THE SURFACE: A SYNTHESIS

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This paper examines the speech-based musical realization of "The Surface" and its attempt to assimilate the poem at the structural, sonic, and expressive level. The software and analysis/re-synthesis techniques used to create timbres heard in the composition are discussed in detail. In addition to technical and structural issues, the common elements of the two art forms are considered within the context of the digital domain.

ACKNOWLEDGMENTS

I would like to express my gratitude to Jon C. Nelson, Joseph Klein, and Cindy McTee for their seemingly endless patience.

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CHAPTER I

INTRODUCTION

The Common Use of Time

According to Pierre Boulez, poetry and music once belonged to a single conception before dividing to explore their distinct potentialities.[1] The two arts evolved independently, each eventually developing a distinct system of organization and specialized field of knowledge. They are both, however, art forms dependent upon time, and continue to follow a similar form of self-referential logic. It is only at the structural level, Boulez argues, that a meaningful synthesis of poetry and music can take place, and the composer must move beyond the initial sensuous response:

> . . . the next [phase] is to establish the direct grasp of the music on a poem, whether it be in overall form and syntax or in the rhythm and the actual verbal sonority. This 'taking-over' process, from the rhetoric to morphology, continues and ensures the faultless transition from one language to another. Communication is in fact established by means of *structure*, whether it be aesthetic or grammatical.[2]

To achieve this complete integration of text and music, the composition must appropriate the element most essential and unique to these two art forms: time. The organization of a poem's or composition's various segments creates an almost palpable temporality set in relief from the continuous flow of daily experience.

Whether hearing lines, phrases, stanzas, or harmonic progressions, one is immediately aware of the sensual surface level elements of a composition. The ability to perceive the context and direction of these individual components gives a work its large-

[1] Pierre Boulez, *Orientations: Collected Writings by Pierre Boulez*,ed. Jean-Jacques Nattiez, trans. Martin Cooper (Cambridge: Harvard University Press, 1986), 186.

[2] Ibid., 196.

scale expressive force. At all levels of a composition organized in such a way, from the macro- to the micro-, many forms of periodicity must be present. For example, at the micro-level (i.e. pulse and phrase structure), repetition creates the sense of continuity and relatedness which is unique to musical and poetic forms. Periodicity is governed at all levels by the accumulation and release of tension. When considering the large-scale aspects of structure, repetition informs the listener's or reader's recognition of a particular form, but it is only after one considers a work in its entirety that the structural rhythm can be determined.

In *Music and Poetry: The Nineteenth Century and After*, Lawrence: Kramer identifies three forms of structural rhythm employed in music and poetry Romantic repetition, generative form, and transitivity.[3]

Kramer defines Romantic repetition as an excessive repetition of a phrase or gesture used to suggest instability. This type of large-scale rhythm asserts time as an impediment, and normally requires the introduction of a new structural element. The new material provides a release from the tension created by the repetition, and so the overall experience of the poem or composition may be thought of as cathartic.

Generative form is an organically conceived structural rhythm based upon an unfolding discourse of contrasting ideas. Here the entire work is usually devoted to some sort of resolution of the ideas where one eventually gains prominence. With each recurrence of materials within this form, time becomes the medium of connection. "It

[3] Lawrence Kramer, *Music and Poetry: The Nineteenth Century and After* (Berkeley and Los Angeles: University of California Press, 1984), 25-124.

situates temporality in an exchange between consciousness and objects, and produces works in which closure is strongly heightened."[4]

Transitivity, the final structural rhythm identified by Kramer, is the most difficult to formalize due to its metaphysical overtones. It might be best understood as the artist's recognition of consciousness as an entity "set over against both the objects and the subject of which it becomes conscious."[5] These works are based upon the transformation of self into either sound or language, and often create textures that are not immediately comprehensible. In this case, time is considered the intermediary of wholeness.

Within a musical setting of a text, two narratives simultaneously unfold: the fixed time of the poem, and its derivative, the variable time of the music.[6] The relatively fixed duration, expressive content, and form of a poem is appropriated by the composition, and so is at once "center and absence"[7] of the synthesis. Traditionally, music distorts the reading of a poem with the addition of melismata and modifications of pitch and duration unnatural to the spoken voice, serving essentially as a form of commentary upon the text. The ability to convert natural sounds - the human voice for example - to the digital domain offers an interesting addition to these conventional methods.

The Digital Presentation

The Surface, a nine-minute computer generated composition for solo tape, explores the potential of these techniques. All materials in this composition are derived, through analysis and re-synthesis of the voice, from a digitally recorded reading of a

[4] Ibid., 229.
[5] Ibid., 18.
[6] Boulez, *Orientations*, 196.
[7] Ibid., 183.

poem. This process of analysis and re-synthesis of natural sounds adds another dimension to the musical realization of text. The utilization of various digital techniques enables the composer to create a rich palette of timbres from a small number of pre-existing sounds. For example, through analysis/re-synthesis one can alter the pitch and time domains of sounds independently while preserving the quality of the timbre. Significantly increasing the duration of a sound often exposes previously inaudible components, which can then be further developed. Through analysis/re-synthesis, the harmonic spectra of two sounds can also be combined so that the characteristic frequencies of one would shape another. These techniques, in addition to others discussed in the following pages, generated sound-events and timbres that assumed the role traditionally played by instruments, and in doing so created a direct correlation between the poetic and musical source.

