

## Preface

We are proud to introduce the proceedings of the Sixth International Conference on *Parallel Problem Solving from Nature*, *PPSN VI*, held in Paris, France, on 18–20 September 2000. PPSN VI was organized in association with the *Genetic and Evolutionary Computing Conference (GECCO'2000)* and the *Congress on Evolutionary Computation (CEC'2000)*, reflecting the beneficial interaction between the conference activities in Europe and in the USA in the field of natural computation.

Starting in 1990 in Dortmund, Germany (Proceedings, LNCS vol. 496, Springer, 1991), this biannual meeting has been held in Brussels, Belgium (Proceedings, Elsevier, 1992), Jerusalem, Israel (Proceedings, LNCS vol. 866, Springer, 1994), Berlin, Germany (Proceedings, LNCS vol. 1141, Springer, 1996), and Amsterdam, The Netherlands (Proceedings, LNCS vol. 1498, Springer, 1998), where it was decided that Paris would be the location of the 2000 conference with Marc Schoenauer as the general chair.

The scientific content of the PPSN conference focuses on problem solving paradigms gleaned from a natural models. Characteristic for *Natural Computing* is the metaphorical use of concepts, principles and mechanisms underlying natural systems, such as evolutionary processes involving mutation, recombination, and selection in natural evolution, annealing or punctuated equilibrium processes of many-particle systems in physics, growth processes in nature and economics, collective intelligence in biology, DNA-based computing in molecular chemistry, and multi-cellular behavioral processes in neural and immune networks.

Hence the reader will find in these proceedings a variety of sections: Analysis and theory of EAs, Genetic programming, Scheduling, Representations and operators, Co-evolution, Constraint handling techniques, Noisy and non-stationary environments, Evolvable hardware and hardware implementation of EAs, Combinatorial optimization, Applications, Machine learning and classifier systems, New algorithms and metaphors, Multi-objective optimization, EA software.

In total, these proceedings contain 2 invited papers and 86 contributions which were selected from 168 paper submissions to the conference organizers. The members of the program committee (listed on the next pages) had to work on an extremely challenging task in submitting their scientific reviews and facilitating the final decision for the acceptance of the top 51% of all submissions. We are very grateful to these volunteer reviewers who offered their scientific expertise in order to come up with a decision that was as fair as possible. We are aware that, in spite of all our efforts, the review process may not be perfect yet. Moreover, due to limited time and space, some good papers could not be accepted. In any case, we want to thank all authors of submitted papers for their participation, and for their – often involuntary – help in fixing problems with the Web-based submission-and-review procedure.

With respect to that submission procedure, we are deeply indebted to the EvoNet Electronic Communication Committee. We strongly believe that this fully electronic procedure simplified the review process greatly, and facilitated a smooth exchange of papers and reviews. The software used was an improved version of that used for the 1998 edition, which has also been used for various other conferences. One of its main original features was that it allowed the reviewers to mark their preferences among the papers related to their field of interest by browsing through the titles and abstracts. This helped us later to assign the papers and optimize the matching between papers and reviewers. Although some human intervention was needed at the end, we believe that a full autonomous system could be evolved in the near future to provide good support for future events.

As usual, PPSN VI is a poster-only conference; that is, all papers are presented as posters to facilitate personal discussion and the exchange of ideas between the presenter and the audience. Although this might imply a smaller audience than in the case of an oral presentation, the presenter of a paper has a better chance to get in touch with the people most interested in her/his topic. Consequently, posters are not “second-class” papers, as they are usually considered in some other conferences — they are just the means of presenting. The 86 papers presented at the conference were grouped into 7 sessions of about 15 papers each. To simplify the orientation within a poster session and to allow the audience to get a global overview of all sessions, each poster session was introduced by one volunteer who gave a brief overview of all papers presented within a session.

Only the three invited speakers presented audience a one-hour oral presentation of their research interests, results and scientific views. Aaron Sloman (Birmingham University, UK), Luc Steels (VUB AI Lab, Brussels and Sony Computer Science Laboratory, Paris) and Henrik Hautop Lund (Lego Lab, University of Aarhus, Denmark) all addressed new and emerging topics in natural computation.

Before the technical sessions began on 18 September, two one-day events took place, in cooperation with the adjacent SAB’2000, the Sixth Simulation of Adaptive Behavior conference, organized in Paris from 11 to 16 September (General Chair, Jean-Arcady Meyer). Seven workshops were organized at Collège de France on 16 September, and twelve tutorials were presented at the PPSN venue on 17 September. Both events addressed issues relevant to either conference, or, in most cases, to both conference themes. We would like to thank the corresponding chairs, David W. Corne (Reading University, UK) and Agoston E. Eiben (Vrije Universiteit Amsterdam and Leiden University, The Netherlands). The list of workshops and tutorials, together with their organizers and presenters, can be found on the following introductory pages.

