

## Preface

This volume presents the proceedings of the 2020 Conference on Artificial Life (ALIFE 2020) which took place online July 13-18. Originally scheduled to be held in Montreal, Canada, this was the first time our conference had been conducted in this manner. Of course, our community was not alone: just about every human community has had to adapt to the covid-19 pandemic and its repercussions. It is difficult to avoid seeing the irony in this: Artificial Life researchers have declared, since the field's inception at a small workshop at Los Alamos in 1987, that we wish to understand how life adapts to unforeseen circumstances. Further, we wish to incorporate learned mechanisms of adaptation into our technologies and, possibly, our societies. Put simply, Artificial Life invites us to think and learn about adaptation; SARS-CoV-2 forces us to adapt. More simple yet: ALife is theory; COVID is practice. There is a long tradition in our field of peering at our computer screens or into our petri dishes, waiting with bated breath to see what new forms emerge. Likewise for the post-pandemic world. Whatever does emerge from the conference, and from the pandemic — and whether we learn from it, and whether we use that knowledge to benefit each other — it is our honor to be part of the adventure with you.

## The ALife 2020 Theme: What Can ALife offer AI?

To some, deep learning seems to be descending the technology hype curve from the Peak of Inflated Expectations to the Trough of Disillusionment; it is timely to consider why. Those working in AI continue to produce brilliant technological advances which, as just one byproduct, continue to restructure entire markets. Why the pessimism then? One reason is the belated observation, yet again, that science and technology cannot be separated from the societies which produce them: the recent public backlash against automated facial recognition is but one example. The field of Artificial Life has acknowledged this inseparability between inquiry and society since its inception at the Santa Fe Institute (SFI) 33 years ago. Among other things, SFI was founded to serve as a think tank dedicated to peaceful uses of technology; it was meant to complement the nuclear weapons development at its sister institution, the Los Alamos National Laboratory<sup>1</sup>. And, just as the study and creation of nuclear power cannot be divorced from its social repercussions, neither can the study and creation of synthetic life or artificial intelligence. Throughout the field's history, ALife researchers have celebrated consilience: we work across disciplinary boundaries; we celebrate the fusion of society and science, and art and technology; and we resist the assumption that only Big Data and Compute are required for creating AI or ALife. Perhaps, moving forward, the gnarly energy and anarchic spirit of inquiry found in our community may help lift AI research out of its current trough and on to the upward-rising Slope of Enlightenment.

## The ALife 2020 Program

We received a total of 183 full paper and abstract submissions. All submissions were reviewed by typically three and in some cases two reviewers. Senior program committee members then performed a topic-wide metareview to derive acceptance decisions. As a result, we accepted 110 contributions for publication and oral presentations. Following the successful model of ALIFE 2018, we selected 11 of these submissions for plenary lightning talks.

The conference program this year included:

- Six keynote presentations spanning diverse areas of Artificial Life research and beyond:
  - Rebecca Kramer-Bottiglio (Yale University)
  - Michael Levin (Tufts University)
  - Melanie Mitchell (Portland State University)
  - Luis Zaman (University of Michigan)
  - Sara Imari Walker (Arizona State University)
  - Lee Cronin (University of Glasgow)
- Numerous contributed talk session, this year organized by presenters' geographic locations rather than topic due to the virtual nature of this year's conference

<sup>1</sup>GA Cowan (2010). Manhattan Project to the Santa Fe Institute: The Memoirs of George A. Cowan. University of New Mexico Press.

