

Josh C Bongard

Curriculum Vitae

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RESEARCH STATEMENT There are two main thrusts in my research group: evolutionary robotics and machine science.

In **evolutionary robotics**, we take a holistic approach to robotics. We teach an AI to design robots “from the ground up” to best be able to perform some desired task. The AI does so by determining where to put motors, sensors, what shape the robot should have, what materials it should be constructed from, and how it should be controlled by a neural network. Only this last aspect of a robot’s design is covered by traditional AI approaches. Most recently, we have adapted this method to create the world’s first computer-designed organisms (the “xenobots”): living robots made from biological tissues, rather than technological components.

In **machine science**, we attempt to automate all aspects of the scientific method. This process usually involves five steps. **1.** A “scientist AI” generates hypotheses about how some system works (e.g. how cells communicate to stabilize after surprise). **2.** An “engineer AI” then dreams up how best to poke the system of interest, or build some interesting version of that system, to test that hypothesis (e.g. a mm-sized robot built from frog tissue). **3.** A “robot scientist” then carries out that intervention, or builds that system variant. **4.** The robot’s success or failure is fed back to the scientist AI, leading it to revise its hypothesis. **5.** This process is repeated until the AIs and robot scientist make a new discovery. Often, this discovery is different or beyond what human scientists may have been capable of imagining.

APPOINTMENTS

- 2015– **Professor**, Department of Computer Science
- 2015– Cyril G. Veinott Green and Gold Professor, Department of Computer Science,
College of Engineering & Mathematical Sciences, University of Vermont
- 2015–2019 Director, [Vermont Advanced Computing Core](#), UVM’s high performance computing facility.
- 2014–2018 Consultant, [Xemo Corporation](#) (spinoff from laboratory)
- 2012–2015 **Associate Professor**, Department of Computer Science
College of Engineering & Mathematical Sciences, University of Vermont
- 2014– *Secondary appointment in the School of Engineering, UVM*
- 2013– *Secondary appointment in the Neuroscience Graduate Program, UVM*
- 2011–2015 Vice chair, [Vermont Complex Systems Center](#)
- 2006–2012 **Assistant Professor**, Department of Computer Science
College of Engineering & Mathematical Sciences, University of Vermont

- 2006– Director, [Morphology, Evolution & Cognition Laboratory](#)
- 2003–2006 **Postdoctoral Associate**, Cornell University
 Advisor: Hod Lipson, Director of the Creative Machines Laboratory
- 1998 Software Engineer, Computing Devices Canada

EDUCATION

- 1999–2003 **Ph.D.**, Department of Informatics, University of Zurich, Switzerland
Incremental Approaches to the Combined Evolution of a Robot's Body and Brain.
 Advisor: Rolf Pfeifer, Director of the Zurich Artificial Intelligence Laboratory
- 1998–1999 **M.S.**, Evolutionary & Adaptive Systems, University of Sussex, UK
Evolving Heterogeneity: Implications for Agent-Based Systems and Collective Problem Solving.
 Advisor: Inman Harvey
- 1993–1997 **B.Sc.**, Honors Computer Science, McMaster University, Canada (graduated *Summa Cum Laude*)
- 1994 Study abroad program, Corpus Christi College, Oxford University, UK

CURRENT FUNDING

- 2022– **Sloan Foundation** award (Co-PI; PI: Don Ingber, Harvard). \$82,558.
 Principles of Molecular and Cellular Self Organization.
- 2021– **NSF DMREF** award (co-PI; PI: Rebecca Kramer-Bottiglio). \$401,103
Design and Optimization of Granular Metamaterials using Artificial Evolution.
- 2020–2022 **NSF NAIRI** Planning [award](#), \$500,000
The [Proteus Institute](#): Intelligence through change.
- 2020–2024 **Army CRREL** award (Co-PI; PI Jeffrey Marshall), \$10M
- 2018–2022 **NSF EFRI** award (co-PI; PI: Rebecca Kramer-Bottiglio), \$496,333
C3 SoRo: Programmable Skins for Moldable and Morphogenetic Soft Robots.

PAST FUNDING

- 2018–2021 **Sloan Foundation** award, \$683,273
Developing an In-Browser, Elastic Supercomputer
- 2018–2021 **DARPA L2M** award (co-PI; PI: Michael Levin, Tufts), \$268,174
Somatic Computation via Bioelectricity for Novel Life-time Learning Machines.
- 2018–2020 **NSF MRI** award (co-PI; PI: Adrian Del Maestro), \$893,120
Acquisition of a GPU Accelerated Vermont Advanced Computing Core.
- 2014–2018 **NSF BIGDATA** award (co-PI; PI: James Bagrow, UVM), \$600,000
Hunch & Crunch: Iterative Crowdsourced Hypothesis Generation.
- 2016–2019 **Army Research Office** award, \$400,000
Morphological Plasticity for the Design, Control, and Deployment of Complex Engineering Systems.

- 2013–2018 **NSF INSPIRE** award (co-PI; PI: Ken Livingston, Vassar College), \$500,000
Evolvability and the emergence of modularity.
- 2016–2017 **NSF EAGER** award, \$100,000
Scalable crowdsourced reinforcement of robot behavior.
- 2015–2017 **NASA ROSES** award (co-PI; PI: Kamalika Das), \$300,000
Uncovering effects of climate variables on global vegetation.
- 2010–2017 **NSF CAREER/PECASE** award, \$499,999
Exploring the Ultimate Mechanisms of Embodied Cognition.
- 2011–2015 **DARPA MSEE** award, \$614,830
Continually Plastic Modeling of Non-Stationary Systems.
- 2011–2014 **DARPA M3** award (co-PI; PI: Greg Hornby, NASA Ames), \$200,000
Rapid Human-Computer Interactive Conceptual Design of Mobile and Manipulative Robot Systems.
- 2007–2011 **Microsoft Research New Faculty Fellowship**, \$200,000
- 2007–2009 **NSF SGER** award, \$192,391
Exploiting ‘Like Me’ Hypotheses for Learning Robots

BOOKS

1. Pfeifer, R. and J. Bongard (2006)
[*How the Body Shapes the Way We Think: A New View of Intelligence*](#),
Boston, MA: MIT Press. (Translated into Chinese, Japanese, Arabic and an E-book)

ARTICLES

43. D Kudithipudi, M Aguilar-Simon, J Babb, M Bazhenov, D Blackiston, J Bongard, AP Brna, S Chakravarthi Raja, N Cheney, J Clune, A Daram, S Fusi, P Helfer, L Kay, N Ketz, Z Kira, S Kolouri, JL Krichmar, S Kriegman, M Levin, S Madireddy, S Manicka, A Marjaninejad, B McNaughton, R Miikulainen, Z Navratilova, T Pandit, A Parker, PK Pilly, S Risi, TJ Sejnowski, A Soltoggio, N Soures, AS Tolia, D Urbina-Melendez, FJ Valero-Cuevas, GM van de Ven, JT Vogelstein, F Wang, R Weiss, A Yanguas-Gil, X Zou, H Siegelmann (2022)
[Biological underpinnings for lifelong learning machines.](#)
Nature Machine Intelligence 4: 1967-210.
42. CA Aubin, B Gorissen, E Milana, PR Buskohl, N Lazarus, GA Slipper, C Keplinger, J Bongard, F Iida, JA Lewis, RF Shepherd (2022)
[Towards enduring autonomous robots via embodied energy.](#)
Nature 602(7897): 393-402.
41. S Kriegman, D Blackiston, M Levin, J Bongard (2021)
[Kinematic self-replication in reconfigurable organisms.](#)
Proceedings of the National Academy of Sciences, 118(49): e2112672118.
40. D Blackiston, E Lederer, S Kriegman, S Garnier, J Bongard, M Levin (2021)
[A cellular platform for the development of synthetic living machines.](#)
Science Robotics, 6(52).
39. JC Bongard & M Levin (2021)

