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Giovanni Squillero et al. (Eds.)

# Applications of Evolutionary Computation

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*Editors*

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# Preface

Evolutionary Computation (EC) is composed of a set of metaheuristics inspired by Darwin's Theory of natural evolution. These methods apply mechanisms based on the principles of genetics and selection, in order to solve, mainly, search, optimization, and machine learning problems. It is a very active research field, with several branches and subfields, and in which an increasing number of researchers and professionals are working.

This book presents a careful selection of state-of-the-art papers, sharing the application of EC approaches to several different problems. Its aim is to inspire other researchers to design and develop their own methods for problem solving.

All the papers in this volume were presented during EvoApplications 2015, which includes a set of different and complementary tracks on application-oriented aspects of EC. This conference was initially baptized as EvoWorkshops in 1998, and during these 18 years it has provided an excellent opportunity for EC researchers to meet and discuss different ways of application of EC to a variety of domains.

EvoApplications is a part of Evo\* (EvoSTAR), Europe's premier colocated event in the field of evolutionary computing. Evo\* 2015 was held during April 8–10 in the beautiful city of Copenhagen, Denmark. This event included, in addition to EvoApplications: EuroGP, the main European event dedicated to genetic programming; EvoCOP, the main European conference on evolutionary computation in combinatorial optimization and EvoMUSART, the main International Conference on Evolutionary and Biologically Inspired Music, Sound, Art, and Design.

The proceedings for all of these events in their 2015 (and previous) editions are also available in the LNCS series.

EvoApplications 2015 consisted of the following individual tracks:

- *EvoBIO*, track on EC and related techniques in bioinformatics and computational biology, which brings together experts across multiple fields, who draw inspiration from biological systems in order to produce solutions to complex biological problems.
- *EvoCOMNET*, track on nature-inspired techniques for telecommunication networks and other parallel and distributed systems. It addresses the application of EC techniques to problems in distributed and connected systems such as telecommunication and computer networks, distribution and logistics networks, interpersonal and interorganizational networks, etc. To address the challenges of these systems, this track 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*, track on evolutionary algorithms and complex systems. It 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 nontrivial. 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.

- *EvoENERGY*, track on EC in energy applications, which is intended as a platform for new, innovative computational intelligence, and nature-inspired techniques in the domain of energy-related optimization research. It seeks for contributions ranging from new control concepts for decentralized generation, strategies for their coordination in the network to the morphological optimization of distributed generators.
- *EvoFIN*, track on evolutionary and natural computation in finance and economics. This 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 coevolutionary. These environments serve as an interesting test bed for novel evolutionary methodologies.
- *EvoGAMES*, track on bio-inspired algorithms in games. It aims to focus the scientific developments in 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 application of a wide range of computational intelligence methods.
- *EvoIASP*, track on EC in image analysis signal processing and pattern recognition. This is the longest-running of all EvoApplication tracks which celebrates its 16th edition this year. It 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.
- *EvoINDUSTRY*, track on nature-inspired techniques in industrial settings, i.e., it seeks contributions from researchers, developers, and industrialists who have utilized EC within an industrial context.
- *EvoNUM*, track on bio-inspired algorithms for continuous parameter optimization. It aims at applications of bio-inspired algorithms, and cross-fertilization between these and more classical numerical optimization algorithms, to continuous optimization problems. It deals with applications where continuous parameters or functions have to be optimized, in fields such as control, chemistry, agriculture, electricity, building and construction, energy, aerospace engineering, and design optimization.
- *EvoPAR*, track on parallel implementation of evolutionary algorithms. It covers all aspects of the application of parallel and distributed systems to EC as well as the application of evolutionary algorithms for improving parallel architectures and distributed computing infrastructures. EvoPAR focuses on the application and improvement of distributed infrastructures, such as grid and cloud computing, peer-to-peer (P2P) system, as well as parallel architectures, GPUs, manycores, etc., in cooperation with evolutionary algorithms.
- *EvoRISK*, track on computational intelligence for risk management, security, and defense applications. This track focuses on challenging problems in risk management, security, and defense, and covers both theoretical developments and

applications of computational intelligence to subjects such as cyber crime, IT security, resilient and self-healing systems, risk management, critical infrastructure protection (CIP), military, counter terrorism and other defense-related aspects, disaster relief, and humanitarian logistics.

- *EvoROBOT*, track on EC in robotics. It focuses on evolutionary robotics: the application of evolutionary computation techniques to automatically design the controllers and/or hardware of autonomous robots, real or simulated, which is a multifaceted field that combines approaches from other fields such as neuro-evolution, evolutionary design, artificial life, or robotics.
- *EvoSTOC*, track on evolutionary algorithms in stochastic and dynamic environments. It 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, providing the first platform to present and discuss the latest research in this field.
- And finally, a General track including those papers dealing with applications not covered by any of the established tracks.

EvoApplications 2015 had 125 submissions, with 52 papers accepted for oral presentation and 21 for poster presentation, but having both types of contributions the same length in the proceedings. These figures correspond to a low acceptance rate of 58.4 %, which is an indicator of the high quality of the articles presented at the conference.

Many people helped to make EvoApplications 2015 a success. We would like to thank first the authors for submitting their work, to the members of the Program Committees for devoting their energy to reviewing those papers, and to the audience for their participation.

We would also like to thank the Institute for Informatics and Digital Innovation at Edinburgh Napier University, UK, for their coordination efforts, especially to Jennifer Willies for her invaluable work and support to organize the Evo\* event along these years.

We are sincerely grateful to Marc Schoenauer of Inria, France, for his great assistance in providing, hosting, and managing the submission, reviewing, and selecting system, MyReview.

We would like to thank the Local Organizers: Paolo Burelli (Aalborg University Copenhagen) and Sebastian Risi (IT University of Copenhagen), and to the National Museum of Denmark at Copenhagen as the venue.

We thank Pablo García Sánchez from Universidad de Granada, Spain for creating and maintaining the official Evo\* 2015 website, and Mauro Castelli from Universidade Nova de Lisboa, Portugal for handling Evo\* 2015 publicity.

Finally, we would also like to express our sincerest gratitude to our invited speakers, who gave the inspiring keynote talks: Pierre-Yves Oudeyer, Research Director at Inria Paris, and Paulien Hogeweg of Utrecht University at The Netherlands.

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