- Two special sessions:
  - Artificial Life and Society, organized by Alex Penn and Jesus Mario Siqueiros Garcia
  - Hybrid Life III: Approaches to integrate biological, artificial and cognitive systems, organized by Manuel Baltieri, Keisuke Suzuki, Hiroyuki Iizuka, Olaf Witkowski, and Lana Sinapayen
- Nine satellite workshops:
  - ALife for Social and Environmental Good (ALife4Good), organized by Olaf Witkowski, Alan Dorin, Julien Hubert, Jitka Cejkova, Steen Rasmussen, Manuel Baltieri, and Antoine Pasquali
  - Developmental Neural Networks Workshop (DevoNN), organized by Julian F. Miller, Sylvain Cussat-Blanc, and Dennis G. Wilson
  - Emerging Researchers in Artificial Life (ERA), organized by Daniel Junghans, Austin J. Ferguson, Acacia Ackles, and Alexander Lalejini
  - Interdisciplinary Approaches to A-Life and the Digital Arts (A-Life and the Arts), organized by Chris Salter, Takashi Ikegami, Alexandre Saunier, and Sofian Audry
  - Lifelike Computing Systems Workshop (LIFELIKE), organized by Anthony Stein, Sven Tomforde, Jean Botev, and Peter Lewis
  - Symbiosis in Artificial Life (SAL), organized by Anya E. Vostinar, Erik Hom, and Luis Zaman
  - Teaching with Artificial Life (TAL), organized by Anya E. Vostinar, Barbara Z. Johnson, and Michael Wiser
  - The First Proteus Workshop, organized by Josh Bongard, Nick Cheney, and Melanie Moses
  - The Second International Workshop on Agent-Based Modelling for Human Behaviour (ABMHuB), organized by Katarzyna (Kasia) Kozdon, Soo Ling Lim, and Peter J. Bentley
- Ten tutorials:
  - The Bibites: Getting the online community involved into Alife through game development (Bibites), organized by Léo Caussan
  - Cartesian Genetic Programming (CGP), organized by Julian Miller
  - Functional Programming for Artificial Life (FPAL), organized by Lance R. Williams
  - Introduction to Artificial Gene Regulatory Networks (AGRN), organized by Sylvain Cussat-Blanc and Wolfgang Banzhaf
  - Introduction to MABE, A tool for studying evolving systems and digital brains (MABE), organized by Clifford Bohm
  - Large Scale Agent Based Modelling with FLAME GPU 2 (FLAME GPU 2), organized by Paul Richmond
  - Molecular programming of swarms for ALife (MolProg), organized by Nathanael Aubert-Kato, Leo Cazenille, and Nicolas Lobato-Dauzier
  - Programming soft alife with SPLAT and ulam (HackSPLAT), organized by Dave Ackley
  - Tracing epidemics with agent-based and network based models (EpiAgeNet), organized by Mikhail Propenko
  - Visualization Principles and Techniques for Research in ALife (ALifeVis2020), organized by Michael McGuffin
- A Virtual Creatures Competition, organized by Sam Kriegman
- An OpenAI Gym Hackathon, organized by Jack Felag

## About the Editors

**Josh Bongard** is the Veinott Professor of Computer Science at the University of Vermont and director of the Morphology, Evolution & Cognition Laboratory. His work involves automated design and manufacture of soft-, evolved-, and crowd-sourced robots, as well as computer-designed organisms. A PECASE, TR35, and Microsoft New Faculty Fellow award recipient, he has received funding from NSF, NASA, DARPA, ARO and the Sloan Foundation. He is the author of the book *How The Body Shapes the Way we Think*, the instructor of a reddit-based evolutionary robotics MOOC, and director of the robotics outreach program Twitch Plays Robotics.

**Juniper Lovato** is the Director of partnerships and external programs at the Vermont Complex Systems Center at UVM where she organizes Complex Systems programs and thinks about multi-scale data ethics. Previously, she was the Director of Education for the Santa Fe Institute in Santa Fe, New Mexico. In her free time she makes/supports makerspaces.

**Lisa Soros** is a Research Associate in the Game Innovation Lab at New York University. She was previously an Assistant Professor of Computer Science at Champlain College and was more previously a Ph.D. student in the Evolutionary Complexity Research Group at the University of Central Florida. Her primary interests include open-ended evolution, virtual worlds, and generative systems writ broadly.

**Laurent Hébert-Dufrésne** is an Assistant Professor of Computer Science at the University of Vermont and the director of the Laboratory for Structure & Dynamics at the Vermont Complex Systems Center. His interests lie in the coevolution of structure and dynamics in complex systems, working on behavioral models of infectious diseases, contagions on networks, and the self-organization of biological and social communities. His work is currently funded by the NIH, NSF, and Google Open Source.

