

# 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:

Engineering Fellow, Raytheon BBN Technologies	2021 - present
Senior Scientist, Raytheon BBN Technologies	2017 - 2021
Scientist, Raytheon BBN Technologies	2008 - 2017
Research Affiliate, University of Iowa, Electrical & Computer Eng.	2013 - present
Research Affiliate, MIT CSAIL / Biological Engineering	2008 - 2018
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	10 terms, 7 summers, 2001-2007

## 2 Grants and Contracts

1. **Raytheon Internal R&D**, *Synthetic Biology*, Jacob Beal, Miles Rogers; Oct. 2021 – Dec. 2021, Funding not disclosable.
2. **NIH**, *CRISPR logic circuits for safe and controllable gene therapies*, Samira Kiani (PI), Mo Ebrahimi-kiani, Jacob Beal November 2020 – February 2022, BBN portion \$205K.
3. **Raytheon Internal R&D**, *Synthetic Biology*, Jacob Beal, Susan Katz, Miles Rogers; Aug. 2019 – June 2020, Funding not disclosable.
4. **DARPA BTO**, *SHEOL: Subterranean Hidden Explosives Organismal Locator*, Allison Taggart (PI), Jacob Beal, Natalie Farny (co-PI), Susan Katz, Michael Nicoletti, Scott Ritter, Dan Wyschogrod, Eric Young (co-PI); Aug. 2019 – Feb. 2021, \$1.6M.
5. **IARPA**, *Develop FAST-NA Screening Technology*, Jacob Beal (PI), Dan Wyschogrod (co-PI), Adam Clore (co-PI); April 2019 – Dec. 2020, \$762K; add-on to Harvard grant *Rapid Tests for Virus Genes the Suppress the Host Antiviral Defenses*, Pamela Silver (PI), Jeffrey Way (co-PI), John Glass (co-PI).
6. **DARPA BTO**, *INSPECT: IN Situ Phenotype Evaluation using CMOS Technology*, Aaron Adler (PI), Fusun Yaman, Susan Katz, Bryan Bartley, Tom Mitchell, Jacob Beal, Slava Epstein (co-PI), David Weitz (co-PI), Jacob Rosenstein (co-PI), Meni Wanunu (co-PI), Ron Weiss (co-PI), Hua Wang (co-PI), Marcia Goldberg (co-PI); Feb. 2019 – July 2022, \$7.0M
7. **IARPA**, *GUARDIAN: Guard for Uncovering Accidental Release, Detecting Intentional Alterations, and Nefariousness*, Nicholas Roehner (PI), Aaron Adler, Fusun Yaman, Susan Katz, Jacob Beal, Dennis Eastburn (co-PI), Adam Abate (co-PI), Joel Bader (co-PI), Eric Young (co-PI), Mona Singh (co-PI), Daniel Wyschogrod, Stavros Tsakalidis; June 2018 – April 2022, funding not yet disclosable.
8. **IARPA**, *Applicability of Malware Signature Extraction to Nucleic Acid Screening*, Jacob Beal (PI), Dan Wyschogrod (co-PI), Adam Clore (co-PI), Aaron Adler, Fusun Yaman, Susan Katz; Feb. 2018 – Feb. 2019, \$777K.
9. **Internal R&D**, *Synthetic Biology*, Aaron Adler (co-PI), Fusun Yaman (co-PI), Susan Katz, Jacob Beal, Joseph Loyall, Oct. 2017 – Sept. 2019, Funding not disclosable.
10. **DARPA I2O**, *XPlan: Domain-Agnostic Experimental Planning*, Daniel Bryce (PI), Jacob Beal (co-PI), Robert Goldman, Sept. 2017 – April 2022, \$3,865K.
11. **DARPA TTO**, *CCAST: Command and Control of Aggregate Swarm Tactics*, Shane Clark (PI), Christopher Miller (co-PI), Julie Adams (co-PI), Kyle Usbeck, Jacob Beal, Kerry Moffitt, Oct. 2017 - Apr. 2021, funding not yet disclosable.

12. **DARPA I2O**, *Causal Hypotheses from Analysis of Obscure Systems (CHAOS)*, James Gentile (PI), Mohammed Eslami (co-PI), Jacob Beal (co-PI), Eric Eaton (co-PI), Aug. 2017 – Feb. 2019, \$282K.
13. **AFRL**, *MTIP ISR Tasking for the Enterprise (MITE)*, Kyle Usbeck (PI), Jacob Beal, June 2017 – Nov. 2018, \$893K.
14. **DARPA BTO**, *FACETS: Fabrication of Autonomously Constructed Engineered Three-dimensional Shapes*, Ron Weiss (PI), Jacob Beal (co-PI), Jonathan Babb, Ed Boydon (co-PI), Stas Shvartsman (co-PI), May 2017 – May 2019, \$583K.
15. **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, April 2017 – March 2021, Funding not yet disclosable.
16. **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, BBN portion \$60K
17. **Semiconductor Research Corporation**, *Preparation of Roadmap Report on Biological System Design*, Jacob Beal (PI), January 2017 – May 2017, \$15K
18. **DARPA DSO**, *Kaleidoscope: Turning System Design Inside-Out*, Alice Leung (PI), Prithwish Basu, Jacob Beal, William Ferguson, Elizabeth Munch, August 2016 – July 2017, \$571K.
19. **NSF Expeditions, subcontracted through Boston University and MIT**, *Living Computing Project*, Doug Densmore (PI), Ron Weiss (co-PI), Jacob Beal (co-PI), Peter Carr (co-PI), Domitilla Del Vecchio (co-PI), Tim Lu (co-PI), Mo Khalil (co-PI), Wilson Wong (co-PI), December 2015 – November 2020, BBN portion \$500K.
20. **DARPA I2O**, *Aggregate Computing and Resiliency in Distributed Systems*, Jacob Beal (PI), July 2014 – September 2015, \$500K
21. **Autodesk**, *Cyborgization of BioCompiler*, Jacob Beal (PI), Jul. 2014 – March 2015. Funding not disclosable.
22. **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 \$348K
23. **Zome Energy Networks**, Jacob Beal (PI), strategic technology consulting, April, 2011 – Dec, 2012. Funding not disclosable.
24. **DARPA DSO** *Morphogenetically Assisted Design Variation (MADV)*, Jacob Beal (PI), Aaron Adler (co-PI), Fusun Yaman, Annan Mozeika, Susan Katz, Jan., 2011–Feb., 2014, \$1,194K
25. **Internal R&D**, *TASBE Web-tools*, Jacob Beal (PI), Aaron Adler, Fusun Yaman, March 2012–Sept. 2012, Funding not disclosable.
26. **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, \$995K.
27. **DARPA TTO, subcontracted through BAE Systems META ARRoW Program**, Joseph Loyall, Jacob Beal, Kurt Rohloff, July 2010–Oct. 2011. Funding not disclosable.
28. **MIT Energy Initiative Seed Fund PACEM: Cooperative Control for Citywide Energy Management**, Jacob Beal, Hal Abelson (PI), 2008–2010, \$90K.

29. **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–Sept. 2009, \$600K.
30. **NSF Robust Intelligence Grant** *Robustness from Non-Stop Collaboration*, Jacob Beal, Keith Bonawitz, Patrick Winston (PI), Gerald Jay Sussman (co-PI), Nov. 2005–Nov. 2008, \$500K.

