SPATIAL CONSIDERATIONS AND THEIR COMPOSITIONAL APPLICATIONS
IN SELECTED ELECTROACOUSTIC MUSIC COMPOSITIONS OF SCOTT A. WYATT

BY

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ABSTRACT

This research seeks to delve deeper into Scott A. Wyatt's diverse array of techniques incorporated in his electroacoustic compositions, with a particular concentration on the processing procedures pertinent to spatialization in his works. This essay examines three of his compositions in specific, designed for eight-channel performance: *In the Arms of Peril* (2001), *On a Roll* (2004) and *ComLinks* (2010). In turn, this research seeks to highlight the evolving utilization of spatialization within the framework of electroacoustic music; and gain deeper understanding of Wyatt's aesthetic and compositional philosophy reflected in his works.

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CHAPTER 1. Introduction

Throughout the history of Western Art Music, many composers have written music with particular spatial orientations in mind. The significance of spatialization in music can be traced back to the antiphonal church music of the *cori spezzati* (broken choir) in Venice during 16th century. Fast forward four centuries, spatialization plays an ever-more significant role in music composition with the emergence of electroacoustic music. Due to the nature of electroacoustic music's performance (the sound's projection into space via loudspeakers), the spatial distribution of sound became one of the most essential compositional factors.

In further research and development of spatialization as a compositional and live-performance methodology within electoacoustic music, Scott A. Wyatt has utilized eight discrete-channel sound systems. In considering Wyatt's various approaches to music spatialization, from specific engineering techniques for electroacoustic realization to pedagogical approaches for electroacoustic music composition, his awareness, compositional approaches and engineering techniques calls for thorough examination.

This research project seeks to delve deeper into Scott A. Wyatt's diverse array of techniques incorporated in his works, with a particular concentration on the processing procedures pertinent to spatialization in his works. This essay will closely examine three of his compositions in specific, designed for eight-channel performance: *In the Arms of Peril* (2001), *On a Roll* (2004) and *ComLinks* (2010). In turn, this research seeks to highlight the evolving utilization of spatialization within the framework of electroacoustic music; and gain deeper understanding of Wyatt's aesthetic and compositional philosophy reflected in his works.

1.1. Research Objectives and Methods

1.1.1. Research Objectives

The broader research objective is to examine the utilization of spatialization within electroacoustic music, through deconstructing Scott A. Wyatt's works. On a sub-level, some of the goals of this research project include the following:

- Overview the steps of Wyatt's compositional procedure by dissecting each stages of the process, addressing different features of the music itself to show how Wyatt produces electroacoustic compositions.
- Examine Wyatt's recording techniques such as microphone choice and positioning, noise management, and handling a diverse range of sound materials.
- Examine Wyatt's approaches to sound processing consisting of various methods used to manipulate sound using computer software and outboard processing equipment.
- Present and explore three selected works examining spatial considerations, formal structure, and other musical features.

1.1.2. Research Methods

The essay aims to explore the research objectives mentioned above in three parts:

- First, it will clarify the terminology regarding sound diffusion and projection. Types of translations utilizing the D-8 System will also be defined.
- Second, Wyatt's engineering features and procedure in compositions will be examined. This will encompass sound material, sound recording, sound processing, sound positioning (specialized 2-D), as well as considerations of space.
- Lastly, Wyatt's three electroacoustic compositions (*In the Arms of Peril, On a Roll, and ComLinks)* will be examined in terms of their (1) Formal Scheme, and (2) Spatialization and Engineering.

1.2. Project Background

Since its founding in 1958 by Lejaren Hiller, the University of Illinois Experimental Music Studios has greatly influenced the development of electroacoustic music, and the multi-

channel sound projection systems in particular. Many composers have actively experimented with these systems in the Experimental Music Studios, including Salvatore Martirano (24-channel Sal-Mar Construction), Ben Johnston (simultaneous playback of multiple stereo recordings), Herbert Brün (four-channel tape performances), and Scott A. Wyatt (8-channel D-8 System).[1] Wyatt has served as the director of Experimental Music Studios for many years, and composed many notable electroacoustic works, reflecting his dedication to in-depth acoustical research coupled with refined studio techniques. Unlike the research interests of many other contemporary composers concentrating primarily on "hi-tech" hardware or the programming techniques (e.g. making new electronic instruments, network performance through internet, laptop ensembles using real-time processing and algorithmic composition), Wyatt focused on the artistic incorporation of informed spatial engineering techniques in order to present sonic events in a traditional manner. With a prime focus on sound diffusion and spatializaion, he designed the D-8 System (Discrete Eight System), a sound system with a precisely designated loudspeaker positioning created to accommodate both research and performance of multi-channel electroacoustic compositions.

1.3. Historical Context

Although composers have considered spatialization in their music for centuries, the advent of electroacoustic music brought with it the integration of space as a core musical parameter. Since Alan Dower Blumlein, who worked for EMI in Britain, invented stereophonic recording and playback techniques in 1931 (British patent #394,325) using two figure-8 polar pattern microphones in 90-degree position to each other, engineers and composers tried to

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[1] Scott A. Wyatt, "Investigative Studies on Sound Diffusion/Projection at the University of Illinois: a report on an explorative collaboration," *Journal Seamus*, 15/1 (2000): 6-17.

extend the possibilities of expressing spatial movement and distribution beyond that of the common stereo sound field.[2] *Table 1* shows a summary of several significant precursors.

Name	Year	Features
Fantasound	1940	- 9 soundtracks - 1st film employing multi-channel surround sound - use of click track, overdubbing
Potentiometer d'espace	1951	- designed by Jacques Poullin and suggested by Schaeffer - enabled a performer to locate sound throughout four loudspeakers: two front, one rear and one above audience - adjusting a transmitter coil with hand toward or away from four large receiver coils surrounding the performer
Gesang der Jünglinge	1956	- composed by Karlheinz Stockhausen - designed for five-track playback using five groups of speakers: four surrounding the audience and one above
Poèm Électronique	1958	- composed by Edgar Varèse - multimedia spectacle employing lights, images and multichannel sound presented in the Philips' Pavilion at the Brussels World Fair - designed for and performed on over 400 loudspeakers[3]
German Pavilion from Osaka World Fair	1970	- world's first spherical concert hall according to Stockhausen's musical specification[4] - 50 groups of loudspeakers located in seven concentric circles were installed in the auditorium
Japan Steel Pavilion from Osaka World Fair	1970	- designed by Toru Takemitsu called 'space theater' - consisted of lighting effects, lasers, and a contribution of sound sculptures by François Bashet - diffused the sound to the 1,300 speakers grouped in 250 locations: in the floor, ceiling, and walls of the pavilion[5] - sound coming from any direction in a fully three-dimensional manner[6]

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[2] "1931 Alan Dower Blumlein Stereo Patent," *Mix: Professional Audio and Music Production*, last modified September 1, 2006, http://www.mixonline.com/TECnology-Hall-of-Fame/alan-dower-blumlein-090106/.

[3] sources differ on the number of speakers from around 400 to 450, e.g. The Grove Dictionary states 425.

[4] Golo Föllmer, "Karlheinz Stockhausen: Spherical Concert Hall," accessed August 18, 2011, http://www.medienkunstnetz.de/works/stockhausen-im-kugelauditorium/.

[5] Emmanuelle Loubet, "The Beginnings of Electronic Music in Japan, with a Focus on the NHK Studio: The 1970s," *Computer Music Journal* 22/ 1 (1998): 49.

[6] Barry Blessler and Linda-ruth Slater, *Spaces Speak, Are You Listening?: Experiencing Aural Architecture* (Cambridge: MIT Press, 2007), 171.

Polytopes	1960s ~1970s	- collective name of a series of multimedia art by Iannis Xenakis - poly=many, tope=places - including sound, light, and space (architecture)
simulation of moving sound sources	1971	- simulated sound moving through physical space using a quadraphonic loudspeaker environment by John M. Chowning - resulted in fairly persuasive illusions of a sound in motion by combining sound information relative to the listener, angular location, distance, and velocity (Doppler Shift) with artificial reverberation
Gmebaphone	1973 -	- the first loudspeaker orchestra by the Groupe de Musique Expèrimentale in Bourges - consisted of amplifiers, sound-treatment systems, loud-speakers, a mixing-console, and a processing system designed for live diffusion and performance[7] - the latest version named the Cybernéphone
Acousmonium	1974 -	- loudspeaker orchestra developed by François Bayle at the Groupe de Recherches Musicales in Paris - consisted of 80 speakers of various sizes placed across a stage at different vertical and horizontal locations based on their range, power, quality, and directional characteristics[8]
BEAST	1982 -	- stands for Birmingham ElectroAcoustic Sound Theatre - the concert sound system of the University of Birmingham's Electroacoustic Music Studios - founded by Jonty Harrison (the Director of the Studios)[9] - currently it has over 100 individual loudspeakers, each discretely addressable[10]
Ambisonic	1970s -	- a series of recording and replay techniques - designed by Michael Gerzon and Peter Fellgettv - utilizes an encoding/decoding approach for sound diffusion

Table 1. Precursors of Multichannel Sound

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[7] Christian Cloziere, "The Gmebaphone Concept and the Cybernèphone Instrumnet," *Computer Music Journal* 25/4 (2001), 81.

[8] "The Acousmonium," accessed August 18, 2011, http://emfinstitute.emf.org/exhibits/acousmonium.html.

[9] "Meet BEAST," accessed August 18, 2011, http://www.birmingham.ac.uk/facilities/BEAST/about/meet-beast.aspx.

[10] "The Acousmonium," accessed August 18, 2011, http://emfinstitute.emf.org/exhibits/acousmonium.html.

CHAPTER 2. Spatialization and Diffusion Utilizing the D-8 System

2.1. D-8 System

Although multichannel sound systems have been employed since the 1940s with cinematic use, a consensual standard format within the electroacoustic music community has not been established until recently. In the early 1990s, with the help of his colleagues, Wyatt installed a multichannel sound system with eight loudspeakers in a fixed location within the Experimental Music Studios at University of Illinois, Urbana-Champaign.

In a report published in 2000, Wyatt presented the 'D-8 System' (Discrete Eight System), as the outcome of continuous experiments concerning multichannel sound diffusion and projection.[11] He chose to work with the eight-channel system because it was workable, affordable, and convenient, with respect to available commercial equipments such as recorders and ADC/DAC units.[12] On account of the popularity of ADAT (Alesis Digital Audio Tape) machines and the lightpipe format, which delivers an eight-channel audio signal through one single optical cable, a lot of pro-audio equipment has eight inputs and outputs or its multiples (i.e. 16, 24...).

Among several configurations of eight loudspeakers in general, the circular pattern (*Figure 1*) is effective primarily for mono source panning, but lacks the ability to maintain stereo images. According to Harrison, another pattern (*Figure 2*) Wyatt introduced in the report[13] is actually the 'main eight' channels of speakers from BEAST basic, which is the minimum setup

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[11] Scott A. Wyatt, "Investigative Studies on Sound Diffusion/Projection at the University of Illinois: a report on an explorative collaboration," 6-17.
[12] *Ibid.*
[13] *Ibid.*

