

Taisa Kushner

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BioFrontiers Institute, Campus Box 596 UCB, Boulder, CO 80309

RESEARCH INTERESTS

Control and Verification of Cyber-Physical Systems, Patient-Specific Optimization of Autonomous Medical Devices, Time Series Analysis for Nonlinear Systems, Handling Sparse Data and Conformance in Machine Learning

EDUCATION

University of Colorado at Boulder

Boulder, CO

Doctor of Philosophy in Computer Science and Interdisciplinary Quantitative Biology (Expected Aug. 2020)

Advised by Dr. Sriram Sankaranarayanan

Masters in Applied Mathematics

Advised by Dr. David Bortz and Dr. Sriram Sankaranarayanan

Aug 2015 – May 2018

St. Olaf College

Northfield, MN

Bachelor of Arts with Distinction

Aug 2010 – May 2014

Mathematics, Mathematical Biology

Relevant Coursework: Design and Analysis of Algorithms, Numerical Analysis, Bioinformatics & Genomics, Approximation Methods, Software Design and Implementation, Operations Research, Graph Theory, Statistical Optimization, Nonlinear Dynamics, Applied Analysis, Closed-Loop Medical Devices, Advanced Linear Control, Computer Aided Verification, Statistical Modeling

COMPUTING LANGUAGES

Python, C++, MatLab, Mathematica, Linux/Unix, SQL

PUBLICATIONS

PUBLISHED PAPERS

- T. Kushner**, A. Sharma, *Bursts of Activity: Temporal Patterns of Help-Seeking and Support in Online Mental Health Forums*. Proceedings of the Web Conference 2020 (WWW '20). (2020) to appear
- T. Kushner**, S. Sankaranarayanan, M. Breton, *Conformance Verification of Neural Network Models for Glucose-Insulin Dynamics*. Proceedings of the 23rd ACM International Conference on Hybrid Systems: Computation and Control (HSCC). (2020) to appear
- M. Narasimhamurthy, **T. Kushner**, S. Dutta, S. Sankaranarayanan, *Verifying Conformance of Neural Network Models: Invited Paper*. 2019 IEEE/ACM International Conference on Computer-Aided Design (ICCAD). (2019) doi: 10.1109/ICCAD45719.2019.8942151
- G.P Forlenza, **T. Kushner**, L. Messer, R.P. Wadwa, S. Sankaranarayanan, *Factory Calibrated Continuous Glucose Monitoring: How it Works, Why it's Safe, and The Dangers of Exploiting Sensors*. Diabetes Technology and Therapeutics. (2019) <http://doi.org/10.1089/dia.2018.0401>
- S. Dutta, **T. Kushner**, S. Jha, S. Sankaranarayanan, N. Shankar, A. Tiwari, *Sherlock: A Tool for Verification of Deep Neural Networks*. Proceedings of the AAAI Spring Symposium on Verification of Neural Networks. (2019)
- S. Dutta*, **T. Kushner***, S. Sankaranarayanan, *Robust Data-Driven Control of Artificial Pancreas Systems using Neural Networks*. Computational Methods in Systems Biology. (CMSB). Lecture Notes in Computer Science, vol 11095. (2018) Springer

- T. Kushner**, D. M. Bortz, D. M. Maahs, S. Sankaranarayanan, *A Data-Driven Approach to Artificial Pancreas Verification and Synthesis*. 9th ACM/IEEE International Conference on Cyber-Physical Systems. 242-252. (2018) doi: 10.1109/ICCPS.2018.00031
- T. Kushner**, S. Keenan, D. M. Bortz, D. M. Maahs, S. Sankaranarayanan. *Towards Personalized Verification and Synthesis for the Artificial Pancreas*. In Proc. Of the Eight International Workshop on Static Analysis and Systems Biology (SASB 2017)
Electronic Notes in Theoretical Computer Science (2018)
- T. Kushner**, A. Simonyan, and F. Y. M. Wan, *A New Approach to Feedback for Robust Signaling Gradients*. Studies in Applied Mathematics, 133 (1): 18–51. (2014) doi: 10.1111/sapm.12041

