Algorithmic melody composition based on fractal geometry of music

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Abstract

There are almost as many styles of music as there are composers, as each composer imparts their own creative preferences and ideas when working on a composition. However, beyond this variety and individuality, are there rules or an underlying structure that essentially differentiates a musical composition from completely random and meaningless collections of notes? It is said that music is the right balance of the predictability (orderliness) and surprise (randomness). Quantitative study of that right balance can be performed by appealing to the notion of the fractal geometry [1]. It has been previously demonstrated that music can be characterized by the fractal geometry, obeying a $1/f^D$ power law, where D can be understood as the fractal dimension [2]-[7]. This suggestion holds for the pitch, melody and rhythm structure as well as for the loudness fluctuation of music [8].

Aim of the current work is to make evident the properties of the fractal geometry of human composed music [2,4]. In addition introduction and demonstration of the basic methodology of the algorithmic music composition is presented. Algorithmic music composition is based on the chaotic nonlinear dynamic systems, self-similar iterative maps or on the more complicated iterative schemes [9,10] taking advantage of the "structured spontaneity" of the nonlinear dynamics by directly transforming the mathematical objects (fractals) to the musical entities. Resulting scores incorporate enough self-similar chaotic structural complexity for the listener to perceive as being musical. It is shown that the fractal geometry is capable of quantifying and describing the human composed music of the different styles and eras [5]. This underlying structure may explain why music sounds generally pleasing, and shows how music composed by the human conciseness harmonizes with the nature at large [1,4]. It is well known that numerous natural phenomena exhibit fractal geometry [1,11] further it has been shown that on the level of neurons human brain resonates more efficiently with the input stimulus that has fractal geometry *cf.* [12,13].

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