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Non-Affirming Strategies in Digital Correlation

by

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Abstract

This paper starts with form as a phenomenon of and in the world. Since the perception of form is the perception of motions on the body, form is understood here as a composite of contiguous motions. Data about these motions is then also data about shapings, tendencies, morphologies, upsets, and resolves in the features of the world they correspond to.

In digital art making, the relationship of the computer to the world is often responsive, such that there is an input data stream and an output data stream. This thesis discusses the causal relation between these two streams, and how different kinds of complexities here might serve to put motions from the world in-play with themselves. These complexities are aimed at resistance, which is the central concern for non-affirming strategy. 'Non-affirming' names the productively differenced and radically juxtaposed—which is form by opposition.

The paper continues with the author's own investigations with the phenomenology of form. Examples and scores are provided for some of the concepts from this thesis when implemented alone. Finally, larger implementations are diagramed which combine concepts for real-time responsive systems.

This paper concludes that non-affirming strategies in responsive systems strengthen the necessity of the computer while backgrounding it in the perceptual field. Like the peripheral and necessary structuration of architecture, our system may enable and modulate the situation without itself being a focal point. A computer, when integral and invisible in the causal relations of motions, enables us to interact more directly with forms already in the world.

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Contents

List of Figures

List of Tables

Chapter 1

Introduction: the response

form is perceivable motions of and in the world, on the body
anything, in dynamic relation to itself, necessarily generates more bodies
in matters of form, causality between bodies should be occluded

Begin in a situation without genealogy.
What's at hand?
We find motions, sometimes concurrent, always independent on my sensitive membranes. We find architectures and bodies, differenced only by their rates of motion. Next, put a computer next to moving things. The interactive system is motions at both ends. The computer, as a pivot, is positioned between two streams: the world and the response. Let's look briefly at this second term.

What is needed about 'response' is site, is conditionality, is current here-and-now-ness. In short, specificity. Otherwise, 'response' might connote anticipation, or prediction and histories, or syntax. This is the sense in which 'response' connotes the general, the categorical, and we haven't any use for it.

The implementation of a responsive system needn't be concerned with synthetics or fabrication or intelligence-making. Instead, 'response' may be traded for 'augmentation'. When memory is discussed here, we are talking about a memory as long as the lifetime of a situation. The response should incite the situation to exceed itself, but the response needn't exceed the situation. If the response is to be made for-this-site and for-this-site-only, then it is made from-this-site and from-this-site-only. In this sense, there is no response, but only augmentation, distortion, extension, transformation.

There is also a sense in which 'response' connotes difference, non-linearity, departure. This too is 'response' that is specific, not derived, but contingent. The performance of specificity demands that contingency be invisible. Confounding the necessity between streams enriches their integrity, respectively. Integrity is what binds the body, the entity, the event. Affording integrity is affording identity- is body-making. My spectatorship is as a body, enmeshed with bodies in the situation. My spectatorship is positioned by all the casual relations between all the bodies in the situation, and the degree to which relations between bodies are specific.

Chapter 2 is about form in terms of topological motions, morphologies and emergence. In Chapter 3 we look at the topological features of data streams, the real and the virtual, and correlative strategies. In this paper, non-affirming strategy relates to the specific, whereas strategies of affirmation relate to the general. Actual implementations, at best, are by necessity a mixture of both. Scores and examples are found in Chapter 4. There are no footnoted explanations or references in the paper's body. Instead, contributions from other writers are discussed in chapter 5: Dynamics and Difference. All references occur in that chapter.

Chapter 2

Form in the World

The technological might connote the progressive, but for our interests, the technological connotes the newly possible, or the possibility of something new. Rather than an iteration mechanism in general, which would include it with letterpresses and railroad spikes, the computer should be aimed at the ahistorical in the most utopic sense. The utopic vision is one of a non-mechanical system—a complex system whose output doesn't necessarily follow. Design of the digital system asks that we first begin in the phenomenal world; in materiality. Without ever leaving an account of the material, we may explore phenomenal-against-phenomenal, bodies-against-bodies. This chapter concludes with the productive possibilities of such a relating.

2.1 Form As Phenomenon

The motions of the world are motions lived. Singularities emerge from the continuum and commotion insofar as my apparatus goes out to meet them. What happens happens to my body. Any activity occurring beyond the range of the apparatus is off the edge of periphery and will not appear. Within the ranges of the apparatus, there are more edges. These are the edges of an entity: the onset of a siren, when red turns to grey, the edges of a chair, the edges of your seat. As art is going by, my body is enmeshed with motions and edges. My perception of form is my perception of ratios among them. Moving edges are latticed in network of unstable masses and weighted scales. This lattice is asymmetrical and topological (made from continuous lines), and best expressed as trajectories. My body, also on its way somewhere, attends theses lines unfairly, with passing bias and fleeting prejudices according to their asymmetries. In a situation, only the most local history is required to feel departures, rests, severities—the edges of a change in motion.

2.2 In Dynamic Relation With Itself

Anything in dynamic relation with itself, necessary generates more bodies. First, self-relation—we mean looking at a thing in every orientation: the end before the beginning, the bottom above the top, the middle on the outsides. Next, this reordering, reorienting is productive.

Form is the experiential phenomena of, not just shapes, but shapes on their way somewhere. Concern with form is a concern with motions. We may augment the motions of a situation with motions from elsewhere in the same composite. By extension, we may counter formal gesture with formal gesture, and the mixture of their tendencies is also formal gesture. This production is contingent on the relation being dynamic. The dynamically related are both different and similar; are both nonsensical and non-arbitrary.

If input to output is nonsensical only, then there is a non-relating between them. Since this correlation is really severed, the relation is random. This strategy, when employed alone, profits from fortunate circumstance. Likewise, if we satisfy the other extreme and employ a non-arbitrary relation between input and output, then they are synonymous. The nonarbitrary is redundant, and profits from insistence.

Between them is a gradient of contingency. Contingent functions are temporal displacement (delay, rate), spatial displacement, transposition, retrograde, inversion. All derive a consequent from an antecedent directly, and thus are homogeneous, in a sense—yet strictly speaking, these functions make for different data. Contingent functions are both derived and wild—wild in the sense that they generate new forms, but derived in the sense that these new forms only contain shapes and content that are already in-play. In a general sense, then, if we want a system that is contingent, then we need only keep a data stream in-play with itself.

2.3 Shape Enables Motion, Content Enables Meaning

Performing functions on the stream requires parsing. We may parse the stream according to its tendencies, trends, trajectories in the data stream—really, only the parameters we come into real contact with (but none of the signals, signifiers, system specific signs). In other words, we may abandon here notions about how the stream performs meaning-making. Too, we may even abandon notions of directionality or historicity and look only for occasions when the stream is 'different from itself'. Though formal structures are our aim, we may shift our attention from form (which is too often enmeshed with meaning-making and reduces shape-content to content only), and instead attend forms (which are shapes and tendencies and trajectories).

So the consequent stream needs no invention. We needn't describe what the antecedent stream is—but only what that stream does, to parse the stream and put those parsings in dynamic relation (thus putting the composite stream in dynamic relation to itself). This dynamic relating is gotten from performing contingent functions on the data stream, and putting derived streams in-play. The consequent and antecedent, in-play together, form yet another composite, or topology, the trajectories of which are not defined by the shapes therein.

2.4 Emergent Topology

by synonym, the terms are arbitrary since we only feel one term
by non sequitur, the terms are arbitrary since we always feel two terms but no relation
by emergence, the two terms produce a specific, third term, not defined by the first two

Why we should prefer an emergent topology to a synonymous one: If we simply take a data stream from one sense modality, and cast it onto another sense modality, then the second data stream is exchangeable for the first without bearing upon it. Since the relatedness between terms is overly synonymous, we encounter something closer to a single term than a dialogue between phenomena. And missing dynamics between two phenomena, their being posited as two terms renders the terms arbitrary.

The two terms are just as arbitrary if enmeshed in a random topology. If no causal relation exists between data streams, then both terms are completely non-exchangeable with each other, and thus are both exchangeable with any other term. Random and redundant topologies alike are non-interactive and lack a demand between their terms. The situation lacks necessity.

In emergent topologies, the consequent calls for its antecedent, and so on, both bearing upon one another, in a feedback loop. The terms are neither exchangeable nor different; are neither the same nor are they divorced. The emergent topology is as asymmetrical as it is self-similar.

Chapter 3

Occluding Causality

The input stream and the output stream must relate wildly. But how do we model wild relation in the computer? We must first enable the system to attend rightly what's singular. This may be achieved by a virtual bifurcation of the stream. While in the virtual, we may recompose our stream with features that don't belong to it. In its own time, the system may come back to us with topologies both familiar and foreign. This chapter first outlines computer attention (singularities), contour and state-space, and computer listening. Following is an overview of virtual, contingent functions and transformative memory. The chapter concludes with a position on emergence and self-organization.

3.1 Division of the Singularity

A shape may not be divorced from its content, but a contour may be divorced from its state-space.

The singularity is attended. It is object-like, surfaced from a flowing stream. It is a moment in which the flowing stream reveals a flow of delineable motions, and delivers us quality from quantity. The singularity is not an object really, since it too is a trajectory like the stream in the background. It is a contiguous sequence delineated from a continuous stream. That sequence is attended as an assembly of shape-content. When a sequence is extricated from the stream, there is no perceivable distinction between 'its shape' and 'its content'. In the real, we encounter both, simultaneously, already enmeshed.

If the shape-content assembly is plotted, however, the stream bifurcates. We may consider two streams: 1. a contour, which corresponds to shape and is a trajectory through discrete values, 2. a state-space, which corresponds to content and is a list of the discrete values in-play. These streams are virtual. By virtual we don't mean 'not-real' or 'imaginary', but only that we've divided something encountered as singular. Such a division enables us to perform virtual functions that are impossible in the real.

3.2 Contour Divorced from State-space

Let's look more closely at how contour may be divorced from its state-space:

Take a sequence: 1, 3, 4, 5, 2, 2, 7, 9, 3, 2, 1.

Contour= n, +2, +1, +1, -3, +0, +5, +2, -6, -1, -1.

State-space= [1, 2, 3, 4, 5, 7, 9].

3.3 Listening

The multifaceted surface of a contour is made from the motions of its features, and the more features we find for a stream, the better we'll be able to say something about the composite of that stream—which is its topology. Even with clumsy resolution, we may plot the speed and direction of a feature as its difference. We need only add the amount of difference for every feature to know when the topology is changing (edge detection), thus delineate events (singularities) in the gradient.

The contours and state-space are moving, and to detect difference our system must remember. To stay current, the system must also forget. The remembering and forgetting should bear as many asymmetries as possible. State-spaces may be weighted in order to collapse multiple trajectories into a single list.

Take the same sequence: 1, 3, 4, 5, 2, 2, 7, 9, 3, 2, 1.

This sequence doesn't say anything about the duration of those values. We could repeat values for a list that shows both the trajectory of values and a trajectory of durations for a sequence like this: 1 1, 3, 4 4 4, 5 5 5 5, 2 2, 2 2, 7 7 7, 9 9, 3, 2, 1 1 1 1 1 1 1 .

Features like duration, rate, intensity should be reflected in a weighted space as having more mass, thus taking longer to forget. The longer a feature value remains in-memory, the more it bears upon the current stream. We can take center of mass on a weighted and unweighted list, compare them, and detect that the feature is moving. For this we only need to divide average/median.

For the difference of some feature, we can take the absolute value of (last average/last median) minus (this average/this median):

Δ = abs((average[n]/median[n])-(average[n+1]/median[n+1])).