## Acknowledgements

ALIFE 2020 would not have been possible without the help of many people. I (Josh Bongard) would like to start by calling special attention to my co-organizers Juniper Lovato, Lisa Soros and Laurent Hébert-Dufresne. Together, they performed a massive amount of work, even before the pandemic forced an online conference and a doubling and redoubling of the organizational effort required to deliver the conference.

We would also like to thank our wonderful conference volunteers Acacia Ackles, Agostino Allesandro Polignano, Amiani Johns, Ashok Urlana, Balasubrahmanyam Estamsetty, Chloe M. Barnes, Nihad Bassis, Ralf Mayet, and many others.

Finally, it goes without saying (but we will say it anyway) that this conference exists in no small part because of our program committee members, who rose to the occasion in spite of challenging circumstances. We are grateful to be part of such a dedicated and thoughtful community.

## Senior Program Committee

Peter Andras  
 Randall Beer  
 Hiroki Sayama  
 Wolfgang Banzhaf  
 Takashi Ikegami  
 David Ha  
 Jitka Cejkova  
 Jean-Baptiste Mouret  
 Tom Froese  
 Tomas Mikolov  
 Philip Isola  
 Susan Stepney  
 Charles Ofria

## Program Committee

Dave Ackley	Andy Adamatzky	Christoph Adami
Eran Agmon	Miguel Aguilera	Martyn Amos
Takaya Arita	Nathanael Aubert-Kato	Joshua Auerbach
Manuel Baltieri	Stuart Bartlett	Manuel Bedia
Peter Bentley	Anton Bernatskiy	Guillaume Beslon
Martin Biehl	James M. Borg	Silvio Capobianco
Timoteo Carletti	Alastair Channon	Nick Cheney
Antoine Cully	Sylvain Cussat-Blanc	Matthew Dale
Kerstin Dautenhahn	Emily Dolson	Alan Dorin
Matthew Egbert	Aniko Ekart	Penelope Faulkner Rainford
Harold Fellersmann	Matthew Fontaine	Rudolf M. Füchslin
Carlos Gershenson	Jean-Louis Giavitto	Kyrre Glette
Laura Grabowski	Heiko Hamann	The Anh Han
Martin Hanczyc	Kyle Harrington	Emma Hart
Yasuhiro Hashimoto	Helmut Hauser	Simon Hickinbotham
Arend Hintze	Petter Holme	Amy Hoover
Tim Hutton	Laurent Hébert-Dufresne	Hiroyuki Iizuka
Eduardo Izquierdo	Klaus Jaffe	Genaro Juarez Martinez
Yoshihiko Kayama	Stephen Kelly	Alexander Lalejini
John Lazarus	Joel Lehman	Peter Lewis
Eric Libby	Soo Ling Lim	Robert Lowe
Herve Luga	George Magoulas	Chris Marriott
Georg Martius	Atsushi Masumori	Barry McMullin
Philip Mckinley	Chrystopher L. Nehaniv	Stefano Nichele
Geoff Nitschke	Mizuki Oka	Norman Packard
Robert Pennock	Andrew Philippides	Jeremy Pitt
Daniel Polani	Simon Powers	Mikhail Prokopenko
Luis M. Rocha	Andrea Roli	Guido Schillaci
Thomas Schmickl	Lana Sinapayen	Lee Spector
Pasquale Stano	Adam Stanton	Kasper Stoy
Reiji Suzuki	Keisuke Suzuki	Claudia Szabo
Tim Taylor	Christof Teuscher	Guy Theraulaz
Vito Trianni	Gunnart Tufte	Marco Villani
Anya Vostinar	Sara Imari Walker	Roger White
Dennis Wilson	Olaf Witkowski	Borys Wrobel
Yuan Yuan	Luis Zaman	Hector Zenil
Xiaoge Zhang	Sebastian von Mammen	

The ALife 2020 Organizing Committee:  
Josh Bongard (Academic Conference Chair)  
Juniper Lovato (General Conference Chair)  
Laurent Hébert-Dufrésne (General Conference Co-Organizer)  
Radhakrishna Dasari (General Conference Co-Organizer)  
Lisa Soros (Program Committee Chair)