### 3 Patents

1. **Design of Time-Delayed Safety Switches for CRISPR Gene Therapy**, Jacob Beal, Samira Kiani, Helen Scott, preliminary filing December, 2021, preliminary filing 63/288302.
2. **Generating Subsequence Catalogs for Nucleic Acid Synthesis**, Jacob Beal, filed April 2021, pending as U.S. Patent Application No. US 17/232749.
3. **FAST-NA for Threat Detection in High-Throughput Sequencing**, Jacob Beal, Tom Mitchell; Daniel Wyschogrod, filed February, 2021, pending as U.S. Patent Application No. US 17/181865
4. **FAST-NA for Detection and Diagnostic Targeting**, Jacob Beal, Tom Mitchell; Daniel Wyschogrod, Allison Taggart, filed February, 2021, pending as U.S. Patent Application No. US 17/181858
5. **Programmable Structural DNA Building Materials**, Anthony Serino, Jacob Beal, Miles Rogers, filed December 2020, pending as U.S. Patent Application No. 17/129197
6. **Identifying Signature Snippets for Nucleic Acid Sequence Types**, Jacob Beal, Daniel Wyschogrod, Steven Jilcott, filed October 2020, Granted as US 11056213 (July, 2021)
7. **Random Codeword Generation for DNA Storage**, Boulat Bash, Jacob Beal, preliminary application filed October, 2017.
8. **Gene Tagging: Tagging Endogenous Genes with miRNAs to Sense mRNA Expression with Multi-Input miRNA Sensors and Memory Devices**, Yinqing Li, Jonathan Babb, Jeremy Gam, Ron Weiss, Jon Chesnut, Jacob Beal, filed June, 2017, Pending as US Provisional case 62/517666
9. **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.
10. **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
11. **Triangulated Rules Engine**, Bradley Kayton, Jon Rappaport, Jacob Beal, filed July 2012. Pending as U.S. Patent Application No. US 13/549245.
12. **Probabilistic Measurement and Verification**, Bradley Kayton, Jon Rappaport, Jacob Beal, filed July 2012. Pending as U.S. Patent Application No. US 13/548802.
13. **Virtual Mass Emulator**, Bradley Kayton, Jon Rappaport, Jacob Beal, Vinayak Ranade, Bradley LaRonde, filed June 2012. Granted as US 9111055 (August, 2015).
14. **Robotic Fabricator**, Annan Michael Mozeika, Aaron Adler, Fusun Yaman-Sirin, Jacob Beal, filed June, 2012 as U.S. Patent Application No. 13/530664, EP2537642.
15. **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) and US 10182760 (January 2019).

16. **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).
17. **Methods and Apparatus for Energy Demand Management**, Jacob Beal and Jonathan Bachrach, filed February, 2009. Granted as US 8271147 (September, 2012), US 8583291 (November, 2013), CA 2753678, and WO 2010-098824. *Further pending as US 2013-0103216, EP 2401797.*

## 4 Teaching

### 4.1 (Co)Supervised Theses

Yuanqiu Mo	Ph.D.	U. Iowa	December 2019	Stability of Aggregate Computing
Meher Samineni	M.S.	U. Utah	August 2018	Software Compliance Testing for Workflows Using the Synthetic Biology Open Language
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 2014 - Spring 2017 (approx. 10 - 20 enrolled students).
- Co-taught University of Iowa ECE course on Wireless Sensor Networks, Fall 2013 - Fall 2016 (approx. 15 - 20 enrolled students).
- 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).
- Conference and summer-school tutorials are listed below, in Section 7.2.

## 5 Professional Service

### 5.1 Panels / Commissions / Standards Organizations

- Member, NIST Flow Cytometry Standards Consortium (January, 2021 - Present)
- Chair of iGEM Engineering Committee (November, 2020 - Present)
- Member, International Gene Synthesis Consortium (April, 2020 - Present)
- Advisory Board, IEEE International Conference on Autonomic Computing and Self-Organizing Systems (December, 2019 - Present)
- Community Liaison for SBOL Industrial Consortium (June, 2019 - Present)
- Chair of BBN Science Development Program Publications Committee (January, 2019 - Present)
- Steering Committee for Synthetic Biology Open Language (January, 2016 - Present)
- Scientific Advisory Board, BioRoboost Consortium (March, 2019 - September, 2021)
- Army Center for Biological Engineering Study Panel (June-July, 2020)
- Chair of Genome Project-write (GP-write) Consortium Standards, Quality Control, and Reporting Working Group (2017 - 2020)
- Genome Project-write (GP-write) Consortium Technology and Infrastructure Development Working Group (2017 - 2020)
- Chair of iGEM Measurement Committee (2014 - 2020)
- Steering Committee of IEEE International Conference on Self-Adaptive and Self-Organizing Systems (2013 - December, 2019).
- Roadmap Executive Committee, SRC SemiSynBio Roadmap Project (June, 2015 - October, 2018)
- Co-Chair of Biological System Design Automation Working Group, SRC SemiSynBio Roadmap Project (June, 2015 - October, 2018)
- 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 - 2019 at BBN Technologies.
- Organizer, Synthetic Biology Seminar Series, 2017 - 2018 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 Conferences, Workshops, and Symposia

- **2021:**
  - Organizer, Air Force Digital Biology Workshop
- **2019:**
  - Organizer, SBOL Visual: Diagrams for Synthetic Biology (Workshop at iGEM 2019)
  - Organizer, Session on Standards In Industry (SynBioBeta 2019)
- **2018:**
  - Organizer, Software Tools for Synthetic Biology Workflows (Workshop at iGEM 2018)
  - Program Co-Chair, 12th International Conference on Self-Adaptive and Self-Organizing Systems (SASO 2018)
  - Organizer, Software for Synthetic Biology Workflows Workshop at Synthetic Biology: Engineering, Evolution and Design (SEED 2018)
- **2017:**
  - Industry & Sponsorship Chair, 11th International Conference on Self-Adaptive and Self-Organizing Systems (SASO 2017)
  - Sponsorship Chair, 9th International Workshop on Bio-Design Automation (IWBDA 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:
  - **2021:** ACS Synthetic Biology; Biomaterials; Computational and Structural Biotechnology Journal; IET Engineering Biology; Swarm Intelligence; The Computer Journal;
  - **2020:** ACS Synthetic Biology; Cellular Immunology; Journal of Medical Virology; Journal of Parallel and Distributed Computing; Molecular Biotechnology; Nature Biotechnology; Soft Computing
  - **2019:** ACM Transactions on Adaptive and Autonomous Systems; Nature Biotechnology; Synthetic Biology



- **2018:** ACS Synthetic Biology; IET Engineering Biology; Nature Biotechnology
- Past approx. 3 years conference program committees (or similar):
  - **2022:** 13th International Conference on Swarm Intelligence (ANTS 2022);
  - **2021:** 2nd IEEE International Conference on Autonomic Computing and Self-Organizing Systems (ACSOS 2021); International Conference on Artificial Life (ALIFE 2021); 15th International Symposium on Distributed Autonomous Robotic Systems/4th International Symposium on Swarm Behavior and Bio-Inspired Robotics (DARS-SWARM 2021); 13th International Workshop on Bio-Design Automation (IWBDA 2021); Lifelike Computing Systems Workshop (LIFELIKE 2021);
  - **2020:** 12th International Conference on Swarm Intelligence (ANTS 2020); 1st IEEE International Conference on Autonomic Computing and Self-Organizing Systems (ACSOS 2020); 12th International Workshop on Bio-Design Automation (IWBDA 2020); Lifelike Computing Systems Workshop (LIFELIKE 2020);
  - **2019:** Workshop on Engineering Collective Adaptive Systems (eCAS 2019); IEEE International Conference on Self-Adaptive and Self-Organizing Systems (SASO 2019); 11th International Workshop on Bio-Design Automation (IWBDA 2019);

