Open-Source 3D Spatializer for Sound and Musical Recognition in MaxMSP using HOA Library and Jitter

Kerobo, Justin A.

Motivation and Background

- A musician, artist, composer, or even scientist has many needs when it comes to the sound space, which is one of the first dimensions of the contemporary musical and sonal thought.
- There are many ways to affect the virtual sonal environment with hardware and software. Of the various tools in the electroacoustical domain, this focuses on spatialization. Using this, an artist can create new music, a composer can change sound directly, and a musician can edit their sound in real-time.
- HOA Library [6] is one of the tools that has allowed for musicians and composers to synthesize, transform and render sound spaces in a creative and artistic way. However, due to Spatium [3], Jamoma [4,5], MIAP [8], and other open-source spatialization tools, HOA Library is widely overlooked.
- Therefore, I developed "SonoSpatial Walk," a 3D audio sequencer that uses MIDI and HOA Library (v2.2) [7] that is dependent on nothing but open-source, cross-platform libraries. I use the HOA Library for the spatialization by getting the values of the environment by the Jitter and OpenGL [1] matrix that creates the objects, space, and scene by values. (Fig 1)
- The program also allows for the saving of sounds and objects in the space, along with reverberation values of the room that are editable due to the HOA Library. You can control the room reverberation, enable keyboard control, Fullscreen, non-movement commands, and navigation commands in the sound space with MIDI control. It all connects by adding a interface by using Java allowed for the traversal of the sound space with a keyboard and mouse to be able to trigger objects. Finally, testing the performance of the system by measuring the sound spatialization to get the finite impulse response (FIR) frequency response by using the buffer~ object in Max to convolve an input signal with samples from an input buffer.

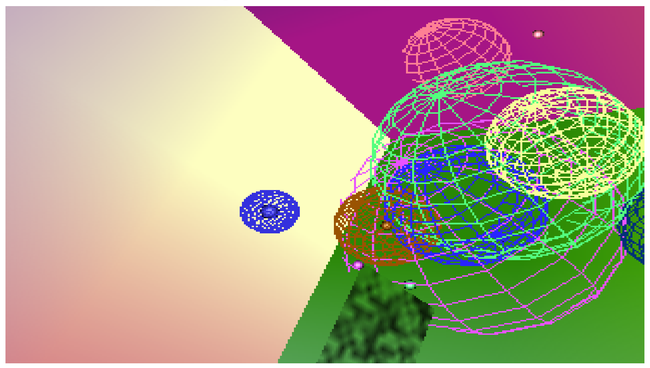

Fig 1. A skybox corner, spheres and triggers; plus the starting plane.

Program Design & Implementation

- The design was developed, improving greatly upon the design of SoundStroll [2], a 3D audio sequencer. ”SonoSpatial Walk” is form of a Max Collective, that uses MIDI and HOA Library (v2.2) that is dependent on nothing but open-source, cross-platform libraries. The overall flow of the data in the application is shown in Figure 2. To start making a proper scene, these patchers, which are shown in Figure 3, must be opened:
  - Graphics (shapes.maxpat),
  - Sphere Setting Interface (sfcolorsgui.maxpat),
  - Sound Spatialization is happening (for example, HOA_ soundhost_2.maxpat)
- The development of SonoSpatial Walk relied upon developing the various Max patches, and connecting multiple tools.

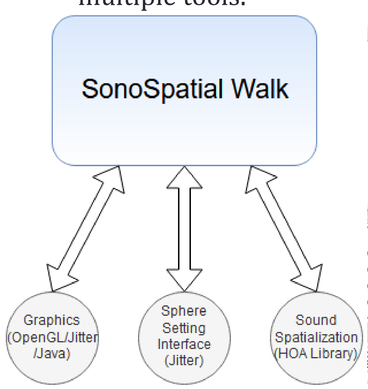

Fig 2. Overview of the flow of data in the collective.

Fig 3. Max Patches

References

1. Cycling ’74. Appendix B: The OpenGL Matrix Format. June 2009. URL: https://docs.cycling74.com /max5/tutorials/jit-tut/jitterappendixb.html.
2. Vic Hug. Tool: SoundStroll. 2014. URL: https://cycling74.com/tools/soundstroll.
3. Rui Penha. spatium. 2012. URL: http://spatium.ruipenha.pt/.
4. Tim Place. A modular standard for structuring patches in Max. Nov. 2006. URL: http://jamoma.org/publications/attachments/jamoma-icmc2006.pdf.
5. Tim Place and Trond Lossius. Modular Patching and Programming for Realtime Media. 2006. URL: http://jamoma.org/.
6. Anne Sedes, Paris Guillot, and Julian Colafrancesco. High Order Ambisonics Library. 2012. URL: http://hoalibrary.mshparisnord.fr/en.
7. Anne Sedes, Pierre Guillot, and Elliot Paris. The HOA library, review and prospects. Sept. 2014. URL: http://speech.di.uoa.gr/ICMC- SMC-2014/images/VOL 1/0855.pdf.
8. Zachary Seldess. “MIAP: Manifold-Interface Amplitude Panning in Max/MSP and Pure Data”. In: Audio Engineering Society Convention 137. Oct. 2014. URL: http://www.aes.org/e-lib/browse.cfm?elib=17435.

Results

- One main performance metric: sound spatialization accuracy tracking with FIR filter using the buffer~ object in Max.
- FIR filter: is a filter whose impulse response is of finite duration.
- When you convolve the signal heard with samples from an input buffer, if the normalized frequency changes, the sound changes within the space, and shows that spatialization is working which is shown in Figure 4.

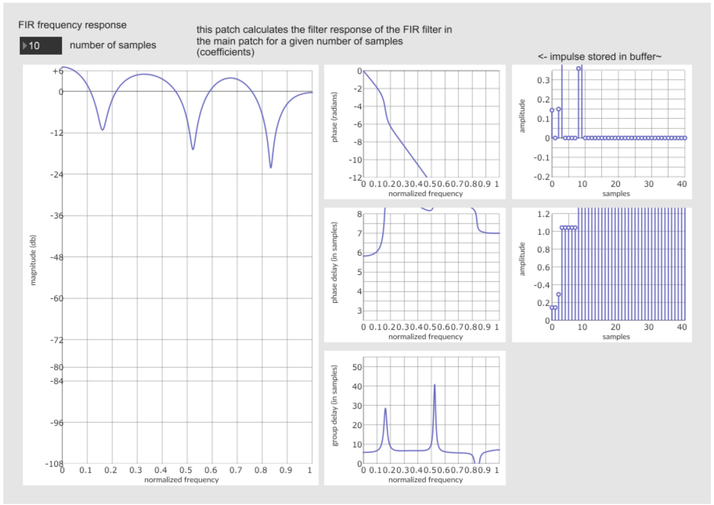

Fig 4. FIR Filter Data

Future Work

- Improve spatialization engine with a more efficient and new algorithm for lower latency systems.
- Add virtual reality headset compatibility.
- Directly map virtual synthesizer control to MIDI, which can be used assign sounds direct to spheres/soundsources.

Acknowledgements

- We are grateful to David Barbella, and Forrest Tobey.
- SoundStroll creator Vic Hug for developing a base using spatialization tools.
- Victor Huguenin, and to the people behind HOA and ICST ambisonics tools and IRCAM Spatializer, and to various Max users whom I could reuse bits of code here and there.