MIKING LANDSCAPE
(Landschaft mikrophonieren)

N. Schütz [1], L. Endres [2]

[1] *ETH Zürich, D-Arch, Institut of Landscape Architecture, Email: schuetz@arch.ethz.ch*

[2] *ETH Zürich, D-Arch, Institut of Landscape Architecture, Email: lendres@ethz.ch*

Abstract

Auditory impressions constitute an important part of the spatial aesthetic landscape experience. The fieldwork we are conducting within the scope of the PhD project *The Acoustic Dimension of Landscape Architecture* by Nadine Schütz at ETH Zurich is aiming at reproducing this experience just as spatially. Through two case studies – the Villa d'Este garden in Tivoli and the Buttes-Chaumont park in Paris – we are experimenting on a novel landscape recording approach that exploits the complementarity of coincident and spaced arrays. The differentiation between an *environmental* reference microphone and situationally positioned *source* microphones, inspired by established orchestra miking arrangements, allows for a dynamical re-composition the sonic landscape experience.

1. Introduction

Landscape is fundamentally a spatial and aesthetic experience formed by the superposition of different perceptual modalities. Auditory impressions constitute an important and integral part of this experience. The characteristics of the sonic landscape experience can best be understood by concrete case studies, the exploration of auditory scenes as they can be perceived in actual landscapes. In order to reconstitute and analyse the field observations, the development of appropriate recording techniques has proved indispensable and became a central part of the research project *The Acoustic Dimension of Landscape Architecture*, conducted by ETH Zurich. The recordings presented at the 29th *Tonmeistertagung* examplified the newly developed method for *Miking Landscape*, which aims at carving out a landscape specific spatial sound recording (and recomposing) approach. This paper contextualizes and explains the development of the method, examplifies its elements through the documentation of selected recording situations and monitoring settings, and discusses challenges and potentials with regard to the further refinement of this work in progress.

2. Research Context

2.1. Sound and Landscape

Landscape cannot only be seen but also be heard. Since the 1970ies, composers, sociologists, and urbanists in the US, Canada, and France called for an open-minded attitude toward the auditory environment, coining the term *soundscape* to study ambient sounds holistically as an environmental resource and in their emotional relevance to humans [1-3]. However, a large discrepancy continues to exist between the theoretical examination of the sound environment and the reality of structural measures in landscape planning and design. The PhD project on *The Acoustic Dimension of Landscape Architecture*, conducted by Nadine Schütz at the Institute of Landscape Architecture at ETH Zurich [4] and funded by the Swiss National Science Foundation (SNSF) [5], hopes to contribute to bridging this gap by relating sonic qualities to the spatial concepts of landscape architectural design.

2.2. Case studies

At the core of this research is the examination and presentation of sonic function in historical and contemporary landscape examples – in the complex context of an actual, designed space. The recordings extracts exemplifying the presented approach for *Miking Landscape* stem from extensive fieldwork conducted in spring 2016 in the garden of *Villa d'Este* in Tivoli (IT) and in the *Parc des Buttes-Chaumont* in Paris (FR). During several days these sites have been acoustically mapped through multiple recordings positions, which were chosen in function of the global acoustic identity inhering in each of these sites respectively. The 38 recording positions for *Parc des Buttes-Chaumont* show how the relationship between this park and the surrounding city is acoustically orchestrated by topography. The 18 recording positions for *Villa d'Este* reveal sequences of various sonic spatialities created through water that shape the auditory experience of this garden.

Fig. 1: Fieldwork at *Villa d'Este* garden in Tivoli (IT): recording sequences of sonic spatialities created through water.

2.3. Instruments for sonic landscape analysis and design

In order to transfer the knowledge gained through such case studies to strategies for the integration of sound in contemporary landscape analysis and design, the development of appropriate tools and techniques is indispensable. The installation of a new research lab, the AudioVisual Lab (AVLab), inaugurated 2016 in the framework of a collaboration between the Chair for Landscape Architecture of Christophe Girot and the Chair for Planning of Landscape and Urban Systems of Adrienne Grêt-Regamey at at ETH Zurich [6], is an important step towards this goal. It offers a surround system for the acoustic simulation of landscape scenarios and is conceived as an instrument to investigate how auditory and visual impressions mutually shape our perception of the environment, through experimental analysis and innovative design approaches.