## 6 Publications

### 6.1 Journal Articles

1. Jacob Beal, Brian Teague, John T. Sexton, Sebastian Castillo-Hair, Nicholas A. DeLateur, Meher Samineni, Jeffery J. Tabor, Ron Weiss, and the Calibrated Flow Cytometry Study Consortium. *Meeting Measurement Precision Requirements for Effective Engineering of Genetic Regulatory Networks*, under review. Preprint available at bioRxiv <https://doi.org/10.1101/2021.10.10.460840>.
2. Yuanqiu Mo, Soura Dasgupta, Jacob Beal. *Stability and Resilience of Distributed Information Spreading in Aggregate Computing, to appear IEEE Transactions on Automatic Control* <https://arxiv.org/abs/2102.10319>
3. Tramy Nguyen, Nicholas Walczak, Daniel Sumorok, Mark Weston, Jacob Beal. *Intent Parser: A Tool for Codification and Sharing of Experimental Design*, ACS Synthetic Biology, online December 2021. <https://doi.org/10.1021/acssynbio.1c00285>
4. Nicholas Roehner, Jeanet Mante, Chris J Myers, Jacob Beal. *Synthetic Biology Curation Tools (SYNBICT)*, ACS Synthetic Biology, 10 (11), pp. 3200–3204, November 2021.
5. Jeanet Mante, Nicholas Roehner, Kevin Keating, James Alastair McLaughlin, Eric Young, Jacob Beal, Chris J Myers. *Curation Principles Derived from the Analysis of the SBOL iGEM Data Set*, ACS Synthetic Biology, 10 (10), pp. 2592–2606, October 2021.
6. Hasan Baig, Pedro Fontanarossa, James McLaughlin, James Scott-Brown, Prashant Vaidyanathan, Thomas Gorochowski, Goksel Misirli, Jacob Beal, Chris Myers. *Synthetic biology open language visual (SBOL visual) version 3.0*, Journal of Integrative Bioinformatics, 18 (3), Article 20210013, October 2021. <https://doi.org/10.1515/jib-2021-0013>
7. Katherine A. Kiwimagi, Justin H. Letendre, Benjamin H. Weinberg, Junmin Wang, Mingzhe Chen, Leandro Watanabe, Chris J. Myers, Jacob Beal, Wilson W. Wong, Ron Weiss. *Quantitative characterization of recombinase-based digitizer circuits enables predictable amplification of biological signals*, Communications Biology, 4, Article 875, July 2021

8. Hasan Baig, Pedro Fontanarossa, Vishwesh Kulkarni, James McLaughlin, Prashant Vaidyanathan, Bryan Bartley, Shyam Bhakta, Swapnil Bhatia, Mike Bissell, Kevin Clancy, Robert Sidney Cox, Angel Goni Moreno, Thomas Gorochofski, Raik Grunberg, Jihwan Lee, Augustin Luna, Curtis Madsen, Goksel Misirli, Tramy Nguyen, Nicolas Le Novere, Zachary Palchick, Matthew Pocock, Nicholas Roehner, Herbert Sauro, James Scott-Brown, John T. Sexton, Guy-Bart Stan, Jeffrey J. Tabor, Logan Terry, Marta Vazquez Vilar, Christopher A. Voigt, Anil Wipat, David Zong, Zach Zundel, Jacob Beal, Chris Myers. *Synthetic biology open language visual (SBOL Visual) version 2.3*, Journal of Integrative Bioinformatics, 18 (3), Article 20200045, June 2021. <https://doi.org/10.1515/jib-2020-0045>
9. Jacob Beal, Geoff S Baldwin, Natalie G Farny, Markus Gershater, Traci Haddock-Angelli, Russell Buckley-Taylor, Ari Dwijayanti, Daisuke Kiga, Meagan Lizarazo, John Marken, Kim de Mora, Randy Rettberg, Vishal Sanchania, Vinoo Selvarajah, Abigail Sison, Marko Storch, Christopher T. Workman and the iGEM Interlab Study Contributors. *Comparative analysis of three studies measuring fluorescence from engineered bacterial genetic constructs*, PLoS ONE, 16 (6): e0252263, June 2021, <https://doi.org/10.1371/journal.pone.0252263>
10. Yuanqiu Mo, Soura Dasgupta, Jacob Beal. *A Lyapunov Analysis of a Most Probable Path Finding Algorithm*, IEEE Control Systems Letters, 6, pp. 1052–1057, June 2021.
11. Jesse Tordoff, Matej Krajnc, Nicholas Walczak, Matthew Lima, Jacob Beal, Stanislav Shvartsman, Ron Weiss. *Incomplete Cell Sorting Creates Engineerable Structures with Long-Term Stability* Cell Reports Physical Science 2 (1), 100305, January 2021.
12. Jacob Beal and Miles Rogers. *Levels of Autonomy in Synthetic Biology Engineering*, Molecular Systems Biology, 16(12), e10019, December 2020.
13. Giorgio Audrito, Jacob Beal, Ferruccio Damiani, Danilo Pianini, and Mirko Viroli. *Field-based Coordination with the Share Operator*, Logical Methods in Computer Science, vol 16, October 2020. *arXiv preprint, October 2019*. <https://arxiv.org/abs/1910.02874>
14. Jacob Beal, Natalie G. Farny, Traci Haddock-Angelli, Vinoo Selvarajah, Geoff S. Baldwin, Russell Buckley-Taylor, Markus Gershater, Daisuke Kiga, John Marken, Vishal Sanchania, Abigail Sison, Christopher T. Workman, and the iGEM Interlab Study Contributors. *Robust Estimation of Bacterial Cell Count from Optical Density*, Communications Biology, 3(1), pp. 1–29, September 2020. *bioRxiv preprint, October 2019*. <https://doi.org/10.1101/803239>
15. James Alastair McLaughlin, Jacob Beal, Goksel Misirli, Raik Grunberg, Bryan A Bartley, James Scott-Brown, Prashant Vaidyanathan, Pedro Fontanarossa, Ernst Oberortner, Anil Wipat, Thomas E Gorochofski, Chris J Myers. *The Synthetic Biology Open Language (SBOL) Version 3: Simplified Data Exchange for Bioengineering*, Frontiers in Bioengineering and Biotechnology, 8:1009, <https://doi.org/10.3389/fbioe.2020.01009>, September 2020.
16. Bradley Brown, Bryan Bartley, Jacob Beal, Jasmine E Bird, Angel Goni-Moreno, James Alastair McLaughlin, Goksel Misirli, Nicholas Roehner, David James Skelton, Chueh Loo Poh, Irina Dana Ofiteru, Katherine James, Anil Wipat. *Capturing Multicellular System Designs Using the Synthetic Biology Open Language (SBOL)*, ACS Synthetic Biology, 9(9), pp. 2410–2417, September, 2020.
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11. Jacob Beal, Mirko Viroli, Danilo Pianini, and Ferruccio Damiani, *Self-adaptation to Device Distribution Changes*, IEEE International Conference on Self-Adaptive and Self-Organizing Systems (SASO), September 2016. *Received Best Paper Award*.
12. Danilo Pianini, Jacob Beal, and Mirko Viroli, *Improving gossip dynamics through overlapping replicates*, International Conference on Coordination Languages and Models, June 2016.
13. 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.
14. 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.
15. 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.
16. 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.
17. Danilo Pianini, Mirko Viroli, Jacob Beal, *Protelis: Practical Aggregate Programming*, ACM Symposium on Applied Computing 2015, April 2015.
18. 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.
19. Aaron Adler, Fusun Yaman, Jacob Beal, Jeff Cleveland, Hala Mostafa, and Annan Mozeika, *A Morphogenetically Assisted Design Variation Tool*, AAAI, July 2013.
20. Jacob Beal, Aaron Adler, and Hala Mostafa, *Mixed Geometric-Topological Representation for Electromechanical Design*, GECCO 2013, July 2013.
21. Jacob Beal, *Engineered Self-Organization Approaches to Adaptive Design*, 2012 Conference on Through-Life Engineering Services, November 2012.
22. Jacob Beal, Jeff Berliner, and Kevin Hunter, *Fast Precise Distributed Control for Energy Demand Management*, IEEE SASO 2012, September 2012.
23. 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.
24. Mirko Viroli, Danilo Pianini, and Jacob Beal, *Linda in Space-Time: An Adaptive Coordination Model for Mobile Ad-Hoc Environments*, Coordination 2012, June 2012.
25. Michael Atighetchi, Jonathan Webb, Jacob Beal, Brian Krisler, and Michael Mayhew, *Cross Domain Identity Management and Entitlement*, Military Communications Conference (MILCOM), November 2011.
26. Mirko Viroli, Jacob Beal, and Matteo Casadei, *Core Operational Semantics of Proto*, ACM Symposium on Applied Computing 2011, March 2011.
27. Jacob Beal and Richard Schantz, *A Spatial Computing Approach to Distributed Algorithms*, 44th Asilomar Conference on Signals, Systems, and Computers, November 2010.
28. Vinayak V. Ranade, and Jacob Beal, *Distributed Control for Small Customer Energy Demand Management*, IEEE SASO 2010, September 2010.

