SIGEVOLution

newsletter of the ACM Special Interest Group on Genetic and Evolutionary Computation

Volume 8
Issue 3

in this issue

EDITORIAL

This issue has somewhat of a creative theme. The front cover showcases an art work generated by the Unplugged Evolutionary Algorithm, a project that combines Artistic Expression and Computer Science by applying evolutionary algorithms in order to study the processes that influence artistic creation. Our feature article , written by Prof. A. Eiben and Prof. J. Smith, is a summary of their recent Nature article, published in May 2015, and discusses how Artificial Evolution can be used to create new objects, bypassing the need for a human designer. Such high-profile coverage of Evolutionary Computing is great news for the field in general. On the same theme, a new book by Kenneth Stanley and Joel Lehman (Why Greatness Cannot be Planned: The Myth of the Objective), previewed on page 7 adds further weight to the argument that biological evolution, science, and human culture are creative, endlessly innovative processes.

The issue also provides a précis of another recent book, written by Mike Preuss, on the subject of Multi-Objective Optimisation by Means of Evolutionary Algorithms. Xiaodong Li of RMIT University, Melbourne, kindly provided a review – it seems clear that the book will provide an excellent and comprehensive resource for researchers and practitioners working in this area. More new research is highlighted in two recent Special Issues from ECJ and GPEM, on the topics of Theory of Evolutionary Algorithms and Semantic Methods in GP respectively.

Finally, both GECCO and PPSN have announced their keynote speakers - be sure to register early to take advantage of the best rates and don't miss out on hearing speakers working at the top of their fields.

As ever, if you have articles, news or stories you would like to see published in the newsletter, please let me know

Emma Hart, Editor

Evolutionary Art

Evolutionary Algorithms have been frequently employed as a means for artistic creation and design, in which human artists guide the creative process, through aesthetic and conceptual evaluation, and computers are in charge of applying more repetitive genetic operations. The success of this interactive version of the evolutionary algorithm is well documented, although researchers are still struggling to find a way for properly encoding good aesthetic measures. But other possibilities exist for computer mediated artistic creation, such as applying an opposite approach: instead of allowing human beings to guide the artistic process, we could establish the main evolutionary algorithm steps as a path to be followed by human artists, such that every step is performed by his hands and brains, while the evolutionary algorithm is the framework that dictates how to progress.

This approach, that we refer to as the Unplugged Evolutionary Algorithm, was applied to produce the collective work XY, recipient of 2013 ACM GECCO Art, Design and Creativity award, as well as XYZ, a new collective artwork that has allowed us to better understand artists way of expressing creativity from the evolutionary algorithm point of view. The work is made up of sixty individual paintings and can be accessed at: http://xyz-project.herokuapp.com/. We hope the approach will not only be useful for researchers to learn from artists, which eventually could in the future allow improvements to available algorithms, but also provide new methodologies for collective art production.

F. Fernández de Vega, C. Cruz, P. Hernández, L. Navarro, V. Albarrán, L. Espada.

The front cover image was generated using the Unplugged Evolutionary Algorithm

Top: Generation 2-1
Bottom: Generation 10-1

Towards the Evolution of Things

A.E. Eiben and **J.E. Smith**

Evolutionary Computing has received major exposure this year. Nature, the top dog of scientific journals, devoted a full-length review article to this field [1]. Evolutionary algorithms have been around for about three decades, without obtaining such high profile coverage, so what changed?

In our view the new interest is based on a possible new role for artificial evolutionary systems. Traditionally, artificial evolution equated to evolutionary problem solving, that is, using evolutionary algorithms as heuristic methods for solving optimization, design, and modelling tasks [2]. We strongly believe that such systems will always be important, and that research in this area will continue to flourish. However, increased interest has been sparked not just by high-profile success stories, but also by interesting developments in other directions. First of all, there is a wider interest in, and debate around AI-in-general, prompted by fears and by some well publicised advances in areas such as deep learning [3]. Perhaps more critically for our field, developments over the last couple of years boosted a latent opportunity of employing artificial evolution far beyond using it as an optimizer. The punchiest way to explain this potential is through the following four statements.

- Evolution can produce intelligence.
- Artificial evolution can produce artificial intelligence.
- The physical form of an agent plays a significant role in its “intelligence”.
- New fabrication technologies are transforming how we can create objects.

The first statement is proven by our own intelligence that is a result of evolution on Earth. The second one, then, is a reasonable expectation, a plausible working hypothesis if you wish - and has been around for more than fifty years.

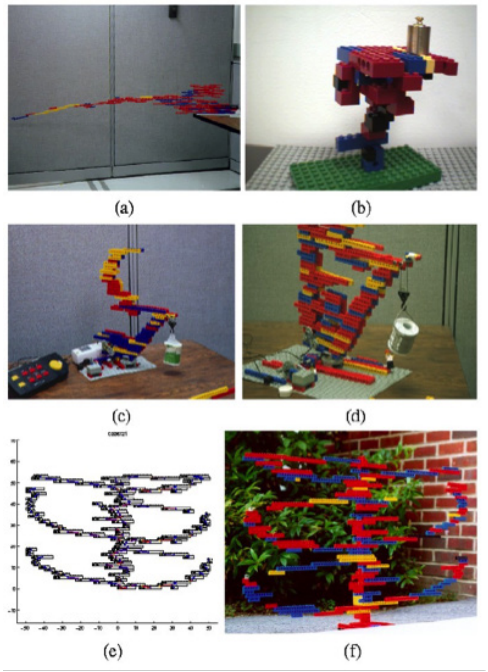


Figure 1. 1998: 2D and 3D LOGO objects evolved in simulation and built in real world afterwards [6]. These constructions are not actuated and have no controllers.

