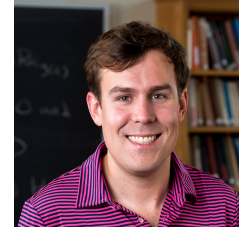


JAMES M. MURPHY

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SUMMARY OF RESEARCH

My research is at the intersection of applied mathematics, data science, and applications to image, signal, and network processing. My recent work focuses on harmonic analysis, high-dimensional statistics and probability, and unsupervised and semisupervised machine learning. I also design and implement fast and robust algorithms for problems in computational science including remotely sensed image processing, biological networks, molecular dynamics simulations, and spatial geography.

POSITIONS

| | |
|---|--|
| Tufts University <i>Associate Professor, Mathematics (Courtesy: Computer Science, ECE)</i> <i>Assistant Professor, Mathematics (Courtesy: Computer Science, ECE)</i> | Medford, MA <i>July 2024 - present</i> <i>September 2018 - June 2024</i> |
| Johns Hopkins University <i>Assistant Research Scientist & Senior Lecturer, Mathematics</i> | Baltimore, MD <i>July 2016 - August 2018</i> |
| Duke University <i>Visiting Assistant Professor, Mathematics</i> | Durham, NC <i>August 2015 - June 2016</i> |
| NASA Goddard Space Flight Center <i>Research Intern, Software Engineering</i> | Greenbelt, MD <i>June 2014-July 2015</i> |

EDUCATION

University of Maryland, College Park
MA in Mathematics (2013), PhD in Mathematics (2015; advisors: John J. Benedetto and Wojciech Czaja)

University of Chicago
BS in Mathematics (2011)

PUBLICATIONS

Preprints:

- [P4] B. Mallery, **J.M. Murphy**^{**}, and S. Aeron^{**}. Synthesis and analysis of data as probability measures with entropy-regularized optimal transport. *arXiv:2501.07446*, 2025. Under review.
- [P3] M. Werenski, B. Mallery, S. Aeron^{**}, and **J.M. Murphy**^{**}. The linear barycentric coding model: Synthesis, analysis, capacity, and applications. *arXiv:2410.23602*, 2024. Under review.
- [P2] M. Mueller, **J.M. Murphy**, and A. Tasissa. Locality regularized reconstruction: Structured sparsity and Delaunay triangulations. *arXiv:2405.00837*, 2024. Under review*.
- [P1] M. Werenski, **J.M. Murphy**, and S. Aeron. Estimation of entropy-regularized optimal transport maps between non-compactly supported measures. *arXiv:2311.11934*, 2023. Under review.

Peer-Reviewed Journal Articles:

