

Curriculum Vitae

Jacob Beal

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1 Education and Appointments

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 - present |
| Research Affiliate, MIT CSAIL / Biological Engineering | 2008 - present |
| Research Affiliate, University of Iowa, Electrical & Computer Engineering | 2013 - present |
| Fellow, Science Commons | 2008 - 2011 |
| 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 |

2 Grants and Contracts

1. **DARPA BTO**, *FACETS: Fabrication of Autonomously Constructed Engineered Three-dimensional Shapes*, Ron Weiss (PI), Jacob Beal, Jonathan Babb, Ed Boydon, Stas Shvartsman, selected for funding; anticipated May, 2017 to April 2019, Funding not yet disclosable.
2. **DARPA I2O**, *Mission-oriented Adaptive Placement of Task and Data (MAP)*, Aaron Paulos (PI), Partha Pal, Jacob Beal, Soura Dasgupta, Ramesh Sitaraman, Bryan Lyles, Will Yeoh, selected for funding; anticipated April, 2017 to March, 2021, Funding not yet disclosable.
3. **NSF EAGER**, *Engineering genetic classifiers to increase the homogeneity of CAR T cells with central memory phenotype*, Wilson Wong (PI), Jacob Beal January 2017 to December 2018, \$59,955.
4. **Semiconductor Research Corporation**, *Preparation of Roadmap Report on Biological System Design*, Jacob Beal (PI), January 2017 – June 2017, \$15,005.
5. **DARPA DSO**, *Kaleidoscope: Turning System Design Inside-Out*, Alice Leung (PI), Prithwish Basu, Jacob Beal, William Ferguson, Elizabeth Munch, August 2016 – February 2017, Funding not disclosable.
6. **NSF Expeditions, subcontracted through Boston University and MIT**, *Living Computing Project*, Doug Densmore (PI), Ron Weiss, Jacob Beal, Peter Carr, Domitilla Del Vecchio, Tim Lu, Mo Khalil, Wilson Wong, January 2016 – December 2020, BBN portion \$500,000.
7. **DARPA I2O**, *Aggregate Computing and Resiliency in Distributed Systems*, Jacob Beal (PI), July 2014 – September 2015, \$499,981.
8. **Autodesk**, *Cyborgization of BioCompiler*, Jacob Beal (PI), Jul. 2014 – March 2015. Funding not disclosable.
9. **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 – July 2016, BBN portion \$347,996.
10. **Zome Energy Networks**, Jacob Beal (PI), strategic technology consulting, April, 2011 – Dec, 2012. Funding not disclosable.
11. **DARPA DSO** *Morphogenetically Assisted Design Variation (MADV)*, Jacob Beal (PI), Aaron Adler (co-PI), Fusun Yaman, Annan Mozeika, Susan Katz, Jan., 2011–Feb., 2014, \$1,193,716
12. **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.
13. **DARPA TTO, subcontracted through BAE Systems** *META ARRoW Program*, Joseph Loyall, Jacob Beal, Kurt Rohloff, July 2010–Oct. 2011. Funding not disclosable.
14. **MIT Energy Initiative Seed Fund** *PACEM: Cooperative Control for Citywide Energy Management*, Jacob Beal, Hal Abelson (PI), 2008–2010, \$90,000.
15. **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.
16. **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.

3 Patents

1. **Method for Identification of Nucleic Acid Signatures**, Jacob Beal, Daniel Wyschogrod, Steven Jilcott, filed December, 2016, Pending as U.S. Patent Application No. US 15/371730.
2. **Generation of Layered Transcriptional Circuitry Using the CRISPR Systems**, Samira Kiani, Ron Weiss, Jacob Beal, Mohammad Ebrahimkhani, Zhen Xie, Yinqing Li, filed May, 2015, Pending as US provisional case 62/156555
3. **Methods of Evaluating Genetic Elements**, Aaron Adler, Fusun Yaman-Sirin, Jacob Beal, filed November 2012. Pending as U.S. Patent Application No. US 13/689415. Also pending as WO2013082300.
4. **Triangulated Rules Engine**, Bradley Kayton, Jon Rappaport, Jacob Beal, filed July 2012. Pending as U.S. Patent Application No. US 13/549245.
5. **Probabilistic Measurement and Verification**, Bradley Kayton, Jon Rappaport, Jacob Beal, filed July 2012. Pending as U.S. Patent Application No. US 13/548802.
6. **Virtual Mass Emulator**, Bradley Kayton, Jon Rappaport, Jacob Beal, Vinayak Ranade, Bradley LaRonde, filed June 2012. Granted as US 9111055 (August, 2015).
7. **Robotic Fabricator**, Annan Michael Mozeika, Aaron Adler, Fusun Yaman-Sirin, Jacob Beal, filed June, 2012 as U.S. Patent Application No. 13/530664, EP2537642.
8. **Smart Garment And Method For Detection Of Body Kinematics And Physical State**, Michael Nicoletti, Scott Ritter, Jacob Beal, Matthew Daily, Jason Holmes, Christopher Park, filed August 2013. Granted as US 9285788 (March 2016).
9. **Methods Of Evaluating Gene Expression Levels**, Aaron Adler, Jacob Beal, Fusun Yaman-Sirin, Ron Weiss, Noah Davidsohn, filed January, 2012. Granted as US 8809057 (August 2014).
10. **Methods and Apparatus for Energy Demand Management**, Jacob Beal and Jonathan Bachrach, filed February, 2009. Granted as US 8271147 (September, 2012) and US 8583291 (November, 2013). *Still pending as CA2753678, EP2401797, WO2010098824.*

4 Teaching

4.1 Supervised Theses

| | | | | |
|---------------------|--------|------------|--------------|---|
| Matteo Francia | M.S. | U. Bologna | March 2017 | A Foundational Library for Aggregate Programming |
| Swati Banerjee Carr | Ph.D. | BU | July 2016 | Reliable Gene Expression And Assembly For Synthetic Biological Devices In E. Coli Through Customized Promoter Insulator Elements And Automated DNA Assembly |
| Noah Davidsohn | Ph.D. | MIT | January 2013 | Predictive Composition of Genetic Circuits in Mammalian Cells From Characterized Parts (co-advised with Ron Weiss) |
| 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 |

4.2 Other Teaching/Mentoring Experience

- Taught a unit of high-level programming languages for biological design in the MIT course “Biological Circuit Engineering Laboratory,” Spring 2016 (approximately 10 enrolled students). Also taught in Spring 2015, Spring 2014.
- Co-taught University of Iowa ECE course on Wireless Sensor Networks, Fall 2016 (approximately 15 enrolled students). Also co-taught this class in Fall 2015, Fall 2014, Fall 2013.
- Taught a full-day hands on class “Spatial Computing: From Manifold Geometric to Networking and Biology,” at the University of Geneva, (approximately 15 students), May, 2014
- 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, in Section 7.2.

5 Professional Service

5.1 Panels / Commissions / Standards Organizations

- Steering Committee for Synthetic Biology Open Language (January, 2016 - Present)
- Roadmap Executive Committee, SRC SemiSynBio Roadmap Project (June, 2015 - Present)
- Steering Committee of IEEE International Conference on Self-Adaptive and Self-Organizing Systems, 2013 - present.
- Chair of Flow Cytometry Working Group, NIST Synthetic Biology Standards Consortium (March, 2015 - March, 2017)
- Editor, Synthetic Biology Open Language (February, 2015 - January, 2017)

5.2 Journal Editing

- Associate Editor, IET Engineering Biology, 2016 - present
- Associate Editor, ACM Transactions on Autonomous and Adaptive Systems, 2011 - present.
- Guest Editor, *IWBDA 2015 Special Issue*, ACS Synthetic Biology, June 2016.
- Guest Editor, *Special Issue on Spatial Computing*, The Computer Journal, December 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.

