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Multi-viewpoint Strategies: Ambisonic Auralization and Localization through Walking and Listening as Places of Negotiation in Conditions of Hybridity and Change

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Abstract

This research introduces the concept of 'liquidity' as a framework through which to observe the ways that the lived-in world and particularly society and culture are experienced and discussed as social subjects. It has become apparent that this notion of 'liquidity' plays an important role in the generation of novelty, that is, to generate new insights and meanings. Recent studies by Bhabha (1994) or Bauman (2007) identify an apparent shift in the way we experience and deal with modern society replacing the rigid cognitive frameworks by more 'fluid' interactions. To understand and to deal with this new concept, a cartography of these liquid times is installed through the design of an artistic Ambisonic sound localization and auralization project. The cartography follows in depth two specific trajectories. What are the merits of a 'point of view' within a liquid society? What type of auralized experiments can be introduced? The scientific and artistic aim is to establish a multi-viewpoint approach (walking, listening and seeing through a state of the art technology) replacing single viewpoint categorization, a concept also to be applied to the reading of the artworks itself.

Keywords

liquid, cartography, multi-viewpoint, sound, localization and auralization, technology, multi-sensory integration

Introduction

This proposal introduces an artistic and scientific project on sound localization and auralization through the hardware development of headphones with a real-time decoder for Ambisonic audio files built in. The 4-channel B-format is translated into a binaural output according to the head position of the listener.

Designing a sound experience with a continuous sphere of Ambisonic audio, this project researches how to establish for the listener a multi-viewpoint experience. The approach is inspired by the dynamic concept of the Flâneur as introduced by Baudelaire, replacing single viewpoint categorization. This concept is re-appropriated for its capacity to connect with the different formulations of change, to indicate a common ground or effect of moving, as an area for creation or discovery.

The research embraces the concept of Liquid Modernity introduced by sociologist Zygmunt Bauman as a framework through which to observe the ways that the lived-in world and particularly art, culture and technology are experienced and discussed as social subjects. The project seeks to define a 'liquid' form of analysis (artistic and scientific) to apprehend the complexity of transforming cultural values. Being liquid or flaneur through sound localization and auralization is proposed as a method or strategy, replacing the isolated and solitary point of view with a multi-viewpoint theoretical and practical approach to deal with and endure new comprehension and meaning.

With the construction of the framework and the concurrent technology, it has become apparent that this notion of 'liquidity', defined as a hybrid position, plays an important role in the generation of novelty, that is, to generate new insights and meanings. It is this hybrid position, shifting between two or more viewing positions, including aural tracking, that should allow us to reveal a more complete picture, world view. By rapidly moving from one model to another the boundaries between the two become blurred, they become permeable, transferring characteristics from one model into the other and vice versa. This feature of shifting perspective is one characteristic of the 'liquid' framework and enables us to enhance meaning by transferring concepts and ideas from one system to another and additionally allows us to discover new connections and relations between them.

A second feature refers to the location of action (or generation of novelty) itself. We will see that this shifting position allows us to retrieve meaning not only within the different systems but also between these systems. In other words, a result of the change of (aural and visual) perspective is that not only new relations are becoming visible and audible, relations that from within the system are invisible, inaudible (not perceived) but also that the location of this information is situated in-between the installed systems of

knowledge (maps, models, or theories). They become locations of meaning and action on their own, or we can say, on their own terms they become 'new' systems. This we could argue is a result of what Zygmunt Bauman (2007, 2011) has called the liquid modern world. Social forms and systems are no longer able to settle down and become established. As a result overall structure makes way for an infinite network of short, small projects and structures which continuously tend to permutate each other. In order to understand the entire system we need to understand the series of infinite smaller structures and their in-betweens. If we now connect to Deleuze's rhizome with no beginning or end, then, we are able to extract a third element of his rhizomatic structure, being the middle or in- between. Also for Deleuze it is this middle (the coming and going) that allows for change and movement where the action takes place and new ideas are born. For Deleuze: "The middle is by no means an average; on the contrary, it is where things pick up speed. Between things does not designate a localizable relation going from one thing to the other and back again, but a perpendicular direction, a transversal movement that sweeps one and the other away, a stream without beginning or end that undermines its banks and picks up speed in the middle.". [1] Also for Régis Debray in his book 'Media Manifestos' (1996), we should focus on the in-between: "Looking not for that which is behind, but for what takes place between, the mediologist beholds himself constrained to set up his footstool before three more dignified arm-chairs: those of the historian of technology, the semiologist and the sociologist. An uncomfortable position but inevitable.". [2]

