

Preface

This volume presents the proceedings of ALIFE 2018, the 2018 Conference on Artificial Life, held July 23rd-27th. It took place in Tokyo, Japan (<http://2018.alife.org>). The ALIFE and ECAL conferences have been the major meeting of the artificial life (ALife) research community since 1987 and 1991, respectively. As a Hybrid of the European Conference on Artificial Life (ECAL) and the International Conference on the Synthesis and Simulation of Living Systems (ALIFE), the 2018 Conference on Artificial Life (ALIFE 2018) will take place outside both Europe and the US, in Tokyo, Japan.

The ALIFE 2018 proceedings clearly show the transition from the 90's ALife studies to 2020's New ALife studies. Much of this transition is contingent on the emergence of new technologies, which have deeply affected the research ecosystem of ALife, as for the rest of the academic landscape. But as technology advances, ALife's importance becomes particularly key, given its unique generative approach in addressing the emergence of life, self-organization phenomena in the data revolution, and the future evolution of machine intelligence.

The field has remarkably also been expanding to arts, design and many more disciplines. Nowadays, beyond C. P. Snow's cultural divide between science and the arts, Artificial Life truly attempts to span all fields of study. The university is not anymore the unique place where a serious study of ALife can be pursued. There are rich resources of new ideas outside the academic domain.

Our hope is this conference reinvents the spirit of ALife and spreads it across all fields and disciplines. As an attempt in this direction, we have organized an art session parallel to the main track. A few months ahead of the main conference, Ryuta Aoki and his team have organized an art hackathon called "ArtHackDay 2018". A total number of 237 people have participated in the hackathon, and three best art works were selected, which will be exhibited at the main conference. We hope that those art works will contribute to promote the broadening field of artificial life.

The ALIFE 2018 Program

We received in total 212 submissions, out of which 64 were accepted as oral presentations and 48 were accepted as poster presentations, both of which are included in these proceedings. This year, there are two types of oral presentations, i.e. lightning and general talks. 15 talks were selected as lightning because they have good quality and a broad audience can be expected. There are three special sessions for discussing more specific targets. The papers submitted to the special sessions were evaluated in the same criterion with the other submitted papers. All papers accepted in the special sessions including lightning and poster papers were listed in the special session in the proceedings. We accepted 27 late breaking abstracts for poster presentations and are available at the conference website <http://2018.alife.org>.

The conference program of this year included:

- Seven keynote presentations of internationally renowned speakers within a wide variety of topics:
 - Elena Antonova (King's College London, UK),
 - Rodney Brooks (MIT, USA),
 - Inman Harvey (University of Sussex, UK),
 - Hiroshi Ishiguro (Osaka University, Japan),

- David O'Reilly (Film Maker, Ireland),
- Kenneth O. Stanley (University of Central Florida, USA), and
- Hyejin Youn (Northwestern University, USA).
- General sessions on:
 - Agency Studies
 - Artificial Chemistry
 - Biology
 - Evolution and Networks
 - Evolutionary Dynamics
 - Evolutionary Robotics
 - Information Theory / Information Flow
 - Neural Controllers
 - Neurons
 - Social Dynamics
- Special sessions on:
 - ALife and Society
(Organisers: Alex Penn and J. Mario Siqueiros)
 - Hybrid Life
(Organisers: Manuel Baltieri, Keisuke Suzuki and Hiroyuki Iizuka)
 - Morphogenetic Engineering
(Organisers: Rene Doursat, Hiroki Sayama)
- A poster presentation session
- Seven workshops:
 - ALife Roadmap Workshop
(Organizers: Olaf Witkowski, Julien Hubert).
 - Third Workshop on Open-Ended Evolution (OEE3): Hallmarks, Mechanisms and Empirical Demonstrations
(Organizers: Mark Bedau, Alastair Channon, Tim Taylor, Norman Packard, Steen Rasmussen and Takashi Ikegami).
 - Cognitive Development, Learning and Representation Co-construction in Human-Robots Systems and Ambient Intelligence Systems
(Organizers: Amélie Cordier, Stéphane Doncieux, Amal El Fallah Seghrouchni, Frank Guérin, Salima Hassas, Bipin Indurkha, Leonardo Lana De Carvalho, Mathieu Lefort, Georgi Stojanov).
 - EVOSLACE: Workshop on the Emergence and Evolution of Social Learning, Communication, Language and Culture in Natural and Artificial Agents
(Organizers: Reiji Suzuki, Michael Spranger, Julien Hubert, James Borg, Hiroto Yonenoh, Jacqueline Heinerman, Chris Marriott, Peter Andras, Kazutoshi Sasahara, Takaya Arita, Takashi Hashimoto, Takayuki Nagai, Yoshinobu Hagiwara, Tadahiyo Taniguchi).