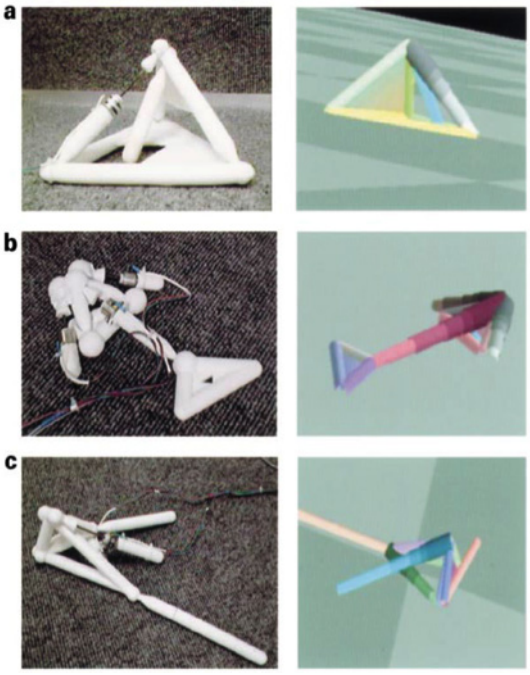


Figure 2. 2000: The GOLEM project [7] co-evolved robot bodies and controllers in simulation and fabricated the evolved robot afterwards. The robots did not have sensors.

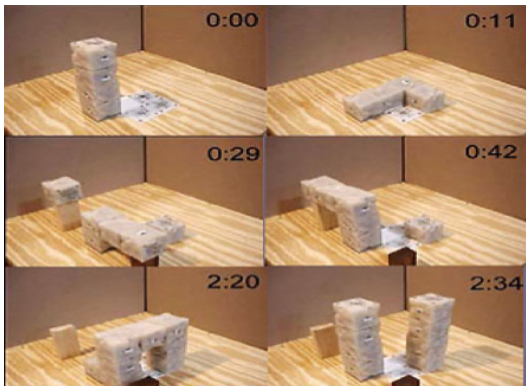


Figure 3. 2005: A physical system based on Molecubes, demonstrated non-adaptive robots able to construct a replica of themselves [8].

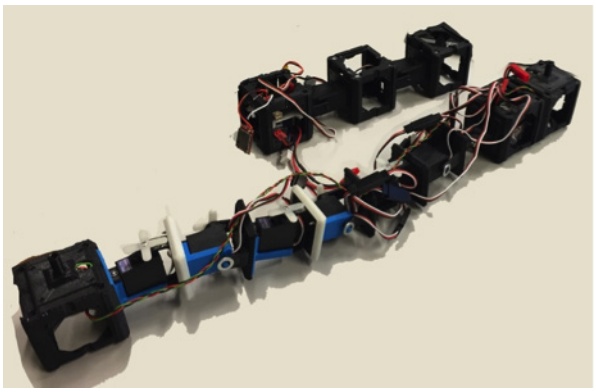


Figure 4. 2014: Robots with Arduino controllers, fixed parts and 3D-printed components that can be evolved in simulation and built afterwards.[9]

The third statement reflects much more recent thinking [4], but raises the question of how we design both bodies and controllers. Designing these separately is a complex task, that becomes even more so when coupled. In the fourth lies part of the answer: if we can now rapidly and automatically fabricate new parts, and assemble things, then we can apply evolutionary algorithms to both design tasks, and so achieve new levels of artificial intelligence.

The quest for artificial intelligence started with a narrow focus on the Mind. The bold dream in the 20th century was to create thinking machines. This was reflected by the Grand Challenge of creating a computer program that can beat the world champion of chess. As we all know, this was successfully accomplished before the end of the century. Acknowledging that intelligence is a characteristic of behaviour which arises from the interactions of mind, body and environment the focus on thinking machines is widening and the bold dream of the 21st century is to create acting machines, commonly known as robots. Judging by the furore generated by an advert purporting to show a robot competing with a world-class table-tennis player [4] , the corresponding Grand Challenge of embodied intelligence to create a robot that can play against a human at sport. Beyond that we have the greater challenges of coordinated action: a team of robots that can beat the world champions of football.

This brings us back to the working hypothesis above that identifies evolution as a potential approach to achieving intelligent behavior in entities with a mind and a body, i.e., in robots. The field of evolutionary robotics [11, 12], aims to evolve the controllers, the morphologies, or both, for real and simulated autonomous robots [13]. Considering the complexity of interactions between environment, morphology and controller, evolution may be not just one approach, but the approach to designing intelligent robots for a range of circumstances.

However, forced by technical constraints the usual modus operandi in evolutionary robotics is quite limited: evolve robot controllers in simulation and transfer the outcome to real hardware afterwards. Thus, even though the final goal is to obtain physical robots with evolved intelligence, the evolutionary process is still digital, which leads to the notorious reality gap problem [14].

