# Sound Spatialization

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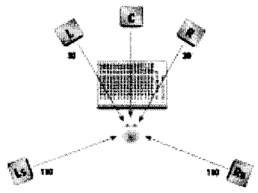

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## Abstract

A proposal is made to create an environment in which to do multi-channel audio mixing and DVD production.

The primary purpose of the facility is to produce surround sound audio mixes in DVD format. These would be synchronized with text, video, slide shows, animations, or other visual information. The facility will permit production of student and faculty works, which could be published and used to showcase work being done at the university.

As an educational tool it will be used to develop aesthetics and approaches to mixing a variety of music styles in a surround sound environment, and as an authoring tool for multimedia educational products for distribution on disk or via the Internet.

In addition, it will support an research program in a number of areas, such as the use of sound spatialization as an organizing principle for music composition, and the development of software to control the motion of virtual sound sources in space with parameters derived from the sound itself.

This facility would be used primarily by Music Media majors and faculty from the School of Music. It

would also serve as a resource for students in the College of Fine Arts and in collaborative projects with other departments such as computer science, fine arts, theatre, communications, KRVS public radio, and the Center for Cultural and Eco-Tourism.

# The purpose of the grant and its impact

The grant proposes to buy equipment and software to create an environment for student and faculty music production and research. A computer with associated peripherals will make it possible to compose and record music, edit it, process it, distribute it in a surround sound space, synchronize it with video, and produce finished DVD disks. The School of Music has a growing Music Media concentration which includes audio production and film scoring. Presently there are approximately twenty million homes in the United States with home theater systems, allowing listeners to experience audio in a surround sound environment, and DVD machines are starting to replace VHS tape decks. There is a market for compelling material, and a need to study sound distribution. It is expected that in the coming years there will be a proliferation of home and concert facilities with multiple audio channel systems, and that surround sound will be an area of growth in media productions. This proposal is designed to prepare students and faculty to take advantage of the potential of the latest technology. As a production facility, this proposal will create an environment in which students and faculty can produce multi-channel works. It will also provide a research environment for the study of sound distribution and spatialization, and a place where software modules can be developed and tested.

The complexities of mixing in a surround sound environment present engineers and musicians with new opportunities and challenges. We have become accustomed to hearing music presented from two loudspeakers. Now when we can have three speakers in front and two in the back, where do we place the instruments in the new sound field? Should only ambient reverberation come from the rear? Should the approach to mixing depend on the kind of music is being mixed, with different settings for symphonic music, small jazz groups, and other genres? Now the listener can be transported to sit in the middle of the orchestra, or moved back to listen from the best seat in the auditorium. Because of DVD's large capacity for data there can even be the option of listening to the same piece from different vantage points, like DVD movies can offer different versions of a story seen from a variety of angles. The DVD listener can switch from one perspective to the other by pressing a button on the remote control. There is as yet no common practice however for the preparation of DVD materials, and these new capabilities provokes those involved to rethink the relationship between composer, performer, and listener. A university is the ideal place to develop these ideas and do the necessary interdisciplinary research, removed from the economic pressures of a release schedule and promotion expenses to recoup. Strategies developed in research facilities can then work their way into society.

Composers throughout history have made use of physical space in their work. In some pieces performers are seated on and off stage, but they usually remain in one place for the duration. Musical styles and instruments have evolved along with the physical spaces in which it was performed. Whenever a new technology appears it is easiest to use it to do familiar tasks done in the past in a more efficient way. It takes more imagination and patience to discover new applications, things that were not possible before. Of special interest to the principal investigator in this project is the control of sound distribution by linking position of a sound to one or more of its own characteristics. For example, the notes of a phrase could move along a path in space with its motion controlled by its pitches or tone quality. Sound in a surround sound environment does not need to be fixed the way it is with human performers on stage. Under computer control the locations it takes could become an organizing formal principle in composition, the way that harmony has been in the past. A facility such as this provides the tools needed to experiment with sound and how it is perceived, and to see what works best in a musical context.