29. Jacob Beal, *Functional Blueprints: an Approach to Modularity in Grown Systems*, 7th International Conference on Swarm Intelligence (ANTS 2010), September 2010.
30. Nelson Elhage and Jacob Beal *Laplacian-Based Consensus on Spatial Computers*, 9th International Conference on Autonomous Agents and Multiagent Systems (AAMAS 2010), May 2010.
31. Jacob Beal and Jennifer Roberts, *Enhancing Methodological Rigor for Computational Cognitive Science: Complexity Analysis*, Cognitive Science Conference, July 2009.
32. Jennifer Roberts and Jacob Beal, *Enhancing Methodological Rigor for Computational Cognitive Science: Core Tenets and Ad Hoc Residuals*, Cognitive Science Conference, July 2009.
33. 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.
34. 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.
35. 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.
36. Jacob Beal, *Flexible Self-Healing Gradients*, ACM Symposium on Applied Computing 2009, March 2009.
37. Jonathan Bachrach, Jacob Beal, Joshua Horowitz, and Dany Qumsiyeh, *Empirical Characterization of Discretization Error in Gradient-based Algorithms*, IEEE SASO 2008, October 2008.
38. 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.
39. Jacob Beal, *Learning Composable Signals for a Cognitive Substrate*, Cognitive Science Conference, July 2008.
40. Jacob Beal, *Shared Focus of Attention for Heterogeneous Agents*, Short Paper, 7th International Conference on Autonomous Agents and Multiagent Systems (AAMAS 2008), May 2008.
41. 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)*.
42. Jonathan Bachrach, Jacob Beal, and Takeshi Fujiwara, *Continuous Space-Time Semantics Allow Adaptive Program Execution*, IEEE SASO 2007, July 2007.
43. Jacob Beal, *What the Assassins' Guild Taught Me About Distributed Computing*, International Conference on Complex Systems (ICCS) 2006, June 2006.
44. Jacob Beal and Sara Bennett, *Predictive Modelling for Fisheries Management in the Colombian Amazon*, International Conference on Complex Systems (ICCS) 2004, June 2004.
45. Jacob Beal, *An Algorithm for Bootstrapping Communications*, International Conference on Complex Systems (ICCS), June 2002.

## 6.4 Peer-Reviewed Conference Abstracts

1. Jake Sumner Ajibode, Jacob Beal, James Scott-Brown, Thomas Gorochofski, Chris Myers and Goksel Misirli. *Towards collaborative and automated development of resources for data standards in synthetic biology*, 13th International Workshop on Bio-Design Automation (IWBDA), September 2021.
2. Julian Abam, Jeanet Mante, Isabel Potzsch, Jake Beal and Chris Myers. *Excel-SBOL Converter: Creating SBOL from Excel Templates and Vice Versa*, 13th International Workshop on Bio-Design Automation (IWBDA), September 2021.
3. Nicholas Roehner, Jacob Beal, Bryan Bartley, Richard Markeloff, Tom Mitchell, Tramy Nguyen, Daniel Sumorok, Nicholas Walczak, Chris Myers, Zach Zundel, James Scholz, Benjamin Hatch, Mark Weston and John Colonna-Romano. *Data Representation in the DARPA SD2 Program*, 13th International Workshop on Bio-Design Automation (IWBDA), September 2021.
4. Daniel Bryce, Robert P. Goldman, Matthew DeHaven, Jacob Beal, Tramy Nguyen, Nicholas Walczak, Mark Weston, George Zheng, Josh Nowak, Joe Stubbs, Niall Gaffney, Matthew Vaughn, Chris Myers. *Round-Trip: An Automated Pipeline for Experimental Design, Execution, and Analysis*, 12th International Workshop on Bio-Design Automation (IWBDA), August 2020.
5. Tramy Nguyen, Nicholas Walczak, Jacob Beal, Daniel Sumorok, Mark Weston. *Intent Parser: a tool for codifying experiment design*, 12th International Workshop on Bio-Design Automation (IWBDA), August 2020.
6. Jacob Beal, Daniel Sumorok, Bryan Bartley, Tramy Nguyen. *Collaborative Terminology: SBOL Project Dictionary*, 12th International Workshop on Bio-Design Automation (IWBDA), August 2020.
7. Matthew Crowther, Lewis Grozinger, James McLaughlin, Goksel Misirli, Jacob Beal, Bryan A. Bartley, Angel Goni-Moreno, Anil Wipat. *Describing engineered biological systems with SBOL3 and Short-BOL2*, 12th International Workshop on Bio-Design Automation (IWBDA), August 2020.
8. Jacob Beal, Nicholas Roehner, Bryan Bartley, Daniel Sumorok, and Thomas Mitchell. *Cross-Organization Exchange of Data, Meta-Data, and Knowledge*, Synthetic Biology for Defense (SB4D), September 2019.
9. Bryan Bartley, Brian Basnight, Jesse Tordoff, Jacob Beal, Ron Weiss. *The Morphogen Circuit Builder and Compiler* 11th International Workshop on Bio-Design Automation (IWBDA), July 2019.
10. Goksel Misirli, Jacob Beal, Thomas E. Gorochofski, Guy-Bart Stan, Anil Wipat, Chris Myers. *SBOL Visual 2 Ontology* 11th International Workshop on Bio-Design Automation (IWBDA), July 2019.
11. Giorgio Audrito, Mirko Viroli, Ferruccio Damiani, Danilo Pianini, and Jacob Beal. *On a Higher-order Calculus of Computational Fields*, “journal-first” track, Formal Techniques for Distributed Objects, Components, and Systems (FORTE), June 2019.
12. Jesse Tordoff, Jacob Beal, Ron Weiss, Bryan Bartley, Gizem Gumuskaya, Katherine Kiwimagi, Matej Krajnc, Kevin Lebo, Stanislav Shvartsman, Allen Tseng and Nicholas Walczak. *Toward Programming 3D Shape Formation in Mammalian Cells*, 10th International Workshop on Bio-Design Automation (IWBDA), August 2018.
13. Bryan Bartley, Christian Atallah, Alasdair Humphries, Vishwesh Kulkarni, Curtis Madsen, Goksel Misirli, Angel Goni-Moreno, Tramy Nguyen, Ernst Oberortner, Nicholas Roehner, Meher Samineni, Zach Zundel, Jacob Beal, Chris Myers, Herbert Sauro, Anil Wipat. *The Synthetic Biology Open Language Supports Integration of the Engineering Life-Cycle for Synthetic Biologists*, 10th International Workshop on Bio-Design Automation (IWBDA), August 2018.

