The Spectral Piano Project

by
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B.Mus., University of Alberta, 1984

Research Project Submitted in Partial Fulfillment
of the Requirements for the Degree of
Master of Fine Arts

in the
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Faculty of Communications, Art and Technology

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Abstract

The Spectral Piano project consists of two parts: the conception, design and physical creation of the Spectral Piano as an instrument, and the composition of a suite of music for it. An apparatus was created to allow direct electromagnetic excitation of 24 strings, producing very different timbres and dynamic envelopes than the conventional hammer driven piano string offers. The spectral piano may simultaneously and uniquely address any spectral component of each excited string. The ability to bend pitch, shimmer, pulse, and simultaneously create multiple pitches and timbres is possible. For the performance, music was composed which contrasts conventional piano with spectral piano in works compositionally linked in a variety of ways.

Keywords: spectral piano; virtual musical gesture; sound mass; augmented piano; timbre; embodied
To my family, for their patience.
Acknowledgements

I would like above all to thank my supervisors, Professor Owen Underhill and Professor Arne Eigenfeldt. Professor Underhill, as my senior supervisor, has provided invaluable advice and musical knowledge, especially in the area of music theory, notation and contemporary influences. I thank Professor Eigenfeldt for his facilitation of my entry into the program, and for his thought provoking suggestions.

Special thanks to Henry Daniel for his mentoring on my paper Is a Musical Gesture's Emotional Affect only Dependent upon its Material?

For the performance itself, my first thanks go to my fine performers, Andrew Czink and Nancy Tam. I appreciated as well your constructive comments on my pieces as seen from the performer’s view.

SCA Technical Director Ben Rogalsky made me feel that my technical requests were welcome and sensible. Resident Technician Mark Eugster enhanced my lighting design in a wonderful way via his side fills. Thanks to Robin Mercy, lighting operator.

My performance documentation was ably assisted by Mike Foster’s audio recording and mixing skills, and Kyle Mulligan’s videography.

In the creation of the spectral piano, I thank above all Andrew McPherson, who provided me with a set of amplifiers, and then followed up with technical support as regards my adaptation of the units to my custom built North American power supply. Shea Keller, thanks for your steady soldering hand. Frogs, from efnet#electronics, thanks for your suggestion of the Schottky diodes which solved my reverse current issue. Tyson Haynes, I appreciated your welcome assistance in the selection of components.

Finally, my wife and son have put up with the combination of my teaching load, my student work in the MFA, and my endless hours physically building the spectral piano apparatus. Your support, love, and interest in my and our collective futures makes it all worthwhile.
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THE THREE FACES OF MIDNIGHT

ALL WORKS COMPOSED BY

DOUG BLACKLEY

A SPEAKERLESS CONCERT OF MUSIC FOR

SPECTRAL PIANO

A PIANO ACOUSTICALLY PRODUCING SHIMMERING, ENDLESS WAVES OF PULSING, FITCHDINING MUSIC
A CONVENTIONAL PIANO WITH UNCONVENTIONAL ABILITIES

PERFORMANCES: DOUG BLACKLEY - ANDREW CZINK - NANCY TAM

8 PM TUESDAY, JANUARY 20TH, 2013

DOUGLAS HUMPHRIES WORLD ARTS CENTRE - GOLDMON CENTRE FOR THE ARTS

SFU

SIMON FRASER UNIVERSITY

Presented in partial fulfillment of the requirements of the Degree of Master of Fine Arts of Simon Fraser University.
Chapter 1.

Introduction

The author of this project would like to reassure the reader that the Project Statement is substantially shorter in length than the accompanying appendix. The Master of Fine Arts degree undertaken at the School for the Contemporary Arts, Simon Fraser University, emphasizes artistic creation, which the Statement serves to describe, and the accompanying materials document. The appendix, undertaken as academic research during the tenure of this degree, serves to present the critical thought undergone prior to, and during, the creation of the artwork.
Chapter 2.

The Spectral Piano Project: Project Statement

The Spectral Piano project consists of two parts: the conception, design and physical creation of the Spectral Piano as an instrument, and the composition of a suite of music for it. The concert presented as The Three Faces of Midnight is a fusion of my work composing for both “conventional” piano and composing for Spectral Piano, and as such, is the culmination of my MFA research into new modes of playing the acoustic piano, alternative approaches to exciting vibration of piano strings, contemporary music theory, piano composition, spectral music and sound mass techniques. The Three Faces performance is an attempt to create a coherent artistic presentation while still representing work composed during my tenure in the MFA program. The pieces chosen are linked together by a variety of techniques, ranging from motivic development, through variations of formal structures based on shared gestural references. While two pieces utilize conventional piano, the Spectral Piano project is the primary focus and is featured in the remainder of the work presented.

The Spectral Piano is a conventional piano with unconventional abilities. It uses electromagnetic forces to directly excite the strings (in addition to the regular hammers). The system that allows this to take place on each treated string begins with the production of a conventional electronic audio signal, similar to the signal produced by a digital piano or synthesizer. This signal is subsequently amplified and then sent into an electromagnet (rather than a speaker). The electromagnet, consisting of a coil wound around a ferrous core, outputs a vibrating magnetic force whose power makes the string of a piano vibrate. Such an instrument falls into the family of “augmented piano”, similar in basic function yet differing from those created by Per Bloland, Assistant Professor at Miami University (Bloland 2007), (Berdahl, Backer, Smith 2005), and Andrew McPherson, Lecturer in Digital
Media at the Centre for Digital Music at Queen Mary, University of London (McPherson, 2010).

John Cage and other composers have previously devised other methods to alter the timbres produced by the acoustic piano. Such modifications, generally referred to as prepared piano, consist of placing objects between the strings, or items such as paper sheets in contact with them. The piano’s timbre may be radically changed by such techniques. The *Spectral Piano* in contrast does not alter the sound of the “host” piano in any way, other than requiring the use of sustain or sostenuto pedal for the creation of sustaining timbres. The *Spectral Piano* excites spectral components of the strings to create new timbres, rather than altering the mechanical construction of the piano itself. A device called an *Ebow* has been used since the 1970’s to electromagnetically excite a single guitar string with a sine wave. The *Ebow* lacks sufficient power to drive the heavier strings found in an acoustic piano, but the technique is directly related to the electromagnetic excitations created on piano strings by the *Spectral Piano* and other members of the family of electromagnetically augmented pianos.