for the playback of stereo tapes. [14] It consists of different proximities and locations of loudspeaker pairs and is designed primarily for presenting stereo images. In this configuration, pair 1 L-R presents the narrow focused stereo field, which reduces the possible "hole in the center" and also enhances intimacy. Pair 2 illustrates a wide stereo field effective for producing lateral movement with incorporation of Pair 1. These four speakers (Pair 1 and 2) should be same type and driven by matching amplifiers.[15] Pair 3 depicts the surround stereo field that fills the space, enveloping the listener, while pair 4 presents a distant stereo field that creates a sound image behind the Pair 1. However, this type of speaker configuration has difficulty in presenting mono source panning, since its prime focus is on varieties of stereo images.
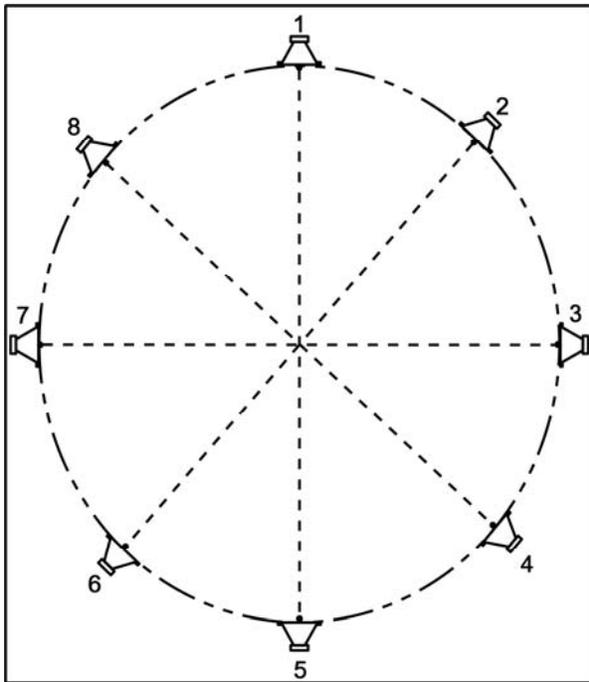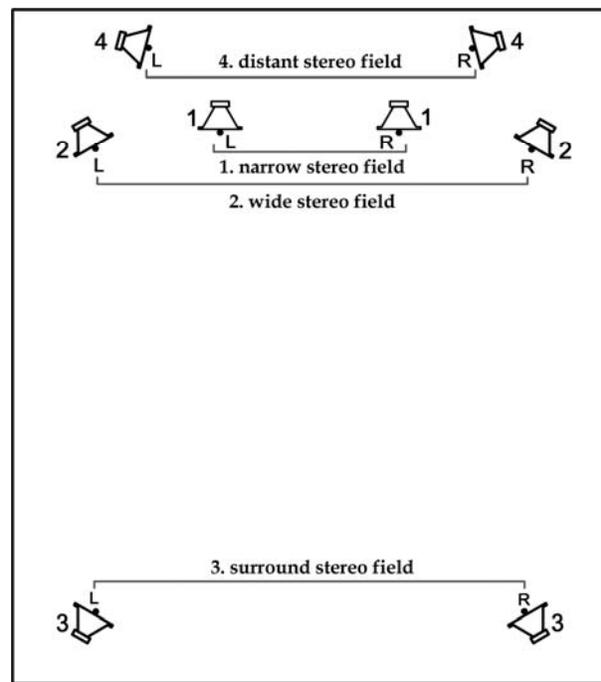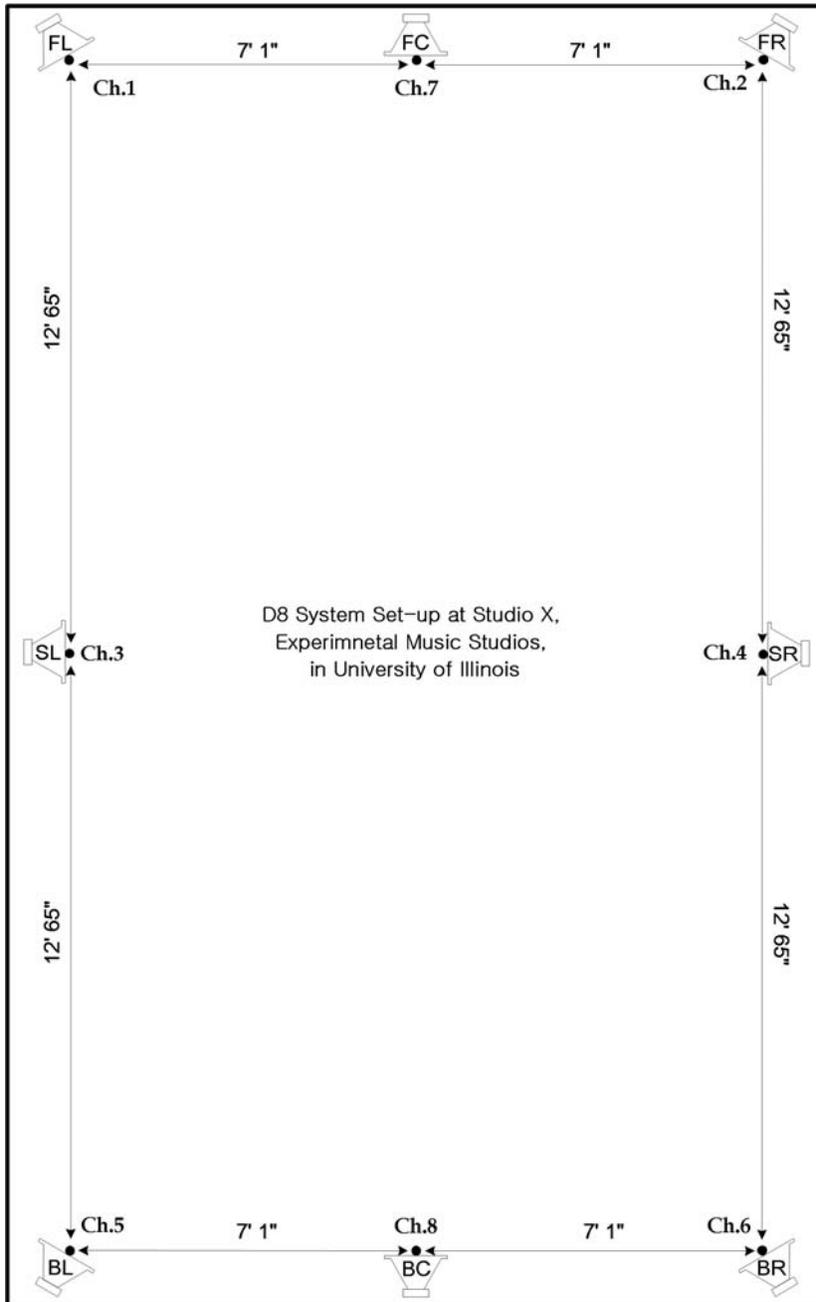

Figure 1. Circular Pattern

Figure 2. Stereo Pairs

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[14] Jonty Harrison. "Diffusion: Theories and Practices, with Particular Reference to the BEAST system." eContact! 2.4. 1999. Accessed February 6, 2012. http://cec.sonus.ca/econtact/Diffusion/Beast.htm.
[15] *Ibid.*

On the other hand, the D-8 System Wyatt adopted (see *Figure 3*), involving three stereo pairs of loudspeakers (front, side and back) plus front and back center-fill loudspeakers, compensates for the weak points of the two configurations mentioned earlier.[16] This approach permits effective longitudinal rolling of stereo images from front to back and vice versa, while also permitting perimeter translation in a circular manner. The fact that it also conforms easily to 5.1 and 7.1 channel commercial based presentations is another positive feature.

Figure 3.
Configuration of D-8 System

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[16] each abbreviation stands for as following; FL-front left, FC-front center, FR-front right, SL-side left, SR-side right, BL-back left, BC-back center, and BR-back right.

2.2. Terminology

Scott A. Wyatt coined and clarified terms regarding sound diffusion and projection.[17]

This essay will employ the definitions of the terminology clarified by him as listed below:

- *spatialization*: *the perception of a sonic environment and/or space. This perception can be created through simulation of the reflective properties of a host space, as well as how a specific sound source is reflected within that environment. (These simulated reflective properties might include: early reflection, reverberation time, and the frequency characteristics of the reflected sound.)*

- *localization*: *the perception of a sound as having a definite location within an environment. In the case of sound projection, this location can be described in terms of the projection plane (see below) and its borders. Localization is created through simulation of distance and direction by manipulation of relative amplitude balance among multiple loudspeakers, relative balance of direct and reflected sound, interaural time differences, and frequency characteristics.*

- *projection plane*: *an abstraction of a flat surface whose orientation is defined by the eight loudspeakers of a D-8 sound projection system, forming a front border (running from Front Left through Front Center to Front Right), a back border (running from Back Left through Back Center to Back Right), a left side border (running from Front Left through Side Left to Back Left) and a right side border (running from Front Right through Side Right to Back Right). Perceived sound sources can be described as having a location in this plane or outside its borders. The purpose of this plane is to describe the perceived motion that takes place within the three dimensional space. Although this motion may be in some way three dimensional, only two dimensions can be controlled by D-8 sound projection and are therefore the only two discussed.*

- *translation*: *the perceived movement of the location of a sound source, which can be described as a vector inside or outside of the projection plane. Translation is accomplished by simulating a change, over time, of the distance or direction of the sound source with respect to the projection plane. Parameters to change might include amplitude, frequency characteristics and balance of direct and reflected sound.*

- *pan*: *the lateral translation of a sound source through or beyond the projection plane. This is accomplished through simulation of changes in relative amplitude balance between two loudspeakers.*

- *roll*: *the longitudinal translation of a sound source through or beyond the projection plane. This is accomplished through simulation of changes in relative amplitude balance between two loudspeakers.*

- *cross*: *the diagonal translation of the sound source through or beyond the projection plane. This is accomplished through a process which combines pan and roll.*

- *contouring*: *the act of performing a translation, amplitude change, timbral shift, or combination of these to a phrase/gesture in support of the characteristic shape of the phrase/gesture.*

- *ornamenting*: *the act of supportively embellishing any one or combination of the perceived location, amplitude or timbral characteristics of a gesture.*

- *articulating*: *the act of accentuating a single event by exaggerating its existing location, amplitude, or timbral characteristics.*

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[17] Scott A. Wyatt, "Investigative Studies on Sound Diffusion/Projection at the University of Illinois: a report on an explorative collaboration," 6-17.

Wyatt also described the hierarchy of compositional elements of an electroacoustic work or instrumental/vocal work as shown in *Table 2*.[18] He emphasized that the significance and/or character of a phrase, gesture, or event must be determined with respect to the contextual characteristics of the composition; phrase, gesture, and event could have similar or the same meaning depending on context.[19] In this essay, these terms and their hierarchy are used to describe his three compositions.

Electroacoustic works	Instrumental/Vocal works
Composition	Composition
Section	Section
Phrase	Phrase
Gesture	Motive
Event	Note

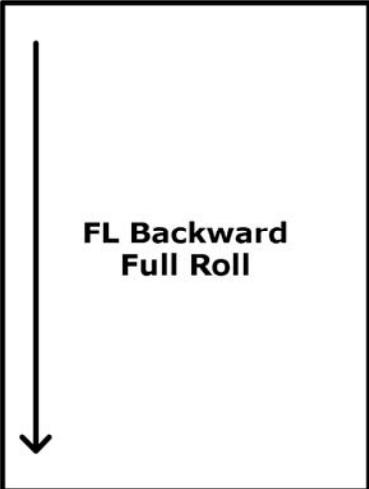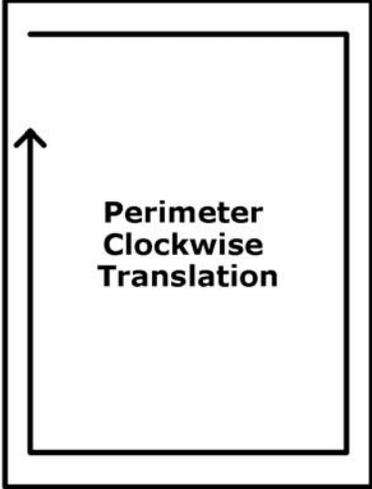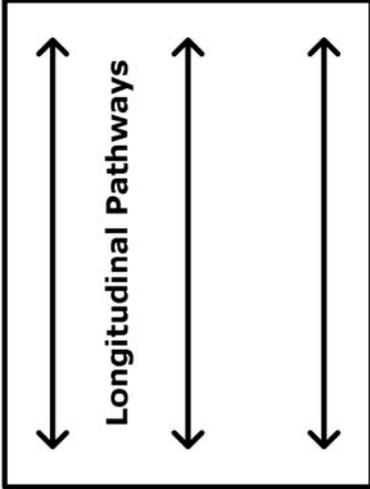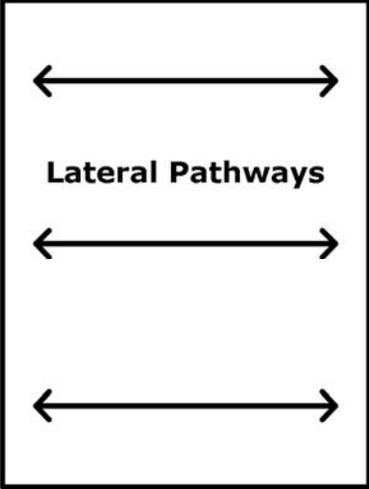***Table 2. Hierarchy of Compositional Elements***

2.3. Types of Translations Utilizing D-8 System

Wyatt has specified examples of possible and useful movement of sound sources within the D-8 System throughout his articles and class materials, and defined these movements as "translations".[20] The various translations that he labeled are not only an essential factor in Wyatt's electroacoustic compositions designed for multichannel sound system (D-8 System), but also a significant analytic tool for his electroacoustic music. The following diagrams show the visual illustration of movement of mono and stereo sound sources within the sonic space of D-8 System:

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[18] Scott A. Wyatt, "Investigative Studies on Sound Diffusion/Projection at the University of Illinois: a report on an explorative collaboration," 6-17.
[19] *Ibid.*
[20] *Ibid.*

Lateral Pathways

Longitudinal Pathways

Perimeter Clockwise Translation

Perimeter Counter-clockwise Translation

FC Leftward Half Pan

FC Rightward Half Pan

FL Backward Full Roll

FL Backward Half Roll

FL Full Cross

FL Center Cross

FL Half Cross

FC Leftward Full Cross

FC Rightward Full Cross

FC Leftward Half Cross

FC Rightward Half Cross

FC Full Spread

FC Half Spread

Stereo B Forward Half Roll

**Stereo S Forward
Half Roll**

**Stereo Backward
Full Roll**

**Stereo Forward
Full Roll**

L　　　　　R

**Stereo Rolls
to
Reversed
Channel Image**

R　　　　　L

CHAPTER 3. Engineering Features and Procedure in Compositions

The procedure in Wyatt's electroacoustic compositions and engineering features he commonly utilized are explored in this chapter.

3.1. Sound Material

In order to gather sound material (one of the earliest steps in the process of composition), Wyatt primarily utilizes two methods: (1) recording the sounds of found objects and manipulating them as in the tradition of Musique Concrète, and (2) electronically generating sounds using analog and/or digital synthesizers, which can take the form of either software or hardware. Looking at his electroacoustic works for fixed-media, it is apparent that the recorded sounds and their manipulation greatly exceed the use of synthesized sounds. Considering that the trend amongst many composers today, is overtly display their newest synthesizing or processing techniques, Wyatt's emphasis on Musique Concrète (the earliest genre of electroacoustic music, now realized digitally), sets his compositional framework apart. Another notable factor in his methodology is his use of the Foley technique, creating the persuasive illusion of recognizable sonic objects by recording sounds from found objects of a different kind (the term originated from film industry).