14. Nicholas Roehner, Bryan Bartley, Jacob Beal, James McLaughlin, Matthew Pocock, Michael Zhang, Zach Zundel, Chris Myers and Anil Wipat. *Specifying Combinatorial Designs with the Synthetic Biology Open Language*, 10th International Workshop on Bio-Design Automation (IWBD A), August 2018.
15. Jesse Tordoff, Matej Krajnc, Nicholas Walczak, Bryan Bartley, Stanislav Y. Shvartsman, Ron Weiss, Jacob Beal. *Programming Self-Organizing Multicellular Shapes*, Mammalian Synthetic Biology Workshop (MSBW), May 2018.
16. Kiri Choi, Nicholas Roehner, Bryan Bartley, Jacob Beal, Kevin Clancy, Goksel Misirli, Raik Grunberg, Ernst Oberortner, Matthew Pocock, Michael Bissell, Curtis Madsen, Tramy Nguyen, Michael Zhang, Zhen Zhang, Zach Zundel, Douglas Densmore, John Gennari, Anil Wipat, Herbert Sauro, and Chris Myers. *Managing the Design-Build-Test Cycle for Synthetic Biology with the Synthetic Biology Open Language*, DNA 23, September 2017
17. Jacob Beal, Nicholas DeLateur, Brian Teague, Ron Weiss, John Sexton, Sebastian Castillo-Hair, and Jeffrey J. Tabor, *Toward Quantitative Comparison of Fluorescent Protein Expression Levels via Fluorescent Beads*, 9th International Workshop on Bio-Design Automation (IWBD A), August 2017.
18. Jacob Beal, *Mathematical Foundations of Variation in Gene Expression*, IET/SynBiCITE Engineering Biology Conference, December 2016.
19. Jacob Beal and Ron Weiss, *Design for Improved Repression in RNA Replicons*, 8th International Workshop on Bio-Design Automation (IWBD A), August 2016.
20. 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.
21. Jacob Beal, *Design of Biological Circuits Using Signal-to-Noise Ratio*, International Workshop on Bio-Design Automation (IWBD A), August 2015.
22. 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 (IWBD A), August 2015.
23. 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 (IWBD A), June 2014.
24. Kyle Usbeck and Jacob Beal, *WebProto: Aggregate Programming for Everyone*, demonstration abstract, IEEE SASO, September 2013 *Received Best Demonstration Award*.
25. Bernat Wiandt, Vilmos Simon, Andras Kokuti, and Jacob Beal, *Spatial Computing Meets Realistic Mobile Wireless Problems*, demonstration abstract, IEEE SASO, September 2013.
26. Fusun Yaman, Aaron Adler, and Jacob Beal, *How can AI help Synthetic Biology?*, Senior Member Talk, AAAI, July 2013.
27. 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.
28. 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.

29. 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.
30. 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.
31. Michal Galdzicki, Ernst Oberortner, Matthew Pocock, Jacqueline Quinn, Mandy Wilson, Evan Appleton, Bryan Bartley, Jacob Beal, Swapnil Bhatia, Robert Cox, Raik Gruenberg, 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.
32. 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*.
33. 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.
34. Jacob Beal and Fusun Yaman, *Toward Automated Design of Cell State Detectors*, 4th International Workshop on Bio-Design Automation, June 2012.
35. Jacob Beal and Aaron Adler, *Automated Design of Synthetic Biology Feedback Circuits*, 2012 Institute of Biological Engineering Conference, March 2012.
36. Aaron Adler, Fusun Yaman, Jeffrey Cleveland, and Jacob Beal, *Morphogenetically Assisted Design Variation*, 2nd International Conference on Morphological Computation, September 2011.
37. Jacob Beal, *Bridging Biology and Engineering Together with Spatial Computing*, International Conference on Membrane Computing, August, 2011.
38. 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.
39. 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.
40. 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.
41. 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.
42. Jacob Beal, Ting Lu, and Ron Weiss, *Automatic Compilation from High-Level Languages to Genetic Regulatory Networks*, 2nd International Workshop on Bio-Design Automation (IWBDAs), June 2010.
43. Jacob Beal, *Functional blueprints: a means of adaptive integration?*, First International Workshop on Morphogenetic Engineering, June 2009.

44. Jonathan Bachrach and Jacob Beal, *Programming a Sensor Network as an Amorphous Medium*, extended abstract for poster at IEEE DCOSS 2006, June 2006.
45. Jacob Beal and Seth Gilbert, *Analyzing Failures as Noise*, LIDS Student Conference, MIT, January 2004.

