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Artificial Evolution

12th International Conference, Evolution Artificielle, EA 2015
Lyon, France, October 26–28, 2015
Revised Selected Papers

Springer

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Preface

This LNCS volume includes the best papers presented at the 12th Biennial International Conference on Artificial Evolution, EA[1] 2015, held in Lyon (France). Previous EA editions took place in Bordeaux (2013), Angers (2011), Strasbourg (2009), Tours (2007), Lille (2005), Marseille (2003), Le Creusot (2001), Dunkerque (1999), Nimes (1997), Brest (1995), and Toulouse (1994).

Authors were invited to present original work relevant to artificial evolution, including, but not limited to: evolutionary computation, evolutionary optimization, co-evolution, artificial life, population dynamics, theory, algorithmics and modeling, implementations, application of evolutionary paradigms to the real world (industry, biosciences), other biologically inspired paradigms (swarm, artificial ants, artificial immune systems, cultural algorithms), memetic algorithms, multi-objective optimization, constraint handling, parallel algorithms, dynamic optimization, machine learning, and hybridization with other soft computing techniques.

Each submitted paper was reviewed by three members of the international Program Committee. Among the 31 submissions received, 18 papers were selected for oral presentation and eight other papers for poster presentation. For the previous editions, a selection of the best papers that were presented at the conference and further revised were published (see LNCS volumes 1063, 1363, 1829, 2310, 2936, 3871, 4926, 5975, 7401, and 8752). Exceptionally, for this edition, the high quality of the 18 papers selected for the oral presentation led us to include a revised version of all these papers in this volume of Springer's LNCS series.

We would like to express our sincere gratitude to our invited speakers: Darell Whitley and Guillaume Beslon.

The success of the conference resulted from the input of many people to whom I would like to express my appreciation: the members of Program Committee and the secondary reviewers for their careful reviews that ensure the quality of the selected papers and of the conference, the members of the Organizing Committee for their efficient work and dedication assisted by Véronique Deslandres and Eric Duchene, the members of the Steering Committee for their valuable assistance, and Aurélien Dumez for his support on the administration of the website.

I take this opportunity to thank the different partners whose financial and material support contributed to the organization of the conference: Polytech'Lyon, University Lyon 1, ERIC, LIRIS, and CNRS.

[1] As for previous editions of the conference, the EA acronym is based on the original French name "Evolution Artificielle."

Last but not least, I thank all the authors who submitted their research papers to the conference, and the authors of accepted papers who attended the conference to present their work. Thank you all.

February 2016

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Lyon, France
12th International Conference on Artificial Evolution

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Invited Speakers

Guillaume Beslon, Professor at the Computer Science Department of the National Institute of Applied Science in Lyon (France), which is part of the Université de Lyon. Member of the Laboratoire d'InfoRmatique en Image et Systèmes d'information (LIRIS, UMR 5205 CNRS); Head of the Inria Beagle Team, former director of Rhône-Alpes Institute of Complex Systems (IXXI).

Can Artificial Evolution Shed Light on Evolution of Complexity in Real Organisms?

Artificial evolution has a long a successful history in optimization. Yet, artificial evolution in a computer can also be used as a model of "real evolution." This field of research, known as "digital genetics" or "in silico experimental evolution," is rapidly growing and results accumulate rapidly. In this talk, I will present how in silico experimental evolution can be used to study the C-value paradox, an open question in biology for more than 40 years. To this aim, I will present aevol, a simulation software developed by the LIRIS/Inria Beagle Team, and show how using such tools can shed new light, often counterintuitive, on this old question.

Darrell Whitley. Prof. Whitley is Chair of the Department of Computer Science at Colorado State University. From 1993 to 1997 Prof. Whitley served as Chair of the Governing Board of the International Society for Genetic Algorithms. In 1999 ISGA merged with the Genetic Programming community to form the International Society for Genetic and Evolutionary Computation. From 1997 to 2002 Prof. Whitley served as Editor-in-Chief for the journal *Evolutionary Computation* published by MIT Press. In 2005 ISGEC became a Special Interest Group (Sigevo) of ACM. In 2007 Prof. Whitley was elected Chair of Sigevo.

Blind No More: Deterministic Move and Recombination Operators for Evolutionary Algorithms

For decades, most local search algorithms have relied on enumerating a neighborhood of solutions in order to locate improving moves. Evolutionary algorithms have similarly relied on random mutation and random recombination operators to generate new candidate solutions.

For k-bounded pseudo-Boolean optimization problems such as MAX-kSAT and NK-Landscapes, we have been able to prove it is possible to exactly identify improving bit flip moves in constant time under reasonable assumptions. Furthermore, this result can be generalized: We can also identify all improving moves within a Hamming radius r in constant time. This means that we no longer need to enumerate neighborhoods for local search, or to use random mutations to locate improving moves.

We can also prove that there exist deterministic forms of recombination that are also guaranteed to return the best possible offspring under reasonable assumptions. Given two parent solutions, the method identifies p subgraphs that partition the variable interactions of the parents. Given p subgraphs, recombination can be done in $O(n)$ time such that crossover returns the best solutions out of 2^p offspring. This form of "partition crossover" has been developed for both k-bounded pseudo-Boolean optimization problems as well as for the traveling salesman problem. Empirical results suggest that partition crossover is highly effective at accelerating search. We can now quickly generate globally optimal results for problems with n = 100,000.

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