- [Living things are not \(20th century\) machines.](#)
Frontiers in Ecology and Evolution, <https://doi.org/10.3389/fevo.2021.650726>
38. DS Shah, JP Powers, LG Tilton, S Kriegman, J Bongard & R Kramer-Bottiglio (2020)
[A soft robot that adapts to environments through shape change.](#)
Nature Machine Intelligence, <https://doi.org/10.1038/s42256-020-00263-1>
 37. F Veenstra, P Gonzalez de Prado Salas, K Stoy, J Bongard, S Risi (2020).
[Death and progress: How evolvability is influenced by intrinsic mortality.](#)
Artificial Life, 26(1): 90-111.
 36. D Shah, B Yang, S Kriegman, M Levin, J Bongard, R Kramer-Bottiglio (2020).
[Shape changing robots: bioinspiration, simulation, and physical realization.](#)
Advanced Materials. e202002882.
 35. S Kriegman, D Blackiston, M Levin, J Bongard. (2020).
[A scalable pipeline for the design of reconfigurable organisms.](#)
Proceedings of the National Academy of Sciences, 117(4): 1853-1859.
 34. I Rahwan, M Cebrian, N Obradovich, J Bongard, J-F Bonnefon, C Breazeal, JW Crandall, NA Christakis, ID Couzin, MO Jackson, NR Jennings, E Kamar, IM Kloumann, H Larochelle, D Lazer, R McElreath, A Mislove, DC Parkes, A Pentland, ME Roberts, A Shariff, JB Tenenbaum & M Wellman (2019).
[Machine behavior.](#)
Nature, 568: 477486
 33. Rounds, T., Bongard, J., Hines, P., & Harvey, J. (2019).
[A crowdsourcing approach to understand weight and weight loss in men.](#)
Preventive Medicine Reports, 13, 224.
 32. Kriegman, S., Cheney, N., & Bongard, J. (2018).
[How morphological development can guide evolution.](#)
Nature Scientific Reports, 8(1): 13934.
 31. F Corucci, N Cheney, F Giorgio-Serchi, J Bongard, and C Laschi (2018)
[Evolving Soft Locomotion in Aquatic and Terrestrial Environments: Effects of Material Properties and Environmental Transitions.](#)
Soft Robotics, 5(4): 475-495.
 30. N Cheney, J Bongard, V SunSpiral, H Lipson (2018)
[Scalable co-optimization of morphology and control in embodied machines.](#)
Journal of The Royal Society Interface, 15(143): 20170937
 29. A Bernatskiy, J Bongard (2018)
[Evolving morphology automatically reformulates the problem of designing modular control.](#)
Adaptive Behavior 26(2): 47-64
 28. MD Wagdy, JC Bongard, JP Bagrow & PDH Hines (2017)
[Crowdsourcing Predictors of Residential Electric Energy Usage.](#)
IEEE Systems Journal, PP(99):1-10.
 27. D Buckingham & JC Bongard (2017)
[Physical Scaffolding Accelerates the Evolution of Robot Behavior.](#)
Artificial Life, 23(3):351-373.

26. F Corucci, N Cheney, S Kriegman, J Bongard, C Laschi (2017)
[Evolutionary developmental soft robotics as a framework to study intelligence and adaptive behavior in animals and plants.](#)
Frontiers in Robotics and AI.
25. N Livingston, A Bernatskiy, K Livingston, ML Smith, J Schwarz, JC Bongard, D Wallach & JH Long Jr (2016)
[Modularity and sparsity: evolution of neural net controllers in physically embodied robots.](#)
Frontiers in Robotics and AI.
24. T Taylor, JE Auerbach, J Bongard, J Clune, S Hickinbotham, C Ofria, M Oka, S Risi, KO Stanley, & J Yosinski (2016)
[WebAL comes of age: A review of the first 21 years of artificial life on the web.](#)
Artificial Life, 22(3) 364–407.
23. C Cappelle, A Bernatskiy, K Livingston, N Livingston, J Bongard (2016)
Morphological modularity can enable the evolution of robot behavior to scale linearly.
Frontiers in Robotics and AI, 3: 59.
22. J Bongard (2015)
[Using robots to investigate the evolution of adaptive behavior.](#)
Current Opinion in Behavioral Sciences, 6: 168–173.
21. M Wagdy & J Bongard (2015)
[Combining computational and social effort for collaborative problem solving.](#)
PLoS ONE, DOI: 10.1371/journal.pone.014524.
20. D Buckingham, C Skalka, and J Bongard (2015)
Inductive machine learning for improved estimation of catchment-scale snow water equivalent.
Journal of Hydrology, 524: 311-325.
19. R Swain, A Berger, J Bongard, & P Hines (2015)
Participation and contribution in crowdsourced surveys.
PLoS ONE, DOI: 10.1371/journal.pone.0120521.
18. Bongard, J. C. & Lipson, H. (2014)
Evolved machines shed light on robustness and resilience.
Proceedings of the IEEE, 102(5): 899–914.
17. Lu, Z. Wu, X. & Bongard, J. C. (2014)
Active learning through adaptive heterogeneous ensembling.
IEEE Transactions on Knowledge and Data Engineering, DOI: 10.1109/TKDE.2014.2304474.
16. Bevelander, K. E., Kaipainen, K., Swain, R., Dohle, S., Bongard, J. C., Hines, P. D. H. & Wansink, B. (2014)
Crowdsourcing novel childhood predictors of adult obesity.
PLoS ONE, 9(2): e87756
15. Auerbach, J. E. & Bongard, J. C. (2014)
Environmental influence on the evolution of morphological complexity in machines.
PLoS Computational Biology, 10(1): e1003399
14. Bongard, J. C. (2013)
Evolutionary robotics.

Communications of the ACM, 56(8): 74—85.

13. Bongard, J. C., Hines, P. D. H., Conger, D., Hurd, P., and Lu, Z. (2012)
Crowdsourcing predictors of behavioral outcomes.
IEEE Transactions on Systems, Man, and Cybernetics, Part A, 43(1): 176–185.
12. Bongard, J. C. (2011)
Morphological change in machines accelerates the evolution of robust behavior.
Proceedings of the National Academy of Sciences, 108(4): 1234-1239.
11. Bongard, J. C. (2011).
Innocent until proven guilty: Reducing robot shaping from polynomial to linear time.
IEEE Transactions on Evolutionary Computation, 15(4): 571—85.
10. Kaipa, K., Bongard, J., Meltzoff, A. (2010).
Self discovery enables robot social cognition: Are you my teacher?
Neural Networks, 23: 1113-1124.
9. Bongard, J. C. (2010).
The utility of evolving simulated robot morphology increases with task complexity
for object manipulation. *Artificial Life*, 16(3): 201-223.
8. Rughani, A. I., Dumont, T. M., Lu, Z., Bongard, J., Horgan, M. A., Penar, P. L., Tranmer, B. I. (2009).
Use of an artificial neural network to predict head injury outcome.
Journal of Neurosurgery, 113(3): 585–90.
7. Bongard J. C. (2009).
Accelerating self-modeling in cooperative robot teams.
IEEE Transactions on Evolutionary Computation, 13(2): 321-332.
6. Bongard, J. and H. Lipson (2007)
Automated reverse engineering of nonlinear dynamical systems.
Proceedings of the National Academy of Sciences, 104(24): 9943-9948.
5. Bongard, J., V. Zykov and H. Lipson (2006)
Resilient machines through continuous self-modeling.
Science, 314: 1118-1121.
4. Kouchmeshky, B., W. Aquino, H. Lipson and J. Bongard (2006)
Co-evolutionary strategy for structural damage identification using minimal physical testing.
International Journal for Numerical Methods in Engineering, 69(5): 1085-1107.
3. Bongard, J. and H. Lipson (2005)
Active coevolutionary learning of deterministic finite automata.
Journal of Machine Learning Research, 6(Oct): 1651-1678.
2. Bongard, J. and H. Lipson (2005)
Nonlinear system identification using coevolution of models and tests.
IEEE Transactions on Evolutionary Computation, 9(4): 361-384.
1. Pfeifer, R., F. Iida and J. Bongard (2005)
New robotics: design principles for intelligent systems.
Artificial Life Special Issue on New Robotics, Evolution and Embodied Cognition, 11(1-2): 99-120.

7. A Cangelosi, J Bongard, MH Fischer, S Nolfi (2015)
[Embodied intelligence](#).
Springer Handbook of Computational Intelligence, pp. 697-714
6. Bongard, J. C. (2014)
Evolving morphological computation.
Opinions and Outlooks on Morphological Computation, ISBN: 978-3-033-04515-6
5. Bongard, J. C. (2014)
Why morphology matters.
Horizons of of Evolutionary Robotics, MIT Press, pp. 125–152.
4. Icke, I., Allgaier, N. A., Danforth, C. M., Whelan, R., Garavan, H., Bongard, J. C. (2013)
A Deterministic and Symbolic Regression Hybrid Applied to Resting-State fMRI data.
Genetic Programming Theory and Practice IX, Springer.
3. Bongard, J. C. (2011)
The ‘What’, ‘How’ and the ‘Why’ of Evolutionary Robotics.
In Doncieux, S., Bredeche, N., Mouret, J.-B. (eds.),
New Horizons in Evolutionary Robotics (Studies in Computational Intelligence), 341: 29-35.
2. Bongard, J. C. (2011)
A Functional Crossover Operator for Genetic Programming.
Genetic Programming Theory and Practice VII, Springer, pp. 195—210
1. Bongard, J. and R. Pfeifer (2003)
Evolving complete agents using artificial ontogeny,
Morpho-functional Machines: The New Species, Springer-Verlag, pp. 237—258.

