Sluicer

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1. PROGRAM NOTES

Sluicer is a performance system for spatial audio improvisation, adaptable to various output channel configurations from stereo to high density loudspeaker arrays. In this work, two 20-voice, erratic synthesizers operate as a roving "chorus" under the player's direction. Both synths have a series of multichannel effects designed to work specifically with high order ambisonic signals, allowing the player to create and alter spatial dimensions. As audio flows, the guiding action is like closing/opening gates in a lock on a waterway. The results are timbral and spatial churns, swells, floods and drains, motion in repetition, expansion, and contraction. Sluicer is programmed in Max with tactile interfaces being high resolution, multi-touch control surfaces and a DJ-style MIDI controller.

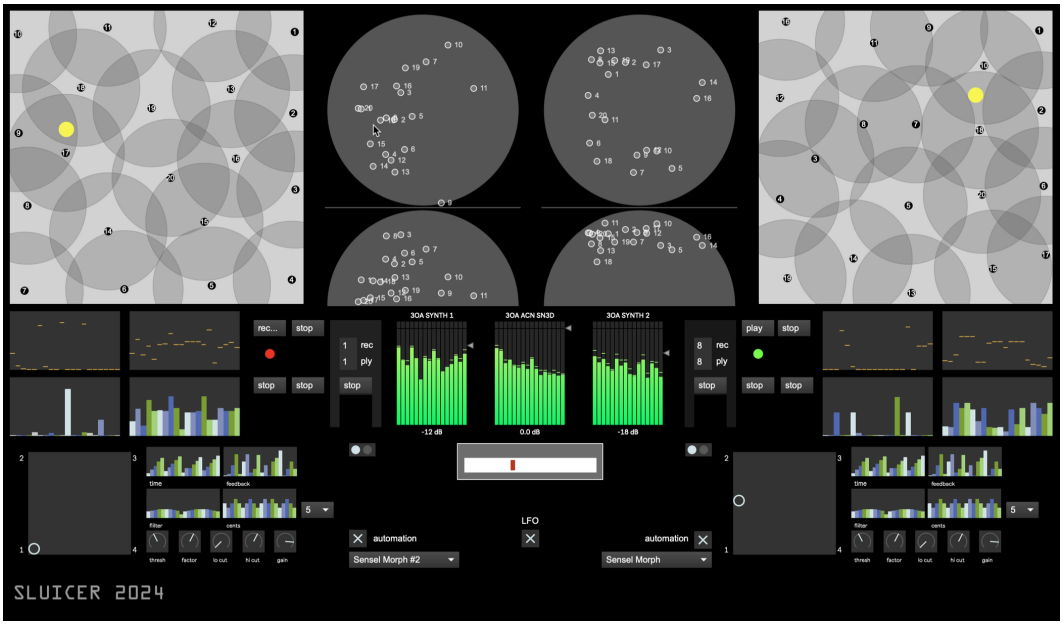

Fig. 1. Sluicer screen interface.

2. PROJECT DESCRIPTION

Since 2015, my artistic work and research has been primarily focused on an area within spatial audio involving High Density Loudspeaker Arrays (HDLA) which are typically permanent installations with 24 or more loudspeakers in a cube or hemisphere configuration. Some HDLA facilities feature hundreds of

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loudspeakers to provide more resolution and precision, and to support a wider range of spatial audio techniques. For this work, I have traveled to various HDLA facilities to participate in residencies and workshops and to perform/present at conferences and festivals.

Sluicer is the most recent performance system I have developed that focuses on HDLAs as new interfaces for musical expression. A core strategy in Sluicer is the use of spatially positioned, multichannel audio effects that alter specific regions of a sound field rather than the audio signal of a specific source (e.g. instrument, voice, track). This approach makes it possible to lock an effect at spatial coordinates such that an audio source moving in 3d space is transformed when its path crosses into a specific zone. This strategy was explored in earlier research with FOAFX, a command line tool for applying spatially positioned audio effects to first order ambisonic sound files.[1]

The approach evident in Sluicer, which I call SFFX (i.e. sound field effects), aims to solve a problem encountered in audio workflows involving ambisonics, wherein several audio effect processes, (e.g. compression, distortion, noise cancellation) cannot be used with encoded 3d audio without ruining the spatial dimensions of the source file or stream. While there are some workarounds known within the 3d audio community,[2] these methods are generally not real-time processes and involve combining several tools and complex signal routing. The goal is to apply an effect to the entire sound field or a region within it without entirely losing the 360° fidelity. An exciting affordance provided by the SFFX approach is that a spatially positioned audio effect can be automated to move through the sound field, resulting in a dynamic spatial wet/dry effect mix. As a practical example, like a spotlight tracking a performer on a stage, SFFX can be used to focus in and increase the gain of a moving sound source while suppressing background noise.