- [J26] N. García Trillos, A. Little, D. McKenzie, and **J.M. Murphy**. Fermat distances: Metric approximation, spectral convergence, and clustering algorithms. *Journal of Machine Learning Research*, 25(176):165, 2024*.
- [J25] K. Cui, R. Li, S.L. Polk, Y. Lin, H. Zhang, **J.M. Murphy**, R.J. Plemmons, and R.H. Chan. Superpixel-based and spatially-regularized diffusion learning for unsupervised hyperspectral image clustering. *IEEE Transactions on Geoscience and Remote Sensing*, 62(4405818), 2024.
- [J24] M. Werenski, S. bin Masud, **J.M. Murphy**, and S. Aeron. On rank energy statistics via optimal transport: Continuity, convergence, and change point detection. *IEEE Transactions on Information Theory*, 70:5168–5190, 2024.
- [J23] A. Tasissa, P. Tankala, **J.M. Murphy**, and D. Ba. K-deep simplex: Deep manifold learning via local dictionaries. *IEEE Transactions on Signal Processing*, 71:3741–3754, 2023.
- [J22] S. bin Masud, M. Werenski, **J.M. Murphy**, and S. Aeron. Multivariate rank via entropic optimal transport: Sample efficiency and generative modeling. *Journal of Machine Learning Research*, 24(160):1–65, 2023.
- [J21] M. Duchin, **J.M. Murphy**, and T. Weighill. Measuring segregation via analysis on graphs. *SIAM Journal on Matrix Analysis and Applications*, 44(1):80–105, 2023*.
- [J20] S.L. Polk, K. Cui, A. Chan, D. Coomes, R.J. Plemmons, and **J.M. Murphy**. Unsupervised diffusion and volume maximization-based clustering of hyperspectral images. *Remote Sensing*, 15(4):1053, 2023.
- [J19] K. Devkota, H. Schmidt, M. Werenski, **J.M. Murphy**, M. Erden, V. Arsenescu, and L.J. Cowen. GLIDER: Function prediction from GLIDE-based neighborhoods. *Bioinformatics*, 38(13):3395–3406, 2022.
- [J18] A. Little, D. McKenzie, and **J.M. Murphy**. Balancing geometry and density: Path distances on high-dimensional data. *SIAM Journal on Mathematics of Data Science*, 4(1):72–99, 2022*.
- [J17] **J.M. Murphy** and S.L. Polk. A multiscale environment for learning by diffusion. *Applied and Computational Harmonic Analysis*, 57:58–100, 2022*.
- [J16] J. Damjanovic, **J.M. Murphy**** , and Y.-S. Lin**. CATBOSS: Cluster analysis of trajectories based on segment splitting. *Journal of Chemical Information and Modeling*, 61(10):5066–5081, 2021.
- [J15] S. Zhang and **J.M. Murphy**. Hyperspectral image clustering with spatially-regularized ultrametrics. *Remote Sensing*, 13(5):995, 2021.
- [J14] L. Cowen, K. Devkota, X. Hu, **J.M. Murphy**, and K. Wu. Diffusion state distances: Multitemporal analysis, fast algorithms, and applications to biological networks. *SIAM Journal on Mathematics of Data Science*, 3(1):142–170, 2021*.
- [J13] E.K Ngang and **J.M. Murphy**. Spectral analysis for non-Hermitian matrices and directed graphs. *Linear Algebra and its Applications*, 604:72–91, 2020*.
- [J12] K. Kashkooli, S.L. Polk, E.Y. Hahm, **J.M. Murphy**, B.R. Ethridge, J. Gitlin, R. Ibala, J. Mekonnen, J.C. Pedemonte, H. Sun, M.B. Westover, R. Barbieri, O. Akeju, and S. Chamadia. Improved tracking of sevoflurane anesthetic states with drug-specific machine learning models. *Journal of Neural Engineering*, 17(4):046020, 2020.
- [J11] **J.M. Murphy**. Spatially regularized active diffusion learning for high-dimensional images. *Pattern Recognition Letters*, 135:213–220, 2020.
- [J10] K. Devkota, **J.M. Murphy**, and L. Cowen. GLIDE: Combining local methods and diffusion state embeddings to predict missing interactions in biological networks. *Bioinformatics*, 36:i464–i473, 2020.

- [J9] A. Little, M. Maggioni, and **J.M. Murphy**. Path-based spectral clustering: Guarantees, robustness to outliers, and fast algorithms. *Journal of Machine Learning Research*, 21(6):1–66, 2020*.
- [J8] **J.M. Murphy** and M. Maggioni. Spectral-spatial diffusion geometry for hyperspectral image clustering. *IEEE Geoscience and Remote Sensing Letters*, 17(7):1243–1247, 2020.
- [J7] **J.M. Murphy** and M. Maggioni. Unsupervised clustering and active learning of hyperspectral images with nonlinear diffusion. *IEEE Transactions on Geoscience and Remote Sensing*, 57(3):1829–1845, 2019.
- [J6] M. Maggioni and **J.M. Murphy**. Learning by active nonlinear diffusion. *Foundations of Data Science*, 1(3):271–291, 2019*.
- [J5] M. Maggioni and **J.M. Murphy**. Learning by unsupervised nonlinear diffusion. *Journal of Machine Learning Research*, 20(160):1–56, 2019*.
- [J4] W. Czaja, **J.M. Murphy**, and D. Weinberg. Superresolution of noisy remotely sensed images through directional representations. *IEEE Geoscience and Remote Sensing Letters*, 15(12):1837–1841, 2018*.
- [J3] W. Czaja, B. Manning, **J.M. Murphy**, and K. Stubbs. Discrete directional Gabor frames. *Applied and Computational Harmonic Analysis*, 45(1):1–21, 2018*.
- [J2] W. Czaja, B. Manning, L. McLean, and **J.M. Murphy**. Fusion of aerial gamma-ray survey and remote sensing data for a deeper understanding of radionuclide fate after radiological incidents: examples from the Fukushima Dai-Ichi response. *Journal of Radioanalytical and Nuclear Chemistry*, 307:2397–2401, 2016*.
- [J1] **J.M. Murphy**, J. Le Moigne, and D.J. Harding. Automatic image registration of remotely sensed data with global shearlet features. *IEEE Transactions on Geoscience and Remote Sensing*, 54(3):1685–1704, 2016.