PEER-REVIEWED CONFERENCE PUBLICATIONS

84. S Kriegman, AM Nasab, D Blackiston, H Steele, M Levin, R Kramer-Bottiglio, J Bongard (2021).
Scale invariant robot behavior with fractals.
Proceedings of the Robotics: Science and Systems Conference.
83. J Powers, R Grindle, L Frati, J Bongard (2021).
A good body is all you need: avoiding catastrophic interference via agent architecture search.
arXiv preprint arXiv:2108.08398
82. B Yang, J Powers, A Parsa, J Bongard, R Kramer-Bottiglio (2021).
Shape Matching: Evolving Fiber Constraints on a Pneumatic Bilayer.
2021 IEEE 4th International Conference on Soft Robotics (RoboSoft), 630-635.
81. Kriegman, Sam, Amir Mohammadi Nasab, Dylan Shah, Hannah Steele, Gabrielle Branin, Michael Levin, Josh Bongard, and Rebecca Kramer-Bottiglio (2020).
Scalable sim-to-real transfer of soft robot designs.
Third IEEE International Conference on Soft Robotics (RoboSoft), pp. 359-366.
80. Rosser, K., Kok, J., Chahl, J., Bongard, J. (2020)
Sim2real gap is non-monotonic with robot complexity for morphology-in-the-loop flapping wing design.
IEEE International Conference on Robotics and Automation (ICRA) (pp. 7001-7007).

79. Matthews, David, and Josh Bongard (2020).
Crowd grounding: finding semantic and behavioral alignment through human robot interaction
Procs. of the Artificial Life Conference, pp. 148-156.
78. Powers, Joshua, Ryan Grindle, Sam Kriegman, Lapo Frati, Nick Cheney, and Josh Bongard (2020).
Morphology Dictates Learnability in Neural Controllers.
Procs. of the Artificial Life Conference, pp. 52-59.
77. Powers, J., Pell, S. and Bongard, J. (2020).
A Framework for Search and Application Agnostic Interactive Optimization.
Procs. of the Artificial Life Conference, pp. 60-68.
76. S Kriegman, S walker, D Shah, M Levin, R Kramer-Bottiglio, J Bongard (2019).
[Automated shapeshifting for function recovery in damaged robots.](#)
Robotics: Science and Systems Proceedings, 10.15607/RSS.2019.XV.028
75. S Beaulieu, S Kriegman, JC Bongard (2018).
[Combating catastrophic forgetting with developmental compression.](#)
GECCO Conference Proceedings, pp. 386–393
74. S Kriegman, N Cheney, F Corucci, JC Bongard (2018).
[Interceptive robustness through environment-mediated morphological development.](#)
GECCO Conference Proceedings, pp. 109–116.
73. F Veenstra, PG de Prado Salas, J Bongard, K Stoy, S Risi (2018).
[Intrinsic Mortality Governs Evolvability.](#)
Artificial Life Conference Proceedings, pp. 242-249.
72. C Cappelle, J Bongard (2018).
[Embodied Embeddings for Hyperneat.](#)
Artificial Life Conference Proceedings, pp. 461-468
71. A Kodali, M Szubert, K Das, S Ganguly, J Bongard (2018).
[Understanding climate-vegetation interactions in global rainforests through a GP-tree analysis.](#)
Parallel Problem Solving from Nature (PPSN) Conference Proceedings, pp. 525-536
70. J Powers, S Kriegman, J Bongard (2018).
[The effects of morphology and fitness on catastrophic interference.](#)
Artificial Life Conference Proceedings, pp. 606-613
69. A Bernatskiy & JC Bongard (2017).
[Choice of robot morphology can prohibit modular control and disrupt evolution.](#)
Procs of the European Conference on Artificial Life, Nancy, France.
68. S Kriegman, N Cheney, F Corucci, JC Bongard (2017).
[A minimal developmental model can increase evolvability in soft robots.](#)
Proceedings of the Genetic and Evolutionary Computation Conference, pp 131-138.
67. C Cappelle, A Bernatskiy, J Bongard (2017).
[Reducing Training Environments in Evolutionary Robotics Through Ecological Modularity.](#)
Proceedings of the Conference on Biomimetic and Biohybrid Systems, pp 95-106.
66. M Szubert, A Kodali, S Ganguly, K Das & JC Bongard (2016)
[Semantic forward propagation for symbolic regression.](#)

Procs of the Parallel Problem Solving from Nature (PPSN) Conference, Edinburgh, UK.

65. S Kriegman, M Szubert, JC Bongard & C Skalka (2016)
[Evolving spatially aggregated features from satellite imagery for regional modeling.](#)
Procs of the Parallel Problem Solving from Nature (PPSN) Conference, Edinburgh, UK.
64. N Powell & JC Bongard (2016)
[Exploring uncertainty and movement in categorical perception using robots.](#)
Procs of the Parallel Problem Solving from Nature (PPSN) Conference, Edinburgh, UK.
63. M Szubert, A Kodali, S Ganguly, K Das & JC Bongard (2016)
[Reducing antagonism between behavioral diversity and fitness in semantic genetic programming.](#)
Procs of the Genetic and Evolutionary Computation Conference (GECCO), Denver, CO.
62. N Cheney, JC Bongard, V SunSpiral & H Lipson (2016)
[On the difficulty of co-optimizing morphology and control in evolved virtual creatures.](#)
15th Intl Conference on the Simulation and Synthesis of Living Systems (ALife 2016), Cancun, MX.
61. F Corucci, N Cheney, H Lipson, C Laschi & JC Bongard (2016)
[Material properties affect evolution's ability to exploit morphological computation in growing soft-bodied creatures.](#)
15th Intl Conference on the Simulation and Synthesis of Living Systems (ALife 2016), Cancun, MX.
60. J Anetsberger & JC Bongard (2016)
[Robots can ground crowd-proposed symbols by forming theories of group mind.](#)
15th Intl Conference on the Simulation and Synthesis of Living Systems (ALife 2016), Cancun, MX.
59. M Wagdy & JC Bongard (2016)
[Social contribution in the design of adaptive machines on the web.](#)
15th Intl Conference on the Simulation and Synthesis of Living Systems (ALife 2016), Cancun, MX.
58. McAndrew, T. C., Bongard, J. C., Danforth, C. M., Dodds, P. S., Hines, P. D., & Bagrow, J. P. (2016).
What we write about when we write about causality: Features of causal statements across large-scale social discourse.
ASONAM 16.
57. M Wagdy & JC Bongard (2015)
[Crowdseeding: a novel approach for designing bioinspired machines.](#)
Fourth Intl Conf on Biomimetics and Biohybrid Systems (Living Machines 2015), Barcelona, Spain.
56. K Zieba & JC Bongard (2015)
[An embodied approach for evolving robust visual classifiers.](#)
Procs of the Genetic and Evolutionary Computation Conference, Madrid, Spain.
55. A Yousefi, JC Bongard & C Skalka (2015)
[A Genetic Programming approach to cost-sensitive control in resource constrained sensor systems.](#)
Procs of the Genetic and Evolutionary Computation Conference, Madrid, Spain.
54. N Cheney, JC Bongard & H Lipson (2015)
[Evolving soft robots in tight spaces.](#)
Procs of the Genetic and Evolutionary Computation Conference, Madrid, Spain.
53. JC Bongard, A Bernatskiy, K Livingston, N Livingston, J Long & M Smith (2015)

[Evolving robot morphology facilitates the evolution of neural modularity and evolvability.](#)
Procs of the Genetic and Evolutionary Computation Conference, Madrid, Spain.

52. Wagyu, M., Bongard, J. C. (2014)
 Collective Design of Robot Locomotion.
Procs of the 14th Intl Conf on the Synthesis and Simulation of Living Systems, New York City.
 Acceptance rate: 49.8%. Citations: 4
51. Bernatskiy, A., Hornby, G., Bongard, J. C. (2014)
 Improving Robot Behavior Optimization by Combining User Preferences.
Procs of the 14th Intl Conf on the Synthesis and Simulation of Living Systems, New York City.
 Acceptance rate: 49.8%. Citations: 3
50. Icke, I., Bongard, J. C. (2013)
 Improving Genetic Programming Based Symbolic Regression Using Deterministic Machine Learning.
Procs of the IEEE Congress on Evolutionary Computation, Cancun, MX.
 Citations: 9
49. Icke, I., Bongard, J. C. (2013)
 Modeling Hierarchy using Symbolic Regression.
Procs of the IEEE Congress on Evolutionary Computation, Cancun, MX.
 Citations: 0
48. Celis, S., Hornby, G. S., Bongard, J. C. (2013)
 Avoiding Local Optima with User Demonstrations and Low-level Control.
Procs of the IEEE Congress on Evolutionary Computation, Cancun, MX.
 Citations: 8
47. Bongard, J. C., Hornby, G. S. (2013)
 Combining Fitness-based Search and User Modeling in Evolutionary Robotics,
Procs of the Genetic and Evolutionary Computation Conference, pp. 159-166.
 Acceptance rate: 36%. Citations: 16
46. Auerbach, J. E., Bongard, J. C. (2012)
 On the Relationship Between Environmental and Mechanical Complexity in Evolved Robots.
ALife XIII, pp. 309-316, DOI: 10.7551/978-0-262-31050-5-ch041.
 Acceptance rate: 50%. Citations: 17
45. Auerbach, J. E., Bongard, J. C. (2012)
 On the Relationship Between Environmental and Morphological Complexity in Evolved Robots,
Procs of the Genetic and Evolutionary Computation Conference, pp. 521-528.
 Acceptance rate: 36%. Citations: 35
44. Hornby, G. S., Bongard, J. C. (2012)
 Accelerating Interactive Evolutionary Algorithms through Comparative and Predictive User Models,
Procs of the Genetic and Evolutionary Computation Conference, DOI: 10.1145/2330163.2330196.
 Acceptance rate: 36%. Citations: 10
43. Hornby, G. S., Bongard, J. C. (2012)
 Learning Comparative User Models for Accelerating Human Computer Collaborative Search.
Procs of the Evolutionary and Biologically Inspired Music, Sound, Art and Design Conf, pp. 117-128.
 Citations: 6
42. Auerbach, J. E., Bongard, J. C. (2011)

