Sonic Morphologies

by Jonathan Philip Axelrod

This paper is focused on math, science and art, and reveals how recording is used in each stage of creation which leads to the finished work. Even the most improvised line has a pre conception. In this way the mind is always writing and transferring the recording of thought into action and space. These works explore how thought is transferred into gesture with a form of code that is symbol. The show is about how fractions and ratios can be used to create a form of musical notation based on the shapes produced by various frequencies, to produce dynamic systems in art. The purpose of the show is to display art that is a musical notation alongside the music itself.

Sound has the ability to move objects, each frequency has a certain degree of motion the appearance of motion within the picture must accommodate for the foreshadowing of actions that will inevitably take place given the wavelengths and measurements. Each material within the image has a certain degree of movement, the stronger materials exhibit the least degree of motion; these contain the most mass and therefore are drawn to the bottom of the picture more by the pull of gravity. This convection results in potential energy that is created by the picture as a whole which is comprised of solid inelastic shapes, yet the fragmentation of these forms creates the possibility for the entire image to be seen as a fluid dynamic medium. The friction between forms in motion creates instances of sound, such as a bow sliding and slipping. This describes the acoustic phenomena inherent in theses forces; which are defined by the lengths and proportions of these forms in contact.

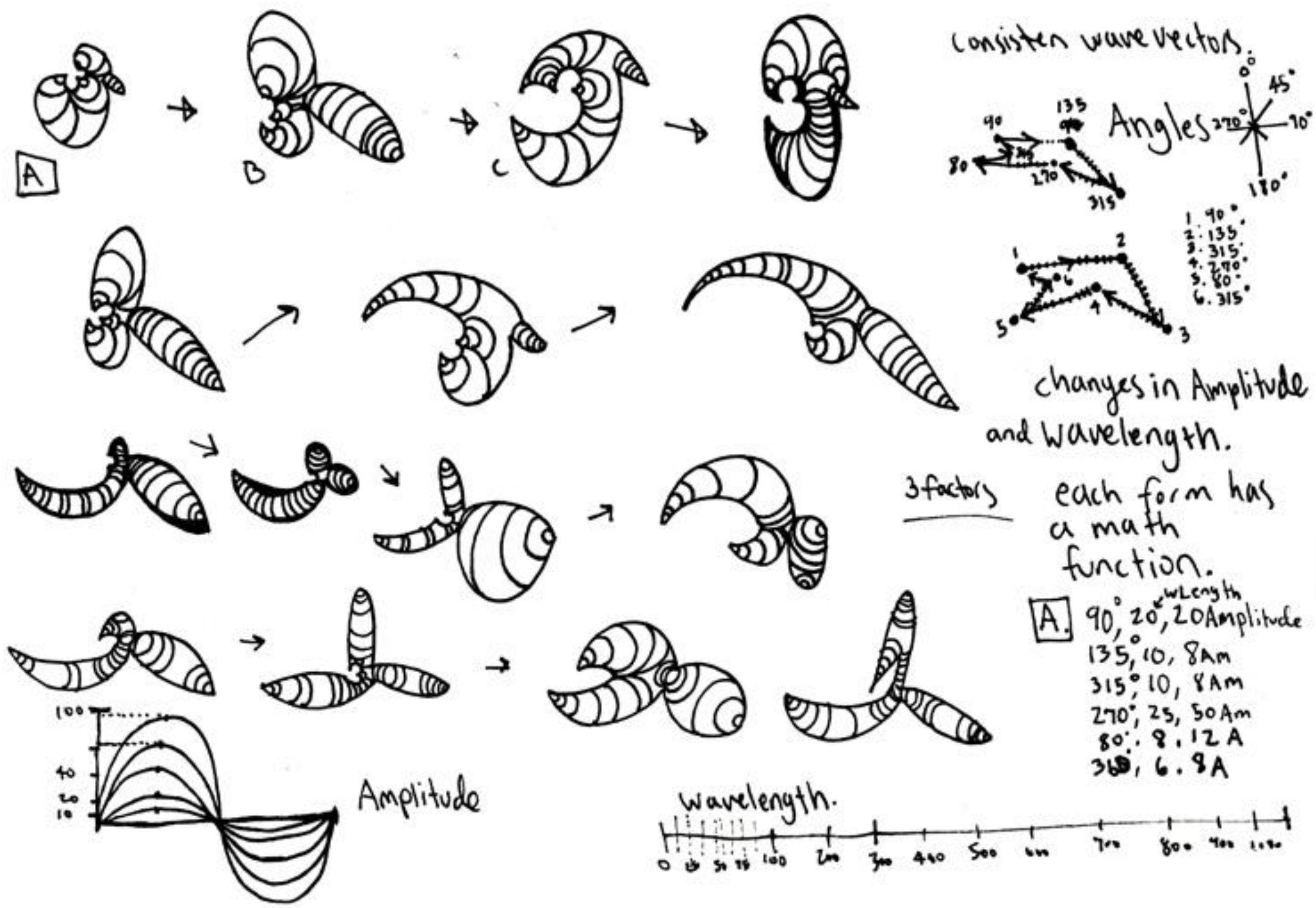
One concept is the division of forms and volumes into equal parts. The process continues as forms divide with ratios into their fundamental building blocks. These parts have even ratios, in that the measurements of the sides create relationships with whole numbers. Beginning with the smallest increment of space that can be seen at a given distance; numerological jumps are made with this length. This process can fragment an ambiguous form into its primary geometric forms which become parts of a set; which bears an auditory potential given the relationships between the primary forms within the shape being divided.

The irrational shape can now be seen as a harmonic chord between the fundamental units of space. The single wave segments are created with specific angular constraints so that the unique 2D angle of each contour creates a set with intervals. These harmonic divisions of two dimensional forms create three dimensional transformations if the divisions are geodesics. This transformation from the second to third dimension repeats at smaller and larger scales. Each geodesic line becomes itself divided by a geodesic and so on; likewise, every form itself can be seen as part of a larger geodesic and so on to the edges of the universe. The single wave segments are created with certain angular constraints so that the curve of the contour of each harmonic is created with a 15 degree interval within a 180 degree range. In this way the geodesic can be thought of as a wave function; wavelength is the diameter.

