PHIL WINSOR'S MYST:
Research and Art

A technical and aesthetic consideration

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ABSTRACT

Believing composition to be both research and art, Phil Winsor was invested in the exploration of expanded techniques for algorithmic composition, intermedia art, sonification, and therapeutic uses of computer controlled music. A proposed research project involving therapeutic effects of music included the building of an instrument to provide algorithmically generated sonic material for researchers to use in assessing the effects of said material on the brain. Using electroencephalograms, researchers could gather data to determine possible beneficial techniques for sonic therapy. The instrument Winsor created was called MYST and this paper will examine that instrument and its use in an intermedia work entitled Myst*.*

1. INTRODUCTION

In his last creative decade American composer Phil Winsor (1938-2012) revisited many of his earlier instrumental works and reimagined them as intermedia works usually adding fractal videos of his own creation. These works seem to reflect a heightened interest in intermedia approaches that Winsor had used throughout his compositional output. In 2005 Winsor created a computer music video entitled *Myst*, which he subtitled an "Immersive Digital Audio with Computer-generated Fractal Images." Unlike several works of this period, this was a new musical work with video. The work bears the name of a software instrument that Winsor developed also called MYST. This instrument was intended for both musical research and musical composition. This paper will examine MYST the instrument and the *Myst* the intermedia work.

2. THE C.A.V.E. AT NATIONAL CHIAO TUNG UNIVERSITY

The Center for Audio-Visual Research (C.A.V.E.) was established in 2004 at National Chiao Tung University (NCTU) in Hsinchu, Taiwan which included the addition of a MA degree in Music Technology. Students were to enter the new program in 2005. In 2005 classes for the Music Technology were being held in the newly constructed facility housing the C.A.V.E. systems located in the basement of the Auditorium Building. In the Fall 2005 semester equipment was still arriving for installation. In an email to Scott Krejci (Computer Systems Manager at the University of North Texas), Winsor writes,

"It took forever to get the 8-channel and 4-channel audio systems ordered because they had to go out for bid… the systems should be here by the end of October. The two video projection systems and screens have been installed, plus the big plasma TV monitor arrived, so we are able to hold the M.A. Degree Music Technology classes in the C.A.V.E. [1]"

Winsor was very pleased with the opportunities that the C.A.V.E. presented for his students. In the same email he writes,

"…it is really neat being able to conduct my undergraduate Multimedia Soundscapes course in the larger performance space. We bought 15 notebook computers so I could treat the class as a workshop - everybody can work on Premiere and Audition as I demonstrate stuff on the large projection screen [1]."

Even though the terms of his visiting professorship did not require teaching, Winsor was happy to teach Algorithmic Composition in addition to the aforementioned Multimedia class.

3. C.A.V.E. MISSION STATEMENT

In October 2005 the Mission Statement for the C.A.V.E. was finalized. It read as follows:

The Center for Audio-Visual Experiment (C.A.V.E.) is an audio-visual research and curricular support facility that provides resources for those wishing to pursue studies in Music Technology and Intermedia Arts.

The purpose of the Center is to:

Provide technological support in the form of computer equipment and software necessary for research in the Intermedia Arts field.

Retain faculty who have expertise in music technology, multimedia technology, and related conceptual areas (Artificial Intelligence, Neural Networks, Cognition, Psychoperceptual Phenomena, Acoustics, etc.); Center faculty will teach undergraduate and graduate courses in Music Technology and Multimedia Arts.

Solicit research proposals from the academic and artistic communities and provide assistance in submitting them to the appropriate funding organizations.

Host symposia, colloquia, and international conferences in Music Technology and Multimedia Arts.

Serve as a recruitment tool to attract talented students and research faculty to National Chiao Tung University.

Present concerts, performances, installations, and other public events in the Taipei area to increase the awareness of technological arts in the community at large [2].

3.1 Grant Proposals

The final version of the Mission Statement includes ten areas of research that the C.A.V.E. would be involved in. Winsor's intent was to establish the Music Technology program at NTCU as the research leader in Asia. Winsor's interest in varied areas of music technology research is evident in this Mission Statement and it led him to initiate interdisciplinary research proposals with several universities. Three abstracts for proposals were discovered on his archived hard drives [3]:

NTCU and the University of Illinois
"Music Visualization, and Scientific Sonification in an Immersive Virtual-Reality Environment."

NCTU and the Stuttgart Staatliche Hochschule fur Musik
"Algorithmic Composition and GUI interface for Csound"

NCTU and the University of Pisa
"The Therapeutic Effects of Music"

It is not believed that the projects involving the University of Illinois or the Stuttgart Hochschule went beyond the proposal stage, (A recent conversation with Sever Tipei verified that the University of Illinois project did not move forward.) however, the greatest amount of effort on Winsor's part is associated with the proposal with the University of Pisa. Winsor was acquainted with Paolo Grigolini, who divides his academic duties as a Physics professor at the University of North Texas and the University of Pisa and was interested in Grigolini's work on Diffusion Entropy Analysis. Researchers in Pisa had developed a time-series analysis method and Winsor's proposal was to study the physiological impact of sonic art structures on health issues using this analysis method.

Winsor states in the research proposal that was submitted for the National Science Council grant process:

"The anticipated effect of this research project (therapeutic sound structures) is to produce a transition from the pathological to the healthy condition. The same technique can be used to analyze the music composition itself to establish to what an extent the non-ergodicity of the musical composition might be beneficial.
[Using the time series analysis method]…"we will analyze the musical composition, the electroencephalogram of medical patients, and other physiological data. This data in turn will be correlated with the relevant data of healthy people. We conjecture that the music composition might trigger a beneficial, therapeutic change if it is made to resonate with the pathology [4]."

Winsor and Chih-Fang Huang (Assistant Director of the C.A.V.E.) invited Chin-Teng Lin, Dean of the College of Computer Science at NCTU, to join the project as a co-leader [5]. At this time, Lin was the director of the Brain Research Center at NCTU. Lin's work with EEG testing and devices was a logical addition to the project team.