BOOK CHAPTERS

- T. Kushner**, B. W. Bequette, F. Cameron, G. Forlenza, D. M. Maahs, S. Sankaranarayanan, *Models, Devices, Properties, and Verification of Artificial Pancreas Systems*. Invited Chapter to appear in Automated Reasoning for Systems Biology and Medicine. Springer-Verlag. (in Press), 2018

*denotes equal contribution

HONORS AND AWARDS

- Finalist, *Three Minute Thesis* (2019)
Top Research Talk, *Rocky Mountain Celebration of Women in Computing* (2018)
Ralph J. Slutz Student Excellence Award, *Faculty Nominated Top Graduate Student Award* (2018)
Top Clinical Research Poster, *Barbara Davis Center Diabetes Day Symposium* (2018)
Research and Innovation Fellowship, *University of Colorado Boulder* (2017)
National Science Foundation Graduate Research Fellowship, *Honorable Mention* (2016)
National Science Foundation Integrative Graduate Education and Research Trainee (2015-2017)
Distinction in Mathematics, *St. Olaf College* (2014)
Honors in Mathematics, *St. Olaf College* (2014)
Mathematical Biosciences Institute (MBI) Undergraduate Research Fellow, *MBI* (2013)
National Science Foundation Fellow, *Center for Interdisciplinary Research* (2012-2013)
Buntrock Academic Scholarship, *St. Olaf College* (2010-2014)

WORKSHOPS

- 9th Summer School on Formal Techniques – SRI** (2019)
SRI International, Menlo Park, California
- CPS Verification & Validation: Industrial Challenges & Foundations – Safe Learning and Safe Acting** (2018)
Carnegie Mellon University, invited speaker
- Statistical and Applied Mathematical Sciences Institute – SAMSI** (2016)
Optimization Program Summer School, fully funded
- Mathematical Biosciences Institute** (2013)
Fellow at Undergraduate Two-Week Summer School, fully funded

LEADERSHIP AND OUTREACH POSITIONS

- Editor**, Colorado Journal for Applied Mathematics (2017 – Present)
- Interdisciplinary Outreach**, Association for Women in Mathematics (AWM) – University of Colorado Boulder Chapter (2016-present)
- Outreach and interdisciplinary collaboration coordinator developing quantitative biology workshop curriculums for high school teachers and under-represented undergraduate populations with the Biological Sciences Initiative at the University of Colorado, Boulder.
- Grand Awards Judge – Assistant Captain**, Colorado State Science and Engineering Fair (2017)

- Junior Mathematics and Computer Sciences Category, grades 6-8
- Science Fair Judge**, Summit Middle School (2016 - 2020)
- Teaching Assistant**, Northfield High School, 2013-2014
 - Mathematics Teaching Assistant, grades 9-12
- Treasurer**, Pi Mu Epsilon – St. Olaf Chapter (2013, 2014)
- Treasurer**, Mathematics Association of America – St. Olaf Chapter (2013, 2014)
- Children's Advocate**, Home Free Battered Women's Shelter, 2007-2014
 - Academic tutor, support group leader and advocate for children who have been displaced due to abuse.