Voids become divided as well so that the subject and the background interlock with these harmonic volumes. The two dimensionality of a window frame is transformed into a three dimensional shape with divisions that are arcs which share the same curve as the contour of the window frame itself. One division of the window creates two forms; so that as the process continues, forms divide and multiply rapidly. This interlocks the space at multiple dimensions with arcs that create foreshortening. The purpose of these works is to find new ways of creating visual descriptions of measure.

Jon Axelrod 2009

Sonomorphs



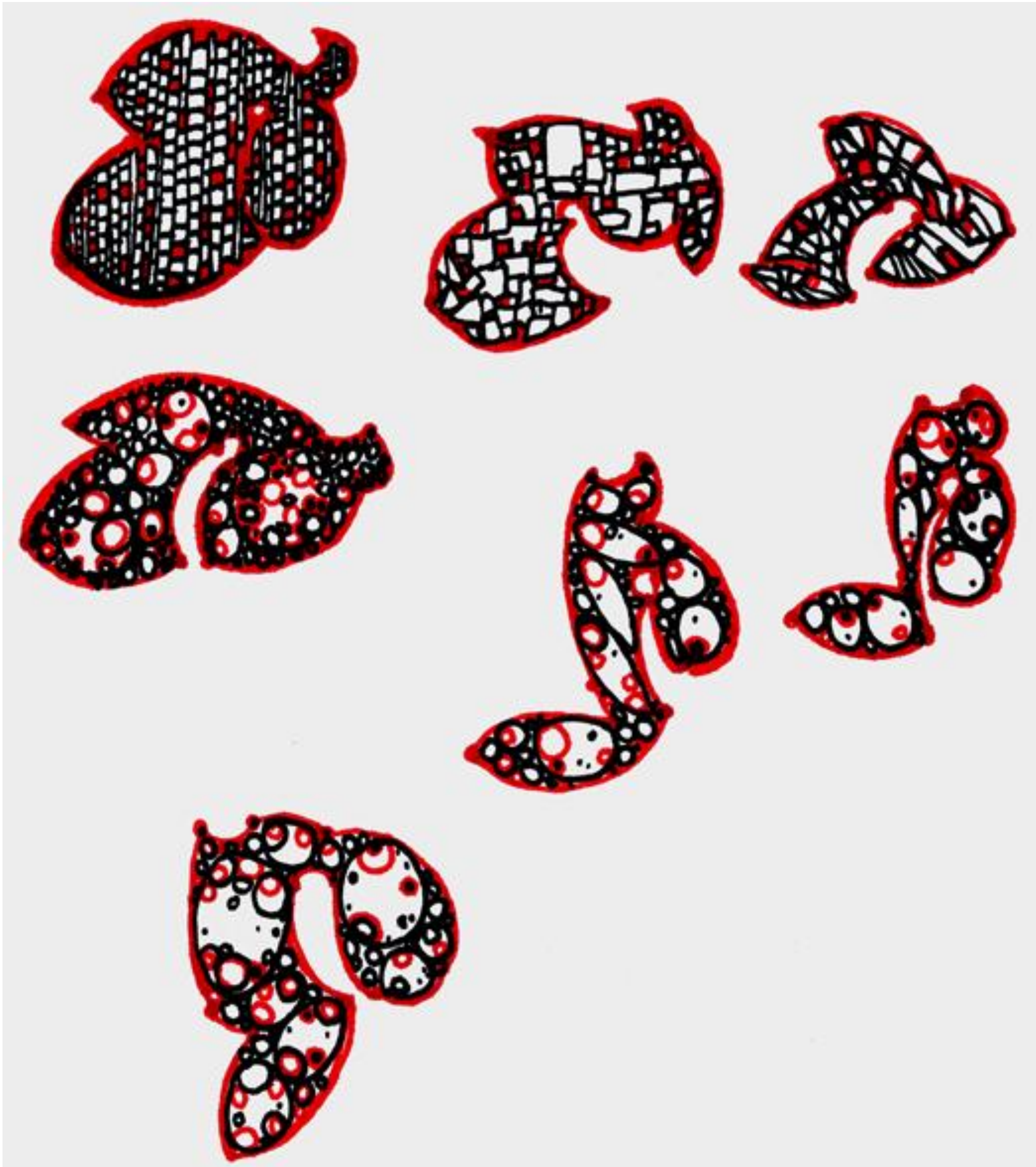
The goals of this project are to understand perceptual processes so closely that it will become possible to create math from physical space and the perception of acoustic phenomena. This code will allow one to create musical phrases and manipulate forms with harmonic intervals, meaning that patterns such harmonic and melodic progression can be visualized.

I am interested in how wave resonance can be used to alter improvisation and thought. As well as how measurements can be used to create mathematic intervals of discrete forms. I am studying the analogy between waves of light and geometric angles that arise from the boundary limitations that these 12 tone equal temperament chromatic wavelengths create, thereby connecting angle with color. The examination is not specifically an optical or gestalt psychological study but more of a mathematic and acoustic examination to create a linguistic structure that accurately analogizes periodic energies such as sound and color with angle. The goal is to record information precisely and accurately without being arbitrary.

The goal is to create symbolic logic that can allow for the illustration of visual mathematics that can be used as quantum fraction measurements. It is about a new mathematics that can be used to write harmonic and melodic information, which then can be permutated. The result is a notation system that also contains information about the amplitudes of individual wavelengths.

By using harmonic proportion and fractions with semiotic constructs to create a grammar, more congruences between physical parts can be created. This allows for greater complexity without the interference of waves with non-proportional measurements.

Once the drawing is created it will be possible to enter the data into a digital audio workstation to alter the sequence as information and then redraw the image. It is possible for the code to be cut and the image deconstructed into shapes with their reciprocal code identified, which can then be combined and redrawn. In this way if each drawing is made from a measurement key then the scale of each drawing could be changed.



