Curriculum Vitae

Jacob Beal

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Contents

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	2021 - present
Senior Scientist, Raytheon BBN	2017 - 2021
Scientist, Raytheon BBN	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

Note: BBN has had several names over the years that I've been there: RTX BBN, Raytheon BBN, Raytheon BBN Technologies, BBN Technologies

2 Grants and Contracts

1. **IARPA**, *Secure Bloom-Filter Analysis and Compression*, Jacob Beal (PI), Daniel Wyschogrod, Allison Taggart, Miles Rogers, May, 2023 - May, 2025, $4.0M.

2. **Science & Technology Futures, Inc.**, *Laboratory Open Protocol Open Datasets (LabOP-OD)*, Dan Bryce (PI), Jacob Beal (co-PI), February 2023 - June, 2023, BBN portion $106K.

3. **International Gene Synthesis Consortium**, *Restricted Pathogens Database Update and Maintenance*, Craig Bartling (PI), Jacob Beal, June 2022 – January 2023, Funding not disclosable.

4. **DARPA BTO**, *Phytosensors 2.0*, C. Neal Stewart (PI), Scott Lenaghan (co-PI), Jacob Beal June 2022 – May 2023, BBN portion $225K.

5. **Internal R&D**, *FAST-NA Risk Reduction*, Jacob Beal, Dan Wyschogrod, Tom Mitchell. April 2022 – December 2022, Funding not disclosable.

6. **Raytheon Internal R&D**, *Synthetic Biology*, Jacob Beal, Miles Rogers; Oct. 2021 – Dec. 2021, Funding not disclosable.

7. **NIH**, *CRISPR logic circuits for safe and controllable gene therapies*, Samira Kiani (PI), Mo Ebrahimkiani, Jacob Beal November 2020 – February 2022, BBN portion $205K.

8. **Raytheon Internal R&D**, *Synthetic Biology*, Jacob Beal, Susan Katz, Miles Rogers; Aug. 2019 – June 2020, Funding not disclosable.

9. **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).

10. **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.

11. **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.

12. **DARPA I2O**, *XPlan: Domain-Agnostic Experimental Planning*, Daniel Bryce (PI), Jacob Beal (co-PI), Robert Goldman, Sept. 2017 – October 2022, BBN portion $3,953K.

13. **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, BBN portion $282K.

14. **AFRL**, *MTIP ISR Tasking for the Enterprise (MITE)*, Kyle Usbeck (PI), Jacob Beal, June 2017 – Nov. 2018, $893K.

15. **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.

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. **Systems and Methods for Evaluating Synthetic Splicing Materials**, Allison Taggart, Miles Rogers, Jacob Beal, preliminary filing November, 2022, U.S. Provisional Application No. 63/421930

2. **Splicing-based Biocontainment**, Allison Taggart, Miles Rogers, Jacob Beal, preliminary filing October, 2022, U.S. Provisional Application No. 63/420496

3. **Design of Time-Delayed Safety Switches for CRISPR Gene Therapy**, Jacob Beal, Samira Kiani, Helen Scott, preliminary filing December, 2021, preliminary filing 63/288302.

4. **Generating Subsequence Catalogs for Nucleic Acid Synthesis**, Jacob Beal, filed April 2021, pending as U.S. Patent Application No. US 17/232749.

5. **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

6. **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

7. **Programmable Structural DNA Building Materials**, Anthony Serino, Jacob Beal, Miles Rogers, filed December 2020, pending as U.S. Patent Application No. 17/129197

8. **Identifying Signature Snippets for Nucleic Acid Sequence Types**, Jacob Beal, Daniel Wyschogrod, Steven Jilcott, filed October 2020, Granted as US 11056213 (July, 2021)

9. **Random Codeword Generation for DNA Storage**, Boulat Bash, Jacob Beal, preliminary application filed October, 2017.

10. **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

11. **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.

12. **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

13. **Triangulated Rules Engine**, Bradley Kayton, Jon Rappaport, Jacob Beal, filed July 2012. Pending as U.S. Patent Application No. US 13/549245.

14. **Probabilistic Measurement and Verification**, Bradley Kayton, Jon Rappaport, Jacob Beal, filed July 2012. Pending as U.S. Patent Application No. US 13/548802.

15. **Virtual Mass Emulator**, Bradley Kayton, Jon Rappaport, Jacob Beal, Vinayak Ranade, Bradley LaRonde, filed June 2012. Granted as US 9111055 (August, 2015).

16. **Robotic Fabricator**, Annan Michael Mozeika, Aaron Adler, Fusun Yaman-Sirin, Jacob Beal, filed June, 2012 as U.S. Patent Application No. 13/530664, EP2537642.

17. **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).

18. **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).

19. **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

Current

- Member, iGEM Engineering Committee (November, 2023 - Present)
- Member, SBOL Industrial Consortium (June, 2023 - Present)
- Member, NIST Flow Cytometry Standards Consortium (January, 2021 - Present)
- Member, International Gene Synthesis Consortium (April, 2020 - Present)
- Advisory Board, IEEE International Conference on Autonomic Computing and Self-Organizing Systems (December, 2019 - present)
- Chair of BBN Science Development Program Publications Committee (January, 2019 - Present)
- Member, ISO/TC276: International Organization for Standardization Biotechnology Technical Committee (May, 2018 - Present)
- Steering Committee for Synthetic Biology Open Language (January, 2016 - Present)

Prior

- Chair of iGEM Engineering Committee (November, 2020 - October, 2023)
- Community Liaison for SBOL Industrial Consortium (June, 2019 - June, 2023)
- 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