In an email to Grigolini in November of 2005, Winsor is hopeful that a National Science Council (NSC) proposal (now the Ministry of Science and Technology, MOST) will be submitted before the end of the year. Winsor anticipated the grant beginning in July of 2006. Included in the proposal is an invitation for a researcher from the collaborating institution to be in residence at NCTU for one or two years [6].

There is no evidence that this proposal was funded by the NSC. There is no research or test data on any Winsor hard drives. There is evidence that Gringolini received funds from the Welch foundation and the Italian government. This information was needed for the NSC grant process [7].

When Winsor returned home for the holidays in December of 2005 he scheduled a meeting with the researchers of the Center for Non-Linear Science Research (CNS) at the University of North Texas. Winsor played examples of the MYST instrument and explained sieve theory principles with this group. These scientists were to supply the data mining expertise to the submitted proposal and made several suggestions as how the testing was to be accomplished.

In May of 2006 Winsor wrote a paper entitled "*The Therapeutic Effects on Physiology of Algorithmically Generated Musical Complexity: and Interactive Mind—body Model.* This paper refers to researchers at the C.A.V.E., the BRC of NCTU, the CNS at UNT, and the Italy Center for Complexity Studies of the University of Pisa working for "the development of the algorithmic and analytic bases for the study of interaction of sound with human physiology." Winsor lists four main purposes of this research consortium:

(1) To set the scientific foundation of Biofeedback and Music Therapy through a coordinated research effort that implies the joint action of Complexity theorists, music composers, and therapists, with the assistance, cooperation and control of professionals in the field of brain physiology.

(2) To improve the algorithms used by neurofeedback therapists. Special attention will be devoted to maintain in the feedback signals the renewal events that are essential for an efficient transport of information from the feed-back signal to the brain.

(3) To design algorithms to adapt algorithmic music composition to the patient's brain complexity in real time.

(4) To create an automatic anti-depressant portable device. The technology of the NCTU Brain Research Center is advanced; its brain-computer interface expertise

is expected to turn the results of this research into the anti-depressant portable device in a relatively short time [8].

A little over a year later, in June 2007 a paper was published by this research group in Physical Review E, an electronic physics journal. The paper is entitled "Brain, Music and non-Poisson renewal processes [9]." Six authors, including Winsor, are listed representing UNT, NCTU and the University of Pisa. Winsor's description of MYST from the NSC grant proposal is included and although it is not labelled by name. MYST is referred to in Section V of this paper which is entitled "Analysis of Music Composition." The conclusion of this section is "that music composition shares the same properties as the EEG signal analyzed in Section IV. This suggests that both human brain and music composition, sharing the condition $\mu < 2$, are complex systems that, in the absence of the exponential truncation, would violate the ergodic condition."

If nothing came of the NSC grant proposal, Winsor's efforts to involve NCTU in an international research project were successful. While the published article does not detail the use of MYST, or include any specific test data, the consideration of the complexity of music composition and its measurable EEG data was exactly the type of research Winsor was hoping to initiate.

There is also evidence of a graduate student (Jenny Ren) at NCTU doing initial research work with the Brain Research Center (BRC) in 2006. This indicates that a Music Therapy Group had been created in the BRC and study involving Classical and Rock Music examples had been initiated as a collaborative project with Music Technology students and students of the BRC [10].

In the submitted grant proposal dated December, 2005 Winsor gives a detailed description of the audio component of the research project: MYST, the Audio Research Instrument [11].

4. MYST: THE INSTRUMENT

MYST is a virtual instrument, subtitled p(itch) spectrum enhancer, that was constructed in MAX/MSP in 2004-2005. Winsor's initial "patch" was built on a PC using the Windows XP operating system. In this description Winsor states that the instrument was designed for composition and research (At the time of this grant submission the first version of the audio portion of the computer music video Myst had been composed.). In describing the research functions of this instrument, Winsor states that "MYST is capable of generating abstract sonic textures that are free from overt cultural influences." Winsor included Presets that would allow researchers to keep a record of all parameters. Using these Presets, "researchers can precisely pinpoint areas of interest in biological data for analysis and comparison with the generative parameters of the sound structures [11]."

The development of the component portions of MYST can be found in a series of sieve demos that Winsor built in MAX in 2004 [12]. These demos are labelled "step1sieves.mxb," etc., totaling 12 files. Most likely these were a pedagogical "gradus ad parnassum" for students in Winsor's Algorithmic Composition class. Winsor freely shared these demos with other instructors at NCTU indicating that he felt they were worthy to be used as a pedagogical tool. While Winsor was very interested in the sieve theory of Xenakis, the labelling of these MAX patches as sieve demos is a bit misleading. A single logical sieve (Figure 1.) is indeed, the basis of each patch but not necessarily the focus of each patch. Instead, a number of the patches display many of the component parts that are found in the MYST instrument.

The patches that impact MYST are:

Step 1 patch: uses a logical sieve with moduli control from 2 to 127.

Step 2 patch: adds a lowest sieve pitch control.

Step 4 patch: adds periodic waveforms and an oscillator external (created by Eric Lyon) [13].

Step 5 patch: add Rhythmic Density controls for random and constant rhythms.

Step 8 patch: adds the Max vst object.

Step 10 patch: adds random waveform selection changed by metro object.

Step 12 patch: adds microtonal frequency shifts.

The Step12sieves.mxb patch displays all of the additions made to the sieve demos (Figure 2.).

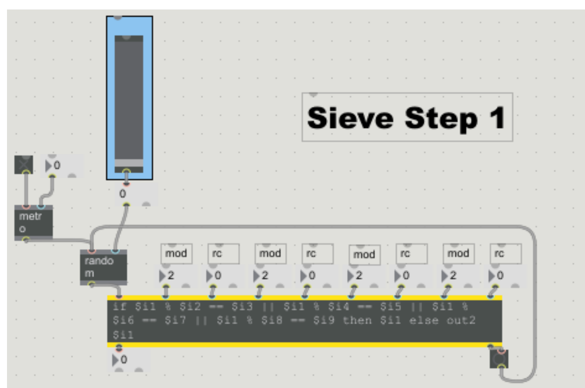

Figure 1. Step1sieves.mxb including if-then-else statement.