This paper will demonstrate *The Surface*'s assimilation of the poem at the structural, sonic, and expressive levels through the use of digital techniques. At the structural level, the composition and poem share a three-part form of similar proportions and contain elements of transitivity. Sonically, the text was appropriated in that all timbres were derived from readings of the poem. From all standpoints, the analysis and re-synthesis techniques utilized are of central importance to the musical realization of the text, and will be discussed in detail. However, before closely examining any of these relationships an understanding of the poem and its structure is necessary.

CHAPTER II

JORIE GRAHAM AND AN ANALYSIS OF "THE SURFACE"

Biographical Introduction

The text selected for musical setting belongs to a contemporary American poet, Jorie Graham (1953 -). "The big hunger,"[1] her compulsion to address the ambitious questions which preoccupied the modernist poets preceding her, is the feature of her poetry I originally found most compelling. As Helen Vendler stated, "[Graham] brings into postwar American poetry the urgent and inescapable need of the modern writer to embody in art a non-teleological universe – a universe without philosophical coherence though bound by a physical law, a universe unconscious of us but which constitutes, by its materiality, our consciousness."[2]

Though born of a Jewish-American artist mother and an Irish-American writer father, Graham grew up in Italy where her family held close associations with other writers, artists, and filmmakers. As a youth, a sense of philosophical wonder was fostered while attending the Rome Lycée Français, where students were regularly assigned essays on a wide range of difficult philosophical abstractions. Not until the age of twenty, after studying at the Sorbonne, did Graham move to the United States to study

[1] Thomas Gardner, "An Interview with Jorie Graham," *Denver Quarterly* 26 (1992): 81.
[2] Helen Vendler, *The Given and the Made: Strategies of Poetic Redefinition* (Cambridge, MA: Harvard University Press, 1995), 92.

filmmaking with Martin Scorcese at New York University. She then studied writing at both Columbia University and the University of Iowa.[3]

These biographical facts have been included because they provided the foundation for the thematic and technical features of Graham's work. The more prominent technical devices employed are analogous with cinematic techniques (e.g. panning, multiple perspectives, and cross-cutting), philosophical diction, and "most centrally, its trying-on of several different linguistic expressions for the 'same thing' – as though language itself offered no perfect match for the material world, and as though 'English' were a congeries of sub-languages, each with its own 'flavor.'" [4]

Analysis of "The Surface"

Before providing an analysis of "The Surface," I will briefly review the format of this collection, entitled *Materialism.* It contains twenty-three poems interspersed with long excerpts from significant thinkers of the Western tradition. These fragments all pertain to either materiality of the world or language. Graham has presumably included the excerpts to trace the Western world's exploration of matter.

"The Surface"

It has a hole in it. Not only where I
concentrate.
The river still ribboning, twisting up,
into its re-
arrangements, chill enlightenments, tight-knotted
quickenings
and loosenings – whispered messages dissolving
the messengers –
the river still glinting-up into its handfuls, heapings,
glassy
forgettings under the river of

[3] Ibid., 91.
[4] Ibid., 92.

my attention –
and the river of my attention laying itself down –
bending,
reassembling – over the quick leaving-offs and windy
obstacles –
and the surface rippling under the wind's attention –
rippling over the accumulations, the slowed-down drifting
permanences
of the cold
bed.
I say *iridescent* and I look down.
The leaves very still as they are carried.[5]

Graham's notion of selfhood throughout *Materialism* is dramatized by focusing on the movement of the material world outside the self. "The Surface" depicts the unfolding drama of consciousness through the representation of the flux of a river. The form of the poem resembles that of a medieval triptych, in which the middle panel (commonly representing the present) is larger than the two side panels (the past and future). Punctuation, in addition to the repetition of keywords, assists in delimiting the sections of the poem.

The brief first section of "The Surface" appears to suggest the inability of the self to perceive consciousness in the present, and when considering the river, the vortexes that form within currents of flowing water. The outer sections of the poem, in contrast to the flowing run-on of the middle, consist of two short fragments.

The first half of the main body of the poem transcribes the movements of a river through its kinetic and descriptive language. Each moment of the sequence, no matter how complete within itself, is immediately superseded: still ribboning, twisting up, re-

[5] Jorie Graham, "The Surface," in *The Dream of the Unified Field: Selected Poems 1974-1994* (Hopewell, NJ: 1995), 197.

arrangements, chill enlightenments, tight-knotted quickenings and loosenings.

The core of the poem is the repetition of "the river of my attention," which not only identifies the river and consciousness, but shifts the perspective to first person. It is also at this moment that the word "down" appears, releasing the tension created through the repetition of "up." In describing the river of consciousness in the second half of this section, a similarly kinetic language is employed but only now in terms of surface and depth rather than stasis and movement.