CONFERENCE TALKS

- T. Kushner**, A. Sharma, *Bursts of Activity: Temporal Patterns of Help-Seeking and Support in Online Mental Health Forums*
The Web Conference (formally WWW), Taipei, Taiwan [to be presented April 2020]
- T. Kushner**, S. Sankaranarayanan, M. Breton, *Model Conformance in Blood Glucose Prediction Tasks*
Talk at the ACM International Conference on Hybrid Systems: Computation and Control [HSCC] Sydney, Australia [to be presented April 2020]
- T. Kushner**, *Data-driven Modeling and Verification for Artificial Pancreas Systems*
Invited talk for Junior PL Day at Northwestern University, Evanston, Illinois [2019]
- T. Kushner**, *Robust Data-Driven Control for Artificial Pancreas Systems using Neural Networks*
Invited talk for CPS Verification & Validation Workshop at Carnegie Mellon University, Pittsburgh, Pennsylvania [2018]
- T. Kushner**, *Data-Driven Control and Verification of Artificial Pancreas Systems*
Awarded top research talk at Rocky Mountain Celebration of Women in Computing (RMCWiC), Denver, Colorado [2018]
- T. Kushner**, S. Dutta, S. Sankaranarayanan, *Robust Data-Driven Control of Artificial Pancreas Systems using Neural Networks*
Talk at the International Conference on Computational Methods in Systems Biology, Brno, Czech Republic [2018]
- T. Kushner**, D. M. Bortz, D. M. Maahs, S. Sankaranarayanan, *A Data-Driven Approach to Artificial Pancreas Verification and Synthesis*
Talk at ACM/IEEE International Conference on Cyber-Physical Systems (CPS Week), Porto, Portugal [2018]
- T. Kushner**, D. M. Bortz, D. M. Maahs, S. Sankaranarayanan, *Personalized Data-Driven Verification and Synthesis for Artificial Pancreas Controller*
E-Poster Discussion at Advanced Technologies & Treatments for Diabetes (ATTD), Vienna, Austria [2018]
- T. Kushner**, D. M. Bortz, D. M. Maahs, S. Sankaranarayanan, *Towards Personalized Verification and Synthesis for the Artificial Pancreas*
Invited talk at SIAM Central States Conference, Ft. Collins, CO [2017]
- Kameyama, K., **Kushner, T.**, Enciso, G., *Non-Linear modeling for the binding of Erk2 phosphorylated Gli1 protein with Sufu*
Talk at the Northfield Undergraduate Mathematics Symposium (NUMS), Northfield, MN [2013]
- Kameyama, K., **Kushner, T.**, Enciso, G., *Non-Linear modeling for the binding of Erk2 phosphorylated Gli1 protein with Sufu*
Talk at the Mathematical Biosciences Institute Undergraduate Capstone Conference (MBI), Columbus, OH [2013]

Kameyama, K., **Kushner, T.**, Enciso, G., *Non-mass-action modeling for the binding of Erk2 phosphorylated Gli1 protein with Sufu*
Talk at the Mathematical and Computational Biology for Undergraduates Conference (MCBU), Irvine, CA [2013]

CONFERENCE POSTER PRESENTATIONS

- T. Kushner**, S. Sankaranarayanan, *Model Conformance in Blood Glucose Prediction Tasks*
To be Presented at Advanced Technologies and Treatments for Diabetes, Madrid, Spain [2020]
- T. Kushner**, G. Forlenza, L. Messer, *Translating Standard Clinical Protocol into Tuning Procedures for Hybrid Closed Loop Systems: 670G, Control-IQ and Loop*
To be Presented at Advanced Technologies and Treatments for Diabetes, Madrid, Spain [2020]
- T. Kushner**, M. Breton, S. Sankaranarayanan, *Multi-Hour Blood Glucose Prediction in T1D: A Patient-Specific Approach Using Shallow Neural Network Models.*
Presented at Advanced Technologies and Treatments for Diabetes, Berlin, Germany [2019]
- T. Kushner**, S. Dutta, S. Sankaranarayanan, *Robust Data-Driven Control of Artificial Pancreas Systems Using Neural Networks.*
Presented at Advanced Technologies and Treatments for Diabetes, Berlin, Germany [2019]
- T. Kushner**, D. M. Bortz, D. M. Maahs, S. Sankaranarayanan, *A Data-Driven Approach to Artificial Pancreas Verification and Synthesis.*
Awarded Best Poster at Barbara Davis Center Diabetes Day Symposium, Aurora, CO [2018]
- Kushner, T.**, Bortz, D.M, Sankaranarayanan, S. *Rapid Evaluation to Prevent Dangerous Regiments in an Artificial Pancreas Controller*
Poster presentation at Society for Industrial and Applied Mathematics Conference on the Life Sciences (SIAM Life Sciences), Boston, MA [2016]
- Kushner, T.**, Wan, F.Y.M., *Negative Feedback and Robustness of Signaling DPP Gradients*
Poster presentation at the International Symposium on Biomathematics and Ecology: Education Research (B.E.E.R), Arlington, VA [2013]
- Kushner, T.**, Wan, F.Y.M., *Negative Feedback and Robustness of Signaling DPP Gradients*
Poster presentation at the Mathematical Biosciences Institute Undergraduate Capstone Conference (MBI), Columbus, OH [2013]
- Anderson, E., **Kushner, T.**, Whitmore, C., Crisp, K., Demas, J., Vandiver, B., *Governing Dynamics of Signal Attenuation in Melanopsin Retinal Ganglion Cells*
Presented at the National Conference on Undergraduate Research (NCUR), LaCrosse, WI [2013]