Fig. 2. Ambisonic energy visualizations with gain reduction effect (left) and gain isolation effect (right) both at 90° azimuth. This creates either a hole (left) or a spotlight (right) in the 3d sound field. Images created with IEM EnergyVisualizer plugin.

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Sluicer utilizes SFFX processes such as looping, pitch shifting, filtering, spectral blurring, and delays. One of the more experimental effects applied, I have coined Sound Field Displacement (SFD). SFD relies on the polygon configurations that underpin High Order Ambisonics for virtual microphone/loudspeaker positions whereby each vertex represents an individual audio channel in the 3d decoding/encoding scheme. With SFD, these vertices are repositioned in uniform ways to create rotations and transpositions or nonuniform ways to create spatial artifacts and discontinuities, offering new immersive qualities. In performance, the player selects from a bank of displacement maps to explore these transformations.

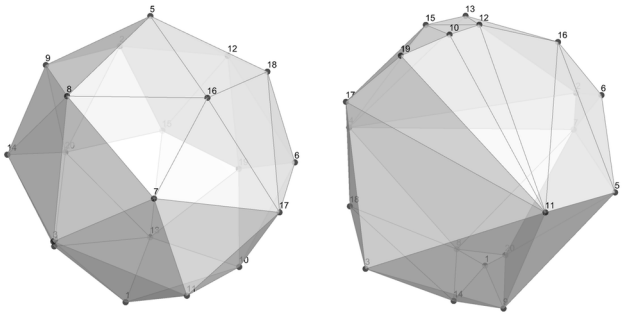

Fig. 3. Polygon representations of spherical 20-channel ambisonic coding. Uniform distribution (left), displacement (right) to create spatial artifacts and discontinuities.

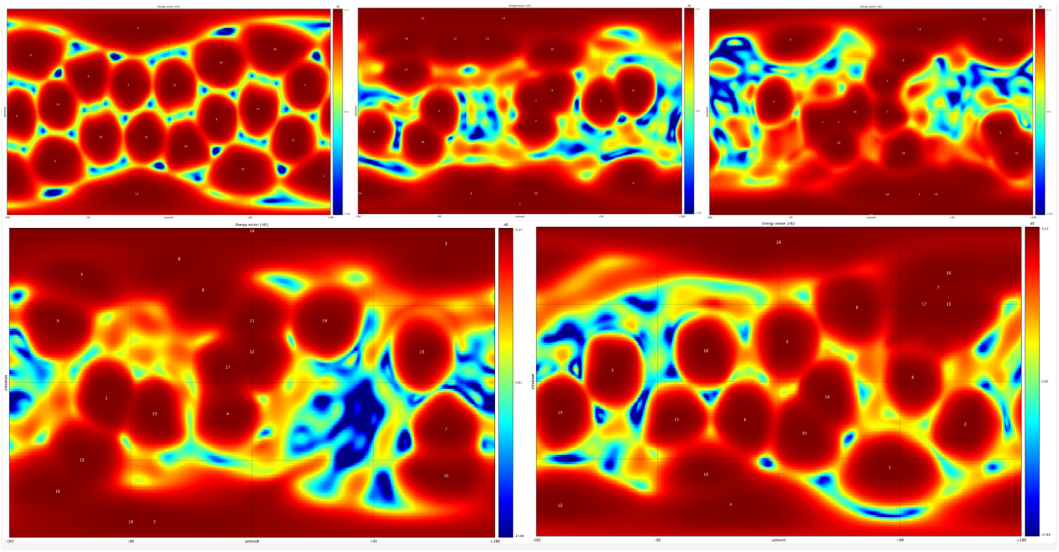

Fig. 4. Energy vector visualizations, 20-channel. Top-left is uniform distribution. Others are sound field displacements. Images created with IRCAM Spat.

