

## Preface

This volume presents the proceedings of the *2019 Conference on Artificial Life* (ALIFE 2019) which took place 29 July – 2 August 2019 in Newcastle upon Tyne, United Kingdom (<https://2019.alife.org/>).

The International Conference on the Synthesis and Simulation of Living Systems (ALIFE) and the European Conference on Artificial Life (ECAL) have been the major meeting of the artificial life (ALife) research community since 1987 and 1991, respectively. Starting with ALIFE 2018 in Tokyo, Japan, these two conferences have merged into the Conference on Artificial Life. This year, the merged ALIFE conference for the first time replaces what would have been an ECAL conference previously. Hosting it in Europe seemed fitting.

## The ALIFE 2019 Theme

This year’s ALIFE conference features the special theme “How Can Artificial Life Help Solve Societal Challenges?” Artificial Life has historically been regarded by its adversaries as an academic “hobby” with little application to real life. We believe that these days are past, as in fact, our interdisciplinary and constantly self-innovating discipline brings together a set of skills and perspectives with a unique potential to tackle some of the most pressing societal challenges of our times. Indeed, our complex systems analysis methodologies have application across a very broad range of domains and provide alternative tools to extract actionable insight than more traditional analysis methods. This special theme ran through the conference in the shape of keynote presentations and satellite events that apply Artificial Life principles to research on e.g. social dynamics, cultural evolution and societal learning, human behaviour, and smart cities.

## The ALIFE 2019 Programme

We received a total of 154 full paper and abstract submissions. All submissions were reviewed by typically three and in some cases two reviewers. Scientific advisors then performed a topic wide metareview to derive acceptance decisions. As a result, we accepted 108 contributions for publication and oral presentations. Submission of posters is still open at the time of writing. Following the successful model of ALIFE 2018, we selected 18 submissions for plenary lightning talks.

Simultaneously to ALIFE 2019, Newcastle University also held the Designer Biology 2019 Conference (<http://designer-biology.org/>), which focusses on the intersection of bioengineering and synthetic biology. With the growing overlap of Wet Artificial Life and Synthetic Biology, we closely aligned these conferences by hosting shared keynote presentations as well as a joint panel discussion and generally encouraged broad interactions among the two audiences.

The conference programme this year included:

- Eight keynotes presentations spanning diverse areas of Artificial Life research, many of which chosen with respect to the conference theme
  - Barry McMullin (Dublin City University, Ireland)
  - Alex Penn (University of Surrey, United Kingdom)
  - Armando Geller (Scensei GmbH, Switzerland)
  - Stefano Battiston (University of Zurich, Switzerland)
  - Ioannis Ieropoulos (University of Bristol, United Kingdom)
  - Roberto Serra (University of Modena, Italy)
  - Nicola Patrón (Earlham Institute, United Kingdom), shared with Designer Biology
  - Kate Adamala (University of Minnesota, United States of America), shared with Designer Biology
- Parallel sessions
  - Complex dynamical systems

- Perception
- Neural networks
- Robot control
- Swarm behaviour
- Artificial chemistry
- Evolution
- Biological systems
- Emergence of innovation and cooperation
- ALife in the social sciences
- Philosophy, language, art and education
- Three special sessions
  - ALife & Society (organized by Alex Penn and Jesus Mario Siqueiros García)
  - Hybrid Life II: Approaches to integrate biological, artificial and cognitive systems (organized by Manuel Baltieri, Keisuke Suzuki, Hiroyuki Iizuka, Olaf Witkowski and Lana Sinapayen)
  - Towards autonomous evolution, production and learning in robotic eco-systems (organized by Emma Hart, Andy M. Tyrrell, Jon Timmis, Alan Winfield and Gusz Eiben)
- A dedicated student session
- Nine satellite workshops
  - Evolution of Human Behaviour: Using Theory to Address Societal Challenges (organized by Cedric Perret, James Borg, The Anh Han, Tom Lenaerts and Simon Powers)
  - The Fourth Workshop on Social Learning and Cultural Evolution (organized by Chris Marriott, Peter Andras, James Borg and Simon Powers)
  - Computational Approaches to Social Dynamics – Data, Modeling, Simulation, and Hybrids (organized by Genki Ichinose, Fernando P. Santos, Francisco C. Santos and Hiroki Sayama)
  - International Workshop on Agent-Based Modelling of Human Behaviour (organized by Soo Ling Lim, Peter J. Bentley, JoEllyn Prouty McLaren and Randall S. Peterson)
  - Chemistry and Artificial Life Forms (organized by Jitka Čejková, Geoff Cooperand and Richard Löffler)
  - Life at the Nexus of Microbial & Synthetic Ecology (organized by Alex Penn and Erik Hom)
  - 2nd Development of Neural Networks Workshop (organized by Julian Miller, Sylvain Cussat-Blanc, Dennis Wilson)
  - Process Modeling and Self-Organization: Methods and Applications (organized by Francis Heylighen, Peter Dittrich and Tomas Veloz)
  - Methodology in Artificial Life (organized by Emily Dolson, Iñaki Fernández Pérez, Penny Faulkner Rainford and Arturo Araujo)
- Five tutorials
  - Intelligent Systems for Smart Cities (organized by Enrique Alba)
  - Simulating Complex Systems with FLAME GPU (organized by Paul Richmond and Mozghan Kabiri Chimeh)
  - Introduction to Avida-ED (organized by Michael Wiser)
  - Introduction to Artificial Gene Regulatory Networks (organized by Sylvain Cussat-Blanc and Wolfgang Banzhaf)
  - Cartesian Genetic Programming (organized by Julian Miller)
- A panel discussion shared with the Designer Biology Conference on how the two disciplines relate themselves to current societal challenges