- Evolving Complete Robots with CPPN-NEAT: The Utility of Recurrent Connections,
Procs of the Genetic and Evolutionary Computation Conference, pp. 1475–1482, ACM: NY, USA
 Acceptance rate: 38%
 Citations: 15
41. Bongard, J. C. (2011)
 Spontaneous Evolution of Structural Modularity in Robot Neural Network Controllers,
Procs of the Genetic and Evolutionary Computation Conference, pp. 251–258, ACM: NY, USA.
 Acceptance rate: 38%
 Citations: 16
 40. Bongard, J. C. (2011)
 Morphological and Environmental Scaffolding Synergize when Evolving Robot Controllers,
Procs of the Genetic and Evolutionary Computation Conference, pp. 179–186, ACM: NY, USA
 Acceptance rate: 38%
 Citations: 14
 39. Auerbach, J. E., Bongard, J. C. (2010)
 Dynamic Resolution in the Co-Evolution of Morphology and Control,
Procs of the 12th Intl Conf on the Synthesis and Simulation of Living Systems.
 Citations: 33
 38. Lu, Z., Wu, X., Zhu, X., Bongard, J. (2010)
 Ensemble Pruning via Individual Contribution Ordering,
The 16th ACM SIGKDD Conference on Knowledge Discovery and Data Mining.
 Citations: 46
 37. Auerbach, J. E., Bongard, J. C. (2010)
 Evolving CPPNs to Grow Three Dimensional Structures.
Procs of the Genetic and Evolutionary Computation Conference, Portland, OR.
 Acceptance rate: 45%. Citations: 34
 36. Bongard, J. C. (2010)
 A Probabilistic Functional Crossover Operator for Genetic Programming.
Procs of the Genetic and Evolutionary Computation Conference, Portland, OR.
 Acceptance rate: 45%. Citations: 8
 35. Bongard, J. C., Hornby, G. S. (2010)
 Guarding Against Premature Convergence while Accelerating Evolutionary Search.
Procs of the Genetic and Evolutionary Computation Conference, Portland, OR.
 Acceptance rate: 45%. Citations: 24
 34. Lu, Z., Wu, X., Bongard, J. (2010)
 Adaptive Informative Sampling for Active Learning.
Procs of The SIAM Conference on Data Mining (SDM 2010), Columbus, Ohio, USA
 Citations: 5
 33. Lu, Z., Wu, X., Bongard, J. C. (2009)
 Active Learning with Adaptive Heterogeneous Ensembles.
Procs of the Intl Conf on Data Mining, Miami, FL.
 Citations: 11
 32. Kaipa, K., Bongard, J. C., Meltzoff A. N. (2009)
 Combined Structure and Motion Extraction from Visual Data Using Evolutionary Active Learning.

- Procs of the Genetic and Evolutionary Computation Conference*, Montreal Canada.
Acceptance rate: 41.4%. Citations: 1
31. Auerbach, J., Bongard, J. C. (2009)
Evolution of Functional Specialization in a Morphologically Homogeneous Robot,
Procs of the Genetic and Evolutionary Computation Conference, Montreal Canada.
Acceptance rate: 41.4%. Citations: 7
 30. Auerbach, J., Bongard, J. C. (2009)
How Robot Morphology and Training Order Affect the Learning of Multiple Behaviors,
IEEE Congress on Evolutionary Computation, Trondheim, Norway.
Citations: 20
 29. Bongard, J. (2008)
Behavior Chaining: Incremental Behavior Integration for Evolutionary Robotics.
Artificial Life XI, MIT Press, Cambridge, MA.
Citations: 42
 28. Bongard, J. (2007)
Synthesizing Physically-Realistic Environmental Models from Robot Exploration,
Advances in Artificial Life: 9th European Conference, Springer-Verlag, Berlin, pp. 806-815.
Citations: 4
 27. Bongard, J. (2007)
Action-Selection and Crossover Strategies for Self-Modeling Machines,
Procs of the Genetic and Evolutionary Computation Conf, ACM Press, New York, NY, pp. 198-205.
Acceptance rate: 46.1%. Citations: 7
 26. Bongard, J. (2007)
Exploiting Multiple Robots to Accelerate Self-Modeling,
Procs of the Genetic and Evolutionary Computation Conf, ACM Press, New York, NY, pp. 214-221.
Acceptance rate: 46.1%. Citations: 3
 25. Lipson, H., J. Bongard, V. Zykov and E. Malone (2006)
Evolutionary Robotics for Legged Machines: From Simulation to Physical Reality,
Procs of the Intelligent Autonomous Systems Conf (IAS-9), pp. 11—18.
Citations: 42
 24. Bongard, J., V. Zykov and H. Lipson (2006)
Automated Synthesis of Body Schema using Multiple Sensor Modalities,
ALIFE X, pp. 220—226.
Citations: 27
 23. Bongard, J. and H. Lipson (2005)
Automatic Synthesis of Multiple Internal Models Through Active Exploration,
AAAI Fall Symposium on Reactive to Anticipatory Cognitive Embodied Systems, Arlington, VA.
Citations: 7
 22. Bongard, J. and H. Lipson (2005)
'Managed Challenge' Alleviates Disengagement in Co-evolutionary System Identification,
Procs of the Genetic and Evolutionary Computation Conference, ACM, pp. 531-538.
Acceptance rate: 46.1%. Citations: 21
 21. White, P., V. Zykov and J. Bongard (2005)

- Three Dimensional Stochastic Reconfiguration of Modular Robots,
Robotics: Science and Systems, Cambridge, MA.
 Citations: 157
20. Bongard J. and Lipson H. (2005)
 Reinventing the Wheel: Experiments in Evolutionary Geometry,
Late Breaking Papers of the Genetic and Evolutionary Computation Conf, Washington DC.
 Citations: 2
 19. Zykov, V., J. Bongard and H. Lipson (2005)
 Co-evolutionary Variance Can Guide Physical Testing in Evolutionary System Identification,
Procs of the NASA/DoD Conf on Evolvable Hardware, June, Washington DC, pp. 213-220.
 Citations: 10
 18. Lipson, H. and J. Bongard (2004)
 An Exploration-Estimation Algorithm for Synthesis and Analysis
 of Engineering Systems Using Minimal Physical Testing,
Procs of the ASME Design Engineering Conferences, Salt Lake City, UT.
 Citations: 17
 17. Zykov, V., J. Bongard and H. Lipson (2004)
 Evolving Dynamic Gaits on a Physical Robot,
Late Breaking Papers for the Genetic and Evolutionary Computation Conf, Seattle, WA.
 Citations: 61
 16. Bongard, J. and H. Lipson (2004)
 Once More Unto the Breach: Co-evolving a Robot and its Simulator,
Procs of the Intl Conf on the Simulation and Synthesis of Living Systems (ALIFE9), pp. 57-62.
 Citations: 37
 15. Bongard, J. and H. Lipson (2004)
 Automated Robot Function Recovery after Unanticipated Failure
 or Environmental Change using a Minimum of Hardware Trials,
Procs of the NASA/DoD Conference on Evolvable Hardware, IEEE Computer Society, pp. 169-176.
 Citations: 32
 14. Bongard, J. and H. Lipson (2004)
 Automating Genetic Network Inference with Minimal Physical Experimentation Using Coevolution,
Procs of the Genetic and Evolutionary Computation Conf, Springer, pp. 333-345.
 Acceptance rate: 50%. Citations: 28
 13. Bongard, J. and H. Lipson (2004)
 Automated Damage Diagnosis and Recovery for Remote Robotics,
Procs of the International Conf on Robotics and Automation (ICRA), Omnipress, pp. 3545-3550.
 Citations: 35
 12. Bongard, J. (2002)
 Evolved Sensor Fusion and Dissociation in an Embodied Agent,
Procs of the EPSRC/BBSRC Intl Workshop on Biologically-Inspired Robotics, pp. 102-109.
 Citations: 8
 11. Frutiger, D. R., Bongard, J. and F. Iida (2002)
 Iterative Product Engineering: Evolutionary Robot Design,
Procs of the Fifth Intl Conf on Climbing and Walking Robots, pp. 619-629.