5.3 Seminar Series

- Organizer, Engineered Self-Organization Seminar Series, 2008 - present at BBN Technologies.
- 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.

5.4 Organization of Conference, Workshop, and Symposia

- **2017:**
 - Industry & Sponsorship Chair, 11th International Conference on Self-Adaptive and Self-Organizing Systems (SASO 2017)
- **2016:**
 - Program Co-Chair, 8th International Workshop on Bio-Design Automation (IWBDA 2016)
 - Organizer, Workshop on Engineering Collective Adaptive Systems (eCAS 2016)
- **2015:**
 - Measurement Track Chair, International Genetically Engineered Machine Competition (iGEM 2015)
 - Program Chair, 7th International Workshop on Bio-Design Automation (IWBDA 2015)
 - Organizer, Workshop on Spatial and Collective Pervasive Computing Systems (SCOPEs)
 - Organizer, Workshop on BioCAD Tools: Design and Mapping to Biological Circuits at Keystone Symposium on Precision Genome Engineering and Synthetic Biology
- **2014:**
 - Publications Chair, 8th International Conference on Self-Adaptive and Self-Organizing Systems (SASO 2014)
 - Measurement Track Chair, International Genetically Engineered Machine Competition (iGEM 2014)
- **2013:**
 - Tutorial Chair, 7th International Conference on Self-Adaptive and Self-Organizing Systems (SASO 2013)
 - Organizer, Workshop on Functional Programming Concepts in Domain-Specific Languages
- **2012:**
 - Organizer, 5th Spatial Computing Workshop (SCW 2012)
 - Organizer, Workshop on Complex Sciences in the Engineering of Computing Systems
- **2011:**

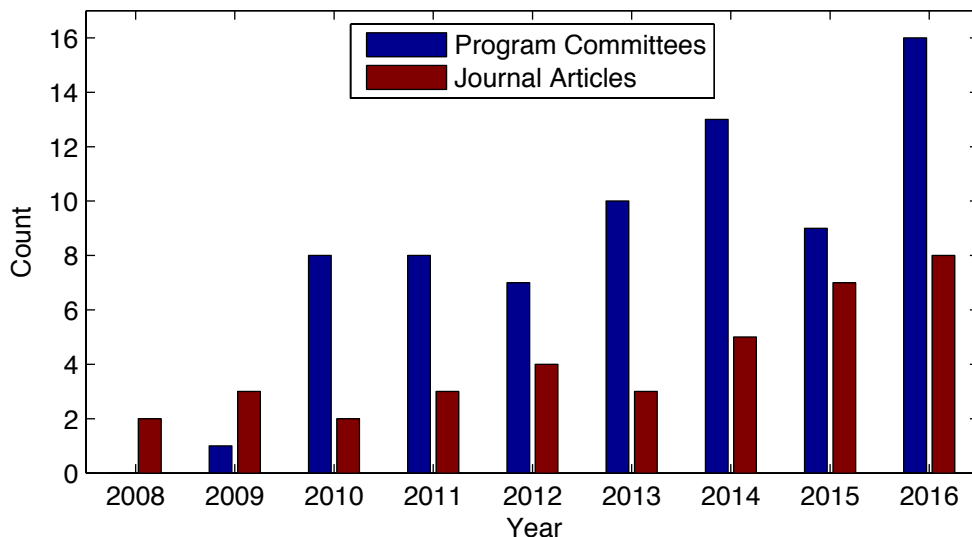
- Program Co-Chair, 5th International Conference on Self-Adaptive and Self-Organizing Systems (SASO 2011)
- Publications Chair, 3rd International Workshop on Bio-Design Automation (IWBDA 2011)
- Organizer, 4th Spatial Computing Workshop (SCW 2011)
- Organizer, 2nd Workshop on Agents Learning Interactively from Human Teachers (ALIHT)
- **2010:**
 - Workshop Chair, IEEE International Conference on Self-Adaptive and Self-Organizing Systems (SASO 2010)
 - Track Chair, *Swarm, Amorphous, Spatial, and Complex Systems Track* of 12th International Symposium on Stabilization, Safety, and Security of Distributed Systems (SSS 2010)
 - Organizer, 3rd Spatial Computing Workshop (SCW 2010)
 - Organizer, Workshop on *Agents Learning Interactively from Human Teachers (ALIHT)*
- **2009:**
 - Poster Co-chair, IEEE International Conference on Self-Adaptive and Self-Organizing Systems (SASO 2009)
 - Organizer, 2nd Spatial Computing Workshop (SCW 2009)
- **2008:**
 - Organizer, 1st Spatial Computing Workshop (SCW 2008)
 - Organizer, *Naturally-Inspired Artificial Intelligence* symposium, in AAAI 2008 Fall Symposium Series, November 2008.
- **2003:** Organizer, *Genesis Workshop* (internal MIT workshop).

5.5 Reviewing

- Past approx. 3 years journal reviewing:
 - **2017:** Autonomous Robots; IEEE Technology and Society Magazine
 - **2016:** ACS Synthetic Biology; Biophysical Journal; Cell Systems; Computational and Applied Mathematics; Computers in Biology and Medicine; Frontiers in Robotics and AI; IEEE Robotics and Automation Letters; IEEE Software; Mathematical Problems in Engineering; Logical Methods in Computer Science
 - **2015:** Acta Biotheoretica; ACS Synthetic Biology; Biosystems; Frontiers in Robotics and AI IEEE Transactions on Mobile Computing; Swarm Intelligence;
 - **2014:** Accounts of Chemical Research; ACS Synthetic Biology; IEEE Transactions on Emerging Topics in Computing (TETC); PTRSA: Philosophical Transactions of the Royal Society part A
- Past approx. 3 years conference program committees (or similar):
 - **2017:** International Workshop on Autonomic High Performance Computing (AHPC 2017); 1st Workshop on Architectures, Languages and Paradigms for IoT (ALPIoT); COORDINATION 2017; Genetic and Evolutionary Computation Conference (GECCO 2017); 27th ACM Great Lakes Symposium on VLSI (GLSVLSI 2017); 14th International Conference on Autonomic Computing (ICAC 2017); Collective Adaptive Systems Track for ACM Symposium on Applied Computing (SAC 2017); 5th International Workshop on Self-Optimisation in Autonomic and Organic Computing Systems (SAOS 2017); IEEE International Conference on Self-Adaptive and Self-Organizing Systems (SASO 2017); 12th International Symposium on Software Engineering for Adaptive and Self-Managing Systems (SEAMS)