McPherson’s *Magnetic Resonator Piano* multiplexes additional timbres across a large array of chromatically placed electromagnets. A given timbre is generated and multiplexed by pitch across all the treated strings. This method allows for very even volume and timbre matching across the keyboard, for example when chromatically accessible fundamentals are excited. The instrument’s primary design focus is to augment the timbral possibilities available to a single live performer. Per Bloland’s *Electromagnetically-Prepared Piano* has the ability to send heterogeneous timbres to each treated string, but does not have chromatically arranged electromagnets. A melodic line played using the *Electromagnetically-Prepared Piano* therefore requires pitches to be created by a mixture of excitation of fundamentals of some strings and overtones of others. This requires complex pitch mapping techniques and some amount of note to note timbre change. This system is very well suited to drones of many colours. The *Spectral Piano* functions much like a combination of both of these instruments. The *Spectral Piano* uses chromatically arranged electromagnets similar to the *Magnetic Resonator Piano*, but may also send heterogeneous timbres to each treated string (as does the *Electromagnetically-Prepared Piano*). The current incarnation of my *Spectral Piano* and Per Bloland’s *Electromagnetically-Prepared Piano* use similar signal amplifiers, which
were designed by Andrew McPherson. The *Spectral Piano*’s design focus is directed at creating an instrument with electromagnetically produced multi-timbral abilities: closer to an instrumental ensemble than an augmented hammer driven instrument.

To produce the sound of such an “instrumental ensemble”, every treated string may be excited in several different ways at the same time. A string with the assistance of controlled electromagnetic force is capable of creating a tone by excitation (for example) of its fundamental. It is also capable of simultaneously outputting other timbres created with excitations of other harmonics. The signal required to create each different part is independently created, then mixed into the overall audio signal controlling the electromagnet(s) used to excite the same destination string or strings. The summed signal has frequency components able to excite the string in different ways at the same time, much like a speaker is able to reproduce more than one sound at once. The instrument as featured in the *Three Faces of Midnight* is primarily played using a combination of live keyboard control of the foregrounded musical elements, and automated pre-prepared sequence playback of background parts. At some points the live player doubles sequenced parts.

The *Spectral Piano* compositions presented in the *Three Faces of Midnight* are my first steps in considering and experimenting with the *Spectral Piano*. The music presented is influenced by studies and concepts of timbre, mass and spectral music, but my work with the instrument to date indicates that it would be possible to go much further within the new possibilities presented.

My paper *Is a Musical Gesture’s Emotional Affect only dependent upon its Material?* (see Appendix A) discusses the concept of a “virtual music gesture” which may be described as a set, or movement vocabulary of imagined physical gestures. Such gestures may inform the creation of musical materials, and help create compositional boundaries useful to a composer wishing to conceptualize unifying compositional elements. A real or imagined event (such as a journey for example) may create a group of subjectively determined gestural responses. Rather than having a single gesture create a single musical response, an entire set of gestures is referenced as a common movement vocabulary creating many possible musical interpretations. Some music composed for the performance utilizes this concept, testing the idea that the gestural vocabulary referenced
may help link the musical materials together in a fashion that does not rely on more conventional methods such as motivic relationships. The success of the experiment may be judged by the listener; I found it provided a rich source of interwoven compositional material and was therefore worth future attention as a personal compositional technique.

*The Three Faces of Midnight* features both my writing for conventional piano and for my graduating *Spectral Piano* project. The writings of Olivier Messiaen, Karel Janeček, and Lubomyr Melnyk influence my writing for what I will term “conventional” piano: piano played in the standard fashion using keys driving hammers. While I chose to write for piano, my models were not limited to piano composition. *Models and Artifice: the collected writings of Tristan Murail* informed me of contemporary techniques in spectral music where I noted certain similarities to electronic synthesis practices. Investigations of sound mass led to Ligeti’s ensemble techniques of micro-polyphony. When I began planning my graduating concert I decided to present work that linked some aspects of all of these areas into a unified whole. As I wished to use timbres unobtainable on the conventional piano, I decided to create a prototype apparatus to demonstrate the results of my research into alternative approaches to exciting vibration of piano strings. This project became the *Spectral Piano* project: the creation of the *Spectral Piano* as an instrument, and the composition of a suite of music written to both stand alone as a musical work and also demonstrate some of the abilities of the *Spectral Piano*.

*The Three Faces of Midnight* consists of the following pieces: *Into the Light*, *Into the Night*, and the *Running on Faith Suite* which has five movements, entitled *Running on Faith*, *Spectralis*, *Aurora*, *Midnight*, and *Return*.

*Into the Light* is written as a response to my overall research into 20th and 21st Century writing for conventional piano. Investigations into concepts pursued by Lubomyr Melnyk, (who manipulates clouds of sound created from very high speed arpeggiated pedal- down playing) uncovered an extension to this technique. His works possess melodic figures created by repeated notes interwoven into the arpeggiated clouds. I decided to reference the repeated note melodic technique but use a thinner, less resonant non-arpeggiated texture to be more transparent and performable. In *Into the Light*, chromatic escapades provide clouds of colour, but my choice to never truly modulate
allows the constancy of a single key centre’s resonance to pervade the entire work. *Into the Light* emerges from a dense cloud of notes into transparency.

The imagined event that *Into the Light* references is a journey through a three dimensional space: not a smooth flight, but one passing through obstacles, gusting wind and drafts along the way. Smooth flight requires balance and stability, represented in *Into the Light* via the use of a consistent key centre, while elements of rapid forward motion reflect in ostinato figures. Obstacles along the way may require a fermata, before progression resumes. Gusting winds and drafts require complex gestures to negotiate, musically heard in chromatic passages that rise and fall in pitch, while a concurrent loss of stability is created by a temporary loss of key centre.

*Into the Night*, the companion work for *Into the Light*, references a similar imagined journey, and is the evening’s introduction to the *Spectral Piano*. Once again, this is not a smooth flight but one shaped by dark grottos and encounters with slow but powerful currents and eddies. *Into the Night* reflects this concept in that musical material subjectively derived from these gestures is primarily composed with long, elongated lines. The slow speed of the “journey” rules out driving ostinatos, so a low 5/4 pulsation emulates the slow but rhythmic strokes required to “swim” deeper into the night. The musical materials (motives, rhythms, harmonic) found in *Into the Night* are quite dissimilar to those in *Into the Night*, yet the formal structures bear similarities as both are depictions of imagined journeys structured via their sets of imagined “movement vocabularies”.

The *Spectral Piano* project consists of both the creation of the instrument and the composition of a body of music for it, entitled The *Running on Faith Suite*. The first movement, *Running on Faith*, composed for conventional piano, uses musical materials (such as motives, harmonic structure, dynamic range, and so forth) that reference a gestural vocabulary as described above. The suite utilizes variations that gradually replace the original ideas with new material composed for the *Spectral Piano*. The creation of the new materials required the development of techniques for the production of timbres utilizing the Spectral Piano hardware.

The first variation, titled *Spectralis*, begins with Spectral Piano playing a simplified motive derived from *Running on Faith*. This section is repeated with doubling from hammer
driven notes; the intent here was to foreground the Spectral Piano over the “conventional” piano. While a thinner, more transparent plucked sound worked well for my Spectral Piano piece \textit{Into the Night}, a new technique was required to create a timbre strong enough to foreground the Spectral Piano over the hammer-driven doubling piano notes. A sawtooth wave was chosen as the primary waveform for string excitation, and an envelope generator controlling an amplifier was used to produce a signal attack transient as close to a vertical rise as possible. The resultant pulse was amplified and sent to a suspended electromagnet, which excited a single string. Excitation of a single string with multiple pitches creates a soft, ethereal sound with some pitches much louder than others, as different harmonics will sound at divergent amplitudes. While this creates a clearly audible pulse as the excited string vibrates, I deemed the sound as too thin and the attack insufficient to foreground the spectral timbre.