3.2. Sound Recording

Wyatt has performed consistent experiments over the years in order to create realistic sound movements that can be realized in multichannel sound environments. As a result, he has developed recording techniques specifically for the D-8 System, as well as techniques for general mono source recordings and stereo recordings. One technique involves placing three

contact microphones (sometimes four), on a table-top or metal sheet. Each microphone position is matched to speaker locations in the D-8 System, usually within a much smaller space, while maintaining the exact distance ratio between each speaker. Then by performing various activities of the found objects within the space that is surrounded by microphones, spatially distinct sound images are created. However, Wyatt always juxtaposes the sound materials he obtains through this multichannel recording with sound sources recorded under different conditions (i.e. mono or stereo recordings). *Figure 4* shows an example of the three microphone setup.
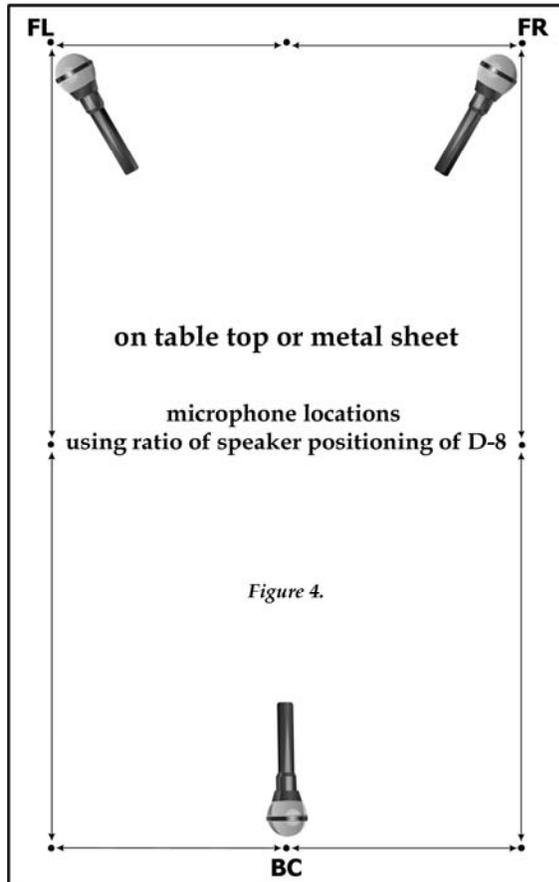
FL   FR

on table top or metal sheet

microphone locations
using ratio of speaker positioning of D-8

Figure 4.

BC

3.3. Sound Processing

For electroacoustic music composers, sound processing is the procedure through which they can generate multiple sound materials from limited sources. Two primary approaches that Wyatt uses to process sounds are (1) external effect-machine processing (utilizing hardware equipments), and (2) computer software (plug-in) processing. He usually uses 'Pro Tools' by Avid as the main assembly application, along with its bundled plug-ins and well-known third party plug-ins such as GRM tools. That being said, the most notable factor in his method is his use of outboard processors. Presently, the popularity of outboard equipment is declining because of the ever-increasing power and convenience of the CPU. However, outboard

processors still play a central role in Wyatt's signal flow of sound processing. Software plug-ins provides much convenience such as ease of access (they are inexpensive) and use. However, these advantages also have weak points, as users of the same plug-in effect may produce similar outcomes. In an effort to avoid this, Wyatt often utilizes combinations of multiple hardware processors manipulated through the mixing-console. This procedure generates unique colors of sound.

3.4. Specialized Two-Dimensional Sound Positioning

Wyatt has developed specific techniques to locate sound images that appear to originate from inside of the listening space, which seems to emanate from a source other than the loudspeakers themselves. This process makes the sound image seem as if it is coming from points near listener where no loudspeakers are positioned. Normally, the remaining horizontal and distance cues used by composers and audio engineers for both stereo and multi-channel environments present sound images that seem as though they emanate only from the location of the loudspeakers themselves. While most audio applications which makes similar effects require the use of a binaural delivery system (headphones, which present no crosstalk interference) or couple specific hardware and software to produce similar effect, the approach that Wyatt uses creates effective outcome within different host listening spaces. In order to realize the technique, Wyatt does the following:

First of all, he experiments with various types of recorded or created sound sources: mono point source, pseudo stereo, true stereo and expanded stereo images (pseudo stereo and expanded stereo sounds are made by adding small amounts of time delay to one of the stereo channels). He then experiments with any of the following processes:

Process Type I

- *copying one channel from the original source and inverting the copied source*

- *adjusting the dynamic: attenuating or amplifying the copied source*

- *manipulating a channel location slightly: changing the stereo-field location or stereo field width*

- *applying time delay to the copied source: a few milliseconds, and then*

- *mixing the copied source with original source*

Process Type II

- *copying both channels from the original source and inverting the copied source*

- *performing steps 2-5 of Process Type I*

Process Type III

- *copying mono source and positioning in both channels (pseudo or 2 channel mono) and inverting the copied source*

- *performing steps 2-5 of Process Type I* [21]

The basic principle of this technique rests in controlling the phase cancellation of the sound images and minimizing crosstalk contamination of the listening space. The outcome of these processes is different based on the size and design of the listening space, the location of the audience, and the characteristics of the sound source material. The effectiveness of such a technique or process is often enhanced by juxtaposing a sound source appearing to emanate directly from a loudspeaker location with a sound image appearing to come from the side or behind the listener where no loudspeakers are positioned.

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[21] Edited from Class-note from 2011, Fall at University of Illinois.

CHAPTER 4. Examination of Three Compositions

In order to examine Wyatt's prime interest and emphasis on spatializaion, three compositions designed for eight-channel fixed-media performance have been selected for examination.

Title	Year	Format	Duration	Publication
In the Arms of Peril	2001	8-channel performance	10:00	SEAMUS volume 11 EAM-2002
On a Roll	2004	8-channel performance	8:21	SEAMUS volume 14 EAM-2005
ComLinks	2010	8-channel performance	8:30	SEAMUS volume 21 EAM-2012

Table 3. Three Selected Compositions

The examination of each composition consists of two parts: (1) formal scheme and features, and (2) spatialization and engineering. Some parts of the compositions are described in the form of graphical representations, which function in a manner similar to the musical score, indicating information on timeframe and amplitude for each channel. The articulations, gestures, and spatial movements, are often directly explained in the graphics. Otherwise, they are labeled on the graphics with clarification in the body of the text.

Before proceeding, two terms, and their relationship with one another, need to be clarified: 'strong percussive attack' and 'space change.' The former stands for an articulation which has a distinguishably loud and strong quality, and usually functions as an ending and/or beginning gesture of a phrase. The latter stands for a moment where sonic space is changed, occurring either suddenly or gradually within the composition. It usually coincides with a 'strong percussive attack.' As a result, both concepts play significant roles in Waytt's electroacoustic compositions; they work as turning points that shift sonic scene, introduce new

sound material, and provide a beginning or ending to phrases and sections. Wyatt's 'space change' is quite different from a modulation or section change in acoustic instrumental music; of course similar effects can be found from many other composers' works, but not so many composers would consider this technique a primary compositional focal point.

4.1. *In the Arms of Peril*

> *"As we proceed with our lives, hopes and dreams, and the daily ventures of life, we are at times exposed to increasingly dangerous provocations, threats and serious challenges. For some, the real issue is survival. In this composition, through the use of sonic environments and events, such confrontations are relived with the persistent search for threads of relief; from the shadow of being in the arms of peril.*
>
> *Unique miking and channel distribution techniques, along with three-dimensional encoding techniques were incorporated to enhance the spatialization and sonic imaging for the piece. "In the Arms of Peril" was originally completed just two months prior to September 11, 2001. On the occasion of the 10th anniversary, this work was revised and remastered, and is now dedicated to the memory of the victims of the 9/11 attack.*
>
> *This work was composed, designed and realized within the University of Illinois Experimental Music Studios specifically for discrete eight-channel performance presentation."* [22]

4.1.1. Formal Scheme

As the composer has described above, this work depicts the threats surrounding daily life and the search for hope and relief from hazard. Considering the atmosphere of the composition, high tension is maintained throughout the piece. Many gestures are subtle and delicate with a soft dynamic and low textural density; however there are various instances of strong percussive attacks, which may imply a threat enclosing us, with or without approaching

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[22] CD Booklet *Music from SEAMUS* volume 11. The Society for Electroacoustic Music in the United States, EAM-2002.

gestures. There appear three distinguishingly loud 'surprising vocal gestures' and a 'screaming vocal gesture'; these work effectively as significant signals which shift and refresh the atmosphere of the composition in terms of timber as well as structure. In this piece in particular, Wyatt utilizes a large percentage of electronically generated sound material in contrast to his other electroacoustic works.

Intro	A1	A2	Transition	B1	B2	Coda
0 : 00 ~ 0 : 43	0 : 43 ~ 2 : 42	2 : 42 ~ 4 : 38	4 : 38 ~ 5 : 12	5 : 12 ~ 7 : 39	7 : 39 ~ 8 : 33	8 : 33 ~ 10 : 00

Table 4. Structure of **In the Arms of Peril**

The overall structure shows a symmetric formation with a timbrally and texturally distinguished **Transition** section in the center. The **Intro** is dynamically very soft, opening up the initial sonic space with sounds of rustling, match-lighting, and footsteps, as well as long synthesized events in the background. Section **A1** features phrases primarily composed of short synthesized events in a relatively fast tempo and vocal whispering gestures. The section ends with a high amplitude car horn-like sound occurring at "2:10"; at this point the tempo slows and the sonic space changes. Section **A2** can be considered a development or a prolongation of **A1**. This section is composed of various timbres comprised of long or short events in phrases with the vocal whispering gestures. The section ends with a surprising vocal gesture occurring at "4:35" which leads to a sudden change in the sonic space. The **Transition** is the most distinguishable section, being comprised of the superimposition of specific pitch-based synthesized events and their sustaining. **B1** is a static and soft dynamic section characterized by various subtle and delicate gestures, and section **B2** comprises gestures which lead to the climax that occurs at "8:20": a wide array of musical parameters such as tempo, density, and dynamics gradually increase towards the point of the surprising vocal gesture.
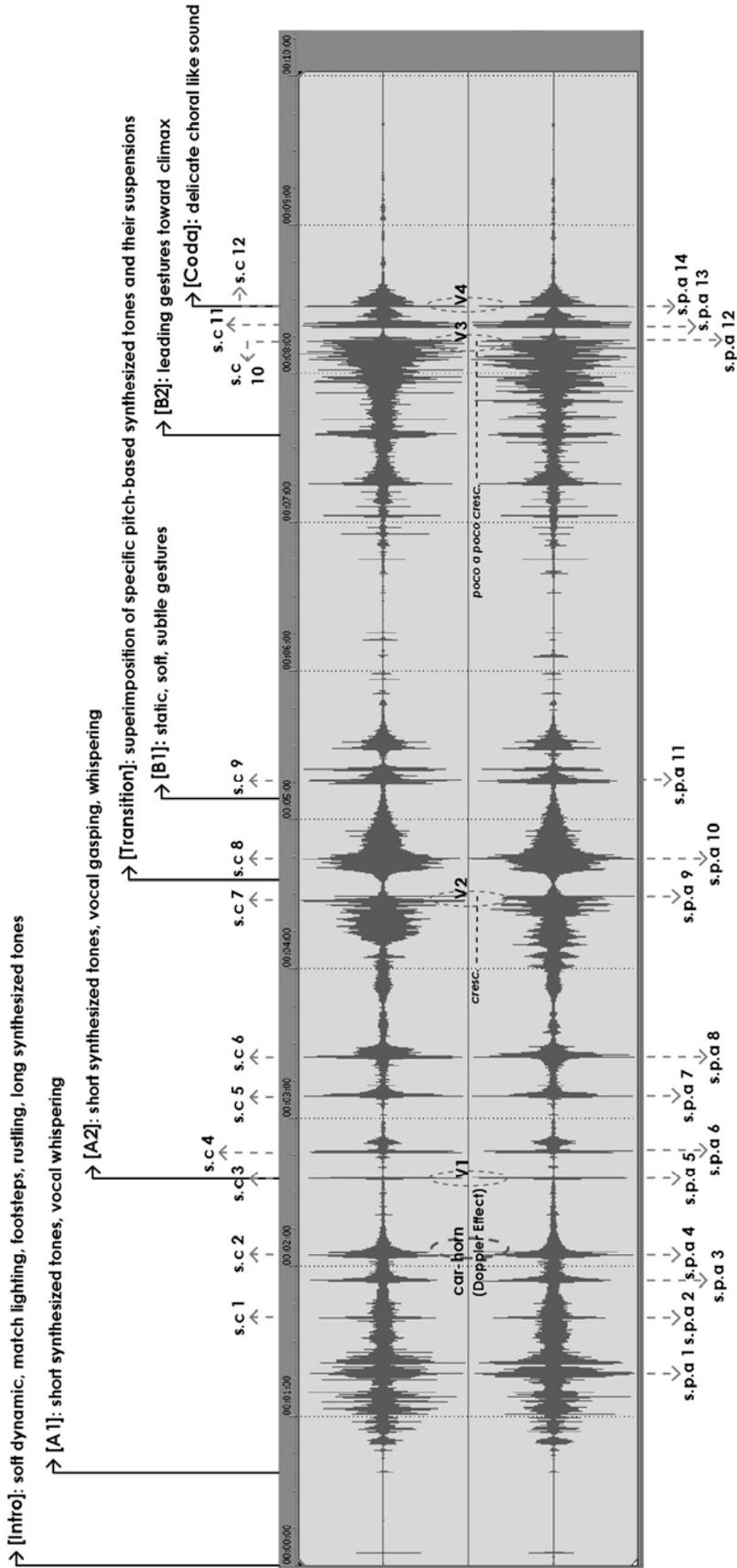
Figure 5. In the Arms of Peril, Structure and Featured Gestures

The **Coda** begins with vocal sounds of screaming with intense percussive articulation in high amplitude, followed by a very soft, delicate, choral-like resonant sound, which may imply the process of finding hope and relief following a time of peril.

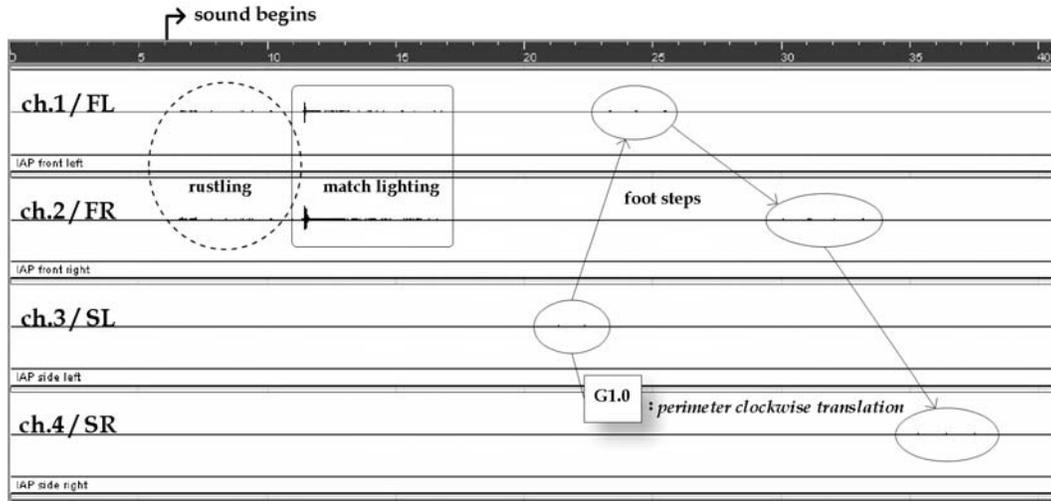### 4.1.2. Spatialization and Engineering

Figure 6. In the Arms of Peril, 0:00 ~ 0:40

Figure 6 demonstrates the opening of *In the Arms of Peril*, while exemplifies a formal device Wyatt frequently to set the stage for his works: utilizing recognizable sonic objects. He builds the initial sonic space of this composition gradually with gentle and delicate gestures; the piece begins with the sounds of rustling and match-lighting at a very soft dynamic, followed by footsteps which add tension to the atmosphere. The footsteps labeled **G1.0** occur in the channel order 3→1→2→4; resulting in a *perimeter clockwise translation*.

