Minh Tang

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Education

2010 **Ph.D in Computer Science**,
Indiana University Bloomington.

2004 **M.S. in Computer Science**,
University of Wisconsin Milwaukee.

2001 **B.S. in Computer Science**,
Assumption University, Thailand.

Work Experience

08/24 – now **Associate Professor**,
Department of Statistics, North Carolina State University.

07/19 – 07/24 **Assistant Professor**,
Department of Statistics, North Carolina State University.

01/17 – 06/19 **Associate Research Professor**,
Department of Applied Mathematics and Statistics, Johns Hopkins University.

07/14 – 12/16 **Assistant Research Professor**,
Department of Applied Mathematics and Statistics, Johns Hopkins University.

10/10 – 06/14 **Postdoctoral Fellow**,
Department of Applied Mathematics and Statistics, Johns Hopkins University.

Research Interests

statistical pattern recognition, dimensionality reduction, statistical inference on graphs

Funded Grants

08/22 – 07/25 sole PI on NSF DMS grant: Spectral methods for single and multiple graph inference

03/17 – 08/21 co-PI on DARPA Data-Driven Discovery of Models (PI: Carey Priebe)

08/18 – 08/19 PI on Microsoft Research Award: Efficiency and Optimality in Graph Inference

Journal Publications (* denote former or current PhD advisees)

2024 Y. Zhang* and **M. Tang**. Exact recovery of community structures using DeepWalk and Node2vec. *IEEE Transactions on Pattern Analysis and Machine Intelligence*, Vol. 46, pp. 1065–1078. DOI link.

2023 X. Du* and **M. Tang**. Hypothesis testing for equality of latent positions in random graphs. *Bernoulli*, Vol. 29, pp. 3221–3254. DOI link.

2023 J. Koo* and **M. Tang** and M. W. Trosset. Popularity adjusted block models are generalized random dot product graphs. *Journal of Computational and Graphical Statistics*, Vol. 32, pp. 131–144. DOI link.

2023 A. Athreya, Z.Lubberts, B. Lewis, V. Lyzinski, M. Kane, Y.Park, C. E. Priebe and **M. Tang**, Numerical tolerance for spectral decompositions of random matrices. *Journal of Computational and Graphical Statistics*, Vol. 32, pp. 145–156. DOI link.

2022 R. Zheng* and V. Lyzinski and C. E. Priebe and **M. Tang**. Vertex nomination between graphs via spectral embedding and quadratic programming. *Journal of Computational and Graphic Statistics*, Vol. 31, pp.1254–1268. DOI link.

2022 P. Rubin-Delanchy and J. Cape* and **M. Tang** and C. E. Priebe. A statistical interpretation of spectral embedding: the generalised random dot product graph. *Journal of the Royal Statistical Society, Series B.*, Vol. 84, pp.1446–1473. DOI link.

2022 J. Chung and B. Varjavand and J. Arroyo-Relion and A. Alaykin and J. Agterberg and **M. Tang** and C. E. Priebe and J. T. Vogelstein, Valid two-sample graph testing via optimal transport Procrustes and multiscale graph correlation with applications in connectomics, *Stat*, Vol. 11. DOI link.

2022 **M. Tang** and J. Cape* and C. E. Priebe. Asymptotically efficient estimators for stochastic blockmodels: the naive MLE, the rank-constrained MLE, and the spectral. *Bernoulli*, Vol. 28, pp. 1049–1073. DOI link.

2022 A. Athreya and J. Cape* and **M. Tang**. Eigenvalues of stochastic blockmodel graphs and random graphs with low-rank edge probability matrices. *Sankhya A*, Vol. 84, pp. 36–63 (Special Issue on Network Analysis). DOI link.

2021 K. Levin and F. Roosta and **M. Tang** and M. Mahoney and C. E. Priebe. Limit theorems for out-of-sample extensions of the adjacency and Laplacian spectral embeddings. *Journal of Machine Learning Research*, Vol. 22. DOI link.