Location of Action

Noise

For Homi Bhabha in his book 'The Location of Culture', published in 1994, it is at the boundaries of cultures, at their interfaces that meanings and values are (mis)read. However, he notices that this interface, in-between or limit is seldom addressed and often even disavowed. In other words, not only are there new locations to be discovered, locations that exist between installed systems of knowledge and that have become visible or audible through a change of perspective, we can equally argue that these map/model spaces are a possible 'new' space for negotiation. These spaces are places that allow for the re-location and re-configuring of concepts that as a result of this process of shifting perspective no longer belong to any one system and it is also a place for the new insights and concepts that were made visible/audible or that were generated in-between locations. This location of action, as defined by a 'liquid' space bears some similarities with the sociological and anthropological concept of the 'Third Space' as expressed by Homi Bhabha and which refers to a place of negotiation where cultural differences as expressed through (mis)reading meanings and (mis)appropriations can be negotiated. In his book on post-colonial cultures Homi Bhabha quotes the American anthropologist Marshall Sahlins: "We have to do not so much with functional dominance as with structural - with different structures of symbolic integration. And to this gross difference in design correspond differences in symbolic performance: between an open, expanding code, responsive by continuous permutation to events it has itself staged, and an apparently static one that seems to know not events, but only its own preconceptions.". [3] [4] In this context Homi Bhabha calls for a 'Third Space', a place where the structure of meaning becomes a complex process. This place is not representable in itself but it is a place where signs and symbols can be appropriated, or even translated, re-historicized and have become regenerated into something new. Accordingly, this new space or 'Third Space' is "the cutting edge of translation and negotiation, the in-between space - that carries the burden of the meaning of culture.". [5]

The aim of this artistic and scientific project is to become a model as well as a generator for novelty embracing and dealing with multi-viewpoint perspectives through multi-sensory integration. Historically we have seen however, that any model or map is only applicable in a limited or located context. This is also true for the proposed project. With the construction of the sound localization and auralization artwork we could argue that this partiality of 'truth' is to be found in the unstable nature of the generated content itself. The liquid nature of the systems and the shifting perspective by default install a limited and therefore unstable novelty. Each concept, through the shifting position, must be evaluated from the standpoint of all the systems, as these in-between places are in constant flux. Thus re-assessing information from different points of view by definition makes its lifespan short or temporary. The in-between space is a temporary space, a space in constant flux subsequently altering the content of the assessed concept.

Models and Mirrors

In his book 'Models and Mirrors, towards an anthropology of public events', published in 1990, the Canadian anthropologist Don Handelman discusses cultural practices and in particular the cross-cultural analysis of public events. In his anthropological work a theory and method are proposed to expand our understanding of symbolic practice including artistic/scientific artefacts. In general terms Handelman considers 'rituals', without making any reference to religion, as practices which "intentionally organize and orientate us to our horizons of being-in- the-world". [6] It is through these practices that we, as humans, have the possibility to react and respond in relation to the options and

prospects that these practices offer. In order to understand these practices of (public) events Handelman's research focuses on their design, or more precisely the logics of the (organization of) practice. In addition, Handelman asks for caution when using encompassing terms such as practice, ritual or public event as these terms (as a sort of master category) tend to exclude all differences amongst them and in doing so homogenize all these events as one simple category. Therefore, in order to include possible differences, Handelman makes a plea "[...] to imagine and to theorize public events as autonomous, as phenomena in their own right, with their own integrities of logic and design". [7]

In particular these events are set up, constructed and destined to offer us a (limited, local, partial or total, global) worldview. These frameworks are often of a multiple and multilayered nature thereby mimicking the complex interrelations that occur within society. Art as part of our culture interacts, reflects and comments upon this society and offers us alternative ways of looking and understanding. Furthermore, change, innovation, in- betweennes or middle, provisionally defined as 'liquid', prove to be driving forces in society. In addition, special attention has been given to the scientific research within (sound) engineering as an important moment in our times influencing large parts of society and as such our thinking about the world giving birth to a series of new theories, models, maps and artworks. Especially the introduction of multimicrophone sound and localization experiments has been analyzed within the fields of art and media to examine the multi-, inter-, inner-concepts related to media and art. Again, 'liquidity' has been proposed as a new framework of thinking characterized by the similar concepts of change and innovation.

