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Interactive Evolution of 3D Models based on Direct Manipulation for Video Games

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Abstract

Interactive evolutionary computation (IEC) is an effective solution for problems of user subjectivity. However, a significant problem with IEC is user fatigue. IEC requires direct evaluation, and so increasing the number of generations results in increased fatigue. We previously reported a method for building a three-dimensional (3D) model using interactive evolution. Here, we propose a method of direct manipulation (DM) using IEC to reduce user fatigue, whereby direct encoding is applied to the final results during post-processing. This allowed instant changes to the shape of the final model, reducing user fatigue. This method can manipulate several parameters of 3D models in real-time. Test results show that IEC with DM is superior to IEC alone.

Keywords: Interactive Evolutionary Computation; 3D Model; Direct Manipulation; Video Game;

1. Introduction

Evolutionary computation (EC) is a useful method to account for user subjectivity [1]. However, it requires control of an evaluation function, which can be inconvenient. Interactive EC (IEC), on the other hand, does not use an evaluation function but rather aesthetic selection to solve problems. However, IEC can lead to user fatigue during the course of an experiment. A number of studies on IEC have attempted to reduce this fatigue [6,7]. Previously, we researched the generation of three-dimensional (3D) models for videogames using IEC, and proposed a method that alters the results using post-processing [2]. In this paper, we describe a new method,

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based on our previous work, that reduces user fatigue through direct manipulation (DM). The scheme is illustrated in Figure 1.

2. Background

We previously reported a method for generating 3D models using IEC [2]. With this tool, amateur gamers can create 3D models that can be directly exported into videogames. However, the use of IEC can require a large number of generations, which can lead to user fatigue. A method that provides an interface that allows users to change the most recent results would allow direct encoding, which would improve the results without fatiguing users. We propose such a method using DM.

Cho et al. showed that evolution can be accelerated using DM [3]. They evolved fashion designs using IEC, and the number of generations decreased when they used DM. Similarly, we can expect to reduce user fatigue using DM.

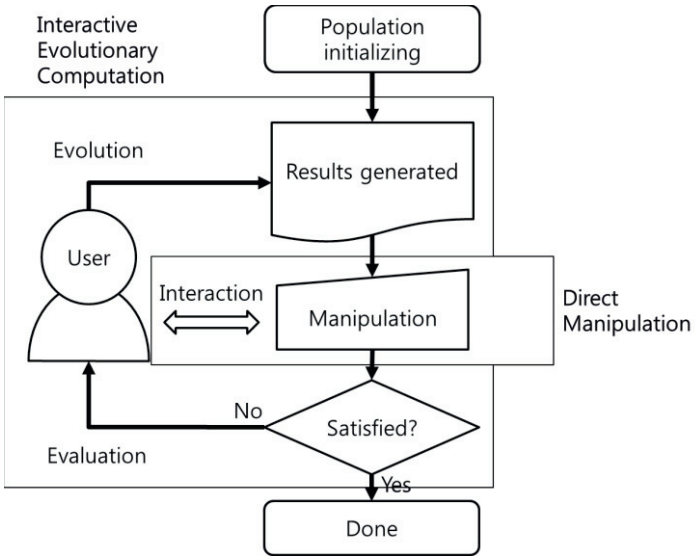

Fig. 1. Overview of direct manipulation based on interactive evolutionary computation.

3. Method for 3D Building Generation using Direct Encoding

In this section, we describe a method for generating 3D models using direct encoding (DE). First, to provide an intuitive method for users, we developed a tool for combining several simple 3D objects to generate complex 3D shapes. Using it, users can change the results intuitively by modifying each object. The changes should have a one-to-one correspondence. If not, then if, for example, one block is changed to two different blocks, the user may become confused.

3.1. Method to Generate 3D Shapes

Our method generates shapes by combining circular, rectangular, and polygonal pillars with three types of end sections, and the objects can be of variable size (Fig. 2). These features are necessary not only for crossover and mutation, but also for changing the size of objects. This method allows users to create complex shapes, particularly because it is not limited to objects of fixed size.