Fig. 2: The AudioVisual Lab (AVLab) at the Department of Architecture ETH Zurich offers a 20.1 surround system for the spatial simulation and experimentation of sonic landscapes scenarios. The symmetrical speaker layout of the 20.1 system, arranged for WFS rendering, can be complemented by four screens allowing for a 360° visual embedding of the recordings in their sites of origin.

While state of the art soundscape research tends to favour binaural recording techniques and headphone rendering for the analysis of acoustic environments [7], the AV Lab was designed to enable a shared and dynamic listening experience. The phenomenological field observations, made for the research on *The Acoustic Dimension of Landscape Architecture*, indicate that the condition if a perceptual experience is made simultaneously with others or individually influences the evaluation of a listening scenario significantly. Accordingly, an analogue research setting seems crucial for a better understanding of sound as an inherent element of lived landscape and architectural space, which is fundamentally a shared experience.

In the same sense – to relate sound to landscape specific thinking and and the perceptual conditions of lived space – the recording approach detailed in the following paragraphs has been developed. The key observation directing this development, is that the relationship between the significance of single sounds and the spatial content of their ensemble forming a complex auditory scene is essential for auditory spatial comfort and recognisability perceived in open spaces. The distinction between *keynotes*, *signals*, and *soundmarks*, already proposed by Schafer [2] who borrowed from visual *Gestalt* theory, provides a useful starting point. Published up-to-date soundscape analysis approaches focus mostly on a discrete mapping of these categories [9]. In contrast, the focus of the research presented here is on the perception of their simultaneous presence in lived space and the spatiality-creating interaction between them. This perception is further influenced by different forms of self-movement and -positioning in the shared space in question.

Beyond these perceptual considerations, the design oriented research on *The Acoustic Dimension of Landscape Architecture* implicates also some practical criteria that codetermined the configuration of equipment and techniques: the workability of the recordings in view of experimental design interventions, and the flexibility for later rendering in different implementation and reproduction contexts.

3. Combined Techniques

3.1. Consistency and situationality

The goal to understand sound as an integral element of landscape involves many levels of consideration, of which two particularly apply to the study of sites that form a clearly circumscribable landscape unity, like a park or a garden. This is, on the one hand, the more global contribution and coherence of sound with regard to the identity of a site. On the other hand, it is the varying listening experience which changes with the listener's change of position within the site. This calls on a first level for a coherent site covering data collection based on a consistent recording setting. The second level of consideration, however, favours a more situational proceeding, which adapts the microphone arrangement in order to capture as precisely as possible the particular auditory scene at each position. For a landscape specific recording approach, both tendencies shall finally be combined in a complementary way.

The choice to work with a soundfield microphone (B-format recording) as a main or reference microphone was made with regard to the above mentioned rendering flexibility needs, and, above all, to maintain the possibility of surround sound data while coherently mapping landscape sites. Typically, such sites come with strongly varying spatial, topographical and ground conditions, which often make it impossible to reproduce multichannel microphone arrangements based on multiple stands. In addition, the compactness of this coincident array system corresponds perfectly to the mobility required for landscape recording, which involves working on large sites, covering numerous recording positions, operating in a small team (two people), preforming fast position changes, and escaping from quickly changing weather conditions far from shelter.

3.2. Coincident and spaced microphone arrays

While the soundfield mic proved appropriate as a basic system for the reconstruction of a general impression of the sites' acoustic identity, the spatial envelopment effect that resulted from the monitoring of the B-format recordings alone was not satisfying. Differentiation between auditory openness and narrowness, clearness and density was missing, as well as the spatial components which make out the uniqueness of each auditory scene – the more or less balanced relationship between individual sounds, their spatial disposition and the overall sonic ambiance. Spatially more differentiated recording methods were needed for the aim of this research. In collaboration with Laura Endres, who joined the research project as a sound engineering consultant, the present approach for *Miking Landscape* was developed. It is inspired by established orchestra miking arrangements and combines coincident and spaced arrays.

