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Applications of Evolutionary Computation

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Preface

Evolutionary Computation (EC) techniques are efficient, nature-inspired methods based on the principles of natural evolution and genetics. Due to their efficiency and simple underlying principles, these methods can be used for a diverse range of activities including problem solving, optimization, machine learning and pattern recognition. A large and continuously increasing number of researchers and professionals make use of EC techniques in various application domains. This volume presents a careful selection of relevant EC examples combined with a thorough examination of the techniques used in EC. The papers in the volume illustrate the current state of the art in the application of EC and should help and inspire researchers and professionals to develop efficient EC methods for design and problem solving.

All papers in this book were presented during EvoApplications 2010, which included a range of events on application-oriented aspects of EC. Since 1998, EvoApplications — formerly known as EvoWorkshops — has provided a unique opportunity for EC researchers to meet and discuss application aspects of EC and has been an important link between EC research and its application in a variety of domains. During these 12 years, new events have arisen, some have disappeared, while others have matured to become conferences of their own, such as EuroGP in 2000, EvoCOP in 2004, and EvoBIO in 2007. And from this year, EvoApplications has become a conference as well.

EvoApplications is part of EVO*, Europe's premier co-located events in the field of evolutionary computing. EVO* was held from the 7th to the 9th of April 2010 in the beautiful city of Istanbul, Turkey, which was European City of Culture in 2010. Evo* 2010 included, in addition to EvoApplications, EuroGP, the main European event dedicated to genetic programming; EvoCOP, the main European conference on EC in combinatorial optimization; EvoBIO, the main European conference on EC and related techniques in bioinformatics and computational biology. The proceedings for all of these events, EuroGP 2010, EvoCOP 2010 and EvoBIO 2010, are also available in the LNCS series (volumes 6021, 6022, and 6023).

Moreover, thanks to the large number of submissions received, the proceedings for EvoApplications 2010 are divided across two volumes. The present volume, which contains contributions for: EvoCOMPLEX, EvoGAMES, EvoIASP, EvoINTELLIGENCE, EvoNUM, and EvoSTOC; and volume two (LNCS 6025), which contains contributions for: EvoCOMNET, EvoENVIRONMENT, EvoFIN, EvoMUSART, and EvoTRANSLOG.

The central aim of the EVO* events is to provide researchers, as well as people from industry, students, and interested newcomers, with an opportunity to present new results, discuss current developments and applications, or just become acquainted with the world of EC. Moreover, it encourages and reinforces

possible synergies and interactions between members of all scientific communities that may benefit from EC techniques.

EvoApplications 2010 consisted of the following individual events:

- *EvoCOMNET*, the 7^{th} European Event on the Application of Nature-Inspired Techniques for Telecommunication Networks and other Parallel and Distributed Systems
- *EvoCOMPLEX*, the 1^{st} European Event on Evolutionary Algorithms and Complex Systems
- *EvoENVIRONMENT*, the 2^{nd} European Event on Nature-Inspired Methods for Environmental Issues
- *EvoFIN*, the 4^{th} European Event on Evolutionary and Natural Computation in Finance and Economics
- *EvoGAMES*, the 2^{nd} European Event on Bio-inspired Algorithms in Games
- *EvoIASP*, the 12^{th} European Event on Evolutionary Computation in Image Analysis and Signal Processing
- *EvoINTELLIGENCE*, the 1^{st} European Event on Nature-Inspired Methods for Intelligent Systems
- *EvoMUSART*, the 8^{th} European Event on Evolutionary and Biologically Inspired Music, Sound, Art and Design
- *EvoNUM*, the 3^{rd} European Event on Bio-inspired Algorithms for Continuous Parameter Optimization
- *EvoSTOC*, the 7^{th} European Event on Evolutionary Algorithms in Stochastic and Dynamic Environments
- *EvoTRANSLOG*, the 4^{th} European Event on Evolutionary Computation in Transportation and Logistics

EvoCOMNET addresses the application of EC techniques to problems in distributed and connected systems such as telecommunication and computer networks, distribution and logistic networks, interpersonal and interorganizational networks, etc. To address these challenges, this event promotes the study and the application of strategies inspired by the observation of biological and evolutionary processes, that usually show the highly desirable characteristics of being distributed, adaptive, scalable, and robust.

EvoCOMPLEX covers all aspects of the interaction of evolutionary algorithms (and metaheuristics in general) with complex systems. Complex systems are ubiquitous in physics, economics, sociology, biology, computer science, and many other scientific areas. Typically, a complex system is composed of smaller aggregated components, whose interaction and interconnectedness are non-trivial. This leads to emergent properties of the system, not anticipated by its isolated components. Furthermore, when the system behavior is studied from a temporal perspective, self-organization patterns typically arise.

EvoENVIRONMENT is devoted to the use of nature-inspired methods for environmental issues. It deals with many diverse topics such as waste management, sewage treatment, control of greenhouse gas emissions, biodegradation of materials, efficient energy use, or use of renewable energies, to name but a few.

EvoFIN is the only European event specifically dedicated to the applications of EC, and related natural computing methodologies, to finance and economics. Financial environments are typically hard, being dynamic, high-dimensional, noisy and co-evolutionary. These environments serve as an interesting test bed for novel evolutionary methodologies.

EvoGAMES aims to focus the scientific developments onto computational intelligence techniques that may be of practical value for utilization in existing or future games. Recently, games, and especially video games, have become an important commercial factor within the software industry, providing an excellent test bed for the application of a wide range of computational intelligence methods.

EvoIASP, the longest-running of all EvoApplications which celebrated its 12th edition this year, has been the first international event solely dedicated to the applications of EC to image analysis and signal processing in complex domains of high industrial and social relevance.