Citations: 16

10. Bongard, J. and R. Pfeifer (2002)
A Method for Isolating Morphological Effects on Evolved Behaviour,
Procs of the Seventh Intl Conf on the Simulation of Adaptive Behaviour (SAB2002), pp. 305-311.
Citations: 48
9. Bongard, J. and R. Pfeifer (2002)
Relating Neural Network Performance to Morphological Differences in Embodied Agents,
Procs of the Sixth Intl Conf on Cognitive and Neural Systems, Boston, USA.
Citations: 1
8. Bongard, J. (2002)
Evolving Modular Genetic Regulatory Networks,
Procs of the IEEE Congress on Evolutionary Computation (CEC2002), IEEE Press, pp. 1872-1877.
Citations: 204
7. Paul, C. and J. Bongard (2001)
The Road Less Travelled: Morphology in the Optimization of Biped Robot Locomotion,
Procs of the IEEE/RSJ Intl Conf on Intelligent Robots and Systems (IROS2001), Hawaii, USA.
Citations: 74
6. Bongard, J. and C. Paul (2001)
Making Evolution an Offer It Can't Refuse: Morphology and the Extradimensional Bypass,
Procs of the Sixth European Conf on Artificial Life, Springer-Verlag, pp. 401-412.
Citations: 58
5. Bongard, J. and R. Pfeifer (2001)
Repeated Structure and Dissociation of Genotypic and Phenotypic Complexity in Artificial Ontogeny,
Procs of the Genetic and Evolutionary Computation Conf, Morgan Kaufmann, pp. 829-836.
Citations: 166
4. Bongard, J. and C. Paul (2000)
Investigating Morphological Symmetry and Locomotive Efficiency using Virtual Embodied Evolution,
Procs of the Sixth Intl Conf on the Simulation of Adaptive Behaviour, MIT Press, pp. 420-429.
Citations: 74
3. Bongard, J. (2000)
Reducing Collective Behavioural Complexity through Heterogeneity,
Artificial Life VII, MIT Press, pp. 327-336.
Citations: 5
2. Bongard, J. (2000)
The Legion System: A Novel Approach to Evolving Heterogeneity for Collective Problem Solving,
Procs of the Third Euro Conf on Genetic Programming, Springer-Verlag, pp. 25—37.
Citations: 37
1. Bongard, J. (1999)
Coevolutionary Dynamics of a Multi-Population Genetic Programming System,
Procs of the Fifth Euro Conf on Artificial Life, Springer-Verlag, pp. 316-321.
Citations: 5

MINIMALLY- REVIEWED PUBLICATIONS

20. Bongard, J. C. (2017)
[The symbol grounding problem.](#)
 Invited Response to the 2017 Edge Question:
[“What scientific term or concept ought to be more widely known?”](#)
19. JC Bongard (2016)
[Evolving soft robots.](#) *Soft Robotics* 3(2): 43-44. Editorial.
18. A Larson, A Bernatskiy, C Cappelle, K Livingston, N Livingston, J Long, J Schwarz, M Smith & JC Bongard (2016)
[Recombination hotspots promote the evolvability of modular systems.](#)
Procs of the Genetic and Evolutionary Computation Conference (GECCO 2016). Poster.
17. Bongard, J. C. (2016)
[I, For One.](#)
 Invited Response to the 2016 Edge Question:
[“What do you consider the most interesting \[scientific\] news?”](#)
16. Bongard, J. C. (2015)
[Manipulators and Manipulanda.](#)
 Invited Response to the 2015 Edge Question:
[“What do you think about machines that think?”](#)
15. JP Bagrow, S Desu, MR Frank, N Manukyan, L Mitchell, A Reagan, EE Bloedorn, LB Booker, LK Branting, MJ Smith, BF Tivnan, CM Danforth, PS Dodds, JC Bongard (2013).
 Shadow networks: Discovering hidden nodes with models of information flow.
arXiv preprint arXiv: 1312.6122
14. Hornby, G. S. & Bongard, J. C. (2013).
 Accelerating Interactive Evolutionary Algorithms through User Modeling.
International Conference on Intelligent User Interfaces.
13. Celis, S., Bongard, J. C. (2012)
 Not All Physics Simulators Can Be Wrong in the Same Way.
Genetic and Evolutionary Computation Conference, pp. 659-660.
12. Beliveau, P., Hornby, G. S., Bongard, J. C. (2012)
 Interactive Simulated Robot Construction and Controller Evolution.
Genetic and Evolutionary Computation Conference, pp. 627- 628.
11. Bongard, J. C., Beliveau, P., Hornby, G. S. (2012)
 Avoiding Local Optima with Interactive Evolutionary Robotics.
Genetic and Evolutionary Computation Conference, pp. 1405—1406.
10. Bongard, J. C. (2011)
 How evolution shapes the way roboticists think.
Procs of the 2nd European Future Technologies Conf and Exhibition (FET 11), 7: 8-10.
9. Bongard, J. (2011).
 Morphogenetic robotics recapitulates artificial ontogeny.
Newsletter of the Autonomous Mental Development Technical Committee. 8(2): 3-4.
8. Bongard, J. (2009).
 Biologically inspired computing.

IEEE Computer, 42(4): 95—98.

7. Lu, Z., Bongard, J. C. (2009)
Exploiting Multiple Classifier Types with Active Learning.
Genetic and Evolutionary Computation Conference (GECCO 2009), Montreal Canada.
6. Bongard, J. C. (2009)
The Impact of Jointly Evolving Robot Morphology and Control on Adaptation Rate.
Genetic and Evolutionary Computation Conference (GECCO 2009), Montreal Canada.
5. Bongard, J. (2008).
Probabilistic Robotics Book Review.
Artificial Life, 14(2): 227—229.
4. Bongard, J. (2008)
Embodied cognition: the other morphology.
The Neuromorphic Engineer, DOI: 10.2417/1200812.1420.
3. Lungarella, M., Iida, F., Bongard, J. and Pfeifer, R. (2008)
AI in the 21st century – with historical reflections,
Proceedings of the 50th Anniversary Summit of Artificial Intelligence, pp. 1-8.
2. Lu, Z., Rughani, A. I., Tranmer, B. I., Bongard, J. (2008)
Informative Sampling for Large Unbalanced Data Sets,
Fourth Workshop on Medical Applications of Genetic and Evolutionary Computation at GECCO 2008.
1. Conduit, R., Adami, C., Lipson, H., Zykov, V. and Bongard, J. (2007).
To sleep, perchance to dream.
Science, 315: 1219-1220.

PATENTS

Awarded “Engineered Multicellular Organisms”. US PCT/US2021/013105.

SERVICE

CO-CHAIR [The 2021 International Workshop on Embodied Intelligence](#)
CHAIR [The 2020 Artificial Life Conference](#) (400+ participants; 39 countries)

EDITORSHIPS

2021 Co-editor, [Swarm Intelligence](#) special issue on Micro and Nano Swarms.
2014– Associate Editor, *Frontiers in Robotics and AI*
2014– Review Editorial Board, *Evolutionary Robotics*
2013– Associate Editor, *Soft Robotics*
2011– Action Editor, *Neural Computation*
2011– Academic Editor, *Public Library of Science (PLOS) ONE*
2013– Guest Associate Editor, *PLOS Computational Biology*

TREASURER

2014– International Society for Artificial Life

MEMBERSHIP

2014– University of Vermont STEM Leadership Council
2014 *13th Intl Conf on the Simulation of Adaptive Behavior*, program committee