Multi-viewpoint

"The explanation is obvious: The Garden of Forking Paths is an incomplete, but not false, image of the universe as Ts'ui Pên conceived it. In contrast to Newton and Schopenhauer, your ancestor did not believe in a uniform, absolute time. He believed in an infinite series of times, in a growing, dizzying net of divergent, convergent and parallel times. This network of times which approached one another, forked, broke off, or were unaware of one another for centuries, embraces all possibilities of time. We do not exist in the majority of these times; in some you exist, and not I; in others I, and not you; in others, both of us. In the present one, which a favorable fate has granted me, you have arrived at my house; in another, while crossing the garden, you found me dead; in still another, I utter these same words, but I am a mistake, a ghost". [8] We start from Borges' Garden of Forking Paths. Firstly his description of a labyrinth with multiple possible entry points and viewing positions can be directly related to the construction (or initial structure) of this research. Secondly, the story is often referred to as the first 'hypertext' novel. For Janet H. Murray in her book 'Hamlet on the Holodeck: The Future of Narrative in Cyberspace' (1997), this text is a good example of a multiform story, described as a narrative where a single situation is presented in multiple versions. The story unfolds itself as a maze with different viewing positions, different entry and end points and the possibility to choose or navigate between the infinite list of options and thus creating a different interpretation of the information. In an essay entitled 'Inventing the Medium' (published in the 'New Media Reader') Murray further comments: "Borges confronts us with the 'pullulating' moment, when we become aware of all the possible choices we might make, all the ways in which we might intersect one another for good or evil." [9]

In order to access these (multiple) local realities embedded in and part of a (possible) larger or global worldview we will reintroduce the stroller or wanderer or flâneur as a device to unravel and present evidence for understanding the increasingly complex ways in which artists (and scientists) develop, model and mirror our world. Most importantly this research is about the ways artists (and scientists) deal with, create and endure new meaning and how they comprehend and construct the world through theories, models and maps. This project will argue that theorizing, modelling and mapping implies (creating) a (series of) local world views in relation to (or even opposed to) a larger global world view and that the concept of 'in- betweenness' is central to the discourses and artworks that shape these world views. In doing so an artwork, triggering the installation of a map, model and/or theory for orientation is needed, which will be called the 'liquid' framework.

Walking, seeing, listening

In literature and philosophy many authors have addressed the character of the wanderer or walker as a tool (or even theoretical construct) for articulating local realities. The best studied example is the 'flâneur' as introduced by Baudelaire in many of his poems as part of 'Les Fleurs du Mal' (The Flowers of Evil) first published in 1857. The idea of the flâneur was inspired for Baudrillard by Edgar Allen Poe's 'The Man of the Crowd' first published in 1840, where a nameless man (the narrator) follows another person through London. This work as well as the idea of the flâneur by Baudelaire are extensively discussed by Walter Benjamin in his book 'Illuminations' (1969). The flâneur feels at home in the city and dwells the streets (anonymously) to look at and register local habits and facts within a multilayered, global entity. A good example for this shift from global or general observations to detailed descriptions can be found in Poe's work: "At first my observations took an abstract and generalizing turn. [...] Soon, however, I descended to details, and regarded with

minute interest the innumerable varieties of figure, dress, air, gait, visage, and expression of countenance." (1840). Bit by bit, the flâneur is able to analyze, categorize and define the different entities that he is overlooking in an attempt to construct the whole, the initially unreadable: "IT WAS well said of a certain German book that "er lasst sich nicht lesen"-it does not permit itself to be read. There are some secrets which do not permit themselves to be told.". [10] Both the characters of Baudelaire and Poe feel comfortable in a fluid, liquid surrounding and their trajectory or path is mainly guided by the interest in seeing, discovering new things, a search for novelty in an active way by walking. As such, the walking becomes an allegory for the intellectual endeavour or processes during the search. For James V. Werner this active process differentiates the walker from the observer and creates a fluid and observational viewpoint rather than a static one, that "allows (indeed compels) him almost completely to 'read' his environment, nearly to transcend the boundary between interpretation and experience [...]". [11] Also for Burton (2010), the flâneur 'strives to be both all-seeing and invisible' and unlike the observer he will do this in an active manner.

