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# ERAN AGMON, Ph.D.

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## EDUCATION AND TRAINING

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- Stanford University**, Stanford, CA *2017–present*  
Postdoctoral Research Fellow, Department of Bioengineering  
*Funding*: NIH F32 Fellowship
- Columbia University**, New York City, NY *2016–2017*  
Postdoctoral Research Scientist, Department of Biological Sciences
- Indiana University**, Bloomington, IN *2016*  
Joint Ph.D., Informatics and Computing, and Cognitive Science  
*Funding*: NSF Integrative Graduate Education and Research Traineeship (IGERT) Fellowship
- Portland State University**, Portland, OR *2011*  
M.Sc. in Systems Science
- University of California, San Diego**, San Diego, CA *2009*  
B.S., Cognitive Science (minor in Biology)

## RESEARCH EXPERIENCE

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- Stanford University** Stanford, CA  
*Integrative, multi-scale modeling in computational biology* *2018–present*  
*Adviser*: Markus W. Covert  
• Led the development of Vivarium – a software tool that can make any mechanistic model into a module that can be wired together in multi-scale composite models.
- Allen Discovery Center for Systems Modeling of Infection** Stanford, CA  
*Whole-cell model of Escherichia coli* *2017–present*  
*Adviser*: Markus W. Covert  
• Worked with computational modelers, software engineers, and experimentalists to build the most comprehensive computational model of *E. coli* in the world.
- Columbia University** New York City, NY  
*Molecular model of membranes, lipid homeostasis, and cell death* *2016–2017*  
*Adviser*: Brent R. Stockwell  
• Developed a coarse-grained molecular model of lipid membrane composition associated with a type of cell death called ferroptosis.  
• Predicted the deformation and degradation of the membrane, which was later experimentally validated.
- Indiana University** Bloomington, IN  
*Dissertation research: Spatial model of metabolism/membrane interactions in a protocell* *2013–2016*  
*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 perturbational analysis to quantify the simulation’s robustness, plasticity, fragility, and viability.
- Indiana University** Bloomington, IN  
*Cellular model of tumor progression* *2015*

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*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.

## Indiana University

*Computational model of action-switching agents*

*Advisor:* Randall D. Beer

- Built a computational model to investigate the dynamics of embedded agents that can autonomously switch between actions, and applied a genetic algorithm for parameter search.

## Portland State University

*Spiking neural model of adaptive sensory processing*

*Advisor:* Patrick Roberts

- Built a spiking neural model of sensory processing in the electroreception of Mormyrid electric fish, which demonstrated their adaptive response to changing environments.

Bloomington, IN  
2011–2013

Portland, OR  
2010–2011

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## PUBLICATIONS

*Published:*

1. Covert, M.W., Gillies, T.E., Kudo, T., and **Agmon, E.** (2021). A forecast for large-scale, predictive biology: lessons from meteorology. *Cell Systems*, 12: 6.
2. **Agmon, E.**, and Spangler, R.K. (2020). A multi-scale approach to modeling *E. coli* chemotaxis. *Entropy*, 22: 1101.
3. 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.
4. Talman, L., **Agmon, E.**, Peirce, S.M., and Covert, M.W. (2019). Multiscale models of infection. *Current Opinion in Biomedical Engineering*, 11, 102-108.
5. **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.
7. **Agmon, E.**, Gates, A.J., and Beer, R.D. (2016). The structure of ontogenies in a model protocell. *Artificial Life* 22 (4): 499-517.
8. 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.
9. **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.
10. **Agmon, E.**, & Beer, R. D. (2014). The evolution and analysis of action switching in embodied agents. *Adaptive Behavior*, 22(1), 3-20.
11. **Agmon, E.** (2014). Action Switching in Brain-Body-Environment Systems. In *Guided Self-Organization: Inception* (pp. 295-318). Springer Berlin Heidelberg.

*Selected conference proceedings:*

1. Covert, M.W., and **Agmon, E.** (2019). Building whole-cell computational models to predict cellular phenotypes and accelerate discovery. *Proceedings of the Solway Conference in Chemistry*.
2. **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.

4. **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**]
5. **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.

*Submitted/under review:*

1. **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.
2. 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*.

*In preparation:*

1. Hickey, J.W., **Agmon, E.**, Covert, M.W., and Nolan, G.P. (in preparation). Integration of CODEX imaging with agent-based models of tumor/t-cell interactions.