- **2022:**
  - Organizer, Workshop on Testing Sequence Screening
  - Co-Chair, NSF ERVA workshop: Leveraging Biology to Power Engineering
- **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 Sythetic 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:
  - **2024:** ACS Synthetic Biology;
  - **2023:** ACS Synthetic Biology; Applied Biosafety; BMC Bioinformatics; OUP Synthetic Biology; Journal of Visualized Experiments (JoVE); PLOS ONE; Swarm Intelligence;
  - **2022:** ACM Transactions on Autonomous and Adaptive Systems; ACS Synthetic Biology; Artificial Life; Current Opinion in Microbiology; Cytometry, Part A; Microbiology Spectrum; Nature Biotechnology; Nature Communications OUP Synthetic Biology;
  - **2021:** ACS Synthetic Biology; Biomaterials; Computational and Structural Biotechnology Journal; IET Engineering Biology; Swarm Intelligence; The Computer Journal;
- Past approx. 3 years conference program committees (or similar):
  - **2024:** 14th International Conference on Swarm Intelligence (ANTS 2024); 5th IEEE International Conference on Autonomic Computing and Self-Organizing Systems (ACSOS 2024);
  - **2023:** 1st Workshop on Autonomic and Self-* Management for the Edge-Cloud Continuum (ASMECC 2023); 4th IEEE International Conference on Autonomic Computing and Self-Organizing Systems (ACSOS 2023); 15th International Workshop on Bio-Design Automation (IWBDA 2022); 8th International Symposium on Software Engineering for Adaptive and Self-Managing Systems (SEAMS 2023)
  - **2022:** 3rd IEEE International Conference on Autonomic Computing and Self-Organizing Systems (ACSOS 2022); 13th International Conference on Swarm Intelligence (ANTS 2022); Int. Symp. on Distributed Autonomous Robotic Systems (DARS 2022); 14th International Workshop on Bio-Design Automation (IWBDA 2022); Lifelike Computing Systems Workshop (LIFELIKE 2022); 7th International Symposium on Software Engineering for Adaptive and Self-Managing Systems (SEAMS 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);

6 Publications

6.1 Journal Articles

1. Jacob Beal, *Flow Cytometry Quantification of Transient Transfections in Mammalian Cells*, to appear, Methods in Molecular Biology (MIMB): Mammalian Synthetic Systems.
   arXiv preprint: https://doi.org/10.48550/arXiv.2305.07948

2. Jacob Beal, Vinoo Selvarajah, Gaël Chambonnier, Traci Haddock, Alejandro Vignoni, Gonzalo Vidal, and Nicholas Roehner, *Standardized Representation of Parts and Assembly for Build Planning*, ACS Synthetic Biology 12, no. 12 (2023): 3646-3655., December 2023.

3. Bryan Bartley, Jacob Beal, Miles Rogers, Daniel Bryce, Robert P Goldman, Benjamin Keller, Peter Lee, Vanessa Biggers, Joshua Nowak, Mark Weston, *Building an Open Representation for Biological Protocols*, ACM Journal on Emerging Technologies in Computing Systems 19, no. 3, pp1-21, June 2023.
bioRxiv preprint: https://doi.org/10.1101/2022.07.05.498808

4. Jacob Beal, Adam Clore, Jeff Manthey, *Studying Pathogens Degrades BLAST-based Pathogen Identification.* Scientific Reports, 13(1), p.5390, April, 2023 *bioRxiv preprint: https://doi.org/10.1101/2022.07.12.499705*

5. Ibrahim Aldulijan, Jacob Beal, Sonja Billerbeck, Jeff Bouffard, Gael Chambonnier, Nikolaos Ntelkis, Isaac Guerreiro, Martin Holub, Paul Ross, Vinoo Selvarajah, Noah Sprent, Gonzalo Vidal, Alejandro Vignoni *Functional Synthetic Biology* Synthetic Biology, Volume 8, Issue 1, April, 2023, https://doi.org/10.1093/synbio/ysad006 *arXiv preprint: https://doi.org/10.48550/arXiv.2207.00538*

6. Lukas Buecherl, Thomas Mitchell, James Scott-Brown, Prashant Vaidyanathan, Gonzalo Vidal, Hasan Baig, Bryan Bartley, Jacob Beal, Matthew Crowther, Pedro Fontanarrosa, Thomas Gorochowski, Raik Grünberg, Vishwesh Kulkarni, James McLaughlin, Goksel Misirli, Ernst Oberortner, Anil Wipat, and Chris Myers. *Synthetic biology open language (SBOL) version 3.1.0.*, Journal of integrative bioinformatics 20, no. 1, 20220058, March 2023.

7. Breschine Cummins, Justin Vrana, Robert C Moseley, Hamed Eramian, Anastasia Deckard, Pedro Fontanarrosa, Daniel Bryce, Mark Weston, George Zheng, Joshua Nowak, Francis C Motta, Mohammed Eslami, Kara Layne Johnson, Robert P Goldman, Chris J Myers, Tessa Johnson, Matthew W Vaughn, Niall Gaffney, Joshua Urrutia, Shweta Gopaulakrishnan, Vanessa Biggers, Trissha Higa, Lorraine Mosqueda, Marcio Gameiro, Tomas Gedeon, Konstantin Mischaikow, Jacob Beal, Bryan Bartley, Tom Mitchell, Tramy T Nguyen, Nicholas Roehner, Steven B Haase, *Robustness and reproducibility of simple and complex synthetic logic circuit designs using a DBTL loop*, Synthetic Biology, Volume 8, Issue 1, March 2023, https://doi.org/10.1093/synbio/ysad005, *bioRxiv preprint: https://doi.org/10.1101/2022.06.10.495560*

8. Yuanqiu Mo, Soura Dasgupta, Jacob Beal. *Stability and Resilience of Distributed Information Spreading in Aggregate Computing*, IEEE Transactions on Automatic Control, 68 (1), January 2023. doi: 10.1109/TAC.2022.3140253.
arXiv preprint: https://arxiv.org/abs/2102.10319

9. Jeanet Mante, Julian Abam, Sai P Samineni, Isabel M Potzsch, Jacob Beal, Chris J Myers, *Excel–SBOL Converter: Creating SBOL from Excel Templates and Vice Versa*, ACS Synthetic Biology, 12 (1), pp. 340–346, January 2023, https://doi.org/10.1021/acssynbio.2c00521
bioRxiv preprint: https://doi.org/10.1101/2022.08.31.505873

10. Yuanqiu Mo, Giorgio Audrito, Soura Dasgupta, and Jacob Beal. *Near-optimal knowledge-free resilient leader election*, Automatica 146, Paper 110583, December 2022. https://doi.org/10.1016/j.automatica.2022.110583

11. Robert P Goldman, Robert Moseley, Nicholas Roehner, Breschine Cummins, Justin D Vrana, Katie J Clowers, Daniel Bryce, Jacob Beal, Matthew DeHaven, Joshua Nowak, Trissha Higa, Vanessa Biggers, Peter Lee, Jeremy P Hunt, Lorraine Mosqueda, Steven B Haase, Mark Weston, George Zheng, Anastasia Deckard, Shweta Gopaulakrishnan, Joseph F Stubbs, Niall I Gaffney, Matthew W Vaughn, Narendra Maheshri, Ekaterina Mikhalev, Bryan Bartley, Richard Markeloff, Tom Mitchell, Tramy Nguyen, Daniel Sumorok, Nicholas Walczak, Chris Myers, Zach Zundel, Benjamin Hatch, James Scholz, John

Colonna-Romano, *Highly-automated, high-throughput replication of yeast-based logic circuit design assessments.*, Synthetic Biology 7, no. 1 (2022): ysac018, October 2022.