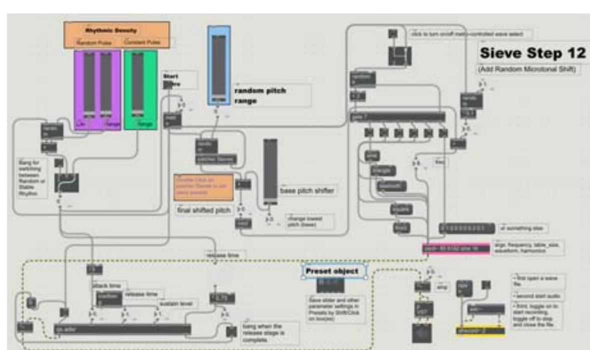

Figure 2. Step12sieves.mxb

4.1 Evolution of the MYST Instrument

Researching the MYST instrument revealed its evolution. Winsor's hard drives yield a multitude of builds that begin in late 2004. It begins with a 50 Oscillator patch with an ADSR envelop, followed by 32 builds of the AR Gen subpatcher (which include work on the random rhythms to sieves switch in the Rhythmic Density patch) and 2 sieve test patches. The MYST instrument is later referred to as MegaMYST and includes 15 different builds in the first half of 2005. Subsequent versions revert to the MYST name and include several builds dealing with correction in the tuning portion of the patch.

The last version of MYST found on Winsor's hard drive is dated 6/12/2005. This is the patch version that has been edited by the author. This version does not include the Master Transpose section found under the Low Pitch Oscillator Presets. The MYST patch presented by Winsor in his writings about the instrument always includes the Master Transpose matrix (Figure 3). This version is not found on any of Winsor's drives.

Range and Register Controls" section has two faders; one fader controls the pitch limit range (the lowest note to pass the sieve) and second fader controls the total pitch register. Each oscillator has a five octave "Low-Pitch Oscillator Preset" that can be written to if the users wish to develop their own presets.

Every oscillator has a set of controls for "Rhythmic Density". A random setting lets the user define the range of values and the shortest rhythmic value. Utilizing an interesting programming approach, a Sieve Map option allows the user to select one the preset pitch sieve types and use the pitch sieve to supply rhythmic values.

Articulations are controlled by an "A(ttack) and R(elease) Gen Ramp Time" object that controls the length of the articulations in a range from 0.1 to 1, corresponding to short and long articulations. Individual oscillators have gain controls that can be set to a constant level or randomized across the range of rhythmic values supplied by the range of the "Rhythmic Density" portion of the patch. Again, Winsor uses one element of the patch

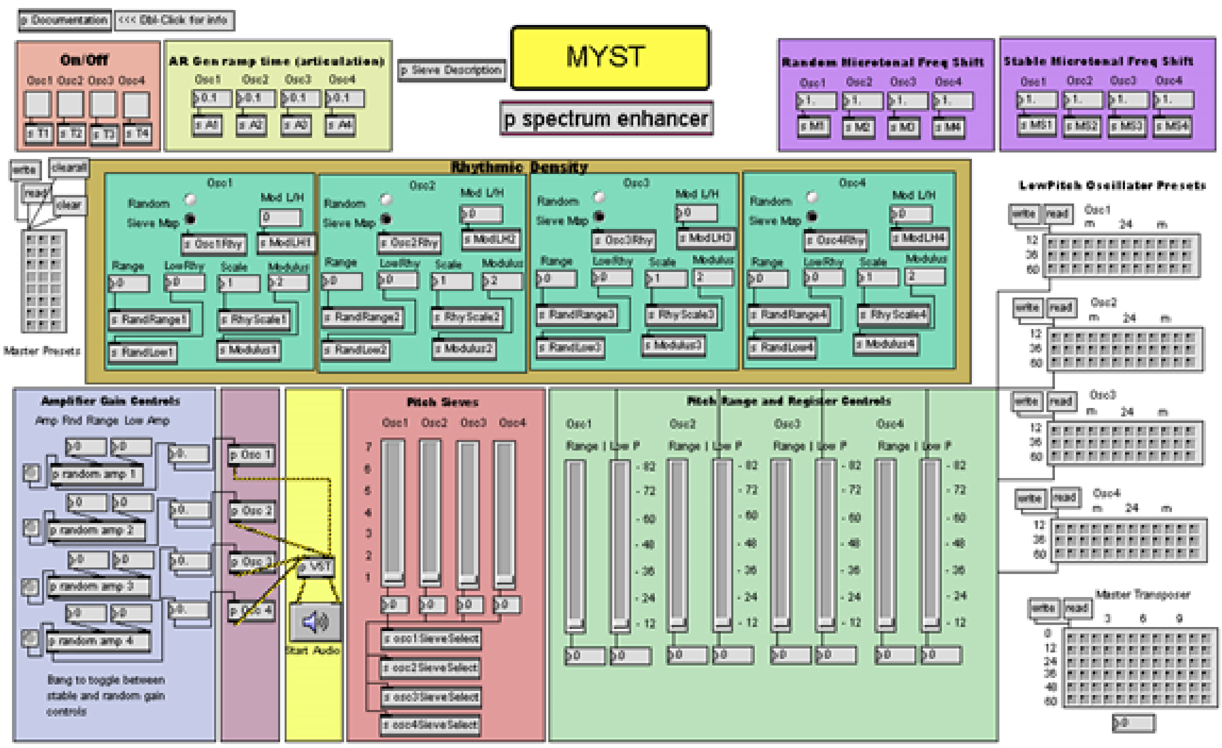

Figure 3. MYST the Instrument, Control Panel.