## AWARDS AND HONORS

<b>NIH F32 Postdoctoral Fellowship.</b>	2020
<i>Adding an environment and motility in a whole-cell model of Escherichia Coli</i>	
<b>Outstanding Dissertation Award, Indiana University Cognitive Science.</b>	2017
<b>Best Paper Award, European Conference on Artificial Life.</b>	2015
<b>1st Place Poster, NSF IGERT Research Showcase.</b>	2015
<b>NSF IGERT Fellowship.</b>	2014–2015
<i>The Dynamics of Brain-Body-Environment Systems in Behavior and Cognition.</i>	
<b>Outstanding Teaching Award, Indiana University Cognitive Science.</b>	2014
<b>1st Place Poster, NSF IGERT Research Showcase.</b>	2014
<b>Supplemental Research Fellowship, Cognitive Science Program.</b>	2014
<b>2nd Place Poster, NSF IGERT Research Showcase</b>	2013
<b>NSF IGERT Fellowship in the Dynamics of Brain-Body-Environment Systems.</b>	2011–2015

## TEACHING AND MENTORSHIP

<b>Stanford University Bioengineering</b>	2019–present
<i>Research Mentor</i>	
<ul style="list-style-type: none"> <li>• Mentored seven BS and PhD students in whole-cell modeling of <i>E. coli</i>.</li> <li>• Organized weekly meetings in which I taught systems biology concepts, reviewed the students' code, and established collaborative practices.</li> </ul>	
<b>SSRP-Amgen Scholars Program</b>	2021
<i>Research Mentor</i>	
<ul style="list-style-type: none"> <li>• This program provides training to undergraduate students who, by reason of their background, work and life experiences, would bring diversity to graduate study in the biomedical and biological sciences.</li> </ul>	
<b>Build-A-Cell Chemical Reaction Network modeling tutorials</b>	2020
<i>Co-instructor</i>	
<b>Stanford International Genetically Engineered Machine (iGEM) competition</b>	2019
<i>Mentor</i>	

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<b>Course: Autonomous Robotics</b> <i>Associate Instructor, Indiana University</i>	2014, 2016
<b>Course: Brains &amp; Minds, Robots &amp; Computers</b> <i>Associate Instructor, Indiana University</i>	2013

## OTHER AFFILIATIONS

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<b>NASA Ames Research Center, Moffett Field, CA</b> <i>Research Affiliate, Center for the Emergence of Life</i> • Consulted on machine learning approaches to modeling RNA synthesis and selection at the origin of life.	2021–present
<b>Institute for Advanced Study, Princeton, NJ</b> <i>Visiting Scholar, Program in Interdisciplinary Studies</i> • Co-founded YHouse, a research institute focused on artificial intelligence and the science of awareness.	2016–2017
<b>Tokyo Institute of Technology, Tokyo, Japan</b> <i>Visitor, Earth-Life Science Institute Origins Network</i> • Worked with an interdisciplinary group of scientists to model molecular evolution at the origins of life.	2017

## INVITED TALKS

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1. **Agmon E.** “Vivarium: an interface and engine for multi-scale modeling in computational biology.” *Build-A-Cell workshop*. NIST, Gaithersburg, MD, 2020.
2. **Agmon E.** “A multi-scale platform for whole-cells and colonies.” *Basement seminar*. Stanford Bioengineering Department, 2020.
3. **Agmon E.** “Structural coupling of a Potts model cell.” *14th European Conference on Artificial Life*. Lyon, France, 2017.
4. **Agmon E.** “Computational models of heterogeneous lipid membranes.” *Frontiers in Computing Systems*. Columbia University, NY, 2017.
5. **Agmon E.** “Simulations of Ferroptosis.” *p53 Multi-Group meeting*. Columbia University, NY, 2017.
6. **Agmon E.** “The biological foundations of enactivism.” *Workshop on the Biological Foundations of Enactivism, at Artificial Life 16*. Cancun, Mexico, 2016.
7. **Agmon E.** “Whole-cell models and perturbation-based analysis.” *Department of Biological Sciences*. Columbia University, NY, 2016.
8. **Agmon E.** “The dynamics of protocell ontogenies.” *ENSO online seminar*. 2016.
9. **Agmon E.** “Ontogeny and adaptivity in a model protocell.” *Evolutionary Systems Biology Lab*. Albert Einstein College of Medicine, NY, 2016.
10. **Agmon E.** “Action switching in embodied, dynamical agents.” *Workshop on self-organization in brain-body-environment system*. University of Cincinnati, OH, 2015.
11. **Agmon E.** “Ontogeny and adaptivity in a model protocell.” *ECAL 15*. York, UK, 2015.
12. **Agmon E.** “The physiology and metabolic closure of organisms.” *Workshop on the causal factors of robustness and plasticity in living systems*. Bloomington, IN, 2014.
13. **Agmon E.** “Biological individuation, ontogeny and adaptation.” *Cognitive Science Program*. Bloomington, IN, 2015.
14. **Agmon E.** “Quantifying robustness in a spatial model of metabolism-boundary co-construction.” *Artificial Life 14*. New York City, NY, 2014.
15. **Agmon E.** “Action switching in embodied, dynamical agents.” *4th Annual Midwest Cognitive Science Conference*. Dayton, OH, 2014.
16. **Agmon E.** “Action switching in brain-body-environment systems.” *Department of Informatics*. University of Zaragoza, Spain, 2013.
17. **Agmon E.** “A dynamical account of probabilistic inference.” *Guided Self-Organization 5*. Sydney, Australia, 2012.