Peer-Reviewed Conference Proceedings:

- [C20] S. Fullenbaum and **J.M. Murphy**. Active learning for hyperspectral images with regularized Wasserstein dictionary learning. In *IEEE Workshop on Hyperspectral Imaging and Signal Processing: Evolution in Remote Sensing*, 2024. To Appear.
- [C19] K. Tripathi and **J.M. Murphy**. Learning by evolving nonlinear diffusion for active learning on hyperspectral images. In *IEEE Workshop on Hyperspectral Imaging and Signal Processing: Evolution in Remote Sensing*, 2024. To Appear.
- [C18] S. Fullenbaum, M. Mueller, A. Tasissa, and **J.M. Murphy**. Hyperspectral image clustering via learned representation in Wasserstein space. In *IEEE International Geoscience and Remote Sensing Symposium*, pages 8791–8796, 2024.
- [C17] S. Fullenbaum, M. Mueller, A. Tasissa, and **J.M. Murphy**. Nonlinear unmixing of hyperspectral images via regularized Wasserstein dictionary learning. In *IEEE International Geoscience and Remote Sensing Symposium*, pages 8289–8294, 2024.
- [C16] M. Mueller, S. Aeron, **J.M. Murphy**^{**}, and A. Tasissa^{**}. Geometric sparse coding in Wasserstein space. In *Proceedings of 2nd Annual Workshop on Topology, Algebra, and Geometry in Machine Learning*, pages 384–403, 2023.
- [C15] J. Damjanovic, Y.-S. Lin^{**}, and **J.M. Murphy**^{**}. Modeling changes in molecular dynamics time series as Wasserstein barycentric interpolations. In *International Conference on Sampling Theory and Applications*, pages 1–7, 2023.
- [C14] K. Cui, R. Li, S.L. Polk, **J.M. Murphy**, R.J. Plemmons, and R.H. Chan. Unsupervised spatial-spectral hyperspectral image reconstruction and clustering with diffusion geometry. In *IEEE Workshop on Hyperspectral Imaging and Signal Processing: Evolution in Remote Sensing*, pages 1–5, 2022.

- [C13] M. Werenski, R. Jiang, A. Tasissa, S. Aeron, and **J.M. Murphy**. Measure estimation in the barycentric coding model. In *International Conference on Machine Learning*, pages 23781–23803, 2022.
- [C12] S.L. Polk, A. Chan, K. Cui, R.J. Plemmons, D.A. Coomes, and **J.M. Murphy**. Unsupervised detection of ash dieback disease (*Hymenoscyphus fraxineus*) using diffusion-based hyperspectral image clustering. In *IEEE International Geoscience and Remote Sensing Symposium*, pages 2287–2290, 2022.
- [C11] S.L. Polk, K. Cui, R.J. Plemmons, and **J.M. Murphy**. Active diffusion and VCA-assisted image segmentation of hyperspectral images. In *IEEE International Geoscience and Remote Sensing Symposium*, pages 1364–1367, 2022.
- [C10] A. Tasissa, D. Nguyen, and **J.M. Murphy**. Deep diffusion processes for active learning of hyperspectral images. In *IEEE International Geoscience and Remote Sensing Symposium*, pages 3665–3668, 2021.
- [C9] S.L. Polk and **J.M. Murphy**. Multiscale clustering of hyperspectral images through spectral-spatial diffusion geometry. In *IEEE International Geoscience and Remote Sensing Symposium*, pages 4688–4691, 2021.
- [C8] **J.M. Murphy**. Patch-based diffusion learning for hyperspectral image clustering. In *IEEE International Geoscience and Remote Sensing Symposium*, pages 1042–1045, 2020.
- [C7] **J.M. Murphy** and M. Maggioni. Unsupervised discriminative dimension reduction for hyperspectral chemical plume segmentation. In *IEEE International Geoscience and Remote Sensing Symposium*, pages 3828–3831, 2019.
- [C6] Y. Liu, B. Tracey, S. Aeron, E. Miller, **J.M. Murphy**, T. Sun, and N. McDannold. Artifact suppression for passive cavitation imaging using U-net CNNs with uncertainty quantification. In *IEEE International Conference on Signal and Image Processing*, pages 1037–1042, 2019.
- [C5] S.L. Polk, K. Kashkooli, S.B. Nagaraj, S. Chamadia, **J.M. Murphy**, H. Sun, M.B. Westover, R. Barbieri, and O. Akeju. Automatic detection of general anesthetic-states using ECG-derived autonomic nervous system features. In *International Conference of the IEEE Engineering in Medicine and Biology Society*, pages 2019–2022, 2019.
- [C4] K. Kashkooli, S.L. Polk, S. Chamadia, E. Hahm, B. Ethridge, J. Gitlin, R. Ibala, J. Mekonnen, J. Pedemonte, **J.M. Murphy**, H. Sun, M.B. Westover, and O. Akeju. Drug-specific models improve the performance of an EEG-based automated brain-state prediction system. In *International Conference of the IEEE Engineering in Medicine and Biology Society*, pages 5808–5811, 2019.
- [C3] **J.M. Murphy** and M. Maggioni. Iterative active learning with diffusion geometry for hyperspectral images. In *IEEE Workshop on Hyperspectral Image and Signal Processing: Evolution in Remote Sensing*, pages 1–5, 2018.
- [C2] **J.M. Murphy** and J. Le Moigne. Shearlet features for registration of remotely sensed multitemporal images. In *IEEE International Geoscience and Remote Sensing Symposium*, pages 1084–1087, 2015.
- [C1] W. Czaja, **J.M. Murphy**, and D. Weinberg. Superresolution of remotely sensed images with anisotropic features. In *IEEE International Conference on Sampling Theory and Applications*, pages 317–321, 2015.*