- **2016:** Coordination Models, Languages and Applications Track for ACM Symposium on Applied Computing (SAC 2016); COORDINATION 2016; FORMal methods for the quantitative Evaluation of Collective Adaptive SysTems (FORECAST 2016); Genetic and Evolutionary Computation Conference (GECCO 2016); IJCAI Workshop on AI for Synthetic Biology; 13th International Conference on Autonomic Computing (ICAC 2016); International Conference on Distributed Computing in Sensor Systems (DCOSS 2016); 10th International Conference on Swarm Intelligence (ANTS 2016); 13th International Symposium on Distributed Autonomous Robotic Systems (DARS 2016); International Workshop on Autonomic High Performance Computing (AHPC 2016); 4th International Workshop on Self-Adaptive and Self-Organising Socio-Technical Systems (SASOST 2016); Fourth International Workshop on Self-Optimisation in Organic and Autonomic Computing Systems (SAOS 2016); 3rd International Workshop on Self-Improving System Integration (SISSY 2016); IEEE International Conference on Self-Adaptive and Self-Organizing Systems (SASO 2016); Doctoral Symposium at IEEE International Conference on Self-Adaptive and Self-Organizing Systems (SASO 2016); 3rd Workshop on Quality Assurance for Self-adaptive, Self-organising Systems (QA4SASO 2016)
- **2015:** 1st ACM SIGAI Career Network Conference (CNC 2015); COORDINATION 2015; Coordination Models, Languages and Applications Track for ACM Symposium on Applied Computing (SAC 2015); European Conference on Artificial Life (ECAL 2015); IEEE International Conference on Self-Adaptive and Self-Organizing Systems (SASO 2015); 3rd International Workshop on Self-Optimisation in Organic and Autonomic Computing Systems (SAOS15); 2nd International Workshop on Self-Improving System Integration (SISSY 2015) Workshop on Distributed Adaptive Systems 2nd Workshop on Quality Assurance for Self-adaptive, Self-organising Systems (QA4SASO 2015)
- **2014:** Coordination Models, Languages and Applications Track for ACM Symposium on Applied Computing (SAC 2014); Design Automation Conference (DAC 2014); Genetic and Evolutionary Computation Conference (GECCO 2014); IEEE International Conference on Self-Adaptive and Self-Organizing Systems (SASO 2014); International Conference on Agents and Artificial Intelligence (ICAART 2014); 7th International Conference on Bio-Inspired Information and Communications Technologies (BICT 2014); International Conference on Swarm Intelligence (ANTS 2014); 14th International Conference on the Synthesis and Simulation of Living systems (ALIFE 14); International Workshop on Autonomic High Performance Computing (AHPC 2014); 6th International Workshop on Bio-Design Automation (IWBDA 2014); 2nd International Workshop on Self-Adaptive and Self-Organising Socio-Technical Systems (SASOST 2014) International Workshop on Self-Optimisation in Organic and Autonomic Computing Systems (SAOS14); Spatial Computing Workshop (SCW 2014); Workshop on Self-Improving Systems Integration (SISSY14)

Reviewing frequency since 2008:



6 Publications

6.1 Journal Articles

1. Robert Sidney Cox, James Alastair McLaughlin, Raik Grunberg, Jacob Beal, Anil Wipat, and Herbert M Sauro. *A Visual Language for Protein Design*, ACS Synthetic Biology, online February, 2017.
2. Jacob Beal, Robert Sidney Cox, Raik Grunberg, James McLaughlin, Tramy Nguyen, Bryan Bartley, Michael Bissell, Kiri Choi, Kevin Clancy, Chris Macklin, Curtis Madsen, Goksel Misirli, Ernst Oberortner, Matthew Pocock, Nicholas Roehner, Meher Samineni, Michael Zhang, Zhen Zhang, Zach Zundel, John Gennari, Chris Myers, Herbert Sauro and Anil Wipat, *Synthetic Biology Open Language (SBOL) Version 2.1.0*, Journal of Integrative Bioinformatics, 13(3):291, December, 2016.
<http://dx.doi.org/10.2390/biecoll-jib-2016-291>
 Also published as: BioBricks Foundation Request for Comments (BBF RFC) #112. doi:1721.1/105278
3. Jacob Beal, Aaron Adler, and Fusun Yaman, *Managing Bioengineering Complexity with AI Techniques*, Elsevier BioSystems, 148, pp 40–46, October 2016. <http://dx.doi.org/10.1016/j.biosystems.2015.08.006>
4. Jacob Beal, *Trading Accuracy for Speed in Approximate Consensus*, Knowledge Engineering Review: Special Issue on Spatial Computing, 31 (4), pp 325–342, September 2016.
5. Nathan J. Hillson, Hector A. Plahar, Jacob Beal, and Ranjini Prithviraj, *Improving Synthetic Biology Communication: Recommended Practices for Visual Depiction and Digital Submission of Genetic Designs*, ACS Synthetic Biology, 5 (6), pp 449–451, June 2016.
6. Nicholas Roehner, Jacob Beal, Kevin Clancy, Bryan Bartley, Goksel Misirli, Raik Grunberg, Ernst Oberortner, Matthew Pocock, Michael Bissell, Curtis Madsen, Tramy Nguyen, Michael Zhang, Zhen Zhang, Zach Zundel, Douglas Densmore, John H. Gennari, Anil Wipat, Herbert M. Sauro, and Chris J. Myers, *Sharing Structure and Function in Biological Design with SBOL 2.0*, ACS Synthetic Biology, 5 (6), pp 498–506, June 2016.
7. Zhen Zhang, Tramy Nguyen, Nicholas Roehner, Goksel Misirli, Matthew Pocock, Ernst Oberortner, Meher Samineni, Zach Zundel, Jacob Beal, Kevin Clancy, Anil Wipat, and Chris Myers, *libSBOLj 2.0: A Java library to support SBOL 2.0*, IEEE Life Sciences Letters, 1 (4), pp 34–37, April 2016.

8. Jacob Beal, Traci Haddock-Angelli, Markus Gershater, Kim de Mora, Meagan Lizarazo, Jim Hollenhorst, Randy Rettberg, with the iGEM Interlab Study Contributors, *Reproducibility of Fluorescent Expression from Engineered Biological Constructs in E. coli.*, PLoS ONE 11(3): e0150182. doi:10.1371/journal.pone.0150182 March 2016.
9. Ferruccio Damiani, Mirko Viroli, Jacob Beal, *A Type-Sound Calculus of Computational Fields*, Science of Computer Programming, Volume 117, pp 17–44, doi:10.1016/j.scico.2015.11.005, February 2016.
10. Sonya V. Iverson, Traci L. Haddock, Jacob Beal, and Douglas M. Densmore, *CIDAR MoClo: Improved MoClo Assembly Standard and New E. coli Part Library Enable Rapid Combinatorial Design for Synthetic and Traditional Biology*, ACS Synthetic Biology, 5 (1), pp 99–103, January, 2016.
11. Jacqueline Quinn, Robert Sidney Cox III, Aaron Adler, Jacob Beal, Swapnil Bhatia, Yizhi Cai, Joanna Chen, Kevin Clancy, Michal Galdzicki, Nathan J. Hillson, Nicolas Le Novere, Akshay J Maheshwari, James Alastair McLaughlin, Chris J. Myers, Umesh P, Matthew Pocock, Cesar Rodriguez, Larisa Soldatova, Guy-Bart V Stan, Neil Swainston, Anil Wipat, and Herbert M Sauro, *SBOL Visual: Standard Schematics for Synthetic Genetic Constructs*, PLoS Biology 13(12): e1002310. doi:10.1371/journal.pbio.1002310, December 2015.
12. Samira Kiani, Alejandro Chavez, Marcelle Tuttle, Richard N Hall, Raj Chari, Dmitry Ter-Ovanesyan, Jason Qian, Benjamin W Pruitt, Jacob Beal, Suhani Vora, Joanna Buchthal, Emma J K Kowal, Mohammad R Ebrahimkhani, James J Collins, Ron Weiss, and George Church, *Cas9 gRNA engineering for selectable genome editing, activation and repression*, Nature Methods 12(11), pp 1051-1054, November 2015.
13. Jacob Beal, Danilo Pianini, and Mirko Viroli, *Aggregate Programming for the Internet of Things*, IEEE Computer, 48(9), pp 22–30, September 2015.
14. Bryan Bartley, Jacob Beal, Kevin Clancy, Goksel Misirli, Nicholas Roehner, Ernst Oberortner, Matthew Pocock, Michael Bissell, Curtis Madsen, Tramy Nguyen, Zhen Zhang, John H. Gennari, Chris Myers, Anil Wipat and Herbert Sauro. *Synthetic Biology Open Language (SBOL) Version 2.0.0*. Journal of Integrative Bioinformatics, 12(2):272, September, 2015. <http://dx.doi.org/10.2390/bieco11-jib-2015-272> Also published as: BioBricks Foundation Request for Comments (BBF RFC) #108. doi:1721.1/98369
15. Jacob Beal and Mirko Viroli, *Formal Foundations of Sensor Network Applications*, SIGSPATIAL Special, Volume 7, Number 2, pp 36–42, July 2015.
16. Jacob Beal, *Signal-to-noise ratio measures efficacy of biological computing devices and circuits*, Frontiers in Bioengineering and Biotechnology, Volume 3, Article #93, June 2015.
17. Jacob Beal and Mirko Viroli, *Space-Time Programming*, Philosophical Transactions of the Royal Society Part A, 73: 20140220. <http://dx.doi.org/10.1098/rsta.2014.0220>, June 2015.
18. Jacob Beal, *Superdiffusive Dispersion and Mixing of Swarms*, ACM Transactions on Autonomous and Adaptive Systems, Vol. 10, No. 2, Article 10, June 2015.
19. Noah Davidsohn, Jacob Beal, Samira Kiani, Aaron Adler, Fusun Yaman, Yinqing Li, Zhen Xie, and Ron Weiss, *Accurate Predictions of Genetic Circuit Behavior from Part Characterization and Modular Composition*, ACS Synthetic Biology, [dx.doi.org/10.1021/sb500263b](https://doi.org/10.1021/sb500263b), 4 (6), pp 673–681, June 2015 (published online November 2014).
20. Jacob Beal, Tyler E. Wagner, Tasuku Kitada, Odisse Azizgolshani, Jordan Moberg Parker, Douglas Densmore, and Ron Weiss, *Model-Driven Engineering of Gene Expression from RNA Replicons*, ACS Synthetic Biology, [dx.doi.org/10.1021/sb500173f](https://doi.org/10.1021/sb500173f), 4 (1), pp 48–56, January 2015.

