

Eran Agmon, Ph.D.

Stanford University
Department of Bioengineering
443 Via Ortega, Stanford, CA 94305
✉ eagmon@stanford.edu
📄 eagmon.tumblr.com

Education and Training

- 2017–present **Postdoctoral Research Fellow**, *Department of Bioengineering, Stanford University.*
NIH F32 Postdoctoral Fellowship
- 2016–2017 **Postdoctoral Research Scientist**, *Department of Biological Sciences, Columbia University.*
- 2016 **Joint Ph.D., Informatics and Computing, and Cognitive Science**, *Indiana University.*
NSF IGERT Fellowship, Dynamics of Brain-Body-Environment Systems
- 2011 **M.Sc., Systems Science**, *Portland State University.*
- 2009 **B.S., Cognitive Science**, *University of California, San Diego.*

Research Experience

- 2018–present **A platform for integrative, multi-scale modeling in computational biology**, *Stanford University*
Advisor: Markus W. Covert,
- Developed Vivarium – a software tool that can make any mechanistic model into a module that can be wired together into large composite models, and then parallelized and run across multiple CPUs.
 - This software simplifies how we build multi-paradigm models that combine modeling frameworks, such as agent based models, ordinary differential equations, stochastic reaction systems, constraint-based models, solid-body physics, and spatial diffusion.
 - We demonstrated its utility by modeling *E. coli* chemotaxis, micro-environment interactions, colony formation, and spatial organization.
- 2017–present **Whole-cell model of *Escherichia coli***, *Stanford University*
Advisor: Markus W. Covert,
- Worked with computational scientists, software engineers, and experimentalists to build the most comprehensive computational model of *E. coli* in the world.
 - Implemented a full factorial simulation protocol to identify flux constraints that agree with experimental fluxome data.
 - Worked with *Fathom*, a visualization design company, to develop software that simplifies how we access the simulation's output.
- 2016–2017 **Molecular model of cell membranes, lipid homeostasis, and disruptions that lead to cell death**, *Columbia University*,
Advisor: Brent R. Stockwell,
- Developed a coarse-grained molecular dynamics model of lipid membrane composition associated with a type of cell death called ferroptosis.
 - Predicted mechanisms for the deformation and degradation of the membrane, which were experimentally validated by collaborators in synthetic biology.

- 2013–2016 **Artificial protocell model (Dissertation research)**, *Indiana University*,
Committee: Randall D. Beer (chair), Colin Allen, Peter M. Todd, James A. Glazier,
• Developed a spatial model of a protocell that emerges from the co-construction of metabolism and membrane.
• Applied a perturbation-based analysis to quantify the robustness, plasticity, fragility, and viability of the simulated cells.
- 2015 **Cellular model of tumor progression.**, *Indiana University*,
Sponsor: Amit Hagar,
• Worked on a Cellular Potts model of tumors cells and their environments, focusing on the altered metabolic state known as the Warburg effect.
- 2011–2013 **Computational model of action-switching agents**, *Indiana University*,
Advisor: Randall D. Beer,
• Built computational models to investigate the multi-scale dynamics of brain-body-environment system.
• Applied genetic algorithms to search the parameter space of continuous-time recurrent neural networks.
- 2011 **Spiking neural model of sensory processing**, *Portland State University*
Advisor: Patrick Roberts,
• Built a spiking neural model of sensory processing in the electroreception of Mormyrid electric fish, which successfully demonstrated their adaptive response to changing environmental conditions.

Other Experience

- 2016–2017 **Visiting Scholar**, *Program in Interdisciplinary Studies, Institute for Advanced Study, Princeton, NJ*,
• Co-founded YHouse, a research institute focused on artificial intelligence and the science of awareness.
- 2017 **Visitor**, *Earth-Life Science Institute Origins Network, Tokyo Institute of Technology, Tokyo, Japan*,
• Worked with an interdisciplinary group of scientists to model molecular evolution at the origins of life.

Teaching and Mentorship

- 2017–present **Research Mentor**,
• Chris Skalnik (undergraduate, Stanford University)
• Michael Yang (undergraduate, Stanford University)
• Colin Kalicki (undergraduate, Stanford University)
• Gabrielle Cohn (undergraduate, Stanford University)
• Julia Schaepe (PhD student, Stanford University)
• Mac Klinkachorn (undergraduate, Stanford University)
• Lee Talman (PhD student, University of Virginia).
- 2020 **Co-instructor**, *Build-A-Cell Chemical Reaction Network modeling tutorials*.
- 2019 **Mentor**, *Stanford International Genetically Engineered Machine (iGEM) competition*.
- 2014, 2016 **Associate Instructor**, *Indiana University*,
• Course: Autonomous Robotics.
- 2013 **Associate Instructor**, *Indiana University*,
• Course: Brains & Minds, Robots & Computers.

