

Curriculum Vitae

Jacob Beal
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Education:

MIT	PhD (EECS)	2007
MIT	M.Eng. (EECS)	2002
MIT	S.B. (Mathematics)	2000
MIT	S.B. (EECS)	2000

Appointments:

Scientist, BBN Technologies	2008 -
Chief Scientist, Zome Energy Networks	2011 -
Research Affiliate, MIT CSAIL	2008 -
Fellow, Science Commons	2008 -
Postdoctoral Associate in MIT Project MAC	2007 - 2008
Teaching Assistant for MIT course 6.034, "Artificial Intelligence"	Four terms, 2000-2003
Research Assistant in MIT Project MAC	Ten terms, seven summers, 2001-2007

Grants and Contracts:

- **DARPA DSO**, *Multi-input, multimodal, mammalian information processing circuits*, Ron Weiss (PI), Chris Voigt (co-PI), Ryan Gill (co-PI), Jacob Beal (co-PI), Douglas Densmore (co-PI), Aug. 2011 – Jul. 2015 (funded through Jul. 2012), BBN portion \$292,734.
- **Zome Energy Networks**, Jacob Beal (PI), strategic technology consulting, April, 2011 – ongoing (funded through Dec, 2011). Funding not disclosable.
- **DARPA DSO** *Morphogenetically Assisted Design Variation (MADV)*, Jacob Beal (PI), Aaron Adler (co-PI), Fusun Yaman, Annan Mozeika, Susan Katz, Jan, 2011–Jan, 2015 (funded through Jan, 2012), \$4,748,662.
- **DARPA I2O** *A Tool-Chain to Accelerate Synthetic Biological Engineering (TASBE)*, Jacob Beal (PI), Aaron Adler, Fusun Yaman, Richard Schantz, Joseph Loyall, Ron Weiss (co-PI), Douglas Densmore (co-PI), Sept. 2010–Nov. 2011, \$995,344.
- **DARPA TTO**, **subcontracted through BAE Systems** *META ARRoW Program*, Joseph Loyall, Jacob Beal, Kurt Rohloff, July 2010–Oct. 2011. Funding not disclosable.
- **MIT Energy Initiative Seed Fund** *PACEM: Cooperative Control for Citywide Energy Management*, Jacob Beal, Hal Abelson (PI), 2008–2010, \$90,000.
- **NSF Biology and Information Technology Grant** *Biologically-Inspired Robust Space/Time Programming of Sensor/Actuator Ensembles*, Jacob Beal, Jonathan Bachrach, Thomas Knight Jr. (PI), Gerald Jay Sussman (co-PI), Sept. 2006–2009, \$600,000.
- **NSF Robust Intelligence Grant** *Robustness from Non-Stop Collaboration*, Jacob Beal, Keith Bonawitz, Patrick Winston (PI), Gerald Jay Sussman (co-PI), Nov. 2005–2008, \$500,000.

Patents:

- Jacob Beal and Jonathan Bachrach, U.S. Patent Application No. 12/394,011, *Methods and Apparatus for Energy Demand Management*, pending, filed February, 2009.

Supervised Theses:

Vinayak Ranade M.Eng. MIT June 2010 Incentives and Control for PACEM
Dany M. Qumsiyeh M.Eng. MIT June 2008 A Distributed Building Evacuation System

Other Teaching/Mentoring Experience:

- Taught a one-week course consisting of five two-hour lectures, *Spatial Computing: From global to local and back again*, at the Third French Complex Systems Summer School in August 2009, to an international group of approximately 30 students with backgrounds varying from undergraduate to experienced researchers in a variety of fields.
- Teaching assistant for MIT course 6.034, “Artificial Intelligence,” four terms, 2000 to 2003. Responsibilities included teaching weekly tutorials to 40-75 students organized into 5-15 student sessions, and design of problem sets and examinations.
- Created and taught the Intensive program within MIT course 6.034, “Artificial Intelligence,” beginning in 2001. Students in the Intensive program work on projects addressing real problems in AI research and applications.
- As a graduate student and postdoc at MIT, I supervised approximately 17 undergraduates through MIT’s Undergraduate Research Opportunities Program (UROP). Of the students who worked for me, at least 5 have already gone on to pursue graduate degrees.
- Conference tutorials are listed below.

