Faculty Colloquia

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Personal Notes

I. Introduction to the notion of "musical artificial intelligence" and "formal syntaxes".

1. What is the purpose of modeling, and theories of modeling? Rene Thom says that they involve both the description of phenomenological states (generally local, since global ones are "impossible to describe and predict") and the prediction of the temporal transformations from a given state to another, with the resultant prediction of the "target" state description. Prediction= future description, but also prediction involves the description of the process (transformational mechanism) itself. Thom states that models can not be completely deterministic, and this is a shortcoming. There are two types of models: kinematic and dynamic. Kinematic models describe the evolution of forms (morphologies) and kinematic ones describe the processes under consideration and, more importantly, parameterize the phenomenological states. Thus, in our case, a clear model of musical form would first include a kinematic description of the relevant musical parameters (as in Tenney's, or as in Polansky/Rosenboom description of morphological spaces, not to mention Rosenboom's work with the notion of "concept spaces" and the construction of attention dependent sonic environments. In these , he is clearly attempting to describe a new musical parametrization).

2. What is the role of musical theory, and what is its importance to our compositional aims. Canetti's theory of the "decay of information" would seem to imply that in order for composition to take place, theory must first account for the status quo in a way that does not necessarily lend support to same. That is, composition as a revolutionary and evolutionary process needs as complete an understanding the preexistant, current notion of "necessary change". In fact, composition without such a theoretical base is thought to be responsible for the "information decay", because composition proceeds on misapprehensions as if they were in fact, and in doing so codifies the stagnant order and retards the progress of evolution. This could be said for example, with the subsequent developments in serial thought which seem to ignore the generative morphological principles of Schoenberg while codifying minor, yet easier to manipulate, "surface level" facets, and indeed turning them into a kind of complex dogma--a restrictive one. Theory must be revolutionary in its redefinition of musical parameters and formal processes, and as such will create the basis for revolutionary composition.

3. The musical/historical role of theory has been one in which certain composers have presented their revolutionary ideas simultaneously with both their compositions and their theoretical treatises. In this we have Zarlino on counterpoint, Rameau on harmony, Berlioz on orchestration, Schoenberg on serialism, Partch on intonation and the corporeal role of music (not to mention Harrison and Tenney on intonation), and Cage on musical form and purpose. In some cases, the most revolutionary composers of a given generation have not been predisposed to codifying their theoretical innovations (Beethoven is a good example of this), but still, many of these have been tremendously influenced by those who did see fit to "theorize".

4. a) The development of a formal language, and the use of computers and other intelligent devices often represents an interest in the simulation of <u>natural musical</u> languages, much in the same way that the development of natural language recognition and simulation in more mainstream AI pre supposes an understanding of formal theories of grammar and syntax. The simulation of these languages has different ramifications in the compositional realm--its practicality is in the development of possiblities for the evolution of the creative domain- the construction of a formal, almost axiomatic base helps to heighten the understanding of the future possiblities and nature of the act itself. In addition, by clearly understanding the current stage of the linguistic and logical development of the art, we can better view the <u>evolutionary</u> nec-ssities of the art.

   b) The high speed and storage capacities of these devices, and the ability to maintain certain levels of phenomenological stability unencumbered (or unenhanced)by human fluctuations, be they nuero-physiological, emotional, or intellectual (or even social or spiritual), makes them useful for the creation of certain experimental aesthetic and compositional/perceptual environments. High speed computers can test out a large number of mechanistic decisions, and in some cases make deterministic tests yeilding a desired <u>musical</u> result where the human mind could not. This can help in the modeling of artistic systems, for the machine can quickly test many aspects of the desireability of certain possible descritptions of a state vs. the desired behavior, and discard or accept those that best fit.

   c) The simulation of musical languages has three categories: <u>perception, composition, and performance</u>. In effect , these could be said to exhaust the relam of musical activity. The simulation of <u>perception</u> is by and large unexplored (Tenney being one of the more interesting pioneers). But it could be argued that the use of computers to "analyse" music, even in the relatively quantitative ways that have been done so far (e.g. cataloging motives, Schenkerian type harmonic statistical characterizations, and the vast acoustical experimentation) are attenpts at the formalization of a perceptual language. What is of more interest to me is the use of even, say, analog circuitry and simpler electronic manipulation (Lucier, Oliveros, Reich, ...) to induce newer perceptual and aesthetic states, and to hva the peculiar characteristics of the technology create new percetual possibilities.