Abstract-Reviewed Conference Proceedings:

- [A7] L. Li, **J.M. Murphy**, and A. Tasissa. Sparse coding for classification via a locality regularizer: With applications to agriculture. In *16th International Conference on Precision Agriculture*, pages 1–6, 2024.
- [A6] N. Kapsin and **J.M. Murphy**. Spatially regularized multiscale graph clustering for electron microscopy. In *SPIE Algorithms and Technologies for Multispectral, Hyperspectral, and Ultraspectral Imagery XXV*, volume 10986, pages 231–238, 2019.

- [A5] **J.M. Murphy** and M. Maggioni. Diffusion geometric methods for fusion of remotely sensed data. In *SPIE Algorithms and Technologies for Multispectral, Hyperspectral, and Ultraspectral Imagery XXIV*, volume 10644, pages 137–147, 2018.
- [A4] E.J. King and **J.M. Murphy**. A theoretical guarantee for data completion via geometric separation. In *Proceedings in Applied Mathematics and Mechanics*, volume 17, pages 833–834, 2017.*
- [A3] **J.M. Murphy**, O.N. Leija, and J. Le Moigne. Agile multi-scale decompositions for automatic image registration. In *SPIE Algorithms and Technologies for Multispectral, Hyperspectral, and Ultraspectral Imagery XXII*, volume 9840, pages 253–261, 2016.
- [A2] E.H. Bosch, W. Czaja, **J.M. Murphy**, and D. Weinberg. Anisotropic representations for superresolution of hyperspectral data. In *SPIE Algorithms and Technologies for Multispectral, Hyperspectral, and Ultraspectral Imagery XXI*, volume 9472, pages 365–373, 2015.*
- [A1] W. Czaja, T. Doster, and **J.M. Murphy**. Wavelet packet mixing for image fusion and pan-sharpening. In *SPIE Algorithms and Technologies for Multispectral, Hyperspectral, and Ultraspectral Imagery XX*, volume 9088, pages 13–26, 2014.*

Edited Book Chapters:

- [B1] M. Duchin and **J.M. Murphy**. Explainer: Measuring clustering and segregation. In *Political Geometry*, pages 293–302. Birkhäuser, 2022*.

Theses:

- [T1] **J.M. Murphy**. *Anisotropic Harmonic Analysis and Integration of Remotely Sensed Data*. PhD thesis, University of Maryland, College Park, 2015.

Other Publications:

- [O1] **J.M. Murphy**. Freshman year can be free online for anyone. *The Baltimore Sun*. August 9, 2018.

* Authors listed alphabetically

** Equal senior contribution

PRESENTATIONS

Invited Conference Presentations:

- [37] Workshop on Hyperspectral Image and Signal Processing: Evolution in Remote Sensing. Helsinki, Finland. December 2024.
- [36] SIAM Conference on Mathematics of Data Science. Atlanta, GA. October 2024.
- [35] NSF Anomaly and Threat Detection Workshop. Alexandria, VA. October 2024.
- [34] NSF Computational Mathematics PI Meeting. Seattle, WA. July 2024.
- [33] IEEE International Geoscience and Remote Sensing Symposium. Athens, Greece. July 2024.
- [32] SIAM Conference on Uncertainty Quantification, minisymposium on “Stochastic Computing and Data Assimilation.” Trieste, Italy. February 2024.
- [31] Brin Mathematics Research Center, workshop on “Scientific Machine Learning: Analysis and Algorithms.” College Park, MD. February 2024.
- [30] NSF Anomaly and Threat Detection + Algorithms for Modern Power Systems Workshop. Arlington, VA. October 2023.

