V'OCT (Ritual): An Interactive Vocal Work for Bodycoder System and 8 Channel Spatialization

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ABSTRACT
V'OCT(Ritual) is a work for solo vocalist/performer and Bodycoder System, composed in residency at Dartington College of Arts (UK) Easter 2010.

This paper looks at the technical and compositional methodologies used in the realization of the work, in particular, the choices made with regard to the mapping of sensor elements to various spatialization functions. Kinaesonics will be discussed in relation to the coding of real-time one-to-one mapping of sound to gesture and its expression in terms of hardware and software design. Four forms of expressivity arising out of interactive work with the Bodycoder system will be identified. How sonic (electro-acoustic), programmed, gestural (kinaesonic) and in terms of the *V'Oct(Ritual)* vocal expressivities are constructed as pragmatic and tangible elements within the compositional practice will be discussed and the subsequent importance of collaboration with a performer will be exposed.

Keywords
Bodycoder, Kinaesonics, Expressivity, Gestural Control, Interactive Performance Mechanisms, Collaboration.

1. INTRODUCTION
In April 2010 the author undertook a 3 weeks self-directed residency at Dartington College, Devon to compose a new piece of work for solo vocalist and Bodycoder System. The departure from the last major suite of works composed for the system (*Vox Circuit Trilogy*) being that the new piece would be written for 8-channels of diffusion. The use of live and real-time performer controlled spatialization in 8-channels brought to light several challenges that needed to be addressed before the actual process of composing the new piece was started.

Before the visit various Max/MSP processing patches had been designed so that most effective use of the residency could be used to compose and rehearse the piece. Additionally an 8-channel foldback system was designed and constructed so that the performer could sensitively monitor the diffused and spatialized material.

2. BACKGROUND
The Author has been creating works for interactive performance systems since 1995, commencing with the development of *A Single Performer Controlled Mechanism for Electronic Dance/Music Theatre - The Navigator* (1995) [2] and *Zero in the Bone* (1997) [3] for soloist and 'Metabone'. In 1997 work began on the design and development of a flexible, wireless performer-worn sensor mechanism for interactive dance [8]. The original Bodycoder System [4] incorporated an 8-channel sensor array that used MIDI as its host protocol. Several interactive dance works resulted including *Bodycoder* (1997), *Lifting Bodies* (1999), *Zeitgeist* (1999) and *Cyborg Dreaming* (2000). A complete re-design of the Mk.1 Bodycoder took place in 2000, resulting in a doubling of the sensor channels to 16 and the use of OSC as the host protocol. It was with the creation of the performance installation *Spiral Fiction* (2002) [1] that the Mk.2 Bodycoder System was first used to control and process live vocalisation. Further experiments with solo voice lead to the composition of a suite of pieces for voice and Bodycoder system: *The Suicided Voice* (2003/7) was created during a 3 weeks self-directed residency at The Banff Centre, Canada, *Hand-to-Mouth* (2007) was composed in the EMS studios at The University of Huddersfield and *Etch* (2007) was composed, in residency on Prince Edward Island, Nova Scotia, Canada. The suite of pieces: *Vox Circuit Trilogy* (2007) had its first complete performance at The Watermans in London.

3. THE BODYCODER SYSTEM – A BRIEF DESCRIPTION
The Bodycoder System is a sensor array designed to be worn on the body of a performer. It is a performance mechanism that enables a soloist to generate, affect, manipulate and control all aspects of a multimedia performance, comprising both audio and video material. As well as movement detection sensors, the Bodycoder System also includes a number of finger mounted 'key' switches that provides the performer with the means of orchestrating and determining the nature of certain pre-defined compositional structures. The ability to work in two operational states in which sensor elements are either active and transmitting sensor data (on-line mode) or disabled with no data transmission (off-line mode) is one of the defining features of The Bodycoder System. This is a unique feature of the Bodycoder System, and is derived from the particular working practices and performance ideologies developed by the author.

To ensure maximum mobility, a radio system is employed. The sixteen channel transmitter/ PWM coder and interface unit is worn on a small belt pack and is designed to accept any combination of switched and proportional inputs. The Bodycoder System employs small resistive bend sensors, backed with thin spring steel and enclosed with heat shrink sleeving. Each bend sensor is terminated in a small SMC screw connector that ensures that a sensor cannot be pulled out during a performance.