Figure 7, comprising the timeframe from "0:40" to "1:40," includes most of the significant features of this work in terms of spatialization and compositional technique: channel paring, approaching gesture, strong percussive attack and space change. First of all, channels 1·2 and 5· 6 share the same sound material, which we can see in the wave shape in *Figure 7*. However, the

front channels have a drier (less reflective), louder sound, resulting in the material sounding closer, more present than the more distanced (due to more reflection and lower amplitude) sound from the back channels. This method of presenting two paired stereo images is frequently used throughout the work, creating a clear sonic image in front of the audience and a wide space behind the audience.
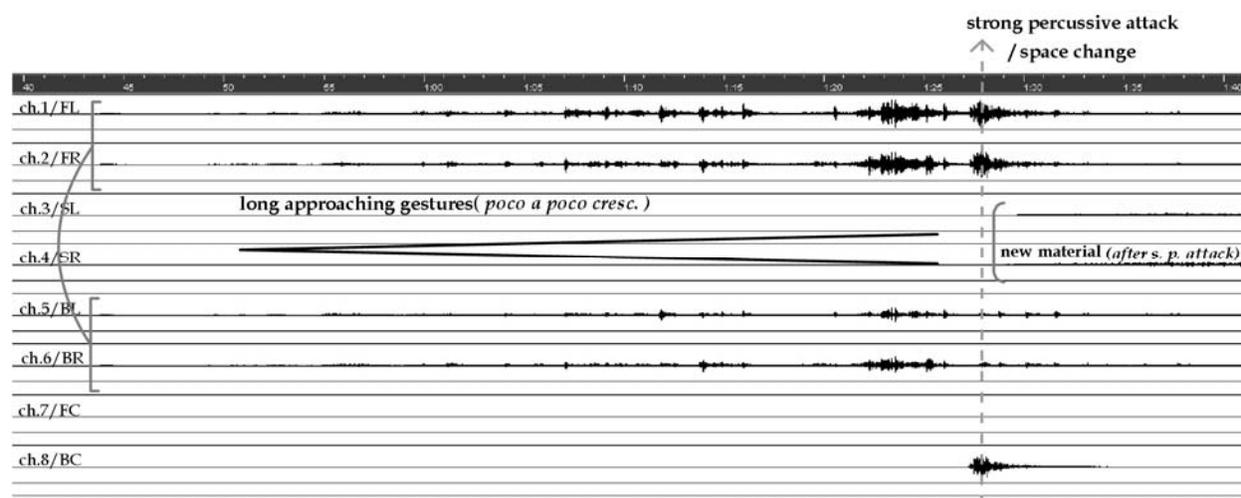

Figure 7. In the Arms of Peril, 0:40 ~ 1:40

In *Figure 7*, there also appear long approaching gestures which lead into the point of strong percussive attack and space change. In order to make this effective, various musical parameters such as amplitude, textural density, and activity of events are gradually increased toward the moment at "1:28." This point (strong percussive attack and space change) functions as the junction of two different materials; new material is introduced right after the moment in the side channels 3 and 4. There are generally two types of combination of strong percussive attack, followed by new material. One method is in introducing the new material immediately, sometimes simultaneously with the attack. In this case the attack has a very fast decay, with no sustain and no release in terms of envelope, so the sonic space is quickly changed. The other combination is one that we can see in *Figure 7*; the attack has relatively longer sustain and

release, followed by new material which has a slow attack. This type creates a gradual change of space. Examples of such a gradual shift of timbre can be easily found in György Ligeti's Cello Concerto (1966) and Chamber Concerto for 13 instruments (1969).

In this work, various types of vocal sound play significant roles which have symbolic meaning: the human being threatened by dangerous environments. The vocal sounds can be classified based on abstractness as follows:

concrete ←				→ abstract	
"hey"	whispering	surprising	gasping	processed	synthesized
5:38 – 5:46 (*very soft*) 8:33 (*very loud*)	1:50 – 2:10 3:15 – 3:30 8:20 – 8:25 8:35 – 8:50	2:42 4:35 8:20	3:53 - 4:34	5:38 5:50 7:38 – 8:20	8:35 – 10:00

Table 5. Various Types of Vocal Sounds

The vocal sound with clear diction saying "hey" first appears at "5:38 – 5:46." In this instance, it is close to a whisper, with a very soft dynamic. When it later appears at "8:33," it accompanies a strong percussive attack with a very loud dynamic. Processed vocal sound materials are distorted and modulated in terms of timbre, while maintaining the characteristics of vocal sound. Classified as 'synthesized,' this is not actual vocal sound, but vocal-like synthesized sound. However, it functions here as vocal sound due to its highly similar timbre. This sound appears at "8:35 - 10:00" in a soft choir-like dynamic sound.

Figure 8 shows another example describing important features of this composition. In this sound scene, around "2:11" labeled **G3.1** to **G3.4**, and encompassing the approach, strong percussive attack, and movement away, Wyatt makes use of *Doppler Effect*, which becomes the most important factor in this scene, mimicking the shift in frequency of the sounds a listener

perceives as objects are in motion with respect to the listener. From the moment of the strong percussive attack at "2:11," the frequency components of the sound in channels 1, 2, 3, 4 and 6 gradually descend. In addition, a gradual reduction of amplitude, along with added reverberation, helps the listener perceive the increasing distance between the listener and the moving sound objects. In addition, **G3.1** consists of a sonic object that moves from front to rear using the center longitudinal pathway: *FC backward full roll* (channel 7→8) in a gesture comprised mainly of low-mid frequency components. **G3.2** comprises an approaching gesture leading into the strong percussive attack point at "2:11" with increasing amplitude. **G3.5** is a soft and static gesture which plays a supportive role as background sound with a mid-low frequency noise-like timbre.
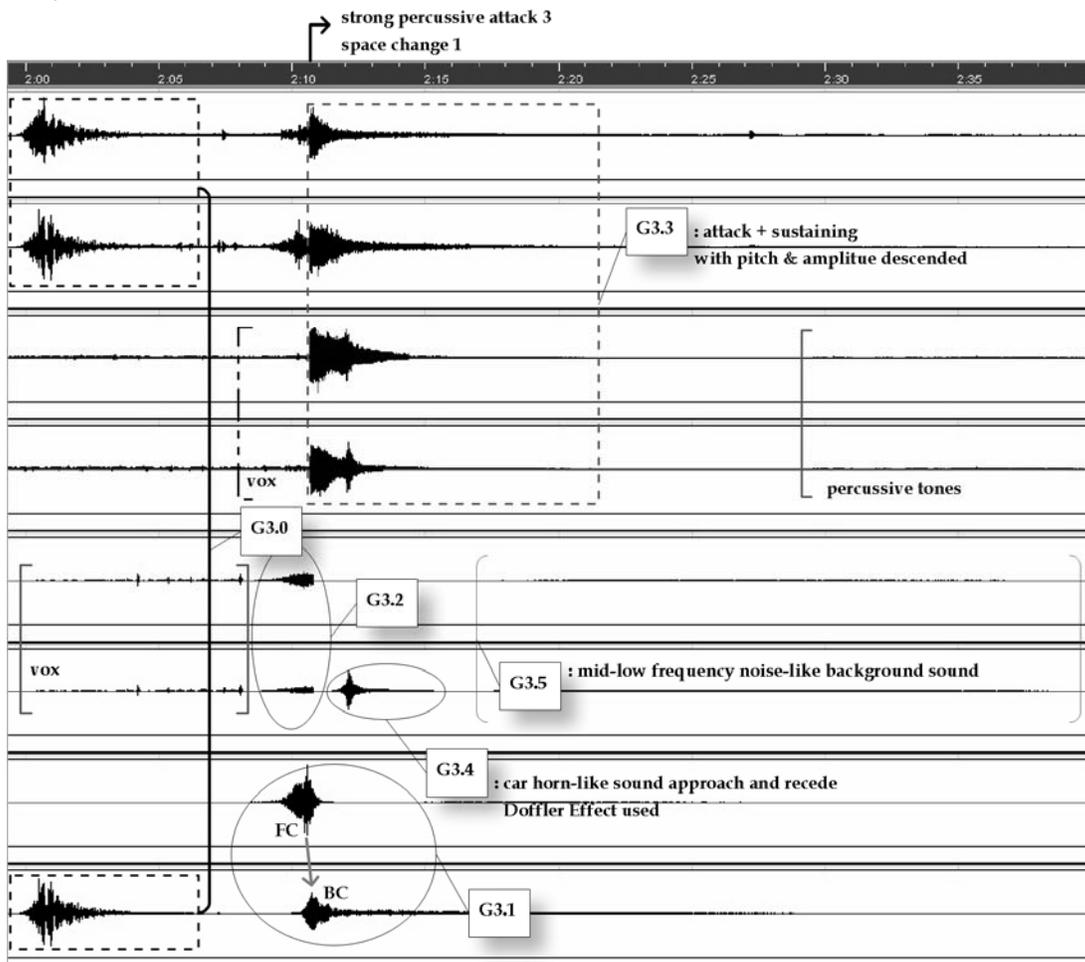

Figure 8. In the Arms of Peril, 2:00~2:40

4.2. *On a Roll*

"On a Roll is a work designed specifically for, and recorded in an eight-channel environment and was realized within the University of Illinois Experimental Music Studios. Three-dimensional encoding techniques were incorporated to enhance the spatialization and sonic imaging for the piece. Sonically, the obvious is not what it seems. As a challenge with regard to sound design, the art of Foley was used to create illusions of rolling objects that you may recognize; hence there are no recordings of actual rolling objects until the last three seconds of the piece."[23]

4.2.1. Formal Scheme

This work is full of sounds which illustrate various forms of rolling motion, which also includes swinging, running, bouncing and flying. All the rolling sound materials (except two seconds at very end) are first realized by the Foley technique; that is, without the use of an actual rolling object. Hence, these sounds are heard as illusions to the listeners' ears. Unlike many compositions in the genre of electroacoustic music, this piece has a carefree quality that can even be described as cheerful and entertaining. Many types of synthesized sounds, which build the abstract sonic atmosphere, accompany the rolling sounds, which create concrete atmosphere, with the exception of the transition section, where the synthesized sound takes a leading role. In order to achieve the rolling characteristic of the work, Wyatt includes numerous movements of sonic objects and the overall tempo is felt as somewhat fast. On another note, every 'strong percussive attack' in this composition works as point of space change, although the importance of these instances varies in terms of

sonic objects	entrance time
elevator	0:02
dice	0:23
roulette	0:26
ping-pong ball	1:54
billiard ball	3:21
type-writer	4:27
subway train	4:51
roller coaster	6:50
jet	7:06

Table 6. Recognizable Sonic Objects and Entrance time

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[23] CD Booklet *Music from SEAMUS* volume 14. The Society for Electroacoustic Music in the United States, EAM-2005.

musical context and/or shifting speed. *Table 6* is the summary of recognizable sonic objects and their entrance time.

Intro	A1	Transition	A2	Coda
0 : 00 ~ 0 : 46	0 : 46 ~ 4 : 18	4 : 18 ~ 4 : 50	4 : 50 ~ 7 : 20	7 : 20 ~ 8 : 31