Recording Setup:

- Recorder: Sound Devices 788t
- Rec. Format: WAV Poly, 48kHz/24bit

Microphones:

- 1x Soundfield (TSL ST450 MKII): SF-Mic
- 4x Omnidirectional (NM KM130) : O-Mics
- 1x Cardioid (NM KM184) : C-Mic

The soundfield microphone was maintained as a mobile basis to capture the general ambient sonic impression. But it was combined with four omnidirectional microphones, to form a situational adaptable spaced array and thus add precision in terms of spaciousness and localization or to add detail and proximity to single sound sources. A cardioid microphone complements the configuration, and replaces in certain (source oriented) recording constellations one of the omnidirectional microphones.

3.3. Heterogeneous listening fields

In an actual auditory landscape situation, not only the perception of single sources but also the relationship between the general sonic environment and such distinct sources change in function of the listener's self-movement and -positioning. The sonic landscape could thus be defined as a *heterogeneous listening field*, the auditory experience related to that spans several perceptual levels, from passive reception to (inter)active exploration. Similarly, to the *shared experience* condition, this *perceptual versatility* condition seems to be a relevant factor for the understanding of the landscape related particularities of the investigated auditory spatialities. The acoustic rendering implemented in this research combines wave field synthesis (WFS) processing and manual speaker assignment, thus re-composing heterogeneous listening fields. Accordingly, listeners can move through the AV Lab at ETH Zurich and explore the occurring shifts in the auditory scene, or simply approach a source related speaker to listen more closely to a sound they are interested – just like in an actual landscape.

4. Three Landscape Miking Prototypes

The combination of coincident and spaced microphone arrays was discussed in connection with the aim to synchronously provide acoustic mapping consistency and situational auditory precision. The target precision, focusing on sound-environment relationships, led to the definition of three typical microphone arrangements. These *Landscape Miking Prototypes* are derived from a typological grouping of sound-environment relationships observed actual landscape listening constellations, and thus convey at the same time a basic vocabulary for understanding and designing sonic landscapes.

While the global acoustic identities of the case study sites described in **2.3** differentiate the role of sound for the experience of the respective site as a whole, this situational typology introduces a new level of comparison that works in a cross-site and cross-epoch mode and is thus valid for all case studies.

4.1. Environment

The first miking prototype, called *environment*, relates to listening positions where the auditory scene provides a rather balanced surround impression, through a combination of more or less distant and distinct sounds which mix into a texture, and smooth gradual shifts between the sonic contents audible in different orientations. The goal of this prototype is to recreate a holistic auditory image. The corresponding microphone arrangement puts the SF-Mic in the middle, with the four O-Mics positioned around it to form a square or rectangle, pointing outside to the corners and spaced as far as possible in order to avoid distinct double image effects.

Fig. 3: Miking prototype *environment*. Recording example (A), in the *Parc des Buttes-Chaumont*, at *Temple de la Sybille* on the summit of the 30m high rock island *Île de la Belvédère* surrounded by an artificial lake in the centre of the park. Miking: SF-Mic at ear height in middle of the round columned temple, 4 O-Mics arranged at the edge of the structure in a square with 3.0m side length, at 1.2m height.

The auditory scene captured this way at the *Temple de la Sybille* in the *Parc des Buttes-Chaumont* (cf. **Figure 3**), can be described as clear distance layering with a gradual shift between front and back; between a distant urban buzzing of irregular faintness of which single sound events emerge from time to time and a denser texture of cumulative single sound events mixed with a closer urban humming.

4.2. Single source

The second miking prototype, called *single source*, relates to an auditory scene dominated by a single sound source, which appears in an object like manner and in certain cases even masks further environmental information in the frontal listening area. The goal of this prototype is to work out the particular foreground-background relationship with the precise location of the dominant source and to capture the sound of this source in a detailed tangible way. In this case, the O-Mics or a combination of O-Mics with the C-Mic are used to create this detailed auditory picture of the source, while the SF-Mic is positioned as an ambient mic at a certain distance.

Fig. 4: Miking prototype *single source*. Recording example (B), in the *Villa d'Este* garden, in front of the fountain *Fontana del Bicchierone*, on the upper terrace of the inclined part of the garden. Miking: Two O-Mics and one C-Mic arranged in a A+B+C oriented and close to the water jet, SF-Mic symmetrically positioned and set back at 1.2m distance from the centre of the source mics arrangement, all mics at ear height.