The exciting new opportunity is to have physically embedded evolutionary processes on real --not simulated-- robots. Figures 1-6 demonstrate progress that has been made to date with self-assembly and the creation of physical artefacts - and the work still to be done. One option is to evolve controllers on-the-fly in a population of real robots (with fixed morphologies). This has been demonstrated in a handful of studies, for instance [15]. Another one is to evolve robot morphologies in real hardware by manually constructing each individual of the next generation. The only example we know of is the work of **John Long** described in [16,17]. The ultimate goal is of course a system

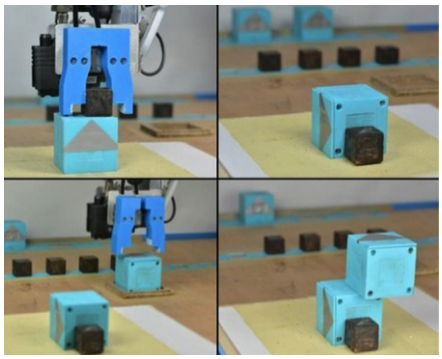


Figure 5. 2015: Quasi hands-free construction of genetically encoded modular robot bodies [10]. Consecutive generations were constructed and evaluated in real hardware The robots had no sensors and were driven by an external PC rather than an onboard controller.

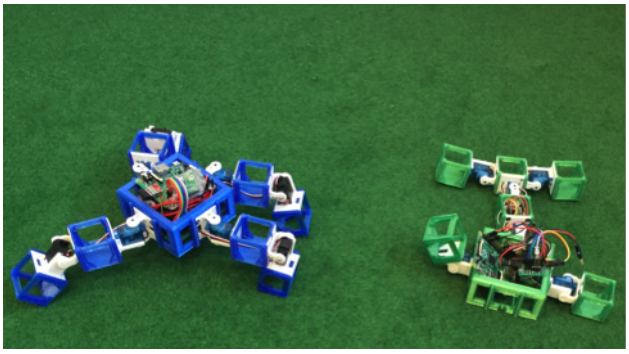


Figure 6. 2016: Robots are constructed in real hardware, undergo online learning, and can meet and mate in real life [18]. Offspring specified by the recombined genome is hand constructed from fixed components and 3D-printed blocks. Design is based on RoboGen [9].

where robots can reproduce themselves and evolve in real space and real time. To date this may seem far fetched, but advances in 3D printing and automated assembly are quickly bringing a robotic EvoSphere within reach [18]. Moreover, increases in the computing power we can put on-board robots, and in our understanding of surrogate modelling, and of how to avoid the reality gap [19] might make it feasible for each robot to add evolution to the life-time learning as a way of improving its controller - so it may not be necessary for evolution of morphologies and controllers to proceed in lock-step. The Evolution of Things may be closer than it seems.

References

1. A.E. Eiben and J. Smith. From evolutionary computation to the evolution of things. Nature, 521(7553):476–482, May 2015.

2. A.E. Eiben and J.E. Smith. Introduction to Evolutionary Computing. Springer, 2nd edition, 2015

3. D. Silver et al. Mastering the game of Go with deep neural networks and tree search Nature 529, 484489 January 2016 doi:10.1038/nature16961

4. R. Pfeifer and J. Bongard. How the Body Shapes the Way We Think. MIT Press, 2006.

5. E. Ackerman. Robots Playing Ping Pong: What's Real, and What's Not? IEEE Spectrum 2014. http://goo.gl/wvXSAN

6. Funes, P. and Pollack, J. B. (1998). Evolutionary body building: Adaptive physical designs for robots. Artificial Life, 4(4):337–357.

7. H. Lipson and J.B. Pollack, Automatic design and manufacture of robotic life forms, Nature, 406:974–978, 2000.

8. Zykov, V., Mytilinaios, E., Adams, B., and Lipson, H. (2005). Self-reproducing machines. Nature, 435(7038): 163–164.

9. J.E.Auerbach et al., Robogen: Robot generation through artificial evolution. In H. Sayama, et al. (eds) Pro.f ALIFE 14 Artificial Life 14, pp 136–137, The MIT Press, 2014.

10. L. Brodbeck, S. Hauser, and F. Iida, Morphological evolution of physical robots through model-free phenotype development, PLoS One, 10(6):e0128444, June 2015.

11. Josh Bongard. Evolutionary robotics. Communications of the ACM, 56(8):74–85, 2013.

12. Stefano Nolfi and Dario Floreano. Evolutionary Robotics: The Biology, Intelligence, and Technology of Self-Organizing Machines. MIT Press, Cambridge, MA, 2000.

13. P.A. Vargas, E.A. Di Paolo, I. Harvey, and P. Husbands, editors. The Horizons of Evolutionary Robotics. MIT Press, 2014.

14. N. Jakobi, P. Husbands, and I Harvey. Noise and the reality gap: The use of simulation in evolutionary robotics. In F. Moran et al., eds, Advances in Artificial Life, pp 704– 720. Springer, 1995.

15. N. Bredeche, J.-M. Montanier, W. Liu, and A.F.T. Winfield. Environment-driven distributed evolutionary adaptation in a population of autonomous robotic agents. Mathematical and Computer Modelling of Dynamical Systems, 18(1):101–129, 2012.

16. John Long. Darwin's Devices: What Evolving Robots Can Teach Us About the History of Life and the Future of Technology. Basic Books, 2012.

17. A Cho. The accidental roboticist. Science, 346(6206):192–194, October 2014.

18. A.E. Eiben. EvoSphere: The world of robot evolution. In A.-H. Dediu et al., editors, Proc. of TPNC 2015, volume 9477 of LNCS, pages 1–17. Springer, 2015.

19. S. Koos, J.-B. Mouret, and S. Doncieux, "The Transferability Approach: Crossing the Reality Gap in Evolutionary Robotics," IEEE Transactions on Evolutionary Computation, , vol. 17, no. 1, pp. 122–145, 2013.


