contextualisation as compared with the remaining two areas of the aforementioned project is probably the most unusual field of design research. However, it is highly useful (Mareis 2016) as it not only reflects the contingency of current practices but also provides their alternative conceptual, discursive and sociopolitical perspectives leading to elaborated practice-based experimentations.

The fact that elephant-nosed fish, sometimes called freshwater elephant-fish or Mormyridae are capable of electroreception and electrolocation became known in the 1950s with the research by Hans Werner Lissmann, an Ukrainian-German-British zoologist, who used electrophysiological measurement techniques involving

2 Three-fold synthesis
Illustration: Susanna
Hertrich



electrodes, amplifiers, headphones, oscillographs and -scopes to record emissions of those so-called weakly electric fish. In 1958 he collected signal characteristics from different species of these fish and suggested, that they 'by means of their electric pulses, can locate objects if their electrical conductivity differs from that of water' (Lissmann 1958, 188). Similar to radar systems in military air force Mormyridae can actively sound out electric field differences of their surroundings by sending out electric pulses and sense their back-reflections. The most recent elaboration of these findings has been conducted by Gerhard von der Emde and his team in Bonn (Germany), who is an advisor of our research project. Von der Emde confirmed already in the late 1990s, that it is mostly the interplay between 'the spatial pattern of voltage change' received by the electroreceptors on their skin and nearby objects, which enable these fish to navigate in darkness. Objects change the electric field and thus change the patterns and currents flowing through their electroreceptors. 'The results of our experiments suggest that electric fish can measure three-dimensional depth by analyzing the electric image of objects projected onto a single, stationary two-dimensional array of electroreceptors' (von der Emde et al. 1998, 893). Since the sense-making of such animals are highly dependent on their environment this research field is called sensory ecology (Dusenbery 1992). It is not merely an accident that in the 1930s Lissmann, the above-mentioned zoologist, had been a PhD-student of Jakob von Uexküll, whose concept of 'Umwelt' was highly influential for example for the forming of the environmental sciences generally, and for at least two more related fields: The first is usually subsumed by the term cybernetics, the second evolving some decades later is called ecological psychology coined by James J. Gibson, who is known for his concept of affordance. Both are highly signif-

icant for the (design) history of human-machine-interfaces and the later rise of service design or user experience design in the 1990s.

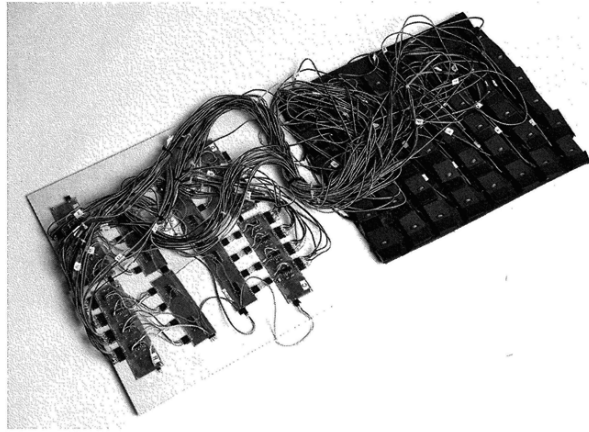
Elephant-nosed fish are not only as objects of research linked with cybernetics but as animals capable to orient themselves in their natural environments as they embody its principles. Cybernetics, a neologism coined by Norbert Wiener in the 1940s, is inspired by the Ancient Greek verb κυβερνάω – meaning to steer, to navigate and to govern. The term refers to a then-new field of science that coupled technological systems such as servomechanisms originating from military fire-control with human and animal sense-making via the now ubiquitous concept of feedback (Wiener 1948; Galison 1994; Mindell 2002).

A feedback circuit is both an abstract, thus non-material, but at once also a matter-dependent concept, which simply describes the changing flow of material properties such as voltage, weight, but also monetary value leading back into its own source and thereby either causing its amplification or reduction. Feedback systems are also building blocks in ecosystem ecology, system dynamics or communication systems. From the 1960s on, they found their way into Californian counter-culture, art, psychedelics (Turner 2006; ter Meulen, Tavy, and Jacobs 2009; Blauvelt 2015; Kallipoliti 2015; Bernes 2017) and as mentioned earlier also design research (Mareis 2015). In fields such as sensory substitution, cybernetics met assistive technology (Mills 2011, 2010), where Paul Bach-y-Rita beginning his work in the late 1960s is regarded as a pioneer.