Direct excitation of whatever string's pitch matches the note in use (in the manner of an augmented piano) adds more body to the sound, but still not enough in this case to successfully foreground the timbre over the doubling hammer attack from the conventional piano. The Spectral Piano, however, is able to map a single incoming pitch to any number of physical strings at once which allowed the final sound to be created in a different manner. Seven individual strings were addressed for each incoming note allowing the transient to be directly generated on a single string's fundamental as well as simultaneously being generated directly on a number of harmonics on other strings. Direct excitation of non-fundamental spectrum components provides a brighter, clearer attack transient, one which is able to foreground over the hammer attack as long as levels are properly balanced between the composed parts.

The centre section of \textit{Spectralis} is the first place to feature solo Spectral Piano. It begins with a simple but powerful timbre (reminiscent of a pipe organ), reserving more complex timbres for later development. This timbre was created with a technique also possible on an augmented piano. A sine tone of a given played pitch is sent directly to excite the fundamental of whatever string is tuned to the same note. With an externally multiplexed output such as McPherson's augmented piano uses, this mapping happens automatically using conventional “voice-stealing”. The Spectral Piano, in contrast, is entirely configurable in software, so a similar routing system was designed using the Logic
Environment (a comprehensive data mapping section present in Apple Computer’s “Logic Studio” software music sequencing application).

One last timbre from this piece is both hauntingly evocative and unique. A high note is held in suspension, then glissandos down and back up to the original pitch. This is a sound most unlike anything possible on a conventional piano. To fulfill this compositional need, frequency modulation synthesis is used to create a highly configurable spectrum, which is assigned to excite a cluster of four pitches (G3, Bb3, D4, and Eb4). These strings are not excited on their fundamentals, but are instead excited with frequencies found two octaves above. This places the excitation high into the tightly clustered upper harmonics of the strings. When the exciting frequency performs a manually controlled glissando, the harmonics of the four differently pitched strings as a grouped cluster are close enough together that the ear hears a constant tone moving in a pitch bend, even though the actual event is a cluster of tones moving from harmonic to harmonic. Such a sound truly demonstrates that the Spectral Piano has rich potential for future generation of new and evocative acoustic timbres.

Aurora, the next variation, is an exploration of short “plucked” Spectral Piano articulations. A simplified melodic figure drawn from Running on Faith is used as a link to the original piece. The plucked sounds are generated in a similar fashion as described above, but the technique is extended by the use of other sound sources modified by similar synthesis methods which create timbral variation within a common general envelope shape. These varied plucks are used for doubling purposes.

The last piece, Midnight, remains a traditional variation in that references to the motive exist, but otherwise it is composed using entirely different musical materials. This piece is a timbral exploration, rather than a melodically based piece. To maximize the utilized timbre’s contribution to the unification of the suite, the primary materials were composed using sounds generated for the previous movements.

The Return, as the closing work, was written to remind the listener of the original musical material and serve as the closure to the entire suite. Conventional piano is reintroduced, and we return as well to the original melodic motif and supporting chords.
The Spectral Piano project has been an inspirational source of new compositional ideas. The timbres that it produces are very much acoustically created, and possess the richness and presence of an acoustic instrument. At the same time, the instrument is able to create timbres with the sound of electronically generated techniques such as are heard via the playback mechanism of loudspeakers when used in electro-acoustic music. The instrument, similar to other acoustic instruments, resonates in response to other acoustic instruments played in proximity, producing a fusion of sound between the instruments in use that is unavailable currently in mixtures of acoustic instruments and instruments that require speakers to be audible. A recent recording session of a duet with cello demonstrated this possibility, as sympathetic resonances were clearly audible between the instruments. The Spectral Piano appears to present many possibilities as a “bridging” instrument between the areas of electronic and acoustic music: an instrument with the shared resonant and rich reality of an acoustic instrument that offers access to timbres normally found only emanating from speakers. It is my hope that the Spectral Piano will be used for compositions by many different composers, and that in the future it will take a place in acoustic ensembles as a rich new resource.

References


Chapter 3.

Project Documentation

*Image 1.* Doug Blackley performing on the spectral piano.

*Note.* Photo by T.Velke; used with permission.
Image 2.  Andrew Czink performing “Into the Light”.

Note. Photos by Kyle Mulligan; used with permission.

Image 3.  Nancy Tam performing ”Running on Faith”.

Note. Photo by Kyle Mulligan; used with permission.
Image 4.  Doug Blackley and Andrew Czink performing “Spectralis”.

Note.  Photo by Kyle Mulligan; used with permission.

Image 5.  Doug Blackley and Andrew Czink performing “Aurora”.

Note.  Photo by Kyle Mulligan; used with permission.

*Note.* Photo by the author.


*Note.* Photo by Kyle Mulligan; used with permission.
Running on Faith

[Music notation]

Running on Faith

[Music notation]

Running on Faith

[Music notation]

Running on Faith

[Music notation]
Appendix A.

Research Paper:
“Is a Musical Gesture's Emotional Affect only Dependent Upon its Material?”

Abstract

Embodied physical gestures have been considered as shaping forces for "musical gestures" in music. An arm sweeps up, and we hear a run of ascending notes: a musical gesture. In this schema, this realization of the music is all there is other than the existence of the referenced physical gestures. If this model is accurate, we have no intermediary stage where other influences might shape, interpret or hold the gestural influence prior to musical realization. This paper postulates the existence of such a stage between the place of physical gesture and the "realized" gesture as heard in music.

In this scheme, embodied physical gestures are accessed, with musical intentionality, as shaping forces in creating an imagined, multi-modal shape that evolves over time. This shape is referred to as a “virtual” musical gesture. This "virtual" multi-modal musically intended "gesture" references the underlying physicality of gesture but by nature is not physically performed. The virtual musical gesture is later accessible as shaping material for the creation of a “realized” musical gesture, actual music within a medium. It may be informed as well by other influences, such as artistic intentionality, but the body’s response remains as a core shaping material.

Keywords:  musical gesture; music, medium; realized musical gesture; virtual musical gesture; embodied
Part 1. Gesture in Music

Introduction

Embodied physical gestures have been considered as shaping forces for "musical gestures" in music. The composer imagines an arm sweeping up (a physically embodied gesture), and we hear a run of ascending notes as a direct response: a musical gesture. In this schema, this realization of the music is all there is, other than the existence of the referenced physical gestures.

If this model is accurate, we have no intermediary stage where other influences might shape, interpret or hold the gestural influence prior to musical realization. I postulate the existence of such a stage between the place of physical gesture and the "realized" gesture as heard in music.