2021 J. Vogelstein and E. Bridgeford and **M. Tang** and D. Zheng and C. Douville and R. Burns and M. Maggioni. Supervised Dimensionality Reduction for Big Data. *Nature Communications*, Vol. 12, article #2872. DOI link.

2021 A. Athreya and **M. Tang** and Y. Park and C. E. Priebe. On estimation and inference in latent structure random graphs. *Statistical Science*, Vol. 36, pp. 68–88. DOI link.

2020 G.-K. Li* and **M. Tang** and N. Charon and C. E. Priebe. Central limit theorems for classical multidimensional scaling. *Electronic Journal of Statistics*, Vol. 14, pp. 2362–2394. DOI link.

2019 J. Cape* and **M. Tang** and C. E. Priebe. On spectral embedding performance and elucidating network structure. *Journal of Network Science*, Vol. 7, pp. 269–291. DOI link.

2019 J. Cape* and **M. Tang** and C. E. Priebe. The two-to-infinity norm and singular subspace geometry with applications to high-dimensional statistics. *Annals of Statistics*, Vol. 47, pp. 2405–2439. This paper was among 4 papers selected for presentation at the 2019 JSM Annals of Statistics Special Invited Sessions. DOI link.

2019 J. Cape* and **M. Tang** and C. E. Priebe. Signal-plus-noise matrix models: eigenvector deviations and fluctuations. *Biometrika*, Vol. 106, pp. 243–250. DOI link.

2019 C. E. Priebe and Y. Park and J. T. Vogelstein and J. M. Conroy and V. Lyzinski and **M. Tang** and A. Athreya and J. Cape and E. Bridgeford. On a "two truths" phenomenon in spectral graph clustering. *PNAS*, Vol. 116, pp. 5995–6000. DOI link.

2018 **M. Tang** and C. E. Priebe. Limit theorems for eigenvectors of the normalized Laplacian for random graphs. *Annals of Statistics*, Vol. 46, pp. 2360–2415. DOI link.

2018 A. Athreya and D. E. Fishkind and K. Levin and V. Lyzinski and Y. Park and Y. Qin and D. L. Sussman and **M. Tang** and J. T. Vogelstein and C. E. Priebe, Statistical inference on random dot product graphs: a survey, *Journal of Machine Learning Research*, Vol. 18. DOI link.

2017 J. Cape* , **M. Tang** and C. E. Priebe. The Kato-Temple inequality and eigenvalue concentration. *Electronic Journal of Statistics*, Vol. 11, pp. 3954–3978. DOI link.

2017 V. Lyzinski, **M. Tang**, A. Athreya, Y. Park and C. E. Priebe. Community detection and classification in hierarchical stochastic blockmodels. *IEEE Transactions on Network Science and Engineering*, Vol. 4, pp. 13–26. DOI link.

2017 **M. Tang**, A. Athreya, D. L. Sussman, V. Lyzinski, Y. Park and C. E. Priebe. A semiparametric two-sample hypothesis testing problem for random graphs. *Journal of Computational and Graphical Statistics*, Vol. 26, pp. 344–354. DOI link.

2017 **M. Tang**, A. Athreya, D. L. Sussman, V. Lyzinski, and C. E. Priebe. A nonparametric two-sample hypothesis testing problem for random dot product graphs. *Bernoulli*, Vol. 23, pp. 1599–1630. DOI link.

2016 A. D. Mali and **M. Tang**. Path-cost bounds for parameterized centralized variants of A^* for static and certain environments. *International Journal on Artificial Intelligence and Tools*, Vol. 25. DOI link.

2016 S. Suwan, D. S. Lee, R. Tang, D. L. Sussman, **M. Tang** and C. E. Priebe. Empirical Bayes estimation for the stochastic blockmodel. *Electronic Journal of Statistics*, Vol. 10, pp. 761–782. DOI link.