For the recording at the *Fontana del Bicchierone* in the *Villa d'Este* garden (cf. **Figure 4**) the SF-Mic could not be positioned far enough from the source oriented proximity mic array. This was due to the limited space available on the small terrace in front of which the fountain is located, and behind which a laterally open but canopied area (gallery) is directly adjacent. The resulting surround impression, which should arise from the completion of the lateral and rear ambient parts to the frontal source, was not convincing. This example shows the importance of the spacing between the source oriented O-Mics and the SF-Mic responsible for capturing the ambient impression in a complementary way.

4.3. Source array

The third miking prototype, called *source array*, relates to a dynamic listening experience shaped by a sequence of physically discrete or linked similar sound sources. For auditory scenes of this type, the listeners self-positioning and -movement plays a particularly significant role. The goal of this prototype is to favour the reconstitution of these spatio-temporal dynamics, the experience of a spatial sequence embedded in a global sound environment. The microphone arrangement follows the locations of the single sources of the sequence, with one O-Mic per source, thus forming irregular patterns with varying heights. While there is no symmetry in the arrangement of these source array mics, the SF-Mic, again responsible for the complementary ambient impression, is positioned and set back at about half way of the pattern. As well as it is the case for the *single source prototype*, it is again the spacing between the source mics and the ambient mic that is crucial for a successful complementary reconstitution of the auditory scene.

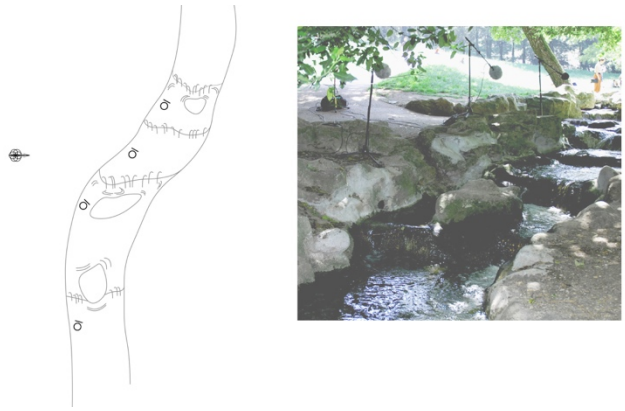

Fig. 5: Miking prototype *source array*. Recording example (C), in the *Parc des Buttes-Chaumont*, along the western creek. Miking: 4 O-Mics positioned at irregular intervals (between 1.6m and 3.4m) and heights (between 1.1m and 1.4m) along the river bed's steps, SF-Mic set back on the footpath, as ambient mic, at ear height.

The reconstitution of the recording example C from Buttes-Chaumont (cf. **Figure 5**) as a heterogeneous listening field in the AV Lab (cf. **3.3.** and **5.1**), provided a revealing listening moment. The local whooshing and bubbling of water moving over steps proved particularly susceptible in terms of *perceptual versatility*. The perceived tonality as well as the overall composition of the auditory scene changes with every little change in listening position.

4.4. Transitions

The definition of the second and third prototype has already indicated that the transitions between them are rather smooth, and can occasionally even be blurred. The recording examples (D) and (E) (cf. **Figure 6** and **Figure 7**) represent such cases, where the crossing of typological landscape consideration and recording systematics lead to the designation of transitional or hybrid miking constellations.

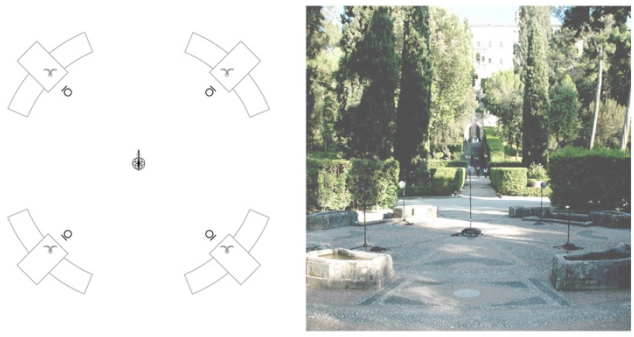

Fig. 6: Recording example (D), in the middle of the lower part of *Villa d'Este* garden, where four fountains in the shape of flowers embedded in the floor form a circular source array. Miking: SF-Mic at ear height in middle, 4 O-Mics arranged around it, inside the fountain circle, in a square with 4.0m side length, at 1.1m height, pointing downwards towards the sources.