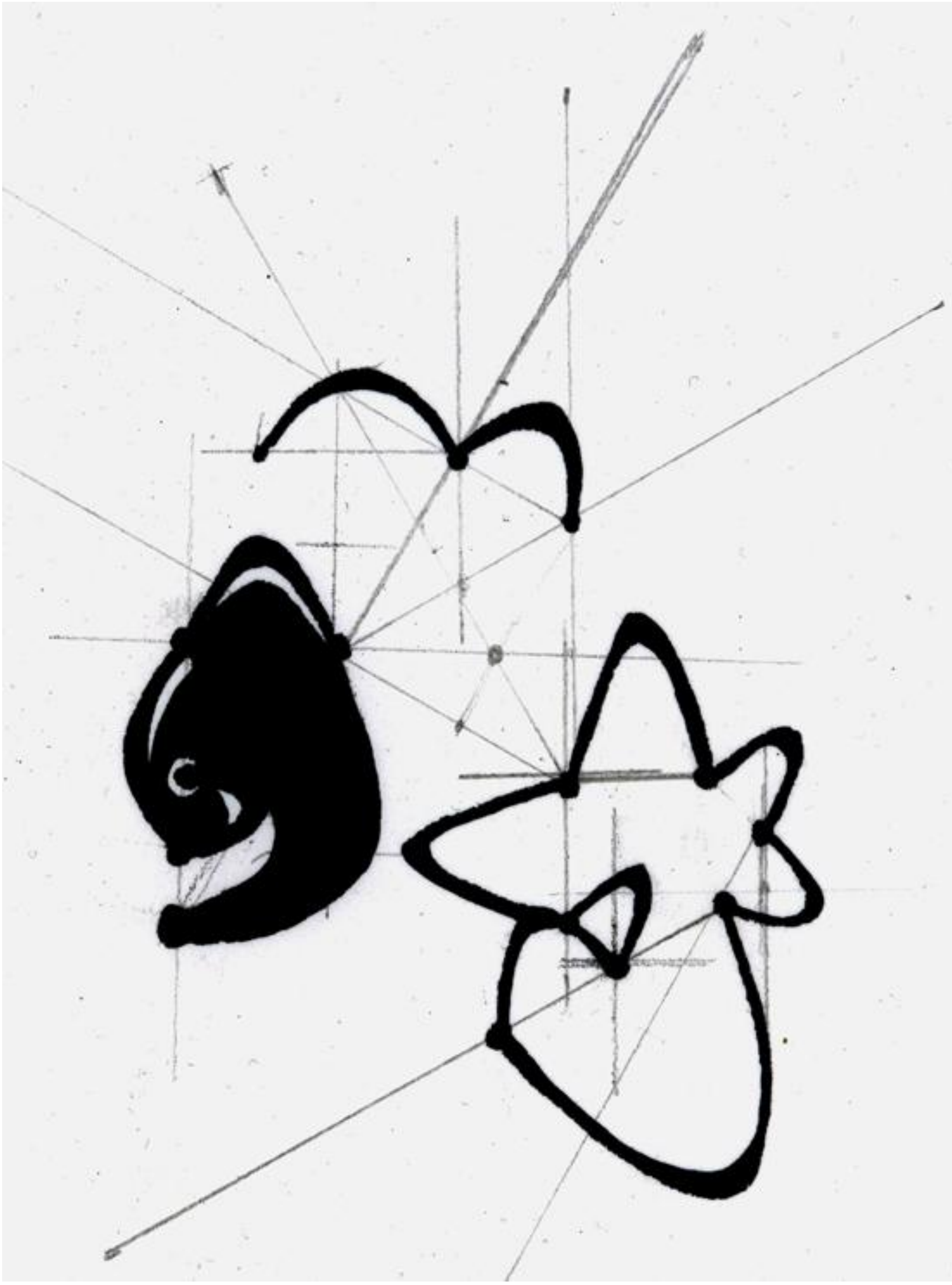
An explanation of a pitch/timing notation system.

B+W drawing system
Necessary tools
Compass
Calculator
Protractor
Strait edge
Graphite and Ink
Matrices
Chromatic Circle with chord angles, 3^{rd}, 4^{th}, etc.
Chromatic wavelength measurements for 3 octaves
Polar coordinates
Amplitude measurements

Navigational Wave Function Equations

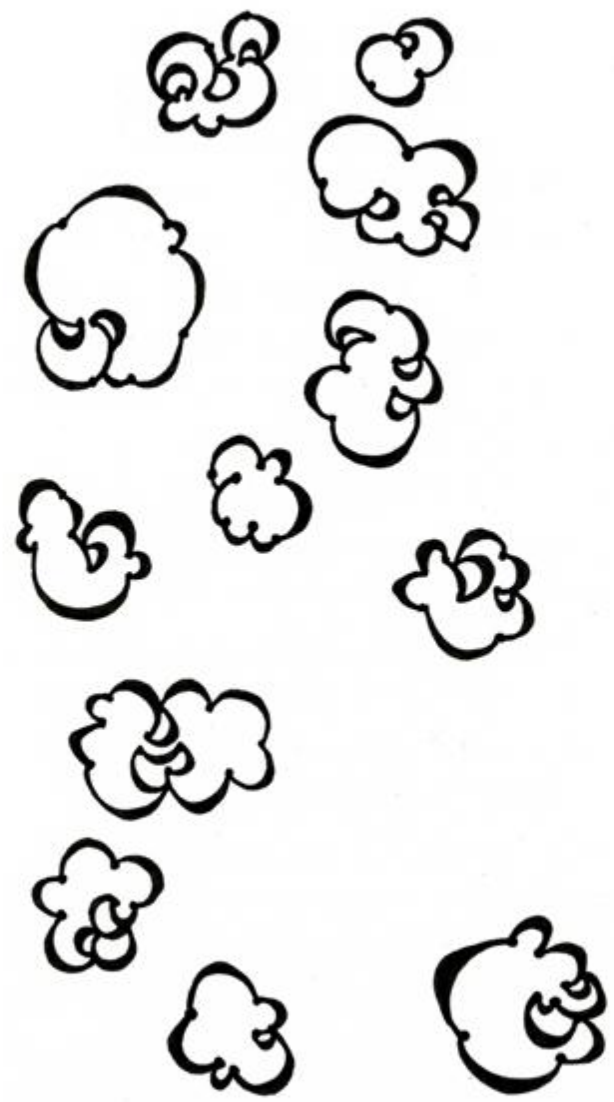
The system is essentially about navigation. It begins at a point from which all the measures originate from. This point can be anywhere in the picture, the first jump taken from this point to the beginning of a note is done with wavelengths, angles and amplitudes to reach a new point which is the location of the first wave with positive (up) or negative(down) amplitude. Zero amplitude is neutral and therefore doesn't create a wave, but it is necessary for the code to be able to traverse space without drawing a line to reach the new position.