- Developing Software Standards for the Artificial Life community
(Organizers: Clifford Bohm, Emily Dolson, Alexander Lalejini, Nitash CG, Charles Ofria).
- PROTOCOGNITION Workshop
(Organizers: Andrew Adamatzky, Yukio Gunji, Jordi Valverdú).
- The Synthetic Approach to Biology and the Cognitive Sciences (SA-BCS 2018):
Developing an Epistemology for the Synthetic Sciences of Life and Cognition
(Organizers: Luisa Damiano, Pasquale Stano).
- One special workshop sponsored by ELSI:
 - Earth, Life and Artificial Life
(Organizers: Nathaniel Virgo, Alexandra Penn, Matthew Egbert, Stuart Bartlett).
- Four tutorials:
 - Avida-ED: A Tool for Artificial Life in the Classroom
(Organizers: Michael Wiser, Robbert Penock)
 - Creative Prediction with Neural Networks
(Organizers: Charles P. Martin, Kyrre Glette, Jim Tørresen)
 - Introduction to Artificial Gene Regulatory Networks
(Organizers: Sylvain Cussat-Blanc, Wolfgang Banzhaf)
 - Simulating Complex Systems with FLAME GPU
(Organizers: Paul Richmond, Mozghan Kabiri Chimeh)
- The ISAL Summer School
- An art exhibition

Special Session Themes

In addition to the main track, ALIFE 2018 had several special sessions, organized by members of the community. Submissions to each session were peer reviewed and accepted submissions appear in this volume.

ALife and Society: Transcending the artificial-natural divide organized by Alex Penn and J. Mario Siqueiros

As part of an ALife conference with Beyond AI as its central theme, this session focuses on how technology in general, and AI in particular, is creating new, complex adaptive, possibly living or cognitive, systems, new modes of being and interaction, and new contexts for evolution and evolutionary dynamics as well as modifying existing ones. All of these “transcending the natural-artificial divide”. Contributions to this session can be divided into three general themes. Firstly, critical historical analyses of the evolution of technology and its impact on society. This theme is not limited to developing a better understanding of our socio-technological past, but, more importantly, encompasses historically-based deep reflection on the possible futures ahead with ALife, AI and hybrid technologies leading the way. The second theme concerns contemporary societal and governance issues related to AI. It is very clear that Artificial Intelligence is having a large impact on society’s organization, values and beliefs, with more profound

changes expected to come. As with other technologies, AI is not neutral regarding social issues, e.g., from the implications and results of human systems monitoring to racism enforced by machine learning algorithms. It is thus important to understand how human-AI systems are being created, evolving and in some cases governed. Contributions focus on the governance of socio-technical systems from the perspective of Ostrom’s governance of the commons. As ALife and AI are increasingly present in our lives, it is important to create cooperative interactions between humans and machines. However this interaction can be significantly improved if the general public not only has a better understanding of these technologies, but can take part in shaping this future. Work on creative participatory engagement with emerging A-Life technology is also highlighted. Finally the role of affective engagements between human-machine and human-machine-human interactions are discussed. As one of the contributions reminds us, hybrid human-machine systems are becoming more common, for example in prosthetics. Traditionally, the machine part of the system is very simple in its behavior and more complex and dynamics capacities would be desirable. However, understanding and designing coupled hybrid human-technologies with such properties is no small feat. Experimental as well as theoretical work on adaptive control of human-machine systems is needed.