4.2 MYST Controls

MYST makes use of four oscillators that, in addition to providing the usual periodic waveform types, can produce complex timbral spectra. Winsor makes use of fractal and stochastic algorithms and logical sieves to develop the sonic structures. Pitch is controlled by seven Logical Sieves that are preset within the patch. The "Pitch Sieve" types include intervals (perfect octaves, fifths and fourths), scales (whole tone) and vertical sonorities (clusters, triads and dominant seventh). Sieves may be linked together to produce larger pitch collections. The "Pitch

to control another, in this case, rhythm is used to control gain.

The dates of various builds of the "Random Microtonal Frequency Shift" section of this patch seems to indicate that this was the last addition to MYST. In his writings concerning the control parameters of MYST, Winsor does not go into detail concerning the microtonal controls. Referring to MYST's real-time control, Winsor states, "Various types of redundant patterning can be established prior to and during the transmission of audio data to the test subject. For example, just intonation and microtonality controls are built into the instrument, so that the researcher can moderate the harmonic content of the texture at any given point…[11]” Random and stable microtonal frequency controls are provided for each oscillator in the patch.

A vst object (a third-party MAX external) has been included to allow VST plugin effects to be added to the instrument. It is not known if effect processing was deemed necessary for the research instrument or if the processing was added for the composition/performance version. It is included in all of Winsor MYST builds.

The MYST interface allows users to gradually move between constant (or stable) states and chaotic (or complex) states. Winsor writes, “This allows control over the redundancy of time-point and pitch/frequency patterns in a hierarchical framework.” While a subject being tested via an EEG, the harmonic content can be adjusted to create shifts in the “harmonic data stream. [8]” This corresponds to the entropic work of Grigolini. Winsor sums up this characteristic saying “we can infinitely control the degree of complexity via overlapping, phase-modulated patterning of melodic, harmonic, rhythmic, and texture-density data.”

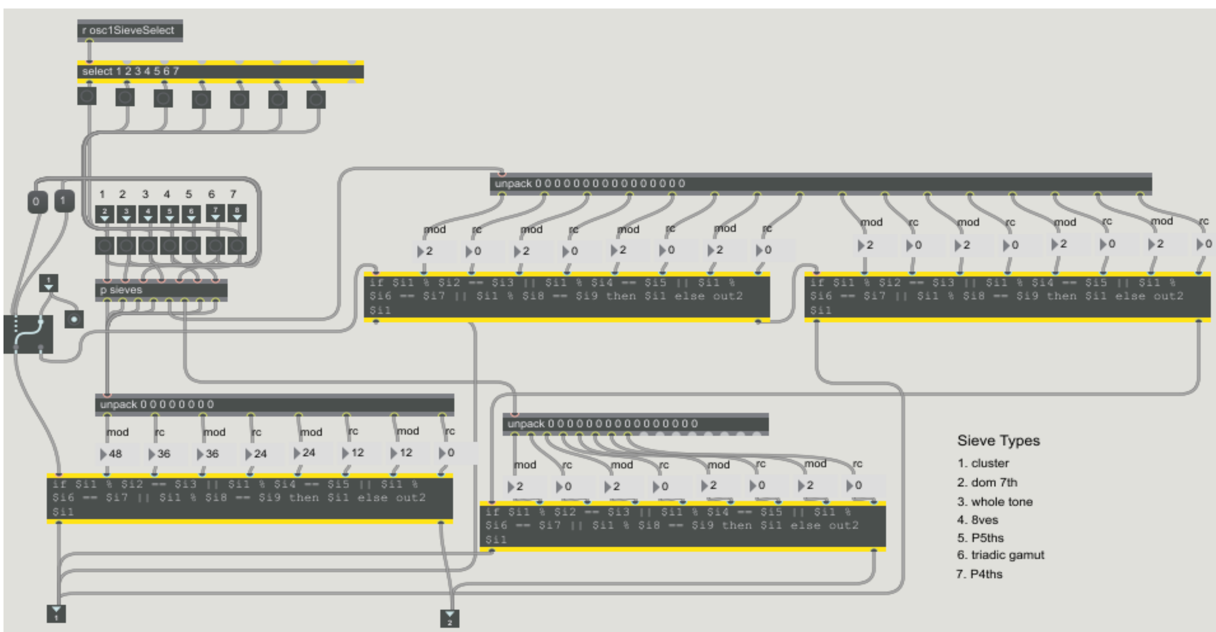

Figure 4. The Sieve Select subpatch.

4.3 Beyond the Control Panel

The Control Panel displays two subpatchers: one for the Amplifier Gain Controls and another for the oscillators. The Osc subpatch, which has one subpatch for each of the four oscillators, contains most of the generative aspects of the instrument. It also includes the Sieve Select subpatch which contains the same if-then-else statement found in the Step1sieves.mxb patch (Figure 4).

The If-Then-Else statement used in the Step1 sieve demo and the Sieve Select subpatch follows:

```
if $i1 % $i2 == $i3 || $i1 % $i4 == $i5 ||
$i1 % $i6 == $i7 || $i1 % $i8 == $i9
        then $i1 else out2 $i1
```

Encapsulated in the Sieve Select subpatch is the Sieves subpatch. This contains the moduli and residual classes for each of the seven sieve structures preset in the MYST instrument (Figure 5).

Each Osc subpatch contains Rhythmic Density Controls, AR Articulation controls (called ramp here), a metro object, an oscillator low pitch fader (called base pitch shifter here) and pitch range fader, oscillator select function and the oscil object. It also has the pitch sieve to rhythm mapping control. The similarity of this subpatch (Figure 6) to the Step12sieves.mxb patch (Figure 2) is obvious with the exception of the replacing the ADSR envelop in the sieve demo patch with the AR Generation controls in MYST.

Once the sieve selection is made on the MYST Control panel a message is sent through the Sieve Select subpatch to the Sieve subpatch. That, in turn, selects the modulus and residual class sent to the if-then-else statements in the Sieve Select subpatch. Successful If-Then evaluation will be sent to output 1 of the subpatch; Else evaluations will be sent to output 2.