Finally, we would like to thank the sponsors, who helped in one way or another to make this conference possible, with all the organizational hurdles that we had to overcome. These sponsors are the *INRIA*, who donated the high competence of the *Bureau des Relations Extérieures* staff that handled

the whole local organization, *EvoNet European Network of Excellence on Evolutionary Computation* ([evonet.dcs.napier.ac.uk](http://evonet.dcs.napier.ac.uk)), the *International Society for Genetic and Evolutionary Computation (ISGEC)* ([www.isgec.org](http://www.isgec.org)), France Telecom, the *Institut Français du Pétrole* ([www.ifp.fr](http://www.ifp.fr)) and *Nutech Solutions, Inc.* ([www.nutechsolutions.com](http://www.nutechsolutions.com)). We would like to give special mention to the *Association Française d'Intelligence Artificielle, AFIA* who intellectually supported this conference.

The invaluable help of Jose Carpio Canada and Pedro Castillo (Geneura Team, University of Granada, Spain) for setting up and maintaining the electronic submission procedure, of Benoît Leblanc (Projet Fractales, INRIA, France) our WebMaster, of Amrit Pratap and Sameer Agrawal (Indian Institute of Technology Kanpur, India) and Pierre Collet (CMAP, Ecole Polytechnique, France) during the process of assigning the papers to the reviewers, of Nathalie Gaudechoux (Projet Fractales, INRIA, France) for the preparation of the camera-ready version of these proceedings was highly appreciated and we would like to thank them personally for their efforts to make PPSN VI a success.

We are sure that these proceedings are a witness of the fruitful cooperation and exchange of ideas between natural computation groups from all parts of the world and mark some major progress in the field — and also that the French cultural traditions, represented during the conference by artistic, oenological and gastronomical events, have helped to support this development and to smoothen cultural barriers . . .

July 2000

Marc Schoenauer  
 Juan Julian Merelo  
 Kalyanmoy Deb, Günter Rudolph and Xin Yao  
 Evelyne Lutton  
 Hans-Paul Schwefel

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 F. Seredynski, Yuhui Shi, Mark C. Sinclair,  
 Moshe Sipper, Alice E. Smith, Jim Smith,

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Don Waagen, Peter Whigham, Darrell Whitley,  
Annie Wu, Xinghuo Yu, Nakao Zensho,  
Eckart Zitzler.

## PPSN VI Tutorials

Pierre Bessiere, *CNRS - IMAG, Leibniz laboratory, France*  
and Emmanuel Mazer, *INRIA Rhône-Alpes & IMAG, France*  
**Bayesian Robot Programming**

David Wolfe Corne, *University of reading, UK*  
**Bioinformatics**

Marco Dorigo, *IRIDIA, Université Libre de Bruxelles, Belgium*  
**An Introduction to Ant Algorithms and Swarm Intelligence**

Kerstin Dautenhahn, *University of Hertfordshire, UK*  
**Socially Intelligent Agents - From Animals to Animats**

Thomas English, *The Tom English Project, USA*  
**No Free Lunch: A Gentle Introduction to Conservation in Optimization and Learning**

Dario Floreano, *Swiss Federal Institute of Technology, Switzerland*  
and Stefano Nolfi, *Institute of Psychology, C.N.R., Italy*  
**Evolutionary Robotics**

Pedro Larranaga and Jose A. Lozano, *University of the Basque Country, Spain*  
**Optimization by learning and simulation of probabilistic graphical models**

Zbigniew Michalewicz, *University of North Carolina, USA*  
**Modern heuristics and evolutionary computation: principles and current issues**

Rolf Pfeifer, *University of Zurich, Switzerland*  
**Embodied Cognitive Science – Understanding intelligence**



XIV Organization

Colin Reeves, *Coventry University, UK*  
**Fitness Landscapes: A Guided Tour**

Moshe Sipper, *Swiss Federal Institute of Technology in Lausanne, Switzerland*  
**Cellular Automata and Self-Replication**

Darrell Whitley, *Colorado State University, USA*  
**Walsh Analysis, Schemata, Embedded Landscapes and No Free Lunch**

## PPSN VI Workshops

### **The CAM-brain Machine**

Hugo de Garis, *Brain Builder Group, Japan*

### **Learning Classifier Systems**

Wolfgang Stolzmann, *Universität Würzburg, Germany,*

Pier Luca Lanzi, *Politecnico di Milano, Italy*

and Stewart Wilson, *University of Illinois at Urbana-Champaign, USA*

### **Methodology**

Jason Daida, *in The University of Michigan, USA*

### **Multiobjective Problem Solving from Nature**

Joshua Knowles, *University of Reading, UK*

### **Parallel and Emergent Computation in Telecommunications**

Martin Oates, *University of Reading, UK*

### **Real-World Applications**

Rajkumar Roy, *Cranfield University, UK*

### **Speech as Adaptive Behaviour**

Luc Steels, *Vrije Universiteit Brussel, Belgium*

and Didier Demolin, *Université Libre de Bruxelles, Belgium*