SoundLab, first three years [studio report]

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ABSTRACT

This is a report on the development of SoundLab, a spatial audio research and practice unit at the School of Creative Media, City University of Hong Kong, co-directed by the authors. We outline how we have developed the lab's objectives in terms of research, artwork, teaching, and outreach. We give a brief account of the local context of electroacoustic music in Hong Kong, both in academia and in independent music and art scenes, to which SoundLab aims to contribute through its activities. We report the design of a hemispherical loudspeaker array dedicated to high spatial resolution audio, developed after consulting a number of academic institutions with comparable facilities and programmes. Recent activities in outreach and research are discussed, and future plans in relation to its objectives are given in closing.

1. SOUNDLAB

Space is key to audio and music. Effective design of sonic space is vital for achieving immersivity in most forms of creative media, such as performance, games, AR/VR/XR, 3D film, and installation. We are dedicated to developing SoundLab, a multifaceted laboratory hosted in a main space, the Multi-Media Theatre (M1060, here referred to as MMT) which we have fitted with a loudspeaker array for high spatial resolution audio. We are additionally developing other spatial audio technologies to augment and complement the main lab. SoundLab is a platform for spatial audio research, teaching, and outreach at City University of Hong Kong. The authors are its joint co-directors, and started to set it up in November 2020 thanks to a grant and facility support from the Applied Computing and Interactive Media Centre at the School of Creative Media. The ACIM grant was renewed two years later, in November 2021. We have previously reported the initial design work for SoundLab [1, 2] and the context of electroacoustic music and related sonic arts in Hong Kong [3].

2. OBJECTIVES

SoundLab is dedicated to establishing City University as the foremost institution within Hong Kong for spatial audio, significantly advancing the profile of the School of Creative Media within Asia and internationally. The team currently consists of three full-time faculty, ~10 fulltime PhD students (as of autumn of 2023), as well as MFA and undergraduate students working on creative projects and student-led concerts. Our work is guided by six research objectives, restated below with a brief statement of what has been achieved so far.

Lab space

The first and most important task for us was to design and develop a lab space for research in spatial audio perception and design. In early 2021 we contacted experts in spatial audio, including Eric Lyon, Tanner Upthegrove, Bill Brunson, Natasha Barrett, Franz Zotter, Matthias Frank, Simon Smith, Scott Wilson, and Craig Jackson, and we are deeply grateful for their advice. Considering needs and resources, we settled on designing a semi-permanent hemispherical rig with 25 equidistant point-source speakers at four levels (for design details see [2]). The installation was fully functional in late 2022. Ring One has 12 speakers on floor stands (see **Figure 1**), Ring Two has 8 speakers slightly below the trusses, and Ring Three has 4 speakers mounted at the upper edge of the trusses, with a time delay (it proved impossible to mount four speakers at the physically optimal positions, on a structure extending above the trusses, due to novel restrictions imposed after an unrelated incident at another stage in Hong Kong). All speakers are Genelec IP 4030a, connected via Cat5 cables on an AES65 digital audio network using high-powered routers and Dante software. Installing the remaining 25th 'zenith speaker' in the catwalk requires a special permit that is pending. Finally, we will be receiving two matching Genelec subwoofers in the autumn of 2023, to be augmented by another two, when funding allows.

Perception research

SoundLab supports empirical research in spatial auditory perception, through perceptual evaluation of soundscape recordings under different reproduction conditions, including headphones, 2ch stereo, surround, and higher-order Ambisonics (HOA). This is a large objective which we have only started to explore. Listening tests were carried out in the past year to support research by PhD candidate Manni Chen on AI-supported studio production

tools [4] and the Open Ambisonics Toolkit [5]; this is a line of inquiry that we intend to pursue.

Technical research

SoundLab supports technical research through the creation of novel sonic artwork for spatial configurations i.e. soundscape composition, multichannel electroacoustic music, computer music, AR, VR. We have created new spatial audio compositions such as [6] or updated previous works [7, 8], and new media artworks [9, 10]. In addition to the faculty Start-Up grants that enable the loudspeaker array, we are currently working larger and multi-faceted granted projects. Lindborg is the Principle Investigator for *Multi-Modal Hong Kong* (2023-25), a three-year project funded by the Hong Kong Government which aims to create a multimodal database of places of culturally valued intangible heritage, specifically soundscape and smellscape. He also works on *Open Ambisonics Toolkit*, a hardware-software low-cost system [5, 11]. Meanwhile, Ikeshiro is the Principle Investigator for a project to investigate binaural audio for virtual environments, and has recently secured another grant to extend this work towards using Ambisonics. Our conference activities in the past 2.5 years include *ArtMachine2, CeReNeM, CMMR, ICAD, ICMC, ICMPC-ESCOM, International Conference Music and Sonic Art, ISEA, KEAMS,* and *Xenakis Centenary Symposium*.

Design research

We share a special interest in sonification. This has led to the creation of DACA, a conference on Data Art for Climate Science (dataclimate.org/) and the associated DAT/ACT Exhibition, both conducted in 2022; a Research Topic on data perceptualization [12], and workshops on spatial sonification of geodata (see below). Fundamental to our approach is to consider the interplay between aesthetic and utilitarian intentionalities, aka *ars musica* and *ars informatica* [13–15]. The cross-modal interaction between visual and auditory perception is another subject that has implications for design, and this is being explored by some of the PhD students.

Pedagogy

Since September 2022 we have conducted several workshops for graduate students, to relate spatial audio to data sonification, field recording, improvisation, and other key topics. Several invited guests, both Hong Kong-based and from abroad, have given workshops and concerts. In the past two years, they include: Christopher Keyes (composer, Baptist University HK), Giorgio Biancorosso (film music scholar, HKU), Yang Yeung (independent curator), Andras Blazsek (sound artist, EU), Mario de Vega (media/sound artist, Mexico), Fiona Lee (sound artist/performer), Sascia Pellegrini (composer, Singapore School of the Arts), Solomon Shiu (soundscape researcher), Andi Lai (machine/sound art), Edwin Lo (media art), and John D'Arcy (composer, UK). These activities are also effective for outreach, discussed further below.