2014	<i>13th Intl Conf on Parallel Problem Solving from Nature</i> , program committee
annually	<i>Genetic and Evolutionary Computation Conference</i> , program committee
annually	<i>Living Machines Conference</i> , program committee
biennially	<i>Artificial Life Conference</i> , program committee
biennially	<i>European Conference on Artificial Life Conference</i> , program committee
2013	<i>Genetic and Evolutionary Computation Conference</i> , track chair
2013	<i>Congress on Evolutionary Computation (CEC)</i> , program committee
2013–	National affiliate, University of Iowa DeLTa center
2011–	<i>Federation of American Scientists (FAS)</i> board of sponsors
2007–	<i>Institute of Electrical and Electronics Engineers (IEEE)</i>
2006–	<i>Association for Computing Machinery (ACM)</i>
REVIEWER	<i>Science</i> <i>Nature</i> <i>Proceedings of the National Academy of Science (PNAS)</i> <i>The MacArthur Foundation</i> <i>Science Robotics</i> <i>Nature Communications</i> <i>PLoS ONE</i> <i>PLoS Computational Biology</i> <i>Neural Computation</i> <i>Journal of Machine Learning Research (JMLR)</i> <i>IEEE Transactions on Evolutionary Computation</i> <i>IEEE Transactions on Robotics</i> <i>Artificial Life</i> <i>Adaptive Behavior</i> <i>IEEE Transactions on Systems, Man and Cybernetics</i> <i>Journal of Neurorobotics</i>
PANELIST	2006– National Science Foundation (NSF) proposal reviews (~ 2 panels / year) 2020 Department of Energy 2013 The EC Flagship Initiative ‘Human Brain Project’ proposal reviewing 2010 National Institutes of Health (NIH) proposal reviewing
INTERNAL	2018 Host of the 2018 Aiken Lecture . 2018– Graduate Student Coordinator for the Computer Science Department 2015– Director, Vermont Advanced Computing Core (UVM’s high performance computing facility) 2013– UVM STEM Leadership Council Member 2011–2015 Vice Chair, Vermont Complex Systems Center
OUTREACH	~10 presentations per year. Representative sample below. 2022 Presentation to ~100 sixth graders about xenobots at Shapleigh Middle School. 2016 Presentation to Abenaki Nation high school students 2015– Twitch Plays Robotics 2012– Governor’s Institute of Vermont presentations (~100 students) 2014–2017 Burlington High School presentation on robotics. 2016 Waldorf School (grades 7 through 12), Toronto 2016 Steelesview Public School , Toronto (grades 2 and 3) 2007–2013 Governor’s Institute of Vermont summer program guest instructor 2013 Boy Scouts of America guest instructor 2013 Reddit AMA (“Ask Me Anything”) 2013– Hour of Code visitor, Vermont middle schools.

TEACHING

- 2014– [Ludobots](#). The world’s only MOOC taught from reddit.
2010– CS206: Evolutionary Robotics. [2021](#). [2020](#). [2019](#). [2018](#). [2017](#). [2016](#).
2007–2021 CS228: Human Computer Interaction. [2020](#). [2019](#). [2018](#). [2016](#). [2015](#).
2006–2008 CS205: Software Engineering.
2009 HCOL: Embodied Cognition.

ADVISING

POSTDOCS

- 2021– [Tyrell Davis](#)
2020–2021 [Sam Kriegman](#)
2017–2018 [Zahra Mahoor](#)
2015–2017 [Marcin Szubert](#)
2012–2013 [Ilknur Icke](#)
2008–2010 [Kaipa Krishnanand](#)

PHD’S

- 2021– [Krishna Srinivasan](#) (Computer Science)
2020– [Amanda Bertschinger](#) (Computer Science)
2019– [Caitlin Grasso](#) (Computer Science). [NSF GRFP](#) recipient.
2019– [Atoosa Parsa](#) (Complex Systems & Data Science)
2017–2021 [Joshua Powers](#) (Computer Science)
2016–2020 [Sam Kriegman](#) (Computer Science). 2019/2020 UVM Outstanding Doctoral [Dissertation](#) Award.
2015–2019 [Collin Cappelle](#) (Computer Science). [Dissertation](#).
2013– 2018 [Anton Bernatskiy](#) (Computer Science). [Dissertation](#).
2013–2016 [Mark Wagyu](#) (Computer Science)) [Dissertation](#).
2009–2013 [Joshua Auerbach](#) (Computer Science))
2006–2011 [Zhenyu Lu](#) (Computer Science)

MASTERS

- 2021– [Nathan Tolley](#) (Computer Science)
2021– [Alexander Medvedeff](#) (Computer Science)
2018–2021 [Ryan Grindle](#) (Computer Science)
2019–2021 [Sida Liu](#) (Computer Science)
2019–2020 [Jack Felag](#) (Computer Science)
2018–2020 [Sarah Pell](#) (Computer Science)
2017–2018 [Alexander Ram](#) (Computer Science)
2017–2018 [Ryan Grindle](#) (Mathematics)
2013–2018 [Roman Popov](#) (Computer Science)
2015–2016 [Nate Powell](#) (Statistics)
*Dissertation: The role of Uncertainty in Categorical Perception
Utilizing Statistical Learning in Robots.*
2015–2016 [Sam Kriegman](#) (Co-advising; statistics)
*Dissertation: Evolving spatially aggregated features
from satellite imagery for regional modeling.*
2014–2015 [Afsoon Yousefi-Zowj](#) (Computer Science)
*Dissertation: A Genetic Programming approach to cost-sensitive control
in wireless sensor networks.*

2014–2015 Karol Zieba (Computer Science)
Dissertation: *Evolving multi-modal sensors.*
2012–2014 [David Buckingham](#) (Computer Science)
Dissertation: *Inductive learning of snowpack distribution models for improved estimation of areal snow water equivalent.*
2012–2014 [Christopher Pierce](#) (Computer Science; project option.)
2010–2012 [Somdeb Chatterjee](#) (Computer Science)
Dissertation: *Crowdsourcing predictors for modeling behavioral outcomes.*
2010–2012 [Yunfei Zhao](#) (Computer Science; project option.)
2008–2010 [Peter Hurd](#) (Computer Science; project option.)

UNDERGRADUATES

2021– [Sidhanth Kafley](#) (Computer Science)
2018– [David Matthews](#) (Computer Science)

2019–2020 Nathan Tolley (Computer Science)
2019 Kyle Morand (Computer Science)
2019 Filip Saulean (Computer Science)
2019 Jean-Baptiste Bohl (Computer Science)
2019 Everest Witman (Computer Science)
2016–2018 Jack Felag (Mathematics)
2015–2016 Ari Larson (Computer Science)
2014–2015 Mariko Totten (Computer Science)
2013–2014 Timothy Rizvanov (Computer Science)
2013–2014 Fritz Davenport (Computer Science)
2013–2014 Alex Berger (Business administration)
2011–2012 Nick Cheney (Computer Science)

PHD DEFENSE COMMITTEE MEMBER

2022 [Jeffrey Brabec](#), University of Vermont.
[Dylan Shah](#), Yale.
2021 [Keene Chin](#), Carnegie Mellon.
[Toby Howison](#), Cambridge University.
2020 [Tønnes Nygaard](#), University of Oslo, Norway
[Karine Miras](#), Vrije Universiteit Amsterdam
Daniel Wilson, UVM
2019 [Elijah Bowen](#), Dartmouth
[Simon Hauser](#), EPFL, Switzerland
2018 [Eric Clark](#), UVM
2016 Thomas McAndrew, UVM
Emily Cody, UVM
2014 Morgan Frank, UVM
Nicholas Chaumont, Keck Graduate Institute
Ahmed Hamed, UVM
Jesse van den Kieboom, EPFL, Switzerland
2013 Eitan Pechenik, UVM
Song Wang, UVM
Karim Chichakly, UVM
Nicolas Allgaier, UVM
2012 Thierry Buecheler, University of Zurich, Switzerland
2011 Sylvain Koos, UPMC, France
2010 Peter Duerr, EPFL, Switzerland

STAFF

2018-2021 [Rachel Dotey](#). Software developer for #UVMComputes project.

