Evaluating the Performance of a New Gestural Instrument Within an Ensemble

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ABSTRACT
This paper discusses one particular mapping for a new gestural instrument called the *AirSticks*. This mapping was designed to be used for improvised or rehearsed duos and restricts the *AirSticks* performer to only utilising the sound source of the other musician playing an acoustic instrument. Several pieces with different musicians were performed and documented, musicians were observed and interviews with these musicians were transcribed. In this paper we will examine the thoughts of these musicians to gather a better understanding of how to design effective ensemble instruments of this type.

Keywords
mapping, new instrument, electronic percussion

1. INTRODUCTION
This paper examines mapping design for a new gestural interface for electronic percussion called the *AirSticks*. The design of the mapping is described and findings from a series of interviews conducted with musicians who performed in ensembles with the *AirSticks* are presented. All of the musicians interviewed collaborated on *Vacuums* or on pieces where the *Vacuum* mapping was used. *Vacuums* are a set of pieces that feature Ilsar playing the *AirSticks*. Ilsar had limited his palette of sounds to only those sampled from the other featured instruments; for example, in *Drum Vacuum One*, an acoustic drum kit was sampled. The process of working on one of these pieces either started from a score or from an improvisation, and either ended with an improvisation or a written composition. All improvisations and compositions were recorded, and most were also filmed (see Table 1). With the exception of some samples pre-recorded during rehearsals for the use in the compositions, all the sounds in these pieces, other than those created by the acoustic instrument, were sampled, triggered and manipulated in real-time by Ilsar on the *AirSticks*. The *AirSticks* allows the electronic percussionist to map various percussive gestures in different spaces to different sounds. It also allows the manipulation of these samples through changes in position and orientation of the hands, fingers and feet.

In this paper, we will give a brief outline of the workings of the *AirSticks*, specifically for the *Vacuum* mapping. We will summarise the initial motivations for the mapping, and discuss how these motivations have changed as other musicians have become involved in the creative process. The data gained from journal entries and the observation of and interviews with the musicians will be summarised, with the themes of composition, improvisation, collaboration and choreography explored.

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2. THE AIRSTICKS
The *AirSticks* are designed to take full advantage of the performance possibilities that open up when a percussionist is not required to strike a surface, while still maintaining a clear relationship between performer gesture and computer generated sounds. The *AirSticks* give the percussionist control over complex sound textures at the same time as allowing them to time and execute precise rhythmic gestures. The interface takes advantage of the motor skills of an expert percussionist and combines it with all the real-time control over sound permitted by modern software [6]. The *AirSticks* are currently made up of the Razer Hydra Gaming Controllers. Position and orientation data for the two controllers is captured and analysed by a custom piece of software running on OSX which outputs MIDI data. The Graphic User Interface, or GUI (see Figure 1), is made of a grid and two floating points that represent the middle of each controller. A differently coloured box and a differently shaped floating point instructs the performer as to the y position of their hands, while the x and z positions are shown on the screen like a curser controlled by a mouse. The performer can see in which box each hand is in, and note that when they tilt past the trigger angle, the box lights up, signaling a note-on message. The faster the performer crosses a tilt point, the greater the velocity. This data is accompanied by MIDI data containing information about hand, finger and foot changes in position and orientation. Combined, this data provides the performer and composer with a plethora of mapping possibilities within such music programs as MAX/MSP and Ableton Live. A MIDI Trainer capability, of particular use with Ableton Live, allows for easy MIDI mapping. For a more comprehensive technical overview of the *AirSticks* and a comparison to other open-air controllers see previous work [6].

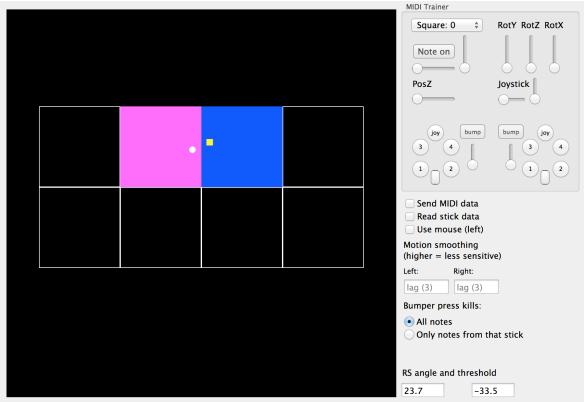

Figure 1. The current Graphic User Interface for the *AirSticks*.