Just as in the London or Paris city settings as described by Poe, Dickens (Night Walks) and Baudelaire, this research is constructed as a map or city maze where the reader or walker can walk through actively in search of those connections which interest or trigger him/her most. Or, in a Deleuzian sense a nomadic travel generating a series of 'close-range' visions in a multiple, variegated environment. [12] Well aware of the multiple and subtle differences between the flâneur, observer or walker as discussed by Deleuze, Benjamin, De Certau or the 'dérive' by Debord amongst others or in the literature by Dickens, Poe, Rousseau or Baudelaire, the concept of walking here is introduced in the simple construct of accessing (and understanding) information on different levels, in different contexts and in different connections. This research does not focus on the flâneur but rather adopts the metaphor of walking as a means to access information in a gradual (local) way in the hope to understand or unravel the total (global). The city or landscape thus becomes the paper, the walker becomes the reader as a means to produce rich or thick information. One can choose to walk intuitively or one can choose to walk following a fixed route. However, one element proper to the flâneur proves to be relevant to the content of the research, mapping or modelling involves a viewing position. Are we in or outside a given system, do we take part or simply observe, do we look from within or above?

Thickening

Just as in cooking a thickener is used to thicken (or increase the viscosity) of fluids, the concept of thickening as described by Clifford Geertz will be used in an attempt to thicken our liquid knowledge society as discussed by Bauman. This act of thickening can be reformulated in the context of accumulating, becoming more intense or intensifying, deepening. Seen in this way the act of thickening becomes a means to deepen the concepts discussed in the research by a strategy of revisiting the postulated 'liquid' framework. In this respect we use the word 'means' instead of 'method' as for Geertz focus should not be on techniques or procedures but on a specific intellectual effort or an elaborated activity or endeavour. This revisiting has been done in three domains (art, sociology and science) to test-drive the idea of the framework set-up to deal with the notion of novelty and change. How do artists, theorists, scientists deal with this notion of new and how this is reflected in their work in particular in the context of the powerful introduction of a liquid society. How do we position (geographically, mentally) ourselves in a given system? Do we take part in the system or do we view from above? Are we in, out or do we simply walk through. And is this mapping a static given or does it initiate certain dynamics? As discussed central is the idea of a 'multilayered' nature, being works (artistic and scientific) where different people on different levels are involved on the level of conception and/or production. Also the way in which we deal with a multi-media environment or total spectacle or model proves to be an important factor for the further development of a framework helping us to understand our lived-in world. In addition, also the way in which a 'subjective' worldview is addressed is key to understand the dynamics of change and novelty.

Furthermore it became apparent that the model/artwork in itself proved to be an interesting concept with which to deal with those 'new' worldviews. As discussed, models are only applicable in and on a local part of reality (world), here again also the grey zones between models prove to generate interesting insights in relation to novelty. How to deal with these new theories of media, how to position these 'new' media in respect to the 'old', how to tell new narratives triggered by new technological discoveries? Out of the results a first model could be identified describing these processes of change in the field of media theory and new media art. In a second stage this 'trans' idea proved to be a central element in mapping and cartography. How do we position ourselves in a given system? Do we take part in the system or do we view from above? Are we in, out or do we simply walk through.

In other words, can we model a framework to deal with our liquid society and how could this model become a generator for the new? Out of this research two other (initially unexpected) elements came to the foreground, the first questions how to interpret map, model or theory. And are these interchangeable or only applicable in certain contexts (local parts of reality)? The second installs a duality (sometimes even a paradox) by being at the same time the con-

struct for interpretation (map, model, theory) and simultaneously the object for construction (trans, change, middle). In other words 'liquid' becomes a model for the interpretation of change but at the same time is responsible for this change, being change itself.