For the total difference, we simply keep a running total of the difference of every feature:

for (int i=0, i< total_number_of_features, i++){Δtotal= Δtotal + Δi}.

In the table and figure below, the difference for some feature changes as numbers are added to the data-set. Notice as redundancies are added, the difference is dropping, but as soon as the number 10 is added to the set at index f, Δ at that index spikes briefly:

Table 1: calculating difference

	set	avg	median	avg/median	Δ
a	1,1,3,4,4,4	0.282	3.5	0.810	n/a
b	3,1,1,3,4,4,4	2.850	3.0	0.952	.142
c	2,1,3,1,1,3,4,4,4	2.560	3.0	0.862	.100
d	4,2,1,3,1,1,3,4,4,4	2.700	3.0	0.900	.048
e	1,4,2,1,3,1,1,3,4,4,4	2.540	3.0	0.848	.052
f	10,1,4,2,1,3,1,1,3,4,4,4	3.170	3.0	1.056	.208
g	10,10,1,4,2,1,3,1,1,3,4,4,4	3.690	3.0	1.231	.175
h	10,10,10,1,4,2,1,3,1,1,3,4,4,4	4.140	3.5	1.184	.047
i	10,10,10,10,1,4,2,1,3,1,1,3,4,4,4	4.530	4.0	1.133	.051
j	10,10,10,10,10,1,4,2,1,3,1,1,3,4,4,4	4.875	4.0	1.219	.086
k	10,10,10,10,10,10,1,4,2,1,3,1,1,3,4,4,4	5.170	4.0	1.294	.075

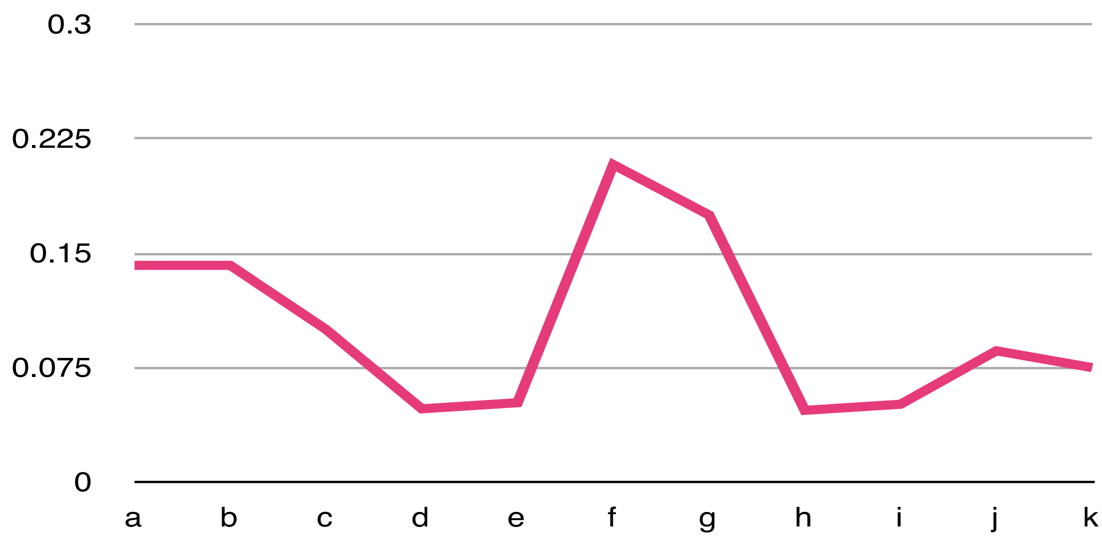

Figure 1: Δ, for some feature

To delineate the edges of an event, we may compare Δtotal against a dynamic threshold. In Figure 2, scrolling left to right, we see Δtotal in black, and its dynamic threshold in green, always resetting to zero by curve. When Δtotal exceeds its threshold this reflects the onset of an event.

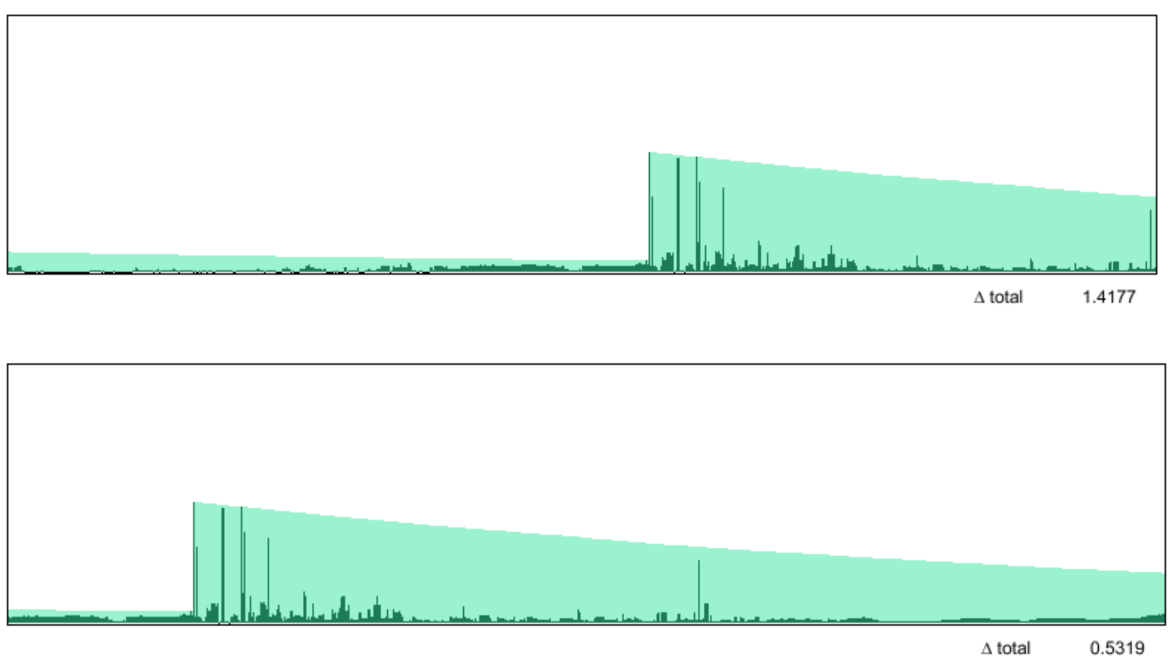

Figure 2: total difference

3.4 Virtual Functions Not Possible in the Real

Of the contingent functions mentioned so far (delay, rate modulation, spatial displacement, retrograde, inversion, transposition), only transposition is virtual. In the other functions, the contour-state-space assembly is regarded as a unity, and this unity is delayed, slowed, moved, or flipped. In the case of transposition, however, contour and state-space are divorced, the state-space is traded for another, and the contour is preserved against the new set of states. The trajectory of the contour, after transposition, will be altered if and only if the new state-space is missing any states from the first space. For example, transposing a sequence which uses 7 states [1, 2, 3, 4, 5, 6, 7] to a 12 state state-space [-1, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10] wouldn't be a perceptible transposition, since our sequence requires 7 states and 7 states only. The extra possible states would be ignored. However, if transposing the same sequence to a state-space with five states, the sequence must change shape. Take the sequence: 1, 2, 3, 4, 3, 2, 1. Now lets transpose the sequence to the state-space [1, 2, 3, 5, 6]. If the transposed sequence is to keep the same length, it must stretch or compress to accommodate the new state-space:

1. 1, 2, 3, 5, 3, 2, 1
2. 1, 2, 3, 3, 3, 2, 1

Or, the transposed sequence might filter out any portion of the sequence that doesn't occur in both state-spaces, and either leave a gap, or shorten the gesture:

3. 1, 2, 3, -, 3, 3, 1
4. 1, 2, 3, 3, 2, 1

3.5 Feature Transformation

Strictly speaking, a transposition should trade out the state-space of a sequence without alteration to the contour of that sequence. Look at this sequence, contour, and state-space:

1, 2, 5, 3, 1; n, +1, +3, -2, -2; [1, 2, 3, 5].

Literal transposition to [6, 7, 8, 10] yields:

6, 7, 10, 8, 6; n, +1, +3, -2, -2; [6, 7, 8, 10].

The configuration of the state-space being transposed to may accommodate the contour of a sequence. When it does not, this is a transformation and may serve as 'affect' in a system. Affective transformations may be implemented in a feature-to-feature graph. That is, for whatever feature of a sequence, we may draw a graph with the state-space of that feature on the x and all possible states on the y axis. Since the state-space being drawn won't use every possible state, we may choose one of the four strategies in 3.4 to fill in the missing values. The function in Figure 3 uses the first strategy, which stretches any contour interval that is narrower than the corresponding states possible:

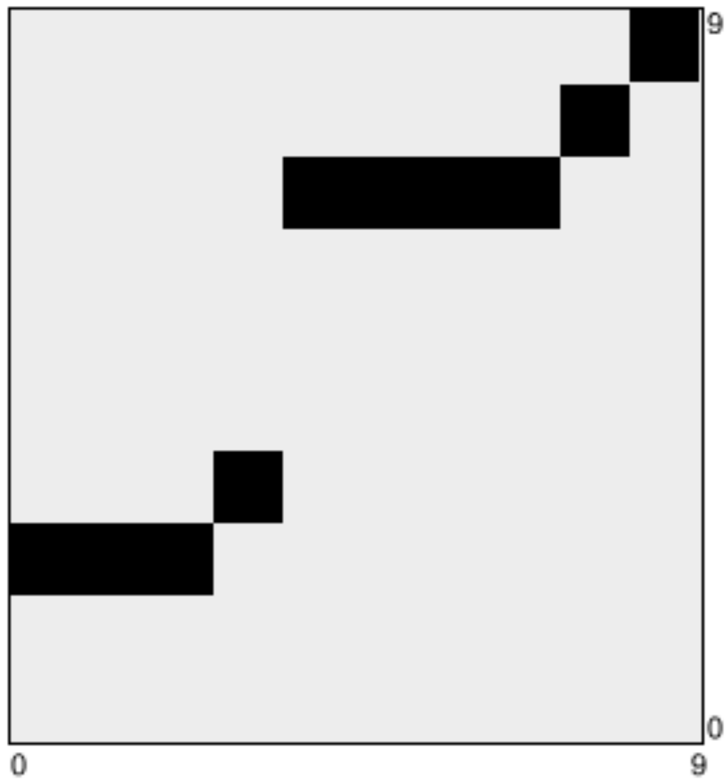

Figure 3: plotting the state-space [2, 3, 7, 8, 9]

The function plotted here expresses the edges of some contour and is non-linear. This function will distort any sequences whose edges exceed its limits. Take the sequence: 1, 3, 4, 5, 2, 2, 7, 9, 3, 2, 1. Transformed by the function in Figure 3, this sequence would yield: 2, 3, 7, 7, 2, 2, 7, 9, 3, 2, 2.

This function transform may enable sequences to interact. Whenever two sequences meet, for some feature, one sequence may affect the other. Feature to feature, the affected sequence struggles to retain its contour against the state-space from the affecting sequence. In this manner, we may allow sequences to push and pull on each other and morphologies result from their collisions.

3.6 Simulacra, Memory

When naming something exchangeable we need only describe its attributes, but to name a singularity, we can't describe what the instance is; instead we must talk about what the instance is doing. That is, we must assess only the attributes of the object whose predicates are in flux.

This has a double meaning for the non-affirming system. First, that a singularity must be recorded as a sequence rather than a static list. The static totals and sums of an event show us things about its discrete values in-play, but to make use of the play itself, we must record the values, their durations, and the spaces between values. The sequence is dynamic (in contour and in state-space).