4. KINEASONICS

The term kinaesonic is derived from a composite of two words: 'kinaesthetic' meaning the movement principles of the body and 'sonic' meaning sound. Kinaesonics therefore refers to the one-to-one mapping of sonic effects to bodily movements and is used to describe a particular form of interactive arts practice associated with the gestural manipulation and real-time processing of electro-acoustic music [9]. The defining of the term kinaesonics was prompted by Drew Hemment's [6] description of my work with the Bodycoder System as Kinesonic: his collision of the terms Kinetic and Sonic. Kinetic implies any moving object, not specifically the human body, and this prompted me to clarify that it is the human body in relation to sound that is at the centre of my interactive practice.

5. EXPRESSIVITY

In using the word expressivity, I am not referring to an aesthetic intention that is to do with a work's reception by an audience: the indication of mood or sentiment through music. Expressivity, in terms of my work with the Bodycoder System, is a pragmatic and tangible compositional practice that is concerned with the construction and manipulation of four interactive and interrelated expressive elements: sonic (electro-acoustic), programmed, gestural (kinaesonic) and in terms of *V'Oct(Ritual),* vocal. It is the sensitive orchestration and control of the changing character of these expressive elements and the choices made with regard to the manner of their interaction and influence on each other that defines the practice and ultimately the individual nature of the resulting works. With respect to the Bodycoder System, and particularly in relation to *V'Oct(Ritual),* expressivity can be sub-divided into four principle forms.

- Gestural = G
- Sonic = S
- Vocal = V
- Programmed = P

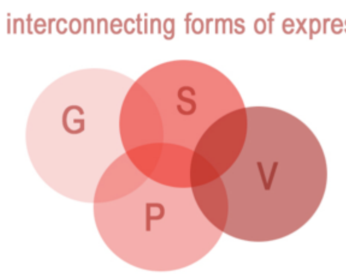

Figure 1. Four principle forms of expressivity

The four forms of expressivity are inter-related and interact with each other in various ways and degrees. An awareness of the interconnectivity of principle forms of expressivity, their interaction and influence on each other, shapes the compositional, development and rehearsal processes.

5.1 Gestural (Kinaesonic)

Gestural (kinaesonic) expressivity refers to the physical movements made by the performer. Gestural expressivity is intimately linked to programmed expressivity through scaling and mapping within Max/MSP that models the kinaesonic relationship between sound processing and physical gesture. Gestures and their location on the body are largely dictated by the performance demands of the composition and ease of articulation. Real-time gestural control of live electro-acoustic processing requires a high degree of physical skill, musicality and aural awareness. The flexibility of the Bodycoder System's hardware, protocols and functionality means that gestural expressivity can be uniquely configured for a range of physicality that corresponds to different types of kinaesonic expressions from moment to moment within a piece.

5.2 Sonic

Sonic expression is concerned with the way in which sound subjected to processing and often re-processing[1] evolves over time and can be layered to create dynamic and dimensional soundscapes. Sonic expressivity in terms of my own compositional practice is founded on this notion of evolution and duration. Such evolutions are considered physical/organic in that they are programmed with a quality of movement (transformation) within the larger sonic landscape[2]. *V'Oct(Ritual)* uses a combination of granularization, compression looping and filtering to create multiphonic layers of sound, portions of which may be subjected to live gestural articulation. Equally, such transformations may operate as separate entities that are not subjected to any form of additional gestural articulation by the performer. In this case their programmed, shaped and automated evolution alone and not their live/gestural articulation is considered expressive. Therefore sonic expression can be modelled entirely within the DSP processing through the programming of variables to create automated sonic events and/or expression that can be shaped (controlled and articulated) through gesture (kineasonics): the gesture of the performer defining the scale and time-frame of sonic transformation. In both cases the nature of the sonic transformation is programmed and scored.

5.3 Programmed

Qualities of sonic expression are modelled in the Max/MSP environment through the use of mapping and scaling processes to translate degrees of physical gesture to control electro-acoustic processes. Expressivity is tuned through the mapping of different ranges of audio and/or visual processing to, for instance, the bend of the arm, wrist etc. Various mapping ratios, for example the proportion of an arm movement to a particular range of sonic manipulation, produce specific physical expressivity. Different scaling ratios vary from sensor to sensor and can be changed from moment to moment within a piece. The real-time expressivity of kinaesonic actions is

[1] This might include timbral and textural development, transformation through fragmentation, the use of randomisation and chance processing, transformation through pitch change, spatialisation and evolution through the use of various mixing and fading techniques.