Professional Service

Journals

- Associate Editor, ACM Transactions on Autonomous and Adaptive Systems, 2011 - present.
- Guest Editor, *Special Issue on Spatial Computing*, The Computer Journal, scheduled for publication in mid-2012.
- Guest Editor, *Special Issue on Spatial Computing*, ACM Transactions on Autonomous and Adaptive Systems, two issues: June & September 2011.
- Guest Editor, *Special Issue on Human-Level Intelligence*, IEEE Intelligent Systems, July 2009.
- Recent reviewing includes the journals “ACS Synthetic Biology”, “Artificial Life”, “Autonomous Agents and Multi-Agent Systems”, “Autonomous Robotics”, “Communications of the ACM”, “Computing”, “IEEE Transactions on Systems, Man, and Cybernetics”, “International Journal of Distributed Sensor Networks”, “Science of Computer Programming”, “Social Robotics”, “Swarm Intelligence”, “The Computer Journal”, and the Cognitive Science Conference and the International Symposium on Stability, Safety, and Security of Distributed Systems, as well as grant reviewing for the US National Science Foundation and the Israel Science Foundation.

Conferences, Seminar Series and Workshops

- Organizer, Engineered Self-Organization Seminar Series, 2008 - present at BBN Technologies.
- Organizer, *Spatial Computing Workshop 2012*, attached to International Conference on Autonomous Agents and Multi-agent Systems (AAMAS 2012). June 2012. Also organized SCW in 2011, 2010, 2009 and 2008, when it was attached to IEEE SASO.
- Organizer, Workshop on *Complex Sciences in the Engineering of Computing Systems* at 25th International Conference on Architecture of Computing Systems, February, 2012.
- Program Co-Chair, 5th International Conference on Self-Adaptive and Self-Organizing Systems (SASO 2011), October 2011.
- Organizer, 2nd Workshop on *Agents Learning Interactively from Human Teachers (ALIHT)* at International Joint Conference on Artificial Intelligence (IJCAI-11), July 2011.
- Publications Chair, 3rd International Workshop on Bio-Design Automation (IWBDA 2011), June 2011.
- Workshop Chair, IEEE International Conference on Self-Adaptive and Self-Organizing Systems (SASO 2010), September 2010.
- Track Chair, *Swarm, Amorphous, Spatial, and Complex Systems Track* of 12th International Symposium on Stabilization, Safety, and Security of Distributed Systems (SSS 2010), September 2010.
- Organizer, Workshop on *Agents Learning Interactively from Human Teachers (ALIHT)* at 9th International Conference on Autonomous Agents and Multi-agent Systems (AAMAS 2010), May 2010.
- Poster Co-chair, IEEE International Conference on Self-Adaptive and Self-Organizing Systems (SASO 2009), September 2009.
- Organizer, *Naturally-Inspired Artificial Intelligence* symposium, in AAAI 2008 Fall Symposium Series, November 2008.
- Organizer, *Genesis Workshop*, internal MIT workshop, September 2003.
- Program committee of:
 - 7th International ICST Conference on Bio-Inspired Models of Network, Information, and Computing Systems (Bionetics 2012), December, 2012 (previously on 2011, 2010 PCs).
 - IEEE International Conference on Self-Adaptive and Self-Organizing Systems (SASO 2012), October 2012 (previously on 2011 and 2010 PC).
 - International Conference on Swarm Intelligence (ANTS 2012), September 2012 (previously on 2010 PC).
 - IEEE Workshop on Bio-Inspired and Self-* Algorithms for Distributed Systems (BADs 2012), June 2012 (previously on 2011 PC)
 - European Conference on Artificial Life (ECAL 2011), August 2011.
 - Self-organizing Complex Systems track for ACM Symposium on Applied Computing, March 2011 (previously on 2010 PC).
 - 10th International Symposium on Distributed Autonomous Robotic Systems (DARS 2010), November 2010.
 - 2nd International Workshop on Bio-Design Automation, June, 2010.
 - Symposium on AI-Inspired Biology, March 2010.
 - Self-Organized Systems track for 11th International Symposium on Stabilization, Safety, and Security of Distributed Systems (SSS 2009), November 2009.

Other Organization

- Founding organizer of the Dangerous Ideas Seminar, a regular series at MIT CSAIL designed to spur cross-pollination of ideas within the lab and to foster creativity by challenging students, faculty, and research staff with each others' ideas. The Dangerous Ideas Seminar ran from 2001 through 2005.