Sensory substitution later called sensory augmentation is a field of research and engineering, which is aiming at building devices and systems, that translate signals from one human sense modality – such as seeing, hearing or feeling – into another. Our extended team member Akitoshi Honda's previous work *Bipolar* (2012) (Fig. 3) has been inspired by Bach-y-Rita's famous tactile television hardware (1969). It consisted of a 20 × 20 vibrator stimulator matrix 'mounted in the back of a dental chair for projecting mechanical television images on the skin of the back of blind subjects' (Bach-Y-Rita et al. 1969, 963). We are currently building a scaled down version with an 8x8 vibrator matrix as it is described further below (Fig. 4).

By turning everything into a system of interdependent feedback loops cybernetics accelerated the rationalisation, capitalisation, and exploitation of everything on our planet and continue to do so nowadays under different disguises and keywords, such as big data, machine learning and artificial intelligence. With the spread of personal computers, digital communication and network protocols such as the IEEE 802.11 in the 1980s, the miniaturization of semiconductor technology, the dissemination of sensor networks and wireless information technology and protocols such as Wi-Fi, Bluetooth or mobile phone protocols we arrived at the most recent age of smart environments, intelligent media-techno-ecologies, which is unnoticeably transforming into a new stage global profit-making. Wireless, insensible electromagnetic infrastructures provide the basis for such high-tech, info-, dataenvironments. Historical contextualisations of these most recent aspects

3 Prototype module for *Bipolar* (2012) by Akitoshi Honda
Photo: Susanna Hertrich

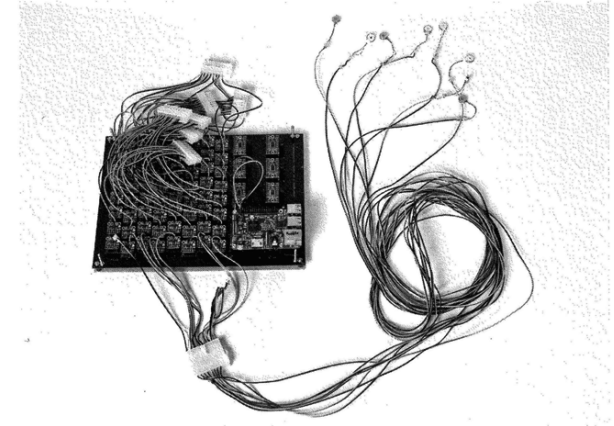


especially the context and discourses about smart homes, offices, and buildings are currently worked out in the research team and provide many alternative sociopolitical perspectives and conceptual brick stones for our fictional world-designing.

The cultural history of the interferences of electromagnetics, esoterics, animism and other more pseudo- or non-scientific fields of knowledge form the last strand of the historical contextualisation linked with 'Sensorium of Animals'. The connex between techno-spiritualism and technical media networks already had its beginning with the dawn of telegraphy and the first explorations of radio even before radio existed as a distinct technology, but was a side effect of telephony (Kahn 2013, 1). With the dissemination of vacuum amplification and high-frequency radio during the 1920s and 1930s esoteric, techno-spiritual and pseudo-scientific narratives and theories exploded exponentially (Borck 2001). Later prominent figures of these contexts inspired by electromagnetic media technology are Wilhelm Reich (Orgone Theory), David Tansley (Radionics), Konstantīns Raudive (Electronic Voice Phenomenon) and many more.

Cross-comparing the aforementioned discourses with East Asian cultures, that come with a long and bulky cultural history of religious world-views such as animism and shamanism provides alternative starting points for our fictional world-designing. In Taoism or Zen Buddhism, practices of working, operating and dealing with energies are crucial. Reactualised as so-called techno-animism (Jensen and Blok 2013), these contexts build a broad spectrum of bizarre narratives, imaginative concepts, alternative metaphors, and terminology. They create linkages between the world of animals, electromagnetic media technology and human-based understanding.

