Sound Scripts

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The Bent Leather Band Ensemble : Children of Grainger

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Stuart Favilla with **Joanne Cannon** and **Garry Greenwood**

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Abstract

Grainger's Free Music remains a rich source of discovery for contemporary Australian musicians. Free Music represents a significant departure point for electronic musicians and instrument makers searching for new musical language, form and expression. This paper presents research undertaken by the Bent Leather Band exploring Grainger's Free Music ideas within a twenty first century music making context embracing live improvisation, instrument and software design. Research outcomes presented in this paper includes a range of creative works; Meta Serpent wind controllers, the fourth generation of the Light Harp controller, new MAX based software engines for signal processing, control-modes and strategies for the instruments and music including Bent Leather Band's latest collection of works "Children of Grainger." This paper discusses technical issues confronting the contemporary electronic instrument builder and presents Bent Leather Band's aim to develop playable instruments.

Free Music

Since late 2003, Grainger's model of "Free Music" has been revisited by a number of Australian composers and experimental musicians. In all cases the Grainger Museum audio collection has revealed a surprising amount of interesting material that has redefined our previous notions of Grainger's Free Music experimental depth and rigor. Warren Burt's work covers the history of the Free Music experiments and presents an appendix of the audio collection.[1] His work rebuilding Grainger's unfinished Electric Eye Tone Tool; a seven part Free Music player machine, was supported by the ABC Listening Room and presented collaborative works for the Electric Eye by Tristram Carey, Catherine Schieve, Wang Zheng Ting and Warren himself. The Blisters Ensemble—an ensemble of Australian improviser/instrument builders including Jon Rose, Rainer Linz, Tom Fryer, Joanne Cannon and myself—were also commissioned by the Listening Room to investigate Grainger's Free Music legacy and this created a radiophonic work *Skeleton in the Museum,* which was selected for the 2004 International Karl Szcuka Pries.

The Bent Leather Band has continued to work on Grainger. We were surprised to discover the diversity of Grainger's experiments. The breadth of the audio collection was a stark contrast to the musical education we received in Melbourne; which sorely neglected Grainger let alone his experiments. I remember first discovering Grainger's Free Music back in the mid 1980s, in the library at La Trobe University. From there we found the Grainger Museum; which has had a long association with experimental electronic music. Finally Joanne and I began our collaboration with Garry Greenwood and through the exhibition of this work at the Grainger Museum, created the opportunity to work there with our Blisters project.

Grainger's Free Music comprises writings, recordings and the actual machines he created. "Music beyond the traditional constraints of pitch and rhythm," was developed through the construction of many bizarre instrumental experiments and prototypes including: sixth tone tuned pianos fitted with player systems, air pump powered reed organs capable of fine controlled portamenti, and large machines, such as the Kangaroo Pouch, which allowed the pitch of up to four electronic valve oscillators to be played by score of cut cardboard and paper rolls.[2]

Grainger's explains his Free Music as "music using gliding tones and irregular rhythms" throughout the 1951 recordings of his experiments and instruments. The 1938 manifesto explains his desire to liberate or *free* sound from the constraints of conventional pitch and rhythm:

> Existing conventional music (whether "classical"; or popular) is tied down by set scales, a tyrannical (whether metrical or irregular) rhythmic pulse that holds the whole tonal fabric in a vice-like grasp and a set of harmonic procedures (whether key-bound or atonal) that are merely habits, and certainly do not deserve to be called laws.[3]

This manifesto also reveals a desire to bypass the role of a performer or interpreter of his music. It directly follows Grainger's experiences composing for and rehearsing Theremin ensembles. His attempts to have his Free Music compositions played by musicians on Theremins never achieved results to his satisfaction.[4] It is doubtful that Grainger knew about categorical perception and perceptual limits on the human ear and how it would affect the performance of glides using Theremins.[5] Grainger was already using player piano technologies and the potential of piano roll devices became the hub of his Free Music activities.

As improvising live ensemble musicians, we had to consider how much Grainger's preference for paper roll player sequencing was going to influence the formation of our music. As improvisers, we are not interested in a paper roll or sequencing technique. But perhaps we share with Grainger a common desire to eliminate the "proverbial middleman," or interpreter.[6] We do know how impressed Grainger was with improvised music generally. He brought the Ellington Band into one of his composition classes in New York and Grainger's own top ten system rated Rarotongan improvised polyphony third;[7] well above Debussy and even Bach.[8] Therefore, as improvisers, we embrace Free Music as an opportunity to escape the rigid harmonic constraints of traditional pitch systems and also as a departure point for the development of new specialised musical instruments.