21. Nicholas Roehner, Ernst Oberortner, Matthew Pocock, Jacob Beal, Kevin Clancy, Curtis Madsen, Goksel Misirli, Anil Wipat, Herbert Sauro, and Chris J. Myers, *Proposed Data Model for the Next Version of the Synthetic Biology Open Language*, ACS Synthetic Biology, [dx.doi.org/10.1021/sb500176h](https://doi.org/10.1021/sb500176h), 4 (1), pp 57–71, January 2015.
22. Jacob Beal, *Bridging the Gap: A Roadmap to Breaking the Biological Design Barrier*, Frontiers in Bioengineering and Biotechnology, 2:87. doi:10.3389/fbioe.2014.00087, January 2015.
23. Samira Kiani, Jacob Beal, Mohammad R Ebrahimkhani, Jin Huh, Richard N Hall, Zhen Xie, Yingqing Li and Ron Weiss, *CRISPR transcriptional repression devices and layered circuits in mammalian cells*, Nature Methods, 11 (7), pp. 723726, July 2014.
24. Michal Galdzicki, Kevin P Clancy, Ernst Oberortner, Matthew Pocock, Jacqueline Y Quinn, Cesar A Rodriguez, Nicholas Roehner, Mandy L Wilson, Laura Adam, J Christopher Anderson, Bryan A Bartley, Jacob Beal, Deepak Chandran, Joanna Chen, Douglas Densmore, Drew Endy, Raik Grunberg, Jennifer Hallinan, Nathan J Hillson, Jeffrey D Johnson, Allan Kuchinsky, Matthew Lux, Goksel Misirli, Jean Peccoud, Hector A Plahar, Evren Sirin, Guy-Bart Stan, Alan Villalobos, Anil Wipat, John H Gennari, Chris J Myers, and Herbert M Sauro, *The Synthetic Biology Open Language (SBOL) provides a community standard for communicating designs in synthetic biology*, Nature Biotechnology, 32(6), June 2014.
25. Jacob Beal, Kyle Usbeck, and Brett Benyo, *On the Evaluation of Space-Time Functions*, The Computer Journal, 56 (12), pp. 1500-1517, December 2013.
26. Alex Papalexopoulos, Jacob Beal, and Steven Florek, *Precise Mass-Market Energy Demand Management Through Stochastic Distributed Computing*, IEEE Transactions on Smart Grid, Volume 4, Issue 4, pages 2017–2027, December 2013.
27. Mirko Viroli, Jacob Beal, and Kyle Usbeck, *Operational Semantics of Proto*, Science of Computer Programming, Volume 78, Issue 6, 1 June 2013, Pages 633–656.
28. Jacob Beal, Ron Weiss, Douglas Densmore, Aaron Adler, Evan Appleton, Jonathan Babb, Swapnil Bhatia, Noah Davidsohn, Traci Haddock, Joseph Loyall, Richard Schantz, Viktor Vasilev, and Fusun Yaman, *An End-to-End Workflow for Engineering of Biological Networks from High-Level Specifications*, ACS Synthetic Biology, Volume 1, Number 8, pages 317–331, July 2012.
29. Fusun Yaman, Swapnil Bhatia, Aaron Adler, Douglas Densmore, and Jacob Beal, *Automated Selection of Synthetic Biology Parts for Genetic Regulatory Networks*, ACS Synthetic Biology, Volume 1, Number 8, pages 332–344, July 2012.
30. 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.
31. Jacob Beal, *Functional Blueprints: An Approach to Modularity in Grown Systems*, Swarm Intelligence Journal, Volume 5, Issue 3-4, pages 257–281, June 2011.
32. 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.
33. 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
34. 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.

6.2 Book Chapters & Theses

1. Jacob Beal and Mirko Viroli. *Aggregate Programming: From Foundations to Applications*, chapter in “Formal Methods for the Quantitative Evaluation of Collective Adaptive Systems.” ed. Marco Bernardo, Rocco De Nicola, and Jane Hillston, Springer International Publishing, pp 233-260, June 2016.
2. Jacob Beal, Aaron Adler, Fusun Yaman, Jeffrey Cleveland, Hala Mostafa, Annan Mozeika, Kyle Usbeck, Gretchen Markiewicz, and Benjamin Axelrod, *Managing Design Change with Functional Blueprints*, chapter in “Through-life Engineering Services” ed. Louis Redding and Rajkumar Roy, Springer International Publishing, pp 269-284, January 2015.
3. Jacob Beal, Stefan Dulman, Kyle Usbeck, Mirko Viroli, Nikolaus Correll, *Organizing the Aggregate: Languages for Spatial Computing*, chapter in “Formal and Practical Aspects of Domain-Specific Languages: Recent Developments,” edited by Marjan Mernik, IGI Global, December 2012.
4. 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, December 2012.
5. 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
6. Hal Abelson, Jacob Beal, and Gerald Jay Sussman, *Amorphous Computing*, article in “Encyclopedia of Complexity and System Science,” Springer-Verlag, March 2009.
7. Jacob Beal, *Learning by Learning to Communicate*, PhD Thesis, August 2007.
8. Jacob Beal, *Programming an Amorphous Computational Medium*, in Unconventional Programming Paradigms, Lecture Notes in Computer Science Vol. 3566, August 2005.
9. Jacob Beal, *Generating Communications Systems Through Shared Context*, Master’s Thesis, January 2002.