The first sound is created by choosing a new distance which is a length based on harmonic intervals. As the line travels to this new destination it moves in an arc that is the amplitude it is also designated with interval measurements so that 1 is the same distance of G, so that G2 is precisely half this length. This allows the image to be tuned to a certain pitch so that if the notes are all in accordance with t he length of the amplitudes a new structure can be visualized and it will allow for more even fractions and the picture will become interlocked with wavelengths that are more often half the amplitude, which would allow the wave to fold onto itself in more ways as it travels through space and changes direction.



Harmonics

The more harmonic the lengths of the wavelengths and amplitudes the easier it will be to make simple or harmonic steps back to the origin, creating a closed loop that is a set of frequencies on a 3 octave chromatic scale of equal or well temperament. This will allow for a simple code to be generated as such. - Note/wavelength – Octave - Amplitude (positive (peak) or negative (trough) - and direction.



Arc to Wavelength Conversion

The wavelengths are only half of a wavelength so that the proportions are preserved but structures can be built from arcs and lines which remain positive peaks unless designated as a negative amplitude in which the arc switches from a peak to a trough. Half wavelengths can be transformed into complete wavelengths after, since the system is relative, and the octaves would be shifted by 2/1.

Fractions of Time

Chord Durations are notated with quantities of closed loops that designate durations in two ways, by transforming the timing of the clusters as such;

3 forms = 1/3 note. 1 equals a whole note, 7 = 1/7 note and so on, but to create a 128th note would be difficult, some simple arithmetic techniques are used.

Shape one = X Shape 2 = Y

$$\frac{1}{X+Y} = N$$

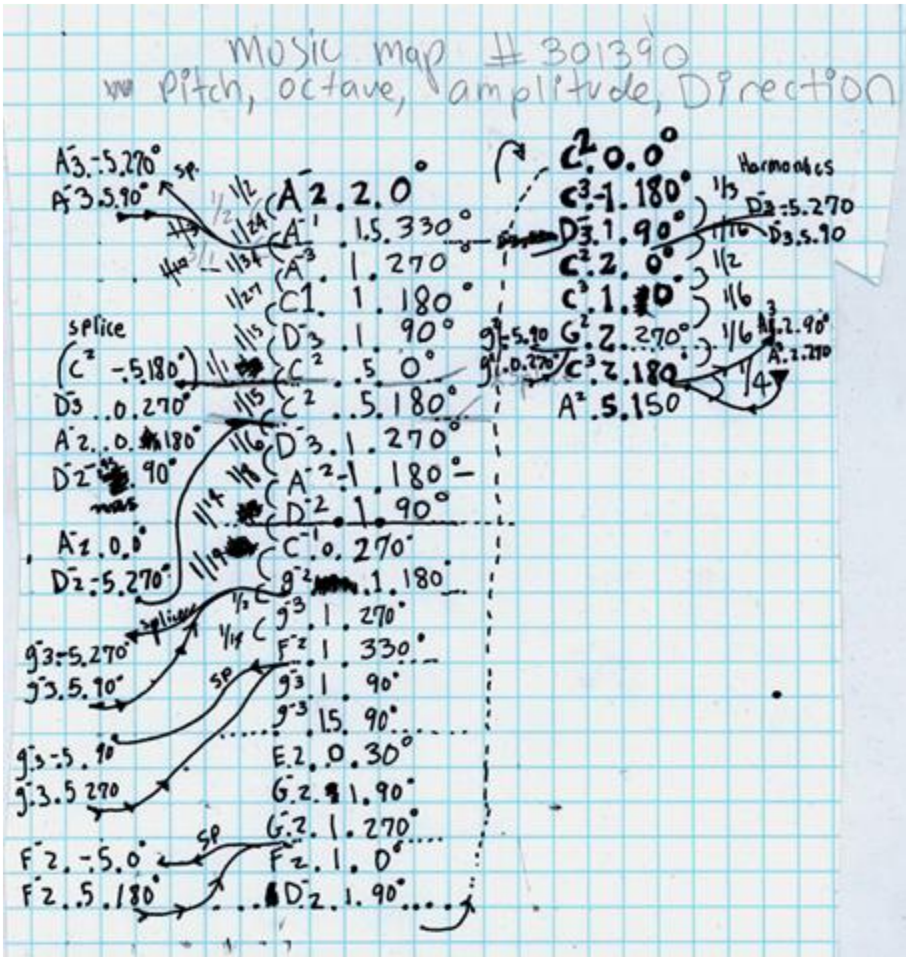
Where by N is a ½ note creating the fraction from a cluster of two.

Multiplied Time

If a note cluster is surrounded by a form that intersects 2 or more notes in the cluster then this outer form becomes the multiplier/divider symbol and both can exist together to create numbers in two ways. (However the initial note clusters also have multiplication and division potentialities, with regards to these systems) The first is the fractal time shortening equation. Its inverse is the spiral rotation time extending equation. The result is a quantified topological transforms that both edits the duration and adds a new frequency. Such as with fractals made from growing spirals from harmonic arcs one rotation at a time, this allows 128th notes to be created without 128 bits in a cluster.