Second, the singularity is not an instance. The singularity is a tendency. Just as the edges of a singularity are delineable from modulations therein, the identity of that singularity against others is an identity in flux. A sequence is susceptible to on going modulation. The sequence is continually replaced with altered versions of itself. Its fluctuation does not reflect a genealogy of versions. The pulsatile figure is instead the same data-object.

Dynamic memory is related to itself destructively, without genealogy, without root or backward retention of an original. Dynamic memory seeks to retain what is vibrant. A feature's contour is most vibrant (as a shape not already enmeshed in its content), when its composition is preserved against some other state-space. This gesture, strictly speaking, is impossible. Contour and its state-space form a qualitatively unique phenomenon that doesn't carry if either of the terms are transposed. The alterations suffered by the contour when preserved against some other set make the contour's outline apparent. Its moving edges are glowing indicators of its shape.

Motion is comparison, and so motion is a function of memory. Memory is likewise a function of motion, since memory too must move to be visible at all.

3.7 Emergence in General

Our aim is a complexity in the composite that exceeds the definitions of the parts. This complexity emerges when two terms, by being near to each other, make a specific, third term. The third term is made from the first two, but defined by neither. It is an effect of their combination. This may happen at many levels and the non-affirming strategy looks for emergence at two places: when and with whom. By 'when' we mean, does the output stream have a temporal structure that is organized separately from the input stream? By 'with whom' we mean, are there novel combinations in and among the streams that exceed the situation?

3.7.1 Hive-Mind

Getting the greatest complexity with the fewest rules involves group-effect (bodies affecting their neighbors). For simple, emergent temporal structures, we may implement a model of distributed power in a cellular network. The cells, with limited instruction and scope, may behave independently yet produce group-patterns across the cells: choruses, refrains, coalitions and counter-insurgencies. These patterns are visible as entities distinct from their parts. The cells themselves need no instruction about patterning, only rules about their neighbors.

If our cellular network were such that every cell was a neighbor to every other, then patterns may distribute within the network more freely. In this arrangement, we may generate an emergent clock with two rules:

1. Cells are independent and pulsatile
2. Simultaneous cells become dependent and pulse together

This is entrainment, self-organizing in the same manner as applause, or how 'Happy Birthday' finds its way. The bodies begin independently, and quickly find the group. Each moment of total convergence may serve as one tick of the clock. The pulse of this clock is the pulse of our output stream.

Chapter 4

A Swampy Crosshatching of Tributaries, No Main Vein

This chapter provides figures and scores from work during my thesis, not as proof of anything, but to demonstrate possible trajectories of modeling and implementation. First, we'll look at smaller works that explore some of the concepts from the paper when implemented by themselves. This includes investigations of formal structures, meaning-making, and motion in simple systems designed for poetry, dance, and music. Finally, larger implementations are discussed alongside figures from my thesis concert, *A Swamply Crosshatching of Tributaries, No Main Vein.* System diagrams from this concert are provided to contrast affirming, static, and otherly-contingent strategy with non-affirming, dynamic, self-contingent strategy.

4.1 Text++

Figure 4: Soloist and Dynamic Text

Before we look at the abstract narrative of bodies, and the even more abstract narrative of sound- let's look at examples of wildly redistributed text. The interest here is exploring a thing-in-dynamic-relation-to-itself with the explicit meaning making in language.

Text++ takes a plain text document of any size and divides it into three sections. These three sections access their portion independently, and the results are combined. In Figure 4, three data streams from the moving dancer are transposed into the three motions of a piece of poetry. This poem was parsed ahead of time such that the units are sometimes larger than a single word. For example, in the top photo in the figure "at snow", "we burn", and "now" are singularities. In the bottom photo, "on your mottled tongue", "our fluid", and "now" are singularities.

With Text++, it is also possible to reorder the text without any parsing at all. In this case, we are affording every word equal weight to every other. In Figure 5, we see 75 lines of mad distribution. The example uses the text from the body of this paper:

Next here the	We but integrity	Begin the the
differenced here the	find exceed integrity	occluded the the
only discussed is	always the binds	be the the
by discussed is	on situation. integrity	should long the
their discussed is	membranes. situation.	bodies long situation
rates discussed is	integrity	a the bodies
of memory the	sensitive for-this-site body	of about in
moving memory the	membranes. for-this-site-	causality the situation
things. as the	only identity-	between long and
moving as event.	We for-this-site identity-	bodies memory and
to as event.	find be is	should about the
next as event.	architectures to My	more talking the
computer as event.	bodies to spectatorship	generates are bodies
only long is	differenced to is	necessarily are bodies
rates talking is	only response enmeshed	itself are bodies
only be is	by exceed enmeshed	to are bodies
differenced be is	their exceed enmeshed	dynamic are bodies
only be affording	next be as	to a and
by be affording	computer be in	itself a the
sensitive is My	a be in	to about to
hand? is affording	Next to in	dynamic about to
We is affording	architectures the in	in about to
always a the	my to situation.	matters as are
independent lifetime body	a the the	dynamic but between
on lifetime body	a the by	matters be and
hand? lifetime body	in the the	between be and

Figure 5: Text++ using the text from this paper

4.2 Bodies

Figure 6: push_push and soloist

The perception of dance is proprioceptive—that is, the motions of a body are the motions of 'my body'. The dancer's body demarcates time and space easily, being so close to home. Unlike text or sound, the motion of bodies is never motion by analogy—a body is body moving. Designing digital correlations without bullying the correlates can be tricky since data collection itself is a mediation of bodies or the space. Dance technology asks that everything be smaller, lighter, and wireless. The smaller the computer, the easier it is to hide, protect, forget. The aim here is designing data collection that is transparent, and doesn't take up space in the minds of performers or members of the audience.

4.2.1 push_push

Figure 7: push_push sensors

The push_push sensors were made on a circular knitting machine. While knitting regular yarn, conductive thread is tied to the yarn and pulled through the machine with it. This makes a soft, variable resistor. At several points, the sensor is connected to power and ground. As the sensor is distorted, pulled, pushed, twisted, folded, or touched with anything conductive, the total resistance, which is fairly high normally, is reduced.

The microcontroller used in push_push is the Xbee series 1 radios. Two of these radios were used in conjunction with the Lilypad Xbee breakout, and a third was used as a receiver on a USB dongle. The Xbees send a serial stream containing their identity (which Xbee it is) and the values on each of its analog pins (0 – 1028). The incoming data is scaled and may quickly be adjusted on the fly.

The connections inside push_push are knots of conductive thread around circular hoops made from 22-gauge wire. Thin hookup wire is stripped for several inches, folded around a hoop, and twisted back on itself like the end of a guitar string before being soldered and heat shrunk.

Two matching strips of inactive knitting are crocheted on either side of the active strip, with a triple-wide strip crocheted to the back for sandwiching the electronics. The Lilypad portion of the sensor circuit was first sewn into a pouch, but after several performances in which soldered connections inside broke from being folded, the radio and hard soldered components were moved to a protective plastic case.

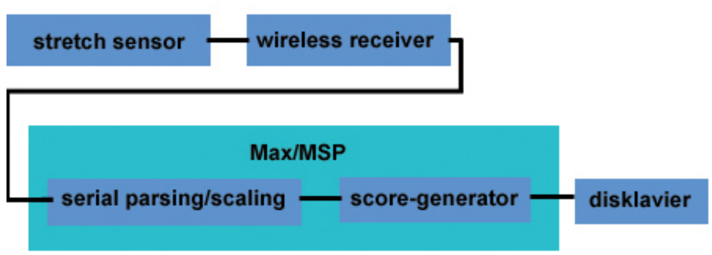

Figure 8: Motion Study for Automatic Piano

The figure above is a system diagram for Motion Study for Automatic Piano. push_push was given to different dancers-pairs and soloists. Its data was mapped to parameters of a real-time score generator outputting MIDI to Disklavier or prepared piano controlled by Vorzetser.

In the first presentation, the six data streams were mapped discretely to parameters of Elastic_Harmonic_Space: density(notes per beat), rhythmic duration, accelerando, repetition (whether the playhead may jump to another position in the score), and likelihood that repetition should jump to a point already heard.

It quickly became apparent that a single scarf, if given control over unsubtle parameters like density or dynamics, makes it possible that one scarf may stop the piece, or render the other parameters void. Accelerando or repetition, for example, have no effect if simultaneously, either the density or dynamics are zero (which is silence).

For subsequent presentations, density and dynamics were a shared sum of data streams from both scarves, scaled such that a single dancer may produce up to half the possible density of notes per beat and up to half the possible velocity. Full density and full dynamics then, requires that both dancers are distorting their scarves. Likewise, a zero value for dynamics and a zero value for density require that both dancers stop moving.

Regardless of how its data-streams are mapped, push_push is a prop. push_push has in itself a certain character that both constrains movement literally (being a interface based on limits and constraint) and constrains movements figuratively (being a pair of scarves with their own associative relations). As an interface, push_push demands to be *interfaced with*. This demand asks that a dancer not only dance, but somehow be dancerly in their engagement with an object that never will belong to them. Always, the prop is another body, and refuses assimilation or integration. However fanciful, the interface is reduced to a switch. The dancer is reduced to switch operator. Figure 9 depicts push_push with a redesign of push_push around the bodyTalk++ PCB. The overall design of the sensor is much looser and knitted in the other direction so that it stretches more easily. This way, a dancer may wear the sensor—trading prop for costume.