6.3 Peer-Reviewed Conference Articles:

1. Jacob Beal, Mirko Viroli, Danilo Pianini, and Ferruccio Damiani, *Self-adaptation to Device Distribution Changes in Situated Computing Systems*, IEEE International Conference on Self-Adaptive and Self-Organizing Systems (SASO), September 2016. *Received Best Paper Award.*
2. Danilo Pianini, Jacob Beal, and Mirko Viroli, *Improving gossip dynamics through overlapping replicates*, International Conference on Coordination Languages and Models, June 2016.
3. Jacob Beal, Kyle Usbeck, Joseph Loyall, and James Metzler, *Opportunistic Sharing of Airborne Sensors*, International Conference on Distributed Computing in Sensor Systems (DCOSS), May, 2016.
4. Shane S. Clark, Jacob Beal, and Partha Pal, *Distributed Recovery for Enterprise Services*, IEEE International Conference on Self-Adaptive and Self-Organizing Systems (SASO), September 2015.
5. Mirko Viroli, Jacob Beal, Ferruccio Damiani, and Danilo Pianini, *Efficient Engineering of Complex Self-Organizing Systems by Self-Stabilising Fields*, IEEE International Conference on Self-Adaptive and Self-Organizing Systems (SASO), September 2015.
6. Ferruccio Damiani, Mirko Viroli, Danilo Pianini, and Jacob Beal, *Code Mobility Meets Self-organisation: a Higher-order Calculus of Computational Fields*, Formal Techniques for Distributed Objects, Components, and Systems (FORTE), pp. 113-128, June 2015.

7. Danilo Pianini, Mirko Viroli, Jacob Beal, *Protelis: Practical Aggregate Programming*, ACM Symposium on Applied Computing 2015, April 2015.
8. Jacob Beal, *Superdiffusive Dispersion and Mixing of Swarms with Reactive Levy Walks*, IEEE International Conference on Self-Adaptive and Self-Organizing Systems (SASO 2013), September 2013.
9. Aaron Adler, Fusun Yaman, Jacob Beal, Jeff Cleveland, Hala Mostafa, and Annan Mozeika, *A Morphogenetically Assisted Design Variation Tool*, AAAI, July 2013.
10. Jacob Beal, Aaron Adler, and Hala Mostafa, *Mixed Geometric-Topological Representation for Electromechanical Design*, GECCO 2013, July 2013.
11. Jacob Beal, *Engineered Self-Organization Approaches to Adaptive Design*, 2012 Conference on Through-Life Engineering Services, November 2012.
12. Jacob Beal, Jeff Berliner, and Kevin Hunter, *Fast Precise Distributed Control for Energy Demand Management*, IEEE SASO 2012, September 2012.
13. Jacob Beal, Hala Mostafa, Benjamin Axelrod, Annan Mozeika, Aaron Adler, Gretchen Markiewicz, and Kyle Usbeck, *A Manifold Operator Representation for Adaptive Design*, GECCO 2012, July 2012.
14. Mirko Viroli, Danilo Pianini, and Jacob Beal, *Linda in Space-Time: An Adaptive Coordination Model for Mobile Ad-Hoc Environments*, Coordination 2012, June 2012.
15. Michael Atighetchi, Jonathan Webb, Jacob Beal, Brian Krisler, and Michael Mayhew, *Cross Domain Identity Management and Entitlement*, Military Communications Conference (MILCOM), November 2011.
16. Mirko Viroli, Jacob Beal, and Matteo Casadei, *Core Operational Semantics of Proto*, ACM Symposium on Applied Computing 2011, March 2011.
17. Jacob Beal and Richard Schantz, *A Spatial Computing Approach to Distributed Algorithms*, 44th Asilomar Conference on Signals, Systems, and Computers, November 2010.
18. Vinayak V. Ranade, and Jacob Beal, *Distributed Control for Small Customer Energy Demand Management*, IEEE SASO 2010, September 2010.
19. Jacob Beal, *Functional Blueprints: an Approach to Modularity in Grown Systems*, 7th International Conference on Swarm Intelligence (ANTS 2010), September 2010.
20. Nelson Elhage and Jacob Beal *Laplacian-Based Consensus on Spatial Computers*, 9th International Conference on Autonomous Agents and Multiagent Systems (AAMAS 2010), May 2010.
21. Jacob Beal and Jennifer Roberts, *Enhancing Methodological Rigor for Computational Cognitive Science: Complexity Analysis*, Cognitive Science Conference, July 2009.
22. Jennifer Roberts and Jacob Beal, *Enhancing Methodological Rigor for Computational Cognitive Science: Core Tenets and Ad Hoc Residuals*, Cognitive Science Conference, July 2009.
23. 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.
24. 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.
25. 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.

26. Jacob Beal, *Flexible Self-Healing Gradients*, ACM Symposium on Applied Computing 2009, March 2009.
27. Jonathan Bachrach, Jacob Beal, Joshua Horowitz, and Dany Qumsiyeh, *Empirical Characterization of Discretization Error in Gradient-based Algorithms*, IEEE SASO 2008, October 2008.
28. 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.
29. Jacob Beal, *Learning Composable Signals for a Cognitive Substrate*, Cognitive Science Conference, July 2008.
30. Jacob Beal, *Shared Focus of Attention for Heterogeneous Agents*, Short Paper, 7th International Conference on Autonomous Agents and Multiagent Systems (AAMAS 2008), May 2008.
31. 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)*.
32. Jonathan Bachrach, Jacob Beal, and Takeshi Fujiwara, *Continuous Space-Time Semantics Allow Adaptive Program Execution*, IEEE SASO 2007, July 2007.
33. Jacob Beal, *What the Assassins' Guild Taught Me About Distributed Computing*, International Conference on Complex Systems (ICCS) 2006, June 2006.
34. Jacob Beal and Sara Bennett, *Predictive Modelling for Fisheries Management in the Colombian Amazon*, International Conference on Complex Systems (ICCS) 2004, June 2004.
35. Jacob Beal, *An Algorithm for Bootstrapping Communications*, International Conference on Complex Systems (ICCS), June 2002.

6.4 Peer-Reviewed Conference Abstracts

1. Jacob Beal, *Mathematical Foundations of Variation in Gene Expression*, IET/SynbiCITE Engineering Biology Conference, December 2016.
2. Jacob Beal and Ron Weiss, *Design for Improved Repression in RNA Replicons*, 8th International Workshop on Bio-Design Automation (IWBDA), August 2016.
3. Danilo Pianini, Mirko Viroli, and Jacob Beal, *Engineering multi-agent systems with aggregate computing*, Principles and Practice of Multi-Agent Systems (PRIMA 2015), October 2015.
4. Jacob Beal, *Design of Biological Circuits Using Signal-to-Noise Ratio*, International Workshop on Bio-Design Automation (IWBDA), August 2015.
5. Bryan Bartley, Jacob Beal, Kevin Clancy, Nathan Hillson, Goksel Misirli, Nicholas Roehner, Matthew Pocock, Tramy Nguyen, Zhen Zhang, Chris Myers, John H Gennari, Herbert Sauro, Curtis Madsen, Anil Wipat, Ernst Oberortner, *The Synthetic Biology Open Language 2.0*, International Workshop on Bio-Design Automation (IWBDA), August 2015.
6. Jacob Beal, Tyler E. Wagner, Tasuku Kitada, Andrey Krivoy, Odisse Azizgolshani, Jordan Moberg Parker, Douglas Densmore, and Ron Weiss, *Precision Design of Expression from RNA Replicons*, International Workshop on Bio-Design Automation (IWBDA), June 2014.
7. Kyle Usbeck and Jacob Beal, *WebProto: Aggregate Programming for Everyone*, demonstration abstract, IEEE SASO, September 2013 *Received Best Demonstration Award*.

