Evolving Virtual Creatures Revisited*

Peter Krčah
Department of Software and Computer Science Education
Charles University
Malostranské nám. 25
118 00 Prague 1, Czech Republic
peter.krcah@matfyz.cz

ABSTRACT

Thirteen years have passed since Karl Sims published his work on evolving virtual creatures. Since then, several novel approaches to neural network evolution and genetic algorithms have been proposed. The aim of our work is to apply recent results in these areas to the virtual creatures proposed by Karl Sims, leading to creatures capable of solving more complex tasks. This paper presents our success in reaching the first milestone - a new and complete implementation of the original virtual creatures. All morphological and control properties of the original creatures were implemented. Laws of physics are simulated using ODE library. Distributed computation is used for CPU-intensive tasks, such as fitness evaluation. Experiments have shown that our system is capable of evolving both morphology and control of the creatures resulting in a variety of non-trivial swimming and walking strategies.

Categories and Subject Descriptors: I.2.9 [ARTIFICIAL INTELLIGENCE]: Robotics; I.2.8 [ARTIFICIAL INTELLIGENCE]: Problem Solving, Control Methods, and Search

General Terms: Algorithms, Experimentation

Keywords: Artificial life, Computer aided/automated design, Evolutionary robotics, Evolving virtual creatures

1. INTRODUCTION

The aim of our work is to apply some of the recent results in relevant research areas to the virtual creatures proposed by Karl Sims [1]. Currently, our creatures have all properties (both morphological and control) of the original creatures. Creatures are placed in a virtual 3D world which is governed by the laws of physics simulated using ODE library [2]. Software is designed with extensibility and modularity in mind. It allows, for example, the evolution of different kinds of organisms using the existing framework or easy incorporation of a different creature control system. Several tools provide better understanding of a genetic algorithm (advanced graph of the fitness function, family tree viewer) and design of the creatures (creature genotype editor).

*This work is supported by the Grant Agency of Charles University in Prague under Grant-No.358/2006/A-INF/MFF.

GECCO'07, July 7–11, 2007, London, England, United Kingdom.
ACM 978-1-59593-697-4/07/0007.

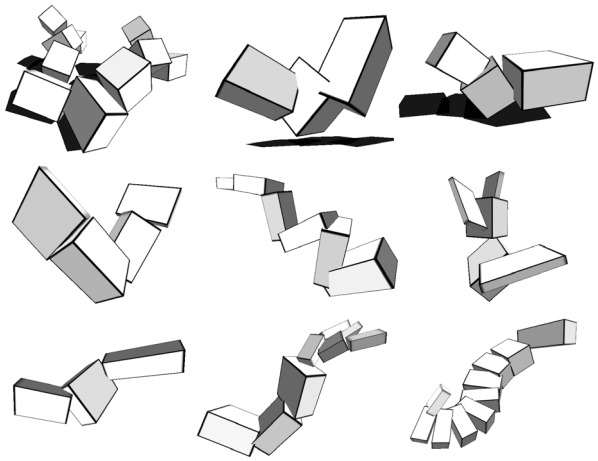

Figure 1: Creatures evolved for walking (top row) and swimming (middle and bottom row).

2. RESULTS AND CONCLUSION

Creatures have been evolved for walking and swimming. Experiments were conducted using the standard genetic algorithm (GA); 20% of the new population was formed by survivors copied from the previous generation, the rest was created by mutation, grafting and crossover operations in the ratio of 4:3:3. GA with 300 creatures per population and 100 generations has taken about 1.5 hours to finish, using the distributed computing with 5 computers (all Pentium IV 2.0GHz, 512MB RAM). A diversity of swimming and walking strategies has been discovered (Figure 1 shows several examples). The search, however, has often led to strategies which exploited inaccuracies in ODE physics engine to the advantage of the evolving creatures. Several techniques have been successfully introduced to prevent this behavior.

In summary, we have successfully evolved various types of virtual creatures with complex walking and swimming strategies. Our software provides several supplementary tools, which makes it suitable for further evolutionary experiments with the virtual creatures. For more information about the project, visit http://ero.matfyz.cz.

3. REFERENCES

[1] K. Sims. Evolving virtual creatures. In *SIGGRAPH '94: Proceedings of the 21st annual conference on Computer graphics and interactive techniques*, pages 15–22, New York, NY, USA, 1994. ACM Press.
[2] R. Smith. ODE manual. Available at http://www.ode.org.