As stated earlier the MYST Control Panel contains a vst subpatch. Winsor did not specify a particular plugin for the instrument. There is a VST folder inside his MYST Builds folder and it contains the GRM Tools plugins as well as the ANWIDA Soft DX Reverb Light. The ANWIDA Reverb is found most often with the MYST builds and has been used by the author when testing the instrument. While a plugin might have been used when the MYST instrument was used in a stand-alone fashion, when used to generate a musical work it is conceivable that Winsor would have used processors contained in Adobe Audition 3.

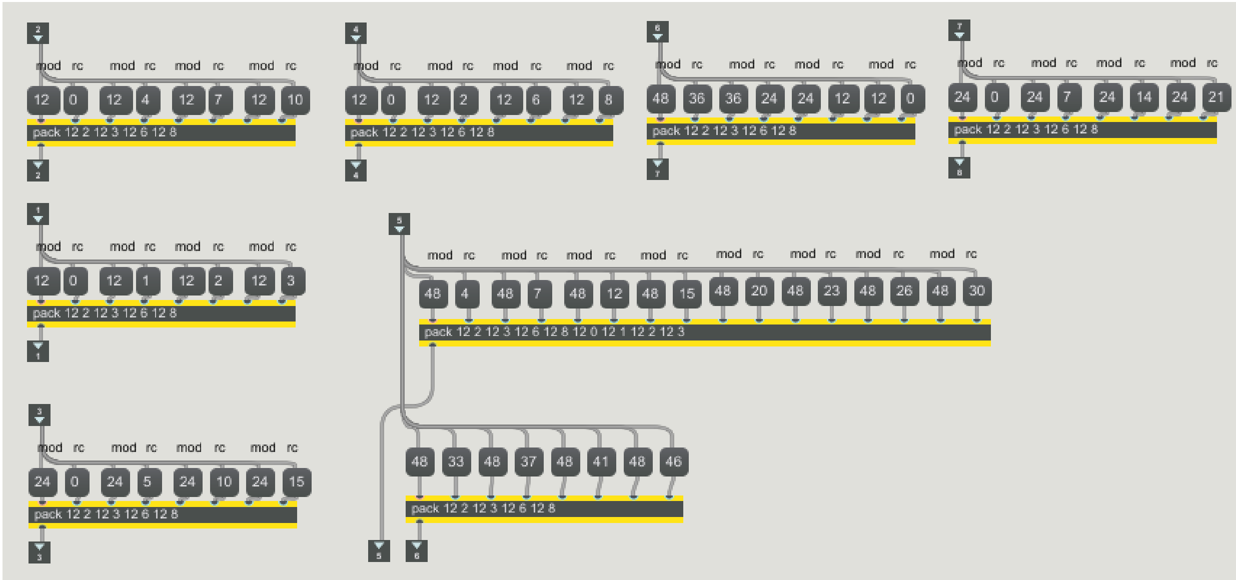

Figure 5. Contents of the Sieves subpatch.

The seven sieve types as displayed in the subpatch above are:

2. Dominant 7ths

4. Whole tone

6. Octaves

7. Perfect 5ths

1. Clusters

5. Triad gamut

3. Perfect 4ths

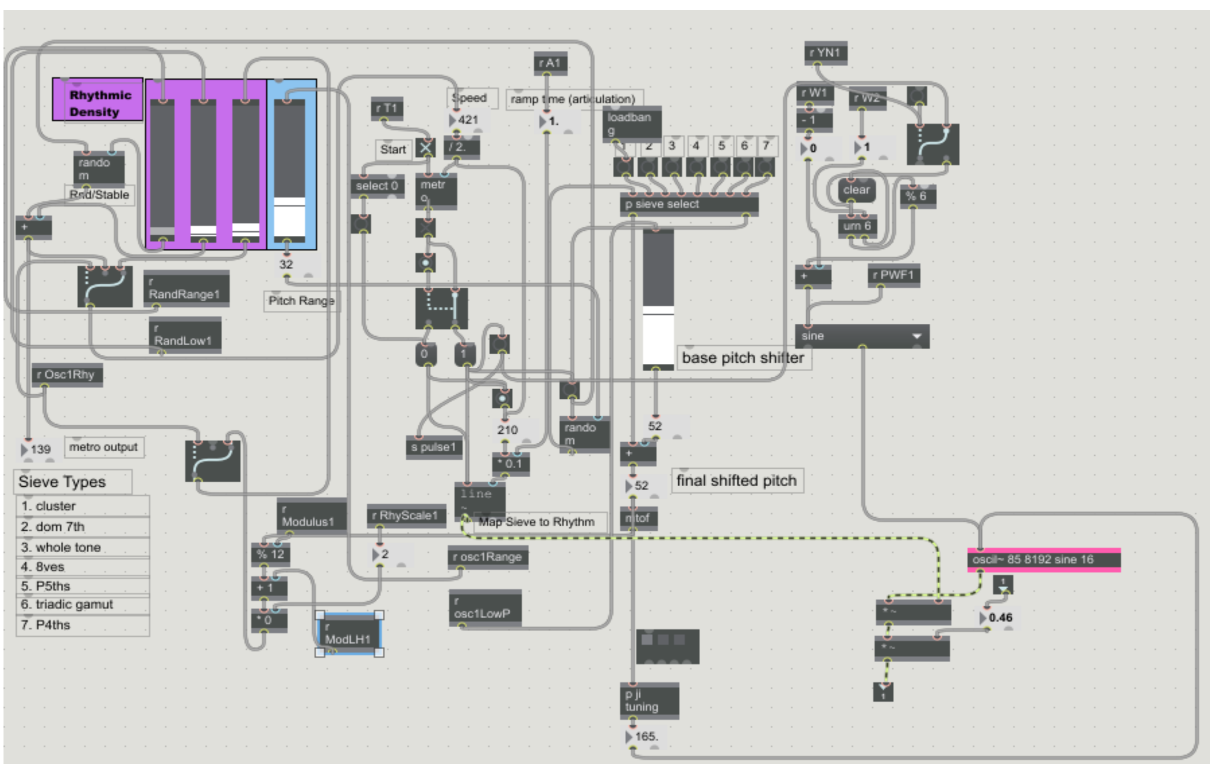

Figure 6. Osc subpatch.