12. Jacob Beal, Cheryl A Telmer, Alejandro Vignoni, Yadira Boada, Geoff S Baldwin, Liam Hallett, Taeyang Lee, Vinoo Selvarajah, Sonja Billerbeck, Bradley Brown, Guo-nan Cai, Liang Cai, Edward Eisenstein, Daisuke Kiga, David Ross, Nina Alperovich, Noah Sprent, Jaclyn Thompson, Eric M Young, Drew Endy, Traci Haddock-Angelli *Multicolor plate reader fluorescence calibration*, Synthetic Biology, 7 (1), ysac010, https://doi.org/10.1093/synbio/ysac010, August 2022.

13. Alexander C Pfotenhauer, Alessandro Occhialini, Mary-Anne Nguyen, Helen Scott, Lezlee T Dice, Stacee A Harbison, Li Li, D Nikki Reuter, Tayler M Schimel, C Neal Stewart Jr, Jacob Beal, Scott C Lenaghan, *Building the Plant SynBio Toolbox through Combinatorial Analysis of DNA Regulatory Elements*, ACS Synthetic Biology, 11 (8), pp. 2741-2755, August 2022. https://doi.org/10.1021/acssynbio.2c00147

14. Tom Mitchell, Jacob Beal, and Bryan Bartley, *pySBOL3: SBOL3 for Python Programmers,* ACS Synthetic Biology, 11 (7), pp. 2523-2526, July 2022. https://doi.org/10.1021/acssynbio.2c00249

15. Helen Scott, Dashan Sun, Jacob Beal, and Samira Kiani, *Simulation-Based Engineering of Time-Delayed Safety Switches for Safer Gene Therapies*, ACS Synthetic Biology, 11 (5), pp. 1782-1789, May 2022. https://doi.org/10.1021/acssynbio.1c00621

16. 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*, ACS Synthetic Biology, 11 (3), pp. 1196-1207, March 2022. https://doi.org/10.1021/acssynbio.1c00488
Preprint available at bioRxiv https://doi.org/10.1101/2021.10.10.460840.

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4. 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.

5. 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.

6. 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.

7. 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.

8. 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 Koeppl, Douglas Densmore, Mario di Bernardo, Gianluca Setti, Springer, May 2011

9. Hal Abelson, Jacob Beal, and Gerald Jay Sussman, *Amorphous Computing*, article in "Encyclopedia of Complexity and System Science," Springer-Verlag, March 2009.

10. Jacob Beal, *Learning by Learning to Communicate*, PhD Thesis, August 2007.

11. Jacob Beal, *Programming an Amorphous Computational Medium*, in Unconventional Programming Paradigms, Lecture Notes in Computer Science Vol. 3566, August 2005.

12. Jacob Beal, *Generating Communications Systems Through Shared Context*, Master's Thesis, January 2002.

6.3 Peer-Reviewed Conference Articles:

1. Aaron Paulos, Soura Dasgupta, Jacob Beal, Yuanqiu Mo, Jon Schewe, Alexander Wald, Partha Pal, Richard Schantz, J Bryan Lyles. *Priority-enabled Load Balancing for Dispersed Computing*, IEEE 5th International Conference on Fog and Edge Computing (ICFEC), May 2021.

2. Yuanqiu Mo, Giorgio Audrito, Soura Dasgupta, and Jacob Beal. *A resilient leader election using aggregate programming blocks*, International Federation of Automatic Control World Congress (IFAC) 2020, July 2020.

3. Yuanqiu Mo, Soura Dasgupta, and Jacob Beal. *Global Uniform Asymptotic Stability of a Generalized Adaptive Bellman-Ford Algorithm*, IEEE Conference on Decision and Control (CDC), December 2019.

4. Khoi D. Hoang, Christabel Wayllace, William Yeoh, Jacob Beal, Soura Dasgupta, Yuanqiu Mo, Aaron Paulos, and Jon Schewe. *New Distributed Constraint Reasoning Algorithms for Load Balancing in Edge Computing* 22nd International Conference on Principles and Practice of Multi-Agent Systems (PRIMA '19), October 2019.

5. Giorgio Audrito, Jacob Beal, Ferruccio Damiani, Danilo Pianini, and Mirko Viroli. *The share operator for field-based coordination*, International Conference on Coordination Languages and Models (COORDINATION '19), June 2019.

6. Yuanqiu Mo, Soura Dasgupta and Jacob Beal, *Robust Stability of Spreading Blocks in Aggregate Programming*, IEEE Conference on Decision and Control (CDC), December 2018. *Received Outstanding Student Paper Award.*

7. Giorgio Audrito, Jacob Beal, Ferruccio Damiani, Mirko Viroli, *Space-Time Universality of Field Calculus*, International Conference on Coordination Languages and Models (COORDINATION '18), June 2018.

8. Mirko Viroli, Jacob Beal, Ferruccio Damiani, Giorgio Audrito, Roberto Casadei, Danilo Pianini, *From Field-Based Coordination to Aggregate Computing*, International Conference on Coordination Languages and Models (COORDINATION '18), June 2018.

9. Fusun Yaman, Aaron Adler, Jacob Beal *AI Challenges in Synthetic Biology Engineering* 30th innovative Applications of Artificial Intelligence (IAAI-18), February 2018

10. Soura Dasgupta and Jacob Beal, *A Lyapunov Analysis for the Robust Stability of an Adaptive Bellman-Ford Algorithm*, IEEE Conference on Decision and Control (CDC), December 2016.

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 Semanics 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. Prasanna Muthukumar, Nicholas Roehner, Kemper Talley, Sean Colbath and Jacob Beal, *Retrobiosynthesis, Biosecurity, and Large Language Models*, AI4Synbio Symposium at AAAI 2023 Fall Symposia, November 2023.

2. Allison Taggart, Miles Rogers and Jacob Beal, *Splicing-based Biocontainment Devices*, 15th International Workshop on Bio-Design Automation (IWBDA), September 2023.