New Instruments

The field of new interfaces for musical expression continues to expand. Musicians are offered increasing access to new technologies that can develop new instruments. Network protocols such as OSC, are beginning to purge the old MIDI language through a range of new interfaces from Kroonde and Gluion. Micro-electronics internet groups such as the MIDI Box network run by Törsten Klose, have made available cheap MIDI circuits and PIC chip software; allowing musicians the chance to construct their own customizable interfaces. Novel controllers, mixers and DJ spatial sensor interfaces for music are available straight off the shelf in music stores.

A constant proliferation of theoretical literature regarding the development of musical instruments has also flourished over the past five years. Amongst this proliferation are ideas that challenge the relevance of traditional notions of music performance such as; whether the role of virtuoso performance is valid or not; and the blurring of the traditional roles of composer, performer and listener.[9] New definitions of what an instrument is and should be is being investigated by a new generation of researchers and is increasingly divergent from any traditional music model embracing a diverse range of performance activities including dance rave events, web based instruments, interactive works, game controllers multimedia installations and mobile phones.

Twenty years ago Jeff Pressing imagined a super-instrument.[10] It posited a human limit of up to ten independent degrees of freedom and provided the player with multiple channels of quality sensory feedback. Controllers were expected to develop high resolutions, scanning rates and sensitivities capable of performing very fine expressive control of music. Although Pressing's instrument has been achieved in part, much of today's work lies in the domain of instruments for public interaction. In stark contrast to Pressing is the work of Ryan Ulyate and David Bianciardi (2000). Their ten commandments of interactivity require "no expertise," "no thinking" and measure quality of control from immediate reactions of players or participants.[11]

Other approaches proposed by Cariou (1998), and Mulder (2000),[12] develop new instruments to existing human motor skills, rather than requiring the musician years of commitment to developing new skills. Pedro Rebelo's work applies the media theory of prosthesis to instruments.[13] Physical modelling is used in an intervention of an acoustic sound to mimic, extend or fulfil a potential of the body (acoustic instrument). For Rebelo, the player's intention and the instrument (which he defines as a point of resistance) constitutes an *acoustic threshold*.

Other interesting areas of research include the continuing development of controllers modelled from existing acoustic instruments such as Cormac Cannon's EpipE Uilleann Pipes (2003) and Diana Young's HyperPuja.[14] Completely new novel instruments designed for a specific form of synthesis or sound generation; including Sile Ómadhráin and Georg Essl's PebbleBox and CrumbleBag controllers for granular synthesis and Blockjam a polyrhythmic sequencer interface that forms a series of interconnecting block switches.[15] The switch's function is displayed by an LED panel and can change throughout an interaction or piece.

Something that seems to be lacking from the field overall is a development of new original music through new instruments/interfaces and although there are many new contributions made to the field in the form of new instrument prototypes, very few of these prototypes are developed to the next generation. The field has also responded to the rise of sound design over music.

Our musical instrument work has been primarily concerned with skilled ensemble performance of new sounds. Our broad research aims have been to create new music, performance and ensemble techniques and new instruments. So far our work has developed in order to embrace specific musical languages. Over the past five years, our language has specialized in beat-less, microtonal and gliding forms of sonic expression. In essence we have been playing a digital form of Grainger's Free Music.

The Evolution of Playability

Our idea of a playable instrument is one that essentially does not limit or inhibit the development of skill. The key is a balance between the instruments' expressive potential, responsiveness, quality of feedback, embodiment of the sound and the instruments' ability to provide the player with an intuitive understanding about the music being played. The instruments we were going to build had to suit the music we played and also work well together in ensemble. We defined this as *playable*, meaning:

- expressive
- responsive
- versatile in solo and ensemble performance
- visceral (naturalness, appropriateness, good visual feedback)
- palpable (allowing for skill development, an instrument you can practice for hours)
- inspiring (intuitive, revealing new things to the player)
- an instrument that has a definitive sound or character.

The focus on playability was intended to unify all aspects of controller interface design across as many possible disciplines, such as cybernetics, HCI, ergonomics, gesture research and skill development. Specific areas we have focused our preliminary research on have included tactile, haptile control and expert skill development,[16] the combination of dominant (attack based) gestures with ancillary or (modifying) gestures and the potential limitations of bimanual control.[17]

The goals of the project were as follows:

- to build an ensemble of new playable electronic instruments
- develop a new improvised music and ensemble
- build prototypes and develop them into mature aesthetic instruments
- explore the language of Percy Grainger's Free Music.