A sudden shift follows in the final part of "The Surface" with the double appearance of "I." It seems significant that the "I" says something, actively providing a concept to the experience whereas before the attention was directed externally.

While attempting to concretize the material world in language, Jorie Graham "forges a deeply sensuous poetry out of the slippage between language and sensation."[6] The power of "The Surface" lies in her intense transcription of the simple action of the material world into a vivid and kinetic language. The movement and stasis captured by the text offers an interesting structure for a musical setting.

[6] James Lomgenbach, *Modern Poetry After Modernism* (New York: Oxford University Press, 1997), 159.

CHAPTER III

THE COMPOSITION

Introduction

In the musical realization of "The Surface," the poem itself provides both the textual and acoustic materials for its own setting, achieving immediacy unique to this form of text setting. All sonic materials in this composition derive from digitally recorded readings of the poem by Rose Marie Chisholm and Abla Hamza. These samples were manipulated using various software.

The initial form of the raw material consisted of several types of articulation of the text. Individual words, as well as the poem in its entirety, were spoken, whispered, and sung. The recording of the voice was then transferred from a digital audio tape to a Macintosh computer where the readings were then edited. This process involved cutting large sections of the readings into phrases, individual words, and phonemes. The next step was to explore, through trial and error, the potential of those materials utilizing various combinations of processes.

An Overview of the Software

Before discussing the composition of *The Surface*, a brief summary of the software used to analyze and re-synthesize the voice is necessary. Spark and GRM Tools are both graphical soundfile editors that provide various effects such as delays, reverbs, and filters. Both provide real-time control over the sound's parameters. Max MSP is an object-oriented programming environment in which a user, through the use of patches,

can create instruments, automated composition programs, and generate sound in real-time. Patches constructed in Max MSP were used extensively and became instrumental in realizing many of the compositional goals. SoundHack is a fast Fourier transform/inverse fast Fourier transform (FFT/IFFT) based analysis/re-synthesis program written by Tom Erbe. This program allows the user to control the size, shape, and resolution of FFT windowing functions. Using analysis data, SoundHack performs the digital signal processing functions convolution and phase vocoding. The timbres generated by these two processes were featured prominently throughout the composition. The RAM-based program Sound Edit 16 is a graphical sound editor used for basic processing functions such as normalizing, reversing, and transposing soundfiles. Pro Tools is a powerful graphical mixing program that displays individual tracks as horizontal bars along a time line. The volume and pan functions of each track can be controlled either in real-time by using faders, or with greater precision by using envelopes. Third-party Pro Tools plug-ins provide many additional processing functions, creating an invaluable compositional tool

Overview of the Composition

The form of the composition, as shown in figure 3.1, reflects the three-part structure of the poem, with divisions occurring after the words “concentrate” and “bed.”

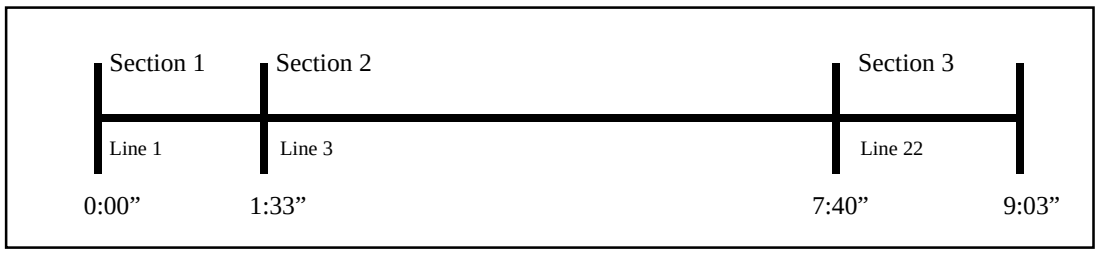

Figure 3.1 Form of *The Surface*

In addition to a period following each of these words a change of perspective occurs, further demarcating the sections. The music articulates these sections through changes of texture and timbre - in the first instance with silence, and in the second through the reduction of activity and change of color. With the exception of some of the more significant words in the body of the poem, the text is primarily presented in linear order.

The composition attempts to convey the structural rhythm of the poem. Tension is created throughout the first half of the text by the repetition of keywords and phrases such as “up” and “the river still.” This serves as an anacrusis to the second half, where the tension is released through the introduction of the word “down” and the identification of the river as “the river of my attention.” The opposition of knottings and loosenings, slowings and quickenings, over and under also contribute to the poem's large-scale rhythm.

In the musical realization, tension forms within the first two sections through the repetition and accretion of similar timbres and gestures, each of which gradually assemble to a climactic point. The structural rhythm of the composition and poem suggest a cathartic experience of time.

Section One – “It has a hole in it.”

The first section consists of short, isolated gestures moving at different rates. The prominence of silence and whispered voice throughout this part is used to evoke the introspective tone of the text, and serve as a somewhat mimetic representation of the subject matter.