Figure 9: push_push and revision with bodyTalk++


Figure 10: push_push and Elastic_Harmonic_Space

4.2.2 Wireless

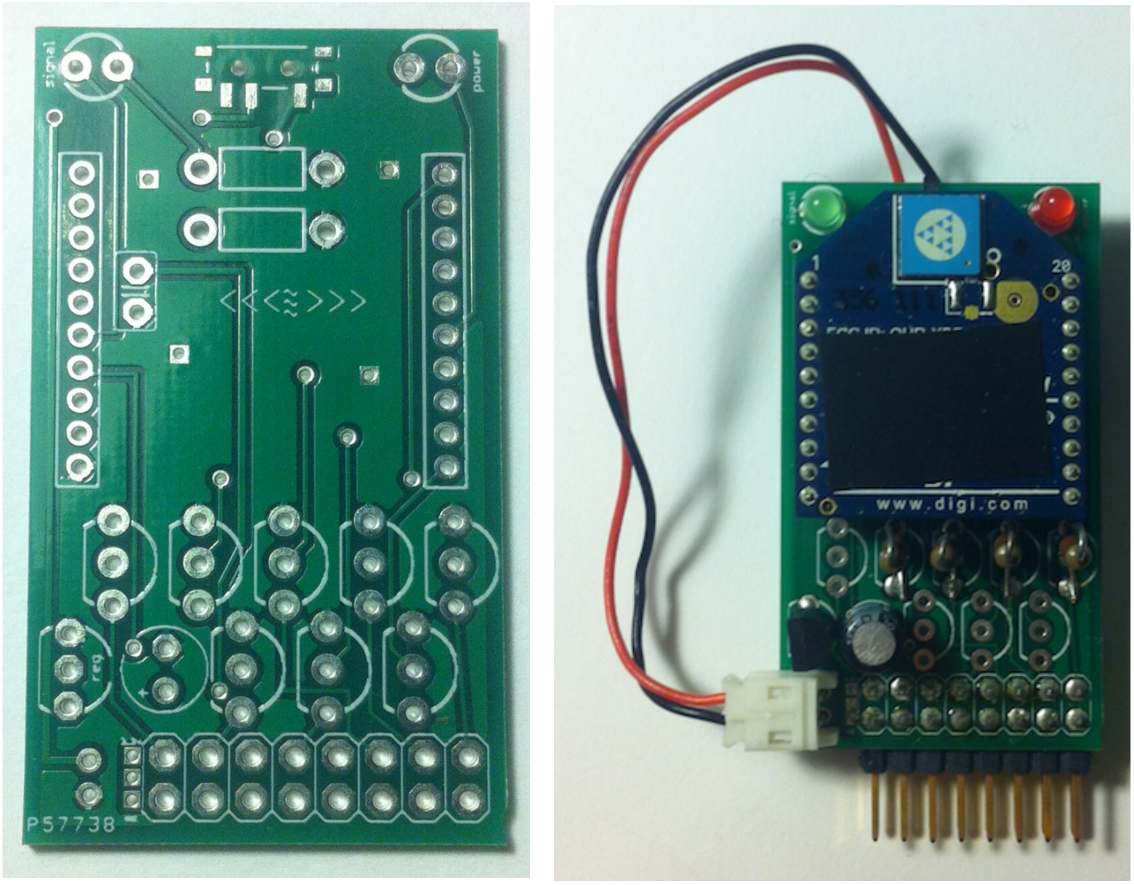

Figure 11: bodyTalk++, printed circuit board for wireless communication

Wireless communication occludes the physical causality between the situation and its responsive system. bodyTalk++ is a small circuit board for Xbee wireless radios. Its design addresses the limitations encountered using the Lilypad Xbee breakout in push_push. A comparison of the boards is found in Figure 12. The Lilypad Xbee was designed for wearable technology, and the pins of Xbee breakout to large pads for sewing to with conductive thread. This makes for a large footprint that is hard to hide or protect. Additionally, sewing and electronics don't mix well since one always needs to transition somewhere in the path from hard things (plastic and wire) to soft things (fabric and thread). It is at these transitions that stress will accumulate, and eventually things will break. bodyTalk++, to circumvent some of these transitions, leaves room on the board for resistors or transistors so the sensor or actuator circuit doesn't have to be sewn. Its power too is onboard. In Figure 12, you can see that the board is no wider than its battery and terminates in header pins to keep its input and output organized and tidy. bodyTalk++ is designed to work as an input or output board, enabling the possibility for the response to occur at/on the body its responding to.

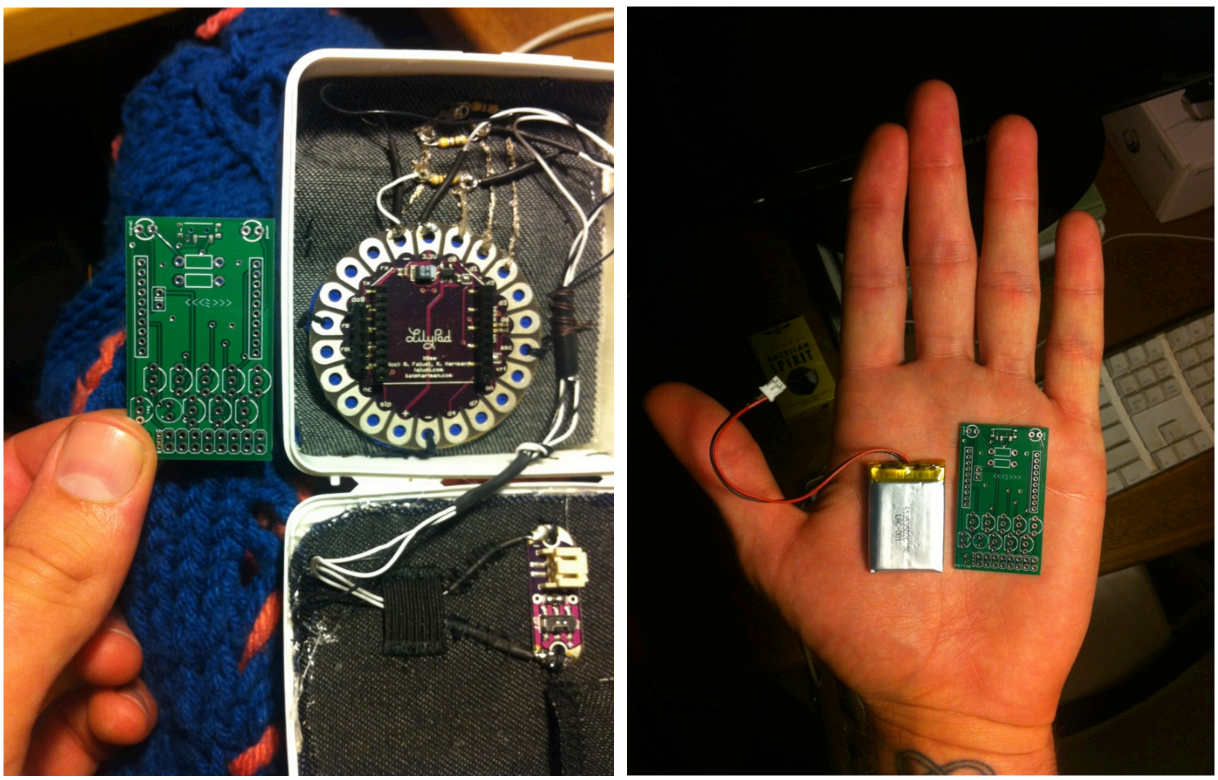

Figure 12: Lilypad Xbee and bodyTalk++ comparison

4.3 Sound

Figure 13: Piece for Tone Generators

Figure 13 details an array of small speakers, each with a 9v battery and a single knob. This knob controls a steady wave of flexible pitch. They are not very loud, but their ranges extend beyond human hearing. They're designed to accompany a dancer on stage. High pitches are very directional—from the audience's perspective, there was a steady complex high tone in the room, for the moving dancer, there was a dynamic score.

A related piece in Figure 14 and 15 is performed at home, but is concerned in similar fashion with the distribution of audible motions. Many of these motions, which are discrete, are encountered as simultaneous until we shift our body, or until someone opens a window or shuts a door. The relation of music to bodies is interesting, since music is in some sense bodiless—rather, its bodies are oblique. Music is parameters and features and motions only, without visual correlate. Unlike visual information, musical information may never be rescanned. Its topological features are fleeting. Sound, in this sense, is irretrievable and often unnoticed. All the same, sound-topology is a real and vibrant architectural phenomenon. From the edges of our periphery, audible tensions suspend and resolve every time we turn our heads from left to right.

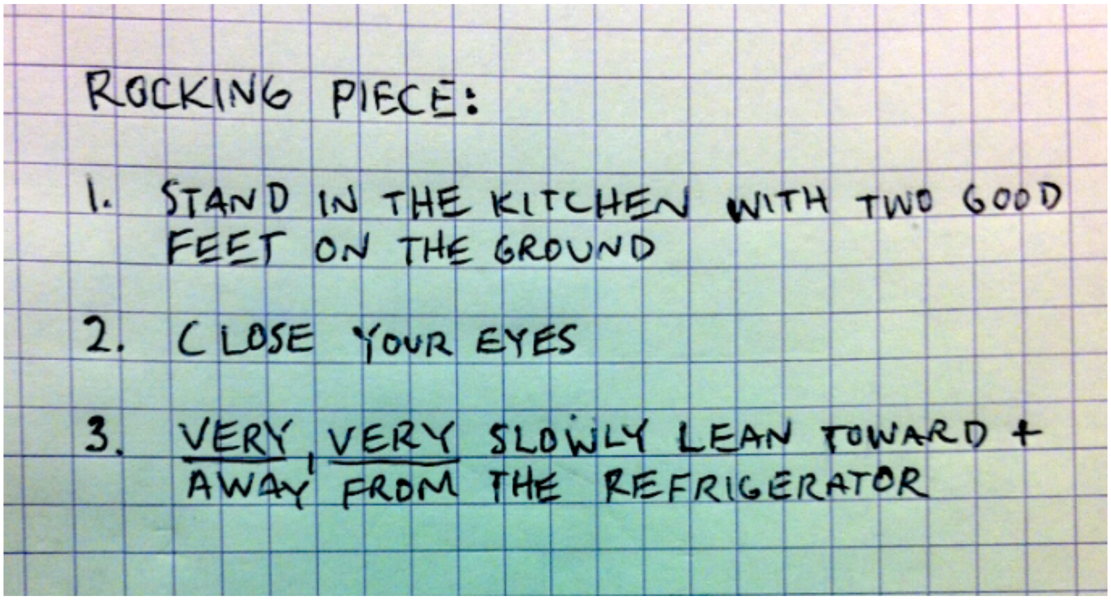

Figure 14: Rocking Piece, Val Verde CA

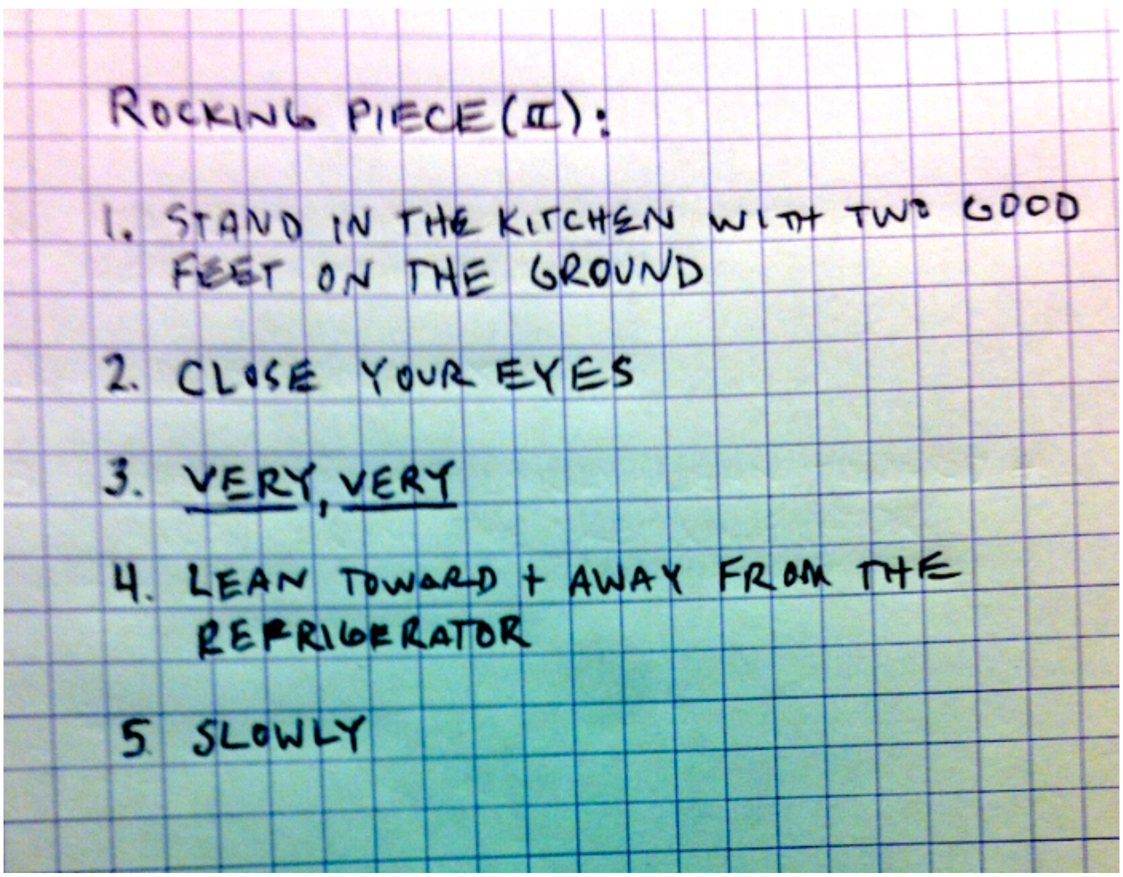

Figure 15: Rocking Piece (II), Val Verde CA

4.3.1 MIDI and Musical Ontology

What are the motions on the body when that body perceives music?