The overall aim of the research was to create successful instruments, their playing techniques and ensemble music simultaneously. Our process was reflexive, sometimes beginning with a sound or process and then finding physical gestures that could effectively control them. Sometimes gestures discovered their own sounds. We investigated playability through the development of two distinct instrument projects; one investigating the potential of light sensors to trace virtual strings for a musician to play (the Light Harp); and another project investigating the potential of live signal processing control of double reed (the Meta Serpents).

Light Harp

The Light Harp uses spotlights and lasers to trace virtual strings through space. The instrument is a MIDI controller and was originally built in collaboration with David Brown (a violin and shakuhachi maker) and Robin Whittle (a notable computer music instrument developer and designer).

After earlier models were built, using wood, fibreglass and steel as construction materials, the current Light Harp was made from leather by the talented Tasmanian leather artist, Garry Greenwood. This version supports an extensive array of controllers. These include an active electromagnetic whammy bar, a two dimensional bamboo whammy bar, two large wheels, breath control and two touch sensitive strips. It is usually played with up to five independent dimensions of freedom. It is also boosted with a control panel of sixteen assignable pots for synthesis parameter control. The instrument controls synthesisers, software synthesisers and signal processing.

The Light Harp's specialized hardware allows for the threshold attenuation of light sensors. This reduces the response time of light sensors (less than 2msec) and makes sensing beams playable of up to 200 MIDI notes a second. This means that unlike conventional keyboards and other controllers, the Light Harp is capable of performing extremely dense and interesting textures not to mention glissandi. It is well suited to the performance of equally tempered microtonal tuning systems such as the sixth tone tuning system used by Grainger to approximate glides and perform "loud unisons," (tremolos) with his own butterfly piano. Within the Free Music project the Light Harp has referenced the butterfly piano by using piano samples as a source timbre for all sound creation.

The experience of building two previous instruments has brought about changes to the instruments dimension and shape. The neck now supports a scalloped tactile playing surface so the player can feel the sensors sitting under the fingertips. The curvature of the neck has been increased making the instrument's dimension more compact and additionally, the ancillary controllers have been grouped in accordance with bimanual control, emphasizing a right handed role for leading attack gestures against a left handed passive modification role.[18] Whenever possible, a breath controller is used to control dynamics or attacks.

Figure 1. Light Harp Ancillary Controllers

Figure 2. Leather Light Harp dimensions 164 x 64 x 29cm

The aesthetic design of the instrument merges elements from Indian music and 1930s valve radio equipment. Bakelite and French polished controller knobs are set against flat polished leather panels. The Indian elements include the dragon (yali) headpiece, human physiology of the pelvis (instrument base), spine and vertebrae (neck and sensors), lotus flower (the tailpiece), and the fluted trumpet end. With the exception of metal control panels, a strip of supporting metal and wooden pieces supporting the base, the instrument is constructed entirely from leather.

Serpents

The evolution of the meta-instrument controllers began with the sensor modification of simple double reed instruments. Joanne Cannon, a bassoonist and Australia's chief protagonist for the creation of an Australian electric bassoon, wanted to transport her reed playing into a signal-processing environment.

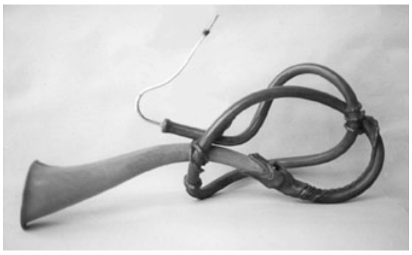

Figure 3. Serpentine Bassoon
photo by Philip Kuruvita 2002
dimensions 33 x 78 x 26cm

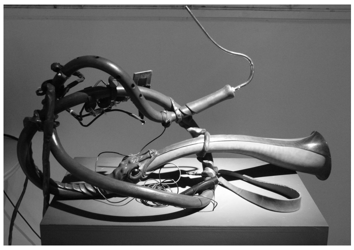

Figure 4. Serpentine Bassoon
controllers attached
photo by authors, 2005

The first prototype instrument used force sensitive resistors and a passive magnetic proximity sensor to track the spatial position of the instrument's bell. This instrument was interfaced via a MIDI control circuit to a laptop running MAX which in turn controlled a number of effects units. The musical language we developed for this instrument made heavy use of delays, which we used to create additional parts. These techniques required fine control of delay times and more controllers were desired to independently control the multiple audio streams. The major drawback of this instrument proved to be its limited tonal production. This led to the idea of making long tubes with open holes.

