Anna V. Little

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EDUCATION

- *PhD mathematics*, Duke Univeristy 2011
  Advisor: Mauro Maggioni
- *BS mathematics*, Samford Univeristy 2005
  Outstanding Math Senior; Samford Honors Society; Minor political science

APPOINTMENTS

- *Assistant Professor*, University of Utah 2021 - present
  Department of Mathematics, Utah Center for Data Science
- *Research Associate*, Michigan State University 2018 - 2020
  Department of Computational Mathematics, Science, and Engineering
- *Assistant Professor*, Jacksonville University (JU) 2012 - 2017
  Department of Mathematics

RESEARCH INTERESTS

High-dimensional data analysis, multiscale methods, clustering algorithms, machine learning, signal processing. My research has utilized tools from statistics, graph theory, linear algebra, and harmonic analysis.

FELLOWSHIPS, GRANTS, AND AWARDS

- NSF DMS 2309570 (PI): $360,000 2023 - 2026
  Moment Invariant Data Aggregation for Signal Processing and Distribution Learning
- NSF RTG DMS 2136198 (Senior Personnel): $911,075 2022 - 2026
  Data-driven Optimization and Inversion
- NSF DMS 1912906/2131292 (PI): $150,000 2019 - 2022
  Collaborative Research: Data-driven Path Metrics for Machine Learning
- American Mathematical Society (AMS) Simons Travel Grant: $4,000 2018 - 2020
- NSF S-STEM 1356544 (co-PI): $625,673 2014 - 2017
  Mathematics, Engineering, & Physics Scholars
- Jacksonville University Faculty Research Grant Spring 2015, Fall 2017
- MAA Project NExT Fellowship 2012 - 2013

PUBLICATIONS

Pre-prints

1. N Garcia Trillos, A Little, D McKenzie, J Murphy. "Fermat Distances: Metric Approximation, Spectral Convergence, and Clustering Algorithms." Arxiv, 2023.

2. L Yin, A Little, M Hirn. "Bispectrum Unbiasing for Dilation-Invariant Multi-reference Alignment." Submitted to *IEEE Transactions on Signal Processing*, 2023.

3. M Alishahi, A Little, J Phillips. "Linear Distance Metric Learning with Noisy Labels." Accepted pending minor revision at *Journal of Machine Learning Research (JMLR)*. Arxiv, 2023.

4. A Manousidaki, A Little, Y Xie. "Clustering and visualization of single-cell RNA-seq data using path metrics." Under revision at *PLOS Computational Biology*. BioRxiv, 2021.

Journal Articles and Book Chapters

1. A Chua, M Hirn, and A Little. "On Generalizations of the Nonwindowed Scattering Transform." *Applied and Computational Harmonic Analysis (ACHA),* Vol. 68, Article 101597, 2024.

2. M Hirn, A Little. "Power Spectrum Unbiasing for Dilation-Invariant Multi-reference Alignment." *Journal of Fourier Analysis and Applications*, Vol. 29, No. 4, 2023.

3. A Little, Y Xie, Q Sun. "An Analysis of Classical Multidimensional Scaling with Applications to Clustering." *Information and Inference: A Journal of the IMA*, Vol. 12, Issue 1, 2023.

4. A Little, D McKenzie, J Murphy. "Balancing Geometry and Density: Path Distances on High-Dimensional Data." *SIAM Journal on Mathematics of Data Science (SIMODS)*, Vol. 4, No. 1, 2022.

5. M Hirn, A Little. "Wavelet Invariants for Statistically Robust Multi-Reference Alignment." *Information and Inference: A Journal of the IMA,* Vol. 10, Issue 4, 2021.

6. A Little, M Maggioni, J Murphy. "Path-Based Spectral Clustering: Guarantees, Robustness to Outliers, and Fast Algorithms." *Journal of Machine Learning Research (JMLR),* Vol. 21, No. 6, 2020.

7. F Seeger, A Little, Y Chen, T Woolf, H Cheng and J Mitchell. "Feature Design for Protein Interface Hotspots using KFC2 and Rosetta." *Research in Data Science*, pp. 177-197, Springer, 2019.

8. L Hart, A Little. "Translating Evidence into Practice: Interpreting Measures of Risk." *The Nurse Practitioner*, Vol. 42, No. 2, 2017.

9. A Little, M Maggioni, L Rosasco. "Multiscale geometric methods for data sets I: Multiscale SVD, noise and curvature." *Applied and Computational Harmonic Analysis (ACHA)*, Vol. 43, Issue 3, 2017.

10. G. Chen, A.V. Little, M. Maggioni. "Multi-Resolution Geometric Analysis for Data in High Dimensions." In *Excursions in Harmonic Analysis*, Vol. 1, Editors T.D. Andrews et al., Birkhauser, 2013.

11. G Chen, A Little, M Maggioni, L Rosasco. "Some recent advances in multiscale geometric analysis of point clouds." In *Wavelets and Multiscale Analysis: Applied and Numerical Harmonic Analysis*, Editors J. Cohen and A. Zayed, Birkhauser, 2011.

12. T Ladner, A Little, K Marks, A Russell. "Positive Solutions to a Diffusive Logistic Equation with Constant Yield Harvesting." *Rose-Hulman Undergraduate Math Journal*, Vol. 6, Issue 1, 2005.

Conference Papers

1. H Chen, A Little, A Narayan. "Largest Angle Path Distance for Multi-Manifold Clustering." *International Conference on Sampling Theory and Applications (SampTA)*, IEEE, 2023.

2. R Liu, S Cantürk, F Wenkel, D Sandfelder, D Kreuzer, A Little, S McGuire, L O'Bray, M Perlmutter, B Rieck, M Hirn, G Wolf, L Rampášek. "Taxonomy of Benchmarks in Graph Representation Learning." *Proceedings of the First Learning on Graphs Conference*, PMLR, Vol. 198, 2022.

3. C Williams, A Little, X Mountrouidou. "Worth the Wait? Time Window Feature Optimization for Attack Classification." *CyberHunt 2019: International Workshop on Big Data Analytics for Cyber Threat Hunting, IEEE BigData Workshop*, Los Angeles, Dec. 2019.

4. L A Clements, H Wang, A Little, W B Lane, and H Duong. "S-STEM: Mathematics, Engineering, and Physics Scholars." *2017 ASEE Annual Conference & Exposition*, 2017.

5. A Little, X Mountrouidou, D Moseley. "Spectral Clustering Technique for Classifying Network Attacks." *IEEE International Conference on Intelligent Data and Security (IDS)*, New York City, April 2016.

6. A Little, A Byrd. "A Multiscale Spectral Method for Learning Number of Clusters." *14th IEEE International Conference on Machine Learning and Applications (ICMLA)*, Miami, Dec. 2015.

7. A Little, M Maggioni, L Rosasco. "Multiscale Geometric Methods for Estimating Intrinsic Dimension." *9th International Conference on Sampling Theory and Applications (SampTA)*, Singapore, May 2011.

8. A Little, Y Jung, M Maggioni. "Multiscale Estimation of Intrinsic Dimensionality of Data Sets." *Association for the Advancement of Artificial Intelligence (AAAI) Fall Symposium (FS-09-04)*, 2009.

9. J Lee, A Little, Y Jung, M Maggioni. "Estimation of Intrinsic Dimensionality of Samples from Noisy Low-dimensional Manifolds in High Dimensions with Multiscale SVD." *15th IEEE Workshop on Statistical Signal Processing (SSP)*, Cardiff, 2009.

SOFTWARE

- A Manousidaki, A Little, Y Xie. *Single-Cell Path Metrics Profiling (scPMP)*. Rcode for scRNA clustering and visualization.
- A Little, M Maggioni, J Murphy. *Ultrametric Spectral Clustering*. Open source toolbox.

TEACHING EXPERIENCE

University of Utah (UU) 2021 - present

- Undergraduate courses taught: Introduction to Data Science, Applied Statistics I, Introduction to Probability, Stochastic Processes and Simulations II
- Graduate courses taught: Mathematical Probability (PhD qualifying exam course)
- Collaborated with Computer Science Faculty to provide introductory data science course covering programming, statistics, and data analysis/wrangling.
- Organized focused reading group in applied spectral graph theory (2022-2023).

Jacksonville University (JU) 2012 - 2017

- Undergraduate courses taught: Business Calculus, Calculus I and II, Elementary Statistics, Biostatistics, Upper-level Statistics, Actuarial Exam P Prep.
- Graduate courses taught: Mathematical Modeling, Linear Algebra.

- Extensive experience using technology and real data in the classroom and with engaged learning.
- Developed a curriculum proposal for a data science major.

Duke University 2007 - 2010

- Undergraduate courses taught: Calculus I and II.
- Supervised discovery-based mathematics learning in weekly lab sessions for Calculus II students.

SERVICE

- **AWM-SIAM Committee** 2024 - current
  Organizing AWM events at annual SIAM meetings including poster session and minisymposium.
- **Group Leader for Women in Data Science and Mathematics, IPAM** Aug. 2023
  Mentoring a team of junior female mathematicians in a research project at WiSDM 2023 workshop.
- **Director of Masters in Statistics Program, UU** 2021 - 2022, 2023 - current
  Served as program representative for UU's masters of statistics with mathematics concentration.
- **Director of Student Engagement, Utah Center for Data Science** 2021 - 2023
  Served as faculty liaison for the data science club.
- **Colloquium Committee Chair, UU** 2021 - 2023
  Invited speakers and organized departmental colloquia and distinguished lecture series.
- **High School and Undergraduate Outreach, UU** Summer 2023
  Gave guest lectures in UU's High School Summer Program and pre-REU Program.
- **Junior High Outreach, UU** 2021 - 2023
  Gave guest lectures in a recreational mathematics class at Fairfield Junior High.
- **Supporting Women in Math, UU** 2021 - 2022
  Participated in Association for Women in Mathematics (AWM) organizational meetings and Faculty Research Panel. Reviewed applications for Women and Mathematics (IAS-WAM22).
- **Datathon4Justice Volunteer, UU** Spring 2022
  Served as a consultant for the Datathon4Justice held at UU, assisting student teams with questions.
- **Reviewer for Grant Proposals** 2020 - 2022
  Reviewed proposals for National Science Foundation (NSF DMS) and Israeli Science Foundation (ISF).
- **Reviewer for Conference and Journal Papers** Various
  Reviewed papers for *Journal of Machine Learning Research (JMLR)*, *SIAM Journal on Mathematics of Data Science (SIMODS)*, *Sampling Theory, Signal Processing, and Data Analysis (STSD)*, *SIAM Journal on Imaging Sciences (SIIMS)*, *International Conference in Machine Learning (ICML)*, *Neural Information Processing Systems (NIPS)*, *Information and Inference*, *Research in Data Science*, *Advances in Computational Mathematics*, *Physica D: Nonlinear Phenomena*, and *American Mathematical Monthly*.
- **SIAM Minisymposium Organizer** 2020, 2022
  Organized minisymposiums at the 2020 and 2022 SIAM annual meetings (Multiscale Data Science Inspired by Biological and Physical Systems/Diffusion-based methods for high dimensional data analysis)
- **Statistical Consultant, JU** 2012 - 2017
  Served as statistical consultant for JU faculty and student research; advised on relevant data analysis

and running statistical software; worked with faculty and students from biology, marine science, nursing, and mathematics; led an initiative to make statistical software more widely available on campus.

- **MEPS Program Member, JU** 2014 - 2017
  As co-PI on the MEPS (Mathematics, Engineering, & Physics Scholars) NSF S-STEM grant, I assisted in the implementation of a learning community scholarship program designed to target and retain underrepresented groups in STEM. Evaluated applications, served as student mentor, and oversaw the academic support structures of the grant.
- **Mathematical Contest in Modeling (MCM) Coach, JU** Feb. 2014 & 2015
  Coached teams of undergraduates participating in the international MCM; both teams won an honorable mention designation and presented their solutions at the JU Research Symposium.
- **MAA Committee on Contributed Paper Sessions** Jan. 2016 - Dec. 2017
  Evaluated proposals for Contributed Paper Sessions at both Mathfest and the Joint Mathematics Meetings.
- **STEM Workshop for Girls Organizer, JU** Spring 2014
  Worked with computer science and engineering faculty to organize a one-day STEM workshop for high school girls. Secured funding, organized background checks for volunteers, and ran mathematics activities.
- **Graduate Faculty Seminar Organizer, Duke** Spring 2010
  Member of team of three graduate students who scheduled and introduced speakers at a weekly seminar designed to foster communication between faculty and graduate students.

OTHER RELEVANT EXPERIENCE

- **Women in Data Science and Mathematics Participant, ICERM** Sum. 2017, 2019
  Participated in research workshops (WiSDM 2017 and 2019) for female data scientists.
- **Project Next Fellow** 2012 - 2013
  Obtained training and mentoring in teaching, scholarship, and professional activities through a professional development program of the MAA for recent mathematics PhD's.
- **Math Coder, WebAssign** 2011 - 2012
  Coded and randomized math questions using WebAssign's educational software for online homework and grading; provided mathematical and educational expertise to support original content initiatives.
- **Actuarial analyst, Vesta Insurance Company** 2005 - 2006
  Analyzed the company's disaster related exposure and assisted in the running of disaster simulation software; obtained actuarial exam certification in probability and financial mathematics.

MENTORING AND GRADUATE COMMITTEES

Postdocs:

- Benjamin Cooper Boniece (UU)

PhD students:

- Haoyu Chen (UU)
- Connor Shrader (UU)

Masters students:

- Cory Rindlisbacher, Magon Bowling, Julie Sherman, Hylia Lee, Kathryn Morris (UU)
- Alicia Byrd (JU)

Graduate committees

- Mathematics (UU): Tory Richardson (oral), Placede Tshiaba (oral), Julie Sherman (oral), Sean Groathouse (masters)
- Computing (UU): Benwei Shi (PhD), Chris Harker (PhD)
- Chemistry (UU): Joshua Bilsky (PhD)
- Computational Mathematics (MSU): Andriana Manousidaki, Liping Yin
- Mathematics (JU): Joanne Mechmech, Alison LePage
- Marine Science (JU): Justina Dacey, Kaitlyn Dietz, and Alexander Paradise
- Business Administration (JU): John Jinkner

PROFESSIONAL PRESENTATIONS

Conferences (international):

- "Largest Angle Path Distance for Multi-Manifold Clustering," Invited Speaker at Sampling Theory and Applications Conference (SampTA), Yale University, July 2023
- "Clustering and dimension reduction via Fermat distances," Invited speaker at 5th International Conference on Econometrics and Statistics (EcoSta), June 2022
- "Continuum Limits and Graph Cuts for Fermat Graph Laplacians," Invited speaker at Workshop on Manifold and Graph-Based Learning, Field's Institute, Toronto, Canada, May 2022
- "Unbiasing Procedures for Scale-invariant Multi-reference Alignment," Online International Conference on Computational Harmonic Analysis, September 2021
- "Wavelet Invariants for Statistically Robust Multi-Reference Alignment," Joint SIAM/CAIMS Annual Meeting, July 2020
- "Exact Community Detection via Classical Multidimensional Scaling," 2nd International Conference on Mathematics of Data Science (ICMDS 2018), Old Dominion University, Norfolk VA, Nov. 2018
- "Path-Based Spectral Clustering: Guarantees, Robustness to Outliers, and Fast Algorithms," 7th International Conference on Computational Harmonic Analysis (ICCHA), Vanderbilt University, Nashville TN, May 2018
- "A Multiscale Spectral Method for Learning Number of Clusters," 14th IEEE International Conference on Machine Learning and Applications, Miami, Dec. 2015 (poster)
- "Estimating the Intrinsic Dimension of High-Dimensional Data Sets," Invited speaker at Institute of Mathematical Statistics Asia Pacific Rim Meeting (IMS-APRM), Taipei, June 2014
- "Estimation of Intrinsic Dimensionality of Samples from Noisy Low-dimensional Manifolds in High Dimensions with Multiscale SVD," IEEE Workshop on Statistical Signal Processing, Cardiff, Sept. 2009

Conferences (non-international):

- "Unbiasing Procedures for Scale-invariant Multi-reference Alignment," Invited speaker at Computational Microscopy Workshop, Institute for Pure & Applied Mathematics, UCLA, Los Angeles CA, Nov. 2022

- "From Fermat Graph Laplacians to Density Accelerated Diffusions," Invited speaker at SIAM Mathematics of Data Science Minisymposium, San Diego CA, Sept. 2022
- "Wavelet Invariants for Statistically Robust Multi-Reference Alignment," Invited speaker at 32nd Inverse Problems Symposium, Purdue University, West Lafayette IN, May 2019
- "Path-Based Spectral Clustering: Guarantees, Robustness to Outliers, and Fast Algorithms," Invited speaker at Association for Women in Mathematics (AWM) Research Symposium, Rice University, Houston TX, April 2019
- "Path-Based Spectral Clustering: Guarantees, Robustness to Outliers, and Fast Algorithms," Symposium on Mathematical Statistics and Applications, Michigan State University, East Lansing MI, Sept. 2018
- "Estimating the Intrinsic Dimension of High-dimensional Data Sets," Invited speaker at First Annual Workshop on Data Sciences, Tennessee State University, April 2015
- "A Multiscale Spectral Algorithm for Estimating the Number of Clusters in a Data Set," FL-MAA and FTYCMA Joint Mathematics Meetings, St. Petersburg, Jan. 2015
- "A Multiscale Spectral Algorithm for Estimating the Number of Clusters in a Data Set," Joint Mathematics Meetings, San Antonio, Jan. 2015
- "Teaching the Physics of Calculus," FL-MAA and FTYCMA Joint Mathematics Meetings, Fort Myers, Feb. 2014
- "Estimating the Intrinsic Dimension of High-dimensional Data Sets," Joint Mathematics Meetings, San Diego, Jan. 2013
- "Intrinsic dimensionality estimation for data sets," 4th Annual Graduate Student Probability Conference, Duke University, April 2010
- "Pythagorean Triples with a Fixed Difference," MAA Southeastern Conference, 2005
- "Trigonometric Fibonacci Sequences," National Conference of Undergraduate Research, 2004

Seminars:

- "Clustering and Visualization of High-dimensional Data using Path Metrics," Data Science Seminar, University of Utah, Jan. 2024
- "Clustering and Visualization of High-dimensional Data using Path Metrics," Mathematical Biology Seminar, University of Utah, Oct. 2023
- "Unbiasing Procedures for Scale-invariant Multi-reference Alignment," Stochastics Seminar, University of Utah, Sept. 2023
- "Robust Statistical Procedures for Finding Structure in Noisy Data," Data Science and Statistics Seminar, Utah State University, Feb. 2023
- "Unbiasing Procedures for Scale-invariant Multi-reference Alignment," One World Seminar Series on the Mathematics of Machine Learning, Dec. 2022
- "Robust Statistical Procedures for Finding Structure in Noisy Data," Applied Math Seminar, Brigham Young University, 2022
- "Tools for Noisy Signal Processing and Robust Clustering," Seismo Tea, University of Utah, 2022
- "The Mathematics of the Signal-to-Noise Ratio and Insights for Data Science," Data Science Seminar, Utah Center for Data Science, Univeristy of Utah, October 2021

- "Clustering High-dimensional Data with Path Metrics: A Balance of Density and Geometry," Mathematical Data Science Seminar, Purdue University, September 2021
- "Clustering High-dimensional Data with Path Metrics: A Balance of Density and Geometry," Colloquium in Applied Mathematics, University of Chicago, April 2021
- "Balancing Geometry and Density: Path Distances on High-Dimensional Data," Applied Mathematics Seminar, University of Utah, April 2021
- "Clustering High-dimensional Data with Path Metrics: A Balance of Density and Geometry," One World MINDS Seminar, December 2020
- "Clustering High-dimensional Data with Path Metrics: A Balance of Density and Geometry," IMA Data Science Seminar, University of Minnesota, October 2020
- "Robust Statistical Procedures for Noisy, High-dimensional Data," University of Wisconsin Madison Statistics Seminar, November 2019
- "Robust Statistical Procedures for Clustering in High Dimensions," Michigan Technological University Mathematics Colloquium, October 2019
- "Robust Statistical Procedures for Clustering in High Dimensions," Johns Hopkins University Data Science Seminar, September 2019
- "Theoretical Guarantees and Exact Cluster Recovery for Classical Multidimensional Scaling," Tufts University Applied Mathematics Seminar, March 2019
- "Multiscale Spectral Approaches for Estimating Number of Clusters," Park City Mathematics Institute Research Seminar, July 2016
- "A Brief Introduction to Minitab," Jacksonville University Faculty Fall Conference, Aug. 2015
- "Classifying data into meaningful groups via spectral clustering," Jacksonville University Science and Engineering Lecture Series, March 2014
- "Finding Low-dimensional Structure in Data Sets," Jacksonville University Math Society, March 2013
- "An Effron Stein Inequality," Probability Working Group, Duke University, Nov. 2009
- "Intrinsic Dimensionality Estimation for Data Sets," Graduate/Faculty Seminar, Duke University, Sept. 2009
- "Introduction to Random Matrix Theory," Probability Working Group, Duke University, March 2009

CONFERENCES ATTENDED

- Sampling Theory and Applications Conference (SampTA), Yale University, July 2023
- Computational Microscopy Workshop, Institute for Pure & Applied Mathematics, UCLA, Los Angeles CA, Nov. 2022
- SIAM Conference on Mathematics of Data Science, San Diego CA, Sept. 2022
- 5th International Conference on Econometrics and Statistics (EcoSta), Hybrid, June 2022
- Workshop on Manifold and Graph-Based Learning, Field's Institute, Toronto, Canada, May 2022
- Online International Conference on Computational Harmonic Analysis, September 2021
- Online Joint SIAM/CAIMS Annual Meeting, July 2020

- Women in Data Science and Mathematics Research Collaboration Workshop (WiSDM), ICERM Research Institute, Brown University, Providence RI, July - Aug. 2019
- 32nd Inverse Problems Symposium, Purdue University, West Lafayette IN, May 2019
- Association for Women in Mathematics (AWM) Research Symposium, Rice University, Houston TX, April 2019
- SIAM Conference on Computational Science and Engineering (SIAM CSE), Spokane WA, Feb. 2019
- 2nd International Conference on Mathematics of Data Science (ICMDS 2018), Old Dominion University, Norfolk VA, Nov. 2018
- Symposium on Mathematical Statistics and Applications, Michigan State University, East Lansing MI, Sept. 2018
- 7th International Conference on Computational Harmonic Analysis (ICCHA), Vanderbilt University, Nashville TN, May 2018
- Women in Data Science and Mathematics Research Collaboration Workshop (WiSDM), ICERM Research Institute, Brown Univeristy, Providence RI, July 2017
- Park City Mathematics Institute Summer Research Program in Data Science, Midway UT, July 2016
- 14th IEEE International Conference on Machine Learning and Applications, Miami, Dec. 2015
- First Annual Workshop on Data Sciences, Tennessee State University, April 2015
- FL-MAA and FTYCMA Joint Mathematics Meetings, St. Petersburg, Jan. 2015
- Joint Mathematics Meetings, San Antonio, Jan. 2015
- Institute of Mathematical Statistics Asia Pacific Rim Meeting (IMS-APRM), Taipei, June 2014
- FL-MAA and FTYCMA Joint Mathematics Meetings, Fort Myers, Feb. 2014
- Winter Workshop: Dimension Reduction and High Dimensional Inference, University of Florida, Jan. 2014
- MAA Mathfest, Hartford, Aug. 2013
- Joint Mathematics Meetings, San Diego, Jan. 2013
- MAA Mathfest, Madison, Aug. 2012
- Joint Mathematics Meetings, Boston, Jan. 2012
- Joint Mathematics Meetings, New Orleans, Jan. 2011
- Workshop on Algorithms for Modern Massive Data Sets, Stanford University, June 2010
- 4th Annual Graduate Student Conference in Probability, Duke University, April 2010
- IEEE Workshop in Statistical Signal Processing, Cardiff, Sept. 2009
- Machine Learning Summer School, University of Chicago, June 2009
- 3rd Annual Graduate Student Conference in Probability, UNC Chapel Hill, May 2009
- IPAM Workshop: Multiscale Representation, Analysis and Modeling of Internet Data and Measurements, UCLA, Sept. 2008