The School of Creative Media offers several courses related to sound and music. Two classes by Lindborg have used the MMT space: in *Sound Installation and Spatialisation*, the acoustic space and loudspeakers enabled a range of teaching and learning activities, including the students' final class project, and in *Music for Film*, a movie screening highlighted surround sound and demonstrated upmixing of stereo to 5.1. A notable student graduation production was made in April 2023 by MFA graduate Longman Luk, supervised by Ikeshiro. The aforementioned Open Ambisonics Toolkit aims to support graduating students and practitioners outside of academia with a way to continue working with spatial audio in their own creative work. It is both an entry-point and a sustainable way of distributing the knowledge developed at SoundLab. First shown at ICAD in June 2023, we will be holding an OAT workshop at SCM in October this year.

Outreach

SoundLab is currently the only institution-based larger facility for spatial audio in Hong Kong. A snapshot image and analysis of the local Hong Kong scene is given in [1]. As we are building capacity for hosting events and concerts of different kinds, presenting sonic and media design and artwork by ourselves and student members of SoundTeam as well as by colleagues, collaboration with other institutions will be increasingly important. We aim to gradually develop outreach, in order to gain publicity and traction for SoundLab as much as to benefit the students and faculty at CityU, and the larger scene in Hong Kong.

3. FUTURE PLANS

Since 2020, SoundLab is an integral part of ACIM and SCM. We will be opening up for undergraduates to do their 4th year final project at SoundLab, related to spatial audio. In the future and subject to the funding situation, we hope to create and establish a creative residency scheme where composers can spend time at SoundLab to compose spatial audio works within the hemispheric loudspeaker rig. The number of PhD students has significantly increased. The two Co-Investigators together currently supervise ten PhD students who are attached to SoundLab, and have Research Assistants funded over grants. To conclude, we feel that SoundLab is approaching a certain 'critical mass', a level of activity that will be sustainable over longer term. For more information and to sign up for our newsletter, visit soundlab.scm.cityu.edu.hk/.

Figure 1. SoundLab: circle of twelve loudspeakers at floor level.

4. REFERENCES

[1] R. Ikeshiro, D. Charrieras, & PM. Lindborg (2022/12). "Charting the scene(s) of sonic arts in Hong Kong. An overview based on 23 interviews with local practitioners and organisers". *Organised Sound*, https://doi.org/10.1017/S1355771822000450

[2] R. Ikeshiro & PM. Lindborg (2022/06). "SoundLab, a spatial audio research/practice unit in Hong Kong". 10 Jun 2022, *Proc. 27th International Symposium on Electronic Art (ISEA)*, https://isea2022.isea-international.org/

[3] R. Ikeshiro & PM. Lindborg (2021/10). "SoundLab and Electroacoustic Music in Hong Kong". *Proc. 2021 Conference of the Korean Electro-Acoustic Music Society*, Seoul, keams.org/emille/keamsac/

[4] M. Chen & PM. Lindborg (2023/01) "Observations on Guitar Music Produced by AI Reverberation and Professional Sound Engineers". *International Journal of Music Science, Technology and Art (IJMSTA)*, doi.org/10.48293/IJMSTA-93

[5] G. Pisano & PM Lindborg (2023/06). "Introducing the Open Ambisonics Toolkit". *Proceedings of the Conference of the International Community for Auditory Display (ICAD).*

[6] PM. Lindborg (2021/11). "Stairway to Helheim", *Soundislands 'Re:Sound'*, ArtScience Museum, Singapore.

[7] PM Lindborg (2022/2010). "Graviton Dance. Generative 3D sound composition". *Asia Composer League Festival*, Christchurch, New Zealand.

[8] R. Ikeshiro (2022/04). "Eternal Accelerando". *Sonorities Festival*, Belfast.

[9] R. Ikeshiro & MetaObjects (2023/06). Sonic Topologies: Hong Kong 地境：香港. With Jacklam Ho, Manni Chen, Cheng Yang Daniel Stempfer. *M+ at Night: Sensory Encounters M+夜不同：感官體驗,* Museum of Visual Culture, Hong Kong.

[10] PM. Lindborg, J. Xiao, F. Aletta, H. Cheung, R. Yue, N. Han, X. Xu. (2023/04). "The Dual City Multi-sensory Experience of Markets". *Symposium on Inclusive Design with Multi-senses*, STEAMhouse, Birmingham City University, UK.

[11] PM. Lindborg & G. Pisano (2023/09). "Learning spatial audio with the Open Ambisonics Toolkit" *Digitally Engaged Learning Conference* (DEL).

[12] PM. Lindborg, SS. Chopra, & K. Groß-Vogt (2023/08). *Data Perceptualization for Climate Science Communication. Frontiers in Psychology, Sec. Human-Media Interaction,* https://doi.org/10.3389/fpsyg.2023.1263971.

[13] P. Vickers & B. Hogg (2006). Sonification abstraite/sonification concrete: An 'aesthetic persepctive space' for classifying auditory displays in the ars musica domain. Proc. ICAD.

[14] D. Worrall (2019). Sonification Design. Springer.

[15] PM. Lindborg, S. Lenzi S & M. Chen (2023/01). "Climate Data Sonification and Visualisation: An Analysis of Aesthetics, Characteristics, and Topics in 32 Recent Projects". *Frontiers in Psychology, Human-Media Interaction,* 10.3389/fpsyg.2022.1020102