8. Bernat Wiandt, Vilmos Simon, Andras Kokuti, and Jacob Beal, *Spatial Computing Meets Realistic Mobile Wireless Problems*, demonstration abstract, IEEE SASO, September 2013.
9. Fusun Yaman, Aaron Adler, and Jacob Beal, *How can AI help Synthetic Biology?*, Senior Member Talk, AAAI, July 2013.
10. Jacqueline Quinn, Michal Galdzicki, Robert Sidney Cox III, Jacob Beal, Kevin Clancy, Nathan Hillson, and Larisa Soldatova, *Synthetic Biology Open Language Visual: an ontological use case*, extended abstract at Bio-Ontologies, July 2013.
11. Noah Davidsohn, Jacob Beal, Aaron Adler, Fusun Yaman, Yinqing Li, Zhen Xie, and Ron Weiss, *Accurate Predictions of Genetic Circuit Behavior from Part Characterization and Modular Composition*, peer-reviewed abstract in 5th International Workshop on Bio-Design Automation, July 2013.
12. Aaron Adler, Fusun Yaman, and Jacob Beal, *Online Tools for Characterization, Design, and Debugging*, peer-reviewed abstract in 5th International Workshop on Bio-Design Automation, July 2013.
13. Jacqueline Quinn, Jacob Beal, Swapnil Bhatia, Patrick Cai, Joanna Chen, Kevin Clancy, Robert Sidney Cox III, Michal Galdzicki, Nathan Hillson, Akshay Maheshwari, Chris Myers, Umesh P, Matthew Pocock, Cesar Rodriguez, Herbert M Sauro, Larisa Soldatova, Guy-Bart Stan, Mandy Wilson, and Drew Endy, *Synthetic Biology Open Language Visual: An Open-Source Graphical Notation for Synthetic Biology*, peer-reviewed abstract in 5th International Workshop on Bio-Design Automation, July 2013.
14. Michal Galdzicki, Ernst Oberortner, Matthew Pocock, Jacqueline Quinn, Mandy Wilson, Evan Appleton, Bryan Bartley, Jacob Beal, Swapnil Bhatia, Robert Cox, Raik Gruunberg, Goksel Misirli, Hector Plahar, Nicholas Roehner, Larisa Soldatova, Guy-Bart Stan, Doug Densmore, Chris J. Myers, Herbert Sauro, and Anil Wipat, *Recent Advances in the Synthetic Biology Open Language*, peer-reviewed abstract in 5th International Workshop on Bio-Design Automation, July 2013.
15. Jacob Beal, Kyle Usbeck, and Jeff Cleveland *Self-Stabilizing Robot Team Formation With Proto*, IEEE SASO 2012 Demonstration Session, September 2012. *Received Best Demonstration Award.*
16. Jacob Beal, Ron Weiss, Douglas Densmore, Aaron Adler, Evan Appleton, Jonathan Babb, Swapnil Bhatia, Noah Davidsohn, Traci Haddock, Joseph Loyall, Richard Schantz, Viktor Vasilev, and Fusun Yaman, *Results from TASBE*, 4th International Workshop on Bio-Design Automation, June 2012.
17. Jacob Beal and Fusun Yaman, *Toward Automated Design of Cell State Detectors*, 4th International Workshop on Bio-Design Automation, June 2012.
18. Jacob Beal and Aaron Adler, *Automated Design of Synthetic Biology Feedback Circuits*, 2012 Institute of Biological Engineering Conference, March 2012.
19. Aaron Adler, Fusun Yaman, Jeffrey Cleveland, and Jacob Beal, *Morphogenetically Assisted Design Variation*, 2nd International Conference on Morphological Computation, September 2011.
20. Jacob Beal, *Bridging Biology and Engineering Together with Spatial Computing*, International Conference on Membrane Computing, August, 2011.
21. 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.
22. 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.

23. 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.
24. 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.
25. 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.
26. Jacob Beal, *Functional blueprints: a means of adaptive integration?*, First International Workshop on Morphogenetic Engineering, June 2009.
27. Jonathan Bachrach and Jacob Beal, *Programming a Sensor Network as an Amorphous Medium*, extended abstract for poster at IEEE DCOSS 2006, June 2006.
28. Jacob Beal and Seth Gilbert, *Analyzing Failures as Noise*, LIDS Student Conference, MIT, January 2004.

6.5 Workshops, Symposia, and Seminars

1. Jacob Beal, Kyle Usbeck, Joseph Loyall, Mason Rowe, and James Metzler *Adaptive Task Reallocation for Airborne Sensor Sharing*, Workshop on Engineering Collective Adaptive Systems (eCAS), September 2016.
2. Mirko Viroli, Antonio Bucchiarone, Danilo Pianini, and Jacob Beal, *Combining Self-Organisation and Autonomic Computing in CASs with Aggregate-MAPE*, Workshop on Engineering Collective Adaptive Systems (eCAS), September 2016.
3. Mirko Viroli and Jacob Beal, *Resiliency with Aggregate Computing: State of the Art and Roadmap*, FORMAL methods for the quantitative Evaluation of Collective Adaptive SysTems (FORECAST), July 2016.
4. Amy Kumar, Jacob Beal, Soura Dasgupta, Raghuraman Mudumbai, *Toward Predicting Distributed Systems Dynamics*, Spatial and COLlective PErvasive Computing Systems (SCOPEs), September 2015.
5. Jacob Beal and Mirko Viroli, *Building blocks for aggregate programming of self-organising applications*, Workshop on Fundamental of Collective Adaptive Systems (FoCAS), September 2014.
6. Jacob Beal, Mirko Viroli, and Ferruccio Damiani, *Towards a Unified Model of Spatial Computing*, 7th Spatial Computing Workshop (SCW'14), May 2014.
7. Andrei Lapets, Marcus Da Silva, Michael Thome, Aaron Adler, Jacob Beal, and Martin Roetteler, *QuaFL: A typed DSL for quantum programming*, Workshop on Functional Programming Concepts in Domain-Specific Languages at 18th ACM SIGPLAN International Conference on Functional Programming (ICFP 2013), pp. 19-26, September 2013.
8. Jacob Beal and Aaron Adler, *Functional synthesis of genetic regulatory networks*, Workshop on Functional Programming Concepts in Domain-Specific Languages at 18th ACM SIGPLAN International Conference on Functional Programming (ICFP 2013), pp. 3-10, September 2013.
9. Mirko Viroli, Ferruccio Damiani, and Jacob Beal, *A Calculus of Computational Fields*, 12th International Workshop on Foundations of Coordination Languages and Self Adaptive Systems (FOCLASA'13), September 2013.

10. Jacob Beal, *Accelerating Approximate Consensus with Self-Organizing Overlays*, 6th Spatial Computing Workshop, May 2013.
11. Jacob Beal, *A Tactical Command Approach to Human Control of Vehicle Swarms*, AAAI 2012 Fall Symposium “Human Control of Bio-Inspired Swarms,” November 2012.
12. Jacob Beal, *A Dimensionless Graceful Degradation Metric for Quantifying Resilience*, Workshop on Evaluation of Self-Adaptive and Self-Organizing Systems, IEEE SASO, September 2012.
13. Jacob Beal, Kyle Usbeck and Brian Krisler, *Lightweight Simulation Scripting with Proto*, 5th Spatial Computing Workshop (SCW’12) at AAMAS 2012, June 2012.
14. Kyle Usbeck and Jacob Beal, *An Agent Framework for Agent Societies*, Actors and Agents Reloaded (AGERE) at SPLASH 2011, October 2011.
15. Jacob Beal and Kyle Usbeck, *On the Evaluation of Space-Time Functions*, 4th Spatial Computing Workshop (SCW) at IEEE SASO 2011, October 2011.
16. 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.
17. 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.
18. Jacob Beal, *A Basis Set of Operators for Space-Time Computations*, 3rd Spatial Computing Workshop, September 2010.
19. Jacob Beal, Alice Leung, and Robert Laddaga, *Spectrum Curricula: Design and Initial Results*, Learning By Demonstration section of 2010 AAAI Robotics Exhibition, July 2010.
20. 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.
21. 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
22. Jacob Beal, *Dynamically Defined Processes for Spatial Computers*, Spatial Computing Workshop 2009, September 2009.
23. 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.
24. Jacob Beal, Paul Robertson, and Robert Laddaga, *Curricula and Metrics to Investigate Human-Like Learning*, AAAI 2009 Spring Symposium “Agents that Learn from Human Teachers,” March, 2009.
25. Jacob Beal and Gerald Jay Sussman, *Engineered Robustness by Controlled Hallucination*, AAAI 2008 Fall Symposium “Naturally-Inspired Artificial Intelligence,” November 2008.
26. Jacob Beal and Jonathan Bachrach, *Cells Are Plausible Targets for High-Level Spatial Languages*, Spatial Computing Workshop, October 2008.
27. Rachel Greenstadt and Jacob Beal, *Cognitive Security for Personal Devices*, First ACM workshop on Artificial Intelligence and Security (AISec), October 2008.