The simulation of a compositonal language has been experimented with in more detail. In particualr, aleatoric, stochastic, random, algorithmic, and other AI structures (tree searches, transformational "grammars") have been used with conseiderable success to produce compositiona which at least hint to us of the descriptions of new compositional/phenomenologic states and processes. The use of high speed computers can in some cases simulate the "decision process" so often talked about in composition. Some good examples are found in the works of Hiller, Xenakis, Mumma (for an interesting case of analog computing), Rosenboom, Tenney, Ames, Polansky, Martirano, and many other contemporary composers (even those associated with the local group the League of Automatic Composers, who have explored many fascinating processes of "group computer composition".)

The simulation of performance languages has perhaps recieved the most attention, especially in the development of new timbres and the compexites of sonic events---somethings the technology most immediately reccomends itself to, and somehting which perhaps presents less thorny aesthetic and compsotional problems. However, there is a great deal of interest in this field, notably in the development of the simulation of more "life-like" sounding instruments, the interaction of machine intelligence with "real-time"cx compositional and performance situations, and with the development of radically differnet philosphies and techniques of musician input to the sonic environment (e.g. Rosenboom's "brainwave" music).

5) The simuation and development of musical language and formal structural model can be broken down into two main areas of exploration: statistical and morphological. These will be defined below. A comprehensive syntax for musical language and thought must integrate the three areas of simulation described above, and indeed the same lahguage must serve for all three. Thus, a musical syntax is one in which the necessary parametric description has been made, and the dynamic theory has also been evolved (the description of processes). This ia at once, a post facto and a priori model, as will be seen.

II. Tenney's Statistical Perception Theory --Design of A perceptron as an example of simulation of natural language through purely statistical means

1. The kinematic step-definition of musical parameters in new way. Non-musically or stylistically biased. Specification of a multi-dimensional embedding for musical parameters.

2. The first basic dynamic model--the ideas of gestalt segregation and cohesion--temporal stream ~~segregati~~ organization

Example 1 — 3. Mehhanism for detection of TG initiation--peak detection.

4. Extension of the dynamic and kinematic realms: hierarchical structuring of TG's and application of above processes to all levels of organization.

5. Selected examples

Example 2 — a) Sample input ~~to~~ program (Varese D. 21.5; first 58 pitches.

Example 3 — b) First page of score of same piece with TG's drawn in.

Example 4 — c) First page of Ruggles' Portals with TG's

Example 5 — d) 2 selected pages from the FORTRAN program

Example 6 — e) pg. 58-59 from Ruggles paper showing comparison between perceptron results and more traditional analysis procedure.

Example 7 — f) pg. 69--map of intensity profiles- showing first hint of higher level morphological considerations.

III. Beginnings of Morphological Theory

A. 1. In this instance, the practival usage of a dynamic theory has preceded the parametrization of morphological states.

Example 8 — 2. David Rosenboom's use of auto-correlation of the evoked response sentic form (acton) with random morphologie to produce morphological tranformations: On Beigng Invisibl

Example 9 — b) Block diagram for synthesis-response system..

B. ~~tx~~ Morpholigcal metric spaces.

1. Dyanimc theory-construction of a formal language for morphogenetic ~~fm~~ considerations.
2. Definition of a shape: order list of of parametric values, in any dimensionality.
3. Morphological space requires the definition of a "topology" for that space. The metric topology will be used, because it seems that the concept of distance is essential to any formal consideration.
4. Construction of any metric on a set of shapes creates a well-ordered space.
5. Sample metric would be

$$\frac{\sum_{1}^{n} \left| a_i - a_{i-1} \right| - \left| b_i - b_{i-1} \right|}{n}$$

This metric is a simple one-giving the absolute value average difference between subsequent events. It is a rough measure of the "curvature" of a form, in correlated format.

6. There are infinitely many matrics possible on a given space. Each metric defines the perceptual criteria for ordering the space by the mind. Indeed, it might be suspected that the most accurate prediction ordereing metrics would be drawn from a study of the sentic forms themselves.

7. An invariant is a function B related to a function A where the distance under some metirc m is zero . The function B is said to be an invariant to A under m .

8. Comments: the inversion tranformation is an invariant under the example metric (because of the absolute values) as is transposition. R trograde, or slight transformati distortion is not. Distortion would be invariant under a metric which simply calculated the directionality of certain intervals (1 if different, zero if equal: this bears a relationship with the so-called Lebesque measure in real analysis.

9. A metric which looked at order values, and calculated absolute values of these, would preserve retrograde as invariant. It can be seen that many of these examples use the consepts of serialism, and Schoenberg himself talked frequently about the notion of invariant forms. These arre used here, however, soley for the sake of convenience.

10) A given formal transformation is said to be continuous if the distance between shape B and the source shape A is less than a certain defined ball of continuity around A. In other words, the perciever may define a certain radius around a given shape in which change is deemed to be undeterminable.

Example 10 — 10) Larry Polansky's Four Voice Canon #3 and #4

Example 11 — 11) David Rosenboom's Nazca Liftoff