The Sponge

A Flexible Interface

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ABSTRACT

The sponge is an interface that allows a clear link to be established between gesture and sound in electroacoustic music. The goals in developing the sponge were to reintroduce the pleasure of playing and to improve the interaction between the composer/performer and the audience. It has been argued that expenditure of effort or energy is required to obtain expressive interfaces. The sponge favors an energy-sound relationship in two ways : 1) it senses acceleration, which is closely related to energy; and 2) it is made out of a flexible material (foam) that requires effort to be squeezed or twisted. Some of the mapping strategies used in a performance context with the sponge are discussed.

Keywords

Interface, electroacoustic music, performance, expressivity, mapping

1. INTRODUCTION

Before electricity was available to the masses, the energy at the origin of all music was human[8]. Since the electroacoustic medium arrived, the human energy is no longer necessary to produce sound. The natural gesture-sound link is severed.

As an electroacoustic composer who used to be a performer, I miss that link which is inherent to the practice of an acoustic instrument. I miss the playful feel and the interaction with the audience.

That is why I decided to build an interface.

The sponge is an interface that looks like a spongy cuboid. Because it is made out of foam, it is squeezable, twistable and flexible.

It was designed mostly for a personal use. The main objective was to allow a clear link to be established between gesture and sound in electroacoustic music.

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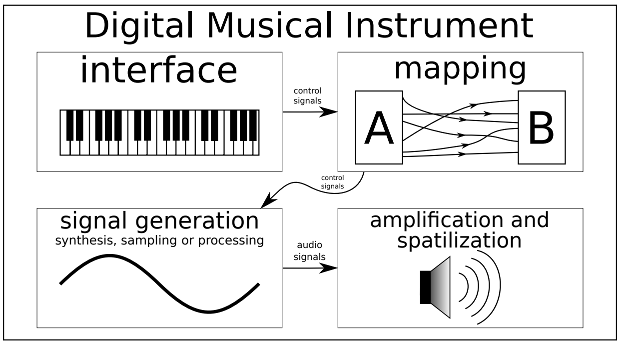

Figure 1: In the context of this paper, a digital musical instrument (DMI) is a complete system, while an interface is the first stage of an instrument.

An Interface

The sponge is considered to be an interface, not an instrument. I am not aware of any consensus on the exact difference. I do not pretend having a definitive answer on that matter, the goal is simply to clarify the terminology used in this article.

I consider an interface to be a device that enables communication between two systems. In the current context, one of the systems is a human while the other is a computer. I consider an instrument to be a more complete device that includes an interface, a mapping stage, a signal generation stage and a sound generation mechanism.

In other words, instruments make sound while interfaces do not. Figure 1 illustrates this nuance.

2. ENERGY AND EFFORT

It has been argued that playing a digital musical instrument (DMI) should require effort or energy[2, 3, 7, 6], especially if one wants it to be expressive. It is possible to achieve that goal using almost any type of interface, as long as the signals from the sensors are appropriately mapped to the musical parameters. A good (and simple) example is found in an experiment led by Hunt and Kirk[2], who mapped the *speed* of a mouse to the amplitude of a sound : to make a sound, the mouse had to move.

This energy-sound relationship has to be created at the mapping stage, but it is also possible to favor it directly in the interface design.

The sponge favors an energy-sound relationship in two ways :

- It senses acceleration, which is closely related to energy.
- It is made out of a flexible material (foam) that re-

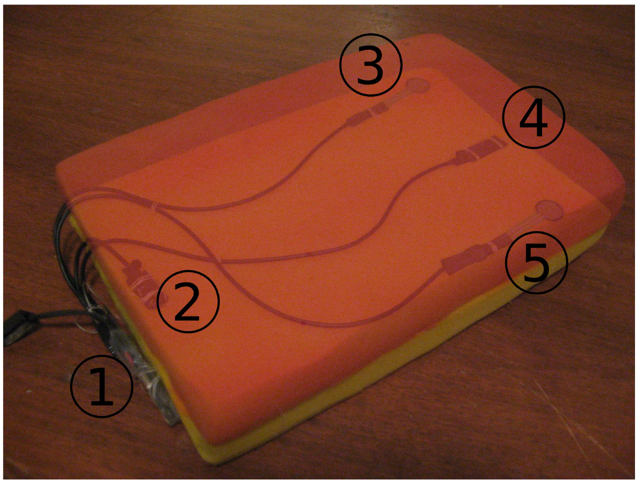

Figure 2: The sponge (transparent view). Wi-microDig interface(1); 3D accelerometer(2); Force Sensing Resistors(3 & 5); 2D accelerometer(4).

quires effort to be squeezed or twisted.

In short, the sponge is well suited to sense energy.

