TJHSST Computer Systems Project Proposal Evolving Motor Techniques for Artificial Life 2007-2008

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November 2, 2007

1 Problem Statement

This project attempts to create and simulate evolving virtual creatures. The creatures should develop complex motor models over time, and even become specialized with the use of different fitness tests. The use of neuron-controlled creatures in combination with gene-controlled allows for a variety of unique creatures to develop.

2 Purpose and Scope

My research project is an attempt to create an artificial lifeform that can evolve and eventually learn to walk efficiently. Hopefully, if the simulation is run multiple times or more than one creature is created, they will be able to develop different methods for movement. Above all I want the creatures to be able to learn from experience and create an efficient way of walking. My programs are written in the breve 3D simulator software.

3 Background

3.1 Research

Most of the background for my project is based on a technical paper written by Karl Sims called "Evolving Virtual Creatures." In it he discusses how a

creatures brain should control it, such as how it should react to outside and inside stimuli, and what receptors detect these stimuli (sensors and neurons). There is also information on how these sensors and neurons affect the evolution of the creature, as well as different specializations for creatures (walking, swimming, jumping, and following).

3.2 Other Projects

Besides the research done by Karl Sims, Nicolas Lassabe, a doctorate student at the Universite Toulouse, has taken Sims' work and created a simulation of it in breve. This is more or less what I want to achieve, although my creatures may not be able to reach the same level of complexity as Lassabe's. His website includes videos of his simulated creatures, but no code or description of his work (he simply references Karl Sims).

4 Procedure and Methodology

4.1 Languages

I'm using the 3D simulation software breve to write my program. breve uses its own programming language called steve. My process for this project has been to start out creating simple walking creatures that have no intelligence. From there I plan to work on giving the creature a "brain" with sensors and neurons, and then work on having this input actually affect its evolution.

4.2 Testing

My program can be tested by tracing the path of evolution and the "effectiveness" of each decision made by the creature, and by observing the beginning and ending stages and seeing if the creature's walking strategy has been improved.

5 Testing and Analysis

5.1 Methods

To test my program I would have to find some measure to compare the efficiency of each decision the creature makes, such as increase in distance traveled over time. By this measure I can then see if the creature is responding to stimuli the way it should, and adapting its methods.

5.2 Dynamic Testing

I can test my programs sensors and neurons by seeing how it reacts to them. Its evolution can also be tested by introducing different stimuli and seeing if the creature evolves to accommodate them.

5.3 Process Modeling

My program cannot really be validated through mathematical formulas since the concept of efficiency is not mathematical. Mathematical formulas for physical simulation such as collision and force are already included in the breve simulator.

5.4 Requirements and Specifications

My program should follow the methodology described by Karl Sims, with creatures that react to their environment and the movements they make and can evolve accordingly. To verify if my program meets these requirements I can measure the distance traveled via the walking method of each evolution, and see if the creature is actually learning to walk more efficiently.

6 Conclusion

6.1 Expected Results

I expect my project to produce a variety of different creatures who have developed efficient, possibly specialized (swimming, jumping) ways of moving themselves.

6.2 Presentation of Results

I believe the best way to display my project would be through a video of a creature's progression, but if that was not possible a graph comparing the distance traveled at each evolution could also demonstrate that the creature is becoming more efficient at walking.

6.3 Final Performance

If all goes well the creature should perform by starting out with a very random, inefficient form of moving. At the beginning the creature may not actually manage to move itself across the ground at all. As it evolves and takes information from its surroundings and the previous decisions it has made, the creature should learn which movements are the best for walking and eventually have an efficient method for walking.