INVITED TALKS

- June, 2022 How robots and xenobots will shape the way we think. [IAS-17 conference](#) (invited).
“Xenobots”. University of Vermont Alumni 50th Reunion (invited).
“[The innate creativity of AI](#)”. Aalto University, Finland (invited).
“AI for biomedical research.” [National Academies Board on Life Sciences Meeting](#) (Invited).
- May, 2022 “AI-driven design of soft robots and biobots.” ARO Biotronics meeting (Invited).
“CDOs”. [Dynamic Landscapes](#) K-12 teacher conference. (Keynote).
- Apr, 2022 [Xenobot replicators](#). Cross Labs Tokyo workshop (invited)
[From rigid to soft to biological robots](#). RoboSoft conference (plenary)
[Empowered neural cellular automata](#). Alt-AI Workshop, RoboSoft conference (invited)
[Xenobot self-replication](#). Embodied Intelligence workshop, RoboSoft conference (invited)
[CGMMs](#). Software workshop, RoboSoft conference (invited)
- Mar, 2022 “What is non-embodied AI missing?” [Embodied Intelligence Conference](#) (Invited).
“CDOs.” Radboud University, Netherlands (Invited).
- Feb, 2022 “Evolving metamaterials/biobots.” [AFRL/DoE Energy Consequences of Information](#) symposium (Invited).
[A xither of Xenobots](#). [Math of Collective Intelligence workshop](#), UCLA. (Invited)
- Jan, 2022 “CDOs for demolishing dichotomous thinking.” [AMOLF](#) group, Netherlands. (Invited)
[L.A.S.E.R. talk](#). Stanford University. (Invited)
“[Kinematic self replication](#).” Quantum Photonics Club. (Invited)
“CDOs; Machine Science.” Kyushu Institute of Technology, Japan. (Invited)
“Evolutionary Robotics.” Kyushu Institute of Technology, Japan. (Invited)
- Nov, 2021 “Evolutionary robotics/CDOs”. [Biophysical Society of Japan Annual Meeting](#). (Invited)
- Oct, 2021 “[Red herrings, iguanas, and xenobots](#).” AI Forward Forum, Tilburg University. (Invited)
- Aug, 2021 “CDOs.” [Allen Institute for AI Lecture Series](#). (Invited)
- July, 2021 “Automated design of biological robots.” [Biological Distributed Algorithms workshop](#). (Invited)
- July, 2021 “Embodying the products of evolutionary computation.” [SFI Frontiers of EC workshop](#). (Invited)
- June, 2021 “CDOs.” [Web a Quebec](#) conference. (Keynote)
- May, 2021 “CDOs.” [UCL Inst. for the Physics of Living Systems](#) Symposium. (Co-keynote w/ Mike Levin)
“CDOs.” AI-Zürich Conference, Switzerland. (Keynote)
- Mar, 2021 “CDOs.” 6th John Cabot University Workshop on posthumanism. Rome. (Keynote)
- Jan, 2021 “Machine Science.” Kyushu Institute of Technology, Japan. (Invited)
“Evolutionary Robotics.” Kyushu Institute of Technology, Japan. (Invited)
- Dec, 2020 “CDOs.” ShanghAI Lecture. (Invited)
- Nov, 2020 “CDOs.” AAAI Fall Symposium on Abstraction and Analogy. (Invited)
- Nov, 2020 “CDOs.” ACM Symposium on Computational Fabrication. (Keynote)
- Oct, 2020 “[Computational background of CDOs](#).” UVM Electrical and Biomedical Engineering seminar.
- Oct, 2020 “CDOs.” [Scifoo](#). Google.
- Oct, 2020 “Crowdsourcing CDO training.” Hybrid Intelligence Round Table. Aarhus University, Denmark.
- Oct, 2020 “CDOs and NLP.” Indiana University (Invited)
- Oct, 2020 [Panel discussion on small-scale robots](#). Life Summit, AI LA. (Invited)
- Sept, 2020 “CDOs.” [Genomics Institute of the Novartis Research Foundation](#) (Invited)
- July, 2020 “[Scaling up automated design and manufacture of soft and biological robots](#).” GECCO workshop (Invited)
- July, 2020 “Evolving the Physical Structure of Compliant, Soft, and Biological Robots.” (AIM2020; Invited)
- June, 2020 “CDOs.” Research and Applied AI Summit ([RAAIS](#)) (Keynote)
- Apr, 2020 “Computer designed organisms (CDOs).” Stanford EE Computer Systems Colloquium (Invited)
- Jan, 2020 “[word2vec2bot](#).” University of Michigan (Invited)
- Dec, 2019 “Soft robots that evolve and develop.” ShanghAI Lecture Series (Invited)
- June, 2019 “[Evolutionary Robotics](#).” Governor’s Institute of Vermont. (Invited)

May, 2019 “Co-optimizing body and control for soft and modular robots.” EPFL, Switzerland. (Invited)

May, 2019 “The effects of Cartesian gravity on robotics.” University of Reading, UK. (Invited)

Mar, 2019 “Sim2real, sim2life, and sim2all.” Yale CS Colloquium (Invited).

Jan, 2019 “[Morphology, evolution and cognition](#).” NECSI Winter School presentation. (Invited)

Dec, 2018 “What evolutionary robotics can teach us about embodied cognition.” ShanghAI Lecture Series (Invited)

Dec, 2018 [Hour of Code](#) presentation to 50 6th graders, Saint Albans City Elementary School.

Nov, 2018 “Embodiment, Evolution & Meaning.” Santa Fe Institute Workshop on AI and the Barrier to Meaning.

Nov, 2018 “[The moral challenges of robotics and AI](#).” Community AI Forum, Mount Mansfield Union High School.

July, 2018 “[Robots as complex systems](#).” ICCS Conference.

July, 2018 “[The role of embodiment in open-ended evolution](#).” ALife Workshop on Open-ended Evolution.

May, 2018 “[Soft robots that morph and behave simultaneously](#).” ICRA Workshop on Soft Robotics.

May, 2018 “Realizing Explainable AI.” [Open Data Science Conference \(ODSC\) East](#).

Feb, 2018 “[Autonomous yet safe machines](#).” Generator VT, Reckless Ideas seminar series.

Nov, 2017 [ShanghAI](#) Lecture Series (Invited)

Sept, 2017 IEEE/RSJ Intl. Conference on Intelligent Robots and Systems (IROS) (**Keynote**)

Sept, 2017 Santa Fe Institute Working Group on Morphological Computation (Invited)

June, 2017 Human Brain Project workshop on embodied cognition (Geneva, CH) (Invited)

Feb, 2017 [SFI](#) Workshop: “Evolution and Restraint of Malicious Behavior in Complex Systems” (Invited)

Oct, 2016 “Speaking to a general audience” for UVM IGERT Smart Grid graduate students (Invited)

Sept, 2016 ASME Smart Materials, Adaptive Structures and Intelligent Systems Conference (Stowe, VT) (Invited)

Sept, 2016 Santa Fe Institute Short Course on Innovation (Austin, TX) (Invited)

Sept, 2016 [Parallel Problem Solving from Nature](#) conference. (University of Stirling, Edinburgh) (**Keynote**)

May, 2016 [Trusted autonomous systems](#). (ACFR, University of Sydney, Australia) (Invited)

May, 2016 Trusted autonomous systems. (Intl. Symp. on Trusted Autonomous Systems, Australia) (**Keynote**)

Mar, 2016 [Some philosophical implications of evolutionary robotics](#). (UPitt [HPS](#) Annual Lecture Series) (Invited)

Feb, 2016 Evo devo robo. ([University of Toronto Cognitive Science Symposium](#)) (Invited)

Dec, 2015 [ShanghAI](#) lecture (simulcast to classrooms in Europe and Asia) (Invited)

Dec, 2015 New Jersey Institute of Technology (host: Gal Haspel, biology) (Invited)

Nov, 2015 UVM Honors College Plenary Lecture (Invited)

Oct, 2015 UMD Workshop on Soft Robotics (Invited)

May, 2015 [Factory of Imagination](#) lecture, Denmark (500 attendees) (**Keynote**)

Feb, 2015 [ShanghAI](#) lecture (simulcast to classrooms in Europe and Asia) (Invited)

Nov, 2014 Cornell Univeristy (host: Robert Shepherd, engineering) (Invited)

Sept, 2014 University of Maryland workshop on soft robotics (Invited)

Aug, 2014 [Scifoo](#) (hosts: Nature, Google, O'Reilly Media, Digital Science) (Invited)

July, 2014 Workshop on Artificial Life and the Web at ALife conference (Invited)

July, 2014 International Society for Artificial Life (ISAL) Summer School (Invited)

June, 2014 DARPA Biological Technologies Office (Invited)

June, 2014 Neural Systems & Behavior Summer School, Woods Hole Marine Biology Lab (Invited)

May, 2014 EPFL, Lausanne, Switzerland (host: Auke Ijspeert) (Invited)

Mar, 2014 National STEM Conference (Concept Schools), Cleveland, OH (**Keynote**)

Mar, 2014 Air Force Research Laboratories (AFRL), Rome, NY (Invited)

Dec, 2013 [ShanghAI](#) lecture (simulcast to 15 classrooms in Europe and Asia) (Invited)

Nov, 2013 National Autonomous University of Mexico (host: Carlos Gershenson) (Invited)

Oct, 2013 University of Iowa [Delta Center](#) (host: Mark Blumberg, psychology) (Invited)

Sept, 2013 eSMC neuroscience/robotics graduate summer school (host: Andreas Engel) (Invited)

Sept, 2013 Evolutionary Biology lecture, University of Zurich (host: Andreas Wagner) (Invited)

Aug, 2013 Gordon Research Conference on Neuroethology (host: Heather Eisten, biology) (Invited)

July, 2013 Soft Robotics Workshop at ETH, Zurich (host: Fumiya Iida, robotics) (**Keynote**)
 June, 2013 Evolution Meeting, SSE Presidential Symposium (host: Richard Lenski, biology) (Invited)
 June, 2013 Evolution Meeting, Education Symposium (host: George Gilchrist, NSF) (Invited)
 Mar, 2013 University of Texas at Austin (host: Dana Ballard, Computer Science) (Invited)

Nov, 2012 Vassar College (host: John Long, biology) (Invited)
 Nov, 2012 Harvard University (host: Radhika Nagpal, engineering) (Invited)
 June, 2012 Tufts University (host: Michael Levin, biology) (Invited)
 Apr, 2012 Tufts University (host: Barry Trimmer, biology) (Invited)
 Jan, 2012 University of Southern California (host: Francisco Valero-Cuevas, bioengineering) (Invited)