- [29] Eigenmaps, Data, and Geometry Workshop. Online. May 2023.
- [28] AMS Sectional Meeting, special session on “Structure-Preserving Machine Learning.” Amherst, MA. October 2022.
- [27] SIAM Conference on Mathematics of Data Science, minisymposium on “Geometry of Data: from Manifolds to Graphs.” Online. September 2022.
- [26] International Conference on Computational Harmonic Analysis. Ingolstadt, Germany. September 2022.
- [25] SIAM Applied and Computational Discrete Algorithms Workshop. Aussois, France. September 2022.
- [24] NSF Anomaly and Threat Detection Workshop. Arlington, VA. May 2022.
- [23] Fields Institute, focus program on “Data Science, Approximation Theory, and Harmonic Analysis.” Toronto, Canada. May 2022.
- [22] Joint Math Meetings, special session on “Statistics and Machine Learning using Topology and Geometry.” Online. April 2022.
- [21] Joint Statistical Meetings, section on “Statistics and National Security.” Online. August 2021.
- [20] SIAM Conference on Applied and Computational Discrete Algorithms. Online. July 2021.
- [19] IEEE International Geoscience and Remote Sensing Symposium. Online. July 2021.
- [18] Joint Math Meetings, special session “Mathematics to the Rescue—Addressing Deficiencies in the Analysis of Overhead Imagery Products.” Online. January 2021.
- [17] NSF Anomaly and Threat Detection + Algorithms for Modern Power Systems Workshop. Online. November 2020.
- [16] District Fourier Talks Conference. Online. October 2020.
- [15] IEEE International Geoscience and Remote Sensing Symposium. Online. September 2020.
- [14] INFORMS Annual Meeting. Seattle, WA. October 2019.
- [13] NSF Anomaly and Threat Detection + Algorithms for Modern Power Systems Workshop. Washington, D.C. October 2019.
- [12] IEEE International Geoscience and Remote Sensing Symposium. Yokohama, Japan. August 2019.
- [11] Large Scale Scientific Computing Conference. Sozopol, Bulgaria. June 2019.
- [10] International Conference on Approximation Theory, special session on “Frames in High-Dimensional Signal and Data Processing.” Nashville, TN. May 2019.
- [9] SPIE Defense+Commercial Sensing Conference. Baltimore, MD. April 2019.
- [8] AMS Sectional Meeting, special session on “Topological Data Analysis, Statistics and Applications.” Auburn, AL. March 2019.
- [7] NSF Anomaly and Threat Detection + Algorithms for Modern Power Systems Workshop. Washington, D.C. October 2018.
- [6] Workshop on Hyperspectral Image and Signal Processing: Evolution in Remote Sensing. Amsterdam, Netherlands. September 2018.
- [5] SPIE Defense+Security Conference. Orlando, FL. April 2018.
- [4] NSF/NGA Anomaly and Threat Detection Workshop. Washington, D.C. September 2017.
- [3] NIH Symposium on Advanced Computational Methods in Biomedical Imaging. Bethesda, MD. October 2016.

- [2] SPIE Defense+Security Conference, Baltimore, MD. April 2016.
- [1] SPIE Defense+Security Conference, Baltimore, MD. April 2015.

Invited Colloquium Presentations:

- [8] Computer Science Colloquium, Wake Forest University. September 2023.
- [7] Mathematics REU Colloquium, Yale University. New Haven, CT. July 2022.
- [6] Mathematics Colloquium, University of Utah. Salt Lake City, UT. September 2021.
- [5] Mathematics Colloquium, Amherst College. Amherst, MA. February 2020.
- [4] Applied Mathematics Colloquium, MIT. Cambridge, MA. May 2019.
- [3] Applied Mathematics Colloquium, UCLA. Los Angeles, CA. January 2019.
- [2] Mathematics Colloquium, Goucher College. Baltimore, MD. December 2017.
- [1] Mathematics Colloquium, University of Alabama. Tuscaloosa, AL. November 2017.