## 6.5 Workshops, Symposia, and Seminars

1. Hunza Zainab, Giorgio Audrito, Soura Dasgupta, Jacob Beal. *Effect of Monotonic Filtering on Graph Collection Dynamics*, Workshop on Engineering Collective Adaptive Systems (eCAS), September 2021. *Extended arXiv version entitled "Monotonic filtering for distributed collection" at: <https://arxiv.org/abs/2107.05791>*
2. Hunza Zainab, Giorgio Audrito, Soura Dasgupta, Jacob Beal. *Improving Collection Dynamics by Monotonic Filtering*, Workshop on Engineering Collective Adaptive Systems (eCAS), August 2020.
3. Aaron Paulos, Soura Dasgupta, Jacob Beal, Yuanqiu Mo, Khoi Hoang, J. Bryan Lyles, Partha Pal, Richard Schantz, Jon Schewe, Ramesh Sitaraman, Alexander Wald, Christabel Wayllace, and William Yeoh. *A Framework for Self-Adaptive Dispersal of Computing Services*. Workshop on Engineering Collective Adaptive Systems (eCAS), June 2019.
4. Khoi D. Hoang, Christabel Wayllace, William Yeoh, Jacob Beal, Soura Dasgupta, Yuanqiu Mo, Aaron Paulos, and Jon Schewe. *New Distributed Constraint Satisfaction Algorithms for Load Balancing in Edge Computing: A Feasibility Study*. International Workshop on Optimization In Multi-Agent Systems (OptMAS-19), May 2019.
5. Daniel Bryce, Robert Goldman, Ugur Kuter, Alex Plotnick, Matt DeHaven, Chris Geib, Jake Beal, Nic Roehner and Bryan Bartley. *Formalizing Sample Transformation Plans*, AAAI Fall Symposium on AI for Synthetic Biology, October 2018.
6. Yuanqiu Mo, Jake Beal and Soura Dasgupta. *An Aggregate Computing Approach to Self-Stabilizing Leader Election*, Workshop on Engineering Collective Adaptive Systems (eCAS), September 2018.
7. Ugur Kuter, Robert P Goldman, Daniel Bryce, Jacob Beal, Matthew DeHaven, Christopher S. Geib, Alexander F. Plotnick, Tramy Nguyen, Nicholas Roehner. *XPlan: Experiment Planning for Synthetic Biology*, Hierarchical Planning, June 2018.
8. Yuanqiu Mo, Jacob Beal, and Soura Dasgupta, *Error in Self-Stabilizing Spanning-Tree Estimation of Collective State*, Workshop on Engineering Collective Adaptive Systems (eCAS), September 2017.
9. Matteo Francia, Danilo Pianini, Jacob Beal, and Mirko Viroli, *Towards a Foundational API for Resilient Distributed Systems Design*, Workshop on Engineering Collective Adaptive Systems (eCAS), September 2017.
10. 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.
11. 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.
12. 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.

13. Amy Kumar, Jacob Beal, Soura Dasgupta, Raghuraman Mudumbai, *Toward Predicting Distributed Systems Dynamics*, Spatial and Collective Pervasive Computing Systems (SCOPES), September 2015.
14. Jacob Beal and Mirko Viroli, *Building blocks for aggregate programming of self-organising applications*, Workshop on Fundamental of Collective Adaptive Systems (FoCAS), September 2014.
15. Jacob Beal, Mirko Viroli, and Ferruccio Damiani, *Towards a Unified Model of Spatial Computing*, 7th Spatial Computing Workshop (SCW'14), May 2014.
16. 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.
17. 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.
18. 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.
19. Jacob Beal, *Accelerating Approximate Consensus with Self-Organizing Overlays*, 6th Spatial Computing Workshop, May 2013.
20. Jacob Beal, *A Tactical Command Approach to Human Control of Vehicle Swarms*, AAAI 2012 Fall Symposium "Human Control of Bio-Inspired Swarms," November 2012.
21. Jacob Beal, *A Dimensionless Graceful Degradation Metric for Quantifying Resilience*, Workshop on Evaluation of Self-Adaptive and Self-Organizing Systems, IEEE SASO, September 2012.
22. Jacob Beal, Kyle Usbeck and Brian Krisler, *Lightweight Simulation Scripting with Proto*, 5th Spatial Computing Workshop (SCW'12) at AAMAS 2012, June 2012.
23. Kyle Usbeck and Jacob Beal, *An Agent Framework for Agent Societies*, Actors and Agents Reloaded (AGERE) at SPLASH 2011, October 2011.
24. Jacob Beal and Kyle Usbeck, *On the Evaluation of Space-Time Functions*, 4th Spatial Computing Workshop (SCW) at IEEE SASO 2011, October 2011.
25. 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.
26. 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.
27. Jacob Beal, *A Basis Set of Operators for Space-Time Computations*, 3rd Spatial Computing Workshop, September 2010.
28. Jacob Beal, Alice Leung, and Robert Laddaga, *Spectrum Curricula: Design and Initial Results*, Learning By Demonstration section of 2010 AAAI Robotics Exhibition, July 2010.
29. 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.



30. 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
31. Jacob Beal, *Dynamically Defined Processes for Spatial Computers*, Spatial Computing Workshop 2009, September 2009.
32. 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.
33. 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.
34. Jacob Beal and Gerald Jay Sussman, *Engineered Robustness by Controlled Hallucination*, AAAI 2008 Fall Symposium “Naturally-Inspired Artificial Intelligence,” November 2008.
35. Jacob Beal and Jonathan Bachrach, *Cells Are Plausible Targets for High-Level Spatial Languages*, Spatial Computing Workshop, October 2008.
36. Rachel Greenstadt and Jacob Beal, *Cognitive Security for Personal Devices*, First ACM workshop on Artificial Intelligence and Security (AISec), October 2008.
37. Jonathan Bachrach and Jacob Beal, *Autonomy in Spatial Computing*, Third Workshop on Hot Topics in Autonomic Computing, June 2008.
38. Jacob Beal, *Developmental Cost for Models of Intelligence*, AAAI 2007 Workshop on Evaluating Architectures for Intelligence, July 2007.
39. Jacob Beal and Jonathan Bachrach, *Programming Manifolds*, Dagstuhl Seminar 06361: Computing Media and Languages for Space-Oriented Computation, Andre DeHon, Jean-Louis Giavitto, and Frederic Gruau eds, December 2006.
40. Jacob Beal, *Sidestepping Impossibility: Combat Consensus in the Assassins’ Guild*, MIT CSAIL Student Workshop 2006, September 2006.
41. 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.
42. Jacob Beal, *Amorphous Medium Language*, Large-Scale Multi-Agent Systems Workshop at AAMAS, July 2005.
43. 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.
44. 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, Thomas Mitchell, Daniel Wyschogrod, Jeff Manthey, Adam Clore, *Highly Distinguished Amino Acid Sequences of 2019-nCoV*, bioRxiv preprint, January, 2020.  
<https://doi.org/10.1101/2020.01.31.929497>
2. Bryan Bartley, Jacob Beal, Jonathan R. Karr, Elizabeth A. Strychalski, *Standards to Enable Genome-Scale Engineering*, GP-Write Consortium, March 2019.
3. Bradley Brown, Christian Atallah, James Alastair McLaughlin, Goksel Misirli, Angel Goni-Moreno, Nicholas Roehner, David James Skelton, Bryan Bartley, Jacob Beal, Chueh Loo Poh, Irina Dana Ofiteru, and Anil Wipat. *Capturing Multicellular System Designs Using the Synthetic Biology Open Language (SBOL)*, bioRxiv preprint, November, 2018. <http://dx.doi.org/10.1101/463844>
4. Victor Zhrinov, et al., *2018 Semiconductor Synthetic Biology Roadmap*, Semiconductor Research Corporation, October, 2018.
5. Jacob Beal and Brian Bramlett, *Summary Report for the SemiSynBio Workshop on an EDA/BDA Interaction Roadmap*, Semiconductor Research Corporation, May 2017.
6. 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>
7. 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>
8. 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.
9. 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*
10. Jacob Beal and Hal Abelson, *PACEM: Cooperative Control for Citywide Energy Management*, whitepaper, August 2008.
11. Jacob Beal, Jonathan Bachrach, and Mark Tobenkin, *Constraint and Restoring Force*, MIT CSAIL Tech Report 2007-044, August 2007.
12. Jonathan Bachrach and Jacob Beal, *Building Spatial Computers*, MIT CSAIL Tech Report 2007-017, March 2007.
13. Jacob Beal, *What the Assassins' Guild Taught Me About Distributed Computing*, MIT CSAIL Technical Report MIT-CSAIL-TR-2006-038, June 2006.