Dec, 2011 Castleton State College, Vermont (Invited)
 Nov, 2011 Global ShanghAI Lecture series (telecast from Vermont) (Invited)
 Oct, 2011 TEDx presentation, University of Vermont (Invited)
 July, 2011 Woods Hole Workshop on Computational Neuroscience (host: Terrence Sejnowski) (Invited)
 May, 2011 [European Future and Emerging Technologies \(FET\) Conference](#), Budapest (**Keynote**)
 Mar, 2011 Annual lecture, Simon Fraser University, Canada (host: Bernard Roitbert) (Invited)
 Jan, 2011 Cognitive Dynamical Systems Workshop, Salk Institute (host: T. Sejnowski) (Invited)

Nov, 2010 Defense Sciences Research Council (DSRC), Washington, DC (**Keynote**)
 Oct, 2010 Michigan State University (host: Charles Ofria, computer science) (Invited)
 Sept, 2010 Perception & Action Workshop, Sante Fe Institute (Invited)
 Sept, 2010 Evolutionary Studies Seminar Series, Binghamton University (Invited)
 Sept, 2010 Intl Workshop on Guided Self-Organization, Indiana University (Invited)
 Sept, 2010 Rensselaer Polytechnic Institute (host: Brent Fajel, cognitive science) (Invited)
 Jan, 2010 Advancement of Artificial Cognitive Systems, ETH, Zurich (**Keynote**)

Oct, 2009 University of Massachusetts, Amherst (Invited)
 Oct, 2009 Evolutionary Robotics Workshop at the IEEE IROS Conference (Invited)
 Sept, 2009 Union College, Schenectady, NY (host: John Rieffel, computer science) (Invited)
 May, 2009 McMaster Origins Institute, Canada (Invited)
 Mar, 2009 University of California San Diego (annual lecture; host: T. Sejnowski) (**Keynote**)
 Mar, 2009 Salk Institute (host: T. Sejnowski) (Invited)
 Feb, 2009 Hughes Research Laboratories, Malibu, CA (Invited)
 Feb, 2009 Pragyan technical festival, India (telecast from Vermont) (Invited)

Oct, 2008 Dartmouth College (host: Tanzeem Choudhury) (Invited)
 Oct, 2008 McMaster University, Canada (host: Simon Haykin) (Invited)
 Sept, 2008 NAE's Frontiers of Engineering Symposium, New Mexico (Invited)
 June, 2008 Telluride Neuromorphic Engineering Workshop (Invited)
 June, 2008 Woods Hole Workshop on Computational Neuroscience (Invited)
 May, 2008 Genetic Programming Theory and Practice, University of Michigan (**Keynote**)
 Apr, 2008 Cognitive Engineering Workshop, Sardinia, IT (Invited)
 Jan, 2008 Boston University (host: Steven Grossberg) (Invited)

Oct, 2007 Elder Education Enrichment program, Vermont (Invited)
 Oct, 2007 IBM T. J. Watson Research Center (host: Kerry Bernstein) (Invited)
 Aug, 2007 National Science Foundation *Science of Learning Workshop* (Invited)

2004 AI Lab, University of Zurich, Switzerland (Invited)

2003 EPSRC Workshop on Evolvability, Hertfordshire, UK (Invited)

2002 Biozentrum, University of Basel, Switzerland (Invited)

- 2002 Massachussets Institute of Technology (host: Rodney Brooks) (Invited)
- 2002 Woods Hole Marine Biological Laboratory (host: Jelle Atema) (Invited)
- 2002 Cognitive Science Department, University of Sussex, UK (Invited)

SELECTED MEDIA COVERAGE

- Mar, 2022 [How we accidentally started making infinite robots](#). Real Science.
[All you need to know about coexisting with living robots](#). The Rhys Lindmark show.
[When robots multiply](#). Grow by Ginkgo.
- Feb, 2022 [Nautilus Magazine](#).
- Jan, 2022 [AI with AI podcast](#). (Xenobot segment starts at 18:21)
[Transform India podcast](#)
Progress, Potential, and Possibilities [podcast](#)
[7 Days](#)
[Newsweek](#).
- Dec, 2021 **Stephen Colbert**
[CNN](#), [BBC](#), [CNBC](#), [Science Friday](#), [Forbes](#), [NPR](#), [New Scientist](#), [The Times](#), [Bloomberg](#), & 100s more.
- Nov, 2021 [CBC Television](#).,
- July, 2021 [Escaped Sapiens](#) podcast.
- May, 2021 [Soft robotics podcast](#). With Mike Levin.
- April, 2021 [Wired Magazine](#).
- April, 2021 [Science Friday](#) / [CBC News](#) / [Washington Post](#) / [New Scientist](#) / [Science News](#) & 100s more
- March, 2021 [Machine behavior](#). *Quarantime.today*
- March, 2021 [CDOs](#). *The Max Relativo show*.
- March, 2021 [The world's first programmable organism](#). *Pioneer Works*
- Dec, 2020 [“Xenobots, one of the four big scientific breakthroughs of 2020.”](#) *The Week*
- Dec, 2020 [Discover Magazine](#).
- Nov, 2020 [Wired](#).
- Apr, 2020 [New York Times](#).
- Jan, 2020 [CNN](#)
- Jan, 2020 [BBC World Service](#).
- Jan, 2020 [NPR's Science Friday](#).
- Hundreds of [additional articles](#) appeared in the global press following the announcement of Xenobots.
- Oct, 2019 [“Soft Robotics Podcast interview”](#). *IEEE RAS*
- Apr, 2019 [“Soft Robots Look to New Environments”](#). *Communications of the ACM*
- Sept, 2018 [“Robotic Skins’ that bring objects to life”](#). *ABC News*
- Feb, 2018 [“Generator to Present Big Thinkers in ‘Reckless Ideas’ Series”](#). *Seven Days*
- May, 2016 [“Reddit Brings a UVM Evolutionary Robotics Class to the World”](#). *Seven Days*
- Dec, 2014 [“Could A.I. be the end of the human race?”](#) *RT America*
- Dec, 2013 [“Beware. Scientists are Creating Machines That Can Evolve on Their Own”](#) *Smithsonian Magazine*
- July, 2013 [“Are Robots The Future Of Human Evolution?”](#) *Through the Wormhole*
- Feb, 2011 [“Bringing Up Robots”](#) *American Scientist*
- Jan, 2011 [“Artificial intelligence based on Darwin’s idea”](#) *Boston Globe*
- June, 2008 [“When Robots Live Among Us”](#) (cover article) *Discovery Magazine*

Sept, 2007 “ ‘Self-aware’ space rovers would be speedy explorers” *Scientific American*
 Nov, 2007 “Six Ideas that Will Change the World” *Esquire*
 Jan, 2007 “The GOLEM in the machine” *Die Zeit*

Nov, 2006 “Injured Robot Learns to Limp” *Nature News*
 Nov, 2006 “New Robot Shrugs Off Injury” *Science News*
 Nov, 2006 “Robotic Recovery” *MIT Technology Review*
 Nov, 2006 “Self-Aware Robots” *Discovery Channel*
 Nov, 2006 “New Robot Can Sense Damage, Recover” *Forbes*
 Nov, 2006 “New Robot Can Sense Damage and Compensate” *USA Today*
 Nov, 2006 “Resilient Robot Hobbles Along, Even if Injured” *Scientific American*

Aug, 2002 “ ‘Animals’ grown from an artificial embryo” *New Scientist*

SCHOLARSHIPS AND PRIZES

2022 ISAL Award for [Outstanding Publication of 2021](#).

2021 The National Academy of Sciences’ **Cozzarelli Prize**. ([Announcement video](#).)
 ISAL Award for [Outstanding Publication of 2020](#)

2020 [Top 10 Biotech Project of the year](#).
[Xenobots](#) nominated for The Design Museum’s [Beazley Design of the Year](#)
 PNAS paper reporting xenobots in Altmetric’s [Top 100](#).

2016 International Society of Artificial Life Education & Outreach Award
 International Society of Artificial Life Best Paper of the Decade Award

2015 Awarded the Cyril G. Veinott Green and Gold Professorship of Computer Science

2014 National STEM Innovation Award (awarded by the [Concept Schools](#))

2013 Scientist of the Year, IEEE Green Mountain Section

2010 Presidential Early Career Award for Scientists and Engineers (**PECASE**). [[Photo with Obama](#)]
 NSF CAREER award.

2008 UVM College of Engineering and Mathematical Sciences
 Milt Silveira Junior Faculty Award

2007 One of *MIT Technology Review*’s TR35: [Top 35 Young Innovators Under 35](#)
 Microsoft New Faculty Fellowship

2002 Best Paper Award, Seventh Intl Conf on the Simulation of Adaptive Behavior

1999 Sante Fe Institute Complex Systems Summer School alumnus

1993–1997 McMaster University Dean’s Honour List