Recording example (D) (**Figure 6**) demonstrates a transition between *source (array)* and *environment* prototype. It is interesting to compare the related listening experience to the one offered by recording example (B) (**Figure 4**). In (B), the auditory scene is unevenly dominated by he focused source, whose rhythmic lapping evokes a language like articulation which tends to replace the the impression of ambient envelopment. In (D), the subtle auditory presence of distinct articulated sources is in balance with the global sonic environment. It is not the mere absence or presence of distinct sources, but their blending with the overall sound environment that is determining for the understanding of this auditory scene.

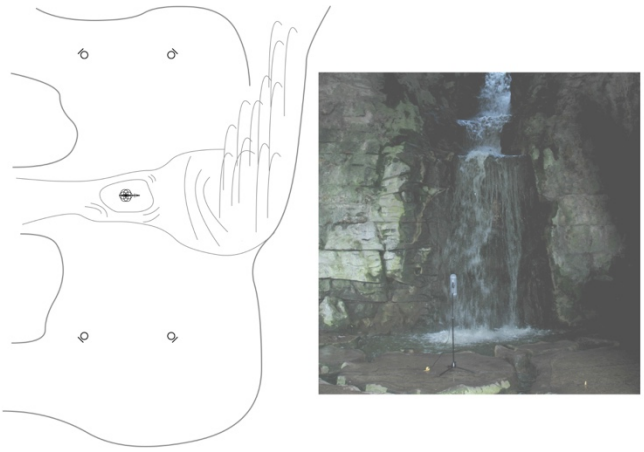

Fig. 7: Recording example (E): *Parc des Buttes-Chaumont*, artificial grotto with roaring cascade. Miking: The SF-Mic is used at the same time as an ambient and source mic, positioned at a distance of 5.0m in front of the source, at 1.4m height. The four O-Mics are spaced in form of a stretched rectangle with 16.0m/5.0m side lenghts and tilted upwards to capture the reflections responsible for the cave feeling (drawing 50% downsized in relation to other illustrations).

In the second transitory example (**Figure 7**), the dominance of the source, a roaring cascade, exceeds and object-like appearance, and at first seems to cover the whole auditory space. But it still leaves some room for audible reflections – of its own sound on the walls – of which nevertheless emerges the spatial impression or environmental feeling typical for caves. In this case, the particular challenge was to record those elements or layers distinctly. This led to another hybrid setting, in which the distinction between source and environmental sound components is redefined. Caves are a frequent element in garden and park designs from different epochs. Yet it appears obvious that their acoustics, which are more similar to indoor space conditions, require a situational re-definition of the microphone roles, which were determined through a prototypical logic conceived for characterizing auditory scenes in outdoor space.

5. Mixing Landscape

5.1. Monitoring in the AV Lab at ETH Zurich

As described in **2.3**, flexibility for later rendering contexts was a relevant criterion for the configuration of the basic recording setting and equipment in this research project. Nevertheless, the monitoring system primarily targeted and used of evaluation, influenced the further refinement of the approach in an iterative process. The AVLab (cf. **Figure 1** and **Figure 8**) is equipped with a 20.1 surround system, creating a relatively large listening area, as it is needed for experimentations in *shared experience* conditions.

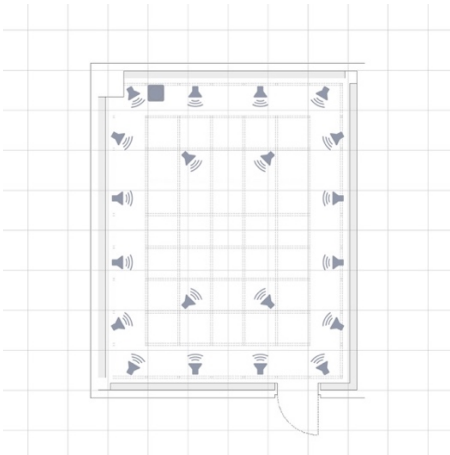

Fig. 8: Floor plan and speaker layout AVLab ETH Zurich. Interior room dimensions: 7.5m x 6.0m x 3.6m. Speaker heights above floor: peripheral speaker array 1.60m, central top speakers 3.00m.