3. Muntaha Samad, Dan Wyschogrod and Jacob Beal, *Biological Malware Detector*, 15th International Workshop on Bio-Design Automation (IWBDA), September 2023.

4. Jacob Beal, *Human-friendly JSON for RDF Objects*, HARMONY 2023, April 2023.

5. Jacob Beal, Dan Wyschogrod, Adam Clore, Jeff Manthey, Tom Mitchell, Steve Murphy, *FAST-NA Scanner: high-speed, low-SWaP computational assessment of biological threats,* 2022 Chemical and Biological Defense Science and Technology (CBD S&T) Conference, December 2022.

6. Dan Wyschogrod, Jeff Manthey, Tom Mitchell, Steven Murphy, Adam Clore, Jacob Beal, *Adapting Malware Detection to DNA Screening,* 14th International Workshop on Bio-Design Automation (IWBDA), October 2022.

7. Jacob Beal, Vinoo Selvarajah, Gael Chambonnier, Traci Haddock-Angelli, Alejandro Vignoni, Gonzalo Vidal, Nicholas Roehner, *Standardizing the Representation of Parts and Devices for Build Planning,* 14th International Workshop on Bio-Design Automation (IWBDA), October 2022.

8. Ibrahim Aldulijan, Jacob Beal, Sonja Billerbeck, Jeff Bouffard, Gael Chambonnier, Nikolaos Delkis, Isaac Guerreiro, Martin Holub, Daisuke Kiga, Jacky Loo, Paul Ross, Vinoo Selvarajah, Noah Sprent, Gonzalo Vidal, Alejandro Vignoni, *Steps Towards Functional Synthetic Biology,* 14th International Workshop on Bio-Design Automation (IWBDA), October 2022.

9. Bryan Bartley, Jacob Beal, Alexis Casas, Jeremy Cahill, Timothy Fallon, Daniel Bryce, Robert P. Goldman, Luiza Hesketh, Tim Dobbs, Alejandro Vignoni, *Implementing Cross-Platform Protocol Execution with the Protocol Activity Modeling Language,* 14th International Workshop on Bio-Design Automation (IWBDA), October 2022.

10. Timothy R. Fallon, Daniel Bryce, Jacob Beal, Jeremy Cahill, Mark Doerr, *Laboratory Open Protocol: developing an open community standard for biological protocols,* Global Biofoundries Alliance 2022, October 2022.

11. Jacob Beal, *Implementing Safe Cross-Document RDF References*, COMBINE 2022, October 2022.

12. Daniel Bryce, Robert P. Goldman, Bryan Bartley, Jacob Beal, Alexis Cassis, Homer Sajonia, Jeremy Cahill, Tim Dobbs, *The Protocol Activity Modeling Language*, COMBINE 2022, October 2022.

13. Jacob Beal, *FAST-NA Scanner: increased speed and accuracy for biological threat screening*, Biodetection, June 2022.

14. Bryan Bartley, Alexis Casas, Jacob Beal, *Early Adoption of Machine-readable Protocols in the iGEM Community,* HARMONY 2022, April 2022.

15. Robert Goldman, Dan Bryce, Bryan Bartley, Jacob Beal, *The Container Ontology and Its Server,* HARMONY 2022, April 2022.

16. Jacob Beal, Bryan Bartley, Tom Mitchell, *SBOL utilities,* HARMONY 2022, April 2022.

17. Tom Mitchell, Bryan Bartley, Jacob Beal, *pySBOL3*, HARMONY 2022, April 2022.

18. Nilesh K Sharma, Felipe Carrillo, Jaclyn Thompson, Allison Taggart, Jacob Beal, Miles Rogers, Natalie Farny, Eric M Young, *Fungal highways enable migration and communication of engineered bacteria in soil*, Microbial Engineering II, April 2022

19. Jacob Beal, Tom Mitchell, Bryan Bartley, Nicholas Roehner, *Agile Data Curation,* AI4Synbio Symposium at AAAI 2022 Spring Symposia, March 2022.

20. Robert P. Goldman, Daniel Bryce, Jacob Beal, Bryan Bartley, *Protocol Modeling for High Throughput Experimentation, Data Analysis, and Replication,* AI4Synbio Symposium at AAAI 2022 Spring Symposia, March 2022.

21. Aaron Adler, Jacob Beal, Partha Pal, Miles Rogers, Dan Wyschogrod. *Peering into the Cyberbio Threat Horizon.* In Hudson CM, Pattengale ND, Iyer RK, Kalbarczyk ZT, Alli N. Genomic and Synthetic Biology Digital Biosecurity. Pacific Symposium on Biocomputing 2022;27:402-406. PMID: 34890167, January 2022.

22. Bryan Bartley, Jacob Beal, Vanessa Biggers, Daniel Bryce, Robert P. Goldman, Benjamin Keller, Peter Lee, Joshua Nowak, Miles Rogers, Mark Weston, *Motivation and progress towards building a common protocol representation* COMBINE 2021, September 2021.

23. Jake Sumner Ajibode, Jacob Beal, James Scott-Brown, Thomas Gorochowski, 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.

24. 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.

25. 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.

26. Jacob Beal, *Implementing Safe Cross-Document RDF References,* COMBINE 2020, October 2020.

27. Daniel Bryce, Jacob Beal, Bryan Bartley, Timothy Fallon, Jeremy Cahill, Mark Doerr, *Laboratory Open Protocol (LabOP),* COMBINE 2020, October 2020.

28. Nicholas Roehner, Jacob Beal, *Synthetic Biology Curation Tools (SYNBICT)*, COMBINE 2020, October 2020.

29. 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.

30. 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.

31. Jacob Beal, Daniel Sumorok, Bryan Bartley, Tramy Nguyen. *Collaborative Terminology: SBOL Project Dictionary*, 12th International Workshop on Bio-Design Automation (IWBDA), August 2020.

32. 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 ShortBOL2*, 12th International Workshop on Bio-Design Automation (IWBDA), August 2020.

33. 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.

34. 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.

35. Goksel Misirli, Jacob Beal, Thomas E. Gorochowski, Guy-Bart Stan, Anil Wipat, Chris Myers. *SBOL Visual 2 Ontology* 11th International Workshop on Bio-Design Automation (IWBDA), July 2019.

36. 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.

37. 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.

38. 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.

39. 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 (IWBDA), August 2018.

40. 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.

41. 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

42. 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 (IWBDA), August 2017.