14. Jacob Beal, *Learning From Snapshot Examples*, MIT AI Memo 2005-012, April 2005.
15. Jacob Beal, Tim Shepard, *Shrinking the Leap of Faith*, publicly available report, March 2005.
16. Jacob Beal and Gerald Jay Sussman, *Biologically-Inspired Robust Spatial Programming*, MIT AI Memo 2005-001, January 2005.
17. Jacob Beal and Tim Shepard, *Deamplification of DoS Attacks via Puzzles*, publicly available report, October 2004.
18. Jacob Beal, *Near-Optimal Distributed Failure Circumscription*, AI Memo 2003-017, August 2003.
19. Jacob Beal, *A Robust Amorphous Hierarchy from Persistent Nodes*, AI Memo 2003-012, May 2003.
20. Jacob Beal, *Persistent Nodes for Reliable Memory in Geographically Local Networks*, AI Memo 2003-011, April 2003.
21. Jacob Beal, *Leaderless Distributed Hierarchy Formation*, AI Memo 2002-021, December 2002.
22. 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. *SBOL Version 3: Data Exchange throughout the Bioengineering Lifecycle*, IWBD, September, 2021.
2. *Quantifying fluorescence and cell count with plate readers*, iGEM 2021 Summer Webinar Series, June 2021.  
Prior version given in iGEM 2020 Summer Webinar Series, July 2020.
3. *Quantifying fluorescence and cell phenotypes with flow cytometry*, iGEM 2021 Summer Webinar Series, June 2021.  
Prior version given in iGEM 2020 Summer Webinar Series, July 2020.
4. *Analysis and visualisation of gene expression data*, After iGEM Academic Publishing Workshops, May, 2021.
5. *SBOL Version 3: Simplified Data Exchange for Bioengineering*, COMBINE, October, 2020.

6. *Introductory SBOL Workshop*, 12th International Workshop of Bio-Design Automation, August 2020 (with other members of the SBOL community).  
Prior versions given at 11th IWBD in July 2019, 10th IWBD in August 2018, 9th IWBD in August 2017, 8th IWBD in August 2016.
7. *SBOL Visual: Diagrams for Synthetic Biology*, International Genetically Engineered Machine Jamboree (iGEM 19), November 2019.
8. *Software Tools for Synthetic Biology Workflows*, International Genetically Engineered Machine Jamboree (iGEM 18), October 2018.
9. *Software Workflows for Synthetic Biology*, Synthetic Biology: Engineering, Evolution and Design (SEED 18), June 2018.
10. *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.
11. *Predictable Self-Organization with Computational Fields*, with Mirko Viroli, IEEE International Conference on Self-Adaptive and Self-Organizing Systems (SASO), September 2014.
12. *High-Level Genetic Circuit Design: The Proto BioCompiler*, MIT, March 2014.
13. *TASBE Synthetic Biology Tools*, Boston University, June 2013. Also given at MIT in July 2013 and June 2014.
14. *Spatial Computing Approaches for Pervasive Systems*, 2010 Pervasive Adaptation (PerAda) Summer School, September 2010.
15. *Spatial Computing for Networked Collaboration*, International Symposium on Collaborative Technologies and Systems (CTS 2010), May 2010.
16. *Spatial Computing for Swarms*, IEEE International Conference on Self-Adaptive and Self-Organizing Systems (SASO), September 2009.
17. *Spatial Computing: From global to local and back again*, five-lecture series at Third French Complex Systems Summer School, August, 2009.
18. *Introduction to Spatial Computing*, Second International Conference on Robot Communication and Coordination (RoboComm), April 2009.
19. *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. *Agile Data Curation: Foundations for Synthetic Biology... and Beyond!*, New Directions in Software Technology (NDIST '21), December 2021.
2. *Automation-Assisted Flow Cytometry Analysis with TASBE Flow Analytics*, NIST Flow Cytometry Standards Consortium Open Meeting, November, 2021.
3. *Building an Open Bioeconomy*, iGEM Open Talks, September 2021.
4. *Agile Data Curation: Foundations for Digital Biology*, Air Force Digital Biology Workshop, September 2021.

5. *Collaborative Design and Build in the iGEM Engineering Committee*, Synthetic Biology: Engineering, Evolution and Design (SEED 21), June 2021.
6. *Levels of Autonomy in Synthetic Biology Engineering*, AI4SynBio workshop at AAAI, March, 2021.
7. *Building a Synthetic Biology StackExchange*, HARMONY, March, 2021.
8. *Precision genetic device engineering with TASBE Flow Analytics*, NIST Flow Cytometry Standards Consortium Workshop, February, 2021.
9. *From Art to Engineering in Synthetic Biology*, Build-a-Cell Workshop, January 2021.
10. *The iGEM Measurement Committee: Building Solid Foundations for SynBio*, BioRoboost Round Table on SynBio and Education, December 2020.
11. *iGEM Measurement Committee*, New England iGEM (NEGEM) Conference 2020, September 2020.
12. *Moving Synthetic Biology from Artisanal Craftwork to an Engineering Ecosystem*, Virtual Workshop on Biological Engineering of Enhanced Materials and Army Collaborative Center for Biological Engineering, July, 2020.
13. *Biological Information Processing: From Experimentation to Engineering*, Given 3 times, at Microsoft Research UK, University of Bristol, and Imperial College London, March 2020.
14. *SBOL Visual Update*, HARMONY 2020, March 2020.
15. *Foundations for Effective SynBio Engineering*, AI in SynBio ASPSM, November 2019.
16. *Open Standards: Building the Informational Ecosystem of the Bioeconomy*, SynBioBeta, October 2019.
17. *Paths to Resilient Biological Information Processing* CalTech, October, 2019. Similar talks were given at the Workshop on Bio-Design for Portability (BD4P), July 2019 and University College London, July 2019.
18. *Knowledge Tools to Lower Sharing Barriers*, DARPA Joint Data Sharing Meeting, July 2019.
19. *iGEM and the Global SynBio Community* International Workshop on Synthetic Biology standards and standardisation, June 2019.
20. *Super-Intelligence vs. NP-completeness*, New Directions in Software Technology (NDIST '18), December 2018.
21. *iGEM 2018 Interlab Study*, International Genetically Engineered Machine Jamboree (iGEM 18), October 2018.
22. *Metrology Matters: Engineering Biomolecular Circuits*, SynBioBeta 2018, October, 2018.
23. *Engineering Complex Behaviors in Biological Organisms*, University of Arizona, June, 2018.
24. *SBOL Visual 2.0*, Synthetic Biology: Engineering, Evolution and Design (SEED 18), June 2018.
25. *Foundations for Engineered Biomolecular Circuits*, Newcastle University, May, 2018.
26. *Standards Requirements for Genome-Scale Engineering*, GP-Write, May 2018.
27. *An introduction to SBOL Visual 2.0*, GP-Write, May 2018.
28. *Foundational Metrology for Engineering Biomolecular Circuits*, Dagstuhl Seminar 18082, "Formal Methods for the Synthesis of Biomolecular Circuits", February 2018