28. Jonathan Bachrach and Jacob Beal, *Autonomy in Spatial Computing*, Third Workshop on Hot Topics in Autonomic Computing, June 2008.
29. Jacob Beal, *Developmental Cost for Models of Intelligence*, AAAI 2007 Workshop on Evaluating Architectures for Intelligence, July 2007.
30. 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.
31. Jacob Beal, *Sidestepping Impossibility: Combat Consensus in the Assassins' Guild*, MIT CSAIL Student Workshop 2006, September 2006.
32. Jacob Beal and Gerald Jay Sussman, *CogSci to AI: It's the Brainware, Stupid!*, AAAI 2006 Spring Symposium "Between a Rock and a Hard Place: Cognitive Science Principles Meet AI-Hard Problems," Stanford, March 2006.
33. Jacob Beal, *Amorphous Medium Language*, Large-Scale Multi-Agent Systems Workshop at AAMAS, July 2005.
34. 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.
35. 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.

6.6 Published Whitepapers and Technical Reports

1. Jacob Beal, Drew Endy, David Grewal, Richard Johnson, and Linda Kahl, *Copyright and Licensing of BBF RFCs*, BioBricks Foundation Request for Comments (BBF RFC) #107, August 2015. <http://hdl.handle.net/1721.1/98266>
2. Jacqueline Quinn, Jacob Beal, Swapnil Bhatia, Patrick Cai, Joanna Chen, Kevin Clancy, Nathan Hillson, Michal Galdzicki, Akshay Maheshwari, Umesh P, Matthew Pocock, Cesar Rodriguez, Guy-Bart Stan, Drew Endy, *Synthetic Biology Open Language Visual (SBOL Visual), version 1.0.0*, BioBricks Foundation Request for Comments (BBF RFC) #93. March 2013. <http://hdl.handle.net/1721.1/78249>
3. Jacob Beal, Ron Weiss, Fusun Yaman, Noah Davidsohn, and Aaron Adler, *A Method for Fast, High-Precision Characterization of Synthetic Biology Devices*, MIT CSAIL Tech Report 2012-008, April 2012.
4. Michal Galdzicki, Mandy Wilson, Cesar A. Rodriguez, Matthew R. Pocock, Ernst Oberortner, Laura Adam, Aaron Adler, J. Christopher Anderson, Jacob Beal, Yizhi Cai, Deepak Chandran, Douglas Densmore, Omri A. Drory, Drew Endy, John H. Gennari, Raik Grunberg, Timothy S. Ham, Nathan J. Hillson, Jeffrey D. Johnson, Allan Kuchinsky, Matthew W. Lux, Curtis Madsen, Goksel Misirli, Chris J. Myers, Carlos Olguin, Jean Peccoud, Hector Plahar, Darren Platt, Nicholas Roehner, Evren Sirin, Trevor F. Smith, Guy-Bart Stan, Alan Villabos, Anil Wipat, and Herbert M. Sauro, *Synthetic Biology Open Language (SBOL) Version 1.1.0*, BioBricks Foundation Request for Comments (BBF RFC) #87, October 2012, <http://dSPACE.mit.edu/handle/1721.1/73909>
Prior version: 1.0.0, BBF RFC #84, October 2011

5. Jacob Beal and Hal Abelson, *PACEM: Cooperative Control for Citywide Energy Management*, whitepaper, August 2008.
6. Jacob Beal, Jonathan Bachrach, and Mark Tobenkin, *Constraint and Restoring Force*, MIT CSAIL Tech Report 2007-044, August 2007.
7. Jonathan Bachrach and Jacob Beal, *Building Spatial Computers*, MIT CSAIL Tech Report 2007-017, March 2007.
8. Jacob Beal, *What the Assassins' Guild Taught Me About Distributed Computing*, MIT CSAIL Technical Report MIT-CSAIL-TR-2006-038, June 2006.
9. Jacob Beal, *Learning From Snapshot Examples*, MIT AI Memo 2005-012, April 2005.
10. Jacob Beal, Tim Shepard, *Shrinking the Leap of Faith*, publicly available report, March 2005.
11. Jacob Beal and Gerald Jay Sussman, *Biologically-Inspired Robust Spatial Programming*, MIT AI Memo 2005-001, January 2005.
12. Jacob Beal and Tim Shepard, *Deamplification of DoS Attacks via Puzzles*, publicly available report, October 2004.
13. Jacob Beal, *Near-Optimal Distributed Failure Circumscription*, AI Memo 2003-017, August 2003.
14. Jacob Beal, *A Robust Amorphous Hierarchy from Persistent Nodes*, AI Memo 2003-012, May 2003.
15. Jacob Beal, *Persistent Nodes for Reliable Memory in Geographically Local Networks*, AI Memo 2003-011, April 2003.
16. Jacob Beal, *Leaderless Distributed Hierarchy Formation*, AI Memo 2002-021, December 2002.
17. Ryan Newton and Jacob Beal, *Amorphous Infrastructure for Language Implementation*, MIT CSAIL Tech Report 2006-015, December 2002.

7 Plenaries, Tutorials, and Other Non-Conference Talks

7.1 Plenary/Keynote Talks

1. *Morphogenetic Engineering: the Bilateria approach to design*, Morphogenetic Prototyping Workshop, Adelaide, Australia, November 2016.
2. *Aggregate Programming*, Tenth International Conference on Swarm Intelligence, Brussels, Belgium, September 2016.
3. *Engineered Self-Organization Approaches to Adaptive Design*, 2012 Conference on Through-Life Engineering Services, Shrivenham, U.K., November 2012.
4. *Bringing Biology and Engineering Together with Spatial Computing*, 12th International Conference on Membrane Computing, Fontainebleau, France, August 2011.
5. *Spatial Computing: From Manifold Geometry to Biology*, AMORPH Conference (Amorphous Computing and Complex Biological Networks), Sheffield, U.K., August 2010.

7.2 Tutorials

1. *Introductory SBOL Workshop*, 8th International Workshop on Bio-Design Automation, August 2016 (with other members of the SBOL community).
2. *Aggregate Programming*, 16th International School on Formal Methods for the Design of Computer, Communication and Software Systems: Quantitative Evaluation of Collective Adaptive Systems, June 2016.
3. *Predictable Self-Organization with Computational Fields*, with Mirko Viroli, IEEE International Conference on Self-Adaptive and Self-Organizing Systems (SASO), September 2014.
4. *High-Level Genetic Circuit Design: The Proto BioCompiler*, MIT, March 2014.
5. *TASBE Synthetic Biology Tools*, Boston University, June 2013. Also given at MIT in July 2013 and June 2014.
6. *Spatial Computing Approaches for Pervasive Systems*, 2010 Pervasive Adaptation (PerAda) Summer School, September 2010.
7. *Spatial Computing for Networked Collaboration*, International Symposium on Collaborative Technologies and Systems (CTS 2010), May 2010.
8. *Spatial Computing for Swarms*, IEEE International Conference on Self-Adaptive and Self-Organizing Systems (SASO), September 2009.
9. *Spatial Computing: From global to local and back again*, five-lecture series at Third French Complex Systems Summer School, August, 2009.
10. *Introduction to Spatial Computing*, Second International Conference on Robot Communication and Coordination (RoboComm), April 2009.
11. *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.

