

Olaf WITKOWSKI

Artificial Life, Evolvable Communication
& Fundamental Principles of Intelligence

Tokyo Institute of Technology
2-12-1-IE-1 Ookayama, Meguro-ku
Tokyo-to 152-8550, Japan
+81 90 6494 1268
olaf.witkowski@gmail.com
Belgian, 34 years old

Experience

- 2016 – present EON Postdoctoral Fellow, [Earth-Life Science Institute](#), Tokyo Institute of Technology. Modeling the emergence of information flows which led to distributed intelligence in living systems.
Visiting Researcher, [Institute for Advanced Study](#), Princeton.
Co-Founder and Research Architect, [YHouse Inc.](#), New York.
- 2015 – 2016 Postdoctoral Fellow, Graduate School of Arts and Sciences, University of Tokyo. Studied multiagent neural-network-based models of massive swarm intelligence.
- 2013 – 2016 Research Scientist in Machine Learning, Advanced Technology Department, MTI Ltd. Designed music recommendation system and artificial scientist for gene expression analysis.
- 2009 – 2011 Research Assistant, Tsujii Lab, University of Tokyo. Developed UIMA NLP toolkit.
- 2007 – 2009 Co-Founder & Chief Research Officer, Commentag LLC. Designed first semantic search engine for Twitter/Microblogging.
- 2007 – 2008 Teaching and Research Assistant, Info. Sys. Unit, Louvain School of Management.

Education

- 2011 – 2015 Doctor's Degree in Computer Science, Graduate School of Information Science and Technology, University of Tokyo.
Thesis Evolution of Coordination and Communication in Groups of Embodied Agents
Supervisor Prof. Takashi IKEGAMI, Graduate School of Arts and Sciences, University of Tokyo.
- 2007 – 2008 Master's Degree in Natural Language Processing (1 year), Center for Natural Language Processing, University of Louvain (UCL).
Internship Natural Language Processing Group, GATE Project, University of Sheffield, UK.
- 2004 – 2007 Master's Degree in Computer Science and Engineering, specialized in Artificial Intelligence, Department of Computer Science, UCL.
Exchange Programme Machine Learning Department, Polytechnic University of Valencia, Spain.
- 2001 – 2004 Bachelor's Degree in Engineering, Faculty of Applied Sciences, UCL.

Languages

French	Mother tongue
English	Fluent
Spanish	Fluent
Polish	Fluent
Vietnamese	Fluent
Japanese	Conversational
Portuguese	Conversational
Italian	Basic
Russian	Basic
Dutch	Basic
Chinese	Basic
Latin	Basic

Expertise

Background: Artificial Life, Neural Networks, Evolutionary Computation, Game & Information Theory, Mathematical Biology, Cryptography, Linguistics.

Teaching: Software Engineering, Machine Learning (2 undergraduate courses). Evolutionary Robotics, Artificial Chemistry, Agent-Based Modeling (mentored 2 graduate and 2 undergraduate students to graduation). Cognitive Science, Robotics (2 summer schools).

Fluent: Java, Python, C. *Conversational:* Assembly, C++, Fortran, Grails, Javascript, Matlab, Objective C, OZ, PHP, Prolog, Ruby, Smalltalk, SQL, Tex, VHDL.

Current Research

Why communicate? Why do scientists bother talking to each other? Anyone with an Internet connection already has access to all the information needed to conduct research. So in theory, scientists could do their work alone locked up in their office. Yet, there seems to be a **huge intrinsic value to exchanging ideas with your peers**. Through repeated transfers from node to node, concepts seem to converge towards new theorems, philosophical concepts, and scientific theories. Understanding fundamental principles of communication can lead us to construct intelligent systems from the bottom up.

However, real life is complex, and hard to examine directly. To understand how living matter undergoes transitions in intelligence, my research focuses on the characterization of information dynamics, not in *life-as-we-know-it*, but in *life-as-it-could-be*, employing 3 tools:

1. the creativity of **artificial life modeling**, from dynamical systems to evolutionary robotics,
2. the capacity of **neural networks** and similar systems to learn patterns, and
3. the language of **information theory**, to understand 1 and 2.

My goal is to **elucidate the nature of information dynamics in living systems**, which allowed them to colonize the Earth and probably other planets, and to understand the future transitions in terms of communication in the bio- and technosphere, which can bring us to new states of technology.