3. PERFORMANCE NOTES

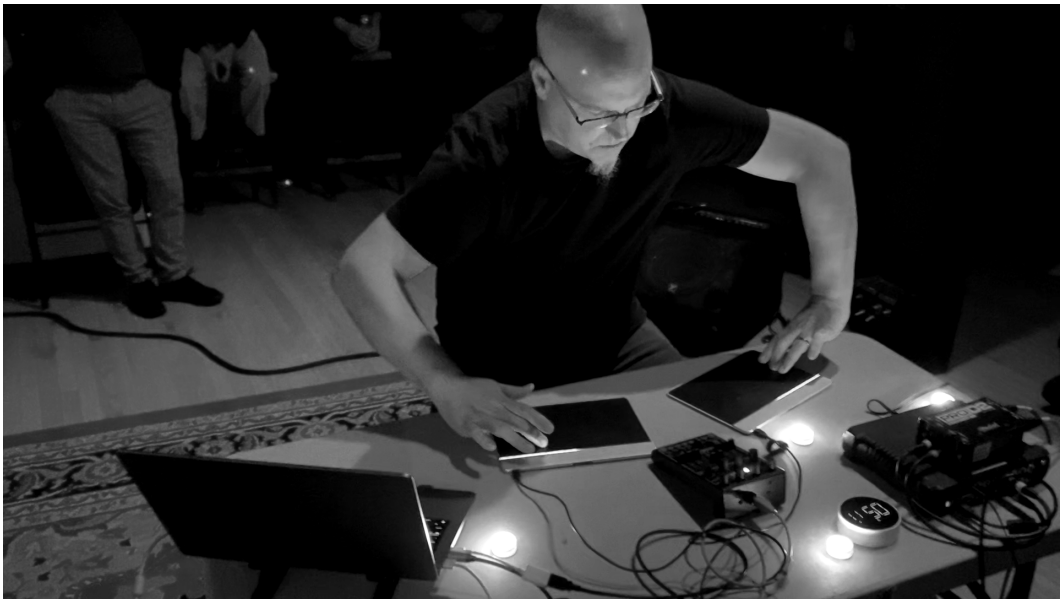

Fig. 5. Sluicer performance set-up.

Sluicer employs High Order Ambisonics, making it possible to decode for a variety of multichannel loudspeaker configurations. It can also be adapted for Wave Field Synthesis. The technical requirements that follow assume a performance in a concert hall or club setting.

PA system: Sluicer can scale to the available loudspeaker systems of the conference, from stereo to very high channel counts.

Duration: Because the work is improvisatory in nature, 12 – 15 minutes is requested for the performance.

Rehearsal: As possible, 30 minutes rehearsal time is requested. Set-up and break-down is relatively quick (~5 minutes).

Performer: The submission author is the composer and performer.

Equipment: I will provide laptop with custom software, USB control interfaces, and multichannel audio interface. I will need the venue to provide a sturdy table and chair, and power with extension cable/power strip for 3 connections: laptop, USB-hub, and audio interface. I will bring necessary adapters for power. I will also need the venue to provide audio cabling between my audio interface (TRS)

and the house system supporting the number of available speaker channels. Alternatively, I can use an audio interface provided by the venue.

4. MEDIA LINKS

- Audio. 13:27 duration, full performance: https://soundcloud.com/s3g/sluicer-trial-1-stereo-decode
- Video. 6:33 duration, rehearsal excerpt: https://youtu.be/6hXwXbzgp9Q

ACKNOWLEDGMENTS

I would like to thank Eric Lyon and the team at Virginia Tech's Cube facility for providing several opportunities to advance my work with High Density Loudspeaker Arrays.

ETHICAL STATEMENT

Sluicer is an original work by the author with self-conducted research and development. There are no known conflicts of interest present in this work, which has benefitted from funding and support of the author's employer, Rhode Island School of Design. There have been no external funders or grants for this project, and no aspect of this research involved studies with animals or the participation of human subjects.

REFERENCES

[1] *FOAFX*. (2022), RISD Studio for Research in Sound & Technology. [Online]. Available: https://github.com/risdsound/foafx

[2] A. Farina. "Performing not linear processing on High Order Ambisonics signals using Adobe Audition CC and the SPS approach." http://pcfarina.eng.unipr.it/Aurora/Ambisonics-Denoising.htm (accessed May 6, 2024).