Each of these initial gestures was designed using the Max MSP patch Granular

2.0, written by Nobuyasu Sakodna.[1] Here, the playback rate of the whispered text in its entirety was significantly compressed to varying degrees, and slight deviations of pitch were produced. An abrupt textural change interrupts the high point achieved by the accumulation of these gestures. The artifacts of the same reading now provide the sound environment for the first intelligible presentation of text. The voice was only slightly altered by independently lowering the original pitch and slowing down the playback rate. Silence is used to emphasize "concentrate" which is significant in that it is the poem's first suggestion of consciousness.

Section Two – "The river . . . "

Due in large part to the kinetic language and external perspective of the text, the body proved to be the most challenging section of the composition to create. In the poem, the words themselves are used to mimic the movement/stasis of the river and the thought process. To present the text in a straightforward manner would be merely descriptive, and with the limited amount of foreground material was not considered an effective presentation. Consequently, the words themselves are treated as the primary material and, in essence, sonically illustrate the knottings and loosenings of the river of consciousness.

The first half of the middle section is similar in shape and texture to the beginning of the composition. Like the beginning, through a process of accretion the texture swells

[1] Nobuy Sakonda, Granular 2.0 (Kobe, Japan, January, 1999) [on-line]; available at www.bekkoame.or.jp/~nsakonda/welcome.html.

to a climax. However, this time it is the accumulation of syllables, words, and finally phrases that create this gesture.

A Max MSP patch obtained from Jon Christopher Nelson was used to generate materials throughout this portion of the work. One of the basic functions of the algorithm is, with the user controlling the degree of randomness, to playback up to twenty-five samples that exhibit varying transposition levels, locations within the stereo field, and random ordering. Phonemes and syllables were entered into the patch and the material generated was then edited once placed into the context of the composition.

In addition to slowly developing sounds created in SoundHack and Pro Tools, the underlying activity and foreground materials throughout this portion were created using the software Spark and GRM Tools. Here, different transposition levels and several types of delay were applied to individual words and phrases to produce varying degrees of intelligibility. These processes were employed in an attempt to portray the fragmentation, accumulation, and reformation of the poem's subject matter

The transition from "the river" to "the river of my attention" is emphasized by a change in timbre and texture along with greater clarity in the presentation of the text. At this point a slowly evolving sound created through granular synthesis techniques emerges. This sound, through the procedure cross-fading, is gradually transformed into other sustained sounds constructed with GRM Tools and SoundHack.

Section Three – "I say Iridescent . . ."

The static texture in the final section suggests the quiet stillness of the closing lines of the poetry. For the first time in this composition the text is presented without

processing to accentuate the return to “I.” This moment in the text, as stated earlier in the analysis of the poem, actively provides a concept to the experience.

The sounds were developed using SoundHack, which through the process of phase vocoding can multiply a phoneme’s duration to several times its normal length. The resultant sounds were then edited and either cross-synthesized using convolution, or brought into GRM Tools, where the harmonic spectrum was altered through the application of various filters.

CHAPTER IV

TIMBRE DESIGN

Role of the Computer

The composer's choice of the computer as an expressive vehicle requires that he or she be more than a creator. In addition to the already arduous task of creation, the composer must also play the role of researcher, instrument builder, theoretician, and performer. The vast possibilities that the computer presents to the modern musician are simultaneously invigorating and overwhelming. A computer provides the composer with the ability to explore the minutiae of a sound's structure, as well as construct entire sound worlds. Through compositional algorithms the computer also allows one to conceive and realize complex structures that unify the macro- and micro-level structures of a composition with unprecedented accuracy and facility. Despite the large number of responsibilities inherent in composition with computers, the possibility of creating complex and powerful music provides a strong impetus.

Analog-to-Digital/Digital-to-Analog Converters

Rather than performing sound synthesis, natural sounds can be converted to the digital domain and then processed. As illustrated in figure 4.1 from Curtis Roads's *The Computer Music Tutorial*,[1] this procedure begins with the conversion of sounds from the analog to the digital domain. Unlike the continuity of analog recording, digital recording reads discrete windows of time similar to a snapshot. A microphone first transduces

[1] Curtis Roads et al., *The Computer Music Tutorial* (Cambridge: The MIT Press, 1996), 21.

deviations in air pressure to electrical voltage, which are then passed through a wire to an analog-to-digital converter (ADC). Here, the voltage is converted into a series of binary numbers at each period of the sample clock, and then digitally stored. This process is reversed when the sound is again converted to an analog signal. In this instance, the binary numbers are read from the digital storage medium to a digital-to-analog converter