4 *Algorithmic Driver Modul* (2017)
Photo: Susanna Hertrich

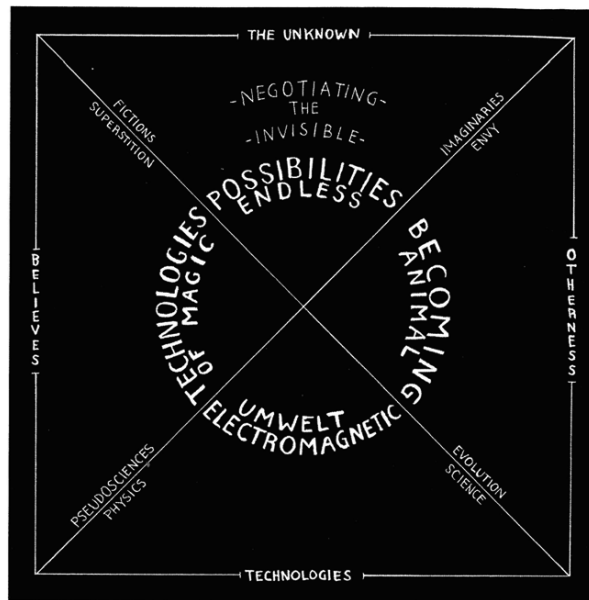


Fictional World-Designing

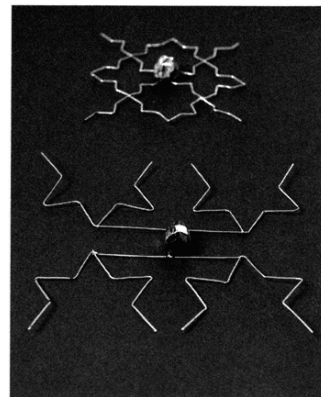
Inspired by approaches such as critical or speculative design (Dunne 2008; Dunne and Raby 2014) fictional world-designing is a way to create various playful scenarios of an alternative or future life, where we could feel our invisible electromagnetic infrastructure, their signals and processes as sensible pulses, rhythms and ticklings. To what degree would that be needed or even become empowering? How and for what situations? What would happen to our conventional senses?

The sensorial ecology of the elephant-nosed fish here operates as a vehicle, which allows us to intertwine the world of animals and its non-human sensorium including all its alterities with its dynamical relationships with non-human worlds full of signal-based and seemingly immaterial aspects of designed invisible environments. Starting with paper-based techniques such as diagrammatisation or quadrant mapping (Fig. 5),³ we have been writing text-based narratives, film exposés or have been pondering about found objects such as a Japanese lucky charm for success with information technology and designed boundary objects (Star and Griesemer 1989; Pierre Johnson et al. 2017) – antennas or crystals – to create different artifact-based stagings and scenarios (Fig. 6, 7). In order to work within a constrained spatial framework, we built a simple micro-studio walled by two pieces of blue coloured plywood each with a size of about two square meters (Fig. 8). Since blue resembles the colour impressions of an aquarium, the studio opens ways to conjure associations with water and fish. This research 'aquarium' contains not only pieces for the fictional worlds but collects also visual, textual and haptic materials from our historical contextualisation operating as triggers and orientation nodes for our

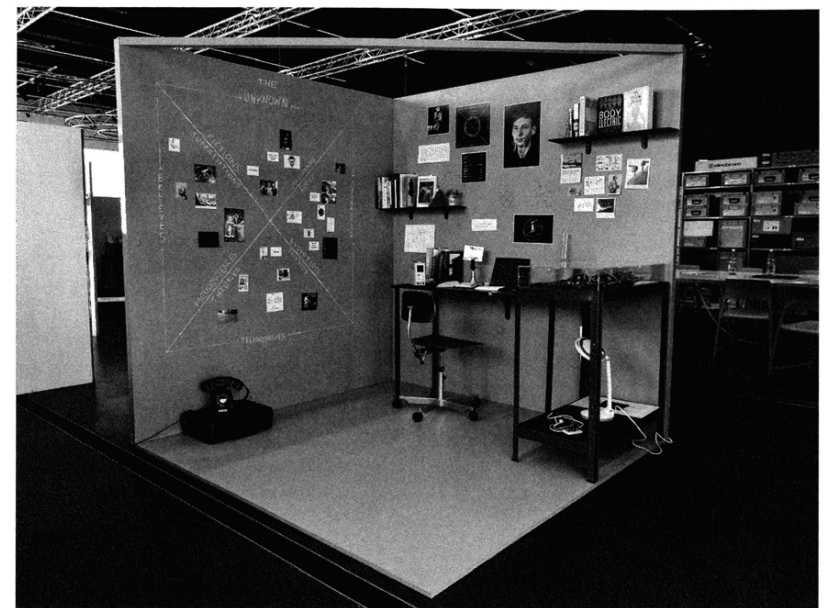
5 Coordinates for mapping exercise
Illustration: Susanna Hertrich