Code Splicing

Each tone cluster may or may not be surrounded by an overlapped shape that connects two or more forms underneath and between. The contour of this outer form can split. To create this break in the code it must be possible to create a point that can be returned to. To do this the line splits to designate a point in space, it leaves behind a series of integers for each successive split, F1, F2, etc. At the completion of the duration transformation, the code recalls these alpha numeric symbols to return to the process of completing the loop. When finalized the equation divides the integers together producing the calculated quantity of time. The line continues writing music with arc measurements of flexible but defined fractions of time.



Spiral fraction Multiplier symbol

To create the split spiral one end can move inside the boundary of the contour, then extending back 180 degrees as a wavelength with frequency and amplitude. With repetitions of this function, spiral rotations are created. It creates the equation 2(X) for each successive arc of the spiral. Where by x is the duration of the cluster. This creates a variety of spiral morphologies, depending on variations in amplitude and the quantity of rotations. The process continues for each turn and finishes at the end of the spiral arm. The equation continues as such, the proofs and sum of the note cluster is:

Shape one = X Shape 2 = Y

$\underline{\quad 1 \qquad\qquad\qquad}$

X+Y = N

Where by N is a ½ note creating the fraction from a cluster of two.

The equation is permutated by each successive spiral arm:

$$2(N) = A$$

If $N=1/4$ then $A = 1/2$

A is the derivative used in the equation for the next rotation.

$$2(A) = P$$

The derivative of each spiral arm is calculated from the first initial note cluster fraction.

Then they can all be multiplied to always produce the same derivative. If this quotient is P and the quotient of the other fractal spiral arm is $Q=1/8$ then their function is:

$(P)(Q) = D$ or

$$1+1/8 = 1/64$$

D is the final fraction unless there is another spiral arm.

This is the foundation of the spiral duration equations. They are simply bracketed by the symbols (S1) code (S1). They create the possibility for extending the harmonic potentialities of chords by creating a system to both designate duration and pitch simultaneously. It will also allow for a wide range of pitches and timings of each form as it is drawn. The successively higher pitches of the spiral are multiplied by the original cluster and therefore can be used to extend the duration of are created with each rotation and must also contain successively lower amplitudes to wrap into a spiral. The harmonic synergistic result is widely potential as there are many ways to create timings. As to how this will alter the notes chromatically; it will mean that shorter duration shape note clusters with many spirals extending the fractions would have high frequencies. And because there are many ways to describe timings that have the same data it will allow for infinite variations in language but still retain the precision of an accurately recorded document. The reciprocal relationship seen in equivalent quantum fraction symbols is more accurately revealed with equations that are constructed from Pythagorean geometry. This geometry can be used to manipulate space in many ways to produce grammatical equivalents which will and must exist in any complex semiotic structure.

Fractal Time Division Symbols and Equations

The inverse function to shorten time proceeds as follows. The line splits like before, it travels inward one arc. It travels back 180 with the same amplitude but stops half way and extends 90 degrees with a new arc that is also 2/1. The process continues and divides the forms into progressively smaller bits that aren’t closed loops but have notes that are the maximum length that will be permitted without creating an enclosure and that will allow for further divisions.

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The *Fractal Equation* begins as follows.

Proofs and initial conditions

Order of Integers

{Note}{Octave}{Amplitude}{Direction}

F1 = Fractal Split Point   C = Wavelength   2nd = 2^{nd} Octave   A = 2 Amplitude

D = 0 Direction   X/2 = ½   X= Last Wavelength

[{C}{$2^{nd\}}$ = 2 Amplitude] $\frac{F1=V/2=Z}{2}$ = W   V= ½ = Original Note Cluster fraction