Gusz Eiben

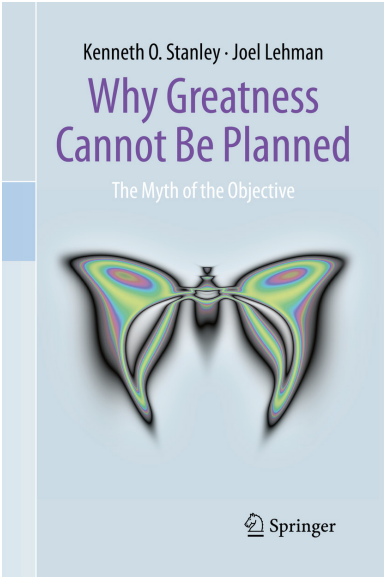
Gusz Eiben is professor of Artificial Intelligence at the Vrije Universiteit Amsterdam. He is one of the European early birds of Evolutionary Computing, his first paper dates back to 1989. Since then he has published over 200 research papers, and he co-authored the first comprehensive book on evolutionary computing (Introduction to Evolutionary Computing, Springer, 2003, 2007, 2015). He has been actively pursuing research related to evolutionary operators, constraint handling, parameter calibration, and most recently evolutionary robotics.


Jim Smith

Jim Smith is Professor in Interactive Artificial Intelligence (AI) at the University of the West of England, Bristol, UK. He has been researching and publishing on aspects of Evolutionary Computation since 1994. A major research interest has been evolutionary systems that "learn how to learn" - whether through self-adaptation of genetic search operators, or via adaptive individual and social learning with Memetic Algorithms. A closely related parallel interest is harnessing evolutionary and other learning paradigms simultaneously to produce more effective and efficient Interactive AI.

Why Greatness Cannot Be Planned: The Myth of the Objective

Authors: **Kenneth O. Stanley, Joel Lehman**



Text for this article from:
http://www.springer.com/gb/book/9783319155234

Liberating message:
Not all pursuits require an objective to justify them

Questioning foundational assumptions:
The way we typically think about achievement could be wrong

Novel scientific argument:
Evidence is provided from experiments with computers

Social benefits:
New approaches to perennial problems are suggested

Accessible style:
Written to appeal to novices and experts alike

Why does modern life revolve around objectives? From how science is funded, to improving how children are educated -- and nearly everything in-between -- our society has become obsessed with a seductive illusion: that greatness results from doggedly measuring improvement in the relentless pursuit of an ambitious goal. In Why Greatness Cannot Be Planned, Stanley and Lehman begin with a surprising scientific discovery in artificial intelligence that leads ultimately to the conclusion that the objective obsession has gone too far. They make the case that great achievement can't be bottled up into mechanical metrics; that innovation is not driven by narrowly focused heroic effort; and that we would be wiser (and the outcomes better) if instead we whole-heartedly embraced serendipitous discovery and playful creativity.

Controversial at its heart, yet refreshingly provocative, this book challenges readers to consider life without a destination and discovery without a compass.

Reviews (from Springer Website: http://www.springer.com/gb/book/9783319155234)

"What is your ultimate goal -- your true objective -- when you pick up a book? The authors of this one believe that there may be no objective at all involved, just a diffuse feeling that a book can change the way you look at the world. They may be right." (**Prof. Christos Papadimitriou**, University of California, Berkeley and Co-author of the New York Times Best Seller "Logicomix")

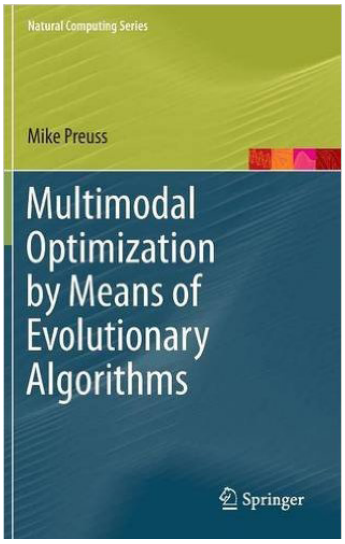
"One of the original aspirations of Artificial Intelligence researchers was to help all of us, as thinking beings, understand ourselves better. Stanley and Lehman are among the few who have managed to achieve this. In this book they not only shed light on a glaring bias in the way we approach the creation of intelligent machines, but have also identified this bias at work in many aspects of our society. It is not every day that a technical book so clearly reveals something new about how we live our own lives and how we might enrich them. I cherish such a rarity, and I urge others to as well." (**Prof. Josh Bongard**, University of Vermont)

"The ideas in this book have revolutionized the field of evolving artificial intelligence. They also help explain why biological evolution, science, and human culture are creative, endlessly innovative processes. Stanley and Lehman's theories are helpful for anyone who wants to foster a culture of innovation in their organization and within their own mind." (**Prof. Jeff Clune**, University of Wyoming)

"Objectives in our lives and careers, and the endeavor to achieve them, can sometimes cause stress and feelings of underachievement. But do we always need objectives? This book challenges common beliefs in our culture and society, revealing indisputable evidence that the biggest discoveries in the arts and sciences are not driven by objectives. The reading provides an uplifting new perspective on creativity, innovation, and happiness." (**Andrea Soltoggio**, Lecturer in Computer Science, Loughborough University)

Multimodal Optimization by Means of Evolutionary Algorithms

Author: **Mike Preuss**
Text from: http://www.springer.com/gb/book/9783319074061



- Describes state of the art in algorithms, measures and test problems
- Approaches multimodal optimization algorithms via model-based simulation and statistics
- Valuable for practitioners with real-world black-box problems

This book offers the first comprehensive taxonomy for multimodal optimization algorithms, work with its root in topics such as niching, parallel evolutionary algorithms, and global optimization.