ADDITIONAL RELEVANT WORK EXPERIENCE

- PhD Research Intern**, Dr. Amit Sharma, Microsoft Research, Bangalore, India
Causal inference for TalkLife, Technologies for Emerging Markets Group
May 2019 – September 2019
- Consultant for Tandem Diabetes**, Tandem Diabetes, San Diego, CA
Consultant for data analytics and patient-specific control optimization
April 2019 - Present
- Research Assistant**, Dr. Marc Breton, Center for Diabetes Technology, University of Virginia Medical School, June-August, 2018
- Research Assistant**, Dr. Michael B. O'Connor, University of Minnesota – Twin Cities, June-October 2014
"The Onset and Regulation of Developmental Timing in Drosophila Melanogaster"
Department of Genetics, Cell Biology & Development
- Research assistant in wet lab genetics and cell biology of drosophila including screens, dissections, genetic crosses, RNAseq, GFP tagging, etc.

- Constructed an algorithm to model developmental timing curves using Matlab – independent project

Researcher, Dr. Ron Gallas, St. Olaf College, 2013-2014

“Chemical and Mathematical Analysis of Ceramics and Development of Crystalline Glazes”

Independent Research Project between Art, Chemistry and Mathematics Departments

- Resultant paper on mathematical theory of crystal formation and porcelain installation exhibited at Flaten Art Museum, Northfield, MN.

RESEARCH FELLOWSHIPS AND TRAINING GRANTS

JDRF Identification of Areas of Artificial Pancreas Algorithm Enhancements Through Big-Data Analysis (2019-2020)

Grant awarded in collaboration with University of Virginia Center for Diabetes Technology

SHF:Small:Rigorous Synthesis and Verification of Decisions using Data-Driven Models (2018-2021)

Grant #NSF – SHF 1815983

Statistical and Applied Mathematical Sciences Institute – SAMSI (2016)

Optimization Program Summer School

Fully funded

NSF IGERT (2015-2017)

Interdisciplinary Quantitative Biology Graduate Fellowship

Grant #NSF – DGE 1144807

Mathematical Biosciences Institute (2013)

Fellow at Undergraduate Two-Week Summer School and

Undergraduate Research Program: Connecting program at University of California – Irvine

Grant #NSF-DMS 0931642

St. Olaf eCIR (2012-2013)

Research Fellow at Expanded Center for Interdisciplinary Research (eCIR).

Grant #NSF- DMS 1045015

PROFESSIONAL AFFILIATIONS

Association for Women in Mathematics (AWM)

Society for Industrial and Applied Mathematics (SIAM)

Association for Computing Machinery (ACM, and ACM-W)

The Institute of Electrical and Electronics Engineers (IEEE)

Pi Mu Epsilon

LANGUAGES

English, fluent

Russian, fluent