{F1}

{C}{2^{nd}}{2}{0}

V/2 = ¼ = Z

{C}{3^{rd}}{0}{180}

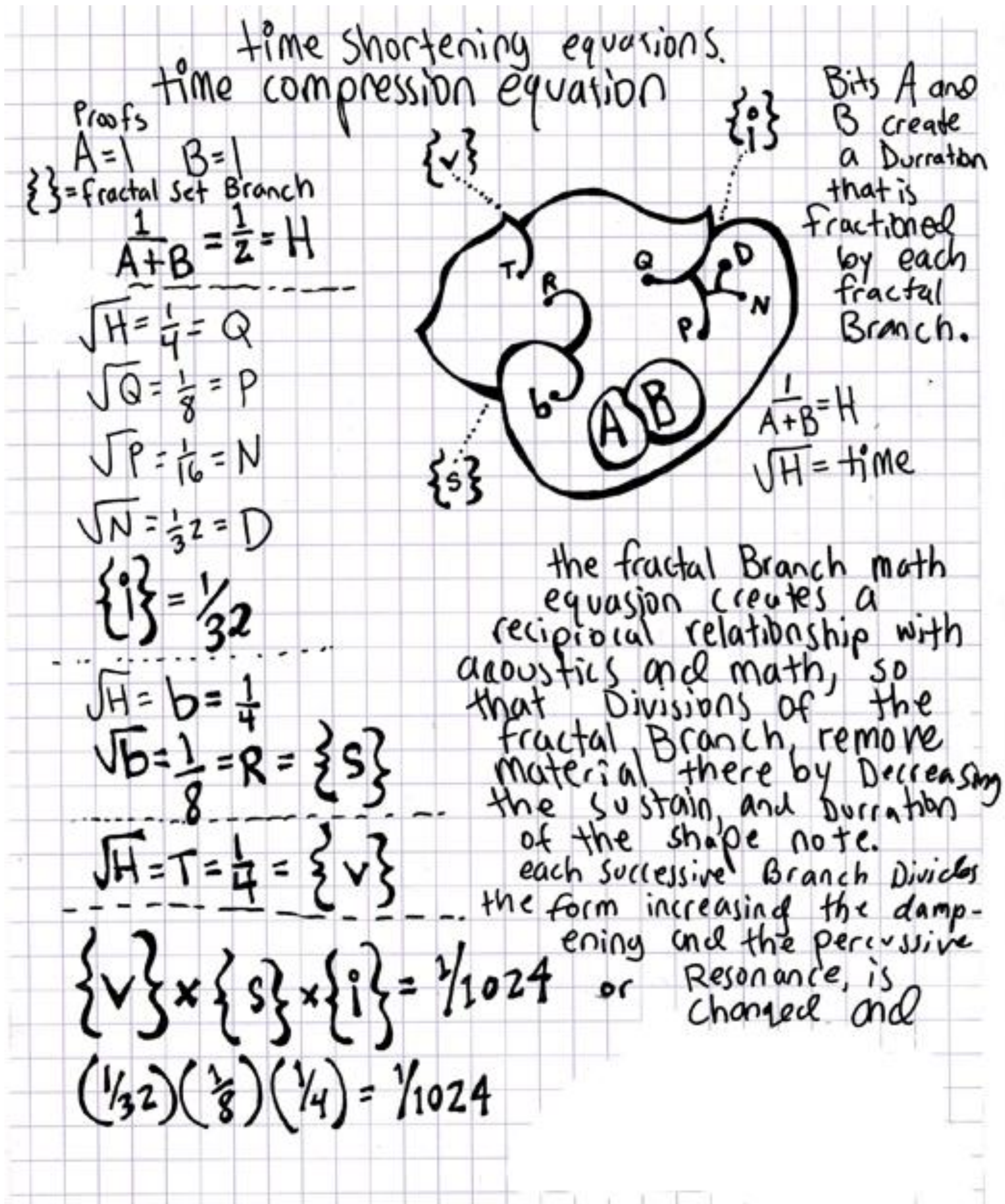
{C}{2^{nd}}{0}{90}

{C}{3^{rd}}{1.5}{180}

Z/2 = 1/8 = W

{F1}

As the process continues, it creates a fractal branching system that can be used to quantify divisions of time to create quicker notes. The symbolic logic is founded upon these mathematical divisions but like its inversion the projection into the 3^{rd} dimension provides more insight. If each fractal arm were recessed to a degree, it is pushed back an interval for each fractal branch division.



Sound and Form

Observations and experience also reveal that the shape being divided could exhibit new percussive potentials, and the divisions also imply that the form can no longer sustain long vibrations, which are dampened by these divisions. These equations allow for the initial tone cluster to be sculpted and that these sculptural transformations create a variety of potential acoustic transformations that are probabilistic but not absolutely finite. It could be possible to produce a transformation from the 2nd to 3rd dimension that is the same proportion as the wavelength thus producing the proportional matter that would cause the resulting probabilistic percussive phenomenal interval inferences. The process is repeated for each spiral arm, the derivatives of each are multiplied and the quotient is flexible in this way so a huge number of fractions can be generated. The result would be a spiral pyramid that is 2 times longer each rotation and ovoid

Chord Clusters

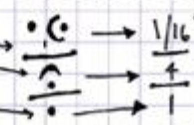
The pitches of these notes are designated by mixing all the waves of each side of a form. So, if a form is composed of just one wavelength such as G3rd octave; then the note of this form is also G 3rd octave. But if the form is composed of G-E-D then they are each played back together in equal proportions, unless the amplitudes are different then the levels of these chords must be altered proportionally with successively more or less decibels balanced at around an average. It is in a sense a chord making process because each note can potentially be combined with a large amount of frequencies at different levels. The visualization of the polytonal chromatic pitches as sets of arcs allows for symmetries between chord inversions and other strange yet to be found Mathematical relationships in music, written as an equation for both Sonic and visual art.

Combining Codes

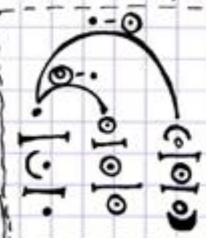
The different mathematic functions combine as one linear function beginning with the initial point of origin and then the first arc of the first shape note in the cluster. At the beginning of the first rest, the end of the first note or the beginning of the second note; the final timing of the first cluster can be calculated with the data that has been recorded thus far. The equations for the spiral and fractal would be spliced into the navigational code only after the navigational code records the cluster. Likewise the measure repetition equation system would have to precede a measure before becoming spliced into the code as well with a systematic order of integers each denoting a different function.

Translation map. for Beat clusters. transforms.

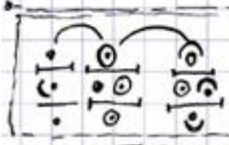
16 → 1/16th note per form
4 → repetitions
1 → Recall #



-Mix-
Three patterns that share the same start time.

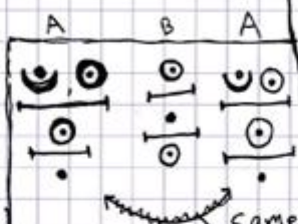


Pattern one mixes with pattern two only. Ptn2 mixes with ptn3.



$1 = \frac{1}{2} \times 2 = \frac{1}{4} \times 4 = \frac{1}{8} \times 8 = \frac{1}{16} \times 16 = \frac{1}{32} \times 32 = \frac{1}{64} \times 64 = \frac{1}{128} \times 128 = \frac{1}{256} \times 256 = \frac{1}{512} \times 512.$

Pattern of equivalence.



→ the numbers above the mix arch indicate the number of times that pattern Plays for, might not Be the same as Rep #.

same Pattern A Plays again after middle pattern is finished. pattern 1 plays again. not neccessarily same durrations.

Silence

Rest notes can be written with rotations in a number of ways. All are with data that does not specify anything besides three integers, the number of rotations, which direction they travel (clockwise or vice versa) and what order they appear. It does not specify wavelengths or amplitudes; knots are used freely to discernibly quantify rotations and directions are indicated with aerodynamically distorted extrusions from the surface of the rest chord. The idea is that if the length of string separating the two objects was rotated it would also be folded or divided, thus producing the fraction ¼.