[2] This idea has some correspondence with the notion of *gestural sonorous objects* further explored in Von Nort, D. (2009) [7].

established through these mapping and scaling choices during the rehearsal process according to various performance preferences including the ease/difficulty of physical execution and the quality of control required.

5.4 Vocal

The expressivity of the acoustic voice is important not only with respect to its unprocessed presence within the sonic landscape, as something of a soloist, but more crucially in the manner in which it interacts with live processing. In *V'Oct(Ritual)* the timbre, pitch and energy of the acoustic voice is used to enliven, activate and articulate certain electro-acoustic processes. A key part of the development of *V'Oct(Ritual)* was concerned with identifying the qualities of acoustic vocal input that resulted in sonically rich interactions. The same concerns informed the choice of phrasing, melody construction, the quality of accents and the use of natural forms of vocal filtering - executed by changing the shape of the mouth and the muscular use of the throat and the larynx: generically known as extended vocal techniques.

6. V'OCT(RITUAL)

6.1 Protocols and Functions

The interface used for *V'OCT(Ritual)* employs twelve switched inputs, four finger switches on a right hand data glove provide individual sensor activation and deactivation, i.e. facilitating on-line and off-line modes of operation. Eight finger switches mounted on the left hand glove provide utility functions such as Max/MSP patch/preset selection and granular sampling and recording. Bend sensors are located, one on each elbow and one on each wrist, the mapping and programmed expressivity (sensor scaling) of each sensor element can be changed during the course of a piece of work.

As in all previous works created for the Bodycoder System the performer is required to control all aspects of the performance with no off-stage intervention from the mixing desk/computer system. In *V'OCT(Ritual)* this includes patch/preset navigation, initiation of granular sampling, compression recording, activation, routing and control of filter and pitch processes and initiation and gestural (kinaesonic) control of various spatialization routines. In terms of spatialization the activation of either wrist sensor, via the right hand data glove, routes the outputs of the selected granulator to one of three spatialization processors. In this way the individual granulator output phases can either move repeatedly between output channels or be gesturally spatialized by the wrist sensors.

6.2 Max/MSP Design

The Max/MSP design for *V'OCT(Ritual)* is based around the principles of granular sampling and compression looping. The main DSP patcher includes two 8-channel compression loopers (each including an 8-channel low-pass filter), two 8-channel granulators and three 8-channel spatializers. The first compression looping patcher consists of eight recording/ playback buffers, the size of each buffer variably pre-set via message boxes, stored in patch presets, that are recalled by the performer. This patcher is designed so that with the onset of a recording command, generated by the activation of a dedicated finger switch, each buffer is sequentially loaded with new vocal material. The output of each buffer is routed to individual output channels. The second compression looper operates by recording into pairs of buffers designated front narrow, front wide, rear wide and rear narrow. In this case the recording of the live vocal signal is sequentially loaded into the front pair of recording buffers through to the rear pair of recording buffers.

The two granulators each output eight, equally-spaced, grain phases that are either connected to a discrete output channel or mixed and fed to one of the three spatialization processors. A master patcher handles all signal routing and processing patcher activation and muting. The master patcher also includes a sensor sub-patcher, a preset messaging patcher and a TouchOSC patcher. The TouchOSC patcher sends patch and recording feedback cues to the performer enabling visual monitoring on an Apple iPod Touch using the TouchOSC application.

6.3 Mapping Strategies for Spatialization

One unusual feature of *V'Oct(Ritual)* is the combination of automated (programmed) and live (performer controlled) spatialization with the performer deciding when it is appropriate to take control of sonic diffusion and the appropriate mode of spatialization.

Automated spatialization operates in two modes, each mode unique to each of the two different granulator abstractions. The first mode operates by randomly positioning each granulator phase signal across individual output channels. The width and speed of panning is pre-set and stored for recall by the performer. The second mode moves the granulator phases through a sequence of preset trajectories that are again recalled by the performer as part of the patch preset recall sequence.