2016 A. Athreya, V. Lyzinski, D. J. Marchette, C. E. Priebe, D. L. Sussman and **M. Tang**. A central limit theorem for scaled eigenvectors of random dot product graphs. *Sankhya Series A*, Vol. 78, pp. 1–18. DOI link.

2015 C. E. Priebe, D. L. Sussman, **M. Tang** and J. T. Vogelstein. Statistical inference on errorfully observed graphs. *Journal of Computational and Graphical Statistics*, Vol. 24, pp. 930–953. DOI link.

2014 V. Lyzinski, D. L. Sussman, **M. Tang**, A. Athreya and C. E. Priebe. Perfect clustering for stochastic blockmodel graphs via adjacency spectral embedding. *Electronic Journal of Statistics*, Vol 8, pp. 2905–2922. DOI link.

2014 C. Shen, M. Sun, **M. Tang** and C. E. Priebe. Generalized canonical correlation analysis for classification in high dimensions. *Journal of Multivariate Analysis*, Vol. 130, pp. 310–322. DOI link.

2014 D. L. Sussman, **M. Tang** and C. E. Priebe. Consistent latent position estimation and vertex classification for random dot product graphs. *IEEE Transactions on Pattern Analysis and Machine Intelligence*, Vol. 36, pp. 48–57. DOI link.

2014 H. Wang, **M. Tang**, Y. Park, and C. E. Priebe. Locality statistics for anomaly detection in time-series of graphs. *IEEE Transactions on Signal Processing.*, Vol. 62, pp. 703–717. DOI link.

2013 D. E. Fishkind, D. L. Sussman, **M. Tang**, J. T. Vogelstein, and C. E. Priebe. Consistent adjacency-spectral partitioning for the stochastic block model when the model parameters are unknown. *SIAM Journal on Matrix Analysis and Applications*, Vol. 34, pp. 23–39. DOI link.

2013 N. H. Lee, J. Yoder, **M. Tang** and C. E. Priebe. On latent position inference from doubly stochastic messaging activities. *Multiscale Modeling and Simulation*, Vol. 11, pp. 683–718. DOI link.

2013 M. Sun, C. E. Priebe and **M. Tang**. Generalized canonical correlation analysis for disparate data fusion. *Pattern Recognition Letters*, Vol. 34, pp. 194–200. DOI link.

2013 **M. Tang**, Y. Park, N. H. Lee and C. E. Priebe. Attribute fusion in a latent process model for time series of graphs. *IEEE Transactions on Signal Processing*, Vol. 61, pp. 1721–1732. DOI link.

2013 **M. Tang** and D. L. Sussman and C. E. Priebe. Universally consistent vertex classification for latent positions graphs. *Annals of Statistics*, Vol. 41, pp. 1406–1430. DOI link.

2012 D. L. Sussman, **M. Tang**, D. E. Fishkind and C. E. Priebe. A consistent adjacency spectral embedding for stochastic blockmodel graphs. *Journal of the American Statistical Association*, Vol. 107, pp. 1119–1128. DOI link.

Manuscripts Under Review (* denote PhD advisees)

2023 Y. Song* and C. E. Priebe and **M. Tang**. Independence testing for inhomogeneous random graphs. arXiv link.

2022 S. Peyman and **M. Tang** and V. Lyzinski, Adversarial contaimination of networks in the setting of vertex nomination: a new trimming method. arXiv link.

2022 R. Zheng* and **M. Tang**, Limit results for distributed estimation of invariant subspaces in multiple networks inference and PCA. arXiv link.

2022 Y. Zhang* and **M. Tang**, Perturbation analysis of randomized SVD and its applications to high-dimensional statistics. arXiv link.

2022 J. Agterberg and **M. Tang** and C. E. Priebe. Nonparametric Two-Sample Hypothesis Testing for Random Graphs with Negative and Repeated Eigenvalues. arXiv link.