First, there is spatiality, which is the ambient mix, or the body's position to and within the composite. And then there is the composite—a mixture of rising and falling pitches, different volumes, and different durations.

MIDI is a digital protocol for describing many of the motions within the composite. As such, it is a parametric reduction of the musical event. This is achieved with two messages: note-on, and note-off. A note-on message contains a note number (pitch) and a velocity (volume). Note-off messages are note-ons whose velocity is zero. So really both messages are the same stream, but this single stream is also five concurrent streams: 1. pitch height, 2. pitch density (number of simultaneous notes), 3. velocity (loudness), 4. rate (the time between notes), 5. duration (length of notes).

While these five streams may combine for a music context, what's interesting about them when taken alone is their non-musicality. This produces a non-musical (or counter-historical, counter-syntactical), ontological framework for talking about the phenomenon of music. In other words, without need for notions of harmony, function, or even melody and rhythm, MIDI allows us to think about music as the combinatorial affect of varied motions.

4.3.2 Elastic_Harmonic_Space

Elastic Harmonic Space is a composing tool designed both as a material generator for traditional composing and as a live feedback system for use with sensor input and automatic instruments capable of playing MIDI, like the Disklavier. The system produces a MIDI stream from 1) motion within harmonic planes dictated by the composer 2) motion from one plane to another 3) formal events from markers at harmonic shifts 4) parametric curves drawn by the composer (or taken from live-input) used to impose formal gestures relating to pitch height, rhythmic complexity, textural density, acceleration and repetition of formal events. Finally, the MIDI stream is filtered according to its intensity such that notes are delayed or attenuated when the stream's intensity surpasses a chosen threshold. Technicalities and examples are presented.

This system should generate music that is non-limited, in the sense that the composer may experiment with different colors, and be able to hear them in wild relations without restriction of playability. Additionally, this experimentation should tell us something about how the experience of form relates to the complexity of musical information happening at once.

If, by some logic, we organize possible chords in a coordinate system, then the relating of chords may be understood as their distance on a Cartesian plane. Or, the phenomenon of a harmonic motion relates to its path within a coordinate system. This system should enable motion to every tonal center, but these motions should somehow be non-exchangeable and laden with preference.

When employing a computer program as a compositional tool, at the outset, we must decide how we will handle constraint and randomicity. In Elastic Harmonic Space, much of the constraint takes place in the formation of content or events, and much of the randomicity is used for ordering and reordering events, which in this system is considered form.

Programming started with a few basic premises:

1. Form is the composite of identities in motion

2. As those identities become more discrete so should the composite become more complex, and by extension, the form should become more expressive

3. In through composed work, we might name every identity that informs a work, and for each identity, draw a parametric curve on an X Y coordinate system in which X is our parameter and Y is time

4. If our curve-reader is processing envelopes in real-time, then we may just as well draw our curves in real-time from some other data stream

Some consideration at the outset was placed on how the parametric curves will be drawn. It was my suspicion that there is perceptible difference between scores generated from curves drawn by a mouse and curves drawn from a tablet or gotten from live physical gestural capture. With this in mind, the system works equally with drawn or live input, and when reading drawn curves, will recalculate for changes on-the-fly.

Limited planes in an elastic space:

Elastic_Harmonic_Space synthesizes motion away from center (tension) and back (resolution). In this system, a harmonic plane is an X Y table, with four cells per dimension, two in each direction, and a [0,0] which serves as the "resolution" of the plane's tonality. Cells are populated by addition to a tonal center. Rather than listing pitches, the tables are a list of intervals. For example, a plane along the X axis, from -2 to 2 might read:

-3, -2, 0, 5	-2, 0, 2, 5	-2, 2, 4, 7	-2, 2, 5, 7	-5, -2, 2, 4

These intervals, for whatever tonal center, yields the following scale degrees:

6 7b 1 4	7b 1 2 4	7b 1 3 5	7b 1 4 5	5 7b 2 4

The intervallic content within planes is populated by the composer arbitrarily, in any color and by any reasoning so long as motion within the plane is understood. The basic principle is that at every beat, motion must occur and will travel away from the center and back to it, such that (-1, 0) (1, 0) (0, -1) and (0, 1) are each a tension that is resolved by some logic at (0, 0). Likewise (-2, 0) is an even greater departure from (0, 0), and is resolved in part by motion back to (-1, 0), and resolved better still by returning to (0, 0).

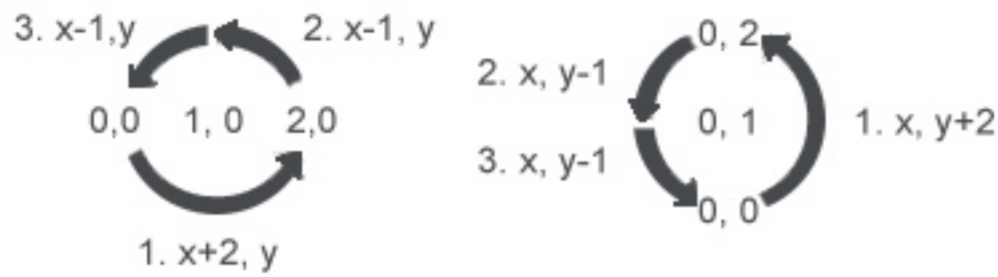

Figure 16. Elastic Motion on Two Axes

Motion within a plane:

The elasticity within a harmonic plane is probability in cascade. When we set the elasticity to 60, if we are sitting at [x=0], there is a 60% chance for [x=1], and a 40% chance for [not x=1]. Within the possibilities of [not x=1], there is a 60% chance for [x=2], and 40% chance for [not x=2]. [not x=2] is 60% [x= -1] and 40% [x=3].

Examining only positive motions along a single dimension for a moment, if elasticity > 50%, the greatest tendencies of each cell are as follows: 0 mostly moves to 1, sometimes to 2. 1 moves back to zero, sometimes to 2. 2 moves to 1, sometimes back to zero.

Each time we arrive at zero, there is an even chance for motion along both axes, and equal chance for positive or negative motion.

Motion between planes:

If the result is [x=3, x= -3, y=3, y= -3], a temporary dimension is added whereby we may change planes. The lowest member of the chord, regardless of inversion, becomes the new tonal center of the next plane after a transposition. For example, if at a cell with C7 voiced [Bb, C, E], we draw [x=3], Bb transposes into the new plane. Since harmonic planes are populated arbitrarily and asymmetrically, by taking any member of a chord as a potential pivot we limit oscillating between the same few tonal centers. That is, modulating from any chord tone encourages wild harmonic motion and discourages rocking back and forth between the same colors.

Each plane is prepended with its interval of transposition- for example, "+7 mixolydian" should mean the lowest member of the preceding chord transposes up 7 MIDI notes (perfect 5th) to become our new tonal center [0,0].

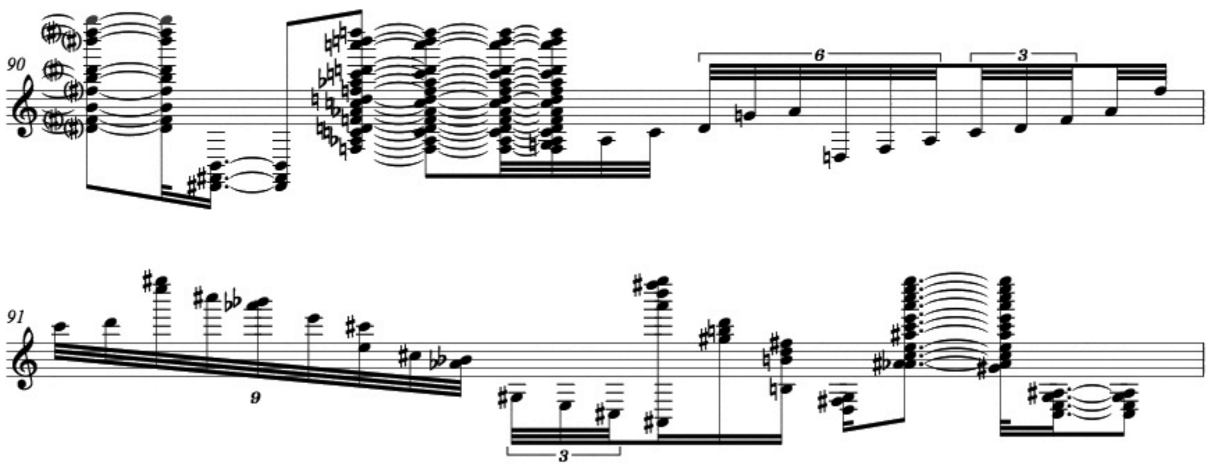

Figure 17. Simplified Example With Tonal Center, Plane, and Position Shared

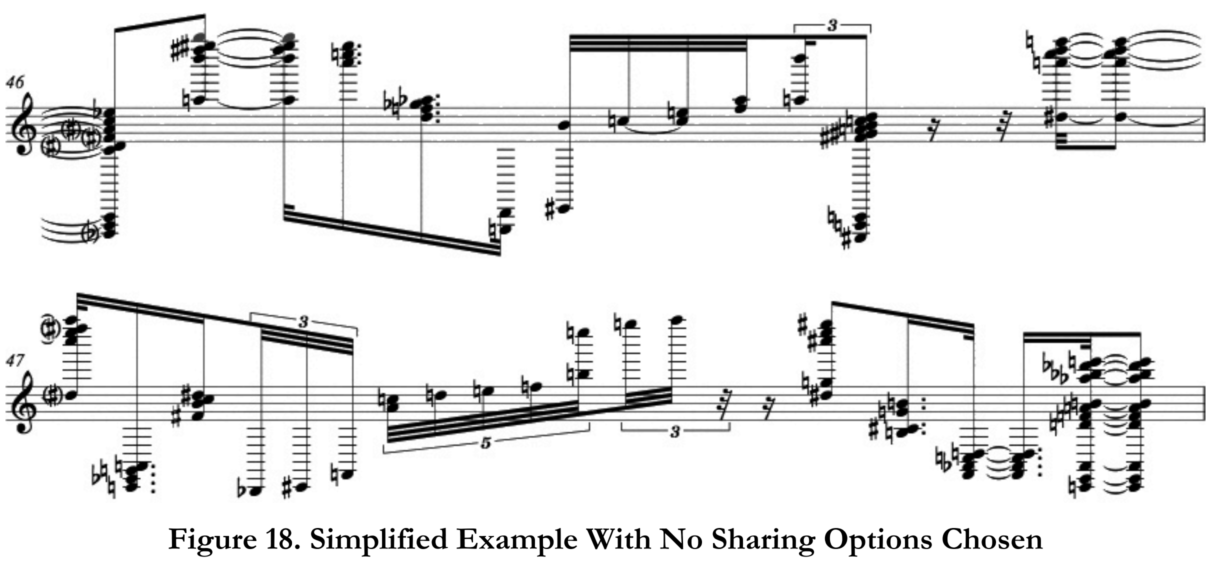

Figure 18. Simplified Example With No Sharing Options Chosen

Consonance and polytonality:

In a given piece, there are four active planes and four independent voices S A T B, which are separated by two octaves each. This produces a 12-16 note chord per every beat, depending on if the planes are populated with 3 or 4 note chords. These voices may each have a different elasticity, and thus move within their respective plane independently and move between planes independently. If a very low elasticity is set for each voice, they will quickly depart from each other and produce dissonance.

