

Nathaniel K. Strawn

Curriculum Vitae

Education

University of Maryland <i>Ph.D. in Mathematics</i>	College Park, MD 9/2007–5/2011
Texas A&M University <i>M.S. in Mathematics</i>	College Station, TX 9/2005–5/2007
Texas A&M University <i>B.S. in Mathematics with Honors, Minor in Physics</i>	College Station, TX 6/2001–5/2005

Employment

- Assistant Professor, Department of Mathematics and Statistics, Georgetown University, 8/2015 – present.
- Senior Research Engineer, The Johns Hopkins University Applied Physics Laboratory, 2/2015 – 6/2015.
- FDA ORISE Fellow, FDA Center for Devices and Radiological Health, 10/2014 – 9/2015.
- Visiting Assistant Professor, Department of Mathematics, Duke University, 6/2013 – 2/2015.
- Postdoctoral Research Associate, joint appointment in Electrical and Computer Engineering and Mathematics, Duke University, 6/2011 – 5/2013.
- Graduate Research Assistant, Norbert Wiener Center for Harmonic Analysis and Applications, UMD, 2/2009–5/2011.
- Graduate Teaching Assistant, Department of Mathematics, UMD, 9/2007–1/2009.
- Graduate Teaching Assistant, Department of Mathematics, TAMU, 9/2005–5/2007

Teaching and Grading Positions

- *Optimization*, Instructor, Georgetown University, Fall 2015
- *Multivariable Calculus for Economists*, Instructor and Course Supervisor, Duke University, Fall 2013
- *Multivariable Calculus for Economists*, Instructor, Duke University, Spring 2013
- *Multivariable Calculus for Economists*, Instructor, Duke University, Spring 2012.
- *Transform Methods for Scientists and Engineers*, GA, UMD, Spring 2009.
- *Elementary Statistics and Probability*, Instructor, UMD, Fall 2008.
- *Analysis Boot Camp for Incoming Graduate Students*, TA, UMD, Summer 2008.
- *Introduction to Linear Algebra*, TA, UMD, Spring 2008.
- *Calculus III*, TA, UMD, Fall 2007.
- *Calculus II*, TA, TAMU, Spring 2007.
- *Calculus I*, TA, TAMU, Fall 2006.
- *Differential Equations*, GA, TAMU, Summer 2006.
- *Fourier Series and Wavelets*, GA, TAMU, Spring 2006.
- *Functions, Trigonometry and Linear Systems*, TA, TAMU, Fall 2005.

Funded Projects

- *Operationally Aware Sensing through Information Scaling*, Funded by DoD Advanced Mathematics for Battlefield Challenges
- *Posterior Concentration for Bayesian Compressed Sensing*, funded by DARPA Mathematics of Sensing, Exploitation, and Execution
- *Compressed Sensing Applications for Software Defined Radio*, funded by Laboratory for Telecommunications Sciences
- *Frame Theoretic Methodology for Dimension Reduction*, funded by National Geospatial Intelligence Agency
- *Tracking Tumors via Image Morphing*, funded by NIH Summer Internship Intramural Training Award