Publications

Google Scholar: https://scholar.google.be/citations?user=B_XJHVkAAAAJ

ResearchGate: https://www.researchgate.net/profile/Olaf_Witkowski

Journal Papers

- Witkowski, O. and Guttenberg, N. (in preparation). Transfer of Knowledge via Differentiably Learned Language. *Frontiers in Robotics and AI*.
- Khajehabdollahi, S. and Witkowski, O. (in preparation). Adaptive Criticality: Exploring the Trade-Off Between Learning and Evolution with Embodied Boltzmann Machines. *Special Issue, Artificial Life*.
- Mariscal, Carlos et al. (pending review) The History and Philosophy of Origins-of-Life Studies: Orientations for the Future. Submitted to *Biological Reviews*.
- Miyahara, K. and Witkowski, O. (2018, in press). Phenomenology and the Cognitive Sciences, Springer.
- Drozd, A., Witkowski, O., Matsuoka, S. and Ikegami, T. (2016). Critical Mass in the Emergence of Collective Intelligence: a Parallelized Simulation of Swarms in Noisy Environments. *Artificial Life and Robotics* 21.3: 317-323.
- Witkowski, O., and Ikegami, T. (2016). Emergence of Swarming Behavior: Foraging Agents Evolve Collective Motion Based on Signaling. *PloS one* 11.4 (2016): e0152756.
- Scharf, C., Virgo, N., Cleaves, H. J., Aono, M. et al. (2015). A Strategy for Origins of Life Research. *Astrobiology* 15.12: 1031-1042
- In Artificial Life Conference Proceedings (pp. 47-54). One Rogers Street, Cambridge, MA 02142-1209 USA journals-info@mit.edu: MIT Press.
- Ikegami, T., Virgo, N., Witkowski, O., Oka, M., Suzuki, R. and Iizuka, H. (2018). Beyond AI: A New Epistemology for Artificial Life and Complex Systems, an Introduction to the 2018 ALIFE conference. In *Artificial Life Conference Proceedings* (pp. 1-4). One Rogers Street, Cambridge, MA 02142-1209 USA journals-info@mit.edu: MIT Press.
- Witkowski, O. and Nitschke, G. (2018). The dynamics of cooperation versus competition. In *Proceedings of the Genetic and Evolutionary Computation Conference Companion* (pp. 115-116). ACM.
- Bartlett S. J., Witkowski O. and Giovannelli D. (2017) Cognition and Learning: A Primary Determinant and Seed of Life. In *Proceedings of XVIIIth Intl Conf on Origin of Life 2017* (LPI Contrib. No. 1967) at UC San Diego, CA, USA.
- Aubert-Kato, N., Witkowski, O., Hoel, E. and Bredeche, N. (2016). Towards Detecting the Emergence of Agency in Evolved Artificial Chemistries. *Artificial Life XV: Late-Breaking Proceedings of the Fifteenth International Conference on the Synthesis and Simulation of Living Systems*, 20-21.
- Witkowski, B. and Witkowski, O. (2016). City's Evolution: Vernacular or Sustainable? In: P. Hajek, J. Tywionak, A. Lupisek, Katerina Sojkova (eds.), *CESB16: Proceedings of the Central Europe towards Sustainable Building Conference 2016*, 635-642.

Peer-Reviewed Papers

- Khajehabdollahi, S. and Witkowski, O. (2018). Critical Learning vs. Evolution: Evolutionary Simulation of a Population of Ising-Embodied Neural Networks.