# ALIFE 2019 as a Demonstrator for Sustainable Conferencing

In line with our theme of facing societal challenges, ALIFE 2019 attempted to revisit the way academic conferences are run in order to reduce the ecological impact of this scientific event. Sustainability implications were considered at all stages of the conference organization.

Our primary aim was not to deliver a one-off event that would meet self-assigned sustainability criteria, but rather to engage with the community in order to develop a longer term agenda for the ALIFE community. This was initiated through an online survey that assessed the acceptance of diverse sustainability measures. The survey – results of which are included in these proceedings – not only provided us with information about which measures would be accepted by the community, but also with a plethora of actionable suggestions for our endeavour.

As the major ecological impact of scientific conferencing is associated with travel, we early on took the decision to open the conference up for remote participation by means of video-conferencing solutions. As a result, the majority of ALIFE 2019 presentations have been live streamed and recordings of talks have been made available through the conference website. Viewers of these live streams were given the opportunity to take part in discussions using online platforms (sli.do). Participants were allowed to submit prerecorded video presentations, that were then discussed using telecommunication technology. A similar remote presentation model was offered to poster presenters. To increase the reach of these activities, we encouraged groups at different universities in Japan, USA and Mexico to organize local seminars to act as remote hubs of the ALIFE 2019 conference.

For local delegates our agenda lead to sustainably sourced, plastic free catering, featuring menus that followed recommendations of the recent EAT-Lancet Commission report on “Healthy Diets from Sustainable Food Systems” – primarily reducing the amount of red meat and increasing the proportion of vegetarian food options. Similarly, all conference merchandize was selected to be plastic free, low-waste and made from recycled material where possible.

While it is too early to see how our endeavours might impact the long-term way of working in the ALIFE community, we were very happy to see our own institution engage in this pilot project. Implementations we have trialed at ALIFE 2019 will now be considered by Newcastle University to develop best practices and guidelines for its future sustainable conference organization.

## About the Editors

Harold Fellermann holds a PhD in Applied Systems Science from the University of Osnabrück, Germany, and is currently a Lecturer for Complex Biosystems at the School of Computing, Newcastle University. His research interests include complex systems, systems and synthetic biology, minimal cell research and DNA nanotechnology.

Jaume Bacardit has received a BEng and MEng in Computer Engineering and a PhD in Computer Science from Ramon Llull University, Spain in 1998, 2000 and 2004, respectively. He is currently Reader in Machine Learning at Newcastle University in the UK. Bacardit’s research interests include the development of machine learning methods for large-scale problems, the design of techniques to extract knowledge and improve the interpretability of machine learning algorithms and the application of these methods to a broad range of problems, mostly in biomedical domains.

Ángel Goñi-Moreno is a Lecturer in Synthetic Biology at Newcastle University (UK) – as part of the Interdisciplinary Computing and Complex Biosystems (ICOS) group. He studied Computer Engineering at the Technical University of Madrid (UPM), Spain, from which he also earned a MSc in Artificial Intelligence and a PhD in Synthetic Biology. After UPM (2010) he joined Martyn Amos’ group at Manchester Metropolitan University (UK) as a postdoc; then moved back to Madrid (2013) to join the Victor de Lorenzo’s lab at the National Center for Biotechnology (CNB-CSIC). In 2016 he moved to the UK and took his position at Newcastle, in which he leads an interdisciplinary team that carries out both theoretical and experimental research in synthetic and systems biology.

Rudolf Fuchsli holds a PhD in Physics and is a Professor of Applied Complex Systems Sciences at the School of Engineering, Zurich University for Applied Sciences. His research interests include applications of complex systems sciences to medicine, social systems and evolutionary engineering. He is co-director of the European Centre for Living Technology in Venice, Italy.

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