Editorial Introduction

Welcome to the third issue of volume 2 of *Evolutionary Computation*! As I have noted in previous issues, we are in the process of expanding the journal in several directions. One of the most exciting dimensions that MIT Press and its journal editors are exploring is the changing face of publishing in the rapidly developing age of low-cost electronic interconnectivity and multimedia delivery capabilities. My position so far as editor of *ECJ* has been a rather conservative one, namely, looking in the short term for ways these developing technologies can complement the journal in its present form.

Behind the scenes we are working to make as much of the submission and reviewing process as possible happen electronically over the Internet. More visibly, MIT Press now has a World Wide Web server on line (http://www-mitpress.mit.edu) and is currently maintaining a section on *Evolutionary Computation*, including subscription information and the titles and abstracts of all published issues. With the help of the authors and others, I would like to see this expanded to include links to authors' home pages, source code, data sets, image files, videos, and other related papers. I encourage you to browse and respond with suggestions.

Issues such as the electronic delivery of journals over the Internet and/or via CD-ROM have more earth-shaking implications for both the publishing and scientific community. As you are probably aware, there are a variety of experiments already underway to explore such possibilities. Although I have been participating in such discussions and following these events with interest, I have no current plans to move *ECJ* in those directions. Your thoughts and comments are always welcome.

This issue provides a nice example of the tremendous variety of activities in the field of evolutionary computation. The first paper, by Rob Smith, provides new insights into the use of internal memory (i.e., internal messages) in learning classifier systems (LCSs). Although effective sets of internal symbols are observed to form (as predicted by LCS theory), this process appears to be limited by "parasite" rules that emerge and persist in standard LCS architectures even though their use of the emerging symbols is inconsistent. Smith proposes and tests an extension to standard LCSs in which a multirule "classifier corporation" scheme is introduced as a means for resolving such problems.

There are many situations in which one wants to simultaneously optimize a system with respect to several objectives (e.g., the speed, cost, and fuel efficiency of a vehicle) without being able to combine such objectives (except artificially) into a single objective function. This usually induces a partial ordering on the solution space and results in a set of nondominated (Pareto-optimal) solutions. There has been considerable interest in using genetic algorithms (GAs) for finding such solution sets, but this inevitably requires changes to the standard GAs, which are typically designed to find a single solution. The paper by N. Srinivas and Kalyanmoy Deb presents a new GA extension involving "nondominated sorting," which appears to have considerable promise for solving such problems.

From the very beginning the GA community has been aware of and concerned about "the representation problem," that is, the fact that a particular fixed representation of the space to be searched induces a bias that makes some problems easy and others hard. A standard example of this is the effects of switching from a standard binary encoding of parameters to a Gray code. This leaves the GA practitioner in the position of having to

understand enough about a particular problem to choose an effective representation. If one has that kind of *a priori* knowledge, it would be silly not to exploit it. In the absence of such information, however, one would still like an effective search algorithm. Various proposals have been made for changing representations "on the fly" as the search proceeds and the properties of the search space become more apparent. The Mathias and Whitley paper describes and evaluates a new approach called "delta coding" that appears to be quite effective for dynamically changing the representation of parameter optimization problems.

The final paper in this issue also deals with representation issues, but more from an operator point of view. Joseph Culberson shows how crossover and mutation induce different but isomorphic structures on a GA search space. By understanding this isomorphism, one can convert problems that are represented in ways in which mutation is the more effective operator into alternative representations for which crossover is more effective. He then uses these insights to argue that traditional GAs do not use crossover all that effectively (in spite of claims to the contrary). These observations led to a new evolutionary algorithm, GIGA (a Gene Invariant GA), which is designed to use crossover more effectively than a traditional GA.

Enjoy!

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