Journal Publications

1. *Topological and statistical behavior classifiers for tracking applications*. with P. Bendich, S. Chin, J. Clarke, J. DeSena, J. Harer, E. Munch, A. Newman, D. Porter, D. Rouse, and A. Watkins. To appear in IEEE Transactions on Aerospace and Electronic Systems.
2. *Multiscale dictionary learning: non-asymptotic bounds and robustness* with M. Maggioni and S. Minsker. To appear in the Journal for Machine Learning Research.
3. *Connectivity and irreducibility of algebraic varieties of finite unit norm tight frames* with J. Cahill and D. Mixon. Submitted.
4. *Bayesian graphical models for multivariate functional data* with H. Zhu and D. Dunson. Submitted.
5. *Finite sample posterior concentration in high-dimensional regression* with A. Armagan, R. Saab, L. Carin, and D. Dunson. Information and Inference, 2014.
6. *Posterior consistency in linear models under shrinkage priors* with A. Armagan, D. Dunson, J. Lee, and W. Bajwa. Biometrika 100(4):1011–1018, 2013.
7. *Constructing finite frames of a given spectrum and set of lengths*, with J. Cahill, M. Fickus, D. Mixon, M. Poteet. Appl. Comp. Harm. Anal. 2012
8. *Optimization over finite frame varieties and structured dictionary design*, Appl. Comp. Harm. Anal. 32:413–434, 2012.
9. *Constructing all self-adjoint matrices with prescribed spectrum and diagonal*, with M. Fickus, D. Mixon, M. Poteet. Adv. Comput. Math. 1–25, 2011..
10. *Finite frame varieties: Nonsingular points, tangent spaces, and explicit local parameterizations*, J. Four. Anal. Appl. 17(5):821–853, 2011.
11. *Manifold structure of spaces of spherical tight frames*, with K. Dykema, Int. J. Pure Appl. Math. 28:217–256, 2006.

Conference Publications

1. *Geometric multi-resolution analysis and data-driven convolutions*, Proc. SPIE Spars. Wave. XVI. 2015.
2. *Geometric multi-resolution analysis for dictionary learning*, with M. Maggioni and S. Minsker. Proc. SPIE Spars. Wave. XVI. 2015.
3. *Connectivity of spaces of finite unit-norm tight frames*, with D. Mixon and J. Cahill. Proc. SPIE Spars. Wave. XVI. 2015.
4. *Multiscale dictionary and manifold learning: non-asymptotic bounds for the Geometric Multi-Resolution Analysis*. with M. Maggioni and S. Minsker. Proceedings of iTwist 2014.
5. *Geometric optimization on spaces of finite frames*, Proc. SPIE Spars. Wave. XIV. 2011.
6. *Tracking kidney tumor dimensional measurements via image morphing*, with J. Yao, Proc. IEEE ICIP, 2010.

Theses, Book Chapters, and Symposia

1. *Algebraic-geometric techniques and geometric insights for finite frames*, Proceedings of AMS Symposia in Applied Mathematics, 2015.
2. *Algebraic geometry and finite frames* with J. Cahill. Finite Frame Theory, Eds. P. G. Casazza and G. Kutyniok, Birkhäuser, Boston, 2012.
3. *Geometric structures and optimization on spaces of finite frames*, Ph.D. Thesis, University of Maryland, 2011.
4. *Geometry and constructions of finite frames*, Master's Thesis, Texas A&M University, 2007.

Invited Talks

- *Geometry and connectivity of spaces of finite unit-norm tight frames*, TADS Seminar, George Mason University, Fairfax, VA, 10/2015
- *Non-Asymptotic Bounds for Geometric Multiresolution Analysis*, Norbert Wiener Center Seminar, University of Maryland, College Park, MD, 9/2015
- *Finite sample posterior concentration in high-dimensional regression*, Information and Inference Best Paper Prize (2nd place), Oxford, UK, 8/2015
- *Geometric multi-resolution analysis and data-driven convolutions*, SPIE Sparsity Wavelets XVI, San Diego, CA, 8/2015
- *Geometric multi-resolution analysis for dictionary learning*, SPIE Sparsity Wavelets XVI, San Diego, CA, 8/2015
- *Connectivity of spaces of finite unit-norm tight frames*, SPIE Sparsity Wavelets XVI, San Diego, CA, 8/2015
- *Algebraic-geometric techniques and geometric insights for finite frames*, Plenary Talk for Frames and Algebraic & Combinatorial Geometry Workshop, Bremen, DE, 7/2015
- *Data-driven frames: Non-asymptotic bounds for Geometric Multiresolution Analysis*, JMM AMS Special Session on Frames and their Applications, San Antonio, TX, 1/2015
- *Algebraic-Geometric Techniques and Geometric Insights for Finite Frames*, AMS Short Course on Finite Frame Theory, San Antonio, TX, 1/2015
- *The Geometry of Data Science*, Selected Topics in Science and Technology Symposium, Institute for Advanced Study, Technical University of Munich, Garching, Germany, 11/2014
- *Statistical Inference with Topological Features*, Duke Data Analysis Seminar, Durham, NC, 4/2014
- *Dictionary Learning and Non-Asymptotic Bounds for Geometric Multi-Resolution Analysis*, GAMM Young Researcher's Minisymposium, Erlangen, Germany, 3/2014
- *Estimation and uncertainty in high dimensional linear regression*, FDA DIAM seminar, Silver Spring, MD, 5/2013
- *Finite sample posterior concentration in high-dimensional regression*, CFE-ERCIM, Oviedo, Spain, 12/2012
- *Posterior concentration in Bayesian compressed sensing*, Operator Algebras, Frames, and Undergraduate Research: A Conference in Honor of the 70th Birthday of David R. Larson, College Station, TX, 7/2012
- *Posterior rates of contraction for sparse Bayesian models*, SIAM Low Rank and Sparse Modeling Minisymposium, Minneapolis, MN, 7/2012
- *Geometric optimization of finite unit-norm tight frames*, SIAM SEAS, Huntsville, AL, 3/2012