Publications

Journal articles

1. Jacob Beal, Ting Lu, Ron Weiss, *Automatic Compilation from High-Level Biologically-Oriented Programming Language to Genetic Regulatory Networks*, PLoS ONE 6(8): e22490. doi:10.1371/journal.pone.0022490, August 2011.
2. Jacob Beal, *Functional Blueprints: An Approach to Modularity in Grown Systems*, Swarm Intelligence Journal, Volume 5, Issue 3-4, pages 257–281, June 2011.
3. Jonathan Bachrach, Jacob Beal, and James McLurkin, *Composable Continuous Space Programs for Robotic Swarms*, Neural Computing and Applications, Special Issue on Swarms, Volume 19, Issue 6 (2010), pages 825–847.
4. Sagar Indurkha and Jacob Beal, *Reaction Factoring and Bipartite Update Graphs Accelerate the Gillespie Algorithm for Large-Scale Biochemical Systems*, in PLoS ONE 5(1): e8125. doi:10.1371/journal.pone.0008125, January 2010
5. Jacob Beal and Jonathan Bachrach, *Infrastructure for Engineered Emergence on Sensor/Actuator Networks*, IEEE Intelligent Systems, (Vol. 21, No. 2) pp. 10-19, March/April 2006.

Book Chapters & Theses

1. Organizing the Aggregate: Languages for Spatial Computing, Jacob Beal, Stefan Dulman, Kyle Usbeck, Mirko Viroli, Nikolaus Correll, chapter in “Formal and Practical Aspects of Domain-Specific Languages: Recent Developments”, edited by Marjan Mernik, *to appear September 2012*.
2. Jacob Beal, *Functional Blueprints: An Approach to Modularity in Grown Systems*, chapter in “Morphogenetic Engineering: Toward Programmable Complex Systems,” edited by Rene Doursat, Hiroki Sayama, and Olivier Michel, Springer, *to appear September 2012*.
3. Jacob Beal, Andrew Phillips, Douglas Densmore, Yizhi Cai, *High-Level Programming Languages for Bio-Molecular Systems*, chapter in “Design and Analysis of Bio-Molecular Circuits,” edited by Heinz Koepl, Douglas Densmore, Mario di Bernardo, Gianluca Setti, Springer, May 2011
4. Hal Abelson, Jacob Beal, and Gerald Jay Sussman, *Amorphous Computing*, article in “Encyclopedia of Complexity and System Science,” Springer-Verlag, March 2009.
5. Jacob Beal, *Learning by Learning to Communicate*, PhD Thesis, August 2007.
6. Jacob Beal, *Programming an Amorphous Computational Medium*, in Unconventional Programming Paradigms, Lecture Notes in Computer Science Vol. 3566, August 2005.
7. Jacob Beal, *Generating Communications Systems Through Shared Context*, Master's Thesis, January 2002.

Conference articles:

1. Mirko Viroli, Jacob Beal, and Matteo Casadei, *Core Operational Semantics of Proto*, ACM Symposium on Applied Computing 2011, March 2011.