Using the same probability-in-cascade, each voice also has an independent elastic setting for inversion whereby 100% elasticity produces the chords exactly as they appear in their harmonic plane, and 0% always produces the chords in 2nd or 3rd inversion. To produce consonance, the composer may set elasticity higher, or choose to have the voices share the same inversion, plane position, plane, and/or tonal center. Different combinations of these settings produce very different colors and if all 4 sharing options are chosen, this produces a completely unison sonority across the four voices. Some notation examples are included in Figure 17 and 18.

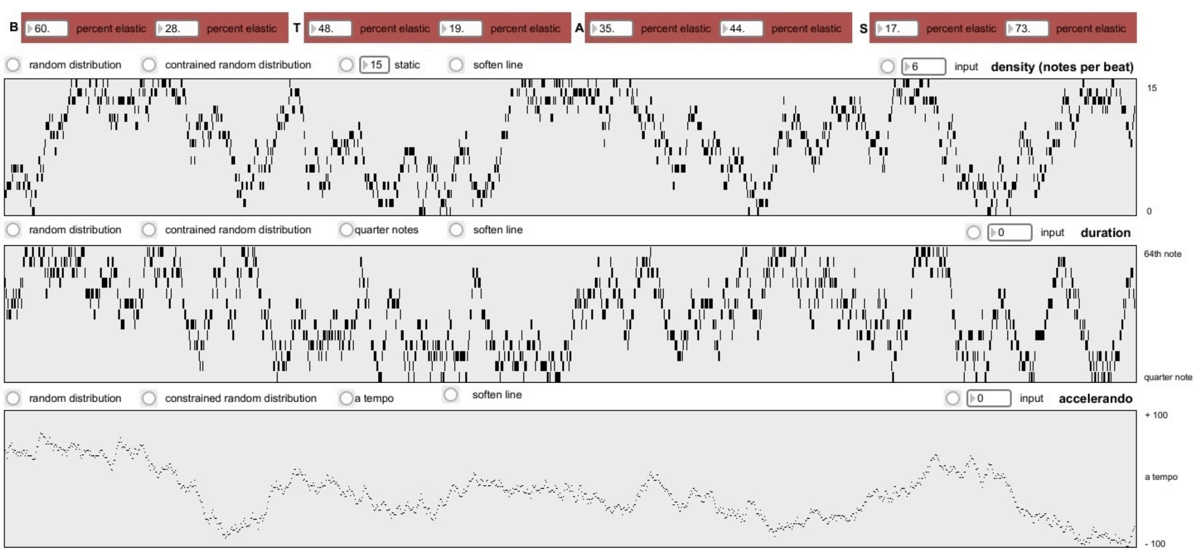

Figure 19. Elasticity Settings and Parametric Curves

Parametric curves:

Ultimately, the system produces a table of pitches 1000 beats long, where the quarter note is the longest rhythmic value. At every index (quarter note), there are 7 parametric curves, drawn by the composer, which are used to write our table, filter the table, and affect playback and repetition. All of them have time as their X axis (1000 beats) and each have the option to randomize, random walk, free-draw and soften line (random, constrained deviation of a curve).

Pitch Height:

This is the first parameter, with values 21-108 (MIDI notes on a piano) on its Y axis, and its line has four settings: low pass, high pass, follow line, ignore line. When ignore line is chosen, this parameter is not used and harmonic motion happens as we've already been discussing—using free probability constrained only by elasticity settings. Using the low pass, the bass voice must be <= the curve at every change of plane. Using high pass, B >= curve. Using follow line, B >= (line - 12) && B <= (curve + 12). The composer may force each voice to always stay within its section by automated inversion. When changes are made to any option discussed so far, the pitch table is repopulated. The rest of the parameters do not affect the table, but affect its playback.

Density:

Density is notes per beat, with values 0-16 on its Y axis. A value of 16 will play the full 12-16 note chord, a value of 1 will play only the lowest member of a chord, and a value of 0 will produce a rest. This parameter is how we may isolate the lower voices, and when used in conjunction with pitch-height, how we may use the system to play a single line or melody.

Duration:

Duration divides each beat, with values quarter note-64th note on its Y axis. A value of quarter note is sustained for a full beat, and anything smaller takes the number of notes for that beat after being filtered by density and divides that many notes by how many times the note value fits into a beat. For example, if a 4 note chord is given an 1/8 note duration, then 2 members of the chord sound on the first half of the beat, and the remaining 2 members sound of the last half of the beat. The direction of arpeggiation is evenly random.

Accelerando and Dynamics:

The user sets a global tempo. Accelerando adds or subtracts from the global tempo per every beat, with -100bpm-+100bpm on its Y axis. Dynamics is the velocity of each beat, with ppp-fff on its Y axis. fff is velocity 127, ppp is velocity 27.

Playback and Formal Events:

The playback parameter controls the linearity of stepping through each beat, with 0-1000 beats on its Y axis. A diagonal line from bottom left to top right produces totally linear playback. Since our table contains no adjacent repetition, drawing curves for this parameter is the first method for producing repetition.

The second method for non-linearity is by using the repetition parameter, with 0%-100% on its Y axis. This is the likelihood that a repetition will occur. A parallel table containing every beat at which a plane shift occurred is organized into four sub-tables: for beats in which a plane shift for only one voice, for two voices, three, or all four. These sub-tables index our formal events—one for every time a voice changed harmonic planes.

Repetition has its own elasticity setting which corresponds to the likelihood that when a formal event is called, it is from the same sub-table. Motion within a sub-table is constrained random. The timing between instances of repetition is independent of playback tempo and is randomized within a set range. The final setting of this parameter is whether the repetition interrupts only a single beat, and continues to playback from where the playhead was, or if it moves the playhead as well (which produces a score of indeterminate length).

Irrational rhythms:

The accelerando parameter assigns a tempo to every beat, so softening this line makes for an expressive metric sensibility—but strictly speaking, this does not produce irrationality, but rather a tempo in flux. Within the beat, the notes in an arpeggio are the same distance apart. Since repetition maintains its own, randomized timing, its interruptions will statistically never occur in phase with anything else, and always break a full beat, change the tempo within a beat, or add length to a beat.

Harmonic leaps:

Since the system synthesizes the piece one beat after another, there is a distance-logic to every consecutive beat. The playback parameter and repetition parameter however, both allow the playhead to skip beats and jump to another part of the piece. These jumps yield a greater harmonic distance than our elastic motions permit.

Final filtering:

The last stage of the MIDI stream is an evaluation of the stream's intensity (i). For every 20 notes in a row, averages are taken for rate, pitch height, and velocity. These are added and divided by three to give the variable i. When the incoming intensity is above a chosen threshold, there is a 20% chance a note will be affected, and 5% chance a note will be disappear. When it's the case that a note is affected, its note on and note off messages are delayed in proportion to how much the threshold has been surpassed. Overall, this breaks up the perfection of arpeggios produced by the computer. Additionally, the velocity of each affected note is randomized (75%-100% of the original value) to gain some independence of voices within a chord.

The system has been used so far, as an aleatoric score generator, a material generator for further composing, and as part of a live feedback system with dance. Though Elastic_Harmonic_Space allows for musical parameters to move independently, and allows the four voices to move in independent directions, the voices always move concurrently. This means rests are not possible, but only grand pauses. In other words, its not possible that one voice may stop and the others continue, or that two of them slow down while the other two speed up. If however, the voices played through their parametric curves independently, then when using this system with push_push, it would be possible to divide the voices across the sensors. This way, one dancer could affect the soprano and alto voice, the other could affect tenor and bass.

4.4 Static (Occluding Causality in an Otherly-Contingent System)

Figure 20: Soloist and Dynamic Lamps

The static system is affirming, and relies on special implementation to provide resistance. In other words, the system provides no resistance of its own. Instead, the input contour is stripped of its state-space and mapped directly to some other state-space. In *A Swampy Crosshatching of Tributaries, No Main Vein*, this system was employed twice. First, it enabled the motions of a dancer to move parts of a poem. Second, it translated motions of a dancer into the flicker of lamps in the space. In both cases, the only causal occluding was the wireless connection between the dancer's sensor and the system response. The dancer wore his sensor underneath a jacket, hiding his input to the system.

4.4.1 Main

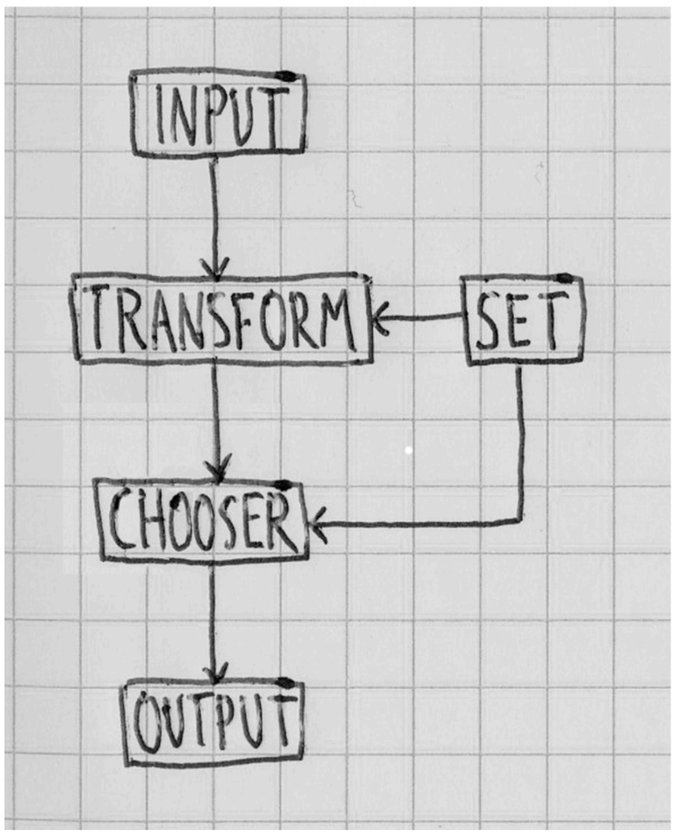

Figure 21: Main (Static)

1. output is input
2. the stream is contours divorced from their state-spaces
3. the data set is a state-space only
4. always, the contour is fitted to the state-space
5. if the contour exceeds its edges, this constitutes an event
6. at each event one choice from the set is outputted

4.5 Dynamic (Occluding Causality in an Self-Contingent System)

Figure 22: Coyote, a dynamic responsive system

Figure 22 shows two pianists, each playing at a conventional piano. Using a Moog Piano Bar, the keys depressed are read by an optical sensor and sent to a computer as a MIDI stream. The output MIDI stream is sent to a Disklavier for both players. The computers are running a dynamic, responsive system called Coyote.

Coyote's framework is non-musical. The system is designed using MIDI, but without relying on musical concepts. Coyote is for data streams. We first listen to the lines of a stream. These lines are moving, concurrently but independently. Changes in these motions are the edges of topologies. Between one edge and the next is the event, or singularity. Singularities are remembered, but never stay as they were. In its own time, the system responds with a stream greatly similar to previous events, but unlike the current stream.

