MetaMuse: A Novel Control Metaphor For Granular Synthesis

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ABSTRACT
Traditional musical instruments have a direct connection between the way they are played or controlled and the properties of the sound produced. This connectedness has, in general, been lacking in computer-based musical instruments. We present a prop-based synthesis controller that uses a metaphor to create a connection between the control and the sound. Specific to granular synthesis, the metaphor is one of falling particles striking a surface to create a sound. The concept is extensible to other metaphors and other synthesis techniques.

Keywords
granular synthesis, metaphors, prop-based interface, computer music

INTRODUCTION AND MOTIVATION
Traditional musical instruments have a physical connection between the sounds they produce and the controlling of those sounds. The connection provides a framework for the musician, making the controllable parameters of the instrument apparent and dictating the skills needed to play aptly. This connectedness is lacking in most computer musical instruments because a stream of numbers replaces the underlying physics of the sound production. While this abstraction provides a lot of flexibility in the design of such instruments, it also results in a lack of apparentness and intuitiveness in the interface, forcing many computer music interfaces to remain fairly simplistic. These instruments don't provide the expressivity required for masterful playing.

Many instrument builders have attempted to overcome this controllability issue, often by falling back on traditional instrument form factors such as keyboards, wind controllers, or bowed controllers [2]. However, such an instrument then becomes confined to the framework created by the original instrument. How, then, can the connectedness of a traditional instrument be extended into non-traditional form factors?

A metaphor can be used to create a connection between the controller and the sound production. Metaphors allow the user to take advantage of his or her real-world experience to form an understanding of the system. A metaphor also creates the instrument' s framework, constraining and clearly defining the control-space while allowing expressivity within that framework. Such a system could provide enough controllability to allow it to be played at a high level of skill.

We explore the use of metaphor using a prop-based interface, which creates a tangible representation of the metaphor while allowing simultaneous control of many variables [1]. The system is based on granular synthesis, which uses short samples of sound played in an overlapping fashion to create an overall sound effect [4]. We use it to create natural rain sounds or human emotional sounds such as laughter or clapping.

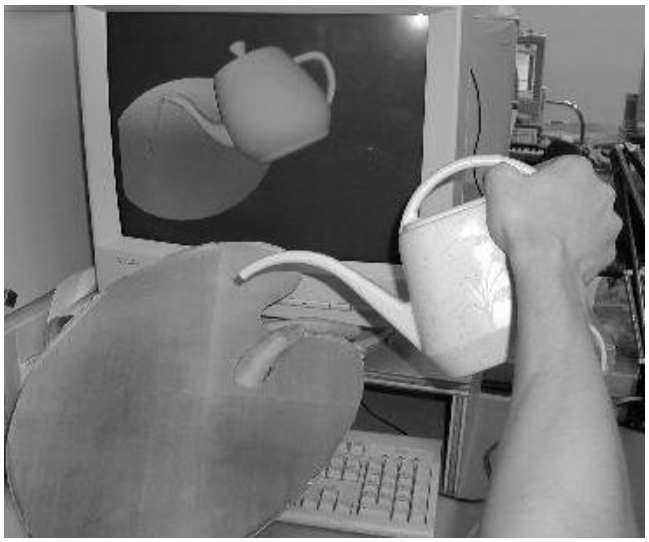

Figure 1: MetaMuse in use, showing props in front of rendered image. Note that the palette's surface has a colour pattern.

DESIGN OF A PARTICLE-DRIVEN INSTRUMENT

MetaMuse uses the metaphor of a falling particle impacting a surface and creating a sound as an interface to a granular synthesis engine. This choice of metaphor defines a class of instruments in the same way that choosing to excite a string with a bow identifies the class of traditional instruments that includes cello and violin. Props are used to control the particle model; the mapping of prop positions into physical model parameters and then into granular synthesis parameters defines the specific instrument within the class.

Two props are used in MetaMuse: a watering can and a flat palette. The watering can affords the creation of particles through the motion of pouring, and acts as real-world pouring experience would lead the user to expect. The palette creates a surface on which the particles can impact. Once again natural parameters are used; for example, the velocity of the particle on impact affects the volume of the resultant sound.

IMPLEMENTATION

MetaMuse is implemented in C and jMax, with a calibration GUI in Tcl/Tk. The physical simulation of the particles is implemented in C and uses a simple physics model. Polhemus Fastrak sensors are mounted on the props to provide position and orientation information to the model, which is updated in real time through a serial port library and graphically represented using calls to the OpenGL libraries. The interface to the synthesis engine is discussed below.

There are several controllable parameters in the synthesis engine. Granular synthesis requires that a sample be played; that sample can be chosen from several samples of varying lengths. The rate at which the sample is played can also be changed, as can its volume. The ways in which these parameters are mapped to the controller are dictated by the metaphor.

Particles are produced at a rate that depends on the tilt angle of the watering can and have an appropriate initial velocity; they then fall freely due to gravity until either they intersect the surface or time out beyond the user's view. When a particle intersects the surface, its relative position and velocity are calculated and sent to jMax through a UDP connection, initiating playback of a granule. The six parameters of position and velocity are used to calculate the synthesis parameters, which are distinct for each granule.

Three sound samples are associated with different positions on the palette and are mixed together on playback depending on their distances from the particle. An abstract pattern on the palette provides a positional frame of reference for the player. The velocity of the particle maps directly to the playback volume, as expected. Multiple particles also have an effect, increasing the overall volume and adding a random offset to the playback rate, which is perceived as a change in pitch. This creates the illusion of multiple, different voices, rather than a single voice repeated many times.

CONCLUSIONS

The MetaMuse system has been implemented and works as described herein, providing an expressive interface for the exploration of a sound space. Two sound spaces have been created: one based on the sound of rainfall on various surfaces, the other consisting of a range of human emotional sounds such as laughter and clapping. Those who have used the system during informal lab demos have found it to be intuitive and enjoyable to use.

FUTURE WORK

MetaMuse will be evaluated through full user testing. We will test controllability by comparing our system with a standard GUI controller and will also examine expressivity.

There are many future directions for this research work. Direct extensions to the system could include more complex mappings involving additional parameters such as variable particle types, and waveform sculpting to allow the player to control granules' attack and sustain. The concept of metaphoric instruments can be explored both within the class of instruments based on particle simulation for granular synthesis and in other classes.

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