The author explains niching in evolutionary algorithms and its benefits; he examines their suitability for use as diagnostic tools for experimental analysis, especially for detecting problem (type) properties; and he measures and compares the performances of niching and canonical EAs using different benchmark test problem sets. His work consolidates the r ecent successes in this domain, presenting and explaining use cases, algorithms, and performance measures, with a focus throughout on the goals of the optimization processes and a deep understanding of the algorithms used.

The book will be useful for researchers and practitioners in the area of computational intelligence, particularly those engaged with heuristic search, multimodal optimization, evolutionary computing, and experimental analysis.

Review by Dr Xiaodong Li, RMIT University, Australia

Optimization is ubiquitous. Many problems in decision making, engineering, and sciences can be formulated as optimization problems. Usually the goal of optimization is to find a single best or optimal solution among various candidate solutions. For multimodal optimization, this goal of optimization has changed to finding multiple optimal (or close to optimal) solutions. This is especially appealing for a decision maker who is more interested in obtaining and comparing multiple solutions before making a final choice. Population-based stochastic search methods such as evolutionary algorithms are in particular good at locating more than one optimal solution, if a specifically-designed population-separation or diversity-maintenance mechanism is adopted. This sort of mechanism is commonly referred to as niching methods. The topic of multimodal optimization using niching methods has been around for over 30 years. It has attracted relatively less attention and has been under-appreciated perhaps, as compared to other hot areas such as multiobjective optimization and constrained optimization. However, in recent years, niching methods has been experiencing a revival, as many researchers and practitioners start to realize its importance in their respective areas. This book by Mike Preuss came out at a perfect time, as it will help further spur the interests on niching methods.

This book represents a rare attempt in synthesizing niching methods and its related topics in a comprehensive manner. It is evident right from the beginning that this book is a clear reflection of author's thinking and contributions to niching research for the past decade. Some of the key highlights in the book include: a revised niching definition, a taxonomy of niching methods, basin (of attraction) identification techniques, the nearest-better clustering method, and a review on performance metrics. Through formal models and careful analysis, the author demonstrates that one can tackle multimodal problems by first identifying basins of attraction in the search space. These techniques can be subsequently considered for designing effective niching methods. Although basin identification is a challenging task, and current techniques do not always provide satisfactory answers, an important lesson is that we need to link the properties of the search space to niching algorithm design. An example following the principle of basin identification is the development of the nearest-better clustering method. This method forms the basis of a simple yet effective niching method, which went on to win the top-place at the IEEE CEC'2013 niching competition on multimodal optimization

Another major contribution of the book is the author's critical review on niching methods and their performance assessment. In particular, the author surveys and discusses a range of possible performance metrics that can be used for comparing and assessing niching methods. Many questions have been raised on

how we can better evaluate niching methods, whether the goal is to locate all global solutions, or all global plus local solutions, or a set of solutions well-spread across the search space. Another question is whether one can assume the prior knowledge of optima, which is often not the case in real-world situations. Clearly, much work needs to be done!

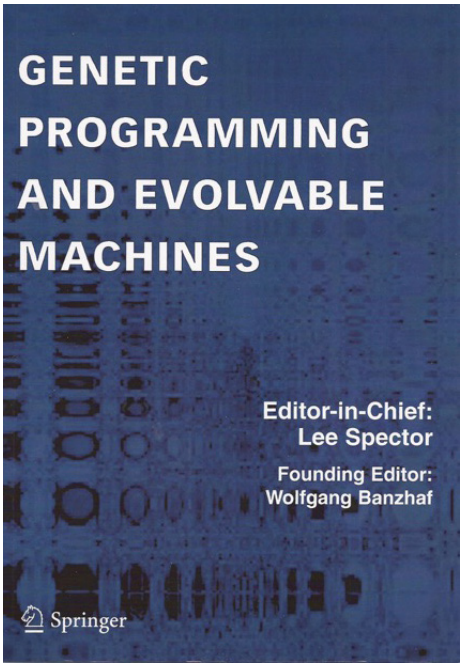
In summary, this book includes many interesting and in-depth discussions and research findings on niching methods. It has identified shortfalls in current practices and raised many interesting questions, providing a fertile ground for future research. For anyone looking for new ideas to work on in the area of niching, this book is a must read! It is sometimes surprising to see many researchers from different disciplinary areas working on their own multimodal problems, without being aware of works in other areas. I sincerely hope this book will reach out to these audiences and help bring down such a barrier.

Xiaodong Li is an Associate Professor at the School of Computer Science and Information Technology, RMIT University, Melbourne, Australia. He received his Ph.D. degree in Artificial Intelligence from University of Otago, Dunedin, New Zealand. His research interests include machine learning, evolutionary computation, complex systems, multiobjective optimization, multimodal optimization (niching), swarm intelligence, data mining/analytics, journey planning, math-heuristic methods for optimization. He is an Associate Editor of IEEE Transactions on Evolutionary Computation, the journal of Swarm Intelligence, and International Journal of Swarm Intelligence Research. Xiaodong is a member of ECML (Evolutionary Computation and Machine Learning) research group.

Genetic Programming and Evolvable Machines: Special Issue on Semantic Methods in Genetic Programming

The first issue of Volume 17 of Genetic Programming and Evolvable Machines is now available for download. This is a special issue on Semantic Methods in Genetic Programming, edited by **Michel O'Neill**, and it also contains two book reviews (which are now free downloads).