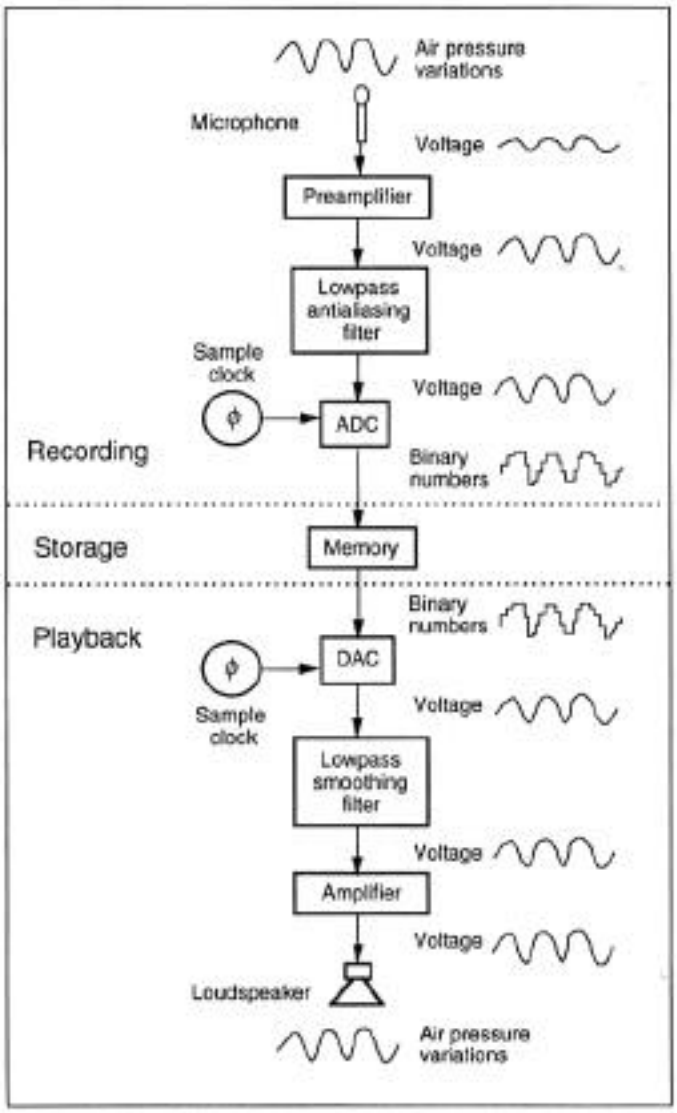

Figure 4.1 Analog-to-digital/digital-to-analog flowchart

(DAC) where they are then converted back to voltage.[2]

Fast Fourier Transform/Inverse Fast Fourier Transform

Fast Fourier transform is the form of analysis-based synthesis primarily used throughout the composition of *The Surface*. Analysis-based synthesis uses the information gathered from existing sound sources to reproduce those sounds, or create a processed sound emanating from the original.

The Fourier series can be used to deconstruct periodic waveforms into combinations of simple sine waves of varying amplitudes, frequencies, and phases. The sinusoids that comprise the spectrum of a sound are referred to as partials. The spectrum, determined by a mathematical procedure called the Fourier transform, is defined as the distribution of energy over frequency, while the waveform is defined as the pattern of amplitude over time. The result of this procedure is a complete description of the sound in the time and frequency domains.

From this analysis, the process called inverse fast Fourier transform (IFFT) is applied to re-synthesize the analysis so that the original sound may be recreated or produce a new one.[3]

Phase Vocoding

The exploration of a sound's potential in *The Surface* often began with the phase vocoding function in SoundHack shown in figure 4.2. Here, sound files can be transposed without affecting the duration and time compressed or expanded without altering the pitch.

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[2] Ibid., 22-24.
[3] Ibid., 1075-1086.

Significantly increasing the duration of a sound often revealed once inaudible elements that were then isolated in a sound editor. These resultant sounds were ordinarily developed further in a similar fashion. The synthesis parameters were originally chosen intuitively. However, through trial and error, settings emerged that produced more desirable results.

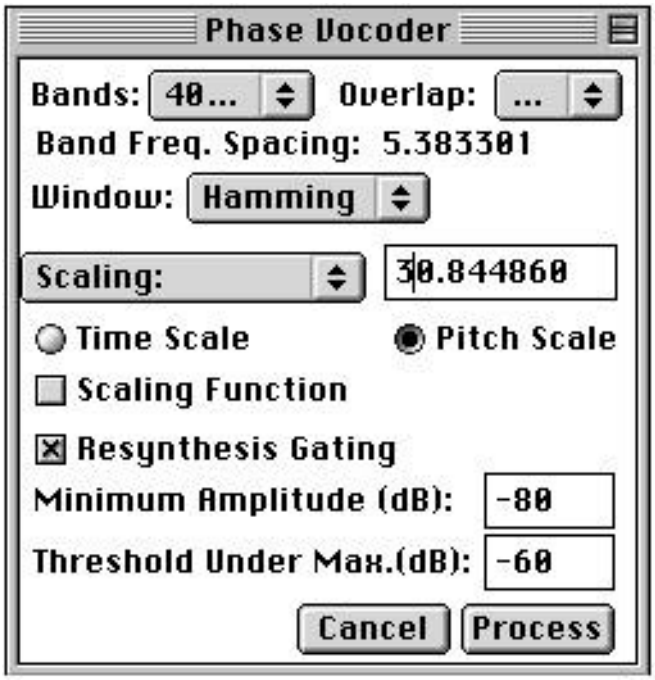

Figure 4.2 SoundHack's phase vocoder window

The phase vocoder is based on the FFT/IFFT analysis/re-synthesis model. The highest number of bands available, a window of 4096, was normally chosen to produce a smoother re-synthesis and fewer undesirable artifacts. The overlap ratio also considerably affected the type of sound generated. When processing the voice, a lower setting would maintain the original character, while higher ratios allowed the FFT