43. Jacob Beal, *Mathematical Foundations of Variation in Gene Expression*, IET/SynBiCITE Engineering Biology Conference, December 2016.

44. Jacob Beal and Ron Weiss, *Design for Improved Repression in RNA Replicons*, 8th International Workshop on Bio-Design Automation (IWBDA), August 2016.

45. 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.

46. Jacob Beal, *Design of Biological Circuits Using Signal-to-Noise Ratio*, International Workshop on Bio-Design Automation (IWBDA), August 2015.

47. 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.

48. 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.

49. Kyle Usbeck and Jacob Beal, *WebProto: Aggregate Programming for Everyone*, demonstration abstract, IEEE SASO, September 2013 *Received Best Demonstration Award.*

50. Bernat Wiandt, Vilmos Simon, Andras Kokuti, and Jacob Beal, *Spatial Computing Meets Realistic Mobile Wireless Problems*, demonstration abstract, IEEE SASO, September 2013.

51. Fusun Yaman, Aaron Adler, and Jacob Beal, *How can AI help Synthetic Biology?*, Senior Member Talk, AAAI, July 2013.

52. 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.

53. 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.

54. 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.

55. 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.

56. 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 Soldotova, 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.

57. 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.*

58. 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.

59. Jacob Beal and Fusun Yaman, *Toward Automated Design of Cell State Detectors*, 4th International Workshop on Bio-Design Automation, June 2012.

60. Jacob Beal and Aaron Adler, *Automated Design of Synthetic Biology Feedback Circuits*, 2012 Institute of Biological Engineering Conference, March 2012.

61. Aaron Adler, Fusun Yaman, Jeffrey Cleveland, and Jacob Beal, *Morphogenetically Assisted Design Variation*, 2nd International Conference on Morphological Computation, September 2011.

62. Jacob Beal, *Bridging Biology and Engineering Together with Spatial Computing*, International Conference on Membrane Computing, August, 2011.

63. 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.

64. 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.

65. 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.

66. 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.

67. 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.

68. Jacob Beal, *Functional blueprints: a means of adaptive integration?*, First International Workshop on Morphogenetic Engineering, June 2009.

69. Jonathan Bachrach and Jacob Beal, *Programming a Sensor Network as an Amorphous Medium*, extended abstract for poster at IEEE DCOSS 2006, June 2006.

70. Jacob Beal and Seth Gilbert, *Analyzing Failures as Noise*, LIDS Student Conference, MIT, January 2004.

6.5 Workshops, Symposia, and Seminars

1. Daniel Wyschogrod, Steven T. Murphy, Jacob Beal, and Allison Taggart, *Securing Fieldable Bioinformatics*, In 2023 IEEE International Conference on Bioinformatics and Biomedicine (BIBM), pp. 3390-3397. IEEE, December, 2023.

2. 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

3. Hunza Zainab, Giorgio Audrito, Soura Dasgupta, Jacob Beal. *Improving Collection Dynamics by Monotonic Filtering*, Workshop on Engineering Collective Adaptive Systems (eCAS), August 2020.

4. 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.

5. 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.

6. 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.

7. 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.

8. 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.

9. 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.

10. 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.

11. 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.

12. 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.

13. 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.

14. Amy Kumar, Jacob Beal, Soura Dasgupta, Raghuraman Mudumbai, *Toward Predicting Distributed Systems Dynamics*, Spatial and COllective PErvasive Computing Systems (SCOPES), September 2015.

15. Jacob Beal and Mirko Viroli, *Building blocks for aggregate programming of self-organising applications*, Workshop on Fundamental of Collective Adaptive Systems (FoCAS), September 2014.

16. Jacob Beal, Mirko Viroli, and Ferruccio Damiani, *Towards a Unified Model of Spatial Computing*, 7th Spatial Computing Workshop (SCW'14), May 2014.

17. 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.

18. 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.

19. 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.

20. Jacob Beal, *Accelerating Approximate Consensus with Self-Organizing Overlays*, 6th Spatial Computing Workshop, May 2013.

21. Jacob Beal, *A Tactical Command Approach to Human Control of Vehicle Swarms*, AAAI 2012 Fall Symposium "Human Control of Bio-Inspired Swarms," November 2012.

22. Jacob Beal, *A Dimensionless Graceful Degradation Metric for Quantifying Resilience*, Workshop on Evaluation of Self-Adaptive and Self-Organizing Systems, IEEE SASO, September 2012.

23. Jacob Beal, Kyle Usbeck and Brian Krisler, *Lightweight Simulation Scripting with Proto*, 5th Spatial Computing Workshop (SCW'12) at AAMAS 2012, June 2012.

24. Kyle Usbeck and Jacob Beal, *An Agent Framework for Agent Societies*, Actors and Agents Reloaded (AGERE) at SPLASH 2011, October 2011.

25. Jacob Beal and Kyle Usbeck, *On the Evaluation of Space-Time Functions*, 4th Spatial Computing Workshop (SCW) at IEEE SASO 2011, October 2011.

26. 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.

27. 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.

28. Jacob Beal, *A Basis Set of Operators for Space-Time Computations*, 3rd Spatial Computing Workshop, September 2010.

29. Jacob Beal, Alice Leung, and Robert Laddaga, *Spectrum Curricula: Design and Initial Results*, Learning By Demonstration section of 2010 AAAI Robotics Exhibition, July 2010.

30. 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.

31. 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

32. Jacob Beal, *Dynamically Defined Processes for Spatial Computers*, Spatial Computing Workshop 2009, September 2009.

33. 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.

34. 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.

35. Jacob Beal and Gerald Jay Sussman, *Engineered Robustness by Controlled Hallucination*, AAAI 2008 Fall Symposium "Naturally-Inspired Artificial Intelligence," November 2008.

36. Jacob Beal and Jonathan Bachrach, *Cells Are Plausible Targets for High-Level Spatial Languages*, Spatial Computing Workshop, October 2008.

37. Rachel Greenstadt and Jacob Beal, *Cognitive Security for Personal Devices*, First ACM workshop on Artificial Intelligence and Security (AISec), October 2008.

38. Jonathan Bachrach and Jacob Beal, *Autonomy in Spatial Computing*, Third Workshop on Hot Topics in Autonomic Computing, June 2008.

39. Jacob Beal, *Developmental Cost for Models of Intelligence*, AAAI 2007 Workshop on Evaluating Architectures for Intelligence, July 2007.