5. *MYST:* THE INTERMEDIA WORK

5.1 *Myst,* the Video

Myst, like many of Winsor's work during this period was based on a fractal video of his own creation. In a letter to Georg Woezer, from the Stuttgart Stattliche Hochschule fur Music Winsor briefly describes his compositional techniques for video works:

"For the past several years I have concentrated mainly on composing computer music videos. I use Fractal animation software to generate abstract imagery, then use an algorithmic procedure I think of as "video granulation" to redistribute the individual video frames according to selected probability distributions. Then I construct the digital audio tracks (usually) using algorithmic congruence to make a connection with the video concept. [14]"

This author has examined this aspect of Winsor's technique in a paper concerning three computer music videos based on Formosan Aboriginal Legends.

"By 2005 Winsor had begun to use computer-generated video material in his multimedia works. Winsor became interested in fractal manipulation as the source for his later video works. He would combine both fractal stills and fractal animations that were generated in ChaosPro, a popular fractal generating program. He would make extensive use of zoom, pan and rotation to "move" inside the fractal images. The fractal images would be imported into Abode Premiere where most of the video animation was accomplished. Unlike many fractal videos that often just present the unfolding of a fractal image, Winsor "layers" his images which present the fractals in a kaleidoscopic multi-level framework. This technique is found in this work and most of his late fractal-based videos [15]."

Also noted in this earlier paper was the use of the MYST instrument in the audio revision of the computer music video *Ritual of Enemy Heads* in 2008.

A comparison of Winsor's hard drives and his burned back-up CDs and DVDs yields several versions of *Myst* videos. Five disks contain *Myst* computer videos (Video Disks (VD) 27-31 as catalogued by the author.). VD 29 contains *Myst2* which contains a different video than other versions and is 5' 29" in duration. It is dated 12 02/2007. VD 30 is an additional copy of VD29.

Myst3 is found on VD 27 and 28. There are two dates on VD27, 8/16/2005 and 2/3/2007. The disk is labelled MASTER and the duration of the work is 7'55." The version found on VD 28 is labelled 2007 and the duration is 7'45." VD 31 is labelled *Myst4*, however, the DVD is defective and only 3'20" of the video is playable.

Winsor's hard drive yields a folder labelled "MYST4 Files." This folder does not contain a *Myst4* video but does contain a *Myst3* .avi file. Other folders contain a *Myst2* version that utilizes the same video as *Myst3* and *Myst4* and a working version of *Myst4.* The dating of these versions on the various storage media leads the author to believe that *Myst4* was the version intended for performance.

Myst begins with 15" of music without video before the viewer peers through a classic Fractal shape, generated from the Mandelbrot set (Figure 7). This shape returns several times through the video. It fades in at 2' 02", 3' 12" and 5' 08." It is unusual for Winsor to repeat such an easily recognized fractal shape. After the empty fractal shape at the beginning, each time the Mandelbrot shape returns it is same.

The first iteration fades from front to back the two subsequent iterations fade from back to front. As is usual in Winsor's fractal videos there is little attempt to "orchestrate" the video events. The three Mandelbrot events listed are not coordinated with changes in the harmonic content of the audio track.

Winsor is constantly combining images that move away from the viewer (rarely against a static background). These are contrasted with images that move forward or from side to side. This work is constructed of several "mini-scenes" which use fade-outs and fade-ins to divide the video. The kaleidoscopic multi-level framework is quite evident in the video portion of *Myst* (Figure 8). To balance the music-only introduction Winsor continues music for 15"-16" after the final video fade.

Figure 7. Opening of *Myst* Video.

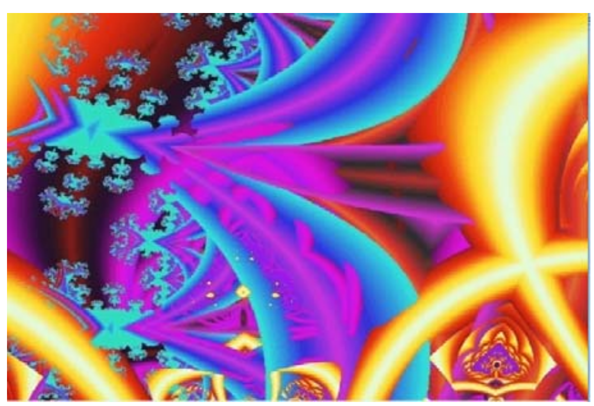

Figure 8. Fractal kaleidoscopic example.

5.2 *Myst,* the Audio

Winsor produced three different audio tracks for *Myst* that are numbered *Myst2, Myst3* and *Myst4*. The video content of all three versions is the same, however, *Myst2* uses a different harmonic progression and different waveforms than those found in *Myst3* and *Myst4.* The changes in *Myst3* and *Myst4* have to do with Winsor's audio processing of the material.

In *Myst2* the rate of harmonic change is much faster and as a result the sensation of harmonic stasis is greatly reduced. *Myst2* has the greatest dynamic range of the three versions. Winsor reduced the dynamic range a small average amount in *Myst3* and an even greater average amount (-3 db) in *Myst4.* A comparison of dynamic statistics is found in Figure 9.

Myst2		Myst3		Myst4	
Eq-Loudness:	-13.16 db	Eq-Loudness:	-12.54 db	Eq-Loudness:	-17.44 db
Loudness:	-13.97 db	Loudness:	-12.42 db	Loudness:	-17.38 db
Max:	-6.39 db	Max:	-7.05db	Max:	-12.51 db
Average:	-15.39 db	Average:	-13.36 db	Average:	-18.24 db
Clip %	0	Clip %	0	Clip %	0

Figure 9. *Myst* dynamic comparison.