Publications

Journal publications

14. Hickey, J.W., **Agmon, E.**, Covert, M.W., and Nolan, G.P. (in preparation). CODEX imaging combined with integrative modeling of tumor/T-cell interactions.
13. Covert, M.W., Gillies, T.E., Kudo, T., and **Agmon, E.** (in review). A forecast for large-scale, predictive biology: lessons from meteorology.
12. **Agmon, E.**, Spangler, R.K., Skalnik, C.J., Poole, W., Morrison, J.H., Peirce, S.M., and Covert, M.W. (in review). Vivarium: an interface and engine for integrative multi-scale modeling in computational biology.
11. Skalnik, C.J., **Agmon, E.**, Spangler, R.K., Talman, L., Morrison, J.H., Peirce, S.M., and Covert, M.W. (in review). Whole-Colony Modeling of *Escherichia coli*.
10. **Agmon, E.**, and Spangler, R.K. (2020). A multi-scale approach to modeling *E. coli* chemotaxis. *Entropy*, 22: 1101.
9. Macklin, D.N., Ruggero, N.A., Carrera, J., Choi, H., Horst, T.A., Mason, J.C., Sun, G., **Agmon, E.**, DeFelice, M.M., Maayan, I., Lane, K., Spangler, R.K., Gillies, T.E., Paull, M.L., Akhter, S., Bray, S.R., Weaver, D.S., Keseler, I.M., Karp, P.D., Morrison, J.H., and Covert, M.W. (2020). Simultaneous cross-evaluation of heterogeneous *E. coli* datasets via mechanistic simulation. *Science*, 369, eaav3751.
8. Talman, L., **Agmon, E.**, Peirce, S.M., and Covert, M.W. (2019). Multiscale models of infection. *Current Opinion in Biomedical Engineering*, 11, 102-108.
7. **Agmon, E.**, Solon, J., Bassereau, P., and Stockwell, B.R. (2018). Modeling the effects of lipid peroxidation during ferroptosis on membrane properties. *Scientific Reports*, 8(1): 5155.
6. **Agmon, E.** and Stockwell, B.R. (2017). Lipid homeostasis and regulated cell death. *Current Opinion in Chemical Biology*. 39: 83-89.
5. **Agmon, E.**, Gates, A.J., and Beer, R.D. (2016). The structure of ontogenies in a model protocell. *Artificial Life* 22 (4): 499-517.
4. Taylor, T., Bedau, M. A., Channon, A., et al. (2016). Open-Ended Evolution: Perspectives from the OEE1 Workshop in York. *Artificial Life* 22 (3): 408-423.
3. **Agmon, E.**, Gates, A.J., Churavy, V. and Beer, R.D. (2016). Exploring the space of viable configurations in a model of metabolism-boundary co-construction. *Artificial Life*, 22 (2): 153-171.
2. **Agmon, E.**, & Beer, R. D. (2014). The evolution and analysis of action switching in embodied agents. *Adaptive Behavior*, 22(1), 3-20.
1. **Agmon, E.** (2014). Action Switching in Brain-Body-Environment Systems. In *Guided Self-Organization: Inception* (pp. 295-318). Springer Berlin Heidelberg.

Selected Proceedings

5. Covert, M.W., and **Agmon, E.** (2019). Building whole-cell computational models to predict cellular phenotypes and accelerate discovery. *Proceedings of the Solvay Conference in Chemistry*.
4. **Agmon, E.**, Glazier, J.A, and Beer, R.D. (2017). Structural Coupling of a Potts Model Cell. *Proceedings of the 14th European Conference on Artificial Life 2017*, (pp. 13-20). MIT Press.
3. Virgo, N., **Agmon, E.**, and Fernando, C. (2017). Lineage selection leads to evolvability at large population sizes. *Proceedings of the Fourteenth European Conference on Artificial Life*, (pp. 420-427). MIT Press.
2. **Agmon, E.**, Gates, A.J., and Beer, R.D. (2015). Ontogeny and adaptivity in a model protocell. In P. Andrews, L. Caves, R. Doursat, S. Hickinbotham, F. Polack, S. Stepney, T. Taylor & J. Timmis (Eds.), *Proceedings of the European Conference on Artificial Life 2015* (pp. 216-223). MIT Press. **[Winner of Best Paper Award]**

1. **Agmon, E.**, Gates, A.J., Churavy, V. and Beer, R.D. (2014). Quantifying robustness in a spatial model of metabolism-boundary co-construction. In H. Sayama, J. Rieffel, S. Risi, R. Doursat & H. Lipson (Eds.), *Artificial Life 14: Proceedings of The Fourteenth International Conference on the Synthesis and Simulation of Living Systems* (pp. 514-521). MIT Press.