6 Vintage container for the chemical element 'ether'. Ether or ether space, the air breathed by the gods in ancient Greek mythology, is a common metaphor for the world of radio signals; Japanese lucky charm for success with information technology as sold at religious sites.
Photo: Susanna Hertrich



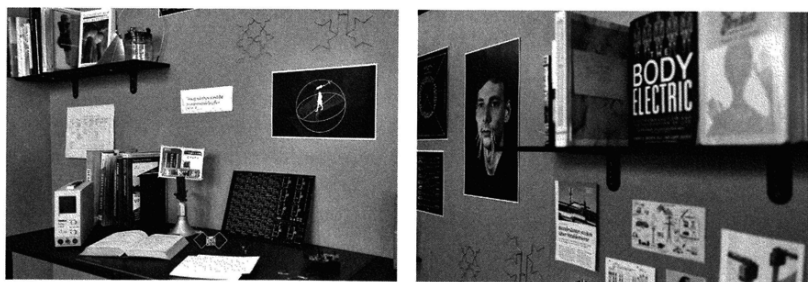
7 Antenna fetish objects
Photo: Susanna Hertrich



8 The research 'aquarium', micro-studio and room for experimentation
Photo: Samuel Hanselmann, IXDM

story-creation and pieces from our media experimentation (Fig. 9–11). It is thus not only a way to exhibit or display but is itself a productive environment allowing us to connect in unexpected ways with our research objects and designed things. It is also a simple and effective method to materialise practice-based research beyond the discursive medium of written text and printed publication. We are currently working on an expanded exhibition set-up that will feature a selection of the described artifacts, the micro-studio itself, a short piece of written fiction describing our final scenario and two short films that are connected with the short novel.

Summarising the scenario-building process, we first began with more straightforward scenarios, where we would transform biologically into elephant-nose fish-inspired beings or where we would have wearables on our body,⁴ and were confronted with the quite obvious issue of invisibility. How can we show the technological operativity of electromagnetic waves, when we cannot see them? This insight made us realise that we would need to focus on artifacts and non-direct ways how human citizens in a future world will handle, operate and work with electromagnetic signals. We constantly extended and refined scenario fragments considering historical contexts, sociopolitical aspects and technological plausibility until we



9–11 The research 'aquarium', details
Photos: Samuel Hanselmann, IXDM

arrived at a utopian scenario, where a group of human citizens perform techno-shamanistic transformations rituals of becoming a super-(techno)-animal in order to protect themselves from the information retrieval machinery of transnational data mining conglomerates. These fictitious techno-anarchist groups are part of alternative closed-loop neighbourhoods, which are ideally economically and sociotechnologically interdependent from these conglomerates. Our focus on sociopolitical issues became rather crucial for our fictional worlds since they not only provide

narrational vectors, but they furthermore sketch/draft alternative ways of living in an increasingly automated, highly complicated and technology-driven world. Our fictions are intended to provoke reflections about our current infrastructures, which are intentionally designed to remain invisible.