Invited Seminar Presentations:

- [27] Probability and Statistics Seminar, Boston University. Boston, MA. November 2024.
- [26] Data Science Seminar, Johns Hopkins University. November 2024.
- [25] Harmonic Analysis and PDE Seminar, City University of New York, November 2024.
- [24] Mathematics of ML Seminar, University of Massachusetts, Amherst, May 2024.
- [23] Pattern Theory Seminar, Brown University. April 2024.
- [22] Optimal Transport Reading Class, Johns Hopkins University. Online. October 2023.
- [21] Codes and Expansions (CodEx) Seminar. Online. April 2023.
- [20] Imaging Seminar, Case Western University. Online. March 2023.
- [19] One World Mathematics of INformation, Data, and Signals (1W-MINDS) Seminar. Online. February 2023.
- [18] Stochastics + Dynamics + Data Seminar, Illinois Institute of Technology. Online. July 2022.
- [17] Data Science Seminar, University of California, Santa Barbara. Online. February 2022.
- [16] Mathematics in Imaging, Data and Optimization Seminar, Rensselaer Polytechnic Institute. Online. November 2021.
- [15] Scientific Computing Seminar, Emory University. Atlanta, GA. November 2021.
- [14] Applied and Computational Math Seminar, Georgia Tech. Online. April 2021.
- [13] Analysis Seminar, Clemson University. Online. February 2021.
- [12] Computation, Representation, and Inference in Signal Processing (CRISP) Group Seminar, Harvard University. Online. August 2020.
- [11] Mathematical Modeling Seminar, Rochester Institute of Technology. Online. April 2020.
- [10] Probability and Statistics Seminar, Boston University. Boston, MA. February 2020.
- [9] Data Science Seminar, Schlumberger Doll Research. Cambridge, MA. December 2019.
- [8] Computing at Pacific Northwest National Lab Lecture Series. Seattle, WA. November 2019.
- [7] Machine Learning Seminar, University of Massachusetts, Lowell. Lowell, MA. October 2019.

- [6] Statistics Seminar, University of Wisconsin, Madison. Madison, WI. May 2019.
- [5] Data Science Seminar, University of Tennessee, Knoxville. Knoxville, TN. January 2018.
- [4] Machine Learning Seminar, Naval Research Laboratory. Washington, D.C. December 2017.
- [3] Norbert Wiener Center Seminar, University of Maryland, College Park. College Park, MD. November 2016.
- [2] Harmonic Analysis Theory and Applications Seminar, Technical University of Denmark. Copenhagen, Denmark. February 2016.
- [1] Software Engineering Division Seminar, NASA Goddard Space Flight Center. Greenbelt, MD. July 2014.

Contributed Conference Presentations:

- [6] Jubilee of Fourier Analysis and Applications. College Park, MD. September 2019.
- [5] Geometric Data Analysis Conference. Chicago, IL. May 2019.
- [4] Institute for Mathematics and Applications, workshop on “Recent Advances in Machine Learning and Computational Methods for Geoscience.” Minneapolis, MN. October 2018.
- [3] Hausdorff Research Institute for Mathematics conference on “Harmonic Analysis, Graphs, and Learning.” Bonn, Germany. March 2016.
- [2] Centre International de Rencontres Mathématiques (CIRM) doctoral school in “Computational Harmonic Analysis with Applications to Signal and Image Processing.” Marseille, France. October 2014.
- [1] Southeastern Analysis Meeting. Clemson, SC. March 2014.

GRANTS AND AWARDS

Grants:

- Tufts Springboard, “Measuring Segregation via Optimal Transport on Graphs,” (PI, 2024-2025).
- NSF DMS-2318894, “ATD: Diffusion and Transport on Graphs: Active Learning, Low-Dimensional Representations, and Anomaly Detection,” (PI, 2023-2026).
- NSF DMS-2309519, “Towards Harmonic Analysis in Wasserstein Space: Low-Dimensional Structures, Learning, and Algorithms” (PI, 2023-2026).
- Tufts Data Intensive Studies Center Seed Grant, “Unsupervised Clustering for Molecular Dynamics: Internal Distance Geometry and Manifold Dictionary Learning” (PI, 2021-2022).
- Robert E. Wise, MD, Research and Education Institute, “Label-free Hyperspectral Imaging for Intraoperative Classification of Platinum-resistant Ovarian Cancer” (Co-PI, 2020-2022).
- The Camille & Henry Dreyfus Foundation, “Low-supervision Machine Learning for Automated Analysis of Molecular Dynamics Simulations” (Co-PI, 2020-2023).
- NSF DMS 1934553, “HDR TRIPODS: Building the Foundation for a Data-Intensive Studies Center” (Senior Personnel, 2019-2023).
- NSF DMS 1924513, “ATD: Landscape Networks and Nonlinear Diffusions for Anomaly Detection and Active Learning” (PI, 2019-2023).
- NSF DMS 1912737, “Collaborative Research: Data-driven Path Metrics for Machine Learning” (PI, 2019-2022).
- Tufts Collaborates, “Decoding the Complexity of Commuting Networks in the United States” (Co-PI, 2019-2020).