Selected Presentations

- Aug. 2020 **"Vivarium: an interface and engine for multi-scale modeling in computational biology"** *Build-A-Cell workshop*, NIST, Gaithersburg, MD.
- Feb. 2020 **"A multi-scale platform for whole-cells and colonies"** *Basement seminar*, Stanford Bioengineering Department.
- Sep. 2017 **"Structural coupling of a Potts model cell,"** *14th European Conference on Artificial Life*, Lyon, France.
- Mar. 2017 **"Computational models of heterogeneous lipid membranes,"** *Frontiers in Computing Systems*, Columbia University, NY.
- Feb. 2017 **"Simulations of Ferroptosis,"** *p53 Multi-Group meeting*, Columbia University, NY.
- July 2016 **"The biological foundations of enactivism,"** *Workshop on the Biological Foundations of Enactivism, at Artificial Life 16*, Cancun, Mexico.
- January 2016 **"The dynamics of protocell ontogenies"**, ENSO online seminar.
- October 2015 **"Ontogeny and adaptivity in a model protocell,"** *Evolutionary Systems Biology Lab. Albert Einstein College of Medicine*, New York, NY.
- October 2015 **"Action switching in embodied, dynamical agents,"** *Workshop on Self-organization in brain-body-environment systems*, University of Cincinnati, OH.
- July 2015 **"Ontogeny and adaptivity in a model protocell,"** *ECAL 15*, York, UK.
- December 2014 **"The physiology and metabolic closure of organisms,"** *Workshop on the causal factors of robustness and plasticity in living systems*, Bloomington, IN.
- August 2014 **"Quantifying robustness in a spatial model of metabolism-boundary co-construction,"** *Artificial Life 14*, New York City, NY.
- May 2014 **"Action switching in embodied, dynamical agents,"** *4th Annual Midwest Cognitive Science Conference*, Dayton, OH.
- June 2013 **"Action switching in brain-body-environment systems,"** *Department of Informatics, University of Zaragoza*, Spain.

Posters

- January 2020 **"A simulation platform for whole-cell/whole-colony modeling,"** *Build-A-Cell workshop*, NASA Ames, Mountain View, CA.
- August 2019 **"Adding an environment and motility to a large-scale model of *Escherichia coli*,"** *qBio*, San Francisco, CA.
- March 2018 **"Towards a whole-cell model of *E. coli*,"** *Allen Discovery Center*, Stanford, CA.
- Jan. 2017 **"The structure of ontogenies in a model protocell,"** *Expanding Views on the Emergence of the Biosphere*, Tokyo Institute of Technology, Tokyo, Japan.

Honors and Awards

- 2020 NIH F32 Postdoctoral Fellowship
- 2017 Outstanding Dissertation Award, Indiana University Cognitive Science
- 2015 Best Paper Award, European Conference on Artificial Life
- 2015 1st Place Poster, IGERT Research Showcase
- 2014-2015 NSF IGERT Fellowship in the Dynamics of Brain-Body-Environment Systems

- 2014 Outstanding Teaching Award, Indiana University Cognitive Science
- 2014 1st Place Poster, IGERT Research Showcase
- 2014 Cognitive Science Supplemental Research Fellowship
- 2013 2nd Place Poster, IGERT Research Showcase
- 2011-2015 NSF IGERT Fellowship in the Dynamics of Brain-Body-Environment Systems

Selected Workshops and Seminars

- September 2017 Agency in the Physical Sciences, at the European Conference on Artificial Life 17. Lyon, France
- March 2017 Frontiers in Computing Systems. Columbia University
- February 2017 p53 P01 Multi-Group meeting. Columbia University
- January 2017 Expanding Views on the Emergence of the Biosphere: 5th ELSI International Symposium. Tokyo Institute of Technology
- July 2016 The Biological Foundations of Enactivism, at Artificial Life 16. Cancun, Mexico
- November 2015 Re-conceptualizing the Origins of Life. Carnegie Institution for Science, Washington D.C.
- October 2015 Self-organization in brain-body-environment systems. University of Cincinnati
- August 2015 Towards an Integrative Approach to the Study of Awareness. Kobe University, Japan
- December 2014 The Causal Factors of Robustness and Plasticity in Living Systems. Indiana University
- July 2013 Adaptivity workshop. University of the Basque Country

Service

- Reviewer IEEE International Conference on Bioinformatics & Biomedicine (BIBM), 2019.
- Program cmte International Conference on Complex Systems (ICCS), 2018.
- Associate Editor Journal of Adaptive Behavior, 2016-present.
- Program cmte Conference on Complex Systems, 2017.
- Organizer Workshop on Agency in the Physical Sciences, at the ECAL 17, September 2017.
- Organizer The Biological Foundations of Enactivism, at Artificial Life 16, July 2016.
- Program cmte Conference on Artificial Life, 2016-2020.
- Reviewer Artificial Life Journal, 2015-present.
- Organizer E-cog: weekly meeting on Embodied, Embedded, and Enactive approaches in Cognitive Science, 2013-2015.
- Organizer Causal Factors of Robustness and Plasticity in Living Systems, 2014.
- Organizer Apophenia: weekly discussions of Complex Systems and Cognitive Science, 2012-2013.
- Organizer IGERT faculty lunches, 2011-2012.