Editorial Introduction to the 2023 Conference on Artificial Life Special Issue

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This special issue of *Artificial Life* presents selected papers from the 2023 Conference on Artificial Life (ALIFE 2023), which took place in Sapporo, Japan, from July 24 to 28, 2023. The conference brought together approximately 380 participants (online and in person) in a vibrant program featuring seven keynote talks, four special sessions, eight workshops, nine tutorials, 99 oral presentations, and 43 poster presentations, in parallel sessions.

ALIFE 2023 was of particular significance as the first hybrid conference following the onset of the COVID-19 pandemic. While ALIFE 2019 pioneered the presence of online elements at ALIFE conferences, subsequent conferences (2020–2022) were held entirely online due to pandemic restrictions. As global conditions improved in 2023, rather than simply reverting to in-person-only formats, we chose to capitalize on the experience accumulated and pushed for a hybrid approach that combined the benefits of both in-person and online attendance.

We believe that the theme of ALIFE 2023, "Ghost in the Machine" (Figure 1), was especially timely as large language models began engaging in increasingly more complex conversations, reviving fundamental questions about the nature of mind and consciousness in Artificial Life research. The conference explored how recent advances in embodiment, complexity science, emergence, agency, and information theory inform our understanding of these concepts–particularly at a time when artificial intelligence can convincingly mimic human cognition. While technological progress

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Figure 1. Original logo and cover design of the ALIFE 2023 conference held in Sapporo, Japan.

in fields like computer simulations, robotics, and synthetic biology continues at a rapid pace, the conference highlighted the importance of keeping core philosophical questions at the heart of Artificial Life research.

With this theme in mind, we aimed to promote research that could address how new technologies are challenging traditional boundaries between organisms and their environments. Brain–machine interfaces, cyborgization, virtual/augmented reality, and the metaverse are creating new forms of extended cognition that transcend conventional spatial limitations. These developments raise profound questions about the nature of consciousness and its relationship to physical embodiment—questions that have been central to Artificial Life research since its inception.

As a special highlight related to this theme, the conference featured a landmark dialogue between Ted Chiang, the renowned science fiction author, and Anil Seth, a leading expert in consciousness science. The conversation was moderated by Susan Stepney, one of the most distinguished researchers in the Artificial Life research community. This special event was streamed online and made freely accessible worldwide, attracting more than 500 viewers and demonstrating the significant public interest in these fundamental questions about mind and consciousness. The substantial participation from Japanese researchers particularly contributed to the development of Artificial Life research within Japan, marking an important step in the field's global expansion.

The conference attracted 243 submissions, reviewed, thanks to the incredible efforts of 200 reviewers, in a double-blind process. Senior program committee members conducted topic-wide

meta-reviews to ensure consistency in acceptance decisions. A total of 142 papers were accepted and published in the open-access conference proceedings available from the MIT Press website (Iizuka et al., 2023). The authors of the best papers (judged on their overall peer review scores and the quality of their presentations) were invited to submit extended versions of their conference manuscripts, which underwent additional rounds of peer review and revision. As a result, six articles are included in this special issue:

- **Moreno et al., "Ecology, Spatial Structure, and Selection Pressure Induce Strong Signatures in Phylogenetic Structure."** Moreno et al. explore how ecological factors, spatial structures, and selection pressures shape evolutionary dynamics and produce detectable signatures in phylogenetic trees. By leveraging computational models, the study reveals how evolutionary processes leave lasting patterns that can be analyzed across diverse systems. This work emphasizes the importance of historical and ecological contexts in understanding long-term evolutionary trajectories, resonating with the conference's broader inquiries into complexity and emergence.
- **Reynolds, "Camouflage From Coevolution of Predator and Prey."** Addressing the themes of perception, adaptation, and environmental interaction, Reynolds presents a novel simulation of predator–prey coevolution. The work explores how adversarial dynamics between evolving prey textures and predator visual systems can lead to the emergence of effective camouflage patterns. By using photographic backgrounds and an open-source computational model, the study provides both theoretical insights and practical methods for environment-specific camouflage generation, connecting evolutionary dynamics with perceptual systems.
- **Giannakakis et al., "Network Bottlenecks and Task Structure Control the Evolution of Interpretable Learning Rules in a Foraging Agent."** Examining learning and adaptation, Giannakakis et al. investigate how network architecture and environmental factors influence the evolution of learning rules in artificial agents. Through evolutionary algorithms applied to foraging tasks, they demonstrate how structural variations, such as activation functions and weight normalization, impact the interpretability and plasticity of evolved behaviors. This research connects directly with the conference's emphasis on how complexity and simplicity interplay in the emergence of adaptive behaviors.
- **Pigozzi, "Of Typewriters and PCs: How the Complication of Computers Limits Us and What to Do About It."** Reflecting on the philosophical and societal implications of technological advancement, Pigozzi critiques the increasing complexity of modern computing technologies. By contrasting the simplicity of typewriters with the intricacy of contemporary computers, the article argues for a return to values of "humanity" and "parsimony" in Artificial Life research. The call for minimally intrusive technologies and simpler cognitive models ties into broader questions of transparency, accessibility, and the ethical responsibilities of researchers.
- **Azevedo Amin et al., "Investigating the Limits of Familiarity-Based Navigation."** In line with the theme's focus on embodiment and minimal cognition, Azevedo Amin et al. examine familiarity-based navigation inspired by insect behavior. By testing shallow neural networks across varying environmental conditions and route lengths, the study uncovers key factors that influence robust navigation. The findings provide insights into how simple biological mechanisms can be translated into power-efficient robotic systems, emphasizing the relevance of embodiment in navigation strategies.
- **Plantec et al., "Flow-Lenia: Emergent Evolutionary Dynamics in Mass Conservative Continuous Cellular Automata."** Expanding on the exploration of self-organizing systems, this paper on Flow-Lenia introduces a mass-conservative extension of the Lenia

cellular automata framework. By enabling the coexistence and interaction of multiple species within a single simulation, Flow-Lenia offers new avenues to study spatially localized patterns and intrinsic evolutionary dynamics. Plantec et al. highlight how simple local rules can produce complex, emergent behaviors, furthering our understanding of open-ended evolution in Artificial Life systems.

In the spirit of the conference's "Ghost in the Machine" theme, these articles invite us to reflect on the intricate relationships between computational models and complex systems in the mind and life sciences. The selected contributions shed light on how seemingly simple rules can generate intricate behaviors, offering a glimpse into the subtle interactions that underlie emergent phenomena. By bridging computational modeling, biological insights, and philosophical inquiries, this collection continues to explore the nuanced landscape of Artificial Life research, opening the door for future work to build on these and other important findings presented at ALIFE 2023.

Reference

Iizuka, H., Suzuki, K., Uno, R., Damiano, L., Spychala, N., Aguilera, M., Izquierdo, E., Suzuki, R., & Baltieri, M. (Eds.). (2023). *ALIFE 2023: Ghost in the Machine: Proceedings of the 2023 Artificial Life Conference*. MIT Press. https://direct.mit.edu/isal/isal2023/volume/35