Awards: Professor Joel Dean Award for Excellence in the Teaching of Mathematics (JHU, 2018); First place in Defense Science and Technology Lab Temporal Anomaly Detection Challenge (Duke, 2015); Jacob K. Goldhaber Travel Grant (UMD, 2014); Aziz/Osborn Gold Medal for Teaching (UMD, 2013); Student Marshall (top 3 % of undergraduate class) (UChicago, 2011); Graduation with general and departmental honors (UChicago, 2011); Phi Beta Kappa (UChicago, 2010).

RESEARCH VISITS AND VISITING POSITIONS

- Harvard University, March-April 2022, 9 weeks.
- University of Utah, September-October 2021, 3 weeks.
- Park City Mathematics Institute, July 2016, 3 weeks.
- Hausdorff Research Institute for Mathematics, February-March 2016, 6 weeks.

TEACHING

Tufts University:

MATH 34 (Calculus II). Fa20.
MATH 123 (Math Aspects of Data Analysis). Fa18, Fa19, Sp23, Sp24.
MATH 165 (Probability Theory). Fa20, Sp24, Fa24.
MATH 166 (Statistics). Sp19, Sp20, Sp21, Sp23.
MATH 237 (Functional Analysis), Sp25.
MATH 260 (Foundations of Statistical and Machine Learning). Sp20.
MATH 270 (Optimal Transport: Theory and Applications). Fa22.

Johns Hopkins University:

MATH 106 (Calculus I for Biology and Social Sciences). Su17.
MATH 202 (Calculus III). Fa17.
MATH 302 (ODE and PDE). Fa16, Su18.

Duke University:

MATH 353 (ODE and PDE). Fa15, Su16.
MATH 790 (Graduate Topics Course in Anisotropic Harmonic Analysis). Fa15.

University of Maryland:

STAT 100 (Introduction to Statistics). Fa11, Sp13, Su15.
MATH 115 (Pre-Calculus). Su13.
MATH 140 (Calculus I). Fa13.

Modern States:

College Algebra
College Mathematics
PreCalculus
Calculus

MENTORSHIP

Postdoctoral Advisor:

Rocío Diaz Martin, Tufts, August 2024-present.
Abiy Tasissa, Tufts. August 2019-August 2021. First position: Assistant Professor at Tufts.

PhD Student Advisor:

David Gentile, Tufts. October 2023-present.
Brendan Mallery, Tufts, co-advised with Shuchin Aeron. January 2022-present.
Matt Werenski, Tufts, co-advised with Shuchin Aeron. June 2020-August 2024.
Marshall Mueller, Tufts, co-advised with Abiy Tasissa. September 2019-May 2024.
Sam Polk, Tufts. September 2018-May 2022. First position: MIT Lincoln Laboratory.

Masters Student Advisor:

Joshua Huang, Tufts. November 2023-present.
Harrison Miller, Tufts. May 2020-May 2021. First position: Alnylam Pharmaceuticals.
Shukan Zhang, Tufts. August 2020-May 2021. First position: Huawei.

Undergraduate Research Advisor:

Kabir Tripathi, Tufts. January 2024-present.
Daniel Peng, Tufts. September 2022-present.
Scott Fullenbaum, Tufts. September 2022-May 2024. First position: Fidelity Investments.
Eugene Henninger-Voss, Tufts. August 2020-May 2021. First position: PhD student at Penn State.
Harris Hardiman-Mostow, Tufts. May 2020-May 2021. First position: NSF GRF at UCLA.
Jonathan Conroy, Tufts. August 2019-June 2020. First position: PhD student at Dartmouth.
Duc Nguyen, Tufts. May 2019-May 2020. First position: PhD student at University of Maryland.
Sebastian Coates, Tufts. August 2019-May 2020. First position: Microsoft.
Bhushan Suwal, Tufts. December 2018-June 2019. First position: PhD student at Boston University.
Nathan Kapsin, JHU. May-September 2018. First position: undergraduate at UChicago.
Miriam Goldman, Duke. May-July 2016. First position: PhD student at UCSF.
Kevin Stubbs, UMD. March 2014-June 2015. First position: PhD student at Duke.

REU Advisor:

Alexis Obu, Tufts University. June-August 2024.
Tadiwanashe Nyamapfene, Rust College. June-August 2024.
Lisa Baek, Brown University. June-August 2024.
Zachary Klein, Columbia University. June-August 2024.
Jordan Banks, Howard University. May-August 2022.
Rachel Stumpf, St. Olaf College. May-August 2022.
Nasir Wynruit, Tufts. May-August 2022.
Opemipo Esan, Penn State. May 2020-March 2021. First position: Uber.

Thesis Defense & Candidacy Committees:

Luca Grosmann, Tufts, Honors Undergraduate Thesis Defense. 2024.
Woojoo Na, Tufts, MA Thesis Defense. 2023
Shoaib bin Masud, Tufts. PhD Thesis Defense. 2022
Martin Buck, Tufts, PhD Candidacy. 2023.
Shuang Guan, Tufts, PhD Candidacy. 2023.
Jovan Damjanovic, Tufts. PhD Thesis Defense. 2023
Matthew Hudes, Tufts. Honors Undergraduate Thesis Defense. 2023.
Kapil Devkota, Tufts. PhD Thesis Defense. 2023
Sam Lichtenberg, Tufts. MA Thesis Defense. 2023.
Casey Cavanaugh, Tufts. PhD Thesis Defense. 2022
Joao Marcos Vensi Basso, Tufts. Honors Undergraduate Thesis Defense. 2020.
Elizabeth Newman, Tufts. PhD Thesis Defense. 2019.
Yue Shen, Tufts. MA Thesis Defense. 2019.
Zian Jiang, Tufts. Honors Undergraduate Thesis Defense. 2019.

SERVICE

Journal Editorial Board Member: ACM Transactions on Probabilistic Machine Learning (2023-present), AIMS Foundations of Data Science (2019-present).

Invited Peer Reviewer: AISTATS, Annals of Statistics, Applied and Computational Harmonic Analysis, Bioinformatics, Biometrika, IEEE/ACM Transactions on Computational Biology and Bioinformatics, IEEE Geoscience and Remote Sensing Letters, IEEE Geoscience and Remote Sensing Magazine, IEEE Signal Processing Letters, IEEE Transactions on Geoscience and Remote Sensing, IEEE Transactions on Image Processing, ICCV, ICML, Information & Inference, Journal of Computational Physics, Journal of Machine Learning Research, Journal of the Royal Statistical Society: Series B, Machine Learning, Mathematical Reviews, Neural Computation, Neural Networks, Pattern Recognition, Physica D, Remote Sensing, SIAM Journal on Applied Mathematics, SIAM Journal on Imaging Science, SIAM Journal of Mathematical Analysis, SIAM Journal on Matrix Analysis and Applications, SIAM Journal on Mathematics of Data Science, SIAM Review, Signal Processing, Statistics & Computing.

Conference & Seminar Organizer:

- IEEE International Geoscience and Remote Sensing Symposium, Session Chair for “Classification and Clustering.” July 2024.
- ICERM. Co-organizer of workshop “Optimal Transport in Data Science.” May 2023.
- Joint Math Meetings. Co-organizer of special session “Topology, Algebra, and Geometry in the Mathematics of Data Science.” January 2023.
- AMS Sectional Meeting. Co-organizer of special session “Mathematics of Data Science.” March 2022.
- International Conference on Computer Vision. Co-organizer of workshop “Topology, Algebra, and Geometry in Computer Vision.” October 2021.
- Tufts Tripods Institute. Co-organizer of workshop on “Topics on Graph Algorithms and Their Applications.” April-May 2021.
- IEEE International Geoscience and Remote Sensing Symposium. Co-organizer of special session “Integrating Physical Models into Machine Learning (ML) Models.” September 2020.
- Tufts Tripods Online Data Science Seminar. Co-organizer. March-June 2020.
- 12th International Conference on Large-Scale Scientific Computations. Organizer of special session “Large Scale Machine Learning: Multiscale Algorithms and Performance Guarantees” and member of the scientific committee. June 2019.
- Tufts University Applied Mathematics Seminar. Co-organizer. January 2019-present.
- Johns Hopkins University Data Science Seminar. Co-organizer. July 2016-August 2018.

Grant Review Panel Service: US NSF ($\times 3$); US ARO; US NASA ($\times 2$); US NIJ; Israeli Ministry of Innovation, Science and Technology; U.S.-Israel Binational Science Foundation.

External Tenure Reviewer: 2024 ($\times 2$)

University Committee Service: Masters in Data Analytics Steering Committee, Tufts University, May 2019-present; Faculty Research Support Advisory Committee, Tufts University, September 2022-present; Graduate Committee for Mathematics Department, Tufts University, September 2018-May 2021 and September 2022-present; Undergraduate Admissions and Financial Aid Committee, Tufts University, September 2019-May 2021.