2021 Y.-J. Chen* and **M. Tang**, Classification of high-dimensional data with spiked covariance matrix structure. arXiv link.

2020 Y. Wang* and S. Lahiri and **M. Tang**. Two-sample Testing on Latent Distance Graphs With Unknown Link Functions. arXiv link.

Conference and Workshop Proceedings (* denote PhD advisees)

2023 K. Hameed* and R. Johnston and B. Younce and **M. Tang** and A. Wilson. Motif-based exploratory data analysis for state-backed platform manipulation on twitter. In *Proceedings of the 17th International AAAI Conference on Web and Social Media.*

2017 K. Levin and A. Athreya and **M. Tang** and C. E. Priebe and V. Lyzinski. A central limit theorem for an omnibus embedding of random dot product graphs. In *Proceddings of the 17th International Conference on Data Mining* arXiv link.

2013 H. Wang and **M. Tang** and C. E. Priebe and Y. Park. Inference in time series of graphs using locality statistics. In *Proceedings of the IEEE Global Conference on Signal and Information Processing.*

2013 J. Feng and X. Tang and **M. Tang** and C. E. Priebe and M. Miller. Metric space structures for computational anatomy. In *Proceedings of the 4th International Workshop on Machine Learning in Medical Imaging.*

2012 M. Sun and **M. Tang** and C. E. Priebe. A comparison of graph embedding methods for vertex nomination. In *Proceedings of the 11th International Conference on Machine Learning and Applications.*

2007 **M. Tang**. Generating functions and the solutions of full-history recurrence equations. In *Proceedings of the European Conference on Combinatorics, Graph Theory, and Applications.*

2004 **M. Tang** and A. D. Mali. Variants of A* for planning. In *Proceedings of the European Conference on Artificial Intelligence.*

2003 **M. Tang** and A. D. Mali. Search control techniques for planning. In *Proceedings of the IEEE International Conference on Tools with Artificial Intelligence.*

Technical Reports

2020 M. Trosset and M. Gao and **M. Tang** and C. E. Priebe. Learning 1-Dimensional Submanifolds for Subsequent Inference on Random Dot Product Graphs. arXiv link.

2020 J. Agterberg and **M. Tang** and C. E. Priebe. On Two Distinct Sources of Nonidentifiability in Latent Position Random Graph Models. arXiv link.

2017 R. Tang and **M. Tang** and J. T. Vogelstein and C. E. Priebe. Robust estimation from multiple graphs under gross error contamination. arXiv link.

2017 P. Rubin-Delanchy and C. E. Priebe and **M. Tang**. Consistency of adjacency spectral embedding for the mixed membership stochastic blockmodel. arXiv link.

2017 C. E. Priebe and Y. Park and **M. Tang** and A. Athreya and V. Lyzinski and J. T. Vogelstein and Y. Qin and B. Cocanougher and K. Eichler and M. Zlatic and A. Cardona. arXiv link.

2013 **M. Tang**, Y. Park and C. E. Priebe. Out-of-sample extension for latent position graphs. arXiv link. The publication by Levin et al. in JMLR was based on a part of this technical report.

Seminars and Invited Talks

07/2024 VIASM Summer School on Mathematical Statistics and Machine Learning, Hanoi, Vietnam

