P.A.I.R.S. - Portable Ambisonic Impulse Response System

Good morning and thank you for joining and supporting all of the SURF Fellows. My name is Andrew Rahman and I'll be talking about my project, P.A.I.R.S. the Portable Ambisonic Impulse Response System. The purpose of the P.A.I.R.S. project is to capture the reverberation of historic spaces using state-of-the-art technology for archival use, future research, experimental composition and performance, and implementation in virtual reality (VR). I intend to record an acoustic representation, or a sonic snapshot, of each space using a technology called impulse response (IR), which will output a collection of digital sound files. Using an ambisonic[1] microphone, as opposed to a set of traditional microphones, allows these files to be decoded into any playback format–mono, stereo, 5.1, binaural,[2] etc. Currently, no one locally is documenting spaces using ambisonics, and the only local IR online is of Alcatraz Prison which was recorded using an older stereo microphone technique. With this project I set out to know what the best practices are for recordings spaces using ambisonics, know what is the best software for convolving and deconvolving[3] the IRs, and to be the first, and possibly last, person to sonically document these spaces prior to their inevitable ruination.

So, let's get technical; how does it work? Ambisonics is a technology developed in the 70's that records and plays back audio in a sphere around the observer. Due to the high cost of production and necessary processing power it is just now gaining real momentum and use thanks to personal computers and virtual reality. The recordings are taken in a proprietary recording format called "B-format," which is incredibly versatile as it can be decoded into any standard

[1] Ambisonics is three-dimensional sound. One dimensional sound is stereo: a standard two-speaker system. Two-dimensional sound is surround sound, but those sounds are still on a horizontal plane only. Ambisonics records the sounds above and below the listener as well.

[2] Binaural literally means "having or relating to two ears." Binaural hearing, along with frequency cues, lets humans and other animals determine the direction and origin of sounds.

[3] The easiest way to think of this is to imagine a recording of a guitar. Then convolving it with one of the IRs will make the guitar sound like it is being played within that space.

microphone format. This means these recordings can be used in a variety of applications and future uses, making them far more valuable than a standard stereo recording. For my project I will be using the first consumer grade Ambisonic microphone, the Brahma Microphone.

This microphone is used to record an Impulse Response, which is like a sonic snapshot of the space. Traditionally IRs were created by firing a blank cartridge from a starter pistol into a space and recording the shot and reverberation tail. Like this, ***clap.*** Aside from this being dangerous and extremely loud, it also creates much more noise in the recording, making it more difficult to use and require more post-processing. However, a newer technology has been created which sends a sine wave that sweeps the entire audible spectrum into the space, exciting it, and causing it to resonate. This makes for a cleaner and easier recording. The sweep will be generated by my laptop and broadcast into the space by a Meyer Sound AMIE studio monitor, which has been generously loaned to me by the manufacturer for the duration of my project. Once the recording has been taken, software is used to remove the sine wave sweep from the recording, leaving only the sound of the space. This process is called “deconvolution.” There are many different softwares that deconvolve audio and generate sine wave sweeps, most of which are freeware, which I will be analyzing as part of my research on a set of criteria such as: installability, usability, sound quality, functionality, features, support, and aesthetic. To attain these recordings the system must be portable as it is taken into each of the sites, set-up, and tore down each time. I intend to get the system to fit into one Pelican case that has been loaned to me by the Center for New Music and Audio Technologies on campus for the duration of my project.

I selected my sites on a few grounds: those that are seismically unsound, their age, and acoustic resonance. Here is an excerpt of the list of sites I intend to record: The South Hall (1873) - This is the only remaining building from the original build of the campus, and because of this it is also the oldest building on campus. The Old Art Gallery (1904) - Just West of Anthony Hall (the building with the Pelican statue), this building has been deemed unusable due to seismic instability and currently functions as bike storage for the UC Police Department. However, it is owned by the music department, who wishes to use it as an additional performance space due to its acoustic resonance. The Hearst Mining Building and Tunnels (1907) - The entryway of the Hearst Mining Building has been used on several occasions for musical performances thanks to its wonderful reverberance. Additionally, the old mining tunnels beneath it have been deemed seismically unstable and are only used sparingly for research on the Hayward fault. The Hayward Fault is what originally inspired me to take on this research as many of these buildings will be destroyed during its next major quake. Recording these tunnels will be a way of directly tying my inspiration into the project. Finally, the Woo Hon Fai Hall (1970) - The old Berkeley Art Museum, with its stark and severe brutalist architecture, has been deemed seismically unsound, despite being built in the 1970s. It is currently out of use, yet it has not been taken down, providing me an opportunity to take advantage of the unique sounds such a unique structure contains.

Due to numerous setbacks I have encountered, which I will not expound upon here, I have yet to do a single recordings and thus cannot draw any conclusions. That said, my next step is to take P.A.I.R.S. to St. Mark’s cathedral and do initial testing. Meanwhile I will contact all the sites to gain access after hours to complete the recordings. After which the analysis of the recordings and softwares will begin.

I’d like to take a moment to thank all of the contributors to this project: George Emblom, music director at St. Mark’s Cathedral, for providing me unlimited access to the church’s Nave for initial testing. Professor Davitt Moroney for encouraging me to pursue this project and providing me with additional spaces and focus for the project. The Mary Nunez Sousa Award for selecting me for their 2016 scholarship to help fund this project. Meyer Sound of Berkeley for loaning the AMIE studio monitor for the duration of my research. The Center for New Music and Audio Technologies for all the research assistance, vital connections, and space to review and analyze my data. My mentor Professor Edmund Campion, director of CNMAT, for providing me encouragement and endless support through all of these setbacks and helping me stay focused by providing me with additional research materials. The entire SURF staff–Sean Burns, Melissa Griffith, and Justin Lopez–for all their hard work helping each of us sort through the mire of bureaucracy, technology, finance, and data. And finally, the Anselm Foundation, for without their support and generous contribution to the Student Undergraduate Research Fellowship program I wouldn't be standing here today. Thanks to this overwhelming support am able to fulfill one of my dreams, one of the reasons I chose to attend UC Berkeley.

Thank you.