The second prototype instrument we built in collaboration with instrument leather instrument maker Garry Greenwood. The Serpentine Bassoon is a leather meta-bassoon, with a 2.4 metre conical bore. The instrument has eight open holes; which can be used to play pitches or closed with stoppers allowing for sensors to be played instead. This instrument produced a variety of timbres reminiscent of bassoons and horns. Two contact condenser microphones were used to pick up a large variety of sounds and the signal was processed using MAX/MSP via a Digi002. Dials were added for fine delay time and other parameter control and three force sensitive resistors were used to control dynamic features of the signal processing such as acoustic or delay feedback etcetera.

The third instrument, dubbed Contra Monster, has a 3.6 metre conical bore and was built for maximum signal processing control. It has two built in condenser microphones, and fifteen controllers including three dials, one fine tuning dial, one fader, two joysticks and six small force sensitive pads; in the place of finger holes. The sensors have been positioned ergonomically for ease and effectiveness of use and the interface was completed with a small built-in display for the performer. The Contra Monster is capable of ten simultaneous degrees of freedom.

Figure 5. Visual Display
Contra Monster 2005

Figure 6. Detail of force-sensitive resistors
Contra Monster 2005

Figure 7. Joystick Controller
Contra Monster 2005

The current instrument was built around a MIDI Box Plus PIC controller that was redesigned to make the circuit board smaller. A small panel of push buttons allows for the instruments controller mode to be changed allowing for over 760 possible assignments for the MIDI controller signals.

Figure 8. Contra Monster
dimensions 55 x 184 x 23cm
photo by author 2005

The aesthetics of the serpents combine the same elements adopted by the Light Harp. The Serpentine Bassoon was made as a direct relative to the Light Harp using the same colour scheme and leather dyes. The Contra Monster's visual aesthetic combines 1930s Bakelite radio dials, French polished panels and an Indian theme of a lotus or orchid design.

Free Music Mappings and Implementation

Software is a necessary part of our process and a laptop is the host computer for practical reasons. The laptop is effectively the live effects studio and MAX software allows all of our sensors to be mapped to all the parameters we use to play our music. Our mappings are fixed, not dynamic, but we will usually switch between several mappings during a performance. The instruments however, constitute the interface between the musician and software with the laptop remaining off. Sensor mappings consists of a number of process stages including sensor adjustment (rectification), rescaling, processing (including averaging/interpolation of data); and finally the mapping and tweaking of a specific parameter of synthesis or signal processing.

Signal processing and synthesis techniques have developed from experiments using delay with modulating or playable delay time. The technique is commonly associated with echoes. However, if the feedback of the signal and the delay time can be accurately controlled, tones and independent lines can be achieved in a myriad of ways.

Signal processing techniques explored so far have included; pitch shifting (coarse, tuned, continuous or modulated), extensive control of delays (to create pitched feedback tones), distortion (overdriven or boosted signals, ring modulation, noise, clipping and unstitched wavelets), and granular treatments (streams, clouds, pitch shifting, distortion, prolongation, and accenting), this list is not exhaustive. We developed processing techniques in MSP but also had great success hacking groups of existing VST format plug-ins including those found in Cycling's Pluggo suite and other freeware plug-ins.

Throughout the project we were conscious of providing each instrument with its own character. This was achieved by limiting the source timbres. In the case of the serpents their source is the sounds created by the double reed anyway, but the Light Harp, a synthesizer controller can play a huge variety of sounds. In the theme of Grainger's microtonal butterfly piano experiments, we limited the Light Harp to using only piano samples.

As our work developed our mapping strategies have grown much larger encompassing sets of over fifty parameters. These mappings are responding to the development of a reflexive approach to playing and are designed to offer a large number of possibilities to a performer. The central idea to these mappings is to create stock standard number of simultaneous sensors whose behaviour can then be governed by a set of ancillary knobs or other more passive systems of control.