- Witkowski, O. and Ikegami, T. (2015). Swarm Ethics: Evolution of Cooperation for Multi-Agent Foraging Model. Proceedings of the First International Symposium on Swarm Behavior and Bio-Inspired Robotics.
- Drozd, A., Witkowski, O., Matsuoka, S. and Ikegami, T. (2015). Signal-Driven Swarming: A Parallel Implementation of Evolved Autonomous Agents to Perform A Foraging Task. Proceedings of the First International Symposium on Swarm Behavior and Bio-Inspired Robotics.
- Aubert-Kato, N., Witkowski, O. and Ikegami, T. (2015). The Hunger Games: Embodied agents evolving foraging strategies on the frugal-greedy spectrum. In: P. Andrews, L. Caves, R. Doursat, S. Hickinbotham, F. Polack, S. Stepney, T. Taylor and J. Timmis (eds.), ECAL 2013: Proceedings of the Thirteenth European Conference on Artificial Life, MA: MIT Press, 13, 357-364.
- Witkowski, O., Nitschke, G. and Ikegami, T. (2015). Signal drives genetic diversity: an agent-based approach to speciation. Proceedings of the Twentieth International Symposium on Artificial Life and Robotics, Springer Japan, 20, 74-77.
- Witkowski, O. and Aubert-Kato, N. (2014). Pseudostatic cooperators: Moving isn't always about going somewhere. In: H. Sayama, J. Rieffel, S. Risi, R. Doursat and H. Lipson (eds.), Artificial Life XIV: Proceedings of the Fourteenth International Conference on the Simulation and Synthesis of Living Systems, MA: MIT Press, 14, 392-397.
- Witkowski, O. and Ikegami, T. (2014). Asynchronous evolution: Emergence of signal-based swarming. In: H. Sayama, J. Rieffel, S. Risi, R. Doursat and H. Lipson (eds.), Artificial Life XIV: Proceedings of the Fourteenth International Conference on the Simulation and Synthesis of Living Systems, MA: MIT Press, 14, 302-309.
- Witkowski, O. and Nitschke, G. (2013). The Transmission of Migratory Behaviors. In: P. Liò, O. Miglino, G. Nicosia, S. Nolfi and M. Pavone (eds.), ECAL 2013: Proceedings of the Twelfth European Conference on Artificial Life, MA: MIT Press, 12, 1218-1220.
- Witkowski, O. and Aubert, N. (2012). Size Does Matter: The Impact of Size on Hoarding Behaviour. In: C. Adami, D. M. Bryson, C. Ofria and R. T. Pennock (eds.), Artificial Life XIII: Proceedings of the Thirteenth International Conference on the Synthesis and Simulation of Living Systems, Cambridge, MA: MIT Press, 13, 542-543.
- Witkowski, O., Nitschke, G. and Ikegami, T. (2012). When is happy hour: An agent's concept of time. In: C. Adami, D. M. Bryson, C. Ofria and R. T. Pennock (eds.), Artificial Life XIII: Proceedings of the Thirteenth International Conference on the Synthesis and Simulation of Living Systems, Cambridge, MA: MIT Press, 13, 544-545.
- McCrohon, L. and Witkowski, O. (2011). Devil in the details: Analysis of a coevolutionary model of language evolution via relaxation of selection. In: T. Lenaerts, M. Giacobini, H. Bersini, P. Bourguine, M. Dorigo, and R. Doursat (eds.), Advances in Artificial Life, ECAL 2011: Proceedings of the Eleventh European Conference on the Synthesis and Simulation of Living Systems, Cambridge, MA: MIT Press, MIT Press, 522-529.

Non Peer-Reviewed Papers

- Markovitch, O., Witkowski, O. and Virgo, N. (2018). Chemical Heredity as Group Selection at the Molecular Level. arXiv preprint arXiv:1802.08024.
- Guttenberg, N., Virgo, N., Witkowski, O., Aoki, H. and Kanai, R. (2016). Permutation-equivariant neural networks applied to dynamics prediction. arXiv preprint arXiv:1612.04530.

Dissertations

- Witkowski, O. (2015). Evolution of Coordination and Communication in Groups of Embodied Agents. PhD thesis, Library for Engineering and Information Science & Technology, University of Tokyo.
- Witkowski, O. (2007). Decrypting Khipu Cords Used by Incas as a Means of Communication: an Example of Ethno-Cryptography. MSc thesis, Library of Exact Sciences, Catholic University of Louvain.

Conferences Presentations

- Witkowski, O. (July 2018). The Future of Collective Intelligence: Investigating the Impact of High-Dimensional Sphere Packing and Massively Multichannel Societies on Communication with Evolutionary Simulation. The 2018 Conference on Artificial Life.
- Witkowski, O. (April 2017). Information Flows, Connectionist Learning and the Transition to Collective Cognition. AI With The Best, International Online Conference. April 29-30, 2017.
- Witkowski, O. (July 2017). The Emergence of Cognition as Parasitic Information Flows, Artificial Life Workshop, July 22, 2017.
- Witkowski, O. (August 2016). Representing Information Flows in the Major Transitions to Complex Life and Cognition. History and Philosophy of Origins Research Workshop at ELSI, Tokyo, Japan. August 24-26, 2016.
- Aubert-Kato, N., Witkowski, O., Hoel, E. and Bredèche, N. (July 2016). Decision Making in Messy Chemistries: Case Study with an Invasion-based Reaction Diffusion Scenario. Proceedings of the International Conference on Unconventional Computation and Natural Computation.

Witkowski, O., Nitschke, G. and Ikegami, T. (March 2012). Time To Migrate: The Effect of Lifespan on Imitation and Culturally Learned Migration. Seventh International Workshop on Natural Computing.