The symmetrical speaker layout is arranged for WFS processed rendering, but allows also for manual speaker assignment. The combination of those two concepts is a characteristical element in the re-composition approach related to the *Miking Landscape* technique presented here – a re-composition which pursues the reconstitution *heterogeneous listening fields* as a potential and particularity of the auditory landscape experience.

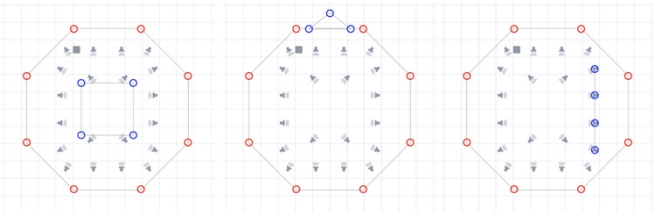

Fig. 9: AVLab routing figures corresponding to the three *Landscape Miking Prototypes*: *environment* (left), *single source* (middle), *source array* (right). These exemplary schemes show the routing patterns for the recordings (A), (B), and (C). The red circles represent the octagonal decoded, WFS processed SF-Mic data. The blue circles represent the O-Mic channels, which are either also WFS processed (left, middle) or manually assigned (right).

The improvement of the B-format decoding as part of the mixing of the eight channels recorded with a SF-Mic and four O-Mics simultaneously is an ongoing process. So far, the decoding to a symmetrical octagon delivered the most stable results with regard to an invariant processing, which would best correspond to the idea of mapping consistency. However, the spatial superposition with the O-Mic channels causes double imaging effects, and requires extensive adaptations in volume and equalisation balance between the single channels, as well as the implementation of different delays.

5.2. Mixing for 5.1 monitoring (TMT)

The change of monitoring system for the representation of the recording examples at the *Talk Back* session of the 29th *Tonmeistertagung*, constituted a flexibility challenge for this ongoing work on the mixing of the landscape recordings. The recomposition process pursued in the AVLab was explained graphically, but the main goal was to reproduce an according listening experience for an audience seated steadily in the midst of an extended 5.1 system. While the reproduction of well balanced ambient auditory scenes could also be optimized in this rendering context, the recordings of auditory scenes with more irregular environment-source(s) relationships proved more fragile. The limits of rendering flexibility were finally clearly revealed in the case of recordings for which the recreation of a walkable *heterogeneous listening field* is crucial, which is achieved in the AVLab through the combination of WFS processing and manual speaker assignment.

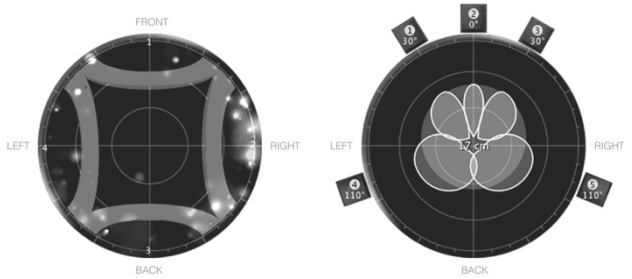

Fig. 10: B-format decoding pattern *Quad* (left) and B-format decoding pattern *5.1 Standard* (right). (reworked screenshots from the Harpex-B decoder window)

Remixing the recordings for 5.1 monitoring involved increased difficulties with regard to B-format decoding. Especially in the case of *environment* prototype recordings (cf. **Figure 3**), the double imaging effects appeared even more pronounced in this rendering context. To avoid these effects, a special B-format decoding pattern *Quad* was applied, using the shotgun mode of the Harpex-B decoder (cf. **Figure 10**). Thus, the channels from the SF-Mic recording and those from the O-Mic work together in a more complementary way, the O-Mic forming an "outrigger" in which the SF-Mic content is embedded.

6. Conclusion

The differentiation between an *environmental* reference microphone and situationally positioned *source* microphones is an experimental attempt to develop a landscape specific recording approach. It results from a disciplinary crossover thinking between landscape perception and design and sound engineering and allows us to dynamically recompose the spatial auditory landscape experience, considering the related human perceptual mechanisms involved in the process of *auditory scene analysis* [8].