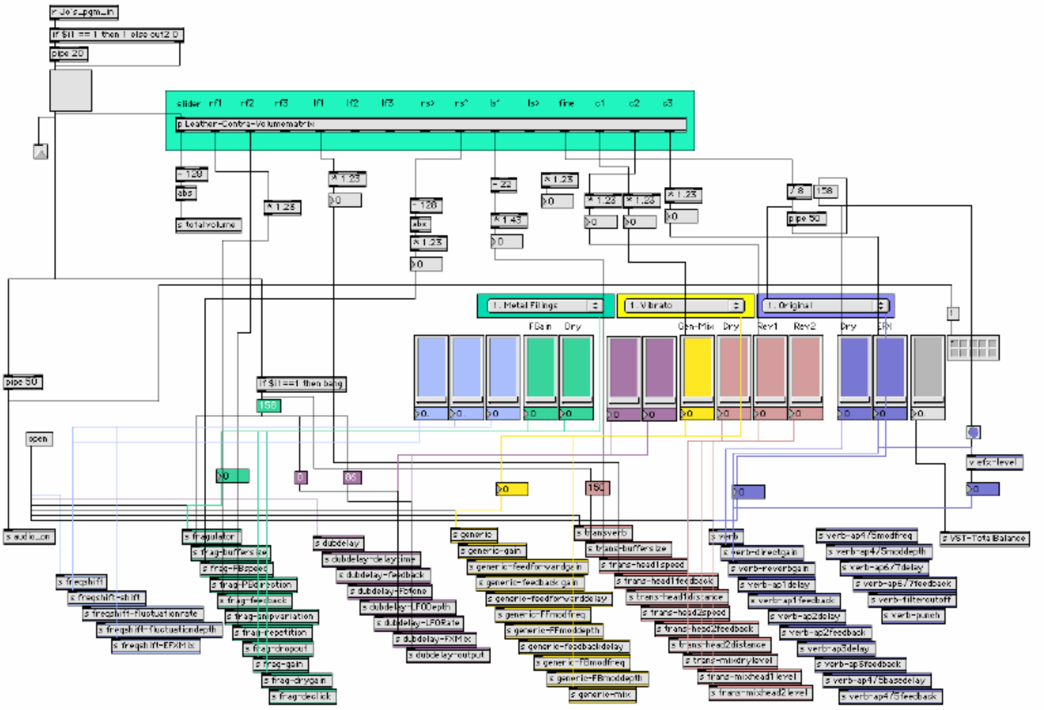

Figure 9. An example of a simple Contra Monster VST plug-in mapping

The Light Harp for example has a standard playable set of sensors including light sensors (pitch or note/sample trigger), breath control (attack/volume), two dimensional whammy bar (push = feedback, side to side = delay time), a force sensitive strip allows for another simultaneous control for filtering, two large dials which can also be played controls fine delay time, modulation speed/depth and or specialized filtering parameters. These main controls are supported by a number of other controllers extending the mapping with up to sixty four additional transformations such as: transposition (+-6ve), re-scaling of temperament (quartertone, sixth tone, seven tet, nine tet, twenty three tet, sixty four tet microtonal sets), fine tuning shifts, modulation controls, envelope controls for filtering or amplitude envelopes, signal processing parameters for delays, flangers, chorusing, flanging, distortion and granular effects. Our experience has found that these larger mappings are intuitive, revealing more each time they are explored.

Intrinsic to the success of mapping gesture is the notion of *embodiment*. This remains a subjective area of research and we define *embodiment* as a convincing relationship between physical gesture and resultant sound. Convincing in this sense does not necessarily mean *realistic*. Nor do we subscribe to the research areas of *audible* gesture or *universal* musical gesture in relation to our work. We believe, for example, that the tiniest movement of a fingertip is entitled to make the hugest possible sound. After all, that is a good example of what a digital instrument can do that acoustic instruments (great pipe organs the exception) do not. We also think of *embodiment* as a process. It is discovery, questioning and searching for a response in the context of an artistic discourse, an ongoing dialogue between the musician, the controller interface, the software mapping and the music.

Future

Currently the instruments' sensor implementations are limited by the small seven bit MIDI controller resolutions. Although we have found ways around these limitations in regards to the control of audio and synthesis processing through data interpolation, averaging and smoothing, these techniques result in data hysteresis (sluggishness) and are really only a compromise.

The next stage of development will involve upgrading the instruments to OSC via Gluion interfaces. The Gluion is capable of much faster scanning rates (up to 1ms) compared to other OSC interfaces on the market. This should offer a sense of immediate control with a significant boost to resolution. The signal latency of computer processing remains a significant problem. We have also found software synthesizers to be limited in terms of polyphony and also in regards to tuning system implementation.

In conclusion, this project has created instruments, techniques and music exploring Grainger's Free Music, i.e. music using gliding tones and irregular rhythms. We have explored and extended Grainger's ideas and legacy through the creation of new *playable* electroacoustic instruments. The research has created a folio of creative work including two finished CD albums, hours of recorded experimental work, international concert performances, exhibitions, television, radio performances and videos.

