# An Approach to Collaborative Performance in a Digital Music Ensemble

Ian Hattwick

Center for Interdisciplinary Research in Music Media and Technology

Input Devices and Music Interaction Laboratory - McGill University

Marcelo Wanderley, advisor

Digital music ensembles (DMEs), whose performers all use digital musical instruments (DMIs), provide the opportunity to explore social aspects of computer music performance within an ensemble setting. Physical computing can provide a framework for a digital music ensemble for many reasons. Tom Igoe describes physical computing as "an approach to learning how humans communicate through computers that starts by considering how humans express themselves physically"[4]. This statement encapsulates several key approaches to ensemble performance in a DME. Considering how humans express themselves physically refers to more than just the use of expressive gestures such as hand movements. It also includes the ways in which interact with our environment, how we position ourselves in space – whether we face each other, move closer and further away from each other – and the ways in which we use eye contact and subtle physical cues. These physical expressions are then used as the conceptual frameworks for computer-mediated forms of human communication. By focusing on performer action and placement in the physical world we are responding to the assertion of many computer musicians who feel that the correlation between visible performer gesture and sonic result is an important part of audience experience [3].

The approach to interaction proposed here consists of two parts – a mapping strategy based on the parameterization of musical elements as well as the following principles for ensemble interaction:

- The performer interface should rely on gestures which would be meaningful to the performer, fellow musicians, and audience.
- Performers should each have their own speaker, which would be positioned on stage as to localize each performer's sound in a different place. However, the performers themselves should not be tied down to a specific location.
- The performer's attention should be on their fellow performers, with interaction being the focus. There should be no central conductor, sheet music, or any kind of visual projection. The performers instruments should not require visual feedback.
- The role of the computer, and its actual physical presence, should be minimized in order to direct attention to the performers.

The most important assumption underlying all of these points is that the focus is on the interaction of the performers. This interaction is dependent upon the clear communication of the performer's intent. This communication takes the form of the performer's physical actions and the sonic result of these actions, and there must be a clear connection between action and sound. The performer must be confident in their command of their instrument; therefore, they must not be burdened with an overly complex instrument or with complex compositions.

The parameterization of musical elements is an approached to mapping used by *The Hub* in their composition *The Minister of Pitch*[1]. Parameterization is made possible through the use of digital musical instruments, in which the control interface is connected to the sound generator by

mapping strategies[5]. Intermediate mapping layers can be used to map input data to perceptual or conceptual variables, where are then mapped to synthesis paramters[6]. The implementation presented here utilizes an intermediate mapping layer which takes each performers' individual control data and integrates them based on a collaborative schema. In this schema one musician's interface is mapped to only control rhythm, while a different musician's interface is mapped to only control pitch.

In the implementation presented here there are three pairs of musicians, each performing with a Nintendo Wii Remote. In each pair one musician deals primarily with pitch and timbre material and the other musician with rhythmic material. The pitch musician uses the accelerometer in their Wiimote to draw waveforms in three dimensions. When they hold down the Wiimote's trigger button the change in acceleration in each axis is written into a wavetable. When the button is released the wavetables are read independently to generate three waveforms, which are mixed together and fed to the audio output of the computer.

The rhythm musician has a system which is oriented towards rhythmic events. The acceleration of the rhythm musician's Wiimote is read at fixed intervals. Rhythmic events are generated at each interval whose maximum amplitude and duration are derived from the accelerometer values. The data from the x-axis is used to create a percussive gated noise sound and the data from the y-axis controls the amplitude of the pitch musicians' sound.

There are three elements to the sound generated by each pair. The first element is the rhythm musician's basic percussive sound which is controlled by the x-axis of their accelerometer. This works independently from the pitch musician. The second element is the sound generated by the pitch musicians. The amplitude of the pitch musicians' sounds are determined by rhythmic events generated from the rhythm musicians' Y-axes. This is similar to the way the rhythm musicians generate their basic percussive sound – at fixed intervals the y-axis acceleration is read and this value used to determine the amplitude and duration of a rhythmic event. This rhythmic event is then used to control a gate through which the pitch musician's sound is fed. When the y-axis reading is very small or zero the pitch musician's sound is effectively silent. The third sonic element generated by each pair is the ring modulation of the pitch musician's sound by a sin wave whose amplitude is controlled by the rhythm musician's x-axis.

# References

[1] Joel Chadabe. *Electric Sound: The Past and Promise of Electric Music*. Prentice Hall, New York, 1996.

[2] John Croft. Theses on liveness. *Organised Sound*, 12(01):59–66, April 2007.

[3] C. Dobrian and D. Koppelman. The "E" in NIME : Musical Expression with New Computer Interfaces. In *Proceedings of the 2006 conference on New interfaces for musical expression*, pages 277–282, Paris, France, 2006. IRCAM - Centre Pompidou in collaboration with Sorbonne University.

[4] Tom Igoe. The FAQs of Physical Computing, 2004.

[5] Eduardo Reck Miranda and Marcelo M. Wanderley. *New Digital Musical Instruments: Control And Interaction Beyond the Keyboard*. A-R Editions, Middleton, WI, 2006.

[6] M.M. Wanderley and P. Depalle. Gestural Control of Sound Synthesis. *Proceedings of the IEEE*, 92(4):632–644, April 2004.