In his landmark book 'The Interpretation of Cultures' published in 1973, the anthropologist Clifford Geertz elaborates on this concept of 'thick description'. For Geertz what a researcher/artist is faced with (except the automated routine of data collection) "is a multiplicity of complex conceptual structures, many of them superimposed upon or knotted into one another, which are at once strange, irregular, and inexplicit, and which he must contrive somehow first to grasp and then to render." [13] Furthermore, understanding (of a culture for instance) for Geertz exposes a certain normalness without reducing the particularities. It renders information accessible and dissolves its possible opacity. However, he also warns that this approach, sometimes referred to as 'seeing (hearing, sic) from the actor's point of view' or 'the verstehen approach', often may lead to a notion of fantasy or speculation and must therefore be approached with great care. As a result, a thick description is needed where case studies, events and theories can be studied in detail, by building layer after layer, so one is able to assess and evaluate the degree in which the conclusions made are also valid or convertible to other systems or situations or time frames. One must not only study the phenomena but also the context in which they take place in order for them to become understandable for a third party. This thick or multilayered description has a double function: "Such a view of how theory functions in an interpretive science suggests that the distinction, relative in any case, that appears in the experimental or observational sciences between 'description' and 'explanation' appears here as one, even more relative, between 'inscription' ('thick description') and 'specification' ('diagnosis') – between setting down the meaning particular social actions have for the actors whose actions they are, and stating, as explicitly as we can manage, what the knowledge thus attained demonstrates about the society in which it is found and, beyond that, about social life as such. Our double task is to uncover the conceptual structures that inform our subjects' acts, the 'said' of social discourse, and to construct a system of analysis in whose terms what is generic to those structures, what belongs to them because they are what they are, will stand out against the other determinants of human behaviour. In ethnography, the office of theory is to provide a vocabulary in which what symbolic action has to say about itself - that is, about the role of culture in human life - can be expressed." [14] In other words, Geertz is well aware that meaning is always changing, always in flux and rooted in a specific culture, therefore he suggests the thick description as a means to describe the phenomena together with their context through a multilayered approach. For this research, it is exactly this multilayered view through a sound localization and auralization artwork that enables understanding as well as context, where results and interpretations from one experience are being transferred and interpreted in a different context to investigate their validity.

Experiments on auditory scene perception embracing liquidity and multi-viewpoint perception

The scientific literature on the auditory perception of sound scenes is vast, and the concept of binaural spatial hearing (Blauert, 1997) turns out to play a central role in any auditory perception task. Models of auditory scene perception are generally based on the segregation of such scenes into auditory events or objects (Bregman, 1994), and are validated with psychoacoustic experiments in which subjects are presented with auditory stimuli in a controlled environment. While such models and experiments have indeed laid the foundations for our current insight into the complex mechanims of how the human auditory system is capable of analyzing, interpreting, and giving meaning to rich auditory scenes, the concepts of liquidity and multi-viewpoint perception are hardly covered in this traditional psychoacoustic framework.

From the technologist's and experimentalist's perspective, the scientific investigation of liquidity and multi-viewpoint perception requires that the subject under study be placed in a dynamic, continuous, and ecological environment and is given the freedom to move, walk, navigate and act in that environment. Such approach implies that the investigator is released from the prerogative of a controlled experimental environment, allowing the experiment to become an artistic and scientific project in which the subject under study takes the role of the flâneur.

In the experiment/artwork, subjects will be presented with binaural sound rendered in wireless headphones while walking in a multilayered physical environment. The rendered sound consists of virtual sound sources that are auralized using an acoustic model of the actual physical environment in which the subject takes the experiment. This will be achieved by making a priori spatial recordings of the scenario where the virtual sound sources are actually placed in the physical environment. These recordings will be made with a sound field microphone positioned at a discrete set of measurement positions. Generating liquidity between measurement positions is performed by interpolation of the measurements, using an interpolation method that takes into account the acoustic properties of the physical environment (Antonello, 2017) and applying principles of optimal mass transport to avoid that the energy of a moving source is artificially scattered during interpolation (Elvander, 2018). [15] [16]

Real-time dynamic binaural rendering will be performed based on the instantaneous position and orientation of the

subject retrieved using a head tracker. This approach indeed fits the objective of virtually synthesizing a truly multi-viewpoint auditory experience while walking. The rendering method will be designed based on recent insights in multi-viewpoint sound source localization which were obtained as the result of a large-scale auralization experiment (De Sena, 2017). [17] Interestingly, in this experiment it was observed that subjects presented with the task of turning towards a virtual sound source will first perform a wide-range angular "scan" of the auditory scene, followed by narrow-range movements around the presumed sound source direction. This behaviour indeed discloses the flâneur's tendency to gradually shift from global observations to detailed descriptions as discussed previously.