The process proceeds in this way, the sum of complete rotations are added and for each successive reverse rotation the time becomes stretched by a power of two. Silences become longer to infinity or shorter. And time moves backward to infinitely a shorter distance until the separation between now and then is less than a 1000^{th} of a second. Or back in time off into longer steps. In this way it is about recording perceptions of time as stopping points in the past or future that become doubled distances of time to perceive more and to unlock new meaning, catching time in a grid of periodic jumps.

If the first rotation is clockwise then it becomes a multiplier symbol, if the first turn is a counter clockwise direction then it is a division. If there is a third rotational direction it is a back in time symbol, which must be the opposite direction of the preceding rotation to be recognized and there only needs to be one. The back in time symbol is directed by the first rotational direction, determining whether it is a multiplier or divider time symbol. The notes at the end of this string exist in negative time and there are ways to use the free space of the present to edit the past and to make more complex polyphonic chords. Without necessitating the use of computers to move back in time digitally or without erasing and starting over. For rest durations the mathematical method used in counting rotations can be constructed so that X is one 360 degree rotation. One example of the equation is here.

X= 4 Number of clockwise rotations.
N= ¼ Fraction of time for first clockwise rotation.
Y= counterclockwise rotation 1   Z=counterclockwise rotation 2
P =counterclockwise rotation 3

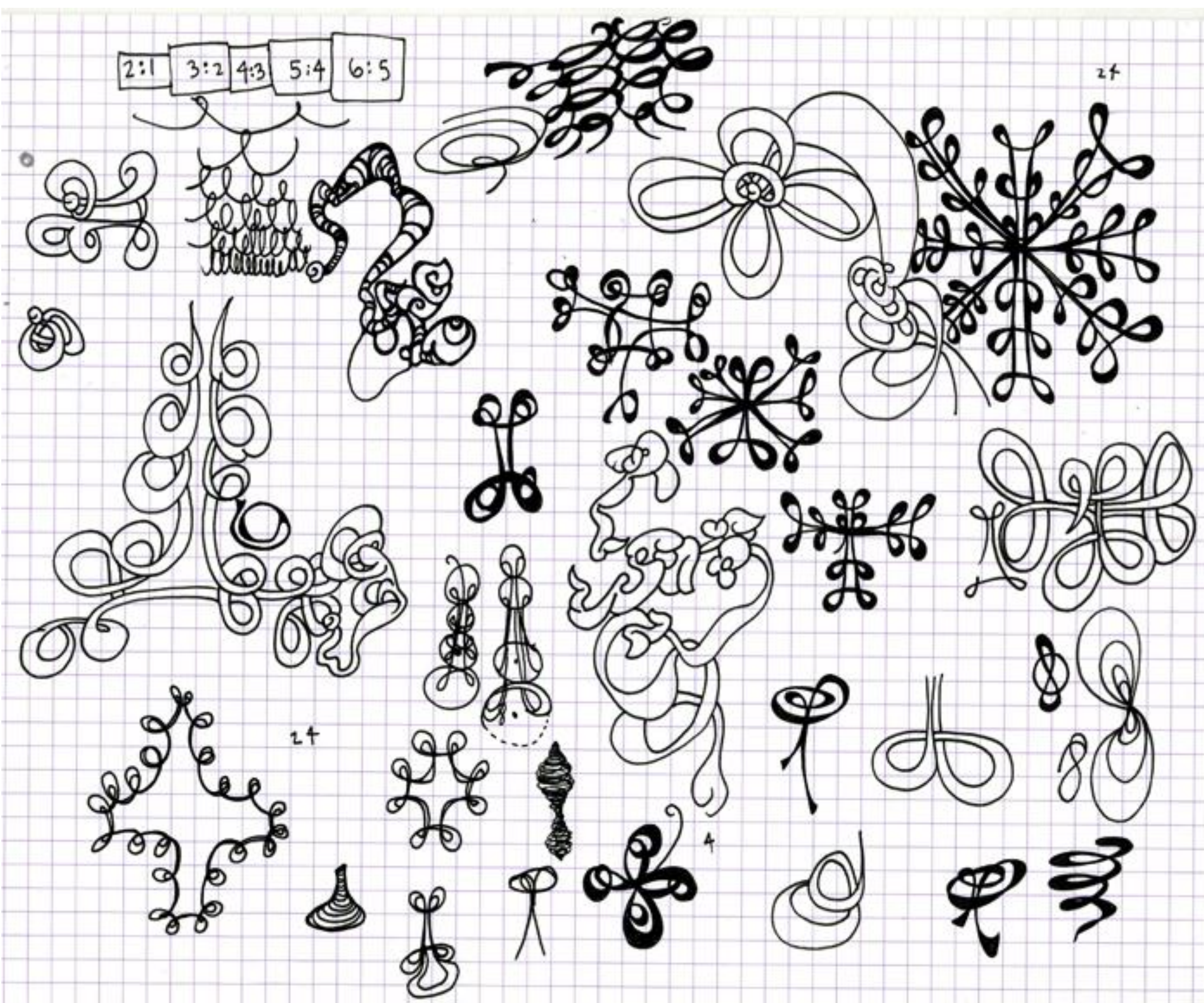
X(.10) = N

N(2) = Y = 1/2

Y(2) = Z = 1

Z(2) = P = 2

P(2) = 4



String Harmonics

Complex chords can be created with note clusters that touch and create simultaneities. These are designated with split strings that create chords. These are produced when the time line splits and each note can or cannot share the same exact start time and ultimately mix at some point.

In this way every wave is analyzed as part of the timing and duration, but all the wavelengths contribute the overtones and the dynamics of the instrument that is performing the piece of music. Before the beginning of the next note the point in time must move to a free space within the image to allow for the expression of a new idea. The next note begins and the process continues until the end of the measure when the code moves back to the beginning, to the very first point with one step or two steps.