windows to merge, producing spectral splatter.[4] Three major FFT windowing functions are available. A window in this case is basically an envelope of varying size and shape imposed upon the data undergoing spectral analysis, each of which affects the sound differently. SoundHack also allows the user to either enter a ratio or an exact duration when working in the time domain. Similarly, a choice of ratio or semitone shift is provided for alterations to the frequency domain. The scaling function is useful for controlling pitch or duration over time, permitting the user to control the evolution of sounds. The sound heard in the concluding moments of *The Surface* is characteristic of this process.

Convolution

The filtering technique known as convolution was another process used to create timbres found in the composition. Convolution multiplies the spectra of two sound files, an input and impulse response file, yielding a cross-synthesis where the common

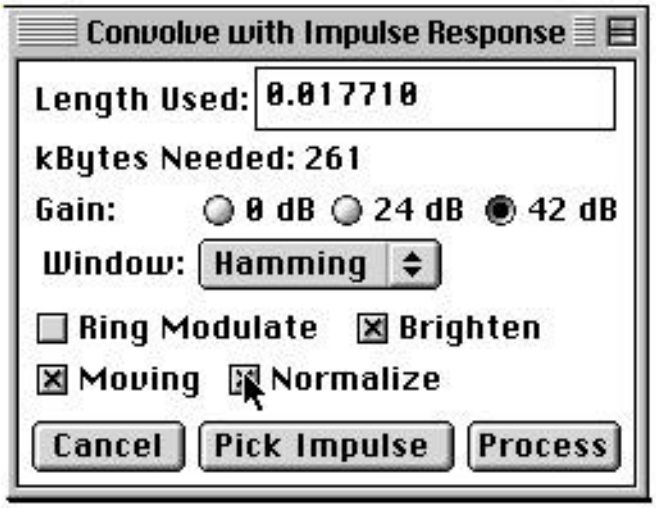

Figure 4.3 SoundHack's convolution window

[4] This term is used in reference to artifacts produced during the phase vocoding process.

frequencies are reinforced. SoundHack's convolution window is shown above in figure 4.3.

While working with convolution in the process of composing *The Surface,* the entire length of impulse files was used. Ordinarily, the amplitude of the resultant sound would be dramatically reduced during synthesis because of the differences of spectra. The exception occurred when the input and impulse files shared similar spectra, which resulted in distortion. For the most part, the gain factor was set to 42dB to compensate for the loss of amplitude. The process frequently removed the higher partials generating sounds that were somewhat flat but could be corrected by selecting the "Brighten" function. "Brighten" consists of a high pass filter that introduces high frequency components while attenuating the lower frequencies. The moving option shifts the impulse response window so that a new section of the response will be processed for every portion of the "length used" field. To ensure the highest possible amplitude, the processed sound file was normalized. Normalization scales the amplitude of a waveform so that the highest amplitude peak of that waveform exhibits the maximum amplitude that sound file bit-depth can represent. The impulse files most often consisted of phonemes or incidental sounds transposed to a lower frequency so that the spectra would be dissimilar. In some cases, reverb was added to taper the decay. A notable example of a timbre created through this process can be heard approximately two minutes and forty seconds into the composition, following the word "river."

Granular Synthesis

Many of the sounds developed for *The Surface* were created using granular synthesis. This process builds timbres from thousands of minute sound grains, each so brief (on average 1 to 100 ms) that they border upon the minimum perceivable event time for duration, frequency, and amplitude discrimination. The grain can be conceptualized as a micro-level sound event with a distinct set of time and pitch parameters.[5]

The sounds constructed by granular synthesis for this composition were developed in the Max MSP patch, Granular 2.0,[6] where the user has real-time control over various parameters. The patch is shown on the following page in figure 4.4. There are three playback modes available to the user: auto sequence, manual, and prism.