3. THE VACUUM MAPPING

There has been a long tradition of percussionists being 'attracted to the use of electronics' [2]. The *Vacuum* mapping was initially designed with the motivation of creating an electro-acoustic instrument that would allow the percussionist to sample and manipulate their sonic environment. In designing this mapping for the *AirSticks*, 'the instrument's responsiveness to its acoustic environment, how it reacts to other instruments and how it reacts to the physical aspects of performing,' was considered [3]. The concept of the accidental was 'exploited through the amount of control exercised over the instrument, from complete - producing exactly what the player dictates - to none at all - letting the instrument have its say' [3]. In a mapping designed for performing a predetermined fixed composition, an instrument must be extremely predictable, whereas a mapping for improvisation may involve a more unpredictable output from the instrument.

3.1 Collaboration

Electro-acoustic improvised music pioneer Evan Parker, in an interview with Derek Bailey, states that for him the 'ideal music is played by groups of musicians who choose one another's company and who improvise freely in relation to the precise emotional, acoustic, psychological and other less tangible atmospheric conditions in effect at the time the music is played' [3]. However, during the beginnings of designing a mapping of a new instrument, work needs to be done alone to get the mapping to a state where these conditions can be dealt with as a musician on an unfamiliar instrument; an instrument that isn't 'conceptually complete,' one which undergoes 'a constant series of revisions, redesigns and upgrades' [12].

For this reason, like most new instruments we see today including Imogen Heap's *Gloves* [8, 9] and Onyx Ashanti's *beatjazz* [11], the earliest *Vacuum* mapping was designed for solo playing. Named the *Air Vacuum*, it culminated in several solo performances by Ilsar where he could sample and manipulate the sounds of a microphone feeding back in the room. Other pre-chosen samples were also used in these semi-improvised pieces. One of these performances with the *Air Vacuum* mapping involved short overlapping duos with other acoustic instruments on either end of his solo. This led to the idea of collaborating with a violinist to make an electro-acoustic improvisation called *Violin Vacuum*. With the success of *Violin Vacuum*, *Vacuum* pieces for *AirSticks* duos with drums, bass, guitar and vocals have all been performed. This process of collaborating with other musicians in the field of electronic music can be a lot more fulfilling than the common approach of cutting up samples in a studio for such musicians as Earle Brown, as he explains in an interview with Derek Bailey.

'...I found it very boring just to sit down in the studio and cut and splice tape and combine these things. I mean I really like the society of making music with people…' [3]

Since this early mapping, the *Vacuum* mapping has been developing in two ways to accommodate different types of collaboration. One use of the mapping is for improvisation or exploration of compositional ideas, while another is for the performing of a composition itself. We argue that using new instruments in more collaborative contexts across both the improvising and composing streams of music will not only help promote the culture of new instruments more rapidly, but through the process of observing and interviewing collaborators, we can design better instruments for high-level social interplay.

3.2 Vacuum Pieces

The process of gathering information from musicians was always a result of a creative process for either improvising or composing a piece. A journal was kept noting down certain ideas that were discussed during rehearsals and interviews were organised after the final performance (see Table 1). A grounded theory approach was taken to avoid hindering the creative process, keeping an open mind to the ideas of the other musicians. Interviews were recorded and transcribed, and the transcriptions were analysed for common themes and concepts. The musicians were invited to recall some of their most memorable performances involving an electronic interface and compare it to the experience of playing alongside the *AirSticks.* Then some of the ideas brought up during rehearsals were discussed finishing with a discussion of future possibilities for the *AirSticks* and new interfaces in general. An action research approach was then taken where information from these interviews was then put back updating the *Vacuum* mapping for the next collaboration.

3.3 Mapping for Improvisation

The *Vacuum* mapping for improvising has evolved throughout the creative process and the interviews with the collaborators. The original mapping utilised the upstroke to record a sample, and the downstroke to play it. This was sparked by the desire to communicate to the acoustic musician as to when they were being recorded. Unfortunately, the effect of the gesture of lifting the hands up into the air was 'confusing' (GJ), resulting in the conventional response of the other musician awaiting an instruction to play. Some performers did not 'feel comfortable feeding sound into the machine' (GJ), and though they commented on liking the 'energy' (GJ) given off by the gestures - falling in line with Pierre Hérbert's philosophy that '…the measure of a work of art is whether one can sense in it the presence of the artist's body' [12] - they felt that the flow of musical ideas was interrupted by the grand gesture of hitting the record button.

