Exploring the Open Ambisonics Toolkit
UbiMus Workshop

PerMagnus Lindborg[1], **Giuseppe Pisano**[2], **Karen Yu**[3]

[1]SoundLab, School of Creative Media, City University of Hong Kong

[2]Norwegian Academy of Music, Oslo, Norway

[3]Contemporary Musiking Hong Kong

{pm.lindborg@cityu.edu.hk, giuseppe.pisano@nmh.no, karen@cmhk.hk

Abstract. *This Workshop on the Open Ambisonics Toolkit will have practical, pedagogical, and theoretical elements. The increasing number of possible applications for spatial audio technologies has caused renewed interest on the subject from academic institutions and resulted in a more wide-spread diffusion of techniques and practices. However, the lack of an integrated methodology for teaching these technologies is clear. This served as a motivation for our team to develop the Open Ambisonics Toolkit (OAT), a hardware-software system for spatial sound pedagogy. We are making experiments and developing a flexible approach to using OAT in various configurations. At this point in developing the project, we seek to engage with potential users of different profiles, experience levels, and expectations, to spread knowledge about our approach and to receive constructive feedback. At UbiMus, we will present the system components and engage participants in a listening experiment and a discussion on spatial audio with a low-cost DIY system.*

1. Open Ambisonics Toolkit

OAT is being developed at SoundLab, School of Creative Media (SCM), thanks to a Teaching Start-up Grant to the first author enabling the hire of the second author for the project. The School offers a wide range of courses, including music and audio technologies, as well as new media applications in contemporary arts and digital communication [1]. Reflecting this diversity, the methods developed for OAT needed to be specific but also versatile. Having the opportunity to intercept student-led and faculty projects, as well as their expectations and issues related to immersive audio, the authors designed a toolkit that focuses on the most frequently encountered problems and provides all required information. OAT is extendable, which will through further development respond to future needs of different types of users. The democratisation of technologies leads potentially to a positive disruption of not only the economies of media production and consumption, but also of electroacoustic music aesthetics itself. Academic institutions have here an opportunity that they should not miss out on, or else ”the democratisation of music technologies and the emergence of ‘bedroom producers’ could lead to universities or public-supported research centres being less central to the development of sonic arts.”[2]. The authors have previously designed and developed low-cost loudspeaker systems for sound installations [3, 4].

The project we are here presenting builds on our previous experiences and takes the pedagogical context into consideration. OAT was designed not only for providing the

necessary theoretical information, but also to share the design of hardware solutions, and document software that we believe answers pedagogical needs. With OAT, students in music technology as well as other learners will be able to explore Ambisonics [5, 6] and adapt the system for their specific needs. They might work in a range of contexts, such as presenting a sound installation at an art exhibition, experimenting with audio VR/AR, or monitoring their 3D audio work in a home studio [2]. With these considerations in mind, the toolkit consists of interconnected modules that are also useful on their own. The main modules are:

Hardware module, in which we describe solutions to build inexpensive loudspeaker setups for Ambisonics in a DIY fashion. Currently, the system we have developed and tested is an eight-channel (8.1) speaker system that can be used in flexible configurations, such as octophonic (2D), cube (3D), and hemispheric (3D). The speakers are driven by amplifiers, DA converter, and CPU.

Software module, where we present software tools available for Ambisonics work with a specific focus on free/open source software compatible with Linux and Raspberry Pi, including Pd, Jack, and AmpDec [7];

Theory module, where we explain Ambisonics in detail and provide documentation. It is accompanied by Pd patches in progressive detail.

We have previously presented OAT at the International Community for Auditory Display (ICAD 2023) [8], at SoundLab in Hong Kong 2023, and the International Computer Music Conference (ICMC 2024) [9]. An article giving a full description of the system is at the present moment in review [10], and OAT documentation and other materials are shared here.

2. Workshop requirements

We will need access to a suitable space for at least five hours: two hours to set up (can be one day in advance), two hours for the Workshop, and one hour to strike out. The leaders will bring to the venue the following pieces of equipment, some of which will be assembled as part of the demonstration.

- 8x Customised mini loudspeakers;
- 8x Amplifiers and audio cables;
- 1x Raspberry Pi and shields;
- 1x Harddisk with software for OAT;
- 1x AudioInjector Octo DA converter;
- 1x Power supply.

Meanwhile, we are unable to bring the following parts, and would like to request that the organiser provide them:

- 1x Workshop room, free floor space 4m x 4m;
- 8x Microphone stands;
- 1x Sub-woofer (e.g. 8”, approx. 45 W) and cables;
- 1x Table (120 cm wide) for equipment;
- 1x Computer screen, keyboard, and mouse;
- 2x Power strips (min. 4 outlets each);
- 1x Swivel stool for sweet-spot listening.

3. Acknowledgements

The development of OAT was funded by Teaching Start-up Grant #6000788 from City University of Hong Kong, to the first author.

4. References

Referências

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

[2] N. Prior, "New amateurs revisited: Popular music, digital technology, and the fate of cultural production," in *Routledge handbook of cultural sociology*, pp. 340–348 (Routledge) (2018).

[3] P. Lindborg, "LW24 [sculptural auditory display]," *National Gallery, Singapore* (2015-12).

[4] P. Lindborg, "Feeling Loki's pain: Designing and evaluating a DIY 3D auditory display for geodata sonification," presented at the *International Conference for Auditory Displays [ICAD]* (2021), doi:http://hdl.handle.net/1853/66341.

[5] D. Malham, "The Early Years of Ambisonics at York," *Audio Engineering Society Conference: 2019 AES International Conference on Immersive and Interactive Audio* (2019).

[6] A. Sèdes, P. Guillot, E. Paris, "The HOA library, review and prospects," presented at the *International Computer Music Conference | Sound and Music Computing*, Proceedings ICMC|SMC, pp. 855 –860 (2014-09), URL `https://hal.science/hal-01196453`.

[7] F. Adriaensen, "AmbDec 0.4. 2 User Manual," (2011), URL `http://kokkinizita.linuxaudio.org/linuxaudio/downloads/ambdec-manual.pdf`.

[8] G. Pisano, P. M. Lindborg, "Introducing the Open Ambisonics Toolkit," presented at the *28th International Conference on Auditory Display (ICAD 2023): Sonification for the Masses* (2023).

[9] P. Lindborg, G. Pisano, "Workshop on a Spatial Audio Pedagogy using the Open Ambisonics Toolkit," presented at the *International Computer Music Conference (ICMC)* (2024-07-07).

[10] G. Pisano, P. M. Lindborg, "Developing the Open Ambisonics Toolkit: Background, Design, Evaluation," *in review* (2024).