Table 7. Structure of On a Roll

Similar to *In the Arms of Peril*, the overall structure is symmetrical (roughly a palindrome) with a **Transition** in the center which is noticeably different in terms of timbre and texture. Firstly, the **Intro** depicts the sounds of a casino where many objects such as dice and roulettes are rolling. A strong percussive attack point at "0:46" shifts the sonic space from this recognizable environment with identifiable sonic objects into an abstract and unidentifiable sonic environment. Section **A1** is composed of the sound of various motions – rolling, swinging, and bouncing – with the support of synthesized sounds. The **Transition** is the only section which involves the synthesized sounds in the forefront. The synthesized sounds have specific pitches and comprise phrases consisting of short events at a fast tempo. Section **A2** continues to employ sounds of rolling activities; however, new types of moving sounds are introduced such as running and flying. In the **Coda** section, the sounds of gradually increased rolling movements are stopped at its point of maximum dynamic and density and are then scattered, producing illusion like splitting into numerous tiny pieces. The composition ends with the presentation of sound movements disappearing into the abstract, unidentifiable sonic space.
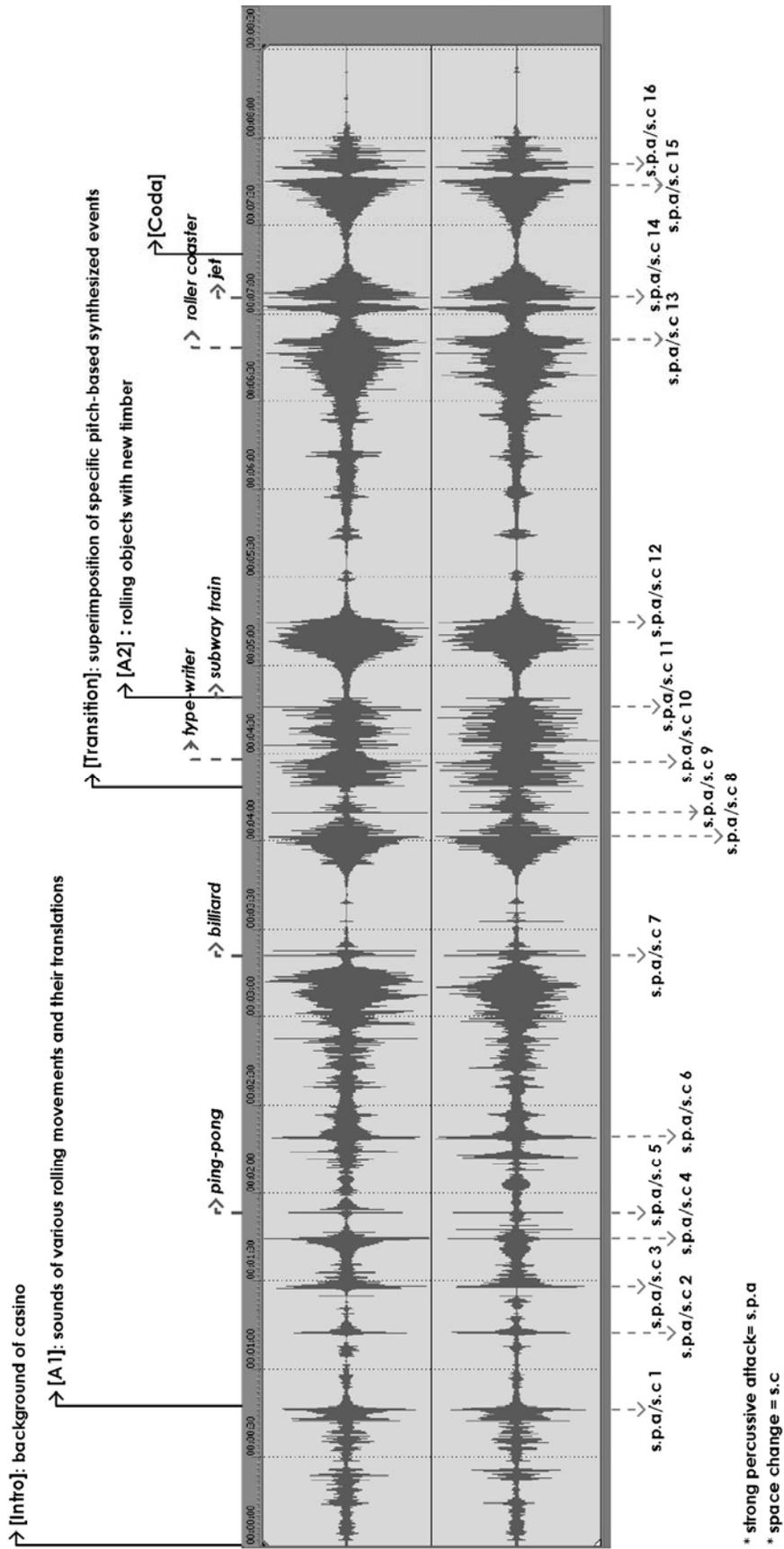
Figure 9. On a Roll, Structure and Featured Gestures
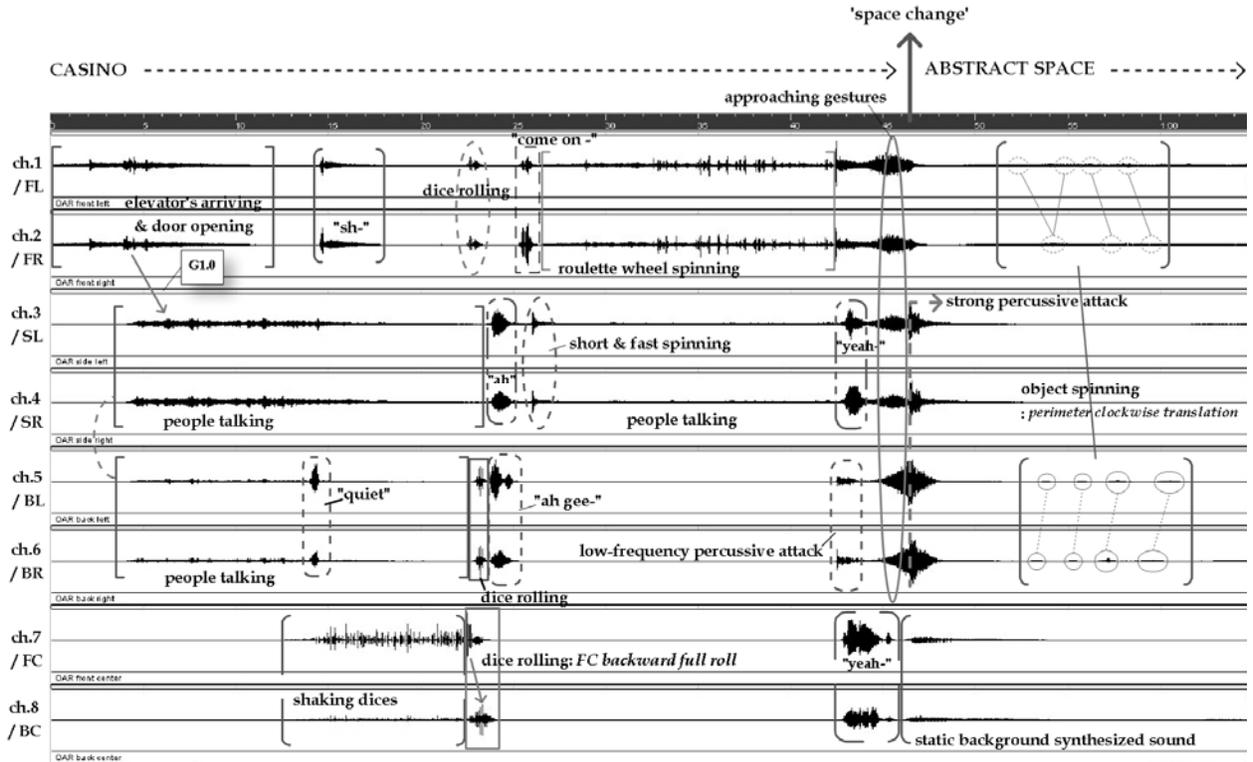
4.2.2. Spatialization and Engineering

Figure 10. On a Roll, 0:00~1:00

The moment where the first space change occurs at "0:46" is the most distinguished juncture throughout the composition. This is due to the fact that it is a moment in which the two greatly contrasting sonic spaces meet (see *Figure 10*). The introduction (initial sonic space) is the only section which employs a ubiquitous and familiar environment. Therefore, when shifting to an abstract and unidentifiable space, it creates a distinct sonic impact for the listeners. The initial sonically recognizable space of this piece is a casino. In this section, all the sound materials used are easily identifiable, realistic and concrete. The piece begins with a signal announcing its arrival (here, both the elevator's and the composition's). When the elevator door opens, the sonic space also opens widely with the sounds of people's talking, cheering, groaning, and so forth emanating from the casino.

Gestures labeled **G1.0** describe the opening scene: the sound of the door opening is played in the front channels, followed by the sound of people talking in the side and rear (the rear channels are more distanced than sides, in order to create more realistic and expanded sonic space). This opening scene produces persuasive illusion for listeners, as if they are actually entering a casino.
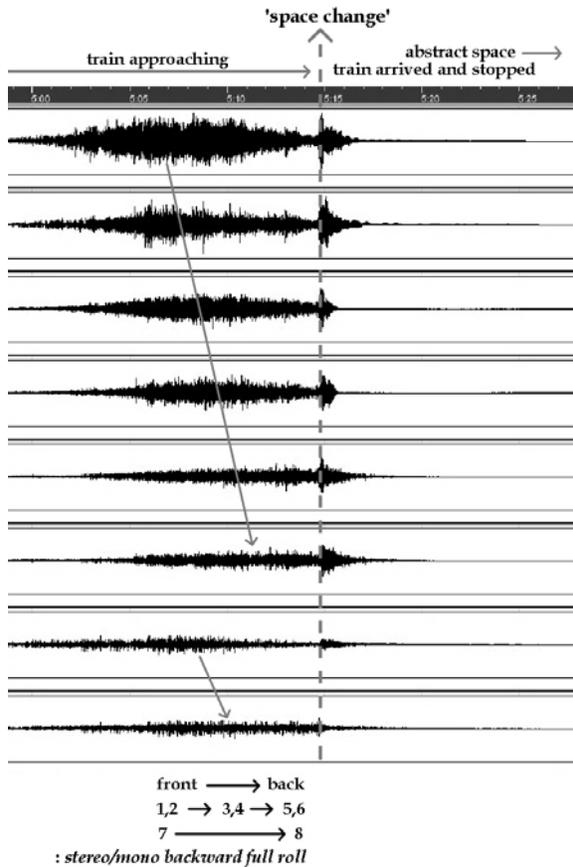
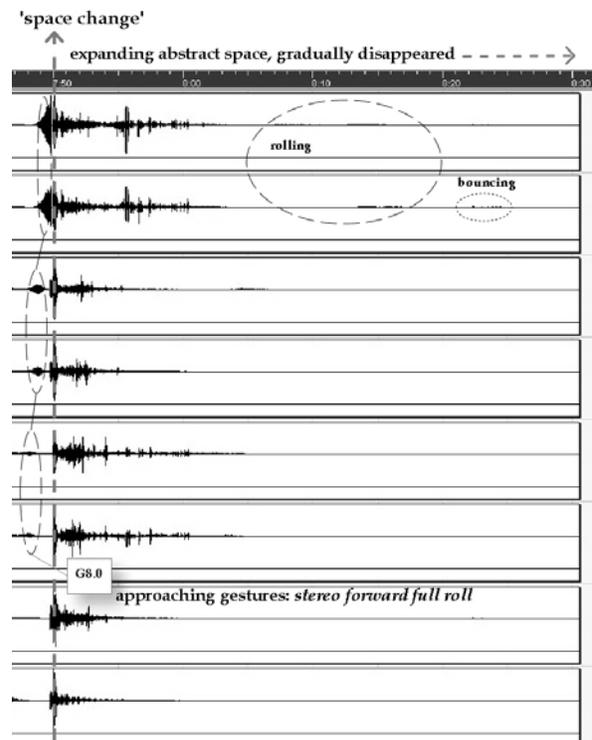*Figure 11. On a Roll, 5:00~5:25   Figure 12. On a Roll, 7:50~8:30*

Another distinguishable juncture of two distinct sonic spaces is at "5:15," where the horn sound of a subway train gradually morphs into the unidentifiable synthesized tone of an abstract space and atmosphere. This sound scene contains relatively long approaching gestures beginning from "4:51" to "5:15," with heavy low frequency components depicting the

movement of a subway train approaching from a far distance. These gestures contain a translation: *backward full roll* occurring through all three longitudinal pathways (see ***Figure 11***).

The last instance of space change in this work is at "7:50," and it portrays an interesting sound scene that ends the composition. The approaching gestures labeled **G8.0** form a translation *stereo forward full roll* in which a stereo image moves from back to front (channels 5·6 → 3·4 → 1·2). When these approaching gestures meet the space change, the sounds of rolling objects the gestures contain are reformatted to numerous tiny fragments, and eventually disappear into the expanded wide sonic space where composition concludes (see ***Figure 12***).
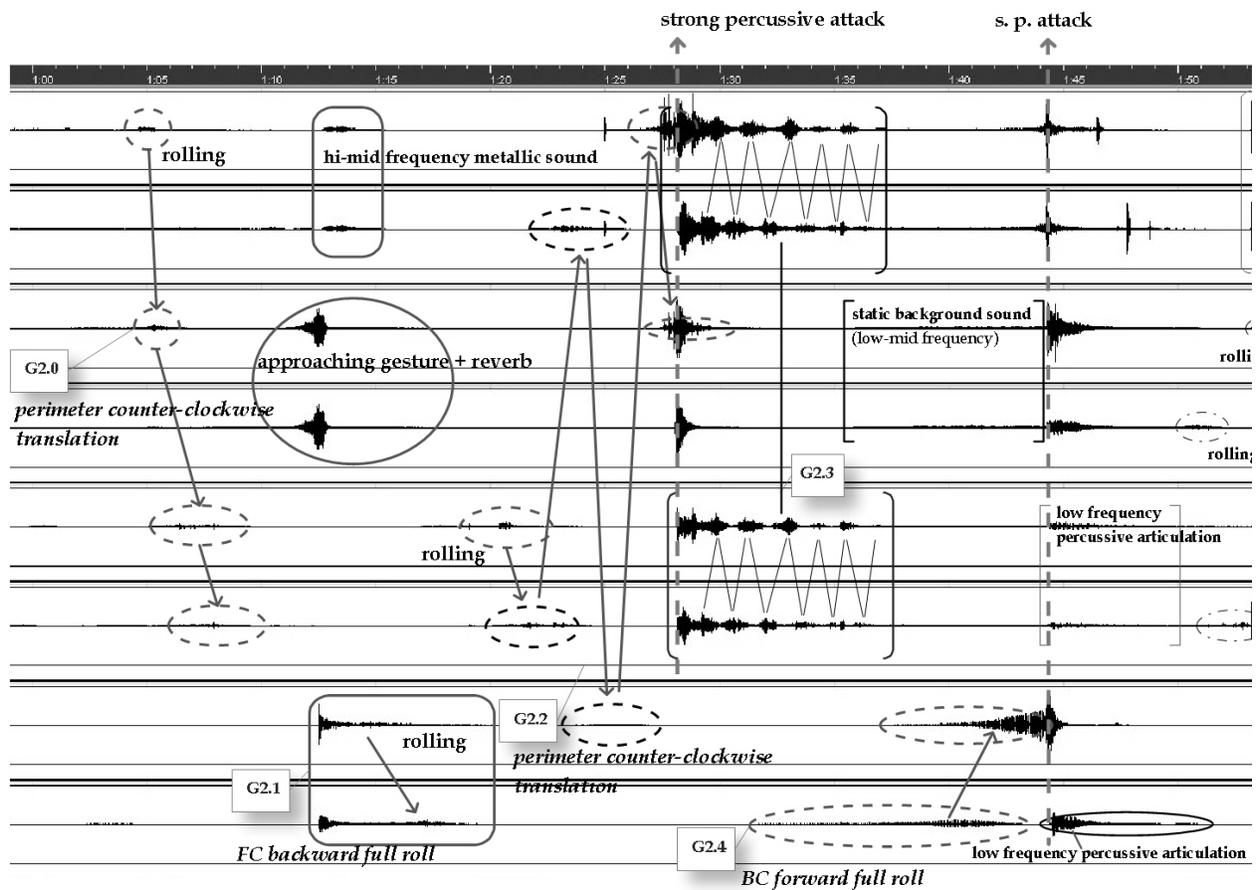