2. Jacob Beal and Richard Schantz, *A Spatial Computing Approach to Distributed Algorithms*, 45th Asilomar Conference on Signals, Systems, and Computers, November 2010.
3. Vinayak V. Ranade, and Jacob Beal, *Distributed Control for Small Customer Energy Demand Management*, IEEE SASO 2010, September 2010.
4. Jacob Beal, *Functional Blueprints: an Approach to Modularity in Grown Systems*, 7th International Conference on Swarm Intelligence (ANTS 2010), September 2010.
5. Nelson Elhage and Jacob Beal *Laplacian-Based Consensus on Spatial Computers*, 9th International Conference on Autonomous Agents and Multiagent Systems (AAMAS 2010), May 2010.
6. Jacob Beal and Jennifer Roberts, *Enhancing Methodological Rigor for Computational Cognitive Science: Complexity Analysis*, Cognitive Science Conference, July 2009.
7. Jennifer Roberts and Jacob Beal, *Enhancing Methodological Rigor for Computational Cognitive Science: Core Tenets and Ad Hoc Residuals*, Cognitive Science Conference, July 2009.
8. Jacob Beal, *Self-Managing Associative Memory for Dynamic Acquisition of Expertise in High-Level Domains*, International Joint Conference on Artificial Intelligence (IJCAI) 2009, July 2009.
9. Jacob Beal, Jonathan Bachrach, Dan Vickery, and Mark Tobenkin, *Fast Self-Stabilization for Gradients*, 2009 IEEE International Conference on Distributed Computing in Sensor Systems (DCOSS), June 2009.
10. Jacob Beal, Nikolaus Correll, Leonardo Urbina, and Jonathan Bachrach, *Behavior Modes for Randomized Robotic Coverage*, Second International Conference on Robot Communication and Coordination, April 2009.
11. Jacob Beal, *Flexible Self-Healing Gradients*, ACM Symposium on Applied Computing 2009, March 2009.
12. Jonathan Bachrach, Jacob Beal, Joshua Horowitz, and Dany Qumsiyeh, *Empirical Characterization of Discretization Error in Gradient-based Algorithms*, IEEE SASO 2008, October 2008.
13. Jacob Beal and Thomas F. Knight, Jr, *Analyzing Composability in a Sparse Encoding Model of Memorization and Association*, IEEE 7th International Conference on Development and Learning (ICDL 2008), August 2008.
14. Jacob Beal, *Learning Composable Signals for a Cognitive Substrate*, Cognitive Science Conference, July 2008.
15. Jacob Beal, *Shared Focus of Attention for Heterogeneous Agents*, Short Paper, 7th International Conference on Autonomous Agents and Multiagent Systems (AAMAS 2008), May 2008.
16. Jacob Beal, Jonathan Bachrach, Dan Vickery, and Mark Tobenkin, *Fast Self-Healing Gradients*, ACM Symposium on Applied Computing 2008, March 2008. *Received Best Paper Award (Artificial Intelligence & Agents Theme)*.
17. Jonathan Bachrach, Jacob Beal, and Takeshi Fujiwara, *Continuous Space-Time Semantics Allow Adaptive Program Execution*, IEEE SASO 2007, July 2007.
18. Jonathan Bachrach and Jacob Beal, *Programming a Sensor Network as an Amorphous Medium*, extended abstract for poster at IEEE DCOSS 2006, June 2006.
19. Jacob Beal, *What the Assassins' Guild Taught Me About Distributed Computing*, International Conference on Complex Systems (ICCS) 2006, June 2006.

20. Jacob Beal and Sara Bennett, *Predictive Modelling for Fisheries Management in the Colombian Amazon*, International Conference on Complex Systems (ICCS) 2004, June 2004.
21. Jacob Beal, *An Algorithm for Bootstrapping Communications*, International Conference on Complex Systems (ICCS), June 2002.

Conference abstracts

1. Jacob Beal and Aaron Adler, *Automated Design of Synthetic Biology Feedback Circuits*, 2012 Institute of Biological Engineering Conference, March 2012.
2. Aaron Adler, Fusun Yaman, Jeffrey Cleveland, and Jacob Beal, *Morphogenetically Assisted Design Variation*, 2nd International Conference on Morphological Computation, September 2011.
3. Jacob Beal, *Bridging Biology and Engineering Together with Spatial Computing*, International Conference on Membrane Computing, August, 2011.
4. Jacob Beal, Annan Mozeika, Jessica Lowell, and Kyle Usbeck, *Morphogenesis as a Reference Architecture for Engineered Systems*, 3rd Morphogenetic Engineering Workshop (MEW) at ECAL 2011.
5. Jacob Beal, Ron Weiss, Douglas Densmore, Aaron Adler, Jonathan Babb, Swapnil Bhatia, Noah Davidsohn, Traci Haddock, Fusun Yaman, Richard Schantz, and Joseph Loyall, *TASBE: A Tool-Chain to Accelerate Synthetic Biological Engineering*, 3rd International Workshop on Bio-Design Automation, June 2011; also at Synthetic Biology 5.0, June 2011.
6. Viktor Vasilev, Chenkai Liu, Traci Haddock, Swapnil Bhatia, Aaron Adler, Fusun Yaman, Jacob Beal, Jonathan Babb, Ron Weiss, and Douglas Densmore, *A Software Stack for Specification and Robotic Execution of Protocols for Synthetic Biological Engineering*, 3rd International Workshop on Bio-Design Automation, June 2011.
7. Fusun Yaman, Swapnil Bhatia, Aaron Adler, Douglas Densmore, Jacob Beal, Ron Weiss, and Noah Davidsohn, *Toward Automated Selection of Parts for Genetic Regulatory Networks*, 3rd International Workshop on Bio-Design Automation, June 2011; also at Synthetic Biology 5.0, June 2011; also at Institute of Biological Engineering annual conference, March 2011.
8. Jacob Beal, Ting Lu, and Ron Weiss, *Automatic Compilation from High-Level Languages to Genetic Regulatory Networks*, 2nd International Workshop on Bio-Design Automation (IWBDA), June 2010; also at Institute of Biological Engineering annual conference, March 2010.
9. Jacob Beal, *Functional blueprints: a means of adaptive integration?*, First International Workshop on Morphogenetic Engineering, June 2009.
10. Jacob Beal and Seth Gilbert, *Analyzing Failures as Noise*, LIDS Student Conference, MIT, January 2004.