Acknowledgments

We dearly acknowledge the contributions of two remarkable Australians. Firstly to Garry Greenwood, who's passing in April this year was a tragic loss. Garry's incredible leatherwork will inspire Australians for years to come. An artist of rare talent we dedicate our work to Garry. We also would like to acknowledge Jeff Pressing for his support and belief in our work over the years previous to his passing. Without Jeff's support, we would never had believed in developing our first prototype.

Bibliography

Burt, Warren, *Percy Grainger's Work With Music Technology Melbourne* (Melbourne: Independent Media Centre, 2005), http://melbourne.indymedia.org/news/2005/02/87624.php

Cannon, Cormac, and S. Hughes and Sile Ómodhráin, "EpipE: Exploration of the Uilleean pipes as a potential controller for computer-based music," *Proceedings of the 2003 Conference on New Interfaces for Musical Expression* (2003).

Choi, I., "A Component Model of Gestural Primitive Throughput," *Proceedings of the 2003 Conference on New Interfaces for Musical Expression* (2003).

Crab, S., "The Free Music Machine," http://www.obsolete.com/120_years/machines/free_music_machine/

Dorum, Eileen, *Percy Grainger: The man behind the music* (Melbourne: I.C. and E.E. Dorum, 1986).

Drefus, K., interview with Burnett Cross (5 March 1976), audio collection, Grainger Museum.

Flew, T., "Beyond ad hocery: Defining creative industries," *Cultural Sites, Cultural Theory, Cultural Policy, The Second International Conference on Cultural Policy Research* (Te Papa, Wellington, New Zealand: 23-26 Jan 2002).

Giles, M., and D. Pear, "Grainger's Top Ten," *Review the Centre For Studies in Australian Music,* 15 (June 2002).

Kessous, L., and D. Arfib, "Bimanuality in Alternate Musical Instruments," *Proceedings of the 2003 Conference on New Interfaces for Musical Expression* (2003).

Mulder, A., "Towards a choice of gestural constraints for instrumental performers," *Trends in Gestural Control of Music* (Paris: Centre Pompidou, 2000).

Nelson, M., and B. Thom, "A Survey of Real-Time MIDI Performance," *Proceedings of the 2004 Conference on New Interfaces for Musical Expression* (2004).

Newton-Dunn, H., and H. Nakano and J. Gibson, "Block Jam: A tangible interface for interactive music," *Proceedings of the 2003 Conference on New Interfaces for Musical Expression* (2003).

Ómadhráin, Sile, and Georg Essl, "PebbleBox and Crumble Bag: Tactile interfaces for granular synthesis," *Proceedings of the 2004 Conference on New Interfaces for Musical Expression* (2004).

Paine, Garth, "Gesture and Music Interaction: Interactive Engagement Through Dynamic Morphology," *Proceedings of the 2004 Conference on New Interfaces for Musical Expression* (2004).

Pressing, Jeff, "Cybernetic Issues in Interactive Performance Systems," *Computer Music Journal*, 14.1 (1990).

Rebelo, Pedro van Walstijn, "Designing Acoustic Thresholds," *Les journées du design sonore* (Paris: IRCAM, 2004).

Shackel, B., "Human Factors and Usability," in Jenny Preece and Laurie Keller, eds, *Human-Computer Interaction: Selected readings* (Hertfordshire: Prentice Hall 1990).

Siegel, J., and W. Siegel, "Categorical Perception of Tonal Intervals: Musicians can't tell sharp from flat," *Perception and Psychophysics* (1977), pp. 399-407.

Ulyate, Ryan, and David Bianciardi, "The Interactive Dance Club: Avoiding chaos in a multi-participant environment," *Computer Music Journal,* 26.3 (Sept 2002), pp. 40-49.

Young, Diana, and Georg Essl, "HyperPuja: A Tibetan singing bowl controller," *Proceedings of the 2003 Conference on New Interfaces for Musical Expression* (2003).

Notes

[1] Burt.
[2] Crab.
[3] Ibid.
[4] Dorum.
[5] Siegel and Siegel, pp. 399-407.
[6] Burnett Cross, in Drefus.
[7] Dorum.
[8] Giles and Pear.
[9] Choi; Paine.
[10] Pressing.
[11] See Ulyate and Bianciardi, pp. 40-49.
[12] Mulder.
[13] Rebelo
[14] Canon; Young
[15] Ómadráin and Essl
[16] Shackel
[17] Kessous and Arfib
[18] Ibid.