A more discreet mapping of using a button on the controller to record was employed, and the idea of instructing the acoustic musician as to when they were being recorded was relegated to a 'figurative gesture - wholly symbolic gesture[s] of the performer' [8], - one that is neither used to produce sound nor a biproduct of producing sound. It is important to note here that mapping discreet movements to sound must be chosen carefully. The more a mapping relies on discreet movements, the more the interface merges with ones like the mouse and keypad, the exact interfaces that the *AirSticks* is attempting to improve on. Discreet movements may give the performer more control over subtle parameters, perhaps leading to a more expressive instrument in one way, but these discreet movements start to hide the correlation between the performer's movement and sound from the other musicians and the audience. Having said that, the button accordion for example relies on small buttons for its playing, but the audience often knows enough about the workings of such an acoustic instrument to feel a sense of virtuosity and expression in the way the musician plays and moves with the instrument.

With the *Vacuum* mapping, different buttons correlate to different boxes in which samples can be triggered. Pitch and speed of the sample could do controlled with a rotation on the y-axis, volume on the x-axis and reverse playing with the thumb. The shortcoming of this part of the original mapping was the inability to avoid silence at the start of a sample within an improvised context, hence the need for a visual cue to start recording. Within the context of performing a rehearsed composition this was absolutely fine, as in *Dark as a Dungeon,*

Table 1. A list of collaborations with the *Vacuum* mapping

Musician Alias	Instrument	Piece	Performance Type	Documentation	Performance Date
BC	Violin	*Violin Vacuum One (Aalborg)*	Improvisation to Camera	Video/ Audio	24/09/ 2013
GJ	Drums	*Drum Vacuum One (Amsterdam)*	Composition for Film	Video/ Audio	11/10/ 2013
NM	Double bass	*Bass Vacuum One (Tel Aviv)*	Live Improvisation	Audio	05/11/ 2013
KS	Guitar/ Electronics	*Dark as a Dungeon*	Composition	Video/ Audio	23/11/ 2013
TM	Guitar/ Effects	*Tales of the Black-Winged Bird (Part II)*	Live Improvisation	Video/ Audio	08/12/ 2013
JM	Voice	*Voice Vacuum One (Sydney)*	Composition for Film	Video/ Audio	22/01/ 2014
JC	Guitar	*Guitar Vacuum One (Sydney)*	Composition for Film	Video/ Audio	23/01/ 2014

a performance to silent film for acoustic guitar, electronics and *AirSticks* that utilised some of the features of the *Vacuum* mapping. Within improvisation, however, the use of a gate has been developed to delay the recording of a sample so that the a sample with a clean attack could be played back. Having said that, 'experimental improvised music is music that turns unexpectedly, leaping abruptly and uncontrollably away from conventions' [1], so having an unpredictability to the mapping, as discussed before, can have its benefits.

Another way of attaining a clean attack was to use granular synthesis, loosely based on the mapping of Michel Waisvisz for his instrument *The Hands* [9]. A strike through the air in certain areas would play the last two seconds of sound recorded. The velocity of the strike would control the velocity of the sample. Pitch could be controlled by moving along the x-axis, grain size and spray could be controlled with the thumb and the sample would remain being played forwards or in reverse by rotating down or up on the x-axis respectively, until a lift above the trigger point would turn the sound off. This use of a percussion instrument metaphor is used to improve transparency [5] and utilise the motor skills of the expert percussionist [10]. The *AirSticks*, as all open-air controllers [13], demands the performer and audience to use their imagination in ways that acoustic instruments, or even electronic pads have not done in the past. Consequently, a virtual space is created around the performer. One obvious way of exploring this space in a meaningful way is to map a layering of a drum kit. The *AirSticks* allows the easy manipulation of this space, moving drums around to places they would not usually be, or changing between different sounds with different approaches to a virtual trigger box. For example, striking a box with the palm facing up could trigger a sound resembling a kick drum, but striking that same box with the palm facing down could trigger a snare sound, with the sounds morphing between each other across the z-axis rotation. Forming continuity between these sounds is a great advantage of such an open-air controllers, morphing between different sounds in the space, as opposed to jumping from one to another. This can help the audience better understand the way the original sampled acoustic sounds are manipulated through movement.

The use of the drum metaphor can also be explored to communicate ideas and cues to the other musicians, as one of the collaborators explains.

'BC: *I think I'd need to play with you more to really understand what the mapping is doing. Because when I understand what the mapping is doing and I understand what you are actually playing, it would be like watching a violinist play, or a drummer play. You know when the drummer is playing the toms, you can see what they are doing, or when they are hitting a cymbal. Whereas with the AirSticks I can't see how the space relates to the sound yet. All I can see is that if you wave your arms around there tends to be more intensity. Or if you hit at a certain rate, it's more like a rhythm. So... Um... being able to read where on your spatial map those different sounds are and having that quite clear so if you move over there I can hear... I can hear that you are moving onto the toms or an equivalent drum kit or I can see that you are about to hit a cymbal or something.*
AI: You'd like it to be more like a drum kit even though it doesn't sound like a drum kit?
BC: No, I'm just using that metaphor for you.'