Professional Activities

- Guest lecturer for IMA Summer Graduate Student Program on Modern Harmonic Analysis and Applications, University of Maryland, 8/2015

- Mentor for Analysis of Dynamic Graphs Summer REU at Duke University, 6/2012
- Reviewer for Applied and Computational Harmonic Analysis
- Reviewer for Bayesian Analysis
- Reviewer for IEEE Transactions on Information Theory
- Reviewer for Kodai Mathematical Journal
- Reviewer for Linear Algebra and Applications
- Reviewer for SIAM Journal on Discrete Mathematics
- Organizer for UMD Student Analysis/PDE/Probability Seminar, 1/2009-5/2011
- Organizer for UMD Mathematics Graduate Student Conference, 5/2008-5/2010
- Organizer for UMD Spotlight on Graduate Research Competition, 5/2008-5/2010
- Student Organizer for Norbert Wiener Center Seminar, 9/2009-9/2010
- Student Representative for UMD Mathematics Graduate Program, 9/2009-5/2011

Coding

- **C++** – custom machine learning pipeline for integrating topological data analysis features with JHU APL MHT/IMM tracking suite, implementations of statistical techniques in the FDA HIVE architecture
- **Clojure** – custom machine learning pipeline for analyzing financial data
- **Clojurescript** – custom machine learning pipeline, website development, and interactive graphs
- **Fortran** – implementation of computational physics projects and numerical methods including finite difference and finite element methods
- **HTML/CSS/Javascript** – website development and interactive graphs
- **Java** – WEKA experiments, custom machine learning pipeline implementation, Android development, code analysis for JHU Applied Physics Laboratory
- **Javascript** – website development, implementations of statistical techniques in the FDA HIVE architecture
- **L^AT_EX** – publications and professional documents
- **Matlab** – FRAMELAB (a package for geometric optimization for structured linear dictionary design), TDAtools (topological data analysis and machine learning suite), compressed sensing experiments, tutorials (machine learning, high dimensional data analysis, and compressed sensing), image morphing implementation using wavelets and BFGS algorithm, image morphing implementation using Canny edge filters and approximate block matching via random projections
- **MySQL** – database for Android development
- **Python** – custom machine learning pipeline, scipy/numpy data visualizations and experiments, geometric deep learning and deep learning methods implemented using Theano, interactive graph experiments
- **Perl** – basic scraping
- **R** – implementations of Geometric Multiresolution Analysis, optimization examples for taught coursework (including interior point methods, LASSO, support vector machines, EM algorithm, etc), visualizations using `rgl`
- **SAS** – statistical analysis of course grades, visualizations