In this scheme, embodied physical gestures are accessed, with musical intentionality, as shaping forces in creating an imagined, multimodal shape that evolves over time. This shape I refer to as a “virtual” musical gesture. This "virtual" multi-modal musically intended "gesture" references the underlying physicality of gesture but by nature is not physically performed. The virtual musical gesture is later accessible as shaping material for the creation of a “realized” musical gesture, actual music within a medium. This virtual musical gesture is also understandable as a different form of visualization of the emotional state or states that the body reacts to with directly embodied physical gesture. It may be informed as well by other influences, but the body’s response remains as a core shaping material.
In this new model, we proceed from physical gesture, to internally visualized virtual musical gesture, then finally reference the virtual musical gesture to provide form and shaping ideas for a realization, or realizations, of the gesture in music. This schema suggests the existence of a type of internal (“virtual”) musical gesture that is never directly heard, but which may be heard through its influence on musical realizations referencing it. This virtual gesture may as well be shaped by considerations (such as artistic intent) that are above and beyond the embodied gestures fundamental to its structure.

This paper discusses first the basic playing fields underlying this argument. Music is structurally considered, as is gesture, and their interaction discussed. Next, a thought experiment is conducted. I describe imagined circumstances which might create certain emotional responses. The responses are linked to physical gestures which might be found in a person internalizing the emotional setting described. From this, I describe a "virtual musical gesture" that might be shaped, with musical intentionality, from the combination of the physical gestures described and the interpreted emotional influences that shaped or created such embodied responses. Finally I discuss two entirely different ways that the virtual musical gesture might be realized into composed music. The examples use different musical materials, and realized are in entirely different musical mediums, thus addressing my core research question:

Different mediums of music use entirely different types of materials to realize musical gestures: music for the piano for example uses melody, harmony, rhythm and so forth, while electro-acoustic music may use timbre, sound mass and articulation. The music we hear in each is sonically different, yet the underlying impression of a progression in affect, mood, or feelings over time may be similar. How is this possible? How might gestures translate between different musical mediums - in this case acoustic and electro-acoustic music; specifically, is a gesture's emotional affect dependent upon its material?

This paper will attempt to make the nature of this musical speculation clear to a non-specialist art practitioner, with the intent of facilitating discussion across the
disciplines. If, in music, a realized musical gesture’s emotional affect is not dependent directly upon its material, but is instead shaped by an underlying virtual musical gesture, then it might follow that in other disciplines an underlying virtual gesture, created with artistic intent, could be similarly realized in non-musical media as well. If this is the case, then discussion might profitably ensue between various disciplines that also deal with gestural attributes in their practice. The notion of the virtual gesture as a building block of embodied emotional tone, with differing realizations in differing artistic mediums may be a superset of the discussion presented in this musically focused examination of gesture in music.

**Gesture and Emotion**

Several different definitions of gesture exist in the literature. For Cassell (1990), “A natural gesture means the types of gestures spontaneously generated by a person telling a story, speaking in public, or holding a conversation.” Antonio Camurri suggests that “expressive gesture is the responsible of the communication of information that we call expressive content. Expressive content is different and in most cases independent from, even if often superimposed to, possible denotative meaning. Expressive content concerns aspects related to feelings, moods, affect, intensity of emotional experience” (Camurri 2001).

Moving to the idea of a musical gesture, Grittan et.al. (2006) suggest that “most scholarship on musical gesture makes a grounding assumption, broadly semiotic in nature: a [musical] gesture is a movement or change in state that becomes marked as significant by an agent. This is to say that for movement or sound to be(come) gesture, it must be taken intentionally by an interpreter, who may or may not be involved in the actual sound production of a performance, in such a manner as to donate it with the trappings of human significance.”

Robert Hatten, in his introduction to his Indiana University course Musical Gesture: Theory and Interpretation, has possibly the most relevant definition:

Musical gesture is biologically and culturally grounded in communicative human movement. Gesture draws upon the close interaction (and intermodality) of a range of human perceptual and motor systems to
synthesize the energetic shaping of motion through time into significant events with unique expressive force. The biological and cultural motivations of musical gesture are further negotiated within the conventions of a musical style, whose elements include both the discrete (pitch, rhythm, meter) and the analog (dynamics, articulation, temporal pacing). Musical gestures are emergent gestalts that convey affective motion, emotion, and agency by fusing otherwise separate elements into continuities of shape and force. (Hatten 2011)

In "Music and Gesture", Gritten and King discuss Hatten's theory:

Musical gesture is biologically grounded, drawing on the close interaction of a range of human perceptual and motor systems that intermodally synthesize the energetic shaping of motion through time into significant events with expressive force... Musical gestures, Hatten argues, are thus emergent gestalts that convey affective motion, emotion, and intentionality by fusing otherwise separate elements into continuities of shape and force. Thematic gestures are marked as significant parts of the discourse of a movement; they may feature articulatory shapes as prominently as pitch shapes... Through a series of developing variation, thematic gestures coordinate the expressive trajectory, and thus motivate the unique form of a movement. (Gritten 2006)

Juslin and Slodoba, in Oxford University Press’s “Handbook of Music and Emotion” provide some definitions of related key terms:

- Affect: An umbrella term that covers evaluative (positive/negative) states (such as mood, emotion, preference).
- Emotion: A brief but intensive affective reaction that usually involves a number of sub-components, such as subjective feeling, physiological arousal, expression, action tendency, and regulation that are more or less “synchronized”.
- Mood: Affective states that are lower in intensity than emotions, that do not have a clear “object”, and which generally last longer than emotions.
- Feeling: Refers to the subjective experience of emotions or moods.
- Arousal: Physical activation of the autonomic nervous system. A component of an emotional response, but which may as well occur in the absence of emotion. Often reflected in “feeling”.
- Emotional perception: All instances where a listener perceives or recognizes emotion in music without necessarily feeling it.
- Communication: A process where a sender conveys an emotion to a receiver who is able to decode the emotion concerned. Note that this is used regardless of whether or not the transmitted emotion is genuinely felt or not. (Juslin 2010)
We have begun discussing the relationships between embodied physical gesture, virtual musical gesture, and realized musical gesture. It is prudent to clarify what this “music” thing is that might in fact be “realized” at the end of this process.


Michael Nyman, in *Experimental Music*, quotes Morse Peckham: “A work of art is any perceptual field which an individual uses as an occasion for performing the role as an art perceiver” (Nyman 2002). Such a definition allows for expansion of the perception of art far beyond the gallery. A continuum is in fact invited; perhaps the painting within the art gallery is at one end, and the light of the moon on the water at the other. The individual may use the occasion to perform the role of art perceiver in either context.

Jonathan Kramer, in *The Time of Music* collapses Peckham’s definition into “Music is that which causes people to perform the role of music perceiver” (Kramer 1988). This invokes a similar continuum onto the area of music. “The advantage of this definition is that it does not give a checklist of attributes that music is supposed to possess. Thus, it works equally well for traditional and experimental music, which may have virtually nothing in common” (Kramer 1988). Kramer discusses just how broad this “musical” playing field might be by remarking: “it is certainly possible to hear traffic noises, for example, or words in an unknown language (sounds with no semiotic content) as music” (Kramer 1988). Once again a continuum is invoked, and a broad one indeed. To consider the use of a musical gesture within music, we need to be clear about the playing field that music creates.