Hybrid life: Approaches to integrate biological, artificial and cognitive systems organized by Manuel Baltieri, Keisuke Suzuki and Hiroyuki Iizuka

Starting from well-established Alife methodologies for the study of life, cognition and artificial systems, we suggest that hybrid systems, which sit at the interfaces of such topics, constitute perhaps the most interesting subject of investigation for the understanding of life, its processes and properties. In our session we aim to discuss and develop three complementary perspectives:

- a unified mathematical language that can be used for the study of different classes of systems while maintaining a common framework of reference,
- the exploration of biological organisms enhanced by artificial systems (or artificial systems augmented with organic parts) in order to investigate the boundaries between living and non-living organisms in hybrid setups, and
- the study of coupled biological-artificial systems highlighting the importance of interactions among systems for the study of living and cognitive organisms, explaining what interactions constitute a biological and/or cognitive creature.

Morphogenetic Engineering organized by Rene Doursat, Hiroki Sayama

This special session aims to promote Morphogenetic Engineering, a field of research exploring the artificial design and implementation of autonomous systems capable of developing complex, heterogeneous morphologies. Particular emphasis is set on the programmability and computing abilities of self-organization, properties that are often underappreciated in complex systems science—while, conversely, the benefits of self-organization are often underappreciated in engineering methodologies. Four papers have been selected for this special session through peer reviews (three for oral presentations and one for a poster) and included here in the proceedings. A wide variety of topics is covered, including: hierarchical, adaptive “holonic” cellular automata (Diaconescu, Tomforde and Müller-Schloer), cell migration models for regeneration (Ferreira, Scheutz and Levin), self-organization of neural networks in the brain (Hiesinger), and a hybrid of cellular automata and artificial neural networks for pattern generation (Moore, Walker and Levin).

About the Editors

Takashi Ikegami is a Professor at the General Systems Sciences, the University of Tokyo. Ph.D (Physics). He works in both installation arts (Filmachine 2006; Mind Time Machine 2010; Long-Good Bye 2017) and complex systems sciences (Oil droplets experiment 2009; perceptual crossing 2014; a large scale boids 2017).

Nathaniel Virgo is an Assistant Professor at the Earth-Life Science Institute (ELSI) in Tokyo. His research interests include the origins of life, artificial chemistry, evolution of evolvability and information theory.

Olaf Witkowski is a Postdoctoral Fellow at the Earth-Life Science Institute (ELSI) in Tokyo, and a Visiting Scholar at the Institute for Advanced Study (IAS) in Princeton. He is also a Co-Founding Member of YHouse Inc. – a nonprofit transdisciplinary research institute focused on the study of awareness, artificial intelligence and complex systems. His research interests are in collective intelligence, emergence and evolution of communication, future paradigms of computation, origins of life and complex systems science.

Mizuki Oka is an Associate Professor at the Department of Computer Science, Graduate School of SIE, University of Tsukuba. She is also co-founder and CEO of Alternative Machine Inc. Her research interests include social-ecological systems, evolutionary dynamics of Internet, and applied artificial life.

Reiji Suzuki is an Associate Professor at the Graduate School of Informatics, Nagoya University, Japan. His research interests include interactions among developmental, ecological and evolutionary processes, and acoustic interactions among songbirds as complex systems.

Hiroyuki Iizuka is an Associate Professor at the Graduate School of Information Science and Technology, Hokkaido University, Japan. His research interests include autopoiesis, the origins of self and communication, deep learning for cognitive modeling, and consciousness.

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We also would like to thank the Program Committee, who provided useful comments on all the submitted papers. Without their help, we could not have had a successful conference.

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Eric Aaron
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Andreas Albrecht

Lee Altenberg
Martyn Amos
Takaya Arita
Elizabeth Aston

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Simon Mcgregor
Mizuki Oka
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Simon Powers
Hiroki Sayama
Eric Silverman

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Tim Taylor
Jon Umerez

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Manuel Baltieri
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Erfan Noury Qarajalar

Norman Packard
Keisuke Suzuki

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