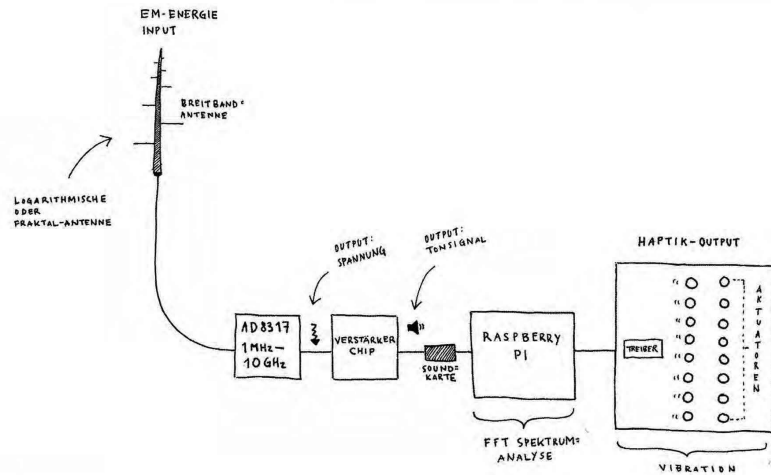
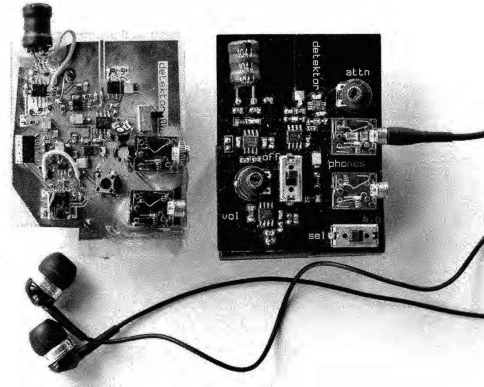
Media Experimentation

Informed by our historical contextualisation we re-build two historical contexts and their experiments in the field of sensory substitution between the tactile and other senses such as hearing and vision. The first of these contexts is the cutaneous rabbit illusion described in the early 1970s by Frank Geldard and Carl Sherrick at the time working at the Cutaneous Communication Laboratory at Princeton University (Geldard and Sherrick 1972). Quick sequences of taps actuated first near the human wrist and then near the elbow create sensations of sequential taps hopping – like a rabbit – up the arm from the wrist towards the elbow, despite the absence of any physical stimulus between these two locations. It is thus possible to create the impression of a higher actuator density than actually present by using appropriate spacing and timing (Jones and Sarter 2008, 97). Directly related with such effects is the context around Paul Bach-y-Rita, who stimulated the skin surface not only with a one-dimensional line but moreover with a two-dimensional area, sometimes also called matrix. We fused this second context with the first into a flexible experimental setting (Fig. 4). We have been furthermore prototyping devices that enable us to sense our high-tech electromagnetic environments (especially Wi-Fi and Bluetooth signals) via a wearable tactile interface.

Tinkering and hands-on experimenting with currently available low-cost modules, parts and devices allows for a grounding of both our fictional world-designing and historical contextualisations. We linked the fictional and speculative aspects of our research to concrete issues of functionality. That way 'Sensorium of Animals' is not merely a fictional or theoretical work but also operates within plausible trajectories. The current system is based on a previous project called *Detektors* (2010) conducted in collaboration with artist researcher Martin Howse (Fig. 12). While *Detektors* enabled us to listen to the electromagnetic signals surrounding us (Miyazaki 2013b), the *Algorithmic Driver Module* (2017) we build in collaboration with the artist and programmer Akitoshi Honda invokes feelings of electromagnetic signaling.⁵

Instead of hearing electromagnetic waves the new system enables to feel them (Fig. 13). The *Algorithmic Driver Module* consists of a Raspberry-Pi (+ low-budget sound card), which conducts an FFT-based spectrum analysis and triggers in some programmed and controlled way the motor driver units connected to 64 button-shaped vibration motors. Driver units and Raspberry-Pi are mounted on a custom-made printed circuit board. We increased the sensibility and bandwidth of the

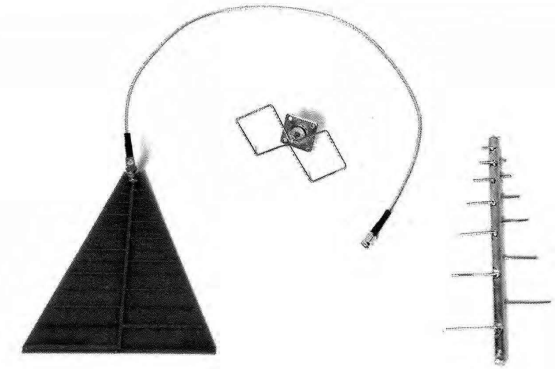
12 Detektors (2010)
by Martin Howse and
Shintaro Miyazaki
Photo: Shintaro Miyazaki