The complete contents are:



"Editorial introduction"
by **Lee Spector**

"Semantic methods in genetic programming"
by **Michael O'Neill**

"Progress properties and fitness bounds for geometric semantic search operators"
by **Tomasz P. Pawlak** and **Krzysztof Krawiec**

"Subtree semantic geometric crossover for genetic programming"
by **Quang Uy Nguyen** and **Tuan Anh Pham**

"Self-tuning geometric semantic Genetic Programming"
by **Mauro Castelli** and **Luca Manzoni**

BOOK REVIEW
"Malachy Eaton: Evolutionary humanoid robotics"
by **Jürgen Leitner**

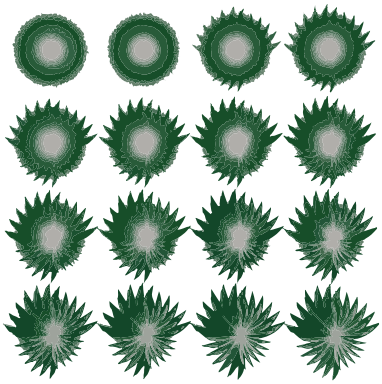
BOOK REVIEW
"Stephen H. Muggleton and Hiroaki Watanabe (Eds.): Latest advances in inductive logic programming"
by **Man Leung Wong**

Special Issue on Theory of Evolutionary Algorithms

Winter 2015, Vol. 23, No. 4, Pages 509-511
Posted Online December 15, 2015.
(doi:10.1162/EVCO_e_00165)

Editorial for Special Issue on Theory of Evolutionary Algorithms 2015

Pietro S. Oliveto
Department of Computer Science, University of Sheffield, UK
(p.oliveto@sheffield.ac.uk)
Andrew M. Sutton
Hasso-Plattner-Institut, Universität Potsdam, Germany
(andrew.sutton@hpi.de)



The theory of evolutionary computation (EC) has experienced rapid and productive growth in recent years. New proof techniques and novel theoretical frameworks have allowed advances in our understanding of the processes and structures inherent in evolutionary optimization. As a result, the frontiers of our knowledge have been expanded further than ever before. Some recent trends in this field, which are covered in this issue, include developments in the understanding of the behavior of evolutionary algorithms (EAs) in dynamic environments rather than just static settings, a theoretical appreciation of the advantages arising from the parallelization of evolutionary algorithms through a greater comprehension of the underlying dynamics, and an understanding of algorithm behavior on broad function classes, including -hard problems.

The primary goal of this special issue is to provide extended and polished versions of diverse examples of the best theoretical work presented at conferences in 2014, and to serve as a forum for researchers to advance the theoretical understanding of evolutionary computation methods. The papers included in this special issue span a plurality of topics and offer the reader a cross section of recent outstanding work in EC theory.

In dynamic optimization the objective function changes over time, and optimization algorithms face the additional challenge of tracking these changes to be successful. The article “Analysis of Randomised Search Heuristics for Dynamic Optimisation,” by Thomas Jansen and Christine Zarges, presents a novel analytical framework for the analysis of randomized search heuristics on dynamic problems inspired by the fixed-budget computations perspective. The authors introduce a new interesting class of bi-stable dynamic functions where the optimum oscillates between two complementary strings, and apply the framework to analyze and compare the performance of evolutionary algorithms and artificial immune systems on the novel class of functions.

Over three decades ago, László Lovász observed that in discrete optimization, submodularity is the counterpart to convexity. However, in contrast to the focus on convex functions in continuous evolutionary optimization, so far submodular functions have received comparatively little attention from EC theoreticians studying discrete functions. The article “Maximizing Submodular Functions under Matroid Constraints by Evolutionary Algorithms,” by Tobias Friedrich and Frank Neumann, addresses this gap by analyzing the performance of evolutionary algorithms on different classes of submodular functions. The maximization of submodular functions is -hard in general, and the authors present several approximation results for monotone submodular and nonmonotone symmetric submodular functions under different kinds of matroid constraints.

The idea behind parallel evolutionary algorithms is to evolve multiple subpopulations in parallel and allow interprocess communication at given time intervals. During these migration phases, fractions of each subpopulation can be shared among the subpopulations. There is very little understanding of how the migration frequency affects algorithmic performance, so setting the migration interval parameter appropriately may be difficult. In the article “Design and Analysis of Schemes for Adapting Migration Intervals in Parallel Evolutionary Algorithms,” Andrea Mambrini and Dirk Sudholt propose two schemes to automatically adapt the migration interval of parallel EAs during execution and provide a rigorous analytical framework that yields upper bounds on the expected runtime and expected communication effort of the parallel EAs with different migration topologies for various function classes.

In the field of genetic programming, a long-standing open problem is how to address the issue of bloat, the emergence during evolution of solution elements that do not contribute significantly or at all to program fitness or semantics but increase program complexity. The article "On the Performance of Different Genetic Programming Approaches for the SORTING Problem," by Markus Wagner, Frank Neumann, and Tommaso Urli, tackles the issue of bloat control in the context of sorting. As a basis for their study, they consider program trees and use some measure of sortedness of an in-order traversal to evaluate their fitness. The authors investigate single- and multiobjective variants of genetic programming algorithms with and without bloat control mechanisms, give rigorous upper bounds on their running times, and complement the study with experiments.

The topic of constraint handling has recently gained traction in the continuous domain. The article "Markov Chain Analysis of Cumulative Step-Size Adaptation on a Linear Constrained Problem," by Alexandre Chotard, Anne Auger, and Nikolaus Hansen, presents a rigorous analysis of a (1,)-Evolution Strategy using resampling on a linear function with a linear constraint. The authors prove the previously assumed property that a Markov chain, describing the behavior of the algorithm, exhibits stability in cases with constant step-size and with cumulative step-size adaptation with cumulation parameter equal to 1. This property characterizes the divergence of the algorithm with constant step-size and the geometric divergence or convergence with step-size adaptation, implying fast convergence of Monte Carlo simulations of the divergence rate.