29. *Surviving Life as a Researcher*, Biomedical Engineering Seminar, University of Iowa, February 2018.
30. *SBOL Visual Quickstart*, BioBuilder Club, January 2018.
31. *iGEM 2017 Interlab Study*, International Genetically Engineered Machine Jamboree (iGEM 17), November 2017.
32. *Engineering Complex Behaviors in Biological Organisms*, ACM Boston, May 2017.
33. *Genome-scale design representation with SBOL*, GP-Write, May 2017.
34. *Aggregate Programming: From Theory to Resilient IoT Services*, University of Iowa, March 2017.
35. *iGEM 2016 Interlab Study*, International Genetically Engineered Machine Jamboree (iGEM 16), October 2016.
36. *Surviving Life as a Researcher*, IEEE SASO 2016 Doctoral Symposium, September 2016.
37. *What EDA can offer to BDA*, SRC Workshop on EDA/BDA Interaction Roadmap, August 2016.
38. *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.
39. *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.
40. *Measuring Biological Computing Devices and Circuits*, Lincoln Laboratories, February 2016.
41. *What you should really learn from immune systems about adversarial design*, New Directions in Software Technology (NDIST '15), December 2015.
42. *SBOL visual: introduction, recent developments, and current challenges*, COMBINE 2015, October 2015.
43. *Report on iGEM Interlab Study*, COMBINE 2015, October 2015.
44. *Development of Standards for Calibrated Flow Cytometry*, COMBINE 2015, October 2015.
45. *iGEM 2015 Interlab Study*, International Genetically Engineered Machine Jamboree (iGEM 15), September 2015.
46. *Engineering Self-Organization: From Networking to Synthetic Biology* Dagstuhl Seminar 15402, "Self-assembly and Self-organization in Computer Science and Biology," September 2015
47. *Ensuring Safe Composition of Distributed Processes*, 2nd Workshop on Quality Assurance for Self-adaptive, Self-organising Systems (QA4SASO 15) at IEEE SASO, September 2015
48. *Synthetic Biology Open Language (SBOL): Community-Driven Standard for Communication of Synthetic Biology Designs*, Synthetic Biology: Engineering, Evolution and Design (SEED 15), June 2015.
49. *Creating Predictable Collective Behaviors with Aggregate Programming*, Dagstuhl Seminar 14512, "Collective Adaptive Systems: Qualitative and Quantitative Modelling and Analysis," December 2014
50. *iGEM 2014 Interlab Study*, International Genetically Engineered Machine Jamboree (iGEM 14), November 2014.
51. *Proto BioCompiler*, Autodesk Workshop at International Genetically Engineered Machine Jamboree (iGEM 14), November 2014.

52. *SBOL Visual: Standard for Synthetic Biology Diagrams*, SynBERC Fall Retreat 2014, September 2014.
53. *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.
54. *Measurements and iGEM 2014*, 3rd New England iGEM Meetup, June 2014.
55. *Merging experimental and computational efforts in BDA*, International Workshop on Bio-Design Automation (IWBD 14), June 2014.
56. *Programming Distributed Algorithms using Computational Fields*, Dagstuhl Seminar 13492, “Geosensor Networks: Bridging Algorithms and Applications,” December 2013
57. *Spatial computing: a unifying approach to computational materials*, Royal Society Meeting on Heterotic Computing, November 2013.
58. *The Importance of Asymmetry for Rapidly Reaching Consensus*, Workshop on Self-Adaptive and Self-Organising Socio-Technical Systems (SASO<sup>ST</sup>), September 2013.
59. *Spatial Computing: From Manifold Geometry to Networking and Biology*, TU Delft, May 2013.
60. *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.
61. *High-Level BioDesign Automation*, SemiSynBio Workshop, February 2013.
62. *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.
63. *Morphogenetic Engineering: The Bilateria approach to design*, New Directions in Software Technology (NDIST ’12), December 2012.
64. *Customer-Centric Restructuring of Energy Markets*, presented on “Smart Grid” panel at Future Energy Conference, November 2012.
65. *From Inspiration to Quantification*, presented on “New Research Directions” panel at IEEE SASO 2012, September 2012.
66. *Spatial Computing: From Manifold Geometry to Networking and Biology*, University of Iowa, February 2012.
67. *Toward Breaking the Complexity Barrier for Synthetic Biology Therapeutics*, IEEE Engineering in Medicine and Biology, August 2011.
68. *Spatial Computing: From Manifold Geometry to Distributed Systems*, TU Delft, Netherlands, August 2011.
69. *High-Level Languages for Synthetic Biology*, MIT Synthetic Biology Lunch seminar series, November 2010.
70. *Automatic Compilation from High-Level Bio-Languages to Genetic Regulatory Networks*, Church Lab & Harvard Molecular Technology Group, November 2010.
71. *Spatial Computing, Synthetic Biology, and Emerging IP Challenges*, Creative Commons, November 2010.

72. *PACEM: The Colored Power Approach to Energy Demand Management*, MIT Energy Initiative Fall 2010 Conference, October 2010.
73. *Spatial Computing: From Manifold Geometry to Biology*, Computer Science Colloquium, Univ. Colorado Boulder at Boulder, October 2010.
74. *Spatial Computing and Proto*, Lecture for Harvard course CS 266 “Bio-inspired Distributed and Multi-Agent Systems,” Harvard, April 2010.
75. *Composable Continuous-Space Programs for Robotic Swarms*, Seminar lecture at Harvard, March 2010.
76. *Composable Continuous-Space Programs for Robotic Swarms*, iRobot, July 2009.
77. *PACEM: Cooperative Control for Citywide Energy Management*, Massachusetts Technology Transfer Offices Day, June 2009.
78. *Spatial Computing*, presented on “Grand Challenges” panel at IEEE SASO 2008, October 2008.
79. *BioBricks & High-Level Programming*, MIT Synthetic Biology Lunch seminar series, April 2008.
80. *Spatial Computing and the Challenge of Engineered Emergence*, Harvard CRCS Privacy and Security Lunch Seminar, April 2008.
81. *Programming Cell Aggregates*, MIT Synthetic Biology Lunch seminar series, January 2008.
82. *Learning by Learning to Communicate*, Dartmouth College, October 2007.
83. *Principles for Engineered Emergence*, Unconventional Computation: Quo Vadis?, March 2007.
84. *Programming Manifolds*, Dagstuhl Seminar 06361, “Computing Media and Languages for Space-Oriented Computation,” September 2006.
85. *Integration by Coincidence: Status and Speculation*, MIT Biologically Inspired Cognitive Architectures (BICA) workshop, January 2006.
86. *Programming an Amorphous Medium*, Unconventional Programming Paradigms workshop, September 2004.

## 8 Awards and Honors

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|------|---|
| 2021 | iGEM Best Veteran Judge   |
| 2021 | BPLA Invented Here! 2021 Award for U.S. Patent No. 11,056,213 entitled “Identifying Signature Snippets for Nucleic Acid Sequence Types” |
| 2019 | Senior Member, American Institute of Chemical Engineers (AIChE)   |
| 2018 | Anita Jones Entrepreneurial Award (BBN award for development of new R&D areas)  |
| 2018 | Outstanding Student Paper (co-author w. student Yuanqiu Mo), IEEE Conference on Decision and Control 2018                               |
| 2016 | Best Paper Award, IEEE SASO 2016  |
| 2015 | Senior Member, Institute of Electrical and Electronics Engineers (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  |