**Definitions of Music**

Music: *Noun*

vocal or instrumental sounds (or both) combined in such a way as to produce beauty of form, harmony, and expression of emotion: the art or science of composing or performing music: a sound perceived as pleasingly harmonious: the background music of softly lapping water. (Oxford 2011)

This definition stretches from traditional “harmonic” music right to the idea that the sound of lapping waves might have inherent “music.” The problem with this is that we can
normally perceive if what we hear is actually “music”, as opposed to hearing something such as lapping water in a musical fashion. If any sound we find pleasing is music, then we have no way to separate the product of a musical gesture from any other gesture that produced a sound! One way to deal with this is to consider that idea that music must be “intentional” in its creation. If music was separated from a sound perceived as being musical in this way, then we might discuss the idea of a musical gesture’s eventual sonic outcome as something different from any other sort of gesture that might eventually result in some sort of a sound.

The Britannica Concise Encyclopedia has a different definition of music:

Music: *Noun*
Art concerned with combining vocal or instrumental sounds for beauty of form or emotional expression, usually according to cultural standards of rhythm, melody, and, in most Western music, harmony. Music most often implies sounds with distinct pitches that are arranged into melodies and organized into patterns of rhythm and metre. The melody will usually be in a certain key or mode, and in Western music it will often suggest harmony that may be made explicit as accompanying chords or counterpoint. (Britannica 2011)

This definition uses a lot of musical terms; it is reliant upon the user’s expertise in the area to understand it. It also appears to make the assumption that music is the product of the devices named, instead of supporting the notion that music might be something else that instead uses the items discussed within a certain area, or medium. To productively discuss this we first need to discuss the “materials” and “mediums” of music.

- Rhythm, melody, harmony, pitch, key, mode, chords, and counterpoint all refer to some of the materials of music. To contextualize discussion at this point, I’ll define some of these terms, very briefly.
- Rhythm: the timing of events.
- Pitch: a “note” as heard in music. A piano has 88 available pitches, or “notes”.
- Harmony: the use of more than one pitch at a time. Commonly found in “chords”.
- Melody: an organized succession of pitches.
- Timbre: quality of sound that distinguishes different instruments from each other. A piano has a different “timbre”, than a trumpet.
In the past century, musical exploration has stretched the boundaries of what might be termed as “music” further. Edgard Varèse, composer of *Ionisation* wrote:

When I was about twenty, I came across a definition of music that seemed suddenly to throw light on my gropings toward music I sensed could exist. Hoene Wronsky, physicist, chemist, musicologist and philosopher of the first half of the nineteenth century, defined music as 'the corporealization of the intelligence that is in sounds. Later in life Varese was known to refer to music simply as “Organized sound”. (Erikson 1975)

Music as “organized sound” is in fact a very useful definition.

**Music, Mediums, and Materials: What Is a Medium?**

A medium, broadly speaking, is something that acts as a means to allow something to be transmitted from some kind of a source, to some kind of a receiver. In art, the source may be argued to be the artist, and the receiver the viewer. The medium is the “thing” used to convey whatever is conveyed. Oil paints are a different medium than watercolours. The underlying theme may be the same, but the thickness, density, and richness of oils will change the entire appearance of the painting. David Davies, however, identifies an issue with this conception of medium:

There is good reason, however, to resist such a simple identification of media in art with the kinds of stuff manipulated by artists, given our general instrumental conception of a medium. For if we make such an identification, we require a further mediating force to explain how manipulations of this stuff achieve the end of articulating an artistic content. For example, applying pigment to a canvas produces a pigment-covered canvas, yet we take the painter to have represented a certain subject, or expressed certain qualities, in the painting. The need for something that mediates between what the artist does in the purely manipulative sense and what the artist does in the artistic sense is even clearer if we consider how almost identically pigmented canvases can articulate very different artistic contents. (Davies 2011)

The musical medium extends this problem. First, we may substitute different musical media for artistic media within Davies’ idea to encounter his same issue. We encounter yet another stage as well with music, however (along with other performance arts such as dance). Music may vary in exact realization with every performance. Not only may the overall medium change, but every usage of a medium for communication will
differ in some ways between performances. There needs to be a clarification that separates what the medium used is physically doing, and how the medium is delivering the artistic content.

**The Artistic Vehicle, and Vehicular Mediums**

Let’s consider the composer as the “source” of a communication transferred via a “medium”, to a receiver. If one argued that the final medium was all there really was in actual existence, then the gesture will have been entirely subsumed. If this is the case then the emotional affect of music written thusly would be entirely dependent upon its material. If, as Davis postulates, the artistic vehicle and the vehicular medium are in fact separate, then this is no longer the case.

An artist might begin with embodied gesture, as something to be articulated into an artistic vehicle: then realize an interpretation of the artistic vehicle via manipulation of vehicular media. In the model I propose, we proceed from physical gesture, to an internally visualized or articulated virtual musical gesture, and then finally reference the virtual musical gesture to provide form for a realization, or realizations, of the musical gesture in actual music. I argue that the virtual music gesture I describe here may in fact be a form of internally visualized or articulated “artistic vehicle”, which exists independently of its eventual realization within a chosen vehicular medium.

A gesture as realized in a vehicular medium might vary to a great degree in physical (or sonic) construction, if the materials used in across vehicular mediums varied widely. The emotional affect of the underlying gesture is, however, still communicated to the receiver via the artistic vehicle as realized in the vehicular medium. It stands to reason that the artist’s skill at this point becomes the critical factor in his/her ability to manipulate the vehicular medium as chosen as a means of communicating the underlying gesture. It should therefore be possible to utilize the same virtual musical gesture between such divergent musical “mediums” as acoustic and electro-acoustic music.
Conclusion

We have discussed the nature of gesture, music, materials, and mediums. A directly mapped correspondence between physical gesture and musical gesture was mentioned as one model connecting these elements. A suggestion was made that an intermediary stage might exist, which produces a new potential schema:

1. Emotional affect and other influences are embodied with physical gesture.
2. Musical intentionality forms a space in which the physical gestures in their emotively affected context may be visualized as a “virtual” musical gesture, which is not physically performed.
3. The virtual musical gesture may be somehow mapped to a variety of realized musical gestures creating audible music existing within a chosen medium.

We discussed David Davies’s suggestion of the “need for something that mediates between what the artist does in the purely manipulative sense and what the artist does in the artistic sense”... breaking the concept of medium apart into “the kind of stuff employed in the making of the thing that conveys an artistic content – term this thing the “artistic vehicle” and the stuff the “vehicular medium” (Davies 2011). I suggested that in music the virtual musical gesture might be a place where this artistic vehicle is conceptualized outside of the vehicular medium chosen to realize the actual music.

