The Melody Triangle - Pattern and Predictability in Music

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ABSTRACT

This is the abstract.

Keywords

Information dynamics, Markov chains, Collaborative performance, Aleatoric composition

1. INTRODUCTION

The Melody Triangle explores patterns of predictabillity in music in an interactive sound installation. This installation makes use of some models developed as part of research into Information Dynamics of Music. Music generally involves patterns in time, often a melodies or chord sequences are repeated, and times they are slightly modified. Composers commonly, consciously or not, play with his or her audience's expectations, by setting up patterns at that seem more or less predictable, and thus manipulating expectations and surprise in the listener. The research into information dynamics explores several different kinds of predictability in musical patterns, how human listeners might perceive these, and how they shape or affect the listening experience.

the statistical properties of this melody is based on where in the physical room the participant is standing, as this is mapped to a statistical space (see below). By exploring the physical space the participants thus explore the predictability of the melodic and rhythmical patterns, based on a simple model of how might guess the next musical event given the previous one. . . .

2. THE INFORMATION DYNAMICS MODEL

(some background on IDyOM) The active space is triangular, with each corner corresponding to three different extremes of predictability/unpredictability. When multiple people are in the space, they can cooperate to create musical polyphonic textures. For example, one person could lay down a predictable repeating bass line by keeping themselves to the periodicity/repetition side of the room, while a companion can generate a freer melodic line by being nearer the 'noise' part of the space.

2.1 User Interface

On the screen is a triangle and a round token.

With the mouse you can click and drag the red token and move it around the screen. When the red token is dragged into the triangle, the system will start generating a sequence of piano notes. The pattern of notes depends on where in the triangle the token is

The information dynamics engine has as input positions in space, and outputs a stream of symbols for each of those coordinates. These symbols are then interpreted as notes in a scale, each individual thus generating a melody. Each stream of symbols is at any one time defined by a transition matrix. A transition matrix defines the probabilistic distribution for the symbol following the current one. In fig x above, on the left we see two transition matrices, the upper one having no uncertainty and therefore outlining a periodic pattern. The lower one containing considerable unpredictability but is nonetheless not completely without perceivable structure, it is of a higher entropy. The current symbol is along the bottom, and in this case there are twelve possibilities. In the upper matrix in fig, we can see for example that symbol 4 must follow symbol 3, and that symbol 10 must follow symbol 4, and so on. Hundreds of transition matrixes are generated, and they are then placed in a 3d statistical space based on 3 information measures calculated from the matrix, these are redundancy, entropy rate, and predictive-information rate [see [cite]]. In fig x on the right, we see a representation of these matrixes distributed; each one of these points corresponds to a transition matrix. Entropy rate is the average uncertainty for the next symbol as we go through the sequence. A looping sequence has 0 entropy, a sequence that is difficult to predict has high entropy rate. Entropy rate is an average of surprisingness over time. Redundancy tells us the difference in uncertainty before we look at the context (the fixed point distribution) and the uncertainty after we look at context. For instance a matrix with high redundancy, such as one that represents a long periodic sequence, would have high uncertainty before we look at the context but as soon as we look at the previous symbol, the uncertainty drops to zero because we now know what is coming next.

Predictive information rate tell us the average reduction in uncertainty upon perceiving a symbol; a system with high predictive information rate means that each symbol tells you more about the next one. If we imagine a purely periodic sequence, each symbol tells you nothing about the next one, that we didn't already know as we already know how the pattern is going. Similarly with a seemingly uncorrelated sequence, seeing the next symbol does not tell us anymore because they are completely independent anyway; there is no pattern. There is a subset of transition matrixes that have high predictive information rate, and it is neither the periodic ones, nor the completely un-corellated ones. Rather they tend to yield output that have certain characteristic patterns, however a listener can't necessarily know when they occur. However a certain sequence of symbols might tell us about which one of the characteristics patterns will show up next. Each symbols tell a us little bit about the future but nothing about the infinite future, we only learn about that as time goes on; there is continual building of prediction.

When we look at the distribution of matrixes generated by a random sampling method in this 3d space of entropy rate, redundancy and predictive information rate, it forms an arch shape that is fairly thin, and it thus becomes a reasonable approximation to pretend that it is just a sheet in two dimensions. It is this triangular sheet that is then mapped on to the screen.

3. TECHNICAL IMPLEMENTATION (NEEDED?)

an application developed in OpenFrameworks would send the individuals positions and a bounding box values (for gesture recognition), to an application running the Information Dynamics Engine [Matlab/Prolog].

4. EXPERIMENTAL PROCEDURE

The study was divided in to 5 subtasks. The axes of the triangle would be randomly rearanged prior for each participant.

this first task, which will last [4/3] minutes, we simply ask you to move the token where ever in the triangle you wish,. This allowed the participant to get use to the environment get use to the interface and get a sense of how position of tokens changes a melody.

In the following tasks a background melody is playing and the participant are asked to find a second melody that 'works well' with the background melody. In each of these tasks the background melody has different statistical properties. In the first it ....., In the second the background melody ... in the third... And finally in the fourth case the melody is in the middle of the triangle, that is it....

5. RESULTS

X participants took part in the study (mean median age). (Prior musical experience?)

5.1 Stats of results

6. OBSERVATION/DISCUSSION

7. ACKNOWLEDGMENTS

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