The Intelligent Behavior of 3D Graphical Avatars Based on Machine Learning Methods

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Abstract

Graphical avatars have gained popularity in many application domains such as three dimensional (3D) animation movies and animated simulations for product design. However, the methods to edit avatars’ behaviors in 3D graphical environments remain to be a challenging research topic. Because the hand-crafted methods are time consuming and inefficient, automatic actions of avatars are required. To achieve autonomous behaviors of avatars, artificial intelligent can be used in this research area. In this thesis, we present a novel approach to construct a system of automatic avatars in 3D graphical environments based on the framework of actors and directors relationship. This thesis intends to simplify the designers’ work and let them make the avatars’ behaviors in 3D graphical environments by giving instructions of specific tasks. After that, the avatars will achieve the goal depending on their own intelligence. Whether the intelligent controlling or policy making system has the efficient skill to accomplish such work is essential for the framework. On the other hand, this framework has a potential of solving the problem that small numbers of 3D animation designers are facing an explosive increase of 3D graphical environments as well as avatars.

A specific framework is created for controlling the behaviors of avatars, such as classifying the difference among the environments and using a theoretical probability model to describe these actions. Because of the requirement of simulating the interactions between avatars and environments after the classification of the environments, Reinforcement Learning is used to compute the policy to control the avatars intelligently in the 3D environments for the solutions of the problems in different
situations. Our approach has solved problems such as the structure of levels for the missions and how the learning algorithm will be used to control the avatars.

Moreover, the decision making needs high speed—even online ability to control the avatars’ actions. To achieve an efficient algorithm, the spectral probability density of stochastic process is used to estimate the optimal policy of actions.

In the thesis, our method to achieve these goals will be presented. The main contributions of this paper are:

- Presenting a novel framework to define the relationship between avatars and environments;
- Presenting an efficient algorithm of reinforcement learning with spectral estimation approach for making the policy of avatars’ actions intelligently;
- Presenting a method for avatars to recognize environments.
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