WORKSHOP WITH THE OPEN AMBISONICS TOOLKIT

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ABSTRACT

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 widespread 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 actively promoting a democratisation of spatial audio through a DIY approach, and our aim is to serve tertiary educational institutions and individuals alike. For the Conference, we propose a practical, hands-on Workshop with OAT. Participants will be familiarised with its modules, learn about the design of a low-cost Ambisonics system, try out one or more spatial configurations of custom-built loudspeakers, and participate in listening tests, optionally using their own sonic materials.

1. WORKSHOP SCOPE AND TARGET

The two authors are the Workshop leaders, and we have designed OAT together, starting the practical development in the autumn of 2022. We suggest that the maximum number of participants should be around twelve. There are no special prerequisites, but a basic knowledge of Ambisonics will be helpful. Workshop duration should be around three to four hours. After having completed the Workshop, participants will have acquired knowledge about Ambisonics technologies implemented in Pd running on Raspberry PI; insights into a pragmatic design of a low-cost 3D hardware-software system; and gained experience and critical skills through listening tests. See **Figure 1**. They will be able to download or copy OAT software, design manuals, and theory materials.

2. OAT: AN OVERVIEW

OAT has been developed at SoundLab, School of Creative Media (SMC), thanks to a Teaching Start-up Grant to the first author enabling the hire of the second author for the project (i.e. the Workshop leaders). 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. 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." [1]. The authors have previously designed and developed low-cost loudspeaker systems for sound installations, such as [2] and [3].

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 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 [4].

With these considerations in mind, the Toolkit consists of interconnected modules that are also useful on their own. At this point in time, the main modules are:

1. Hardware module, in which we describe solutions to build inexpensive loudspeaker setups for Ambisonics in a DIY fashion. Currently, the system we have dev eloped 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.
2. 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, ALSA, and AmpDec [5];
3. Theory module, where we explain Ambisonics in detail and provide documentation. It is accompanied by Pd patches in progressive detail.

Further information is available at the project website (NOT ANONYMOUS): http://soundlab.scm.cityu.edu.hk/teaching-start-up-grant-2022-23/

3. TECHNICAL REQUIREMENTS

We will need access to the Workshop room one day in advance (for at least four hours) for preparations, and two hours post-workshop time for striking out. The Workshop leaders will bring or ship to the venue the following pieces of equipment, some of which will be assembled on site.

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

- 1x Workshop room with free floorspace 4m x 4m;
- 8x Microphone stands;
- 1x Subwoofer (approx. 45W) and cables;
- 1x Table (120 cm wide) for equipment
- 1x Computer screen, keyboard, and mouse;
- 2x Power strips (≥ 4 outlets each);
- 1x Swivel stool for sweet-spot listening.

Figure 1. OAT in an octophonic (8.1) configuration during listening tests.

4. ACKNOWLEDGMENT

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