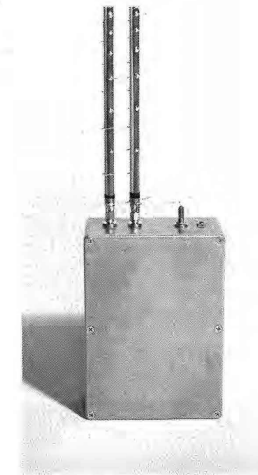
13 Schematic of the prototype system
Illustration: Susanna Hertrich

receiver device from 100 Mhz–3 Ghz to 1 MHz–10 GHz. The transformation of these radio waves into sound is based on so-called logarithmic radio frequency detectors – small integrated chips – fabricated by Analog Devices (Fig. 15). These micro-circuits operate similarly to decibel meters for sound waves, but instead measure the power of electromagnetic waves and relate that to changes in voltage. As these voltages fluctuate very quickly they become audible, when amplified and connected to a

14 Antenna experiments
Photo: Susanna Hertrich



15 New detector with a
broader sensibility, case-
in-case construction
Photo: Susanna Hertrich



loudspeaker. The specific acoustic characteristics, dynamics and signatures of the detected electromagnetic waves are translated, coded and mapped to selected vibratory activation patterns. This is currently in an early phase of testing and refining. We are furthermore experimenting with different antenna designs (Fig. 14), are testing different vibratory activation patterns and ways to attach the small vibrator buttons to our upper and lower limbs or torso.

Synthesis

To summarise, the threefold synthesis of the approaches explained above might be one method to tackle the question posed at the beginning, which was: 'How can people like you and me open-up new ways of acting against protected modes of media designs in the age of smart cities, homes and cars that are planned to be invisible?' With the project, we basically want to link the world of electromagnetic waves and the vast informational infrastructures they provide with the manifold facets of the fictional worlds they afford. These realms are additionally informed by our historical contextualisation. Such an approach might offer broader insights for our concern of social empowerment in the age of complex techno-ecological entanglements. To describe it metaphorically: We avoid creating a smooth, monolithic and glossy body of insights, instead, we aim to make this body more porous, manifold with many little docking sites and holes providing space of linkage. The threefold synthesis is a vehicle to make things appear more complicated and complex than they seem to be. Materialisation is surely a straightforward way to tackle issues of design, which becomes increasingly ungraspable, invisible and unperceivable. The simplicity and inaccessibility of designed environments such as our wireless information spheres is an illusion and prevents the possibility of self-exploration, production, and determination. Increasing complexity by an oscillation between materialisation and theorisation is furthermore a form of ethico-aesthetic (Guattari 1995, 8) and design-based resistance towards overly profit oriented forms of research mostly capitalizing the reduction of complexity leading to more calculable and thus economically valuable forms of design. Feeling the pulsations and vast activity of data exchange, collection, and surveillance provide not merely ways to become sensible and raise awareness about hidden, still crucial information on infrastructures of urban life, but moreover offer generative and playful frameworks for further experimental research in design. And this especially concerning our contemporary condition, where 'life' and 'living' are increasingly enabled, controlled and dependent on invisible, electromagnetic, quasi 'magical' infrastructures.

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- 1 Subtitle is 'Electroreception in Experimental and Historical Media and Design Research', <https://sensorium.ixdm.ch/>, Swiss National Science Foundation-Project No. 159849.
 - 2 See (Miyazaki 2013a; Pias 2010 [2002]; Bolz, Kittler, and Tholen 1994) on the media history and archaeology of digital technologies.
 - 3 See also left side wall in figure 8.
 - 4 The project 'feelSpace' is an interesting working example for recent work on this topic. <http://www.feelspace.de/navibelt/>
 - 5 See (Grönvall, Fritsch and Vallgård 2016) for a similar approach.

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