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Artificial Evolution

Third European Conference AE '97
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Selected Papers



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Preface

The Artificial Evolution conference was originally conceived as a forum for the French-speaking Evolutionary Computation community, but has of late been acquiring a very cosmopolitan audience, with the Asian research community represented by several papers in these proceedings. However, AE remains as intended a small and friendly gathering, which will continue to be held every two years, alternating with PPSN, which is the main meeting-place of the European evolutionary computation community.

Previous AE meets were held in Toulouse and Brest, and the organizing committee yet again maliciously deprived the attendees of the attractions of Parisian night-life, by siting the conference in the sunny city of Nimes, with EERIE graciously doing the hosting.

The invited talk on financial applications of Tabu Search was delivered orally by Stavros Zenios of Cyprus University, although the paper on the foundations of the method included here was authored by his colleague Fred Glover of the University of Colorado. As regards the main body of papers, exactly twice the number published were in fact submitted to the review procedure, and all papers for the main conference were directed to three referees. One referee became the designated “minder” for each paper, and helped us track the status of the revisions during the process leading to publication. In this way, 38 original submissions were winnowed down to 28 oral presentations at the conference, and these in turn, with the adjunction of some of the evolvable hardware and robotics material, gave rise to the 20 papers selected for inclusion in these proceedings.

Some conference attendees had the pleasure of assisting in a real-time version of the refereeing process, by judging the Khepera contest. These tiny robots had already been demonstrated at the 1995 conference by Francesco Mondada, and the manufacturer graciously donated one sample as a prize for the team with the robot evincing the most interesting behavior. Olivier Michel provided his simulator as a training test-bed, and organized the contest; entries were judged on the basis of both simulated and real-world behavior. The description of the winning entry — the Nightwatch — has been included in the proceedings, and the organizing committee wishes to thank the computer staff at EERIE for the use of their facilities, and the entrants for the entertainment they provided to all attendees.

An evolvable hardware workshop was organized at the last minute, or rather in the last month preceeding the conference. Professor Eduardo Sanchez of EPFL demonstrated the Firefly machine, and Olivier Michel showed the 3-dimensional version of his Khepera simulator and described his idea of “internet gateways” by means of which a simulated robot might jump into different simulated environments hosted by various computers on the net. Two full-length papers on the CAM-Brain project spearheaded by Hugo de Garis at ATR were also presented at the workshop and have been included in these proceedings.

The papers selected for this volume have been grouped into the following six sections which broadly reflect the organization of the oral presentations.

1. **Invited Paper** where the state of the art in Scatter Search is described by Fred Glover.
2. **GA Operators:** Devising new genetic operators, be they general-purpose or problem-specific, is a popular research area in evolutionary computation. Jens Gottlieb and Nico Voss analyze two data representation and special operators the context of the satisfiability problem. Cathy Escazut and Philippe Collard introduce the *dreamy GA*, which includes a diversity-preserving mechanism inspired by the biological reality of REM sleep. Peyral et al. introduce explicit memory in the form of two virtual individuals, the *winner* and the *loser*, and examine the effects of social interactions (attraction, avoidance) between these and the individuals of the population. Gusz Eiben introduces SAW, a constraint handling mechanism by means of adaptative penalties, and examines its use in graph coloring.
3. **Applications:** The growing acceptance of evolutionary computation is demonstrated by the steady flow of papers describing applications very far from “pure” optimization. In these proceedings, Cristina Cuenca and Jean-Claude Heudin present an evolutionary user preference learning agent for the Internet. A. Piccolboni and G. Mauri optimize an energy function in order to predict protein folding. Isabelle Servet et al. compare the effectiveness of three optimization methods, namely multiple restart hill-climbing, PBIL, and GAs, for the inverse problem of computing traffic streams in telephone nets. Christine Gaspin and Thomas Schiex apply GAs to the problem of genetic mapping in molecular biology, and test their algorithms on gene data for the *trichogramma brassicae* wasp. Two application studies involve finite automata: Leblanc et al. address the inverse problem, in particular for automata with fixed points. And Julio Tanomaru generates Turing machines to solve simple arithmetical problems.
4. **Theoretical contributions:** Theoretical understanding seems to lag behind practice in the area of evolutionary computation; however, progress in the analysis of the behavior of the algorithms is now being made. Here Alexandru Agapie employs a Markovian model to derive minimal sufficient convergence conditions for the binary elitist genetic algorithm. Sangyeop Oh and Hyunsoo Yoon use the framework of computational ecosystems to examine punctuated equilibria where an SGA transits suddenly between metastable states. Bart Naudts and Alain Verschoren also examine the search dynamics of the SGA, specifically while solving an NP complete class of problems. Günter Rudolph investigates the influence of mutation distributions other than the conventional normal distribution.
5. **Methodologies:** This section of the proceedings has collected studies reflecting the general experience of the authors with evolutionary computation methods. Eric Dedieu et al. describe *opportunistic emergence* of robotic behaviors in the course of evolution. Ralf Salomon and Peter Eggenberger

define adaptation as the tracking of an optimum that moves with time, and compare the abilities of ES and GA in this respect. Christine Crisan and Heinz Muehlenbein conclude that a small modification of a solution followed by a restart helps search to escape local minima traps in the frequency assignment problem. Rochet et al. investigate the relevance of existing epistasis measures to GA-hardness. Finally, Marc Schoenauer and Leila Kallel attempt to estimate a priori the performance of crossover operators.

6. **Evolvable Hardware and Robotics:** The winning application in the Khepera Contest is presented here, with a robot doing a nightwatchman's rounds, detecting the state of light sources in its environment, and making a status report after each patrol. Two workshop papers from Hugo de Garis's Brain Building Project at ATR have been included here: Felix Gers et al. detail the cellular automaton model underlying the project's efforts, and describe some evolvability simulations, and the architecture of the hardware implementation in progress. A more speculative paper by de Garis et al. explores the issues raised by large scale neural evolvable structures with up to a billion neurons.

At this point, we would like to mention Catherine Dalverny, Isabelle Maurin, and Rachel Henaff at the EERIE in Nimes, and Geo Boléat of the CMAP in Paris, and thank them for their invaluable assistance with the nuts and bolts of organizing, and Aldjia Mazari who helped us escape from L^AT_EXhell. Finally, we would like to thank the EA97 program committee members for the service they rendered to the community by ensuring the high scientific content of the papers presented. The names of these very busy people, who still found time or made time to do the refereeing, are listed on the following page. The following additional referees, also donated their time: B.Ami, P. Brisset, M. Clergue, A. Gaspar, Leila Kallel, Tom Lenaerts, D. Memmi, Jean-Pierre Tillich, and Thomas Unger.

December 97

Jin-Kao Hao,
Evelyne Lutton,
Edmund Ronald,
Marc Schoenauer
and Dominique Snyers.

Artificial Evolution 97 - AE'97

October 22-24 1997

EMA-EERIE, Nîmes, France

EA'97 is the third conference on Evolutionary Computation organized in France. Following EA'94 in Toulouse and EA'95 in Brest, the Conference is sited in Nîmes, a 2000-year-old Roman City of Art and History, 45 km from the beautiful Mediterranean Sea.

EA'97 is hosted by LGI2P, common research laboratory in Computer Science and Production Engineering of the Ecole des Mines d'Alès (EMA) and Ecole pour les Etudes et la Recherche en Informatique et Electronique (EERIE).

Organizing Committee

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Highlights

An invited talk by F. Glover and S. Zenios

25 paper presentations

Khepera Contest, organized by Olivier Michel

Evolvable Hardware workshop, organized by Edmund Ronald

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