FRACTAL STRUCTURES AND FORMALIZED COMPOSITION.

Magnus Eldénius,
Director of the EAM-studio at the School of Music and MusicoLOGY
Gothenburg University, Sweden
tel +46 31 773 40 37 fax +46 31 773 40 30 email: eldenius@musik.gu.se

ABSTRACT: Mappings from non-linear functions to music involve a large number of aesthetic choices. It is a matter of aesthetic approach as to whether those choices should cover all the stages in such processes in composition. This paper illustrates some examples where the aesthetic choice is an overwhelming principle in the use of non-linear functions. Metrical scaling is a matter of importance in most music, and an algorithm is presented, which calculates large scale functions from small metrical cells. The choice of algorithms creating fractal Brownian structures is discussed from a musical point of view.

One of the main purposes of constructing fractal algorithms in music is to try to find similarities between the behavior of certain complex phenomena, mapped to a chosen space, and the structure of patterns produced using comprehensible mathematical algorithms. Studies of the phenomena do not necessarily "establish" have to be associated with the formulas. In fact, it may be better if the formulas are built in an intuitive way, in the phase of searching and rejecting structural similarities. Such intuitions could be influenced by theories about phenomena more or less relevant to music and could, at the same time, be guided by principles of composition throughout history, especially by principles not specific to tonality.

Many composing projects in the area of fractals and the chaotic behavior of certain phenomena have been carried out at the Lindblad Studio at the School of Music and MusicoLOGY in Gothenburg, Sweden, using this approach.

Different affinities between small metrical cells and large scale metrical structures are found in such musical material. Metrical scaling is of importance irrespective of whether one studies Indian ragas, classical western music or the use of golden sections in the music of Bartók.

We have tried to transform metrical proportions, found in small rhythmic cells, to simple mathematical functions, mapping the proportions to small graphic figures. The intersections between parts of the cells are characterized by a discontinuity of the 1st order derivative. The functions are made so that the integral will increase exponentially with increasing length of the path. Through superposition of these cells, where a new cell starts at every point of discontinuity in the first order derivative, the resulting graphic patterns reflect different possibilities of additive and rhythmic superpositions of a certain cell.

It is obvious that decisive relationships between metrical sections in the small cell result in periodic graphical patterns. Non-divisible relationships, such as the golden section, on the other hand, result in graphic patterns with an almost chaotic structure.

It is therefore of interest to study phase spaces made up of these graphics and also to compare them with phase spaces constructed out of the dynamic behavior of different musical parameters. Phase spaces made up of these graphics give us extra information about the auto-correlation and the degree of chaos in the structure, but some of this information is already built into the process. The fact that they arise out of iterations with successive displacements correlated to the proportions in the cell automatically reflects the degree of auto-correlation. Normally, when constructing phase spaces, the delta parameter or the phase distance has to be arbitrarily chosen and the result must be evaluated for every new choice.

In this practical situations, where the algorithms have been used to develop material for composition, we have used metrical proportions calculated from the reading of poetry, preferably by the
author, in order to implement some kind of interministic causality, a characteristic property of fractals, the function is superposed randomly positive or negative and thereby results in a curve, more convenient to musical use. The discontinuities in the first order derivative are still preserved, mapping the same points.

The use of vocal sounds (glottal, fricatives, formants) as metrical elements in, for example, a rap, a Bach cantata or slavic-romantic music, inspired us to pick out metric proportions in different frequency intervals in the frequency domain.

Using collage theorem in the same manner we will also try to investigate connections between large scale structures and rhythmic cells in music and lyrics. Our main purpose, however, is to develop material for composition.

From this point of view, fractal curves mapping time-dynamic phenomena are fascinating. The combination of fractal structures, fractal dimension, estimated occupation of space, etc. makes Fractal Brownian Motion constructed with algorithms as inverted FFT or midpoint displacement very appropriate to musical applications. This is not only because they are handy to interpret as time-dynamic variations of musical parameters, but mostly because they contain something fundamental and natural, appealing to many musicians and composers, not only in the computer area. Music, like all art, needs some reliable foundation or space out of which some unexpected or informative events can create an emotional profile. If structures could be characterised as the ultimate example of "the most common structure - never seen" and could, in that sense, be compared with most of phenomena in nature.

Between two aesthetic or emotional events there has to be some redundant transport in time, a phenomenon that seems to be characteristic of all human activity. The use of fractal structures as fractal Brownian motion could thus be most useful, if the structure is limited to fractal within a certain interval.

We have used fractal Brownian structures realised by inverted FFT which makes it possible to decide where the scaling starts and stops. Above the interval of scaling, it is periodic and beneath the interval the fractal function is increasingly smooth. These characteristics are used in making these dimensional artificial frequency domains which could be used in convolutions between real and artificial sounds.

In the process of composing, where some material is collected from physical models, the mapping to musical parameters has to be treated with an artistic approach rather than a raw technical transformation from graphics to score. In spite of the increasing cooperation among physicists, programmers and composers there is still quite a "gap in the span" between the real purpose of art and mathematical or physical modelling. There is a tendency for musicians to overestimate the behaviour of physical models and figures which are raw models, constructed to resemble one side of a natural phenomenon. We are trying to decrease this gap, first of all by being aware of the problem, but we are also trying to develop a more direct dialogue with composers with similar interests in the matter of "aesthetic mapping".

References:

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