In *A Swampy Crosshatching of Tributaries, No Main Vein*, Coyote was used in a musical context: piano > Coyote > player-piano. But the system could be employed equally well in any context, and may be combined with the other systems discussed so far. If for example, we wanted a truly dynamic relation between dancer and poem we might implement the following path: bodyTalk++ > Elastic_Harmonic_Space > Coyote > Text++. The remaining sections detail Coyote in block diagrams: main, transform, memory, and entrainment.

4.5.1 Main

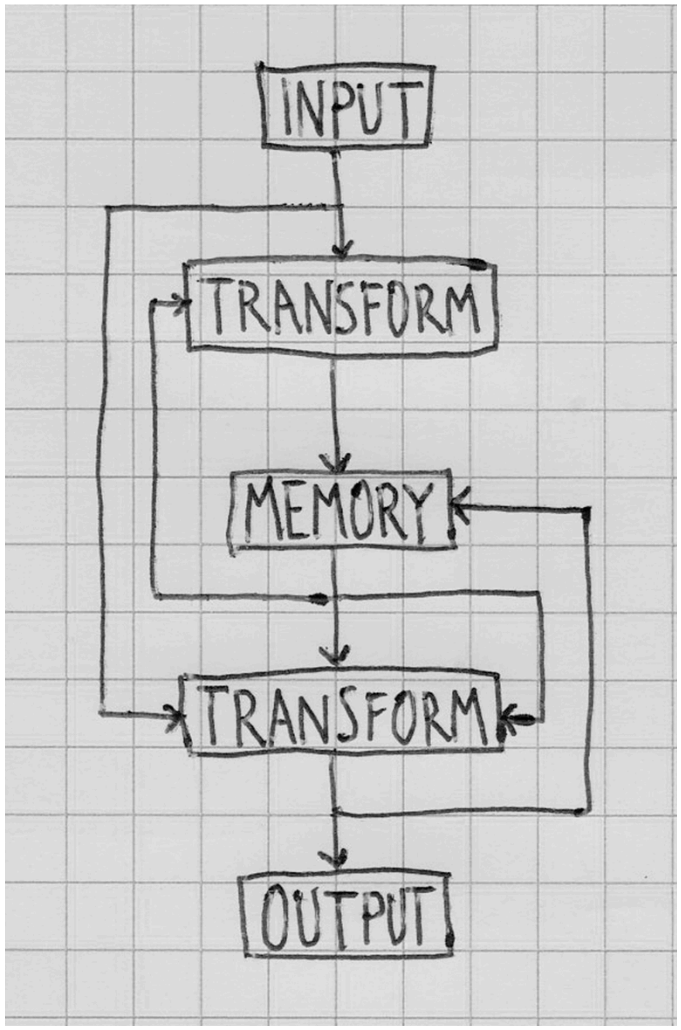

Figure 23. Main (Dynamic)

1. output is different from input
2. the relation of output to input is:
    A. nonsensical
    B. non-arbitrary
3. memory is the matter
4. the nonsensical is gotten from confounding the relation of data streams to memory
5. input streams may affect output streams before they are outputted
6. outgoing streams may affect input streams and/or other outgoing streams
7. if any two streams are simultaneous, one is affecting the other(s)

8. all changes are stored destructively

9. there is no original

10. the non-arbitrary is gotten from feedback

11. any novel topologies are composites of:

    A. the topologies they are replacing

    B. the topologies they've come into situation with

12. the non-arbitrary is contingent, and bears upon itself

4.5.2 Transform

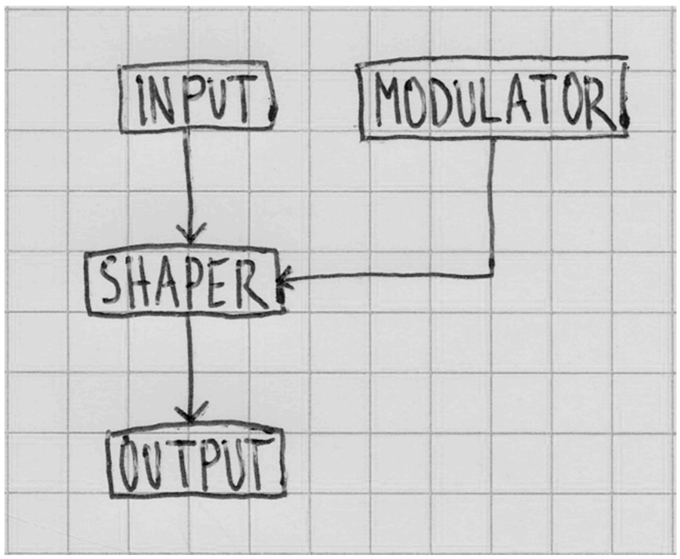

Figure 24. Transform

1. the stream is a composite of topological features

2. each feature is a contour and a state-space

3. if the input stream is simultaneous with the modulator stream, for some affected feature the input stream:

    A. retains the general contour of its feature

    B. inherits a state-space from the modulator's feature

4. other features continue without affect

4.5.3 Memory

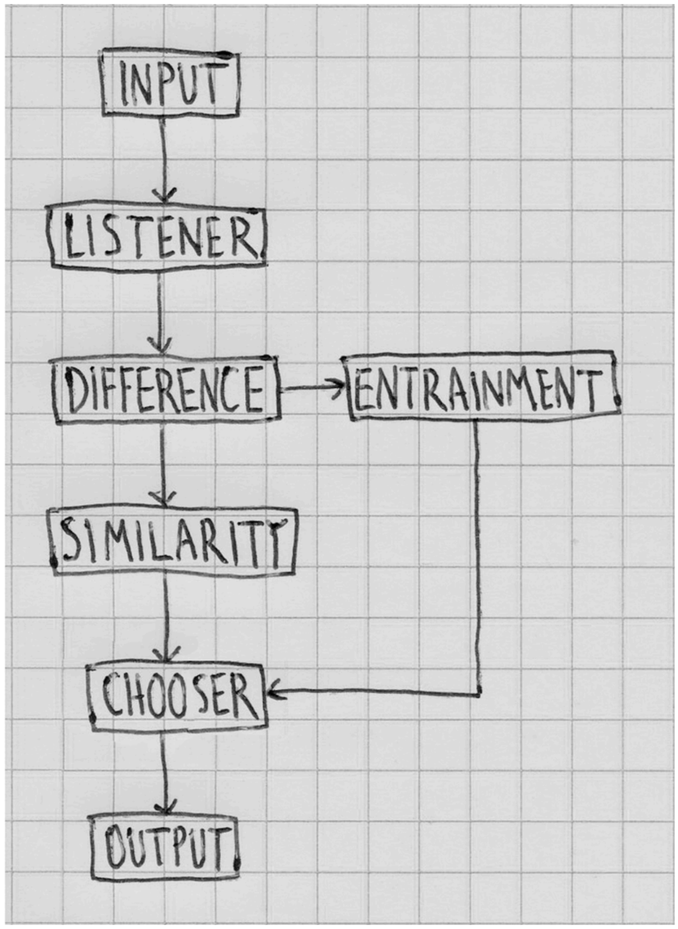

Figure 25. Memory

1. separate by difference, group by similarity
2. the features of the incoming stream are remembered and forgotten in a dynamic array of weighted state-spaces
3. when the edges of a contour exceed their state-space, this novelty constitutes an event
4. events are used to parse the stream into stored sequences
5. the input stream is compared, feature-to-feature, to every sequence, for a dynamic list of proximity
6. when a choice is triggered, the most distantly related sequence is recited

4.5.4 Entrainment

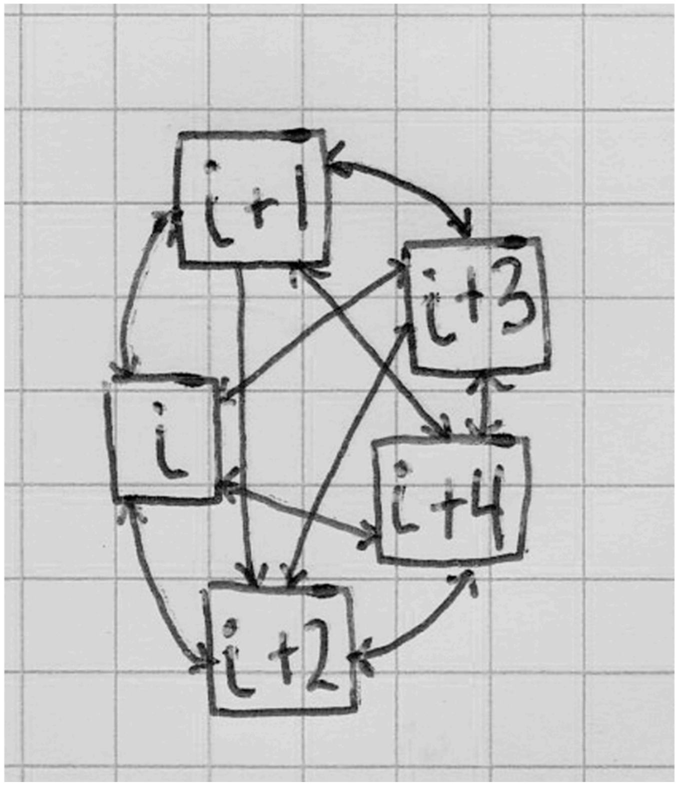

Figure 26. Entrainment

1. every new sequence introduces a new pulsing into a matrix in which all pulsings are connected
2. every pulsing begins at a random rate
3. if any pulses are simultaneous, those pulsings inherit an average of their rates
4. if a pulsing pulses alone, it resets to a new random rate
5. if all pulses are simultaneous, the matrix triggers one choice before all pulsings reset with new random rates

Chapter 5

Dynamics and Difference

In digital art making, what does resistance look like?

In Computer Music Experiences, James Tenney [1] describes analyzing traffic in a tunnel and the isolation of 'single elements within the total sonorous "mass," to feel, kinesthetically, the characteristic rhythmic articulations of the various elements in combination, etc.' He's talking about the phenomenal world in relation to making electronic music from filtered noise, and also how music is the discrete motions of parameters. I first wanted to draw the parameters and swapped the noise out for the harmonic planes used in Elastic_Harmonic_Space. It was after finishing that program that I started to outline the ideas in this paper. How does the system 1. begin without memory, 2. move independently? What is a musical, responsive system which doesn't employ/deploy musical concepts? From here my attention turned to the thing-in-relation-to-itself; the rhizome.

> We're tired of trees. We should stop believing in trees, roots, and radicles. They've made us suffer too much. All of arborescent culture is founded on them, from biology to linguistics. Nothing is beautiful or loving or political aside from underground stems and aerial roots, adventitious growths and rhizomes. Amsterdam, a city entirely without roots, a rhizome-city with its stem-canals, where utility connects with the greatest folly in relation to a commercial war machine. Thought is not arborescent, and the brain is not a rooted or ramified matter. What are wrongly called "dendrites" do not assure the connection of neurons in a continuous fabric. The discontinuity between cells, the role of the axons, the functioning of the synapses, the existence of synaptic microfissures, the leap each message makes across these fissures, make the brain a multiplicity immersed in its plane of consistency or neuroglia, a whole uncertain, probabilistic system ("the

> uncertain nervous system"). Many people have a tree growing in their heads, but the brain itself is much more a grass than a tree. "The axon and the dendrite twist around each other like bindweed around brambles, with synapses at each of the thorns." The same goes for memory. Neurologists and psychophysiologists distinguish between long-term memory and short-term memory (on the order of a minute). The difference between them is not simply quantitative: short-term memory is of the rhizome or diagram type, and long-term memory is arborescent and centralized (imprint, engram, tracing, or photograph). Short-term memory is in no way subject to a law of contiguity or immediacy to its object; it can act at a distance, come or return a long time after, but always under conditions of discontinuity, rupture, and multiplicity [2].