In their seminal 2006 paper, Droste, Jansen, and Wegener introduced the concept of black box complexity in order to establish a complexity theory for general-purpose randomized search heuristics. Generally speaking, the black box complexity of a problem is a lower bound on the number of function evaluations needed by any black box algorithm to solve it. Recently, black box models have been refined and developed extensively, allowing the hardness of objective function classes to be more precisely understood. The article "Unbiased Black Box Complexities of Jump Functions," by Benjamin Doerr, Carola Doerr, and Timo Kötzing, analyzes the unbiased black box complexity of a Jump function class where in each function a local optimum is k bits in distance from the global optimum. The authors provide polynomial upper bounds on the black box complexity of Jump for different sizes of the gap. In particular, they show that an unbiased polynomial-time black box algorithm exists even when almost all of the search space is a plateau of constant fitness.

The guest editors would like to thank the authors for their contributions, the referees for their careful reviewing and constructive comments, and the editor-in-chief, Hans-Georg Beyer, for his support in preparing this special issue.

GECCO 2016: 25th International Conference on Genetic Algorithms and 21st Annual Conference on Genetic Programming

July 20 - 24, Denver, Colorado, USA

Early registration deadline: April 28th 2016
http://gecco-2016.sigevo.org/index.html/Registration

Keynotes:

1. **Title: The Challenges of Natural Algorithms**
Bernard Chazelle
Eugene Higgins Professor of Computer Science at Princeton University
https://www.cs.princeton.edu/~chazelle/

2. **Title: To be announced**
Holger Hoos
Professor of Computer Science and a Faculty Associate at the Peter Wall Institute for Advanced Studies at the University of British Columbia (Canada)
http://www.cs.ubc.ca/~hoos/

CFP - PPSN 2016: 14th International Conference on Parallel Problem Solving from Nature

PPSN 2016 will be held in **Edinburgh**, Scotland, UK, **17-21 September 2016**

Full details here: http://www.ppsn2016.org/conference/call-for-papers

This biennial meeting brings together researchers and practitioners in the field of Natural Computing: the study of computational systems inspired by nature, including biological, ecological, physical, chemical, and social systems. This is a fast-growing interdisciplinary field, featuring a range of techniques and methods for dealing with large, complex, and dynamic problems with various sources of potential uncertainties.

PPSN 2016 will showcase a wide range of topics in Natural Computing including, but not restricted to: Evolutionary Computation, Artificial Neural Networks, Artificial Life, Swarm Intelligence, Artificial Immune Systems, Self-Organising Systems, Emergent Behaviours, Molecular Computing, Evolutionary Robotics, Evolvable Hardware and Applications to Real-World Problems. PPSN 2016 will also feature workshops and tutorials covering advanced and fundamental topics in the field of Natural Computing.

Paper submission deadline: April 4, 2016

PPSN 2016
September 17-21st 2016, Edinburgh, Scotland

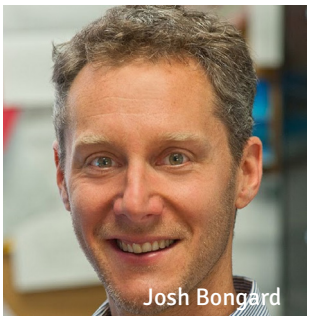
Keynote speakers:

Susan Stepney, University of York, UK


Susan Stepney

Susan Stepney was originally a theoretical astrophysicist. She moved to industry where she used formal methods to prove the security of smart card applications. In 2002 she returned to academia as Professor of Computer Science at the University of York, UK, where she leads the Non-Standard Computation research group. Since 2012 she has been Director of the York Centre for Complex Systems Analysis. She is on the board of directors of the International Society for Artificial life, and is a member of EPSRC's ICT Strategic Advisory Team. Her current research interests include unconventional models of computation, complex systems, artificial chemistries, emergence, open-ended evolution, and bio-inspired computing.

Josh Bongard, University of Vermont, USA


Josh Bongard

Josh Bongard obtained his Bachelors degree in Computer Science from McMaster University, Canada; his Masters degree from the University of Sussex, United Kingdom; his PhD from the University of Zurich, Switzerland; and served as a postdoctoral associate at Cornell University. In 2006 he was named a Microsoft New Faculty Fellow, as well as one of the top 35 innovators under the age of 35 by MIT's Technology Review Magazine. In 2011 he received a Presidential Early Career Award for Scientists and Engineers (PECASE) from Barack Obama at the White House. Josh is currently the Veinott Professor of Computer Science at the University of Vermont. His research foci include evolutionary robotics, crowdsourcing, and machine science.

Katie Bentley, Harvard Medical School, USA, Bentley_LA


Katie Bentley

Katie Bentley earned a PhD in Computer Science from UCL in 2006 after completing an MSc in Evolutionary and Adaptive systems at the University of Sussex in 2002 with a focus on morphogenesis in natural and artificial systems. She was awarded a Cancer Research UK postdoctoral fellowship to develop agent-based models integrated with in vitro and in vivo experiments of blood vessel growth at the London Research Institute in 2006. She was then funded by a Leducq Fondation transatlantic network grant to travel between five highly distinguished Vascular Biology Labs based at Yale, UCLA, KU Leuven and CR UK and develop predictive models tested in vivo. Dr. Bentley was appointed Assistant Professor of Pathology, Harvard Medical School and group leader of the Computational Biology Laboratory at the Center for Vascular Biology Research, Beth Israel Deaconess Medical Center, Boston (2013). She has also recently been appointed Associate Professor at the Rudbeck Laboratories, University of Uppsala, Sweden to lead a second vascular modeling lab integrated within their vascular biology department. Dr. Bentley is on the Board of Directors for the International Society of Artificial Life.