Witkowski, O. (September 2011). A Two-Speed Language Evolution: Exploring the Linguistic Carrying Capacity. Proceedings of the International Confer-

ence: Ways to Protolanguage 2.

Witkowski, O. (July 2011). Can Cultural Adaptation Lead to Evolutionary Suicide? Proceedings of the Twenty-Third Annual Human Behavior & Evolution Society Conference (HBES 2011).

Witkowski, O. (August 2010) . A Two-Speed Language Evolution. Proceedings of the Fourth Annual International Free Linguistics Conference.

Honors & Fellowships

- 2016 – 2018 ELSI Origins Network Postdoctoral Fellowship Grant, supported by the John Templeton Foundation; Study Title: “Information Flows in the Major Transitions of Evolution”. Hosting Institutions: Earth-Life Science Institute, Tokyo Institute of Technology & Institute for Advanced Study.
- 2010 – 2013 MEXT Monbukagakusho Scholarship from Japanese Government for PhD Program. Hosting Institution: University of Tokyo (Ikegami Lab/Artificial Life).
- 2008 – 2010 MEXT Monbukagakusho Scholarship from Japanese Government for Independent Research Project. Hosting Institution: University of Tokyo (Tsuji Lab/Natural Language Processing).
- 2010 IST International Research Program Fellowship, Université du Québec à Montréal (UQAM), Canada.
- 2008 Grant for Student Mobility for Internships, Hosting Institution: University of Sheffield (UK).
- 2007 Obtained the protected title of Civil Engineer, with Honors (UCL, Belgium).
- 2007 – 2008 Erasmus European Scholarship for Master’s Students. Hosting Institution: Polytechnic University of Valencia (Spain).

Invited Talks & Workshops

- 2018 *What is the Foundation for a Theory of Life?* ASU-SFI Origin of Life Theory Working Group Meeting. Global Biosocial Complexity Initiative Space, Arizona State University, USA. November 11-13.
- 2018 *The Future of Artificial Life Research.* ALife Roadmap Workshop. ALIFE 2018 Conference, Tokyo, Japan. July 23-27.
- 2018 *Evolution of Life through the Lens of Computation.* Leslie Valiant Lab, Harvard University, Boston, USA. June 15-16.
- 2018 *From Life to Brains: The Emergence of Collective Computation.* McGill University, Montreal, Canada. February 21.
- 2017 *Information Flows, Connectionist Learning and the Transition to Collective Cognition.* AI With The Best, International Online Conference. April 29-30.
- 2017 *Characterizing Cognition as Information Flows.* Cognition Lunch Salon, Princeton, USA. March 23.
- 2017 *When Do Autonomous Agents Act Collectively?* Biological Complexity: Can It Be Quantified? Beyond Center Workshops on the Physics of Living Matter. Institute for Advanced Study, Princeton, USA. February 1-3.
- 2016 *Representing Information Flows in the Major Transitions to Complex Life and Cognition.* History and Philosophy of Origins Research Workshop at ELSI, Tokyo, Japan. August 24-26.
- 2016 *Complex Systems & Artificial Life.* Institute for Advanced Study, Princeton, USA. February 2-March 30.

- 2015 *Signal-Driven Swarm Intelligence and Evolutionary Robotics*. Molecular Robotics Symposium, Tokyo, Japan. October 28.
- 2015 *Deep Learning and Swarm Intelligence: Towards Higher Levels of Cognition*. University of Cape Town, Cape Town, South Africa. September 7-11.
- 2015 EON International Roadmap Workshop, ELSI, Tokyo, Japan. August 28.
- 2015 EON Workshop on the Spontaneous Emergence of Autonomous Agents in Complex Systems, Kobe, Japan. August 12-14.
- 2015 *The Value of Signals in the Evolution of Collective Behavior*. Workshop on Artificial Life and Embodied Systems. Institute of Intelligent Systems and Robotics, Paris, France. June 25.
- 2015 *Evolution of Coordination to Cooperation to Language: An Artificial Life Approach*. Sackler Centre for Consciousness Science, University of Sussex, UK. July 25.
- 2015 *Open-Ended Modeling: How to Make Artificial Life Do Better At Studying Real Life?* Workshop on Artificial Life and Open-Ended Evolution at ELSI, Tokyo, Japan. May 21.
- 2013 *Time To Migrate: The Effect of Lifespan on Imitation and Culturally Learned Migration*. Seventh International Workshop on Natural Computing, Tokyo, Japan. March 21.
- 2012 *Evolution of Artificial Communication in Embodied Agents: The Impact of Temporal Concept on Communicative Behavior*. Artificial Life Summer Workshop, Sapporo, Japan. August 2-3.
- 2012 *Size Does Matter: The Impact of Size on Hoarding Behaviour*. Bio UT International Life Sciences Symposium, Tokyo, Japan. May 21.
- 2011 *A Two-Speed Language Evolution: Exploring the Linguistic Carrying Capacity*. International Conference Protolang 2, Torun, Poland. September 19-21.
- 2011 *Language Evolution in a Population of Simulated Agents*. Artificial Life Summer Workshop, Yamanaka, Japan. July 23-25.