Sine to Triangle Series

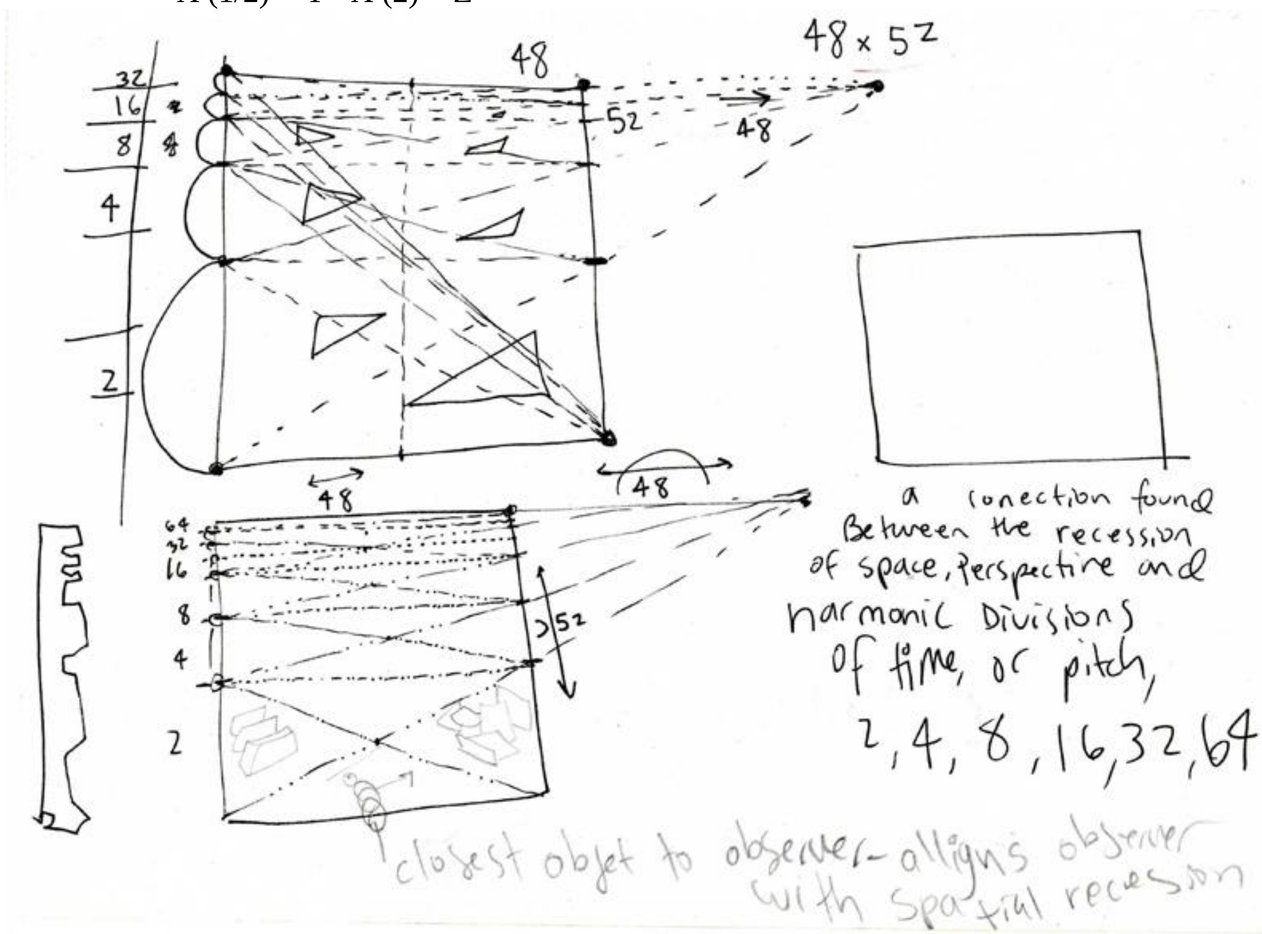
There is a way of using triangles to analyze the sine contour curves of a 2d image and translate it into a periodic frequency. For this to proceed, a triangle would be constructed from standard amplitude to both ends of the arc. This would allow the form to be translated into a geometric angle number. When the sum of the angles are added together and divided by the sum of the integers; an average angle is found, no matter how many sides the form has. However, if there are convex and concave angles, each would have to be measured and averaged independently. When an average angle is found, it can be compared with the analogous scale of notes, balanced at the center with F sharp aligned with the average of averages. This is because there must be a way of analyzing the forms within a picture, and how they create a collective symphonic potential. By superimposing F# with the average of averages and the lowest and highest numbers are aligned with C and B as close as possible. The picture has the greatest range of notes possible within the range of one octave. In this way the image can be translated into sound only after all the angles of every form in the picture are averaged up. This process will allow for a system to be created, translating sine arcs to triangles and vice versa. The code can be used to produce permutations of morphology from acoustic distortions and harmonics. The opposite would be the distortion of a song by the transcription into a drawing where the code is altered and the result is a new melodic or harmonic creation found only through the elaboration of a drawing.

Perspective

Each region of the horizon creates a proportional shift to this key. This creates an illusion of perspective and aligns the system with the fractal divisions caused by perspective. It begins at a certain position then moving back or forward in the picture 2/1 changes the equation by this ratio.

X = Original Distance
Y = 2/1 Step Back
Z = 2/1 Step Forward

X (1/2) = Y   X (2) = Z



Conclusion

I have created a set of semiotic rules with measurements and quantifiable actions. These must be seen clearly in order for the language to function. This clarity alters the image and creates the necessity to elaborate upon a motion or form with as much observable clues as possible. The foreshortening and illusion must be exaggerated so that there is no question as to whether something is rotating and how many times it rotates. All these systems can be linked into a single equation that is a navigational system that is combined into a string of sequential and linear equations. These systems require that certain initial conditions to be made so that the image does not contradict or produce a pattern that isn't at all rhythmically controlled. It is about ways of using math and images to record projections in time forward and reverses. In this way it is a type of symbolic logic that has the ability to express recursive and periodic energies as a language. I am interested in the connections between high energy, shorter wavelengths and types of matter with more gravitation. In other words, the congruence between science, the pictograph and the geometric can be seen as a universal language that would exist in any world.

Jon Axelrod 2008