Announcing the Final Examination of Brian Woolley for the degree of Doctor of Philosophy

Time & Location: June 4, 2012 at 3:00 PM in HEC 450
Title: Novelty-Assisted Interactive Evolution of Control Behaviors

The field of evolutionary computation is inspired by the achievements of natural evolution, in which there is no final objective. Yet the pursuit of objectives is ubiquitous in simulated evolution because evolutionary algorithms that can consistently achieve established benchmarks are lauded as successful, thus reinforcing this paradigm. A significant problem is that such objective approaches assume that intermediate stepping stones will increasingly resemble the final objective when in fact they often do not. The consequence is that while solutions may exist, searching for such objectives may not discover them. This problem with objectives is demonstrated through an experiment in this dissertation that compares how images discovered serendipitously during interactive evolution in an online system called Picbreeder cannot be rediscovered when they become the final objective of the very same algorithm that originally evolved them. This negative result demonstrates that pursuing an objective limits evolution by selecting offspring only based on the final objective. Furthermore, even when high fitness is achieved, the experimental results suggest that the resulting solutions are typically brittle, piecewise representations that only perform well by exploiting idiosyncratic features in the target. In response to this problem, the dissertation next highlights the importance of leveraging human insight during search as an alternative to articulating explicit objectives. In particular, a new approach called novelty-assisted interactive evolutionary computation (NA-IEC) combines human intuition with a method called novelty search for the first time to facilitate the serendipitous discovery of agent behaviors. In this approach, the human user directs evolution by selecting what is interesting from the on-screen population of behaviors. However, unlike in typical IEC, the user can then request that the next generation be filled with novel descendants, as opposed to only the direct descendants of typical IEC. The result of such an approach, unconstrained by a priori objectives, is that it traverses key stepping stones that ultimately accumulate meaningful domain knowledge.

Major: Computer Engineering

Educational Career:
Bachelor’s of Computer Engineering, BS, 2002, California State University, Sacramento
Master’s of Computer Engineering, MS, 2007, Air Force Institute of Technology

Committee in Charge:
Dr. Kenneth O. Stanley, Chair, Electrical Engineering & Computer Science
Dr. Charles E. Hughes, Electrical Engineering & Computer Science
Avelino J. Gonzalez, Electrical Engineering & Computer Science
Annie S. Wu, Electrical Engineering & Computer Science
Peter A. Hancock, Psychology

Approved for distribution by Dr. Kenneth O. Stanley, Committee Chair, on April 10, 2012.

The public is welcome to attend.