PhD Opportunity: University of Haute Alsace, France

Title: Integration of machine learning methods in metaheuristics
Supervisors: L.Idoumghar, J. Lepagnot & M. Brévilliers
Contact: lhassane.idoumghar@uha.fr
Location: University of Haute Alsace, France
Duration: 36 months

Description

The design of efficient optimization methods is a major concern for many industries (automotive, aerospace, broadcast, etc). Indeed, in recent years, many exact methods and heuristics, increasingly efficient, have been proposed to solve difficult problems.

Metaheuristics are an interesting class of approaches to solve large-scale problems. Indeed, their diversity enables them to be adapted to different types of problems. To take advantage of this variety, many hybrid methods, for example using two metaheuristics, exist in the literature. Unfortunately, at present, this type of hybridization is mainly achieved statically and the parameter setting is mainly performed experimentally. Thus, one of the limitations of this type of method relates to the set of hybridization parameters to be defined (how to combine two approaches, when to instantiate a particular approach, etc).

Through this PhD thesis, our objective is to answer these questions by developing new metaheuristics that incorporate one or more machine learning methods in order to better guide the search towards a better solution in the search space, often exponential.

References

[1] Sghir, J.- K. Hao, I. Ben Jaafar, K. Ghédira. "A multi-agent based optimization method applied to the quadratic assignment problem", Expert Systems with Applications, vol. 42, no. 23, pp. 9252-9262, 2015.
[2] J. Maturana, F. Lardeux, F. Saubion. "On Migration Policies in Dynamic Island Models", in Proc. 12th Biennal International Conference on Artificial Evolution, Lyon, France, October 2015, pp. 336-343.
[3] L. Idoumghar, N. Chérin, R. Roche, A. Miraoui. "Hybrid ICA - PSO algorithm for continuous optimization", Journal of Applied Mathematics and Computation, vol. 219, no. 24, pp. 11149-11170, 2013.
[4] E. M. Cochrane, J. E. Beasley. "The co-adaptive neural network approach to the Euclidean Travelling Salesman Problem", Neural Networks, vol. 16, no. 10, pp. 1499-1525, 2003.

Work plan

This work consists of the following phases:

- Write a state of the art about machine learning methods and metaheuristics
- Study the exploration process of the hybrid methods developed by our team in order to extract useful information/knowledge
- Propose new hybrid methods incorporating learning mechanisms
- Propose massively parallel versions
- Validate the proposed approaches on academic and industrial problems studied by our team

Prerequisites

- The candidate must have a Master or equivalent in computer science or applied mathematics.
- The candidate must have good knowledge of the following areas: metaheuristics, machine learning, GPU programming.
- Programming language: C++.
- Good knowledge of development under Linux.
- The candidate must be fluent in English.

Application

Send a CV, the report cards containing all your marks obtained during your Master studies, 2-3 recommendation letters.

About this newsletter

SIGEVOlution is the newsletter of SIGEVO, the ACM Special Interest Group on Genetic and Evolutionary Computation.

To join SIGEVO, please follow this link [WWW]

Contributing to SIGEVOlution

We solicit contributions in the following categories:

Art: Are you working with Evolutionary Art? We are always looking for nice evolutionary art for the cover page of the newsletter.

Short surveys and position papers: We invite short surveys and position papers in EC and EC related areas. We are also interested in applications of EC technologies that have solved interesting and important problems

Software: Are you are a developer of an EC software and you wish to tell us about it? Then, send us a short summary or a short tutorial of your software.

Lost Gems: Did you read an interesting EC paper that, in your opinion, did not receive enough attention or should be rediscovered? Then send us a page about it.

Dissertations: We invite short summaries, around a page, of theses in EC-related areas that have been recently discussed and are available online.

Meetings Reports: Did you participate to an interesting EC-related event? Would you be willing to tell us about it? Then, send us a short summary, around half a page, about the event.

Forthcoming Events: If you have an EC event you wish to announce, this is the place.

News and Announcements: Is there anything you wish to announce, such as an employment vacancy? This is the place.

Letters: If you want to ask or to say something to SIGEVO members, please write us a letter!

Suggestions: If you have a suggestion about how to improve the newsletter, please send us an email

Contributions will be reviewed by members of the newsletter board.

We accept contributions in LATEX, MS Word, and plain text.

Enquiries about submissions and contributions can be emailed to editor@sigevolution.org

All the issues of SIGEVOlution are also available online at: www.sigevolution.org

Notice to Contributing Authors to SIG Newsletters

By submitting your article for distribution in the Special Interest Group publication, you hereby grant to ACM the following non-exclusive, perpetual, worldwide rights:

- to publish in print on condition of acceptance by the editor
- to digitize and post your article in the electronic version of this publication
- to include the article in the ACM Digital Library
- to allow users to copy and distribute the article for noncommercial, educational or research purposes

However, as a contributing author, you retain copyright to your article and ACM will make every effort to refer requests for commercial use directly to you.

Editor: **Emma Hart**
Associate Editors: **Darrell Whitley**, **Una-May O-Reilly**, **James McDermott**, **Gabriela Ochoa**
Design & Layout: **Callum Egan**