40. 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.

41. Jacob Beal, *Sidestepping Impossibility: Combat Consensus in the Assassins' Guild*, MIT CSAIL Student Workshop 2006, September 2006.

42. 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.

43. Jacob Beal, *Amorphous Medium Language*, Large-Scale Multi-Agent Systems Workshop at AAMAS, July 2005.

44. 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.

45. 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, Sarah Carter, Adam Clore, Christina LaPosa, *Workshop Report: Testing Sequence Screening* December, 2022. https://zenodo.org/doi/10.5281/zenodo.10214844

2. Breschine Cummins, Robert C Moseley, Anastasia Deckard, Mark Weston, George Zheng, Daniel Bryce, Joshua Nowak, Marcio Gameiro, Tomas Gedeon, Konstantin Mischaikow, Jacob Beal, Tessa Johnson, Matthew Vaughn, Niall I Gaffney, Shweta Gopaulakrishnan, Joshua Urrutia, Robert P Goldman, Bryan Bartley, Tramy T Nguyen, Nicholas Roehner, Tom Mitchell, Justin D Vrana, Katie J Clowers, Narendra Maheshri, Diveena Becker, Ekaterina Mikhalev, Vanessa Biggers, Trissha Higa, Lorraine Mosqueda, Steven B Haase, *Computational prediction of synthetic circuit function across growth conditions*, bioRxiv preprint, June 2022.
https://doi.org/10.1101/2022.06.13.495701

3. Jacob Beal, Dan Wyschogrod, Tom Mitchell, Susan Katz, December 2021 Jeff Manthey and Adam Clore, *Development and transition of FAST-NA screening technology*, BBN Technical Report 8622, Raytheon BBN Technologies, December 2021.

4. 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

5. Bryan Bartley, Jacob Beal, Jonathan R. Karr, Elizabeth A. Strychalski, *Standards to Enable Genome-Scale Engineering*, GP-Write Consortium, March 2019.

6. 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

7. Victor Zhrinov, et al., *2018 Semiconductor Synthetic Biology Roadmap*, Semiconductor Research Corporation, October, 2018.

8. Jacob Beal and Brian Bramlett, *Summary Report for the SemiSynBio Workshop on an EDA/BDA Interaction Roadmap*, Semiconductor Research Corporation, May 2017.

9. 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`

10. 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

11. 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.

12. 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

13. Jacob Beal and Hal Abelson, *PACEM: Cooperative Control for Citywide Energy Management*, whitepaper, August 2008.

14. Jacob Beal, Jonathan Bachrach, and Mark Tobenkin, *Constraint and Restoring Force*, MIT CSAIL Tech Report 2007-044, August 2007.

15. Jonathan Bachrach and Jacob Beal, *Building Spatial Computers*, MIT CSAIL Tech Report 2007-017, March 2007.

16. Jacob Beal, *What the Assassins' Guild Taught Me About Distributed Computing*, MIT CSAIL Technical Report MIT-CSAIL-TR-2006-038, June 2006.

17. Jacob Beal, *Learning From Snapshot Examples*, MIT AI Memo 2005-012, April 2005.

18. Jacob Beal,Tim Shepard, *Shrinking the Leap of Faith*, publicly available report, March 2005.

19. Jacob Beal and Gerald Jay Sussman, *Biologically-Inspired Robust Spatial Programming*, MIT AI Memo 2005-001, January 2005.

20. Jacob Beal and Tim Shepard, *Deamplification of DoS Attacks via Puzzles*, publicly available report, October 2004.

21. Jacob Beal, *Near-Optimal Distributed Failure Circumscription*, AI Memo 2003-017, August 2003.

22. Jacob Beal, *A Robust Amorphous Hierarchy from Persistent Nodes*, AI Memo 2003-012, May 2003.

23. Jacob Beal, *Persistent Nodes for Reliable Memory in Geographically Local Networks*, AI Memo 2003-011, April 2003.

24. Jacob Beal, *Leaderless Distributed Hierarchy Formation*, AI Memo 2002-021, December 2002.

25. 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. *Integrating DBTL with Agile Data Curation*, EMSL Integration 2022: AI/ML for advancing discoveries in biological and environmental sciences, Richland, Washington, October 2022.

2. *Morphogenetic Engineering: the Bilateria approach to design*, Morphogenetic Prototyping Workshop, Adelaide, Australia, November 2016.

3. *Aggregate Programming*, Tenth International Conference on Swarm Intelligence, Brussels, Belgium, September 2016.

4. *Engineered Self-Organization Approaches to Adaptive Design*, 2012 Conference on Through-Life Engineering Services, Shrivenham, U.K., November 2012.

5. *Bringing Biology and Engineering Together with Spatial Computing*, 12th International Conference on Membrane Computing, Fontainbleau, France, August 2011.

6. *Spatial Computing: From Manifold Geometry to Biology*, AMORPH Conference (Amorphous Computing and Complex Biological Networks), Sheffield, U.K., August 2010.

7.2 Tutorials

1. *Synthetic Biology Open Language: Data Model version 3*, 15th International Workshop on Bio-Design Automation (IWBDA), September, 2023.

2. *Automating Laboratory Protocols with the Protocol Activity Modeling Language*, 14th International Workshop on Bio-Design Automation (IWBDA), October, 2022.

3. *SBOL Version 3: Data Exchange throughout the Bioengineering Lifecycle*, 14th International Workshop on Bio-Design Automation (IWBDA), October, 2022.
   Prior version given in 13th IWBDA in September, 2021.

4. *Introduction to the Protocol Activity Modeling Language (PAML)*, HARMONY 2022, April 2022.

5. *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.

6. *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.

7. *Analysis and visualisation of gene expression data*, After iGEM Academic Publishing Workshops, May, 2021.

8. *SBOL Version 3: Simplified Data Exchange for Bioengineering*, COMBINE, October, 2020.

9. *Introductory SBOL Workshop*, 12th International Workshop of Bio-Design Automation, August 2020 (with other members of the SBOL community).
   Prior versions given at 11th IWBDA in July 2019, 10th IWBDA in August 2018, 9th IWBDA in August 2017, 8th IWBDA in August 2016.

10. *SBOL Visual: Diagrams for Synthetic Biology*, International Genetically Engineered Machine Jamboree (iGEM 19), November 2019.

11. *Software Tools for Synthetic Biology Workflows*, International Genetically Engineered Machine Jamboree (iGEM 18), October 2018.