In the second part of this paper, I would like to present a “thought experiment” where I discuss how the postulated three stage “embodied gesture - virtual musical gesture - realized music gesture” model might be used in the process of creating actual realized music in contrasting mediums. The intent here is to show that the potential schema described above might in fact allow the creation of different realizations of an underlying artistic vehicle.
Part 2. Encoding the Musical Gesture

Introduction

Given the inherent multi-modality of movement within a virtual musical gesture as it changes over time, how might the composer take it as a shaping force in devising music within a chosen vehicular medium? Roger Seruton, in *Music and Gesture* (Gritten 2006) describes emotion as “intransitive”, and claims that it is not mappable within a context of simplistic, semiotic code-like reduction. Expression in music is as well not easily decoded into a simple or easily namable characteristic such as "happy" or "sad". Music seems to have an inherent depth where a number of affective characteristics are combined in an interwoven matrix that shifts and reshapes over time. It appears that part of the art of the composer might be to make musical choices that work both within the materials found in the vehicular medium of choice, and within the context formulated within the artistic vehicle as visualized in the virtual musical gesture. This is a complex art indeed.

Next, I will conduct a “thought experiment”, where I conceptually test the model by describing the proposed chain of events in detail. I will begin by describing an emotionally influenced life situation, then move to relating possible embodied gestural responses to it. Next, I shall describe imagined attributes of a virtual musical gesture as created by the application of musical intentionality to a consideration of the embodied gestures and their environment. Finally, I shall describe two contrasting realizations of the virtual musical gesture within two very different mediums of music.

Emotions, Gestures, and the Virtual Musical Gesture

Imagine an undercurrent of long term life tension, a set of important and cascading deadlines, and a perceived lack of clarity in specificity of the requested materials required to meet the deadlines. This is a situation of “not knowing what to do”, with no clear route to solving the problems creating the emotional tension, enough to make some individuals have an emotionally shaped physical response. The body may respond to such emotional tension to the point of physical illness. Let us imagine a series of cycling, long form unvolitional contractions in the central body region, during an episode when the listed concerns are fore-grounded to one’s attention. Next, imagine that a serious mistake has
been made in some life area, which is suddenly placed in a position of being exposed. This thought returns and returns, so flashes of fearful response appear, over and over, as yet another overlay to the situation. The flashes create short body contractions, clenching of fists, and a pounding but short term increase in heart rate. Each flash captures the sufferer’s attention, foregrounding over the two previously described levels of longer term aspects of gestural responses to the overall situation.

We have three durational levels here of embodied gesture. The long term life tension will be in real life virtually stationary during this episode, but it will still be an underlying gestural “mask”. “There are many methods for defending our personal zones; one of them is by masking. Masking means controlling our body so that it will not give out messages that the mind wants to hide. Masking includes facial gestures and can involve the whole body.” (BVSDE 2011) The repeating contractions will be felt over a much shorter time period, and the flashes of fear will take place over a very short time frame. The intensities are correspondingly different as well.

If a composer wishes to access these emotions as embodied as the building blocks of a realized musical gesture, some form of imagined reduction of these elements must take place. This is the creation of the imagined virtual musical gesture, a gesturally related shape that is visualized in detail but not physically performed. I next describe the creation of one such virtual musical gesture.

**The Virtual Musical Gesture: An Example**

I first imagine, as a composer using a musical intent, a dark undulation, cycling round and round. This shape is heavy and cloudy, and reflects repetitive centralized deep body contractions. As related to the physical gesture, the duration of the cycling is neither fast nor extremely slow. The duration usable as found in the originating gesture.

The long form of underlying life tension has a different shape. This has less heaviness, and is a sustaining shape that will only evolve over a comparatively long duration. At the same time, it will not evoke either a simple or overly pleasurable response. The duration of the real world gesture is extremely long, so it will undergo an imagined durational reduction to have greater affect within the virtual musical gesture.
The third aspect of the imagined virtual musical gesture relates to the flashes of fearful response. Here I imagine short events that foreground themselves over other aspects described. As these are built upon quick sequential flashes of thought, and instant gestural response, this part of the virtual musical gesture has identifiable short articulated structures.

The virtual musical gesture here described is filled with imagery useful for the eventual realized musical gesture(s). The virtual gesture is not a direct gestural translation, as it incorporates events of extremely long and extremely short durations into a single imagined time frame. Intensities and multi-modalities are shaped and interpreted in ways that create structure for the artistic vehicle. External influences and ideas may assist the shaping as well, but for purposes of brevity we will here make mention only that such possibilities exist.

In "Structural Functions of Music", Wallace Berry defines musical structure to be "the punctuated shaping of time and "space" into lines of growth, decline, and stasis hierarchically ordered" (Berry 5). This is, as well, an apt description of the nature of a virtual musical gesture.

**Example 1: Realization in the Medium of Acoustic Music**

To simplify this example, I will consider only musical materials available to an ensemble consisting of piano and string quartet. I will begin with a discussion of how pitch might facilitate the required "dark undulation."

Pitch refers to how high or low a sound is perceived to be. Western musicians think of pitch as being divided into twelve different notes, each with a letter name such as C, or D#. We feel a low pitch in our bodies as physical vibrations. The pitches in this medium were chosen due to their relationships to the physics of a vibrating string, which leads to that fact that certain pitches in a given musical context sound like they are at "home" in stability, while others may have the ability to “dominate” the listener's expectations in a way that provokes an expectation or desire for those dominant notes to return “home” to the overall tone of the piece. The pitch with the greatest amount of “home” to it is referred to as the tonic (the primary tone), and is the root of the phenomena known as “tonality.”
The “dark, cloudy” aspect described will be dramatically affected by the pitch range chosen. Lower notes have a deeper, richer sound, while the higher notes are thinner and brighter. The higher notes speak very quickly, while the lower take a tiny but appreciable moment for the sound to reach full volume. This is referred to as the “attack” of the sound. I will select a low pitched sound to facilitate the “dark” aspect, and to produce a more “cloudy” attack on the notes. Low pitched piano is the choice for the “dark undulations”.

Harmony is the relationships between all musical sounds heard at the same time, perceived as one simultaneous fusion. When several different pitches are heard at once, this is referred to as a “chord”. In the most common “diatonic” harmony the chords will also have ability to create the impression in the listener that the music is either “home” (tonic function), or has a need to move someplace not home (sub-dominant function), or has a need to return “home” (dominant function). If a tonic to dominant cycle was undulated back and forth here, we would create an impression of “home” to “wants to go home”, over and over again. At no point does the dark undulation of the musical gesture suggest this sort of relationship, so I will choose non diatonic chords on the piano to avoid the “home, wants to go home” cycle. Chords of two or three notes produce a more transparent sound, compared to “complex” chords using four or more, so complex chords would be more suitable. The choice of materials here therefore is low pitched piano notes, in complex, non-diatonic chords. At least two different chords are needed to create the alternating contractions and releases described as undulations, so we will have a “progression” of chords. The exact choice of the chords must wait until other aspects of the realization of the virtual musical gesture have been considered.