3. THE SPONGE

3.1 Design

A lot of new interfaces for music are based on existing acoustic instruments. They can be very valuable for a performer who already masters his instrument and wants to use his skills to perform electronic music, but such an interface can also be a double-edge blade. It will condition the way the interface is played and even how the music is written for it. Moreover, the audience's expectations will be influenced by the look of the interface.

The sponge was designed so that it does not remind of any traditional acoustic instrument and so that it would not dictate any musical paradigm.

3.2 Construction

3.2.1 *Sensors*

The sponge is made out of two layers of foam in between which all the sensors are sewn or glued. Figure 2 is a transparent view of the sponge where the 4 sensors and the Bluetooth interface can be seen.

FSRs sense the squeeze on two specific spots of the sponge. Accelerometers are used to capture movements, vibration, shocks and tilt. Their data can be processed to obtain pitch and roll. They are each located at one end of the interface (2 & 4 in figure 2). By comparing the pitch and roll at both ends, we obtain the torsion and flexion of the sponge.

3.2.2 *Conversion and Communication*

The sponge uses a Wi-microDig[1] interface. It is a commercial Bluetooth device which is capable of converting 8 channels of analog signal to digital data. The resolution is 10 bits and the maximum sampling rate is 1500 Hz.

The sponge uses seven of the eight channels available :

- 3 channels for the 3D accelerometer.
- 2 channels for the 2D accelerometer.

[1]The Wi-microDig interface is commercialized by Infusion Systems. More information can be found on their website : www.infusionsystems.com.

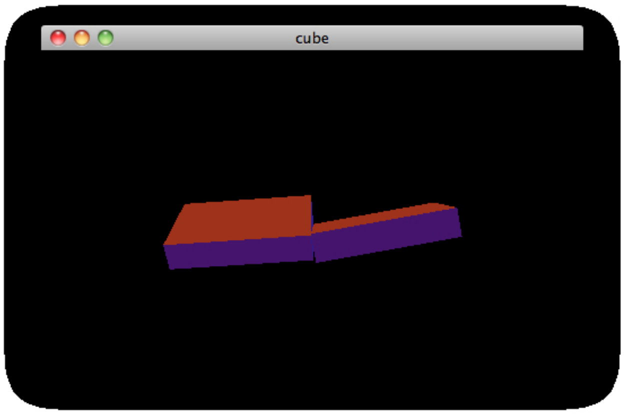

Figure 3: A visual feedback for the sponge: each cuboid follows the position of an accelerometer. Width and thickness represent the pressure applied on the FSRs.

- 1 channel for each of the two FSRs.

3.3 Software

The sponge is used in conjonction with the SuperCollider environment (SC).[2] [3] The Wi-microDig appears to the operating system (OS) as a standard serial device. SC can easily handle such a device, but the data (which is in the form of MIDI sysex messages) still has to be parsed. To accomplish this task, the *Wimicrodig* SC object was written. It provides high level methods to receive and send data to the Wi-microDig.

To be able to debug more easily and work more comfortably, a visual feedback that gives an overview of the state of all the sensors is very useful. For that purpose, a 3D representation of the sponge was used. Two cuboids each represent one accelerometer. Their pitch and roll follow the position of the sponge while their width and thickness follow the pressure on the FSRs. Figure 3 is a screenshot of that visual representation.

4. MAPPING STRATEGIES

Electroacoustic music is often composed using a digital audio workstation. On such a tool, sound parameters are almost always controlled discretely and sequentially. When playing an acoustic instrument, a single gesture has an impact on several parameters. Such a global control allows the production of complex articulations. Articulations are a variation of a multitude of interconnected parameters at the same time. Adjusting these parameters sequentially is a very tedious task.

I believe that to be expressive, a musical phrase needs to be articulated on many layers. The goal is to move the focus away from the parameter level (objective) to the character level (subjective). Therefore, I favour complex many-to-many mappings.

Mapping is an inherent part of my compositional process which is why a different mapping was used for each of the two works composed for the sponge. Their title, *Cymbale* and *Clarinette*, is a direct reference to the sonic material the interface is mapped to.

In *Clarinette*, the mapping is divided in two layers, following the advice of [4] and references therein. The first

[2]The SuperCollider software and its documentation can be found on sourceforge : supercollider.sourceforge.net
[3]The version of SC used for this project is 3.3.1 for Mac OS X.