12. *Software Workflows for Synthetic Biology*, Synthetic Biology: Engineering, Evolution and Design (SEED 18), June 2018.

13. *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.

14. *Predictable Self-Organization with Computational Fields*, with Mirko Viroli, IEEE International Conference on Self-Adaptive and Self-Organizing Systems (SASO), September 2014.

15. *High-Level Genetic Circuit Design: The Proto BioCompiler*, MIT, March 2014.

16. *TASBE Synthetic Biology Tools*, Boston University, June 2013. Also given at MIT in July 2013 and June 2014.

17. *Spatial Computing Approaches for Pervasive Systems*, 2010 Pervasive Adaptation (PerAda) Summer School, September 2010.

18. *Spatial Computing for Networked Collaboration*, International Symposium on Collaborative Technologies and Systems (CTS 2010), May 2010.

19. *Spatial Computing for Swarms*, IEEE International Conference on Self-Adaptive and Self-Organizing Systems (SASO), September 2009.

20. *Spatial Computing: From global to local and back again*, five-lecture series at Third French Complex Systems Summer School, August, 2009.

21. *Introduction to Spatial Computing*, Second International Conference on Robot Communication and Coordination (RoboComm), April 2009.

22. *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 for Modeling and Design*, NIH Interagency Modeling and Analysis Group Working Group Multiscale Modeling and Viral Pandemics, January 2024.

2. *The DNA Frontier: Implications and Applications of Screening and Synthesis*, Panel Moderator, iGEM Jamboree, November 2023.

3. *How Do We Improve Engineering in iGEM?*, iGEM Jamboree, November 2023.

4. *Progress and Prospects on a Nucleic Acid Screening Test Set*, US Department of Commerce, BIS Materials and Equipment Technical Advisory Committee, September 2023.

5. *Biosecurity Panel Discussion*, Moderator, 15th International Workshop on Bio-Design Automation (IWBDA), September 2023.

6. *Biosecurity: Safeguarding Synthetic Biology Against Misuse*, Panelist, SynBioBeta 2023, May 2023.

7. *The Roadmap to Biosecurity: Are We on Track?*, Panelist, SynBioBeta 2023, May 2023.

8. *Surviving Life as a Researcher*, Biomedical Science Seminar, University of Iowa, February 2023.

9. *Sharing Information in the Screening Community*, Workshop on Testing Sequence Screening, November 2022.

10. *Functional Synthetic Biology*, iGEM Jamboree, October 2022.

11. *Technical feasibility of nucleic acid screening vs. 2022 draft guidelines*, EBRC Workshop on Screening Framework Guidance for Providers and Users of Synthetic Oligonucleotides, June 2022.

12. *Studying Pathogens Degrades BLAST-based Pathogen Identification*, International Gene Synthesis Consortium, June 2022.

13. *Agile Data Curation*, Bits-in-Bio Seminar, March 2022.

14. *Biological Information Processing: From Experimentation to Engineering*, University of Maryland, February 2022. Updated version of the 2020 talk with the same title.

15. *Agile Data Curation: Foundations for Synthetic Biology... and Beyond!*, New Directions in Software Technology (NDIST '21), December 2021.

16. *Automation-Assisted Flow Cytometry Analysis with TASBE Flow Analytics*, NIST Flow Cytometry Standards Consortium Open Meeting, November, 2021.

17. *Building an Open Bioeconomy*, iGEM Open Talks, September 2021.

18. *Agile Data Curation: Foundations for Digital Biology*, Air Force Digital Biology Workshop, September 2021.

19. *Collaborative Design and Build in the iGEM Engineering Committee*, Synthetic Biology: Engineering, Evolution and Design (SEED 21), June 2021.

20. *Levels of Autonomy in Synthetic Biology Engineering*, AI4SynBio workshop at AAAI, March, 2021.

21. *Building a Synthetic Biology StackExchange*, HARMONY, March, 2021.

22. *Precision genetic device engineering with TASBE Flow Analytics*, NIST Flow Cytometry Standards Consortium Workshop, February, 2021.

23. *From Art to Engineering in Synthetic Biology*, Build-a-Cell Workshop, January 2021.

24. *The iGEM Measurement Committee: Building Solid Foundations for SynBio*, BioRoboost Round Table on SynBio and Education, December 2020.

25. *iGEM Measurement Committee*, New England iGEM (NEGEM) Conference 2020, September 2020.

26. *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.

27. *Biological Information Processing: From Experimentation to Engineering*, Given 3 times, at Microsoft Research UK, University of Bristol, and Imperial College London, March 2020.

28. *SBOL Visual Update*, HARMONY 2020, March 2020.

29. *Foundations for Effective SynBio Engineering*, AI in SynBio ASPSM, November 2019.

30. *Open Standards: Building the Informational Ecosystem of the Bioeconomy*, SynBioBeta, October 2019.

31. *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.

32. *Knowledge Tools to Lower Sharing Barriers*, DARPA Joint Data Sharing Meeting, July 2019.

33. *iGEM and the Global SynBio Community* International Workshop on Synthetic Biology standards and standardisation, June 2019.

34. *Super-Intelligence vs. NP-completeness*, New Directions in Software Technology (NDIST '18), December 2018.

35. *iGEM 2018 Interlab Study*, International Genetically Engineered Machine Jamboree (iGEM 18), October 2018.

36. *Metrology Matters: Engineering Biomolecular Circuits*, SynBioBeta 2018, October, 2018.

37. *Engineering Complex Behaviors in Biological Organisms*, University of Arizona, June, 2018.

38. *SBOL Visual 2.0*, Synthetic Biology: Engineering, Evolution and Design (SEED 18), June 2018.

39. *Foundations for Engineered Biomolecular Circuits*, Newcastle University, May, 2018.

40. *Standards Requirements for Genome-Scale Engineering*, GP-Write, May 2018.

41. *An introduction to SBOL Visual 2.0*, GP-Write, May 2018.

42. *Foundational Metrology for Engineering Biomolecular Circuits*, Dagstuhl Seminar 18082, "Formal Methods for the Synthesis of Biomolecular Circuits", February 2018

43. *Surviving Life as a Researcher*, Biomedical Engineering Seminar, University of Iowa, February 2018.

44. *SBOL Visual Quickstart*, BioBuilder Club, January 2018.

45. *iGEM 2017 Interlab Study*, International Genetically Engineered Machine Jamboree (iGEM 17), November 2017.