07/2024 2nd Joint Conference on Statistics and Data Science, Kunming, China

09/2023 Department of Statistics and Probability, Michigan State University.
09/2023 Department of Mathematics, Georgia Institute of Technology
08/2023 Joint Statistical Meetings, Toronto.
08/2023 EcoStat, Tokyo, Japan
07/2023 International Chinese Statistical Association Conference, Hongkong.
06/2023 Statistical Networks Analysis and Beyond (SNAB) Workshop, Anchorage, Alaska
10/2022 Operation Research Seminar, North Carolina State University.
11/2021 Department of Mathematics and Statistics, University of Massachusetts, Amherst.
12/2020 CMStatistics, London, UK.
04/2020 Department of Mathematics, University of Maryland
12/2019 CMStatistics, London, UK.
11/2018 Department of Biostatistics, Yale University.
09/2017 Department of Mathematics and Statistics, Boston University.
08/2017 Joint Statistical Meetings, Baltimore, MD, USA.
11/2015 Department of Statistics, Indiana University Bloomington.
02/2015 School of Industrial and Systems Engineering, Georgia Institute of Technology.
02/2015 Department of Statistics, Virginia Tech.
08/2014 Joint Statistical Meetings, Boston, MA, USA.
05/2012 Interface Symposia, Houston, TX, USA.

Teaching

NCSU ST790: Concentration inequalities and their applications to machine learning and statistics (F24)
NCSU ST 371: Introduction to probability and distribution theory (F22,S23,F23)
NCSU ST790: Statistical inference on graphs (F20, S22)
NCSU ST 501: Fundamentals of statistica inference (F20, F21, F22, F24)
NCSU ST 421: Mathematical statistics I (S20)
NCSU ST 442: Introduction to data science (F19, F21,F23)
JHU Generalized linear mixed models & longitudinal data analysis (S17, S18, S19)
JHU Professor Joel Dean Award for Excellence in Teaching (S16)
JHU Topics in statistical pattern recognition (S16)
JHU Applied statistics and data analysis (F13, F14, F15, F16, F17, F18)
JHU Statistical learning and high-dimensional data analysis (S11)

Mentoring

NCSU PhD thesis advisor of Khuzaima Hammed (defended August 2024).
NCSU PhD thesis advisor of Yukun Song (defended August 2024).
NCSU PhD thesis advisor of Yichi Zhang (defended June 2023); co-advisor with Shu Yang. Yichi is currently an Assistant Professor in the Department of Statistics at Indiana University
NCSU PhD thesis advisor of Xinjie Du (graduated May 2023).
NCSU PhD thesis advisor of Runbing Zheng (graduated May 2023). Runbing is currently a Rufus Isaacs Postdoctoral Fellow in the Department of Applied Mathematics and Statistics at Johns Hopkins University.
NCSU PhD thesis advisor of John Koo at Indiana University Bloomington (graduated January 2023); co-advisor with Michael W. Trosset. John is currently a postdoctoral fellow at the Indiana University School of Medicine.
NCSU PhD thesis advisor of Alex Chen (graduated July 2022)

NCSU PhD thesis advisor of Yiran Wang (graduated December 2021); co-advisor with Soumendra Lahiri.

JHU PhD thesis advisor of Gongkai Li (graduated May 2019); co-advisor with Carey E. Priebe.

JHU PhD thesis advisor of Joshua Cape (graduated March 2019); co-advisor with Carey E. Priebe. Joshua is currently an Assistant Professor in the Department of Statistics at the University of Wisconsin, Madison.

JHU MS thesis advisor of Jipeng Zhang (graduated December 2019).

JHU MS thesis advisor of Erin Hunt (graduated May 2019).

JHU MS thesis advisor of Fanwen Zhu (graduated July 2018).

Professional Services

August 2019 Organized the JSM Invited Session on Exploiting Latent Structure for Network Inference (co-organizer Avanti Athreya).

October 2023 Organizing the 2023 Workshop on Statistical Inference on Networks and High-dimensional Data at the University of Maryland. (co-organizer Avanti Athreya and Vince Lyzinski.

2012–current Refereed papers for *Annals of Statistics, Annals of Applied Statistics, Statistical Science, Journal of Computational and Graphical Statistics, IEEE Transactions on Signal Processing, IEEE Transactions on Network Science, Journal of the American Statistical Association, Journal of the Royal Statistical Society, Series B., Electronic Journal of Statistics, Journal of Machine Learning Research, IEEE Transactions on Knowledge and Data Engineering, Bernoulli, Biometrics, Journal of Statistical Planning and Inference.*