Workshops, Symposia, and Seminars

1. Kyle Usbeck and Jacob Beal, *An Agent Framework for Agent Societies*, Actors and Agents Reloaded (AGERE) at SPLASH 2011, October 2011.
2. Jacob Beal and Kyle Usbeck, *On the Evaluation of Space-Time Functions*, 4th Spatial Computing Workshop (SCW) at IEEE SASO 2011, October 2011.
3. Jacob Beal, Jessica Lowell, Annan Mozeika, and Kyle Usbeck, *Using Morphogenetic Models to Develop Spatial Structures*, 4th Spatial Computing Workshop (SCW) at IEEE SASO 2011, October 2011.
4. Jacob Beal, Jonathan Webb, and Michael Atighetchi, *Adjustable Autonomy for Cross-Domain Entitlement Decisions*, 3rd ACM workshop on Artificial Intelligence and Security (AISec), October 2010.

5. Jacob Beal, *A Basis Set of Operators for Space-Time Computations*, 3rd Spatial Computing Workshop, September 2010.
6. Jacob Beal, Alice Leung, and Robert Laddaga, *Spectrum Curricula: Design and Initial Results*, Learning By Demonstration section of 2010 AAI Robotics Exhibition, July 2010.
7. Jacob Beal, Alice Leung, and Robert Laddaga, *Spectrum Curricula for Measuring Teachability*, Workshop on *Agents Learning Interactively from Human Teachers (ALIHT)* at 9th International Conference on Autonomous Agents and Multi-agent Systems (AAMAS 2010), May 2010.
8. Mark Burstein, Robert P. Goldman, Drew V. McDermott, David McDonald, Jacob Beal, and John Maraist, *LTML - A Language for Representing Semantic Web Service Workflow Procedures*, workshop on “Semantics for the Rest of Us – Variants of Semantic Web Languages in the Real World”, at 8th International Semantic Web Conference, October 2009
9. Jacob Beal, *Dynamically Defined Processes for Spatial Computers*, Spatial Computing Workshop 2009, September 2009.
10. Richard Schantz, Jacob Beal, Joe Loyall, Partha Pal, Kurt Rohloff, and A. Bestavros, *Research Challenges in Information Systems for the Next Generation Electric Grid*, Proceedings of the National Workshop on New Research Directions for Future Cyber-Physical Energy Systems, June 2009.
11. Jacob Beal, Paul Robertson, and Robert Laddaga, *Curricula and Metrics to Investigate Human-Like Learning*, AAI 2009 Spring Symposium “Agents that Learn from Human Teachers”, March, 2009.
12. Jacob Beal and Gerald Jay Sussman, *Engineered Robustness by Controlled Hallucination*, AAI 2008 Fall Symposium “Naturally-Inspired Artificial Intelligence”, November 2008.
13. Jacob Beal and Jonathan Bachrach, *Cells Are Plausible Targets for High-Level Spatial Languages*, Spatial Computing Workshop, October 2008.
14. Rachel Greenstadt and Jacob Beal, *Cognitive Security for Personal Devices*, First ACM workshop on Artificial Intelligence and Security (AISec), October 2008.
15. Jonathan Bachrach and Jacob Beal, *Autonomy in Spatial Computing*, Third Workshop on Hot Topics in Autonomic Computing, June 2008.
16. Jacob Beal, *Developmental Cost for Models of Intelligence*, AAI 2007 Workshop on Evaluating Architectures for Intelligence, July 2007.
17. Jacob Beal and Jonathan Bachrach, *Programming Manifolds*, Dagstuhl Seminar 06361: Computing Media and Languages for Space-Oriented Computation, Andre DeHon, Jean-Louis Giavitto, and Fred-eric Gruau eds, December 2006.
18. Jacob Beal, *Sidestepping Impossibility: Combat Consensus in the Assassins’ Guild*, MIT CSAIL Student Workshop 2006, September 2006.
19. Jacob Beal and Gerald Jay Sussman, *CogSci to AI: It’s the Brainware, Stupid!*, AAI 2006 Spring Symposium “Between a Rock and a Hard Place: Cognitive Science Principles Meet AI-Hard Problems”, Stanford, March 2006.
20. Jacob Beal, *Amorphous Medium Language*, Large-Scale Multi-Agent Systems Workshop at AAMAS, July 2005.
21. Jacob Beal and Seth Gilbert, *RamboNodes for the Metropolitan Ad Hoc Network*, Workshop on Dependability in Wireless Ad Hoc Networks and Sensor Networks, part of the International Conference on Dependable Systems and Networks, June 2004.