46. *Engineering Complex Behaviors in Biological Organisms*, ACM Boston, May 2017.

47. *Genome-scale design representation with SBOL*, GP-Write, May 2017.

48. *Aggregate Programming: From Theory to Resilient IoT Services*, University of Iowa, March 2017.

49. *iGEM 2016 Interlab Study*, International Genetically Engineered Machine Jamboree (iGEM 16), October 2016.

50. *Surviving Life as a Researcher*, IEEE SASO 2016 Doctoral Symposium, September 2016.

51. *What EDA can offer to BDA*, SRC Workshop on EDA/BDA Interaction Roadmap, August 2016.

52. *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.

53. *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.

54. *Measuring Biological Computing Devices and Circuits*, Lincoln Laboratories, February 2016.

55. *What you should really learn from immune systems about adversarial design*, New Directions in Software Technology (NDIST '15), December 2015.

56. *SBOL visual: introduction, recent developments, and current challenges*, COMBINE 2015, October 2015.

57. *Report on iGEM Interlab Study*, COMBINE 2015, October 2015.

58. *Development of Standards for Calibrated Flow Cytometry*, COMBINE 2015, October 2015.

59. *iGEM 2015 Interlab Study*, International Genetically Engineered Machine Jamboree (iGEM 15), September 2015.

60. *Engineering Self-Organization: From Networking to Synthetic Biology* Dagstuhl Seminar 15402, "Self-assembly and Self- organization in Computer Science and Biology," September 2015

61. *Ensuring Safe Composition of Distributed Processes*, 2nd Workshop on Quality Assurance for Self-adaptive, Self-organising Systems (QA4SASO 15) at IEEE SASO, September 2015

62. *Synthetic Biology Open Language (SBOL): Community-Driven Standard for Communication of Synthetic Biology Designs*, Synthetic Biology: Engineering, Evolution and Design (SEED 15), June 2015.

63. *Creating Predictable Collective Behaviors with Aggregate Programming*, Dagstuhl Seminar 14512, "Collective Adaptive Systems: Qualitative and Quantitative Modelling and Analysis," December 2014

64. *iGEM 2014 Interlab Study*, International Genetically Engineered Machine Jamboree (iGEM 14), November 2014.

65. *Proto BioCompiler*, Autodesk Workshop at International Genetically Engineered Machine Jamboree (iGEM 14), November 2014.

66. *SBOL Visual: Standard for Synthetic Biology Diagrams*, SynBERC Fall Retreat 2014, September 2014.

67. *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.

68. *Measurements and iGEM 2014*, 3rd New England iGEM Meetup, June 2014.

69. *Merging experimental and computational efforts in BDA*, International Workshop on Bio-Design Automation (IWBDA 14), June 2014.

70. *Programming Distributed Algorithms using Computational Fields*, Dagstuhl Seminar 13492, "Geosensor Networks: Bridging Algorithms and Applications," December 2013

71. *Spatial computing: a unifying approach to computational materials*, Royal Society Meeting on Heterotic Computing, November 2013.

72. *The Importance of Asymmetry for Rapidly Reaching Consensus*, Workshop on Self-Adaptive and Self-Organising Socio-Technical Systems (SASOˆST), September 2013.

73. *Spatial Computing: From Manifold Geometry to Networking and Biology*, TU Delft, May 2013.

74. *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.

75. *High-Level BioDesign Automation*, SemiSynBio Workshop, February 2013.

76. *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.

77. *Morphogenetic Engineering: The Bilateria approach to design*, New Directions in Software Technology (NDIST '12), December 2012.

78. *Customer-Centric Restructuring of Energy Markets*, presented on "Smart Grid" panel at Future Energy Conference, November 2012.

79. *From Inspiration to Quantification*, presented on "New Research Directions" panel at IEEE SASO 2012, September 2012.

80. *Spatial Computing: From Manifold Geometry to Networking and Biology*, University of Iowa, February 2012.

81. *Toward Breaking the Complexity Barrier for Synthetic Biology Therapeutics*, IEEE Engineering in Medicine and Biology, August 2011.

82. *Spatial Computing: From Manifold Geometry to Distributed Systems*, TU Delft, Netherlands, August 2011.

83. *High-Level Languages for Synthetic Biology*, MIT Synthetic Biology Lunch seminar series, November 2010.

84. *Automatic Compilation from High-Level Bio-Languages to Genetic Regulatory Networks*, Church Lab & Harvard Molecular Technology Group, November 2010.

85. *Spatial Computing, Synthetic Biology, and Emerging IP Challenges*, Creative Commons, November 2010.

86. *PACEM: The Colored Power Approach to Energy Demand Management*, MIT Energy Initiative Fall 2010 Conference, October 2010.

87. *Spatial Computing: From Manifold Geometry to Biology*, Computer Science Colloqium, Univ. Colorado Boulder at Boulder, October 2010.

88. *Spatial Computing and Proto*, Lecture for Harvard course CS 266 "Bio-inspired Distributed and Multi-Agent Systems," Harvard, April 2010.

89. *Composable Continuous-Space Programs for Robotic Swarms*, Seminar lecture at Harvard, March 2010.

90. *Composable Continuous-Space Programs for Robotic Swarms*, iRobot, July 2009.

91. *PACEM: Cooperative Control for Citywide Energy Management*, Massachusetts Technology Transfer Offices Day, June 2009.

92. *Spatial Computing*, presented on "Grand Challenges" panel at IEEE SASO 2008, October 2008.

93. *BioBricks & High-Level Programming*, MIT Synthetic Biology Lunch seminar series, April 2008.

94. *Spatial Computing and the Challenge of Engineered Emergence*, Harvard CRCS Privacy and Security Lunch Seminar, April 2008.

95. *Programming Cell Aggregates*, MIT Synthetic Biology Lunch seminar series, January 2008.

96. *Learning by Learning to Communicate*, Dartmouth College, October 2007.

97. *Principles for Engineered Emergence*, Unconventional Computation: Quo Vadis?, March 2007.

98. *Programming Manifolds*, Dagstuhl Seminar 06361, "Computing Media and Languages for Space-Oriented Computation," September 2006.

99. *Integration by Coincidence: Status and Speculation*, MIT Biologically Inspired Cognitive Architectures (BICA) workshop, January 2006.

100. *Programming an Amorphous Medium*, Unconventional Programming Paradigms workshop, September 2004.

8 Awards and Honors

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