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## SELECTED POSTERS

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

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## SELECTED WORKSHOPS AND SEMINARS

<b>Build-A-Cell (virtual).</b> <i>Hosted by NIST, Gaithersburg, MD.</i>	2020
<b>Build-A-Cell.</b> <i>NASA Ames, Mountain View, CA.</i>	2020
<b>qBio.</b> <i>San Francisco, CA.</i>	2019
<b>Agency in the Physical Sciences, at the Conference on Artificial Life 17.</b> <i>Lyon, France.</i>	2017
<b>Frontiers in Computing Systems.</b> <i>Columbia University, NY.</i>	2017
<b>Expanding Views on the Emergence of the Biosphere: 5th ELSI International Symposium.</b> <i>Tokyo Institute of Technology, Tokyo, Japan.</i>	2017
<b>The Biological Foundations of Enactivism, at Artificial Life 16.</b> <i>Cancun, Mexico.</i>	2016
<b>Re-conceptualizing the Origins of Life.</b> <i>Carnegie Institution for Science, Washington D.C.</i>	2015
<b>Self-organization in brain-body-environment systems.</b> <i>University of Cincinnati, OH.</i>	2015
<b>Towards an Integrative Approach to the Study of Awareness.</b> <i>Kobe University, Japan.</i>	2015
<b>The Causal Factors of Robustness and Plasticity in Living Systems.</b> <i>Indiana University, IN.</i>	2014
<b>Adaptivity workshop.</b> <i>University of the Basque Country, San Sebastian, Spain.</i>	2013
<b>New England Complex Systems Institute Summer School.</b> <i>Massachusetts Institute of Technology, MA.</i>	2010

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## PROFESSIONAL SERVICE

<b>Reviewer.</b> <i>IEEE International Conference on Bioinformatics &amp; Biomedicine (BIBM).</i>	2019
<b>Program committee.</b> <i>International Conference on Complex Systems (ICCS).</i>	2018
<b>Associate Editor.</b> <i>Journal of Adaptive Behavior.</i>	2016–present
<b>Program committee.</b> <i>Conference on Complex Systems.</i>	2017
<b>Organizer.</b> <i>Workshop on Agency in the Physical Sciences, at the ECAL 17</i>	2017
<b>Organizer.</b> <i>The Biological Foundations of Enactivism, at Artificial Life 16</i>	2016
<b>Program committee.</b> <i>Conference on Artificial Life.</i>	2016–2020
<b>Program committee.</b> <i>Artificial Life 15: The Fifteenth International Conference on the Synthesis and Simulation of Living Systems.</i>	2016
<b>Reviewer.</b> <i>Artificial Life Journal</i>	2015–present
<b>Organizer.</b> <i>E-cog: weekly meeting on Embodied, Embedded, and Enactive approaches in Cog Sci</i>	2013–2015
<b>Organizer.</b> <i>Workshop on the Causal Factors of Robustness and Plasticity in Living Systems.</i>	2014
<b>Organizer.</b> <i>Apophenia: weekly discussions of Complex Systems and Cognitive Science</i>	2012–2013
<b>Organizer.</b> <i>NSF IGERT faculty lunches</i>	2011–2012