Figure 13. On a Roll, 1:00~1:50

Since the focus of the composition is on sounds of rolling and similar activities, a large number of translations are employed. For example (see *Figure 13*), various types of successive translations can be found from "1:00" to "1:45." These four translations of sonic materials (labeled **G2.0** to **G2.4**) are presented without superimposition in order to realize clear movements of each sonic object through the listening planes. *Figure 14* is a visual illustration of the translations labeled **G2.0** - **G 2.4** in *Figure 13*.
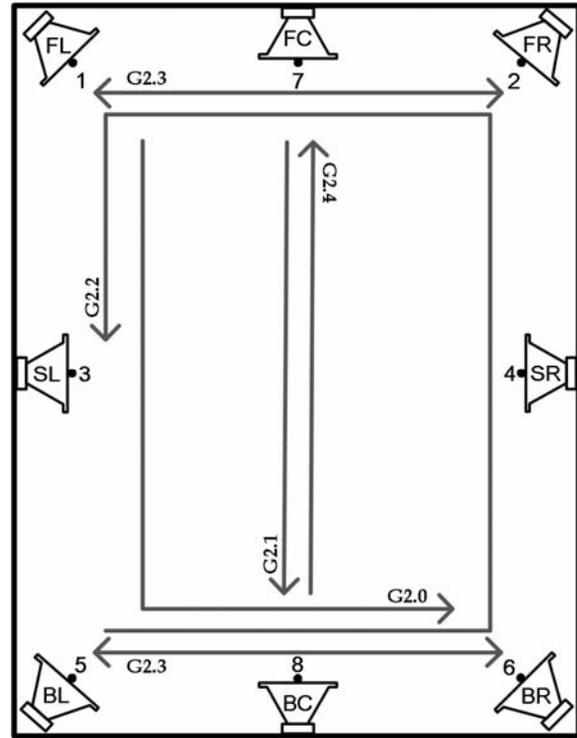
Figure 14. On a Roll, Translations of G2.0 - G2.4

4.3. *ComLinks*

"This work is a setting of associated sounds and activities depicting our incessant pursuit of instant communication. As perhaps with many of you, within my lifetime, I have experienced early rotary phones, partly lines, phone booths, touchtone phone, wireless phones, bag phones, cell phones, and smart phones, not to mention IM, Skype, tweeting and texting trends. There may be commentary here…

Three-dimensional techniques were employed to position sounds and activities within the audience listening area. ComLinks was realized within the University of Illinois Experimental Music Studios."[24]

4.3.1. Formal Scheme

Intro	A1	A2	A3	A4	A5	Coda
0 : 00 ~ 2 : 12	2 : 12 ~ 3 : 20	3 : 20 ~ 4 : 01	4 : 01 ~ 4 : 59	4 : 59 ~ 6 : 24	6 : 24 ~ 6 : 57	6 : 57 ~ 8 : 33

Table 8. Structure of ComLinks

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[24] Program note by the composer, from the concert in February 9, 2011 at Music Building Auditorium in University of Illinois at Urbana-Champaign.
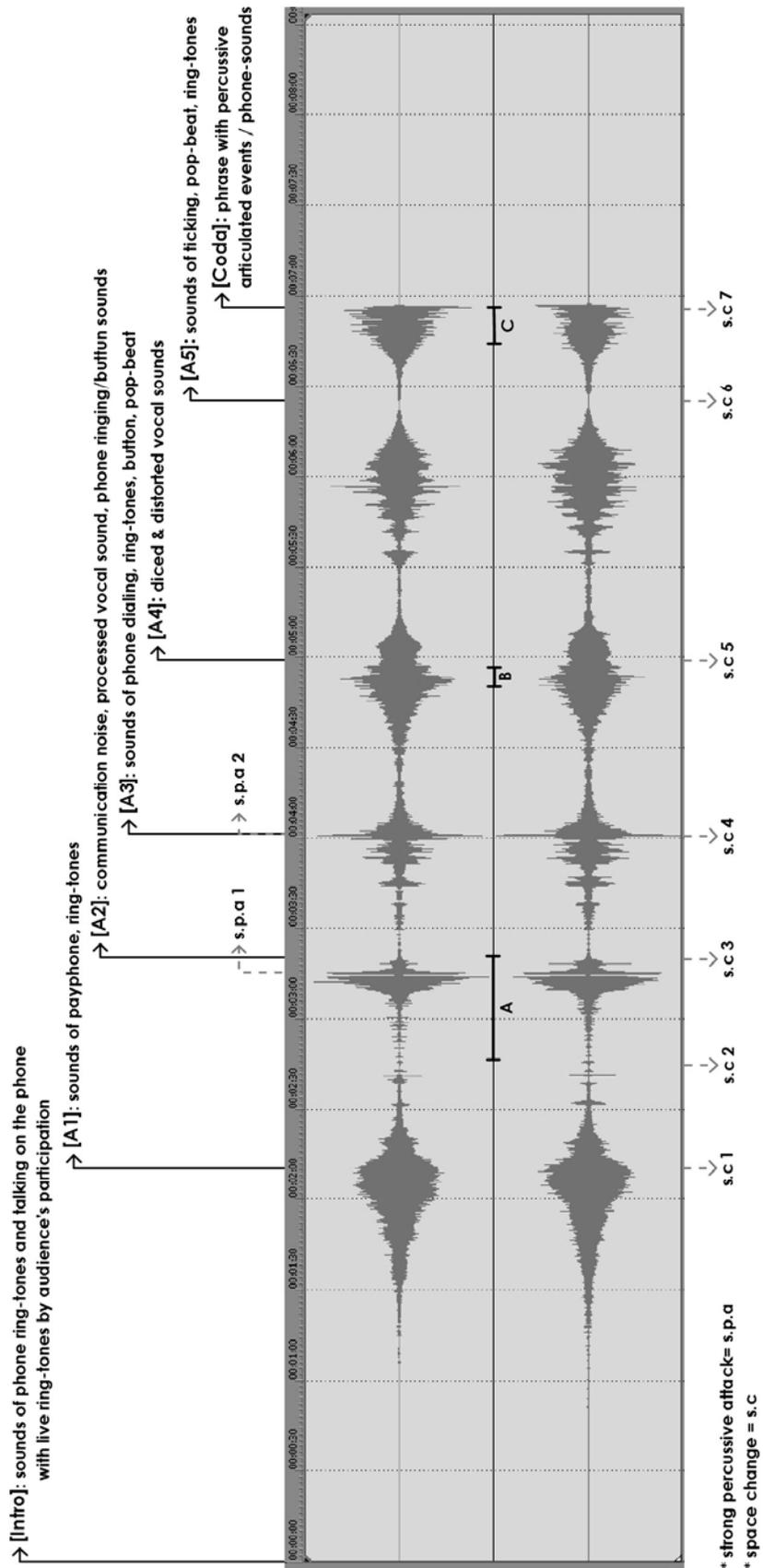
Figure 15. *ComLinks, Structure and Featured Gestures*

→ [Intro]: sounds of phone ring-tones and talking on the phone
with live ring-tones by audience's participation

→ [A1]: sounds of payphone, ring-tones

→ [A2]: communication noise, processed vocal sound, phone ringing/button sounds

→ [A3]: sounds of phone dialing, ring-tones, button, pop-beat

→ [A4]: diced & distorted vocal sounds

→ [A5]: sounds of ticking, pop-beat, ring-tones

→ [Coda]: phrase with percussive
articulated events / phone-sounds

→ s.p.a 1

→ s.p.a 2

s.c 1   s.c 2   s.c 3   s.c 4   s.c 5   s.c 6   s.c 7

A

B

C

*strong percussive attack= s.p.a
*space change = s.c

A : inside payphone (=sonic space)
B : phone connection fail message
C : metric beat-loop

3 3

As the composer explained in the program note, this work describes and satirizes today's instant communication, since our lives revolve around numerous forms of easy-access communication media. To accommodate this, a variety of electronic communication sounds are employed as the primary sound source, including phone ringing, dialing, beeping, talking, and texting. For this piece, Wyatt recorded the voices of various students and friends of his (varying in gender, age, and language) having conversations on the phone. He builds a familiar sonic space for listeners by using various types of recognizable sonic objects that we hear and experience every day, along with live cell phone ringtones playing from participating members of the audience. By positioning those sound materials in the multi-channel listening area, a distinctively interesting sonic environment is produced.

As far as spatializaion is concerned, the use of the gradual shift of sonic space sets this piece apart from the other two works examined. There are only two instances of the strong percussive attack throughout the work, while seven changes of space occur. Unlike what occurs in the previous two pieces, the space changes in this piece are created by a gradual shift generated by having the two spaces dovetail one another, overlapping the two spaces for some amount of time during the spatial transition, not by a sudden change at a specific moment. The initial spatial setup is the most distinguishable part of this composition. Wyatt creates a unique sound environment by utilizing a combination of sounds from loudspeakers and actual ringtones of cell phones by live performance with audience participation. This setup is obviously different from sonic illusion. The first space change coincides with a section change at "2:12" (most points of space change and section change are same in this work) and is perhaps the most dramatic moment; the space shifts from an extremely realistic environment into an abstract and indefinite space, as if the audience moves from real world to virtual space. Sections **A1** to **A5** consist of the sound of repeated attempts to make a connection via phone-dialing (the

attempt of communication) and being disconnected (the failure of communication). The piece could be understood as a variation form, involving many types of communication sounds while incorporating various timbres and textures. The first part of the **Coda** has sound material reminiscent of the **Intro,** which is then followed by very soft and subtle gestures, resulting in a discreet and uncertain sonic-space. At "7:13," tapping sounds, similar to the sound of keyboard texting (non-verbal communication), are employed in the front channels (channels 1, 2, and 7). The composition ends with tones of a lingering error message containing three ascending pitches at "8:20" (the disconnection of communication).
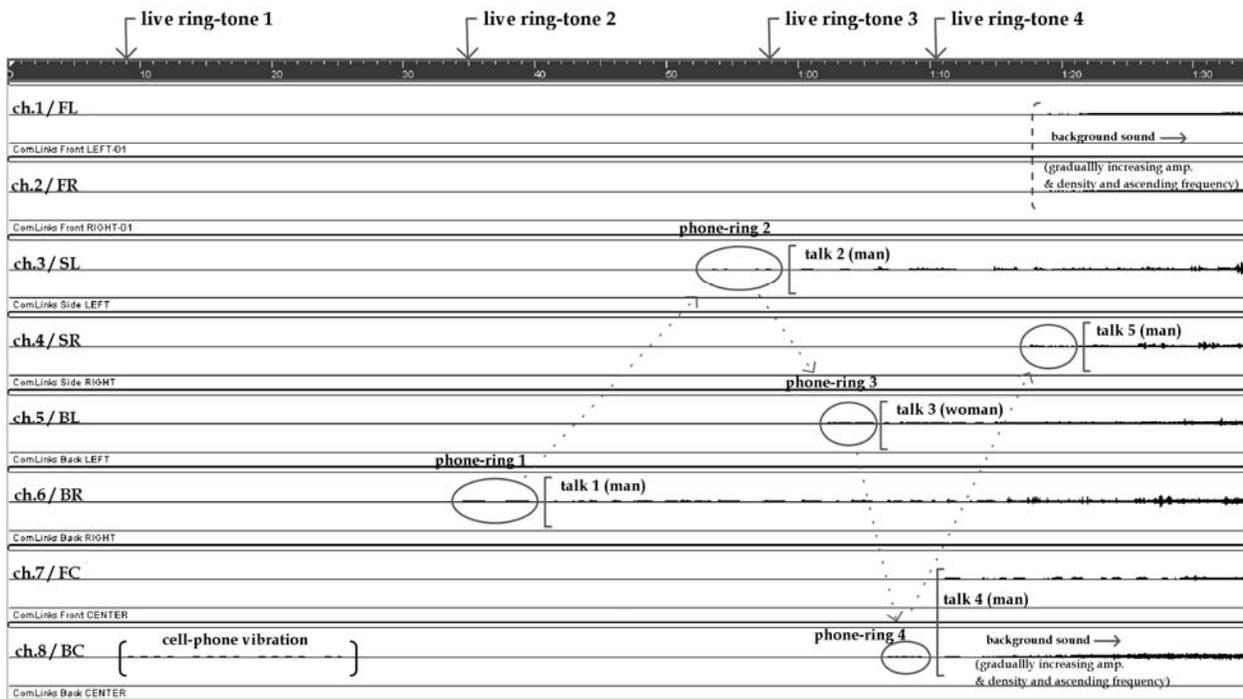
4.3.2. Spatialization and Engineering

Figure 16. ComLinks, 0:00~1:30

Wyatt opens up the initial sonic space with the sound of a cell-phone vibrating, emitted behind the audience (BC, channel 8), followed by the sound of people talking on the phone, along with actual real time ringtones of cell phones produced through audience participation.

He indicates the points for live-ringtone at "0:09,"" 0:33,"" 0:58" and "1:10" (see *Figure 16*). In addition, the sound of a person talking on the phone appears in the following sequences of channels: 6, 3, 5, 7/8, and 4. It is also important to note that the front two channels (1, 2) are excluded for building this initial spatial setup in order to enhance intimacy, since the other six loudspeakers are closer to the audience (and the audience usually does not prefer sit in the very front corners); this enhances the illusion that sound is originated from somewhere near the listener. By utilizing these multiple sound originations, the piece converts the listening area into a space alive and full of active sounds.