22. Jacob Beal, Carl Blaurock, Keith Bonawitz, Kyrilian Dyer, Paul Elliott, Paul Eremenko, Eric Feron, Emilio Frazzoli, Benjamin Ingram, Michael Lester, Manway Liu, Stefan Marti, Joshua Napoli, Kailas Narendran, and Scott Rasmussen, *The Development of a Small Autonomous Helicopter Robot for Search and Rescue in Hostile Environments*, Proceedings of the AUVSI Annual Symposium, July 1999.

Published Whitepapers and Technical Reports:

1. Anil Wipat, Alan Villalobos, Guy-Bart Stan, Trevor Smith, Herbert Sauro, Nicholas Roehner, Matthew Pockock, Hector Plahar, Jean Peccoud, Chris Myers, Goksel Misirli, Curtis Madsen, Matthex Lux, Allan Kuchinsky, Timothy Ham, Raik Grunberg, John Gennari, Drew Endy, Omri Drory, Douglas Densmore, Deepak Chandran, Jacob Beal, J. Christopher Anderson, Aaron Adler, Laura Adam, Cesar Rodriguez, Mandy Wilson, and Michal Galdzicki, *Synthetic Biology Open Language (SBOL) Version 1.0.0*, BioBricks Foundation Request for Comments (BBF RFC) #84, October 2011, <http://dspace.mit.edu/handle/1721.1/66172>
2. Jacob Beal and Hal Abelson, *PACEM: Cooperative Control for Citywide Energy Management*, whitepaper, August 2008.
3. Jacob Beal, Jonathan Bachrach, and Mark Tobenkin, *Constraint and Restoring Force*, MIT CSAIL Tech Report 2007-044, August 2007.
4. Jonathan Bachrach and Jacob Beal, *Building Spatial Computers*, MIT CSAIL Tech Report 2007-017, March 2007.
5. Jacob Beal, *What the Assassins' Guild Taught Me About Distributed Computing*, MIT CSAIL Technical Report MIT-CSAIL-TR-2006-038, June 2006.
6. Jacob Beal, *Learning From Snapshot Examples*, MIT AI Memo 2005-012, April 2005.
7. Jacob Beal, Tim Shepard, *Shrinking the Leap of Faith*, publicly available report, March 2005.
8. Jacob Beal and Gerald Jay Sussman, *Biologically-Inspired Robust Spatial Programming*, MIT AI Memo 2005-001, January 2005.
9. Jacob Beal and Tim Shepard, *Deamplification of DoS Attacks via Puzzles*, publicly available report, October 2004.
10. Jacob Beal, *Near-Optimal Distributed Failure Circumscription*, AI Memo 2003-017, August 2003.
11. Jacob Beal, *A Robust Amorphous Hierarchy from Persistent Nodes*, AI Memo 2003-012, May 2003.
12. Jacob Beal, *Persistent Nodes for Reliable Memory in Geographically Local Networks*, AI Memo 2003-011, April 2003.
13. Jacob Beal, *Leaderless Distributed Hierarchy Formation*, AI Memo 2002-021, December 2002.
14. Ryan Newton and Jacob Beal, *Amorphous Infrastructure for Language Implementation*, MIT CSAIL Tech Report 2006-015, December 2002.