I want to read Deleuze as saying that everything in the rhizome is already touching already. So juxtaposing the first with the middle, or the outside with the last is like traversing the connections in a nodal network. If we consider the art-object a rhizome, then its parts are the nodes. Further, I'd like the rhizome to be a formal structure, so traversing the form is the same thing as making a formal gesture.

The non-rhizomatic is the categorical, and so the singularity (node) is vibrant, resistant to category—made from difference. "All identities are only simulated, produced as an optical "effect" by the more profound game of difference and repetition. We propose to think difference in itself independently of the forms of representation which reduce it to the Same, and the relation of different to different independently of those forms which make them pass through the negative."[3] I read this to mean a singularity is attended insofar as it's changing. I've modeled this vibrancy aspect as computer listening (separate by difference) and dynamic memory (storage of mutable data).

Since I'm using a computer, it would surely be possible to keep track of all the changes, and retain all the variations to a sequence. Long-term memory however, is categorical and originary. For the responsive system to be specific, the system can't have an agenda which precedes the situation. The system knows no achievement nor resolve; is not trying to get back to the garden. I'm thinking here of an image from Donna Haraway:

> Unlike the hopes of Frankenstein's monster, the cyborg does not expect its father to save it through a restoration of the garden; that is, through the fabrication of a

> heterosexual mate, through its completion in a finished whole, a city and cosmos. The cyborg does not dream of community on the model of the organic family, this time without the oedipal project. The cyborg would not recognize the Garden of Eden; it is not made of mud and cannot dream of returning to dust. [4]

And so our system has no memory before the situation, but only capacities. Tenney again, from Temporal Gestalt Perception in Music [5]: "What is needed is some way to combine or integrate the interval-magnitudes of all parameters into a single measure of change or difference." Patterns across our system's sensitive membranes constitute changes in the stream. These changes delineate sequences, but the sequences aren't original either. Deleuze reads simulacrum as not only devoid of its referent, but as indicating there was never a referent to begin with. "The simulacrum is not a copy, but that which overturns all copies by also overturning the models: every thought becomes an aggression." [3] I read this to say 'a thing' and 'a thing moving' is a tautology. And we see non-affirming strategy take on an avoidance of *essentialist* or *originary* structures when possible.

Come this far, our system is capable of responding, but when should it respond? At this point, my interest turned to ontological investigation of simple machines and cellular automata:

> The rules are applied to the entire population simultaneously and repeatedly for as long as the simulation is allowed to last. The fact that the interactions are rigidly specified by rules implies that they are *not emergent*. On the other hand, as the population interacts patterns of states in neighboring cells appear and these are indeed emergent since the patterns have properties, tendencies, and capacities that are not present in the individual automata. [6]

Manuel DeLanda here is looking at automata as a basis for bottom-up modeling of emergent, complex, chaotic or near-chaotic systems. For my purposes, I read *Philosophy and Simulation* as position on elegance—the argument being, complexity exceeds itself; is proportional to elegance. The degree to which a system's behavior is complex is inversely proportional to how many rules the system requires. Here, I'm talking about emergence in relation to giving the system a pulse, but the network or hive-effect is sought at every scale.

Non-affirming strategy is formal gesture by juxtaposition. This is form as group-effect. DeLanda again, talking about Delueze' relations of exteriority:

> [T]he reason why the properties of a whole cannot be reduced to those of its parts is that they are the result not of an aggregation of the components' own properties but of the actual exercise of the capacities. These capacities do depend on a component's properties but cannot be reduced to them since they involve reference to the properties of other interacting entities. Relations of exteriority guarantee that assemblages may be taken apart while at the same time allowing that the interactions between parts may result in a true synthesis. [7]

Chapter 6

Conclusion

We are looking for self-coherence in a member, disparate confluences among the group. The non-affirming should situate bodies in an unexpected loop. The system's contribution and its situation are like, in kind, but different enough for the situation to bear upon itself. The transfer is synesthetic; motions traversing sense modalities; wild distributions of power. If the system's contribution and the situation are exchangeable, or, if the system is confused for a situation-in-itself, the integrity of both are compromised. Their feedback loop is reliant on their asymmetry.

Motion at all is the unequal distributions of power, and any record of it should modulate, if only to maintain its reference. The record is a sequence. The sequence is moving.

The motions within memory serve augmentation. This extension puts the situation in dynamic relation with itself. As such, or to this end, the system is backgrounded. The hidden mechanism puts motions in-play with motions, without distraction. The system is not a body, but a means towards a dynamic architecture.

6.1 Non-affirming In Contrast To Calligramic

Much like the composition of calligram, in which the shape of a poem signals the poem's content, in digital interactive art, which is multimodal, the synesthetic relations between one mode and another are the same as the relation between the subject and its representation.

In the calligram mode, the second term is an instantiation of the first. Or, more precisely the first term and second term are the first and second instantiations of a hidden essential term. The first term is gotten from the hidden term, the second from the first. In this mode, the hidden term is dear to us. We make an imitation of this term, as precious as the real parent. Precious too are any of its children. This is the genealogical—a single memory across many iterations of the parent. It is bread-crumbs in the forest and mistakes the imitation for the original.

The calligram, first of all, is not possible. Across modalities, we will always find transliteration errors. Error occurs anytime we express the contour from one state-space, as the 'same' contour in another state-space. This distortion exists in opposition to the parent, and is a mistake. In the calligramic mode, the Eifel-Tower-poem must be in the shape of the Eifel Tower. The project requires the truncation or extension of line, and a simplified silhouette. Since the line must already fit inside the outline, and since the outline must already contain the line, the representational potency of each is reduced in favor of a tautology when combined.

Non-affirming strategy permits a dog-poem in the shape of the Eifel Tower. We get three things instead of one: this 'dog-poem', this 'Eifel Tower', this 'dog-poem-Eifel Tower'. The third term is emergent since it is neither defined by 'dog-poem' nor 'Eifel Tower', but is contingent still on both terms. In a signal path, this 'dog-poem' is input, 'Eifel Tower' is output, and 'dog-poem-Eifel Tower' names the feedback loop and asks, "what has a dog to do with a tower?". Our dog comes into view by its refusal to be encapsulated by a shape that doesn't belong to it. Our tower persists as a shifting silhouette- its edge modulated by foreign concept. Vibrant and glowing, is the part of the outline that withstands pressures from the poem to be different from what it would be.

6.2 Non-affirming In Contrast To Demonstrative

The non-affirming is imbued with simulacrum, its copies have no original. This is Peter Pan and his shadow—the reference is divorced from its referent, recursively, in asymmetrical feedback. Else is technical demonstration.

When the art-object is a technical demonstration, it is a causal demonstration. In this mode of spectatorship, the logics must all agree. The events, in order, should all be turned-out and visible, all process exposed. This mode is the mode of staring into a machine. Consider watching a vibraphone player. The player motions match the pitch motions-insofar as the keys to the player's left are lower in pitch, and each and every time the player moves to their right, the pitch goes up.

Consider the causality of a bassoon player. Engrossed are we with the line, and phrase, and morphologies of tone as topologies are traversed. But it's not very upsetting if the motions of the player go one direction, and the sound goes another. The logic may change without distraction since the art-object is not at the mechanism, but out at the necessity between the player and their instrument, between their command and their commotions.

6.2.1 Integrity of Terms

When causality itself is made the spectacle, we risk the integrity of the terms. Let's look, for example, at two possible strategies for making an interactive musical score to accompany a dance concert. 1. Employing non-affirming strategies, we capture a certain set of motions in the piece, put those motions in-play with some of the motions in the musical score. This system asks that dancers dance as dancers only. 2. On the other hand, if our system is affirming totally, then the causal relation between the terms, dance and music, negates their respective integrity- collapsing the two into a false unity. This system makes demands on the choreography, and asks that dancers dance as musicians. The difference between these strategies is not subtle, and makes for very different work: 1. a dance concert *with* music which is dynamic, and necessarily for this piece. 2. a dance concert *about* music which is dynamic, and necessarily for this piece.

An affirming strategy, by-itself, leaves little room for the piece to be about anything more than affirmation.

6.3 Motions In The World

The responsive system is only concerned with parts of the situation that are moving. Detailing what's always true about the situation doesn't reveal the situation like detailing what's changing about it. The responsive system seeks to parse out the singularity, whose predicates are in flux. To parse the dynamic from the static, we must extricate the singularity from the instance, and as such, take its contour and state-space as specific and pulsing.

All things being pulsatile, and all pulses being referential, motion is a matter of memory. In order that the memory behave like the motions it seeks to imitate, let its records run free and distort each other. Let a computer not be a perfect memory thing, which is a static memory thing, but a dynamic memory thing.

6.3.1 Mimetic Independence

We want first to afford logical independence to the parts from the composite. This is parsing, and allows us to recall sequences out of order. This is the bare requirement for juxtaposing disparate contours of motion. When non-adjacent sequences, in-play together, overlap at all, this creates emergent relations between them. Still, if this independence is strictly maintained, these engagements are non-productive. The feedback loop is not completed, the terms in-play won't bear marks of their interactions. They may continue, faithful to some 'original', and never marry into wild coincidence or strange fortune, never get augmented or undone. In this sense, the independent sequence is never 'in-play' at all, since emergence in the composite hasn't any effect on the parts.

6.3.2 Mimetic Vulnerability

Rather than regarding a table of data as a precious record, or even an ordered temporal sequence (slices of a unified whole), the indices should be granted more than logical independence (temporal displacement). They should also be granted a logical vulnerability (difference making difference) such that the data at each index is susceptible to modification by data at other indices. As the table is reordered, and its indices are recalled, let the resulting combinations of sequences change the sequences combined. In this model, the only way a sequence retains perfect integrity is if it is never recalled, or recalled in isolation. As a result, as soon as the model is running, it will not be possible to retrieve any original data input.

The situation is the same when considering recalled sequences in-play with the incoming data stream: the identity of the recalled sequence is modified by its interacting with the incoming stream, but so too is the recording of the incoming stream modified by its interacting with other data. The extent to which newly incoming data arrives to an already congested system will radically alter the 'faithfulness' of its record.

6.4 Computers for Doing Magic With

Why is the computer there? To ensure its necessity, we must hide it. A computer, when integral and invisible in the causal relations of motions, enables us to interact more directly with forms in and from the world.

Backgrounding the computer is backgrounding the interaction. The computer should transmit the correlate transparently—grafted onto the living branch. Interface is interference:

interface as such, distracts from the enablement; is mediated transfer. Mediation, as a thing unto itself, siphons attention to the interfacing, from the motions interfaced with. The unmediated transmission however, is specific and requires no special contortions of the body, there is no lexicon, there is no joystick. This is play, but a game without score. The backgrounded computer seeks to occlude the distinction between interaction and action, not by resolving them, but by obscuring the first—leaving only action. The too-visible computer enables correlations that incorporate the machine. The composite in this case is the mechanical and the computer is a monolith. The monolith is never as permanent as it portends; never casts a long enough shadow to ensure its own necessity. The hidden computer is shadows only. It is obscured by bodies and makes moves when we are looking the other way. When the computer is integral, the input and output lose distinction behind the same scrim. We are concealing the virtual situation: that one stream happens as the result of the other. We are un-concealing the real situation: one of moving bodies; the world just as we found it.

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