One is led to the first space change (and section change) at "2:11" by Wyatt's typical approaching gestures. However, as mentioned above, the space is changed by gradually overlapping two different types of sonic materials; at the moment of "2:11," the new material is introduced while the amplitude of the previous material quickly decays and then sustains.
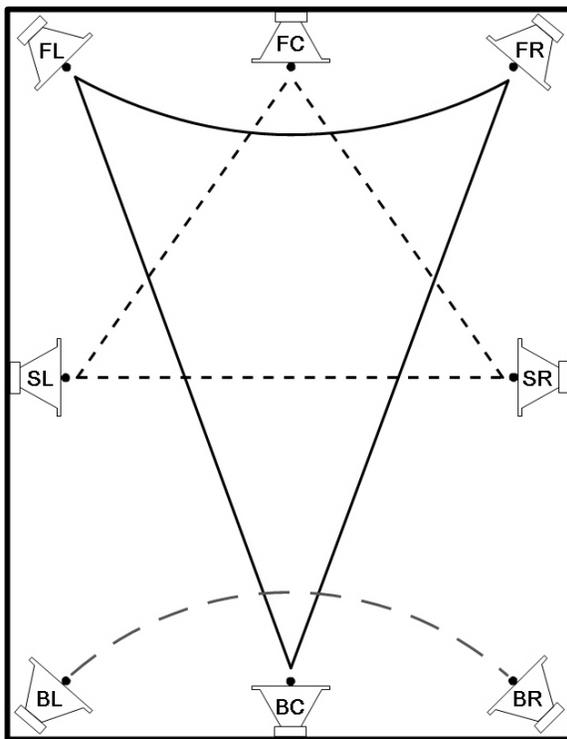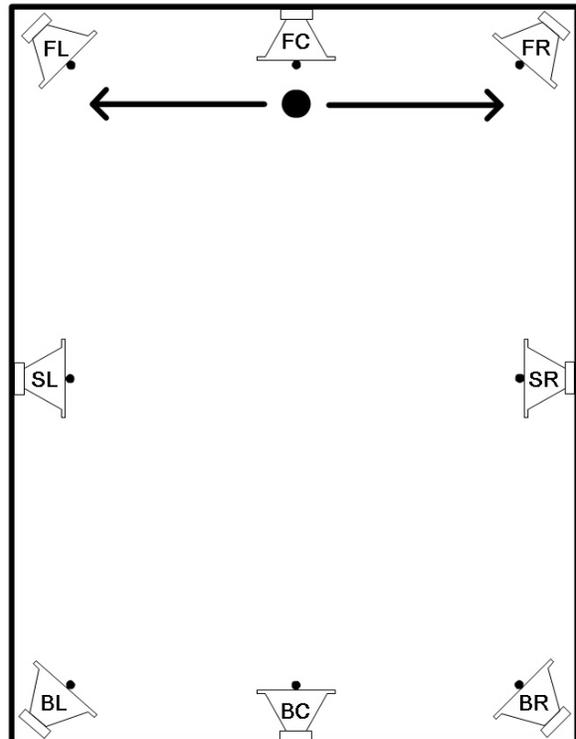

Figure 17. Complex Timbral Space   *Figure 18. FC bi-directional half pan*

There are several significant sonic scenes in terms of spatializaion. First, around "2:11," the gestures are paired up based on the timber of the source material used as follows: channel 1·2·8 (phone bell-like timbre), 3·4·7 (suspended cymbal-like timbre), and 5-6 (low frequency tone). As we can see in the *Figure 17*, this manner of channel pairing creates a timbrally intertwined complex space. Another example is a gesture occurring at "2:35," which utilizes a technique in which a mono sound source initially appears in front center, and is then suddenly expanded to a wide and far-distanced stereo image, sounding as though what is left is the shadow of the initial sound. It is visually described at *Figure 18*.

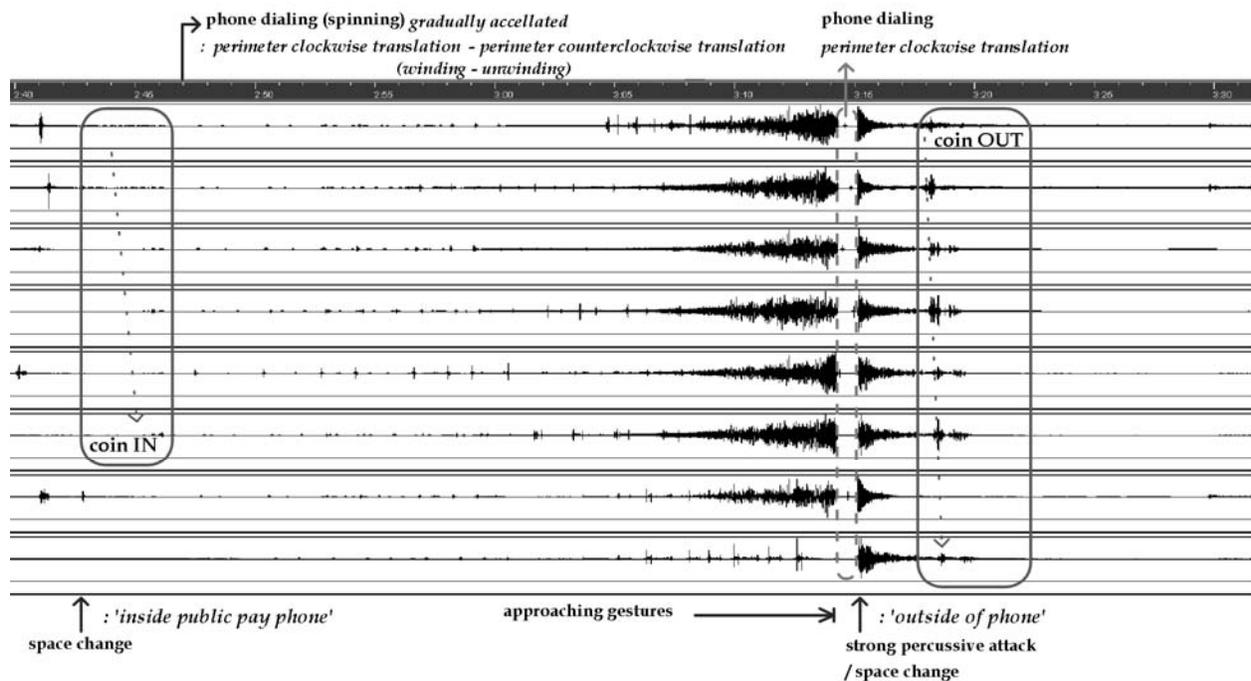*Figure 19. ComLinks, 2:40~3:30*

Figure 19 shows a rather interesting sonic scene that includes gestures which describe the insertion of a coin, dialing, and hanging up of a public pay phone, followed by the sound of a coin being dispensed. For depicting the gesture of inserting a coin, Wyatt spatialized the stereo sound source by moving it from front to back, so it sounds as though the coin moving through

the listening space from front to back, through channels 7→1·2→5·6; *variant stereo backward full roll* (see *Figure 22*). This gesture shifts the sonic space in order to place the audience inside the phone. Furthermore, in the gesture that follows, dialing on a rotary phone is mimicked with the sound spinning around the audience, enhancing the illusion. The dialing gesture repeats, illustrating the winding and unwinding motions, spinning around the audience first clockwise through channels 5→3→1→7→2→4→6→8 then counterclockwise, through channels 6→4→2→7→ 1→3→5→8→6→4 (see *Figure 20* and *Figure 21*).
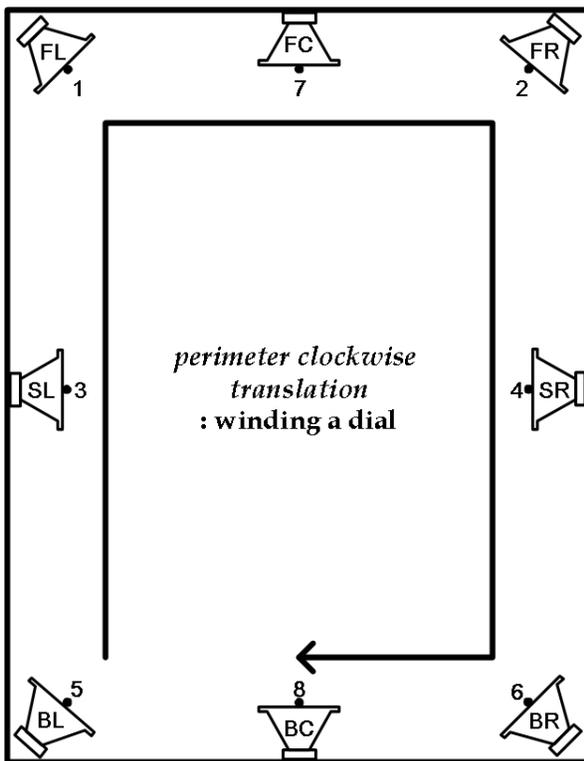
Figure 20. *perimeter clockwise translation*   Figure 21. *perimeter counter-clockwise translation*
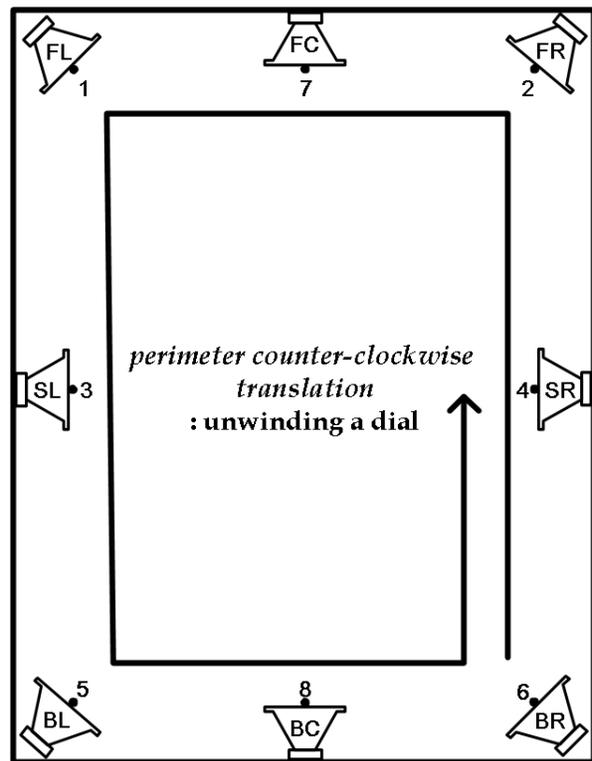
Right after the strong percussive attack at "3:15," the sonic space shifts as gestures illustrate a coin is being dispensed from the phone, signifying the disconnection of communication. This gesture utilizes a *stereo backward full roll* before the sound image then

converges to the back center channel: channels 1·2→3·4→5·6→8. However, unlike when the coin was being inserted, it now bounces, making it clear to the listener that the coin has left the pay phone. *Figure 23* visually illustrates the translation.

Figure 22. *variant stereo backward full roll*   Figure 23. *variant stereo backward full roll*

CHAPTER 5. Conclusion

This essay sought to articulate that the spatialization is arguably one of the most significant features in the compositions of electroacoustic music by Scott A. Wyatt. In order to illustrate this aspect, this research examined his three works in particular in terms of several features. These included space changes; the relat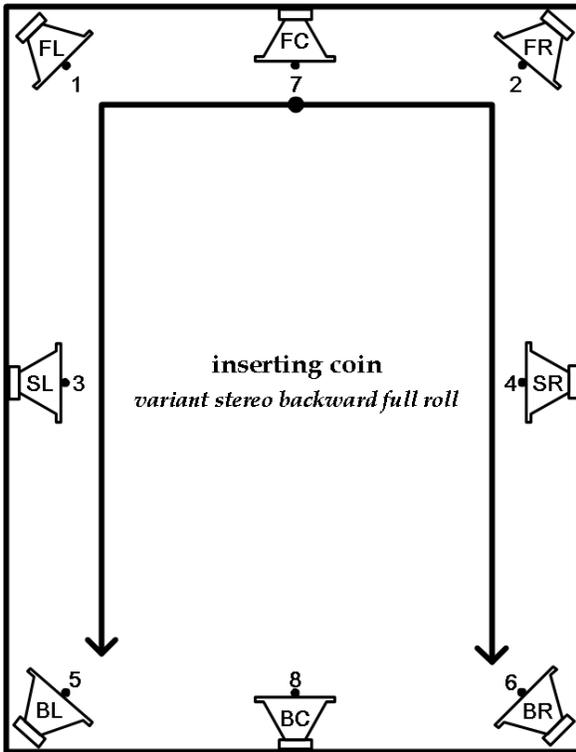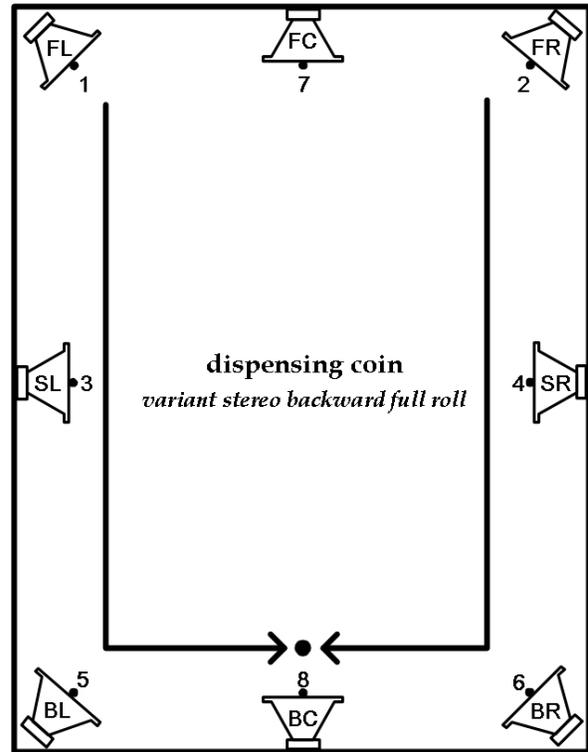ionship between recorded and synthesized types of sound source; simulation of movements of sound sources; and several other common practices.