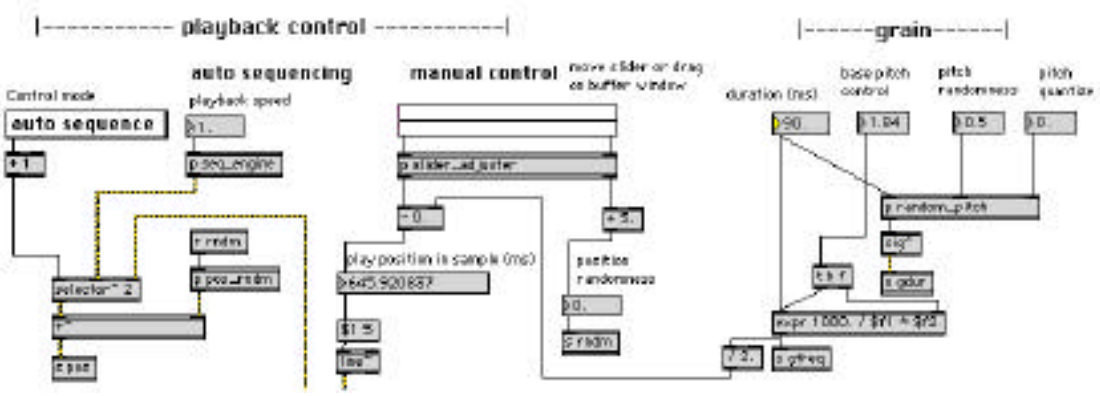

Figure 4.4 Granular 2.0 patch

Each mode produces drastically different results. Auto sequence allows one to control the playback speed and direction of a sound file. By entering a slow playback speed, this function was often used to stretch time in a manner analogous to phase vocoding. The manual mode of playback is controlled by moving a slider to select

[5] Ibid., 168-184.
[6] Nobuy Sakonda, Granular 2.0.

portions of a buffer window. In addition to this method, an exact location within the sample can be selected by entering a precise play position. In order to generate fragmented materials for *The Surface*, small segments of the reading were combined with silence and then played back in this mode with a great deal of position randomness. The prism mode was also utilized to develop many of the timbres heard in the piece. Here, the user has gestural control of the position and frequency parameters through movements of the computer's mouse. The prism mode window is shown in figure 4.5.

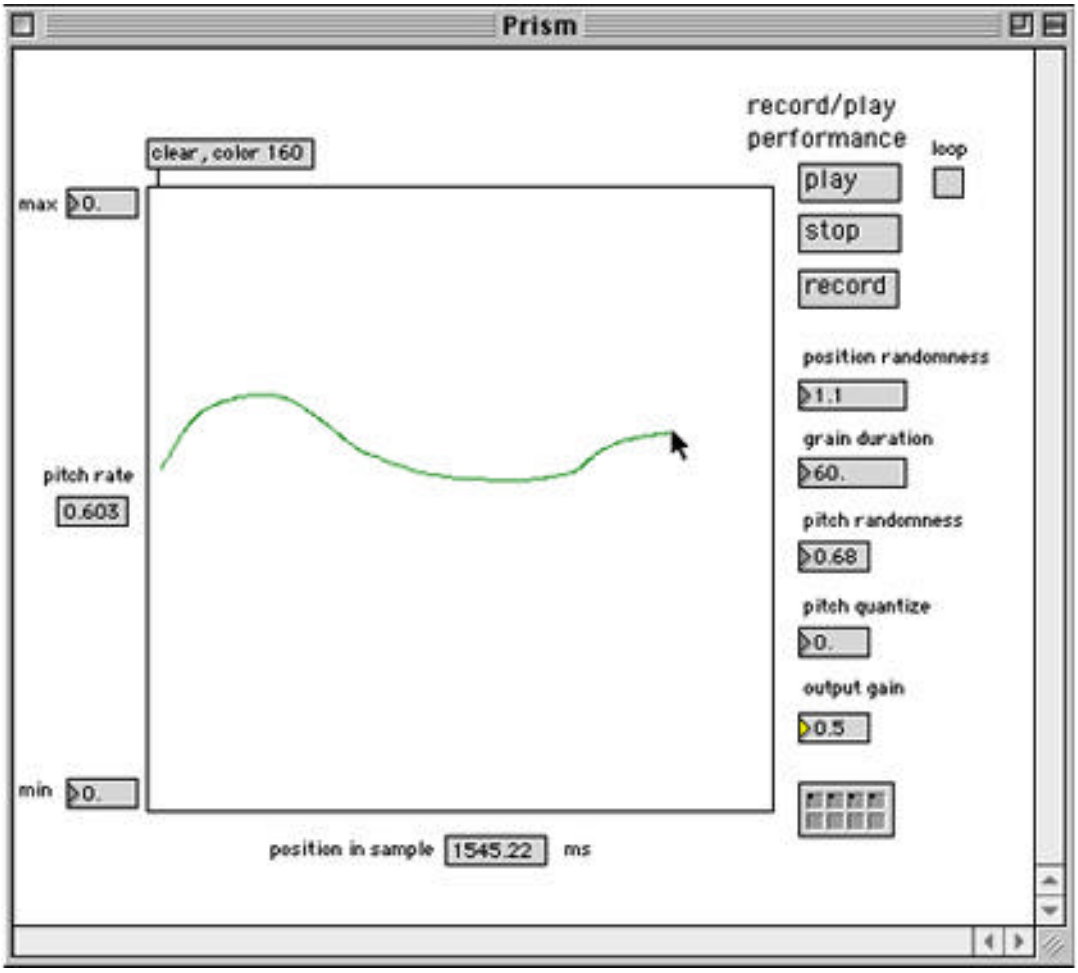

Figure 4.5 Prism mode window

The vertical axis represents frequency, the range of which is determined by the user, and the horizontal axis represents position within the sound file. The whispered gestures heard in the first section of *The Surface* were created in this mode.

