

# Preface

This volume presents the proceedings of ALife 2016, *the Fifteenth International Conference on the Synthesis and Simulation of Living Systems*, held July 4th-8th. It took place in Latin America for the first time in Cancún, México (<http://xva.life>).

## 1 The ALife 2016 Program

We received in total 174 submissions, out of which 68 were accepted as oral presentations and 41 were accepted as poster presentations, both of which are included in these proceedings. We accepted 21 late breaking abstracts for poster presentations and are available at the conference website <http://xva.life>.

The conference program of this year included:

- Eight keynote presentations of internationally renowned speakers within a wide variety of topics:
  - Randall Beer (Indiana University),
  - Mark Bickhard (Lehigh University),
  - Ezequiel Di Paolo (Ikerbasque),
  - Jorge M. Pacheco (Universidade do Minho, Portugal),
  - Alexandra Penn (University of Surrey),
  - Ken Rinaldo (The Ohio State University),
  - Francisco C. Santos (Instituto Superior Técnico, University of Lisbon, Portugal), and
  - Linda Smith (Indiana University, Bloomington).
- Parallel sessions on:
  - ALife and society
  - Origins of life and protocells
  - Self-organization and automation
  - Robotics
  - Genetics
  - Open-ended evolution

- Morphology
  - Evolvability
  - Cooperation and collective behavior
  - Development
  - Learning and Memory
  - Ecology
  - Artificial societies
  - Language and culture evolution
  - Computational biology
  - Artificial chemistries
  - Living technology
  - Human-Computer interaction
  - Theory and measures
- Eight workshops:
    - SCBCS: Synthesizing Concepts from Biology and Computer Science (Organizers: Emily Dolson and Charles Ofria).
    - SLCS: Steering Living and Life-like Complex Systems (Organizers: Alexandra Penn, Rob Mills, and Emma Hart).
    - SLACE: Social Learning and Cultural Evolution (Organizers: Chris Marriot, Peter Andras, James Borg, and Paulo Smaldino).
    - BFE: The Biological Foundations of Enactivism (Organizers: Eran Agmon, Nathaniel Virgo, Tom Froese, and Matthew Egbert).
    - OEE: Open Ended Evolution: Recent Progress (Organizers: Mark Bedau, Alastair Channon, and Tim Taylor).
    - GSO: Eight International Workshop on Guided Self-Organization (Organizers: Mikhail Prokopenko, Carlos Gershenson, and Daniel Polani).
    - MEW: Morphogenetic Engineering Workshop (Organizers: René Doursat and Hiroki Sayama).
    - EGT: Multidisciplinary applications of evolutionary game theory (Organizers: Tom Lenaerts, Luis A. Martínez-Vaquero, Jelena Grujic, Francisco C. Santos, and Tom Froese).
  - Five tutorials:
    - **MABE**: An Introduction to MABE ( Modular Agent Based Evolution) and Markov Network Brains.
    - **AVIDA-ED**: Avida-ED, a tool for teaching a classroom research.
    - **AEVOL**: In silico experimental evolution with the Aevol Software.

- **ISA**: Introductory Statistics for ALife Experiments: A Visual Approach.
  - **NetLogo**: A low threshold/high ceiling for programming multi-agent models.
- The third ISAL Summer School.
  - Art exhibition  
(Ken Rinaldo (The Ohio State University), Tatsuo Unemi (Soka University), Daniel Bisig (University of Zurich), Mario García-Valdez (Instituto Tecnológico de Tijuana), Eduardo Makoszay Mayén, and Antonio Isaac Gómez).

## 2 About the Editors

Carlos Gershenson is a tenured research professor at the Instituto de Investigaciones en Matemáticas Aplicadas y en Sistemas of the Universidad Nacional Autónoma de México, where he leads the Self-organizing Systems Lab. His research interests include complex systems, self-organization, urbanism, philosophy, and artificial life.

Tom Froese is Associate Professor at the Research Institute for Applied Mathematics and Systems of the National Autonomous University of Mexico, Mexico City. He is also affiliated with the Center for the Sciences of Complexity at the same university. His research interests include evolutionary robotics, origins of life, and cognitive science.

J. Mario Siqueiros is Associate Professor at the Instituto de Investigaciones en Matemáticas Aplicadas y en Sistemas of the Universidad Nacional Autónoma de México. His research interests include complex systems, computational social science, emergence and evolution of culture, social-ecological systems, and philosophy of biology.

Wendy Aguilar works as a Research Assistant at the Department of Computer Science, Instituto de Investigaciones en Matemáticas Aplicadas y en Sistemas at the Universidad Nacional Autónoma de México. She received the PhD., M.Sc., and B.Sc. degrees in Computer Science from the Universidad Nacional Autónoma de México (UNAM). Her research areas include developmental artificial intelligence and computational creativity.

Eduardo Izquierdo is an Assistant Professor in the Cognitive Science Program at Indiana University. He is also affiliated to the Program in Neuroscience, School of Informatics and Computing, the Indiana University Network Science Institute, the Center for Complex Networks and Systems Research, and the Center for the Integrative Study of Animal Behavior. His research is focused on the understanding of behavior from brain-body-environment interactions in simple model organisms.

Hiroki Sayama is Director of the Center for Collective Dynamics of Complex Systems and Associate Professor of Systems Science and Industrial Engineering, at Binghamton University, State University of New York, USA. His research areas include complex systems, dynamical networks, artificial chemistry, computational social science, and interactive evolutionary computation.

### 3 About the Conference Logo

In recognition of the Maya, this year's *ALife* conference logo includes a Mayan hieroglyph for soul-heart (Figure 1), which is closely related with life. It is read *o'hlis*, and refers to one of the essential animating souls or forces that is specific to the human species with its emotions, knowledge, and thought (Erik Velásquez García, pers. comm.). This force is also an embodiment of the spirit of the god that was principally responsible for the creation of humanity, the god of maize, since the Maya believed that our flesh was originally made from ground corn. The hieroglyph is surrounded by motifs related to the artificial forces of the contemporary world: mechanical and digital technologies. The three bars below *ALife* are the number fifteen in Mayan numerals (one bar represents the number 5), indicating the fifteenth edition of the conference.



Figure 1: The conference logo of ALife XV.

### 4 Acknowledgments

We are grateful for generous support from the Consejo Nacional de Ciencia y Tecnología, and from the Coordinación de la Investigación Científica and the Instituto de Investigaciones en Matemáticas Aplicadas y en Sistemas, both of which pertain to the Universidad Nacional Autónoma de México. Especially, Héctor Benítez Pérez, William Lee Alardín and Carlos Arámburo de la Hoz gave us their full support for the successful organization of the event.

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During the planning of the conference, several people were supportive. Carlos Coello, Genaro Juárez Martínez and Héctor Zenil provided useful advice; Mara Elena Vega helped with Mayan hieroglyphs, and Vanessa Gil Tejada designed the logo.

The logistics, administration, and production were possible thanks to several people, including Gerardo Betancourt, Alana Burad, Dinorah Cervantes, Andrea Domínguez, Aurora García, María del Mar Gargari, Jaimes Gironés, Héctor Gómez Escobar, Lorena Hernández García, Connie James, Rosy Mata, David Ramos, and Natalín Vázquez Cervantes.

We would like to express our gratitude to those who participated in ensuring the quality of the works presented in this conference:

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