Many space changes occur in the three compositions, particularly during the moment of a strong percussive attack, but the most notable feature is the formal technique. Along with the strong percussive attack, the sonic space shifts, opening up a new space, which Wyatt fills with new contrasting sound materials.

In the Arms of Peril			On a Roll			ComLinks		
space change	strong percussive attack	section	space change	strong percussive attack	section	space change	strong percussive attack	section
12	14	7	16	16	5	7	2	7

Table 9. Total Numbers of Space Change, Strong Percussive Attack and Section

As the above table indicates, the number of space changes and strong percussive attacks are strongly correlated, except in *ComLinks*. In the case of *On a Roll*, the numbers for these two events are the same, and are in fact formally linked together - every space change occurs following a strong percussive attack. *In the Arms of Peril* presents a similar situation, although there are two strong percussive attacks that do not result in a change of space. Unlike these two compositions, *ComLinks* has only two strong percussive attack points which are not directly correlated to space changes. In this piece, space changes function as formal markers, thus the number of space changes and sections are equal.

The relationship between recorded and synthesized types of sound source is also important to note when discussing Wyatt's compositions. In *In the Arms of Peril*, synthesized sounds play a primary role, while recorded sound sources and their manipulations are utilized as the primary source in the other two compositions examined above. When recorded sound materials are the primary sound source, synthesized sound materials play supportive roles, emphasizing, prolonging, and morphing the primary gestures, as well as constructing the atmosphere of the music in the mid- or background. When recorded materials are in a more subordinate function, they often assist in articulating and ornamenting foreground gestures that are primarily synthesized.

In terms of simulating movements of sound sources, Wyatt has specified all the possible translations which maximize the effectiveness of utilizing the D-8 System (see *page 14*). In comparing the three compositions in the aspect of positioning sound materials, it is important to define each composition's unique features. *In the Arms of Peril* primarily locates stereo images using the four corner channels (channel 1, 2, 3 and 4), positioning the clear image in the front with the distanced image in the rear. *On a Roll* utilizes an overwhelming number of translations in order to mimic the motion of rolling objects, while *ComLinks* uses various types of translations, and the creative employment of live ringtones.

Aside from the aforementioned three features, several other common practices can be found in Wyatt's electroacoustic compositions as well. First of all, 'retaining the listener's interest' seemed to be one of the composer's high priorities in his electroacoustic works. This principle is derived from his considerations about the nature of performance in the electroacoustic genre. With music for fixed-media in particular, it is quite easy for audience members to lose their focus on the music, since because there is no performer on the stage with

which to watch and interact. In order to overcome this setback, Wyatt set up several musical devices.

For one, he generally opts for compact designs in terms of duration. It is hard to find an electroacoustic work of his which lasts longer than 10 minutes. This relatively moderate length of work reflects such compositional principles. Secondly, in musical sense, the composer generally uses a moderate to fast tempo, and avoids maintaining moments of stasis for any significant length of time. The use of 'strong percussive attacks' is a device that he often uses to escape a more static atmosphere. Another element in Wyatt's approach to maintain a listener's attention is his consideration of timbre when employing sound materials. He tends to avoid repeating similar timbres of sound.

The projection of social messages is another practice that the electroacoustic works of Scott A. Wyatt have in common. In the case of *In the Arms of Peril*, he points out the dangerous circumstances surrounding us and expresses the persistent nature of humans to search for hope and relief from hazardous and perilous events. On the other hand, *ComLinks* presents a theme that draws one's attention to the capacity for instant communication in our hyper-connected society. The concrete sound sources that Wyatt's uses help to make this feature strong, since recognizable sonic objects have an ability to deliver more direct messages or symbolic meaning to the audience.

A sense of intimacy is another significant component of his compositions. In *On a Roll*, the venue of the **Intro** section is a Casino, which is described by sound events such as the elevator's arrival, the casino games themselves, and the acclamations and sighs of the casino's guests. Also, the rolling objects described in the piece are quite diverse, from a ping-pong ball to billiard balls, a car, a jet, a subway train, and many others. All of these objects are found in daily life. Another good example that shows intimacy in Wyatt's music is in how he invites audience

members to play their cell-phone ringtones in *ComLinks*. In doing this, the piece confounds the listeners' expectations in the concert hall, surrounding them with sounds coming from unexpected origins and directions.

As far as musical structure is concerned, *In the Arms of Peril* and *On a Roll* have roughly symmetrical, palindromic forms**: Intro – Body – Transition – Body – Coda**. On the other hand, *ComLinks* consists of a set of continuous variations. A common element that links the three compositions is manner in which space setup during **Intro** section. All three create a realistic sonic environment using recognizable sonic objects which is followed by a significantly contrasting sonic space frames the new section.

In conclusion, this essay has explored Scott A. Wyatt's spatial considerations and their compositional applications based on three selected electroacoustic compositions designed for eight-channel performance: *In the Arms of Peril*, *On a Roll* and *ComLinks*. His particular interests about sound and space are exemplified in these works. As discussed, Wyatt produces various types of sonic space, incorporating sound materials created by recording found objects or through synthesis. These materials are then manipulated by various processors, such as external hardware effect-machines and plug-in type software processors. His music often delivers social messages to the audience within a relatively short to moderate duration. In addition, his works maintain adequate tension along with intimacy. With particular emphasis on his utilization of the D-8 System, the eight-channel sound system he designed for Experimental Studio in University of Illinois, Wyatt has created sonic spaces in which various kinds of sound movements (translations) are presented. In addition to this, he has clarified related terms and possible sound translations within the D-8 System listening area.

His musical principles and their approaches to the genre of multi-channel electroacoustic music are the consequence of his persistent research and experiments as

educator, researcher, studio director, and composer over the years. For musicians and students who have a desire to seek professional knowledge and practical information about the spatialization and diffusion in the multichannel sound system, the works of Wyatt not only provide good study material, but also an enjoyable listening experience.

BIBLIOGRAPHY

Books

D'Allonnes, Olivier Revault. *Xenakis/Les Polytopes*. Paris: Balland, 1975.

Dodge, Charles, and Thomas A. Jerse. *Computer Music: Synthesis, Composition, and Performance*. New York: Schirmer Books, 1997.

Chadabe, Joel. *Electric Sound: the Past and Promise of Electronic Music.* Upper Saddle River, New Jersey: Prentice Hall, 1997.

Xenakis, Iannis. *Music and Architecture : architectural projects, texts, and realizations*. Hillsdale, New York: Pendragon Press, 2008.

Articles

Austin, Kevin. "On Sound Projection." *Contact!* 8/2 (1995): 55-67.

Austin, Larry. "Sound Diffusion in Composition and Performance Practice: an Interview with Denis Smalley." *Computer Music Journal* 24/2 (2000): 10-21.

Austin, Larry. "Sound Diffusion in Composition and Performance Practice II: an Interview with Ambrose Field." *Computer Music Journal* 25/4 (2001): 21-30.

Braasch, Jonas, Nils Peters, and Daniel L. Valente. "A Loudspeaker-Based Projection Technique for Spatial Music Applications Using Virtual Microphone Control." *Computer Music Journal* 32/3 (2008): 55-71.

Clozier, Christian. "The Gmebaphone Concept and the Cybernéphone Instrument." *Computer Music Journal* 25/4 (2001): 81-90.

Cross, Lowell. "Electronic Music, 1948-1953." *Perspectives of New Music* 7/1 (1968): 32-65.

Dack, Jack. "Diffusion as Performance**.**" Accessed May 20, 2011. http://www.sonic.mdx.ac.uk/research/dackdiffusion.html.

Dhomont, Francis. "Acousmatic Update." *Contact* 8/2 (1995): 49-54.

Harley, James. "The Electroacoustic Music of Iannis Xenakis." *Computer Music Journal*, 26/1 (2002): 33-57.

Kendall, Gary S. "A 3-D Sound Primer: Directional Hearing and Stereo Reproduction." *Computer Music Journal* 19/4 (1995): 23-46.

Malham, David G. "Toward Reality Equivalence in Spatial Sound Diffusion." *Computer Music Journal* 25/4 (2001): 31-38.

Malham, David G. and Anthony Myatt. "3D Sound Spatialization using AmbisonicTechniques." *Computer Music Journal* 19/4 (1995): 58-70.

Merlier, Bertrand. "Space in Electroacoustic Music, 5.1 surround systems and DTS encoding," Thélème Contemporain, 2009. Accessed June 17, 2011. http://tc2.free.fr/espace/articles/Conf51GB.pdf

Merlier, Bertrand. "Vocabulary of Space Perception in Electroacoustic Musics Composed or Spatialised in Pentaphony," 2008. Accessed August 13, 2011. http://tc2.free.fr/espace/articles/SMC08_Merlier.pdf

Ouzounian, Gascia. "Visualizing Acousitc Space." *Musiques Contemporaines* 17/3 (2007): 45-56.

Smalley, Denis. "Spectromorphology: explaining sound shapes." *Organised Sound* 2/2 (1997): 107-126.

Waytt, Scott. A. "Investigative Studies on Sound Diffusion/Projection at the University of Illinois: a report on an explorative collaboration." Journal Seamus 15/1 (2000): 6-17.

Zelli, Bijan. "Space and Computer Music; A Survey of Methods, Systems and Musical Implications." *eContact!* 11.4. 2009. Accessed June 17, 2011. http://cec.sonus.ca/econtact/11_4/zelli_space.html

Webpages

Mix: Professional Audio and Music Production. "1931 Alan Dower Blumlein Stereo Patent," Last modified September 1, 2006. http://www.mixonline.com/TECnology-Hall-of-Fame/alan-dower-blumlein-090106/.

Kay, Jonathan, Kimber Ghent, Brian Chumney and Erik Lutkins. "Film Sound History 40's." Accessed August 16, 2011. http://frank.mtsu.edu/~smpte/forties.html.

John, Smalley. "Gesang der Jünglinge: History and Analysis", 2000. Accessed April 12, 2011. http://music.columbia.edu/masterpieces/notes/stockhausen/GesangHistoryandAnalysis.pdf.

Föllmer, Golo. "Karlheinz Stockhausen: Spherical Concert Hall." Accessed August 18, 2011.

http://www.medienkunstnetz.de/works/stockhausen-im-kugelauditorium/.

Sound Recordings/ CD Booklet

Stockhausen, Karlheinz. "Electronische Musik." *Stockhausen 3: Electronische Musik 1952-1960*.

Stockhausen-Verlag (1996).

APPENDIX

I. Biography of Scott A. Wyatt

Scott A. Wyatt**,** Professor of Composition, serves as the director of the University of Illinois Experimental Music Studios, and among numerous other honors that he has received, he was one of the winners of the International Society for Contemporary Music National Composers Competition of 1978, the National Flute Association's 1979 Composition Competition, the 1979 Concorso Internazionale Luigi Russolo Composition Competition in Italy, the 1984 International Confederation of Electro-Acoustic Music competition in Bourges, France and a finalist in the 1989 International Electro-Acoustic Music Competition in Bourges, France. His composition teachers include Larry Nelson, John Melby, Salvatore Martirano, Herbert Brün, and Paul Martin Zonn. He was the 1990 recipient of an Arnold Beckman Research Award for the development of digital timescaling applications, and among others, several 1996-2004 grants for the development and application of positional three-dimensional audio imaging for multi-channel audio. He served as president of SEAMUS (the Society for Electro-Acoustic Music in the United States) from 1989 until 1996, and he remains on its Board of Directors. His compositions are recorded on CAPSTONE, CENTAUR, GMEB Cultures Electroniques Series, Library of Congress, MARK, OFFICE, SEAMUS, UBRES and VERIATZA recordings.[25]

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[25] Edited from Program note (concert in February 9, 2011 at Music Building Auditorium in University of Illinois at Urbana-Champaign) and CD booklet (EMS-2008).

II. List of Scott A. Wyatt's Selected Compositions Involving Electroacoustic Music

Title	Year	Format	Duration	Publication
Four for Flute	1976	flute with electroacoutic accompaniment consists of 4 movements	18:00	Media Press inc.
All for One	1979	solo percussion with electroacoustic music	10:58	Cultures Electroniques-15[26] Le Chant Du Monde – LCD
Three for One	1981	tuba with electroacousitc accompaniment consists of 3 movements	10:30	Tuba Euphonium Press
Time Mark	1989	solo percussion with tape accompaniment	8:45	Media Press inc./ SEAMUS volume 2 EAM-9401
Counterpoints	1992	soprano saxophone with tape accompaniment and live processing	8:42	Media Press inc./ SEAMUS volume 3 EAM-9402
Lifepoints	1993	tuba, percussion and tape accompaniment consists of 3 movements	10:00	Media Press inc.
A Time of Being	1996	mixed chorus, percussion and tape	9:22	SEAMUS volume 6 EAM-9701
Private Play	1997	8-channel performance	5:50	SEAMUS volume 8 EAM-9901
In the Arms of Peril	2001	8-channel performance	10:00	SEAMUS volume 11 EAM-2002
Night Visitors	2002	8-channel performance	8:48	SEAMUS volume 12 EAM-2003
On a Roll	2004	8-channel performance	8:21	SEAMUS volume 14 EAM-2005
All At Risk	2004	video and 8-channel performance	9:00	SEAMUS DVD ONE
…and nature is alone	2005	8-channel performance	11:00	Available from composer
A Road Beyond	2007	8-channel performance / trumpet with live processing and electroacoustic accompaniment	8:15	SEAMUS volume 17 EAM-2008
of gray twilight	2008	8-channel performance	7:18	In Celebration of the 50th Anniversary of the University of Illinois Experimental Music Studios EMS-2008
Risky Business	2008	fixed-media playback , live continuum performance, and two giant Tesla Coils (producing 1,800,000 Volts)	9:00	Available from composer
ComLinks	2010	8-channel performance	8:30	SEAMUS volume 21 EAM-2012

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[26] Collection of prize winning compositions from the 28th Competition of Electroacoustic Music, Bourges, 1991.