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Genetic algorithms for music variation on genom platform

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Abstract

This paper considers the problems of algorithmic music variations and modeling of musical creativity in general with a help of genetic algorithms. The proposed model of algorithmic musical variations with genetic algorithms is based on analysis and adaptation of ideas about algorithmic musical variations provided by R. Kh. Zaripov. Implementation of created model is based on Genom software, the platform for experiments in modeling of musical creativity with genetic algorithms. Experiments show that the proposed model can be used to create simple musical variations. The practical application of this system lies in interactive help for composer in creationof various musical ideas for further development. Several experimental results are shown in a form of musical scores.

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*Keywords:*genetic algorithms; evolutionary music systems;search space; algorithmic music; modeling of music creativity.

1. Introduction

Genetic algorithms (GA) is a set of techniques, mainly used for problems of optimization. The idea behind GA is inspired by natural selection. In GA each possible solution from search space corresponds to some individual in a

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population. Population evolves until it reaches the desired solution or wastes all available resources (time, material or maximum number of generations). This concept is suitable for applications with large and ill-behaved search space. Minimal criteria for use of GA is the possibility of representing solutions in a symbol form, and the presence of methods to evaluate the solutions. The specifics of modeling of music compositions and problems inherent in this area correspond the concept of GA. This set of techniques finds its application in not only algorithmic music composition like in Biles (1992) and Jacob (1995) works but also in rhythm generation Dostal (2005), FM synthesis Horner, Beauchamp and Haken (1993) and so on. One of the first works in this area was done in early 90s. It shows the results of usage of GA for computer-assisted music composition Horner and Goldberg (1991).

This paper describes the possibility of algorithmic music variation (MV) with GA. Implementation of the proposed model is based on Genom software platform. First part describes theoretical background and methods of algorithmic musical variation. Second part describes implementation details and challenges of applying GA to MV on Genom and in general.

2. Methods

2.1. Musical variations as algorithmic process

In general, music variation is one of the composing techniques where a chosen main theme or a melody is repeated with some melodic, harmonic or rhythmic modification. There are many different forms of variations but this work considers only simple monophonic melody variations. This simplification allows building more comprehensive model of algorithmic MV preserving the main essence.

First work in modeling of musical creativity on the computer was carried out by Russian researcher R. Kh. Zaripov (1960). In his book R. Kh. Zaripov explores the possibility of modeling of musical variations on a computer. The system he created is able to generate musical variations for short monophonic melodies. The choice of monophonic melodies as a research material is not accidental; this limitation significantly reduces the space of search and provides more vivid and definite results for analysis. Melody is one of the most important parts of musical composition as the author says. Melody is a monophonic expression of a musical idea and it is its main building block Zaripov (1983).

The key idea behind his work is the transfer of invariant structure. Invariant structure (invariants) always relates to some specific form or shape and it is a set of immutable characteristics. There is no one universal rule to choose invariants from a music artifact. One melody may have different sets of invariants. Other important part of the transfer is transformants — procedures, which are applied to a melody to transform it without changing its invariants. Different transformation can break invariants of some sets and do not change them in others.

Before the creation of those key components the author analyses the melody and decomposes its structure. Firstly, melody is a sequence of tones in major or minor scale that is divided into smaller structures (phrase, sentence, chain).

His system implements following top-level algorithm:

- Random generator suggests new note
- The predefined rules determine whether the suggested note is appropriate or not
- Previous steps are repeated until the entire composition is created

This process, as explained by R. Kh. Zaripov, imitates a composer at work. As a rule a composer does not know the next note and the composing process seems random, however it actually obeys certain rules. The researcher tries to encode these possible rules manually. The rules are provided via matrix of transitions.

Most systems encode domain knowledge via parameters. Some of them are constants and others variables. For the sake of simplicity and due to the limit knowledge of the object of study some variable parameters became constants. For example, the system in the current paper uses fixed timeline encoding and only diatonic scale. These assumptions free more resources for more meaningful aspects of the domain area. R. Kh. Zaripov uses the following parameters in his system: