Alexander Strang

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EMPLOYMENT

William H. Kruskal Instructor, Department of Statistics, University of Chicago, September 2020

EDUCATION

PhD: Applied Mathematics
Case Western Reserve University, August 2020
BS: Mathematics and Physics
Case Western Reserve University, May 2016

PUBLICATIONS

Published:

- H.Kim, S. Sanz-Alonso, A. Strang *Hierarchical Ensemble Kalman Methods with Sparsity-Promoting Generalized Gamma Hyperpriors* FoDS (2023) `http://arxiv.org/abs/2205.09322`
- D. Chen, A. Strang, A. W. Eckford, P.J. Thomas *Continuous-time Inference Algorithm for Partially Observable Markov Process* IEEE Transactions on Signal Processing (2022)
- S. Agrawal, H. Kim, D. Sanz-Alonso, A. Strang *A Variational Inference Approach to Inverse Problems with Gamma Hyperpriors* SIAM Journal of Uncertainty Quantification (2022)
- A. Strang, K. C. Abbott, and P. J. Thomas. *The Network HHD: Quantifying Cyclic Competition in Trait-Performance Models of Tournaments* SIREV (2022)
- Patterson, Amy, A. Strang and K. C. Abbott. *When and where we can expect to see early warning signals in multispecies systems approaching tipping points: insights from theory* the American Naturalist (2021)
- Strang, Alexander. *Solutions to the Minimum Variance Problem using Delaunay triangulation.* SIAM Discrete Mathematics (2020).
- Strang, Alexander. *Applications of the Helmholtz-Hodge decompositions to networks and random processes* Case Western Reserve University, Dissertation (2020).
- Calvetti, Daniela, M. Pragliola, E. Somersalo, and A. Strang. *Sparse reconstructions from few noisy data: analysis of hierarchical Bayesian models with generalized gamma hyperpriors.* Inverse Problems (2019).
- Calvetti, Daniela, E. Somersalo, and A. Strang. *Hierachical Bayesian models and sparsity: l 2-magic.* Inverse Problems (2019).
- Strang, Alexander, K. C. Abbott, and P. J. Thomas. *How to avoid an extinction time paradox.* Theoretical Ecology (2019).

- Strang, Alexander, O. Haynes, N. D. Cahill, and D. A. Narayan. *Generalized relationships between characteristic path length, efficiency, clustering coefficients, and density.* Social Network Analysis and Mining 8 (2018).
- Strang, Alexander, O. Haynes, R. Florez, and D. A. Narayan. *Enumerating shortest paths and determining edge betweeness centrality in Cartesian products of paths and cycles* Bulletin of the ICA (2018)

In review:

- Z. Si, Y. Liu and A. Strang. *Path-Following Methods for Maximum a Posteriori Estimators in Bayesian hierarchical models* SIOPT (2022) `https://arxiv.org/abs/2211.07113`
- C. Cebra, A. Strang. *Similarity Suppresses Cyclicity: Why Similar Competitors Form Hierarchies* SIAP (2022) `https://arxiv.org/abs/2205.08015`
- A. Strang, D. Sewell, K. Alcedo, D. Rosenbluth. *Principal Trade-off Analysis* ICLR (2022) `https://arxiv.org/abs/2206.07520`
- A. Strang, W. Huffmeyer, H. B. Rollins, K. C. Abbott, P. J. Thomas *Noise source importance in linear stochastic models of biological systems that grow, shrink, wander, or persist* PLoS Computational Biology (2022)

In prep:

- P. Bai, Y. Liu, Q. Sun, P. Zhou, D. Sewell, K. Alcedo, D. Wise, D. Rosenbluth, and A. Strang. *Functional Principal Trade-off Analysis: A Universal Approximation Theory for Disc Game Embedding* ICML (2023)
- C. Cebra, A. Strang. *Selection and Almost Sure Hierarchy in Evolutionary Game Theory* PNAS (2022)
- A. Strang, D. Sewell, K. Alcedo, D. Rosenbluth. *Competition Among Similar Competitors: An Analysis of Quadratic Competition Models* Econometrika (2022)

Non-academic publications:

- Alexander Strang and Peter Thomas. *Math explains why Democrats may have trouble picking a candidate.* The Conversation, (June 20th, 2019).

SPEAKING

Conference Talks:

- SIAM MDS, Machine Learning I. *Principal Trade-off Analysis and Disc Game Embedding of Functional Form Games.* (September 2022)
- Lockheed Martin AI Summit, project representative. *Functional Principal Trade-off Analysis.* (September 2022)
- FACM, New Jersey Institute of Technology, *From Local Correlations to Global Structure in Stochastic Wiring Patterns*, (May 2022)
- Joint Mathematics Meetings, AMS Special Session on Stochastic Models in Studying Biological Systems, *Robust Foundations for Stochastic Shielding via Moment Closure and Minimum Variance Bounds*, (April 2022)
- Joint Mathematics Meetings ILAS Special Session on Matrix Analysis and Applications, invited talk, *Applications of the Combinatorial Helmholtz-Hodge Decomposition to Near Equilibrium Systems*, (April 2022)

- DARPA/STO "Gamebreaker" Final Demonstrations, invited speaker, (October 2021)
- SIAM CSE 2021, Minisymposium on Hierarchical Bayesian Models, *Path tracing and sensitivity to hyperparameters in a Bayesian hierarchical model*, (March 2021)
- Applied Inverse Problems, Minisymposium on Model Reduction, *Automatic model reduction via hierarchical Bayesian priors*, (July 2019)
- Joint Mathematics Meetings, Contributed Talk, *Generalized relationships between characteristic path length, efficiency, clustering coefficients, and density*, (January 2015)

Seminars:

- Invited Seminar Speaker. University of Nevada Reno, Matrix Analysis Seminar, invited speaker. *Almost Certain Hessian Invertibility in Optimization*. (September 2022)
- Invited Seminar Speaker, Carnegie Mellon University, Geometry and Optimization Seminar. *A Functional Theory for Principal Trade-off Analysis*. (September 2022)
- Invited Seminar Speaker, Yale, Biostatistics Seminar. *Motivic Expansion of Global Information in Spike Train Data*. (September 2022)
- Invited Seminar Speaker, University of North Carolina Chapel Hill. *The Weak Rotation Expansion: Using the Helmholtz-Hodge Decomposition to Explain Markov Chains Near Equilibrium*, (September 2022)
- Invited Colloquium Talk, Iowa State University, *From Local to Global Structure in Random Edge Flows* (April 2022)
- Topology Seminar, Northeastern University *The Weak Rotation Expansion: Using the Helmholtz-Hodge Decomposition to Explain Markov Chains Near Equilibrium*, (October 2021)
- Inverse Problems and Imaging Seminar, University of Chicago *From Convex to Non-convex MAP Estimation by Path-Tracing in a Bayesian Hierarchical Model*, (November 2020)
- Analysis and Probability Seminar, Case Western Reserve University *Minimizing variance via Delaunay triangulation*, (December 2019)

Workshops:

- BIRS Workshop on Applications of Hodge Theory on Networks, lead organizer, (January 2023)
- JMM, Special Session on Stochastic Modelling in Biology, co-organizer, (January 2022)
- BIRS Workshop on Mathematical Models in Biology: from Information Theory to Thermodynamics, (July 2020)
- UC San Diego Winter Workshop on Topics in Optimization, Differential Equations, and Data Analysis, (January 2020)
- Santa Fe Institute, Spatio-Temporal Patterning in Ecology: Insights from Statistical Physics and Nonlinear Dynamics, (August 2018)

Radio:

- NPR Interview, WGBH, Living Lab Radio, (June 30th 2019)

REVIEWING

SIAM Journal of Uncertainty Quantification: 2022 *Boletín de la Sociedad Matemática Mexicana:* 2022 *Linear and Multilinear Algebra:* 2022, 2021 *Linear Algebra and its Applications:* 2022, 2020 *Chaos:* 2022 *Nature Sustainability:* 2021 *Microsoft ICML:* 2021, *Theoretical Ecology:* 2021, 2019 *Scientific Reports:* 2020

TEACHING EXPERIENCE

Instructor:

- Numerical Linear Algebra: Fall 2022, Fall 2021, Winter 2021
- Topics Course (Learning in Games): Spring 2022
- Dynamical Systems: Winter 2022
- Differential Equations: Spring 2021
- Multivariate Calculus: Fall 2019
- Differential Calculus: Spring 2019

Mentoring: I have mentored 5 undergraduate students (2 currently), 6 masters students (5 currently), and co-mentor 1 PhD student.

AWARDS

Suzuki Postdoctoral Fellowship Award 2022

CONSULTING

Alexander Strang Consulting LLC:

- Contracted with Lockheed Martin (DARPA: Gamebreaker) (2021)

LEADERSHIP

- *BIRS Workshop: Applications of Hodge Theory on Networks* Lead organizer (January 2023)
- *Joint Mathematics Meetings Special Session: Stochastic models in studying biological systems* Organizer (April 2022)
- *Volunteer Track and Cross Country Coach at Kenwood Academy* March 2022 - ongoing
- *Community Outreach and Engagement Committee* Committee chair January 2022 - ongoing
- *Committee on Community, Equity, Diversity, and Inclusion:* Member 2020 - ongoing
- *Math Graduate Student Association:* Vice-President (2019 - 2020)

OUTREACH and SERVICE

- *Community Outreach and Engagement Committee* Proposed the committee to the department, serving committee chair. Developed service opportunities with community partners. January 2022 - ongoing
- *Volunteer Track and Cross Country Coach* Kenwood Academy High School, work as an assistant coach and designed the season training program. March 2022 - ongoing
- *Habitat for Humanity* Volunteer. September 2021 - ongoing
- *Seeds of Literacy* Designed exercises and experimental demonstrations for adult education. (January - March 2019)

TECHNICAL EXPERTISE

Languages & Software: MatLab, Python, LaTex.
Expertise: Simulation of Stochastic Processes, Bayesian Inference, Non-Equilibrium Thermodynamics, Graph Theory, Optimization, Systems of Competing Agents

REFERENCES

Research:
- David Rosenbluth, industry collaborator, david.rosenbluth@lmco.com
- Lek-Heng Lim, mentor, lekheng@statistics.chicago.edu,
- Mary Silber, mentor, msilber@uchicago.edu
- Peter Thomas, advisor, pjthomas@case.edu
- Daniela Calvetti, mentor, dxc57@case.edu
- Karen Abbott, mentor, kca27@case.edu

Teaching:
- Mary Silber, mentor, msilber@uchicago.edu

Leadership and Outreach:
- Rina Foygel Barber, rina@uchicago.edu
- Michael Runnels, merunnels@uchicago.edu