On top of these options for sampling and triggering, the *Vacuum* mapping also features a set of gestures that enable the manipulation of the recorded samples and the acoustic instrument in real time. These include reverbs, delays, vocoders, distortions, bit reducers, equalisers and panning, all mapped to gestures that can be learned by the other musician, except for mode changes between these effects which were mapped to discreet buttons.

'BC: The gestural elements of the instrument are really quite powerful. And the reason why they are powerful is because they cue me... the intensity of your movements reflect the sound, so sometimes you are waving your arms around quite fast, and you're doing beat, or... you know I can see what you are doing, so in that way it's like an acoustic instrument and it's much more um... informative for me. I feel like I am playing with someone, whereas if you are playing from behind a laptop it is much more one sided, it's not nearly as inspiring for the improvisation I think.'

3.4 Compositional Approach

The *Vacuum* mapping for the performance of a composition did not feature the ability to sample in real-time, only to manipulate. Samples were prerecorded and edited earlier in the creative process so that the composer could have more control over them. Some of these compositional ideas came from an improvisation, others from previously composed pieces. Samples for the compositions were placed in the virtual boxes and manipulated in a similar fashion to the mapping for improvisation.

Perry Cook informs instrument designers to 'make a piece, not an instrument or controller' [4]. Similarly, Schell and Battier coined the term 'composed instruments' design to help instrument designers think of mapping in a new way. They split electronic instruments into three categories – 'musical instrument, machine and representation' – to help us understand their complexities [14]. They define a musical instrument as something that enables 'the performer enough degrees of liberty to explore personal and original ways of playing with it.' [14]. For them, a machine 'is under the control of complex computational and algorithmic layers,' while a representation combines the two first categories. 'Composers use the representational nature of the system to define events, write scores and specify the computational and algorithmic layers while performers can apply gestural controls and adjust parameters' [14]. This combination of the composer and performer in new instrument design is analogous with the approach taken with the *Vacuum* mapping in combining the roles of the electronic producer and the expert percussionist. A compositional approach here starts with the electronic producer making a sketch of a piece of music on a computer, deciding on the main structures of the piece and the samples to be used. The electronic producer then turns their attention to deciding how to perform the piece, in other words how to map this sound to movement. Taking on the role of a percussionist, the electronic producer then learns how to play the piece on the *AirSticks,* improvising around the main structures of the piece, adding more layers of manipulation of parameters to the mapping. Finally, the percussionist collaborates with the acoustic musician in the rehearsal room to complete the semi-improvised composition, which includes the live manipulation of the acoustic instrument. The 'score' is then left open for different interpretations during each live performance.

Another way of looking at this trajectory of the creative process is defining these sections as composition, performance and choreography, and identifying the order at which they are placed. In the example above, composition moves to gesture mapping or choreography, then to rehearsing improvisations or playing with the written material, and finally to performing the semi-improvised work.

In the field of instrument design, this trajectory more commonly begins with the gesture mapping. Though changing this trajectory does not necessarily solve the problem of how sounds should be mapped to movements, starting with a more complete composition can inspire different ways of mapping sound to movement, or in this more choreographic approach, movement to sound. An example of this within the piece *Dark as a Dungeon* was the mapping of sounds to a confined small space during a section in the composition that represented men going down a shaft into a mine, juxtaposed against the mapping of sounds to an open large space in a section representing the vastness of a mountainous landscape. The collaborator in this case mentioned that 'it was great to have that visually [the choreography of the *AirSticks*] as part of the performance…' (KS).

4. FUTURE WORK

In this paper we have taken the approach of analysing the thoughts of expert musicians to help create a better mapping for a gestural instrument. Through performing several new works with these musicians, we do not only increase the output of creative works on new instruments to help promote the culture of new instrument design, we can also investigate ways of improving the way we map movement to sound, and sound to movement. By collaborating in several different ways, either through improvisation or composition, we can improve the experiences of musicians in utilising new instruments in their ensembles. More data about what musicians need and want from new instruments as composers or as collaborators can be used to improve new interfaces. We will continue to use the *AirSticks* in as many different contexts as possible and observe and interview musicians who come in contact with the instrument to get a better understanding of new instrument design for ensemble playing. See www.alonilsar.com for the latest performances on the *AirSticks.*

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