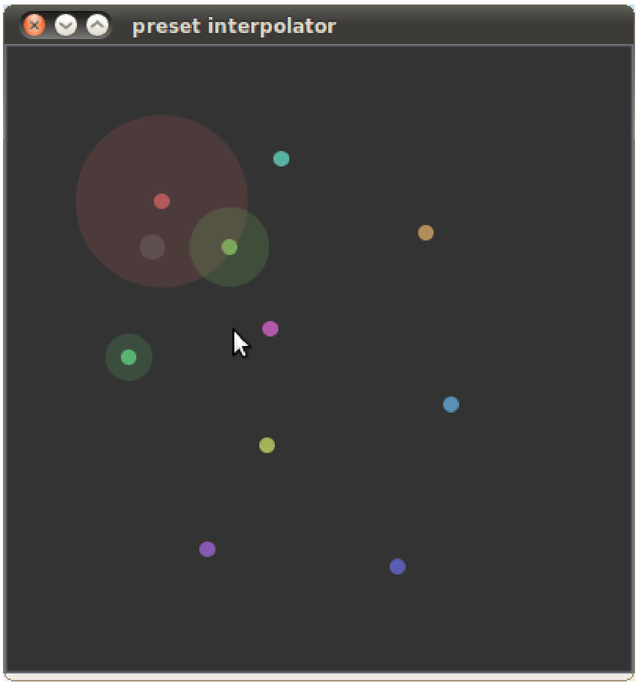

Figure 4: In the preset interpolation GUI, each colored point represents a preset. The bigger grey point represents the interpolated position. The transparent circles around the points represent the weight of each preset.

layer combines data from multiple sensors to extract torsion, flexion, vibration and squeeze.

The second layer uses a strategy inspired by [5] and [1]: a 2D preset interpolation system. Describing this system is beyond the scope of this paper, but here is an overview of its characteristics:

- it was programmed in the SuperCollider environment and works under Linux and Mac OS X;
- the 2D map of the presets is editable via a graphical user interface (GUI);
- each preset is represented by a point and can be placed anywhere in the space;
- each preset can have any number of parameters;
- each parameter can be assigned any task (controlling an SC Synth, sending OSC or MIDI messages, etc);
- each parameter can be scaled to any range.

This mapping sytem allows a simultaneous control of a virtually infinite number of parameters. Such a global control is analogous to the one found in acoustic instruments.

However, as I discovered with my first project(*Cymbale*), a simple one-to-one strategy can also be effective in establishing an interaction with the audience. Data from the sensors was directly applied to additive synthesis parameters. Shocks were used to trigger cymbal samples and to navigate in the different sections of the piece. By mapping an accelerometer axis directly to amplitude, a tremolo effect could be produced simply by wiggling or bending the interface. According to feedback received from the audience, the link between gesture and sound was easy to perceive and to understand. From the performer's point of view, having such a fine control over the tremolo is very pleasing.

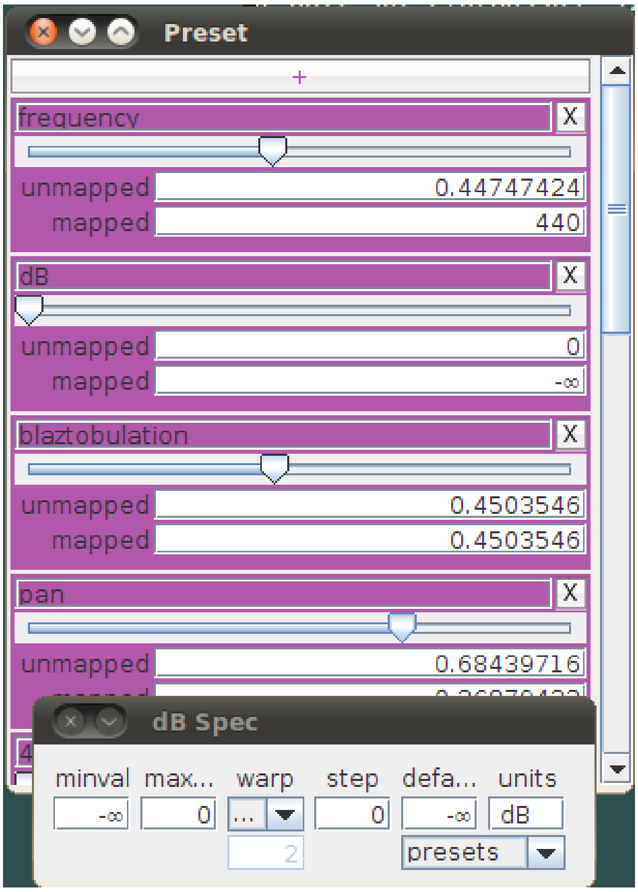

Figure 5: When a preset point is double-clicked in the preset interpolation GUI, the preset window is opened. Each preset may contain any number of parameters. The range and action of each parameter are user configurable.

5. CONCLUSION

The sponge is part of a solution to the severed gesture-sound link problem and has certain haptic characteristics that could favor expressivity.

Future plans include improving the hardware, but most of the challenge resides in the mapping. Building on the simple one-to-one mapping that established a clear gesture-sound link, more evolved techniques will be explored in upcoming compositions.

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