Gesturally controlled spatialization operates in three modes. The first mode is enabled by the simultaneous activation of both wrist sensors. This effectively mixes the eight grain phases of the active granulator into a pair of channels, each comprised of four grain phases. These mixed granular pairs are routed so that one channel can be gesturally panned between the front and rear channels (right hand side) and the front and rear channels (left hand side) using the sensor elements located on the right and left wrist respectively. The second spatialization mode is enabled by the activation of an individual wrist sensor that effectively routes a mix of all grain phases to two rotational spatializers, the right wrist controlling a panning in an anticlockwise direction and the left wrist controlling a panning in a clockwise direction. The remaining spatializer is selected by the operation of a dedicated finger switch. Once this switch has been detected a mix of all eight granulator phases is routed to a triggered panner. Subsequent detection of this finger switch pans the combined signal from its current location to a randomly selected output channel. The duration of each pan trajectory is dynamically controllable by the right wrist sensor, operating in a range of between 0 and 2500mS.

6.4 Eight Channel Monitoring System

In designing a piece for interactive, performer controlled spatialization it is of paramount importance that the performer can monitor the live and processed vocalisations without having to be situated in the 'sweet spot' of an auditorium. To achieve an intimate and sensitive level of control a custom 8-channel monitor array was designed and constructed using relatively cheap, active computer monitors. Each pair of *Bose Soundsticks II* employs a floor mounted sub bass unit that also houses the amplifier circuitry. The level of signal sent to each sub bass can be controlled via a control on each unit that allows a balance to be set up between each pair of mid/high drivers and the sub bass driver. The mid/high range speakers were mounted on fabricated brackets mounted on round-base microphone stands, see Figure 2. Each Bose mid/high unit incorporates four individual drivers in a vertical housing that transmits a highly focused sound source that is ideal for multichannel, close-field monitoring. 8-channels of audio is transmitted from the mix position via an ADAT optical link utilizing an optical line driver/receiver to ensure signal integrity. It is important that the performer has independent control over the signal sent to the monitor array. To achieve this a custom MIDI foot pedal is employed together with a MIDI line driver/receiver sending a simple MIDI controller signal to the computer system.

Figure 2. *V'Oct(Ritual)* in Rehearsal

7. COMPOSITIONAL PROCESSES

Working collaboratively with a performer is not only a conscious artistic choice but one that is necessitated by the real-time and interactive nature of the work. In terms of *V'OCT(RITUAL),* the acoustic vocalisations of the performer form the raw input material of the piece – this too is difficult to simulate without the presence of the performer.

Programmed expressivity such as sensor scaling, mapping and response composed within the Max/MSP software, also impacts upon the physicality (gestural expressivity) of the performer, it is therefore necessary that the performer participates in decisions that prescribe their physicality.

Because of the level of real-time control and responsibilities for both initiation and navigation of the Max/MSP environment as part of the realisation of the live performance, it is necessary that the performer is completely cogent with the larger hardware and software architecture of the piece. This knowledge is established through the compositional /development and rehearsal phases of a piece.

The development and learning of the acoustic vocal score, the internalising of the gestural kinaesonic score, and an understanding of the larger architecture of a piece is established over periods of intensive rehearsal.

The performer's collaborative input and their intimate knowledge of the architecture of a work is a defining characteristic of the practice. This knowledge affords the performer both security within the live performance /composition and a level of autonomy that excludes the need for outside interventions from the mixing desk. This produces a truer level of virtuosity, not simply in terms of quality of gestural and vocal expressivity, but also in terms of self-determined control within the pre-composed structures.

8. CONCLUSION

Advancing into the area of performer controlled spatialization is a new development in my practice which poses some interesting aesthetic and technical problems. It is an area of interactive and electro-acoustic music practice that for a number of years has been generating debate with regard to the authority of the performer over the diffusion of their own instrument. Simon Emmerson suggests "we might consider giving the performer some say over what happens in projecting field information. This would complete our idealized control revolution returning considerably more power to the performer than current systems allow" [5]. In terms of my own future practice with the Bodycoder System my chief concerns are how to integrate spatialization into the compositional integrity of works in terms of sonic and programmed expressivities. Also how gestural spatialization is executed in such a way that it is not seen as merely demonstrative. Gestural spatialization also adds to the control responsibilities of the performer and it is expected that there will be a range of skills and particular perceptions that will need to be more clearly identified and refined. This may change established patterns of practice and will inevitably add another dimension to the collaborative process.

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