Research Organizations

- 2018 Program Chair of 7th ELSI International Symposium on Origins of Life “Comparative Emergence”
- 2018 **Program Chair of ALIFE 2018 – the 2018 Conference on Artificial Life “Beyond AI”** held July 23rd-27th in Tokyo (First edition of a unified international conference in artificial life, unifying the major meetings in the Artificial Life field, ECAL and ALIFE, started in 1987)
- 2018 Co-Organizer of Workshop “Leslie Valiant’s Learning Vision”, School of Engineering and Applied Sciences, Harvard University
- 2018 – present **Coordinator for the ELSI Origins Network (EON) project, a global network of researchers working on the origins of life**. EON was created and funded to form a world-wide and interdisciplinary network for research into the Origin of Life, to pursue leading-edge research at ELSI, in TokyoTech and throughout the whole network, and to internationalize research and higher education in Japan.
- 2017 – present **Co-Founder and Chief Research Architect at YHouse Inc., nonprofit transdisciplinary research institute focused on the study of awareness, artificial intelligence and complex systems**, New York City. Coordinated the development of 14 research projects, and form a network including 20 institutions, ending up fundraising more than US\$100,000 over the first two years of the organization.
- 2016 – present Co-Organizer of the IAS Cognition Lunch, weekly interdisciplinary academic meeting at the Institute for Advanced Study (Princeton)
- 2016 – present **Founder and Principal Organizer of the Consciousness Club, biweekly interdisciplinary science outreach event** in New York City – over 1000 members
- 2016 – 2017 Scientific Board for Conscious Machine Project (CREST Grant “Towards constructing artificial consciousness based on the integrated information theory”, ARAYA Brain Imaging)

- 2016 Scientific Team for the Strategy for Origins of Life Research (SOLR) Roadmap Workshop
- 2015 – present Chair of Coordinating Committee for Initiative for a Synthesis in Studies of Awareness (ISSA), organizing joint research projects and biennial summer schools
- 2011 – present Member of International Society for Artificial Life (ISAL)
- 2010 – present Organizing Member of Tokyo Evolutionary Linguistics Group
- 2006 – present Member of MIT Khipu Research Group (CSAIL, MIT)

Review Editorial Boards

- 2018 – present Phenomenology and the Cognitive Sciences; New Journal of Physics; Cognitive Systems; Research Special Issue on Social Learning and Cultural Evolution
- 2017 – present Biosystems Journal; Frontiers in Physics; Adaptive behavior
- 2016 – present Artificial Life, Journal of the International Society for Artificial Life
- 2015 – present International Conference on the Synthesis and Simulation of Living Systems (Annual PC); International Symposium on Swarm Behavior and Bio-Inspired Robotics (Biennial PC)
- 2013 – present Evolutionary Robotics for the Journal Frontiers in Robotics and AI

Outreach Activities

- 2018 EON Interdisciplinary Talk: “The Collective Computation of Life: Emergence and Expansion of Cognition in the Universe”, EON Annual Meeting, Tokyo. January 5-6.
- 2017 Nerdnite Talk: “Befriending the Alien: Expansion of Intelligence in the Universe”, Nagatacho GRID, Tokyo. December 15.
- 2017 IAS Lunch Talk: “Ethics and AI”, Program for Interdisciplinary Studies, Institute of Advanced Study, Princeton. March 8.
- 2017 Talk for the AMIAS board of trustees: “The Collective Computation of Life” (see abstract towards the end of this file), Institute for Advanced Study, Princeton. November 3.
- 2017 Talk at Cognition Lunch Salon: “Characterizing Cognition as Information Flows”, Institute for Advanced Study, Princeton. March 23.
- 2017 Public Talk at WeWork: “The Collective Computation of Life”, New York, October 25.
- 2016 Public Talk at Consciousness Club: “AlphaGo and the Future of AI”, New York. October 12.