The “long form of underlying life tension” has a different shape. In this interpretation it has less heaviness (or “dark”), and is a sustaining shape that will only evolve over a comparatively long duration (to help evoke duration despite the durational compression created in our virtual musical gesture). It will not evoke a simple or overly pleasurable response in the listener. We need a musical material that provides a long sustaining sound in the appropriate pitch range, and it should be able to change how it sounds over time. When discussing both musical sounds and human speech, the term used for the changing sounds produced over time is “articulation.” Strings have possibly the widest possible range of articulations of any of the traditional Western instruments, so they are the obvious choice as the producers of our “long, less heavy, and evolving over
time” aspect to our realized musical gesture. We will choose an articulation aptly named “poco espressivo” (slightly expressive), which evolves over time, and may be played in a sustaining fashion. This creates our basic timbre, and articulation, but does not address all of our requirements alone.

We need a sound that evokes neither a simple or overly pleasurable response, and which will operate given our choice of articulation. One material that will achieve this is harmony: we may use a “dissonant” (harsh, discordant) chord to create a tension effect. Here we run into a different issue: these more static pitches chosen will interact with the changing pitches found in the moving chords required for the “dark undulations” of the piano. The solution is to ensure that at least one or two of the pitches used on the piano are common tones between all the chords. These constant pitches will be suitable as well for our sustaining string pitches.

We have the remaining “flashes of fear” to arrange. These are qualitatively different from the other aspects discussed so far: they refer to a conscious thought, and the effect of the thought, as opposed to a long form mood (as now heard in the strings) or the undulating un-volitional embodied body contractions developed in the piano. A thought has a beginning, and an end, very much like a melody (albeit in this instance an unpleasant one).

Melody is the perception of a series of notes sounded in succession in some type of connected line. Melody normally receives primary attention from the listener: in the case of our virtual musical gesture, the thought arrives in a jarring fashion, and commands attention. Higher notes on the piano speak quickly, command attention, and when played aggressively have a cutting attack. That suits one aspect, but the high piano notes lack the depth or “weight” of low pitch. We also need a sound that is not quite a string, nor a piano, as both of those sounds have had a convention established in our use that links them to the elements already described. The solution here is to have the piano play high notes, as described, while the cello simultaneously plays low notes, creating a new sound that is a fusion of both timbres. The piano gives attack and clarity, while the cello provides weight and dark import. The musical term for this is “doubling”, where one part is played on two different instruments (though the parts may not be quite identical). The final choice here then is the nature of the melody itself.
The realized musical gesture described might have different uses when complete. If it is heard as a short section within a longer piece of music, then the melody will have to be chosen with consideration of the context of the entire work. A melody in a longer work is frequently heard in many guises, the “motive” (identifiable melody) being varied using a number of techniques with the aim that it remain identifiable but have a different affective quality. If this virtual musical gesture was used to create an entire, short piece of music, then the melody might be something fast, angular, and disjoined, so as to reflect the nature of the arrival of the thought as described. If the musical gesture was only one of many used to create a longer work, then the melody in question might be a variation of a melody already in use, in which case the properties just mentioned might be overlaid on the existing melodic shape to create a motivic variation which both echoed the pre-existing melody and the incorporated influence of the described angular interpretation of the underlying virtual musical gesture.

**Introduction to Electro-Acoustic Music**

Electro-acoustic music is perhaps less familiar to many people than music for the piano and string quartet. Before we discuss how this same virtual musical gesture might be realized within this entirely different medium of electro-acoustic music, I would like to take the liberty of describing it further.

Barry Truax said the term electro-acoustic:

is often used more loosely to refer to any process for the electronic generation and/or manipulation of sound signals, including techniques of sound synthesis for the electronic or digital generation of such signals. When the purpose of such manipulation is artistic, the result is commonly called electro-acoustic music. (Truax)

The composition of electro-acoustic music involves understanding the nature of and control of an entirely different set of instruments than are found in acoustic music. The instruments are in a sense both much more complex, and much simpler than acoustic instruments. Electronic devices may have many settings that the composer must set in an informed fashion in order to create the precise sort of sound imagined, which is difficult. At the same time, the commodification of electronic music devices has led to the availability
of many devices that have been preset to respond in certain ways that cause the device in question to immediately output organized sound of a specific type. The availability of such presets may make the creation of certain types of electro-acoustic music much simpler than writing for “real-world” acoustic instruments, but comes at the cost of relinquishing much of the in-depth control that is possible to have over the nature of the music created.

Such tones are created on devices generally known as “sound synthesizers”, or just synthesizers.

Synthesizers have two basic functional blocks: a control interface, which is how the parameters which define the end product are set; and a 'synthesis engine', which interprets the parameter values and produces the output. In most cases there is a degree of abstraction involved between the control interface and the synthesis engine itself. This is because the complexity of the synthesis process is often very high, and it is often necessary to reduce the apparent complexity of the control by using some sort of simpler conceptual model. (Ross 3)

Synthesized sounds are the basic building block of electronic music, equal in function to the “sound” part, or “timbre” of acoustic instruments. Control of timbre is one of the primary differences between acoustic and electro-acoustic music.

Timbre is sometimes referred to as "Tone Colour" and refers to the differing qualities heard in sound that make one instrument sound different from another. A trumpet sounds very different than a clarinet, as an example. With acoustic music, the instrument's timbre is inherent in the instrument itself (though many existing acoustic instruments have been explored for new possible timbres). With electronic music the basic instrumental timbre is generated as part of the compositional process, and as such, may be considered as the first level of composition.

**Example 2: Realization in Electro-Acoustic Music**

So, once again our virtual musical gesture requires a dark and cloudy undulation, cycling round and round. “Heavy, and cloudy” is an excellent way to describe the timbre of a sound. The next choice for the composer here in realizing these attributes in the medium of electro-acoustic music would be to determine the most appropriate method for electronically generating such a sound. Describing the actual methodology of each
general technique is beyond this paper, but a short discussion will assist the reader’s observation of the thinking involved. General types of synthesis techniques as described in *Sound, Synthesis, and Sampling* include:

- **Subtractive:** Subtractive synthesis takes a 'raw' sound which is usually rich in harmonics, and filters it to remove some of the harmonic content.
- **Additive:** Additive synthesis adds together lots of sine [basic] waves with different frequencies to produce the final timbre.
- **Physical modelling:** Physical modelling uses mathematical equations which attempt to describe how an [acoustic] instrument works. (Ross 2004)

Other synthesis types of interest include:

- **FM (or frequency modulation):** FM uses the pitch of one sound and uses it to modulate or control the pitch of another sound. FM sounds very detailed, and has a somewhat cutting timbre generally.
- **Granular (or particle):** This type of synthesis breaks sound into tiny particles. Huge numbers of particles are emitted, and the listener perceives them all as a single “cloud” of sound. Granular synthesis often has a buzzy quality of sound.

It makes sense to select the technique that inherently sounds the closest to our need. Subtractive often removes high frequencies, so a given sound may sound “dark”, while “cloudy”, as an attribute associated with imprecise edges may be created by “enveloping” the basic sound in a shape controlling as aspect such as level or timbre as a function over time. Additive would be workable here, but is enormously time consuming. Physical modelling is a poor choice, as we do not want to emulate another acoustic instrument or require physically playable expressive control. FM is workable, but provides very detailed, clear sounds, which are not best suited to “cloudy” darkness. Granular synthesis tends to have a “buzzy” texture, providing sonic detail unsuited to our requirement. I will choose subtractive synthesis: a basic waveform known as a sawtooth will be filtered and enveloped to create a generally dark sound, with the envelope removing any sharp “edges” on the onset and release of the durational aspect to the sound.