One of the goals of this facility would be to produce software modules that move sound dynamically and automatically, and musical productions that demonstrate these effects. The development of software modules that plug into established software packages is emerging as a way for small teams of developers to create products. It is hoped that algorithms for processing sound developed in our facility could be marketed as software additions for commercial sequencing and mixing software, or be included in hardware such as synthesizer keyboards.

An advanced research and production facility such as this naturally depends upon and benefits from interdisciplinary involvement. Music technology is a specialty within music and relies on expertise in other fields such as computer science, graphics, animation, video, and communication in order to take full advantage of the rich environment of multimedia and interactive productions. Musicians who are not technically inclined along with students and faculty in other disciplines would be attracted to this facility, approaching it from different perspectives, with their own individual needs and areas of expertise. The technology creates a meeting ground where people learn from each other. Performers are needed to produce quality sound and want to make multimedia recordings. Artists are needed to create engaging designs to accompany the music. Computer experts are needed to get the most out of the equipment and create new capabilities. Engineers are needed to record, synthesize and process music. Where all these domains intersect is the room in which the equipment is set up. We expect that collaborative projects will emerge involving departments of visual arts, communications, as well as KRVS public radio and ULL's Center for Cultural and Eco-Tourism. We hope that a large number and variety of productions will result, such as concert recording, original musical compositions, student portfolios and demonstrations, and the musicological study and dissemination of regional culture.

**The projected lifetime** of the equipment is five years

**The person responsible** for the grant's implementation, installation, maintenance, operation, and training is Dr. Robert Willey. His Masters Degree is in Computer Music in which he specialized in sound distribution. During his doctorate studies he did pioneering work in processing systems for music performance. He currently teaches music media courses (studio recording and MIDI) and music theory.

# Budget details

For more information regarding the equipment and software cited below, follow the links on the page: http://www.louisiana.edu/~rkw3943/grants/spatial/links.htm

### 1. Equipment

**Computer —**Power Mac G4 (Apple)

A computer will be used as center of the audio workstation. The G4's Superdrive option is required in order to burn finished DVD's. A second hard drive should be added to one of the bays for audio files in order to increase the number of possible channels and improve performance. 1 Gb of RAM is recommended to allow for the running of software plugins along with the host applications of sequencing and mixing.

**Audio interface —** Digi 002 (Digidesign)

Advanced digital/analog audio interface. Includes a processing card to install in computer and

an integrated digital audio mixer (which can be used separately from the system for remote applications). Allows for microphones and electronic instruments to be recorded on the computer, to mix down tracks, and to distribute them to separate output channels. Comes bundled with ProTools and additional software.

**Amplifier —** AVR-683 (Denon)

Takes output of Digi 002 mixer and amplifies the signal before sending to the loudspeakers. Five amplifier channels, separate inputs for each channel, surround sound decoding, Dolby decoding.

**Loudspeakers —** 5 monitors for surround sound, 1 powered subwoofer for low frequencies. "5.1 Surround Sound" means five smaller loudspeakers around the listeners, with an additional subwoofer to handle the low frequencies from all the channels. In total six speakers are needed:

(5)"Monitor One Mk2" speakers (Alesis), arranged front left, center, right, rear left and right

(1) powered subwoofer. The subwoofer having its own amplifier is recommended when using home A/V amplifiers such as the Denon AVR-683.

## 2. Software

**ProTools** — industry standard program for digital music production. Allows for recording MIDI, microphones, and line level signals.

**DVD Studio Pro** — professional DVD authoring, assembling surround sound files and doing Dolby encoding.

**Final Cut Pro** 3 — non-linear audio and video editing.

The following three programs are needed in addition for research purposes:

- **Max / MSP** — a graphical programming environment for MIDI and audio processing. Includes over four hundred objects with which applications can be developed. This is the language in which our signal processing applications to control sound spatialization would be developed.
- **Pluggo 3** — comes with a large library of plugins and virtual synthesis instruments, and support for new plug in development. This is how stand alone applications could be developed and distributed.
- **Jitter 1.0** — set of video, matrix, and 3-D dynamic interactive graphics objects for the Max graphical programming environment. This would add interest to music productions when published in DVD format.

Budget spreadsheet

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