In addition to the reduction in level in the three versions Winsor also manipulated the stereo spectrum of the audio material reducing the stereo spread in *Myst 4*. A phase analysis of *Myst2* and *Myst4* displays this difference in the spatial aspect of the stereo spectrum.

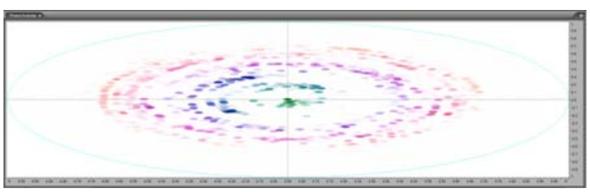

Figure 10a. Phase analysis of *MYST2*.

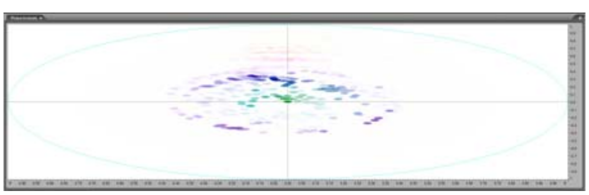

Figure 10b. Phase analysis of *Myst4.*

It is not clear why Winsor reduced either the dynamic level or the width of the stereo spectrum for *Myst4.* It may be conjectured that the rather static aspect of harmonic change was best served by a more "concentrated" approach to the stereo imaging so that sound would seem to emanate from the center of the video image. The audio of *Myst4* has a better dynamic balance than *Myst2* but Winsor could have made better use of the available headroom since the level is quite low, averaging -18 db.

Since the material in *Myst2* is not related to the other versions of *Myst*, the discussion of dynamic range processing will be limited to *Myst3* and *Myst4.* The difference in dynamic range in the different versions of *Myst3* and *Myst4* is demonstrated in the following examples.

Winsor uses little or no dynamic processing on *Myst3*. If a compressor was employed the compressions ratio was very small, perhaps 1.25:1, which would be typical for the mastering of an audio file. The speed of the attack portion of the compression envelop would seem to be relatively slow to allow for the attacks of pitches to be unprocessed. In *Myst4* it seems as though the ratio and attack values are about the same but the threshold for the compressor was set lower.

The difference in dynamic range is due to the lack of gain in the output stage of the compressor. This would have restored the gain lost in the compression process. Winsor also changes the time of the fade-in and fade-out in *Myst4*, opting for a faster fade value in this version.

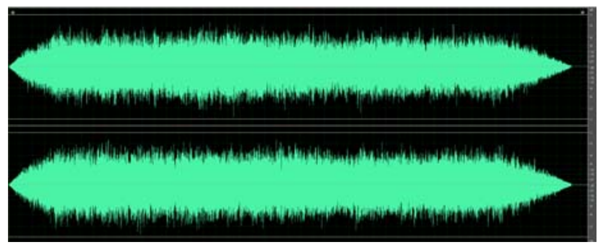

Figure 11a. Waveform image of *Myst3.*

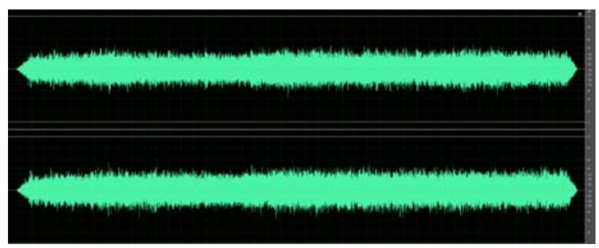

Figure 11b. Waveform image of *Myst4.*

The oscillators that Winsor employs in *Myst2* make use of more complex periodic waveforms and as a result has the largest frequency range of the three versions. In *Myst3* and *Myst4* Winsor deliberately limits the high frequency content.

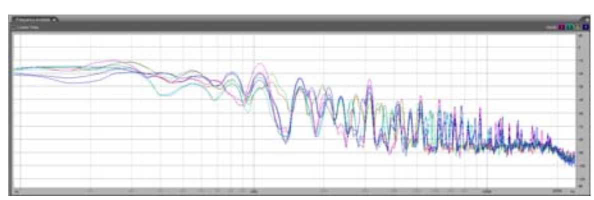

Figure 12a. *Myst2* frequency graph.

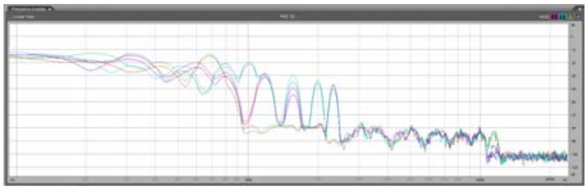

Figure 12b. *Myst3* frequency graph.

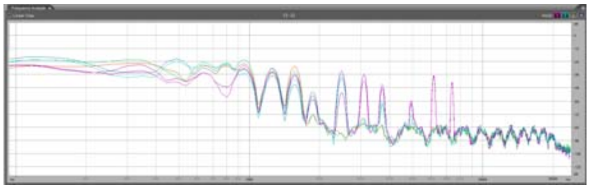

Figure 12c. *Myst4* frequency graph.

It is theorized that Winsor placed a low-pass filter in-line on the Master output of the virtual console in Adobe Audition 3 (his audio editor of choice). This would account for the severe reduction in high-frequency content. This is especially evident in the frequency graph of *Myst3* (Figure 12b). By allowing for higher harmonic content in *Myst4* the high-frequency filtering is less and falls off at a higher frequency (Figure 12c).