Our realization of the “undulating” quality of the sound in the acoustic medium used alternations of pitches to build different chords. Electronic synthesis has many other ways to create an undulation in the sound, without changing notes. I will therefore create an
undulating “envelope” control, which will alter aspects of the sound over time in a pulsing fashion. The brightness of the sound, the timbre, the physical position in space, and many other attributes of sound are all modifiable over time by such controller envelopes. I will create a “dark, cloudy undulation” by modifying the very nature of the sound itself over time, in contrast to changing notes as in an acoustic performance.

Our next attribute relates to the long form of underlying life tension. Electronically generated sound shares the underlying physics of sound with acoustic music, but one important difference exists which is that pretty well any electronic instrument may create any pitch. Very few acoustic instruments have the ability to play “between the notes”. This limitation has influenced the nature of music composed for acoustic ensembles by quantizing the nature of pitch to the notes as found on the piano. The “notes in between” are normally not in use, except when “bending” notes in the pursuit of expressivity. One category of techniques that does however use these spaces between the notes is referred to as “sound mass” techniques.

Krzysztof Penderecki’s piece for string orchestra *Threnody for the Victims of Hiroshima* is a definitive work of sound mass composition. In Threnody, Penderecki used the “space between the notes” as a generator of a new type of timbre, a massive and sometimes emotionally disturbing type of expressive and controllable sonic event. Imagine 50 different pitches found between three adjacent notes on a piano: the result being that the pitches cannot be perceived as independent notes but instead blur into a “fused” timbre.

This technique is totally suited to the electro-acoustic medium, as the ability to control pitch in extreme detail is endemic to electronic synthesis. Penderecki’s acoustic use of this in technique in fact is borrowed from electro-acoustics:

It was while working in the electronic music studio of the Polish national radio, in Warsaw, that Penderecki began to discover sounds that he was unable to realize using conventional instrumental techniques. The new techniques (particularly for strings) and new notational methods, which we often associate with Penderecki’s work, were thus an attempt to transpose electronic sounds into the orchestral domain. (Barry 2011)
Erikson comments:

What may be of musical significance is the average width between elements of our tonal mass. We are no longer (if we ever were) bound to think only in increments of chromatic half steps. Computer techniques allow precise control of the width between elements, easy specification of their frequencies and more sharply marked edges than is possible with any filters we have today. (Erikson 1975)

The sounds created with this technique, born in electronics, are perfectly suited to our requirement of a not overly heavy sustaining shape evolves over a comparatively long duration. We will therefore realize the “long form tension” by utilizing synthesized sound mass clusters.

We have only the “flashes of fearful response” to deal with. Once again, we consider the idea of a thought, a sequence of events over time. In the acoustic realm, melody’s corresponding note sequence over time answered this. In the electro-acoustic medium, I’d like to choose a note sequence as well, but a special type of note sequence that is not normally heard in acoustic music. This is the adoption of something called “sample and hold” as a melodic generating controller.

Imagine sweeping your arm, left to right, while wiggling your hand up and down. If you were to capture that gesture to paper, you would have a wiggling line. The horizontal represents time, and the vertical pitch, for our use. Take a ruler, and mark an x upon the line every 3 horizontal inches, regardless of the vertical height of the marking involved. This technique will provide us with a melodic sequence, but one where the notes are in no way linked to the acoustic convention of twelve note to the octave; they instead are pitched in the “space between the notes”. This will provide an unusual aspect to our melodic “thought” evoked that should work well as a stress inducing element.

For the timbral aspect, we need something precise, detailed, and able to cut through the other sonic elements of our electronically realized musical gesture. This requirement is suited to the character of FM synthesis, so the choice of the technique is an easy one. For the specialists amongst us, I suggest C:M = 1:1.41 cascaded to 1:2, with feedback and independent envelope control on each modulator as a starting point for this.

This completes the second realization of the described virtual musical gesture.
**Conclusion**

An arm lifts and sweeps, and a run of notes correspondingly rises and swells. Direct transference of gesture into a musically gesture, is well researched. In this paper I have proposed that an intervening state may exist: the virtual musical gesture. The virtual musical gesture, as an imagined set of simultaneous trajectories over time, is never physically performed. Durational aspects of long form physical gestures may be shortened, while very short gestures may be imagined as taking more time. The composer’s artistic intent may be fluidly infused into a virtual gesture, as no physical or vehicular medium need to be manipulated:

The virtual musical gesture informs the creation of a realized musical gesture. It may be realized in different mediums, creating music that sounds sonically very different, but the underlying gesture → virtual musical gesture → realized musical gesture structure allows the informing musical gesture to exist outside of the final medium.

**Further Research**

Further research would be of benefit in providing forms of evidence that the proposed model works as suggested. At least two such avenues exist, the first using the model in a “practice as research” context of composing music. Practice research is a form of academic research which incorporates an element of practice in the methodology or research output. The second avenue might be to create a statistically validated study in the field of music and psychology.

A methodology to use this model within practice as research might involve writing a set of pieces of music that reference the same virtual musical gestures yet are realized in two entirely different mediums. The success of this enterprise would provide one form of evidence to support the idea.
Further research might also be undertaken in the area of music and psychology. A two part study might be conducted:

**Phase 1**

Virtual music gestures are created, which are realized in a number of different mediums. The examples are played to a statistically valid random sample of test participants, who fill out questionnaires. The data gathered would be analyzed to see if sonically different musical pieces based on the same virtual musical gesture are considered to be more similar to each other than to other music presented which is not realized from the same virtual musical gesture.

**Phase 2**

Realized examples are given to an experienced dance choreographer, who choreographs a short dance for each piece, taking care to create movements that echo both the imagined emotive and gestural content of each musical piece. The dances are subjected to analysis by experienced observers and a computer analysis system such as the EyesWeb system. Emotional and gestural data over time are output. This data is given to an experienced composer, who transcribes it into a “derived” virtual musical gesture. The virtual musical gesture is used to realize new pieces, and once again the same questionnaire is given to participants. The data is analyzed using statistical software such as SPSS to see if a correlation is found between music examples created from the original virtual musical gesture, and the new examples realized from the derived virtual musical gesture. This would provide evidence supporting the idea that a virtual musical gesture can, in some form, be extracted from a realized musical gesture. This would allow virtual musical gestures to be transferred from an examined realized gesture into a new realized gesture, after the requisite steps were followed.
Works Cited


Appendix B.

**DVD The Three Faces of Midnight**

**Creator**
Doug Blackley

**Description**
This DVD contains video recordings of the *Three Faces of Midnight* performance.

**Filenames**
- Introduction
- *Into the Light*
- *Into the Night*
- *Running on Faith*
- Spectralis
- Aurora
- Midnight
- Return
- Concert closing