Conclusion

This paper sketched the setting of the research, outlining the framework of thinking from within three concrete settings, (i) new media theorie(s) and its associated artistic practices (or vice versa), (ii) the construction of models/artworks and their power to generate new meanings and insights and (iii) the crucial role of science in its generating constructive power by the means of artefacts and its philosophical implications when constructing and using these models. All discussed the current ideas of thinking in the relative fields and established the need for an alternative (new) means of interpretation. In this set up, the role of the 'liquid' framework has proven to be crucial by articulating new positions through which to interpret the different constituting elements. The concept of being in-between, in movement, dynamic, open ended, multiple entryways and multiplicity has been denoted and is the underlying overcoupling engine. As discussed, in terms of our perception, we might say the 'world' first appears for us in the form of a representation, and often in the form of models and maps. But people do not experience the world the way it is represented in maps and equally it is impossible to perceive the world in its total reality. Immanuel Kant refers to this aspect of perceiving the world as a 'regulativ Idee' (a border concept) a concept that leads our experience but that in itself is not experienceable. Where maps used to be representations of a territory installed by a nation or state, they have now also become representations of other forms of 'reality' visualizing a broader cultural debate. Therefore the mapping has been substituted by an artwork, a sound walk, including all possible references (both artistic as well as scientific), to indicate our multilayered lived-in world. Only by acknowledging these multiple points of view, here expressed through technology and art, the research has installed itself as an autonomous practice or tool that allows us to orient ourselves or to find or share common interests. As such, as Baudrillard puts it, the map even precedes the territory. In our case, the walk and binaural experience precedes reality. The work has gained an authoritative power that can overrule reality. What has been put on the map/artwork is affirmed to be real, what is left out is considered not to exist. The work has become more real than the lived experience. By the very act of condensing complex information about this world into a sound experience, art can strengthen/initiate a feeling of orientation or disorientation.

References

[1] Gilles Deleuze and Felix Guattari, *A Thousand Plateaus*, trans. Brian Massumi (University of Minnesota Press, Minneapolis, 1988), 28.

[2] Regis Debray, *Media Manifestos* (Verso, London, 1996), 18.

[3] Marshall Sahlins, *Culture and Practical Reason* (Chicago University Press, Chicago, 1976), 211.

[4] Homi K. Bhabha, *The Location of Culture* (Routledge, New York, 1994), 54.

[5] Homi K. Bhabha, *The Location of Culture*, 56.

[6] Don Handelman, *Models and Mirrors, towards an anthropology of public events* (Berghahn Books, New York, 1990), x.

[7] Don Handelman, *Models and Mirrors, towards an anthropology of public events*, xiv.

[8] Jorge Luis Borges, "The Garden of Forking Paths", in *Labyrinths: Selected Stories and Other Writings* (Penguin Books, London, 200), 187.

[9] Janet H. Murray, "Inventing the Medium", in *The New Media Reader*, ed. Noah Wardrip-Fruin and Nick Montfort (Cambridge and London: MIT Press, 2003), 3.

[10] Edgar Allen Poe, *The Man of the Crowd* (originally published in Atkinson's Casket, 1840).

[11] James V. Werner, *American Flaneur: The Cosmic Physiognomy of Edgar Allen Poe* (Routledge, New York, 2004), 154.

[12] Gilles Deleuze and Felix Guattari, *A Thousand Plateaus*, trans. Brian Massumi (University of Minnesota Press, Minneapolis, 1988), 543

[13] Clifford Geertz, *The Interpretation of Cultures* (Basic Books, New York, 1973), 10.

[14] Clifford Geertz, *The Interpretation of Cultures*, 27.

[15] N. Antonello, E. De Sena, M. Moonen, P. A. Naylor, and T. van Waterschoot, "Room impulse response interpolation using a sparse spatio-temporal representation of the sound field," IEEE/ACM Trans. *Audio Speech Language Process.*, vol. 25, no. 10, (Oct. 2017): 1929.

[16] F. Elvander, A. Jakobsson, and J. Karlsson, "Interpolation and Extrapolation of Toeplitz Matrices via Optimal Mass Transport," IEEE Trans. *Signal Process*., vol. 66, no. 20, (Oct. 2018): 5285.