Winsor's revision of audio material in *Myst3* and *Myst4*, includes a slower rate of harmonic change and an overt use of triadic material. He also reduces the complexity of the waveforms to more easily bring out the triadic aspects as an unfolding of the harmonic series. This can be seen in a comparison of the three frequency graphs in Figure 12. While *Myst3* and *Myst4* are quite similar and the unfolding of harmonic components is easily evident, Winsor increases the number harmonic partials in *Myst4*. This was most likely accomplished by adjusting the cutoff frequency in a low-pass filter since the musical material is the same in both versions. In both *Myst3* and *Myst4* the high frequency material above 8K Hz is severely attenuated (-84 db or more).

In all three versions the musical material is organized around major triadic harmonies. Because Winsor used the same material in what became the final version of *Myst, Myst4* will be the focus of his harmonic organization. The triadic harmonies unfold through time using the lower partials of the harmonic series over a drone. The lowest pitch is determined by the Low Pitch fader included for each oscillator in the MYST instrument. Winsor uses the spectral shaping aspect of MYST to accentuate different triadic members in the overtone series generally up to the 12^{th} partial but sometimes to the 16^{th} partial. This resembles the filter-sweeping technique often found in works utilizing analog synthesizers.

Winsor also forgoes equal temperament and uses the Microtonal Frequency Shift portion of MYST to initiate microtonal "shadings." This is most noticeable in the thirds of the chords that Winsor unfolds. It is also quite noticeable when harmonies overlap and "collide." Because of the consistency of the microtonal shifting throughout the work it is thought that Winsor made use of the Stable portion of the Frequency Shift as opposed to randomized tuning shifts.

Winsor makes use of three root movement types in this work: movement by ascending Perfect 4ths, movement up or down a third and movement of a tritone. Winsor makes no attempt to connect the chords in the common-practice "common tone" tradition. Instead harmonies overlap and fade in and out (easily accomplished in multitracking software). The most striking dissonances occur when a median relationship is used and the triads have dissonant tones between them. An example of this occurs between C major and A major where the cross relation of the C and C# creates dissonance. It also occurs in the movement from E major to Bb major where the B and Bb are dissonant. This is the only type of dissonance that occurs in *Myst*. A harmonic plot of *Myst4* follows in Figure 13.

The opening Bb to G "progression gives the aural impression that the listener has joined a work already in progress. The Bb section has a duration of only 4" before moving to G which as the longest section of the work could lead the listener to accept G as tonic. The root movement of G to C, however, gives a strong harmonic sense of resolution, although Winsor avoids any use of a 7^{th} with the G harmony.

Myst 4 Harmonic Plot

Key:	Bb-G	C	A	D	G	C
Location in Audio:	0"–1'04	1'04"–1'52"	1'52"–2'30"	2'30"–3'09"	3'09"–3'28'	3'28'–4' 10'
Duration:	1'04"	48"	38"	39"	21"	42"
Key:	E	Bb	E	C	Bb	E
Location in Audio:	4'10'–4'57"	4'57"–5'44"	5'44"–6'17"	6'17"–6'58"	6'58"-7'27"	7'27"-7'45"
Duration:	38"	47"	33"	41"	25"	18"

Figure 13. Harmonic Plot of *Myst4.*

Once arriving at C Winsor takes a familiar tonal path to return to C. Using a linking harmonic movement from C to A which is followed by a series of ascending Perfect 4ths. Winsor then abandons the movement by 4ths using another median relationship to establish E. Tritone movement to Bb is used to open and close the second half of the work. The final progression continues after the video giving the impression that the work is continuing and the listener has been left behind. Speculative perhaps, but the balance created by the use of music before and after the video seems quite effective.

6. CONCLUSIONS

Not every seedling bears fruit. With the establishment of the C.A.V.E. Winsor felt that NCTU was laying the groundwork to take the lead in computer composition and computer music research. To reach that goal Winsor felt, in part, it was imperative to establish a number of research partnerships with established institutions in the computer music field. This is clearly stated in the Mission statement of the C.A.V.E. Of the research proposals that were suggested, Winsor gravitated to the proposal involving the University of Pisa and Paolo Grigolini. Since Grigolini was also on the faculty the University of North Texas, Winsor was familiar with his research. This project would also allow Winsor to enlist the assistance of the NTCU Brain Research Center because of their work with EEG testing. Unfortunately, there is no evidence that this project was funded, and the initial research conducted with the Music Therapy Group of the BRC is introductory. In those initial studies the MYST Instrument was not used. Because of this it is not possible to assess the performance of the MYST instrument as a research tool. Nor can any of the research premises put forth in the Grant Prospectus be evaluated.

On the other hand, Winsor created an instrument whose very controls give insights to his aesthetic approach and compositional methodology. One stated goal for MYST was to generate “abstract sonic textures that are free from overt cultural influences.” Winsor believed that the linguistic models being used to shape musical form was an organizing paradigm that had long lost its expressive capability. There is no formal organization implied in the output of the MYST instrument. Winsor was interested in the sieve theory of Iannis Xenakis and the ability of sieves to be used as filters. He had earlier investigated using logical sieves to extract harmonic and melodic material for computer composition and interactive, generative game music. In MYST sieves are used to generate the pitch information and pitch sieves can be linked to the rhythmic output of the instrument. The random elements of MYST also reflect a constant in Winsor’s music, the use stochastics’ as an organizing element. Random options for rhythm, tuning and amplifier gain are built into MYST.

Myst, the computer music video, does not make use of MYST as a real-time instrument. Instead, Winsor uses the generative capability of the instrument to generate the minimal, harmonic based material to accompany the fractal video. It is a reflection of the parameters of the MYST instrument:

1. Harmonic material generated by the sieves unfolds through time over a drone created by the Low Pitch Register control.

2. The constant rhythmic pace which adds to the harmonic sense of stasis is contrasted by the use of random elements.

3. These random elements are used to control the gain so the harmonic unfolding has changing dynamic levels. This is evident in the unequal volume of in the temporal unfolding of triadic material.

4. The microtonal shift creates an element of temperament tension as what should be familiar intervals are slightly “out of tune.”

MYST the instrument and *Myst* the computer music video are both successful in concept and execution and further evidence of Phil Winsor’s restless need for creative advancement.

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