7.3 Other Invited Presentations

1. *iGEM 2016 Interlab Study*, International Genetically Engineered Machine Jamboree (iGEM 16), October 2016.
2. *Surviving Life as a Researcher*, IEEE SASO 2016 Doctoral Symposium, September 2016.
3. *What EDA can offer to BDA*, SRC Workshop on EDA/BDA Interaction Roadmap, August 2016.
4. *Hybrid assays for precision design of genetic regulatory networks*, ARO/NSF/SRC Technical Exchange Meeting on Cell-Semiconductor Interfaces and Hybrid Semiconductor-Biological Systems, July 2016.
5. *Engineering Complex Behaviors in Biological Organisms*, 26th GLSVLSI Conference, May 2016. Similar talks were given at the National Institute of Standards and Technology in April 2016 and at the University of Iowa in December 2015.
6. *Measuring Biological Computing Devices and Circuits*, Lincoln Laboratories, February 2016.
7. *What you should really learn from immune systems about adversarial design*, New Directions in Software Technology (NDIST '15), December 2015.
8. *SBOL visual: introduction, recent developments, and current challenges*, COMBINE 2015, October 2015.

9. *Report on iGEM Interlab Study*, COMBINE 2015, October 2015.
10. *Development of Standards for Calibrated Flow Cytometry*, COMBINE 2015, October 2015.
11. *iGEM 2015 Interlab Study*, International Genetically Engineered Machine Jamboree (iGEM 15), September 2015.
12. *Engineering Self-Organization: From Networking to Synthetic Biology* Dagstuhl Seminar 15402, “Self-assembly and Self-organization in Computer Science and Biology,” September 2015
13. *Ensuring Safe Composition of Distributed Processes*, 2nd Workshop on Quality Assurance for Self-adaptive, Self-organising Systems (QA4SASO 15) at IEEE SASO, September 2015
14. *Synthetic Biology Open Language (SBOL): Community-Driven Standard for Communication of Synthetic Biology Designs*, Synthetic Biology: Engineering, Evolution and Design (SEED 15), June 2015.
15. *Creating Predictable Collective Behaviors with Aggregate Programming*, Dagstuhl Seminar 14512, “Collective Adaptive Systems: Qualitative and Quantitative Modelling and Analysis,” December 2014
16. *iGEM 2014 Interlab Study*, International Genetically Engineered Machine Jamboree (iGEM 14), November 2014.
17. *Proto BioCompiler*, Autodesk Workshop at International Genetically Engineered Machine Jamboree (iGEM 14), November 2014.
18. *SBOL Visual: Standard for Synthetic Biology Diagrams*, SynBERC Fall Retreat 2014, September 2014.
19. *High Precision Modeling and Design of Genetic Regulatory Networks*, Synthetic Biology: Engineering, Evolution and Design (SEED 14), July 2014. Also given at International Genetically Engineered Machine Jamboree (iGEM 14) in November 2014.
20. *Measurements and iGEM 2014*, 3rd New England iGEM Meetup, June 2014.
21. *Merging experimental and computational efforts in BDA*, International Workshop on Bio-Design Automation (IWBDA 14), June 2014.
22. *Programming Distributed Algorithms using Computational Fields*, Dagstuhl Seminar 13492, “Geosensor Networks: Bridging Algorithms and Applications,” December 2013
23. *Spatial computing: a unifying approach to computational materials*, Royal Society Meeting on Heterotic Computing, November 2013.
24. *The Importance of Asymmetry for Rapidly Reaching Consensus*, Workshop on Self-Adaptive and Self-Organising Socio-Technical Systems (SASOST), September 2013.
25. *Spatial Computing: From Manifold Geometry to Networking and Biology*, TU Delft, May 2013.
26. *Metrology and Predictive Design for Synthetic Biology*, MIT, March 2013. A similar talk was also given at Lincoln Laboratories in September 2013, Imperial College in November 2013, Newcastle University in November 2013, Northwestern University in November 2013, and at New Directions in Software Technology (NDIST '13) in December 2013.
27. *High-Level BioDesign Automation*, SemiSynBio Workshop, February 2013.
28. *Fast, Scalable Demand-Shaping with ColorPower*, Washington State University, January 2013. Same talk also given to Pacific Northwest National Labs and Snohomish PUD, both also in January 2013.
29. *Morphogenetic Engineering: The Bilateria approach to design*, New Directions in Software Technology (NDIST '12), December 2012.

30. *Customer-Centric Restructuring of Energy Markets*, presented on “Smart Grid” panel at Future Energy Conference, November 2012.
31. *From Inspiration to Quantification*, presented on “New Research Directions” panel at IEEE SASO 2012, September 2012.
32. *Spatial Computing: From Manifold Geometry to Networking and Biology*, University of Iowa, February 2012.
33. *Toward Breaking the Complexity Barrier for Synthetic Biology Therapeutics*, IEEE Engineering in Medicine and Biology, August 2011.
34. *Spatial Computing: From Manifold Geometry to Distributed Systems*, TU Delft, Netherlands, August 2011.
35. *High-Level Languages for Synthetic Biology*, MIT Synthetic Biology Lunch seminar series, November 2010.
36. *Automatic Compilation from High-Level Bio-Languages to Genetic Regulatory Networks*, Church Lab & Harvard Molecular Technology Group, November 2010.
37. *Spatial Computing, Synthetic Biology, and Emerging IP Challenges*, Creative Commons, November 2010.
38. *PACEM: The Colored Power Approach to Energy Demand Management*, MIT Energy Initiative Fall 2010 Conference, October 2010.
39. *Spatial Computing: From Manifold Geometry to Biology*, Computer Science Colloquium, Univ. Colorado Boulder at Boulder, October 2010.
40. *Spatial Computing and Proto*, Lecture for Harvard course CS 266 “Bio-inspired Distributed and Multi-Agent Systems,” Harvard, April 2010.
41. *Composable Continuous-Space Programs for Robotic Swarms*, Seminar lecture at Harvard, March 2010.
42. *Composable Continuous-Space Programs for Robotic Swarms*, iRobot, July 2009.
43. *PACEM: Cooperative Control for Citywide Energy Management*, Massachusetts Technology Transfer Offices Day, June 2009.
44. *Spatial Computing*, presented on “Grand Challenges” panel at IEEE SASO 2008, October 2008.
45. *BioBricks & High-Level Programming*, MIT Synthetic Biology Lunch seminar series, April 2008.
46. *Spatial Computing and the Challenge of Engineered Emergence*, Harvard CRCS Privacy and Security Lunch Seminar, April 2008.
47. *Programming Cell Aggregates*, MIT Synthetic Biology Lunch seminar series, January 2008.
48. *Learning by Learning to Communicate*, Dartmouth College, October 2007.
49. *Principles for Engineered Emergence*, Unconventional Computation: Quo Vadis?, March 2007.
50. *Programming Manifolds*, Dagstuhl Seminar 06361, “Computing Media and Languages for Space-Oriented Computation,” September 2006.
51. *Integration by Coincidence: Status and Speculation*, MIT Biologically Inspired Cognitive Architectures (BICA) workshop, January 2006.
52. *Programming an Amorphous Medium*, Unconventional Programming Paradigms workshop, September 2004.

8 Awards and Honors

- 2016 Best Paper Award, IEEE SASO 2016
- 2015 Senior Member, IEEE
- 2013 Best Demonstration Award, IEEE SASO 2013
- 2012 Best Demonstration Award, IEEE SASO 2012
- 2008 Best Paper Award (Artificial Intelligence & Agents Theme), ACM SAC 2008
- 2000 Tau Beta Pi, Engineering Honor Society