Remixing the recordings for 5.1 monitoring led to some fruitful insights, in particular for the improvement of B-format decoding for the combination with O-Mic channels. The possibility of a complementary *Quad* shotgun decoding confirmed the versatility advantages of recording with a SF-Mic and helps to bypass some major difficulties linked to the coincident array system. This experience showed us that the potential of shotgun B-format decoding patterns is a direction we didn't yet exploit far enough. To test it also for monitoring in the AVLab at ETH Zurich might lead to important refinements with regard to the combination of WFS processing and manual speaker assignment.

The focus of this contribution was on the new approach we developed for *Miking Landscape*. However, it was important to discuss the combination of techniques on all three levels – conceptual and phenomenological background, recording constellations, and mixing experiments. While this presentation suggests a one-way-workflow, the recording approach was essentially developed through an iterative process between perceiving, conceiving, miking, and mixing.

7. References

[1] Wrightson, K.: An introduction to Acoustic Ecology. Soundscape, vol.1, no.1 (2000), 10-13.

[2] Schafer, R.M.: The Soundscape: Our Sonic Environment and the Tuning of the World. Destiny Books, Ronchester Vt, 1994. (The tuning of the world. Knopf, New York, 1977.)

[3] Southworth, M.: The Sonic Environment of Cities. Environment and Behaviour, vol. 1, no.1 (1969), 49-70.

[4] Project URL, ETH Zurich Institute of Landscape Architecture: http://girot.arch.ethz.ch/research/digital-media-perception/the-acoustic-dimension

[5] Project URL, SNSF database: http://p3.snf.ch/Project-149472

[6] URL: http://lvml.ethz.ch/

[7] Genuit, K. and Fiebig, A.: "Human Hearing-Related Measurement and Analysis of Acoustic Environments: Requisite for Soundscape Investigation" in: Soundscape and the built environment, R. Kang and B. Schulte-Fortkamp.B, CRC Press, Boca Raton FL, 2016, pp. 133-160.

[7] Kang, R. et al.: "Mapping of Soundscape" in: Soundscape and the built environment, R. Kang and B. Schulte-Fortkamp, CRC Press, Boca Raton FL, 2016, pp. 161-196.

[8] Bregman, A.S.: Auditory Scene Analysis: The Perceptual Organization of Sound. MIT Press, Cambridge, 1999.

tmt29

expertise in audio media

29. Tonmeistertagung
VDT International Convention

17.11.– 20.11.2016 Köln | Cologne

Tagungsbericht
Conference Proceedings

ISBN 978-3-9812830-7-5

tmt29

expertise in audio media

29. Tonmeistertagung
VDT International Convention

17.11.– 20.11.2016 Köln | Cologne

Hinweis:
Der Tagungsbericht enthält die von den Referenten eingereichten schriftlichen Arbeiten. Weitere Informationen sind auf der Website www.tonmeister.de/tmt/2016 verfügbar, insbesondere Präsentationsfolien und anderes Material zu Workshops, Poster- und Produktpräsentationen.

Note:
The Proceedings contain written Papers submitted by the presenters. More information is available at our website www.tonmeister.de/tmt/2016 , in particular presentation slides and further material from Workshops, Poster Presentations and Product Contributions.

ISBN 978-3-9812830-7-5

tmt29

expertise in audio media

29. Tonmeistertagung
VDT International Convention

Verband Deutscher Tonmeister e.V.
Am Zaarshäuschen 9 · DE-51427 Bergisch Gladbach
Telefon: +49 2204 2 35 95 · Telefax: +49 22 04 20 15 43
E-Mail: vdt@tonmeister.de

Der gesamte TMT 2016 Tagungsbericht oder einzelne Beiträge stehen zum Download zur Verfügung:
www.tonmeister.de/tmt/2016

The complete TMT 2016 Conference Proceedings as well as individual articles are available for download:
www.tonmeister.de/tmt/2016

ISBN 978-3-9812830-7-5

tmt29

expertise in audio media

Themenübersicht | Topic Overview

ISBN 978-3-9812830-7-5

tmt29

expertise in audio media

29. Tonmeistertagung
VDT International Convention

Impressum

Veröffentlicht vom Verband Deutscher Tonmeister e.V.
Bergisch Gladbach, Januar 2017

Redaktion: Carsten Bänfer, Wolfgang Hoeg, Günther Theile
Layout: Andrea Krahmer

ISBN 978-3-9812830-7-5