Tutorials:

1. *Spatial Computing Approaches for Pervasive Systems*, 2010 Pervasive Adaptation (PerAda) Summer School, September 2010.
2. *Spatial Computing for Networked Collaboration*, International Symposium on Collaborative Technologies and Systems (CTS 2010), May 2010.

3. *Spatial Computing for Swarms*, 2009 IEEE International Conference on Self-Adaptive and Self-Organizing Systems (SASO), September 2009.
4. *Spatial Computing: From global to local and back again*, five-lecture series at Third French Complex Systems Summer School, August, 2009.
5. *Introduction to Spatial Computing*, Second International Conference on Robot Communication and Coordination (RoboComm), April 2009.
6. *Spatial Approaches to Pervasive Computing*, with Marco Mamei and Christian Borcea, 2008 IEEE International Conference on Self-Adaptive and Self-Organizing Systems (SASO), October 2008.

Plenary Talks:

1. *Bringing Biology and Engineering Together with Spatial Computing*, 12th International Conference on Membrane Computing, August 2011.
2. *Spatial Computing: From Manifold Geometry to Biology*, AMORPH Conference (Amorphous Computing and Complex Biological Networks), Sheffield, U.K., August 2010.

Other Invited Presentations:

1. *Spatial Computing: From Manifold Geometry to Networking and Biology*, University of Iowa, February 2012.
2. *Toward Breaking the Complexity Barrier for Synthetic Biology Therapeutics*, IEEE Engineering in Medicine and Biology, August 2011.
3. *Spatial Computing: From Manifold Geometry to Distributed Systems*, TU Delft, Netherlands, August 2011.
4. *High-Level Languages for Synthetic Biology*, MIT Synthetic Biology Lunch seminar series, November 2010.
5. *Automatic Compilation from High-Level Bio-Languages to Genetic Regulatory Networks*, Church Lab & Harvard Molecular Technology Group, November 2010.
6. *Spatial Computing, Synthetic Biology, and Emerging IP Challenges*, Creative Commons, November 2010.
7. *PACEM: The Colored Power Approach to Energy Demand Management*, MIT Energy Initiative Fall 2010 Conference, October 2010.
8. *Spatial Computing: From Manifold Geometry to Biology*, Computer Science Colloquium, Univ. Colorado Boulder at Boulder, October 2010.
9. *Spatial Computing and Proto*, Lecture for Harvard course CS 266 “Bio-inspired Distributed and Multi-Agent Systems,” Harvard, April 2010.
10. *Composable Continuous-Space Programs for Robotic Swarms*, Seminar lecture at Harvard, March 2010.
11. *Composable Continuous-Space Programs for Robotic Swarms*, iRobot, July 2009.
12. *PACEM: Cooperative Control for Citywide Energy Management*, Massachusetts Technology Transfer Offices Day, June 2009.
13. *Spatial Computing*, presented on “Grand Challenges” panel at IEEE SASO 2008, October 2008.

14. *BioBricks & High-Level Programming*, MIT Synthetic Biology Lunch seminar series, April 2008.
15. *Spatial Computing and the Challenge of Engineered Emergence*, Harvard CRCS Privacy and Security Lunch Seminar, April 2008.
16. *Programming Cell Aggregates*, MIT Synthetic Biology Lunch seminar series, January 2008.
17. *Learning by Learning to Communicate*, Dartmouth College, October 2007.
18. *Principles for Engineered Emergence*, Unconventional Computation: Quo Vadis?, March 2007.
19. *Programming Manifolds*, Dagstuhl Seminar 06361, "Computing Media and Languages for Space-Oriented Computation," September 2006.
20. *Integration by Coincidence: Status and Speculation*, MIT Biologically Inspired Cognitive Architectures (BICA) workshop, January 2006.
21. *Programming an Amorphous Medium*, Unconventional Programming Paradigms workshop, September 2004.

Graduate Advisors:

Gerald J. Sussman	MIT
Patrick H. Winston	MIT
Tom Knight	MIT
Joel Moses	MIT

Awards and Honors:

2008 Best Paper Award (Artificial Intelligence & Agents Theme), ACM SAC 2008
 2000 Tau Beta Pi, Engineering Honor Society

Other Relevant Experience:

1. Grandmaster of the MIT Assassin's Guild, 2001-2002, a live-action role-playing student group. Ran more than 20 games (starting in 1998) under the auspices of the Guild, with games ranging up to 10 days in length and over 60 participants playing.