EvoINTELLIGENCE is devoted to the use of nature-inspired methods to create all kinds of intelligent systems. The scope of the event includes evolutionary robotics, artificial life and related areas. Intelligent systems do not necessarily have to exhibit human or animal-like intelligence. Intelligent behavior can also be found in everyday devices such as a digital video recorder or handheld devices such as an MP3 player which learn from the human who is operating the device.

EvoMUSART addresses all practitioners interested in the use of EC techniques for the development of creative systems. There is a growing interest in the application of these techniques in fields such as art, music, architecture and design. The goal of this event is to bring together researchers that use EC in this context, providing an opportunity to promote, present and discuss the latest work in the area, fostering its further developments and collaboration among researchers.

EvoNUM aims at applications of bio-inspired algorithms, and cross-fertilization between these and more classical numerical optimization algorithms, to continuous optimization problems in engineering. It deals with theoretical aspects and engineering applications where continuous parameters or functions have to be optimized, in fields such as control, chemistry, agriculture, electricity, building and construction, energy, aerospace engineering, design optimization.

EvoSTOC addresses the application of EC in stochastic and dynamic environments. This includes optimization problems with changing, noisy, and/or approximated fitness functions and optimization problems that require robust solutions. These topics recently gained increasing attention in the EC community and EvoSTOC was the first event that provided a platform to present and discuss the latest research in this field.

EvoTRANSLOG deals with all aspects of the use of evolutionary computation, local search and other nature-inspired optimization and design techniques for the transportation and logistics domain. The impact of these problems on the modern economy and society has been growing steadily over the last few decades, and the event aims at design and optimization techniques such as

evolutionary computing approaches allowing the use of computer systems for systematic design, optimization, and improvement of systems in the transportation and logistics domain.

Continuing in the tradition of adapting the list of the events to the needs and demands of the researchers working in the field of evolutionary computing, EvoINTERACTION, the European Event on Interactive Evolution and Humanized Computational Intelligence, and EvoHOT, the European Event on Bio-inspired Heuristics for Design Automation, decided not to run in 2010 and will run again in 2011. Two new events were also proposed this year: EvoCOMPLEX, the First European Event on Evolutionary Algorithms and Complex Systems, and EvoINTELLIGENCE, the First European Event on Nature-Inspired Methods for Intelligent Systems.

The number of submissions to EvoApplications 2010 was once again very high, cumulating 188 entries (with respect to 133 in 2008 and 143 in 2009). The following table shows relevant statistics for EvoApplications 2010 (both short and long papers are considered in the acceptance statistics), compared with those from the 2009 edition:

Event	2010			2009		
	Submissions	Accept	Ratio	Submissions	Accept	Ratio
EvoCOMNET	17	12	71%	21	15	71%
EvoCOMPLEX	12	6	50%	-	-	-
EvoENVIRONMENT	5	4	80%	5	4	80%
EvoFIN	17	10	59%	14	8	57%
EvoGAMES	25	15	60%	15	10	67%
EvoIASP	24	15	62%	14	7	50%
EvoINTELLIGENCE	8	5	62%	-	-	-
EvoMUSART	36	16	44%	26	17	65%
EvoNUM	25	15	60%	16	9	56%
EvoSTOC	11	6	54%	11	7	64%
EvoTRANSLOG	11	5	45%	11	6	54%
Total	191	109	57%	143	91	64%

As for previous years, accepted papers were split into oral presentations and posters. However, this year, each event made their own decision on paper length for these two categories. Hence, for some events, papers in both categories are of the same length. The acceptance rate of 57.1% for EvoApplications 2010, along with the significant number of submissions, is an indicator of the high quality of the articles presented at the events, showing the liveliness of the scientific movement in the corresponding fields.

Many people have helped make EvoApplications a success. We would like to thank the following institutions:

- Computer Engineering Department of Istanbul Technical University, Turkey, for supporting the local organization
- Istanbul Technical University, Microsoft Turkey, and the Scientific and Technological Research Council of Turkey, for their patronage of the event

– Centre for Emergent Computing at Edinburgh Napier University, Scotland, for administrative help and event coordination

We want to especially acknowledge our invited speakers: Kevin Warwick (University of Reading, UK), Luigi Luca Cavalli-Sforza (Stanford School of Medicine, USA); and Günther Raidl (Vienna University of Technology, Austria) and Jens Gottlieb (SAP, Walldorf, Germany) for their special EvoCOP 10th anniversary talk.

We are also very grateful to all the people who provided local support, in particular Sanem Sarıel-Talay, Şule Gündüz-Öğüdücü, Ayşegül Yayımlı, Gülşen Cebiroğlu-Eryiğit, and H. Turgut Uyar.

Even with an excellent support and location, an event like EVO* would not have been feasible without authors submitting their work, members of the Program Committees dedicating their energy in reviewing those papers, and an audience. All these people deserve our gratitude.

Finally, we are grateful to all those involved in the preparation of the event, especially Jennifer Willies for her unfaltering dedication to the coordination of the event over the years. Without her support, running such a type of conference with a large number of different organizers and different opinions would be unmanageable. Further thanks to the local organizer A. Şima (Etaner) Uyar for making the organization of such an event possible and successful. Last but surely not least, we want to specially acknowledge Stephen Dignum for his hard work as Publicity Chair of the event, and Marc Schoenauer for his continuous help in setting up and maintaining the MyReview management software.

April 2010

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Organization

EvoApplications 2010 was part of EVO* 2010, Europe's premier co-located events in the field of evolutionary computing, that also included the conferences EuroGP 2010, EvoCOP 2010, and EvoBIO 2010.

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