Granular 2.0 also enables the user to control the duration, transposition level, and degree of pitch randomness of grains in real-time. Many of the compositional objectives were realized through the use of this software.

Filters

Four of the more common types of filters applied to timbres heard in *The Surface* are depicted in Figure 4.6 from *The Computer Music Tutorial*. Filters are devices that either reinforce or attenuate frequencies of a sound's spectrum by combining a slightly

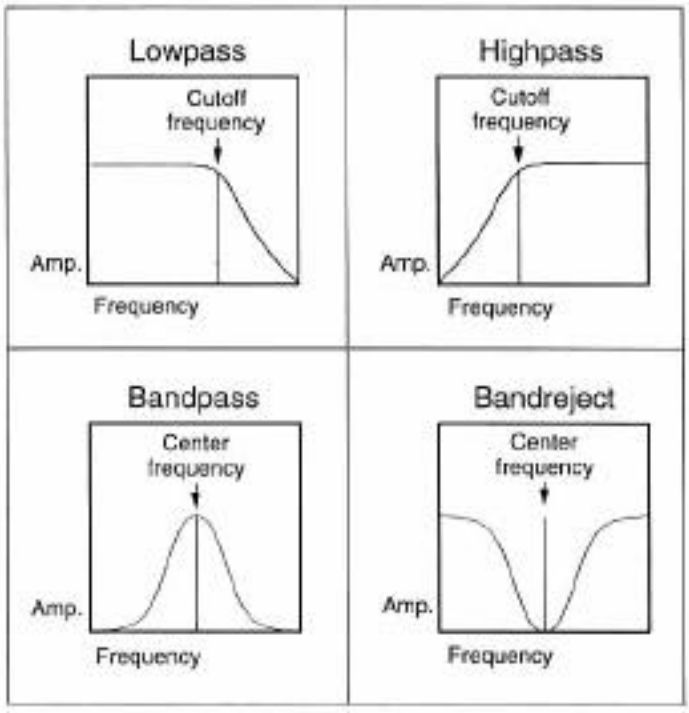

Figure 4.6 Four basic filters.

delayed signal with the original. The mixture of the two signals produces a new waveform with a different spectrum. A wide range of filters with distinct frequency response curves can be constructed through various combinations of delays and mixing sums.

Lowpass and highpass filters either cut or boost frequencies above or below a given threshold. The cutoff frequency of these filters, which can be controlled in real-time using GRM Tools, is the juncture in the spectrum at which the filter reduces the signal to approximately half of its original amplitude. Frequencies attenuated below this point are considered to be in the stopband of a filter , and those above in the passband. A bandpass filter limits the boosted frequencies to a narrow range. The bandwidth of this filter is determined by the difference between the higher and lower cutoff frequencies. The center frequency is the maximum point of amplitude. Conversely, when considering a bandreject filter the center frequency is the minimum point of amplitude. The comb filter was also employed to shape sounds heard throughout the composition. This filter consists of several evenly spaced sharp curves in its frequency response, which create a series of peaks and troughs in the spectrum of the input signal. Most timbres heard in the composition utilized one of these filters at some stage in their development. An example of a timbre processed in a highpass filter is the sustained sound heard after the word "still," approximately four minutes and thirteen seconds into the composition.

Digital Delay

Digital delay was applied to the voice throughout the middle section of *The Surface* to emphasize the language's movement. This form of delay receives input

samples and stores them in the computer's memory for a short period before sending them out again. A long delay time was generally selected so that the processed sounds would be heard as repetitions of the original. A data structure within the signal processor contains a list of sequential memory locations holding each of the sound files. At each sample period, the oldest sample is read and then replaced with a new incoming sample placed in the same location. The pointer then moves to the next position that now contains the oldest sample. As this is a circular data structure, the process repeats once the read/write pointer reaches the final memory location.[7]

[7] Roads, *The Computer Music Tutorial*, 432-435.

CHAPTER V

CONCLUSION

Composition within the digital domain creates the potential for a more direct correlation between a poem and its musical realization. In *The Surface,* the text alone serves as the structure, accompaniment, and expressive content, forming a synthesis unique to this type of composition.

Each art form relies upon a different set of elements to create meaning. In poetry, the intelligibility of a language is essential to the construction of meaning, and therefore, dependent upon the spoken voice. Music, on the other hand, organizes pure sound, and utilizing spoken voice exclusively, denies its inherent potential. By digitally manipulating various forms of speaking, *The Surface* attempts to place the poem itself at the core of the composition.

Digital signal processing and micro-editing enable the composer to create a continuum of intelligibility ranging from speech to pure sound. Throughout this composition the spoken voice presents both the narrative of the poem, and through timbres derived from its recitation, the musical commentary.

On the structural level, the music assumes both the form and large-scale rhythm of the poem. The timbral areas of the composition are divided to reflect the poem's three-part form and exhibit similar proportions. The structural anacrusis of the text is also recreated in the musical realization through the repetition and transformation of sounds.

Although the complete assimilation of one art form by the other is ineffective, digital techniques provide a direct correlation between music and poetry, and offer intriguing additions to the traditional methods of text setting.

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