[17] E. De Sena, M. Brookes, P. A. Naylor, and T. van Waterschoot, "Localisation experiments with reporting by head orientation: statistical framework and case study," *J. Audio Eng. Soc*., vol. 65, no. 12, (Dec. 2017): 982.

Bibliography

Charles Baudelaire, *Les Fleurs du Mal* (reprinted in Charles Baudelaire, Oeuvres complètes, Paris, 1961).

Jean Baudrillard, *Simulations* (Semiotext[e] & The MIT Press, Cambridge, 1983).

Zygmunt Bauman, *Liguid Times: Living in an Age of Uncertainty* (Polity Press, Cambridge, 2007).

Zygmunt Bauman, *Culture in a Liquid Modern World* (Polity Press, Cambridge, 2011).

Walter Benjamin, *Illuminations* (Schocken, New York, 1969).
Jens Blauert, *Spatial Hearing: The Psychophysics of Human Sound Localization* (Cambridge, MA: MIT Press, 1997).

A. S. Bregman, *Auditory scene analysis: The perceptual organization of sound* (MIT Press, 1994).

Richard D. E. Burton, *The Flâneur and his City: Patterns of Daily Life in Paris 1815-1851* (Manchester University Press, Manchester, 2010).

Michel De Certeau, *The Writing of History* (Columbia University Press, New York, 1988).

Guy Debord, *Society of the Spectacle* (Rebel Press, London, originally published in 1967, Paris, 2006).

Charles Dickens, *Night Walks* (Penguin Books, London, originally published as Chapter 13 of the Uncommercial Traveller, 1861, 2010).

Immanuel Kant, *Critique of Pure Reason* (Cambridge University Press, Cambridge, 1999).

Janet H. Murray, *Hamlet on the Holodeck: The Future of Narrative in Cyberspace* (The Free Press, New York, 1997).

Authors Biographies

Steven Devleminck holds a Master degree in Engineering from the Vrije Universiteit Brussel and a PhD in Art and Philosophy from the University of the Arts, London. Previously, he was the Director of the Transmedia Research Programme in Arts, Media and Design of the Leuven University College of the Arts (LUCA), and visiting Professor at maHKU, Utrecht. Currently he is the Head of the Mediated Environments Research Group at LUCA School of Arts and Professor at the Department of Computer Science at KU Leuven. His publications include books and a series of internationally published articles and conference papers. His practice based work has been shown internationally. Research interests are mediated environments, interactive technology, cartography and mapping. He is the Scientific Coordinator of the Innoviris Anticipate 'Smart Urban Community Interface Blocks' research project investigating the design of IoT toolkits for creating interactive urban interventions for both placemaking and civic purposes.

Boris Debackere is an artist and researcher lecturing at LUCA School of Arts, KU Leuven. Debackere is currently serving as the head of V2_Lab in Rotterdam, an instigator of artistic projects that interrogate and illuminate contemporary issues in art, science, technology, and society. As a media artist, his primary interest lies in the interplay of art with the social and technological space. In the field of digital art, his practice has a multimedial character with a recurring key concept: to experience the materiality and performativity of a medium that might appear to be a virtual environment. Debackere received the Liedts-Meesen new media nomination 2010, won the Georges Delete 2014 Prize for Best Original Music and Sound Design and received the 2015 Ensor Sound Design Award.

Toon van Waterschoot received MSc (2001) and PhD (2009) degrees in Electrical Engineering from KU Leuven, Belgium, where he is currently Associate Professor. He has previously held teaching and research positions at Delft University of Technology in The Netherlands and the University of Lugano in Switzerland. His research interests are in signal processing, machine learning, and numerical optimization, applied to acoustic signal enhancement, acoustic modeling, audio analysis, and audio reproduction. He has been the Scientific Coordinator of the Marie Curie Initial Training Network "Dereverberation and Reverberation of Audio, Music, and Speech (DREAMS)" and currently holds a Consolidator Grant of the European Research Council on "The Spatial Dynamics of Room Acoustics (SONORA)". He is a Director of the European Association for Signal Processing (EURASIP), a Member of the IEEE Audio and Acoustic Signal Processing Technical Committee, and a Founding Member of the European Acoustics Association's Technical Committee in Audio Signal Processing.