RAHUL SINGH

CONTACT INFORMATION

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Research: Google Scholar
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SUMMARY

My research lies at the intersection of signal processing, machine learning, and neuroscience, with a strong emphasis on developing principled methods to address challenges in structured and complex data. My work spans these interconnected areas: graph signal processing and representation learning, probabilistic graphical models, optimal transport, distributional reinforcement learning, and applications in neuroscience.

APPOINTMENTS

Yale University, New Haven, CT, USA — **Jul 2023 - Present**

Postdoctoral Research Associate

Mentors: Prof. Joy Hirsch and Prof. Smita Krishnaswamy

EDUCATION

Georgia Institute of Technology, Atlanta, GA, USA — **May 2023**

Ph.D. - Machine Learning
Dissertation: Learning with Structured Data
Advisor: Prof. Yongxin Chen

Iowa State University, Ames, IA, USA — **Dec 2018**

M.Eng. - Electrical Engineering
Advisor: Prof. Yongxin Chen

Indian Institute of Space Science and Technology, Trivandrum, India — **Jul 2015**

M.Tech. - Digital Signal Processing
Dissertation: Complex Networks: A Signal Processing Perspective
Advisor: Prof. Manoj BS

KIIT University, Bhubaneswar, India — **Jul 2013**

B.Tech. - Electronics and Telecommunication Engineering

HONORS AND AWARDS

Trainee Professional Development Award, Society for Neuroscience (SfN) — **2024**
Wu Tsai Postdoctoral Fellowship, Yale University — **2023-2026**
Teaching Excellence Award, Iowa State University — **2018**
Best Paper Award,
International Conference on Signal Processing and Communications (SPCOM) — **2016**
Graduate Study Scholarship, Department of Space, Government of India — **2013-2016**

EXPERIENCE

Intern — **May 2022 - Aug 2022**
Intel AI, San Diego, CA, USA

Intern — **May 2021 - Aug 2021**
Mitsubishi Electric Research Lab (MERL), Boston, MA, USA

Graduate Research and Teaching Assistant — **Aug 2018 - May 2023**
Georgia Institute of Technology, Atlanta, GA, USA

Graduate Research and Teaching Assistant — **Aug 2016 - Jul 2018**
Iowa State University, Ames, IA, USA

Senior Project Fellow — **Aug 2015 - Jul 2016**
Indian Institute of Space Science And Technology, Trivandrum, India

PUBLICATIONS
(⋆ indicates co-first authors)

Book

B. S. Manoj, A. Chakraborty, and **R. Singh**, "Complex Networks: A Networking and Signal Processing Perspective," *Prentice Hall PTR, New Jersey, USA,* 2018.

Journals

10. **R. Singh**, Y. Zhang, D. Bhaskar, V. Srihari, C. Tek, X. Zhang, J Adam Noah, S. Krishnaswamy and J. Hirsch, "Deep Multimodal Representations and Classification of First-Episode Psychosis via Live Face Processing," *Frontiers in Psychiatry, 2024. (In press)*
9. X. Zhang, J Adam Noah, **R. Singh**, J. McPartland and J. Hirsch, "Support Vector Machine Prediction of Individual Autism Diagnostic Observation Schedule (ADOS) scores based on Neural Responses during Live eye-to-eye Contact," *Scientific Reports, 2024.*
8. **R. Singh** and Y. Chen, "Signed Graph Neural Networks: A Frequency Perspective," *Transactions on Machine Learning Research, 2023.*
7. **R. Singh** and Y. Chen, "Learning Gaussian Hidden Markov Models From Aggregate Data," *IEEE Control Systems Letters, 2023.*
6. **R. Singh**, I. Hassler, Q. Zhang, J. Karlsson, and Y. Chen, "Inference with Aggregate Data in Probabilistic Graphical Models: An Optimal Transport Approach," *IEEE Transactions on Automatic Control, 2022.*
5. Q. Zhang*, **R. Singh***, and Y. Chen, "Inference of Aggregate Hidden Markov Models with Continuous Observations," *IEEE Control Systems Letters, 2022.*
4. **R. Singh**, Q. Zhang, and Y. Chen, "Learning Hidden Markov Models from Aggregate Observations," *Automatica, 2022.*
3. I. Hassler*, **R. Singh***, Q. Zhang, J. Karlsson, and Y. Chen, "Multi-marginal Optimal Transport and Probabilistic Graphical Models," *IEEE Transactions on Information Theory, 2021.*
2. **R. Singh**, I. Haasler, Q. Zhang, J. Karlsson, Y. Chen, "Incremental Inference of Collective Graphical Models," *IEEE Control Systems Letters, 2021.*
1. **R. Singh**, A. Chakraborty, and B. S. Manoj, "GFT Centrality: A New Node Importance Measure for Complex Networks," *Physica A: Statistical Mechanics and its Applications, 2017.*

Conferences

7. A. Afrasiyabi, D. Bhaskar, E. Busch, L. Caplette, **R. Singh**, G. Lajoie, N. Turk-Browne, and S. Krishnaswamy, "SAMBA: Latent Representation Learning for Multimodal Brain Activity Translation," *International Conference on Acoustics, Speech, and Signal Processing (ICASSP) , 2025.*
6. **R. Singh**, K. Lee, and Y. Chen, "Sample-based Distributional Policy Gradient," *4^{th} Conference on Learning for Dynamics and Control (L4DC), 2022.*
5. **R. Singh** and Y. Chen, "Inference of Collective Gaussian Hidden Markov Models," *IEEE Conference on Decision and Control (CDC), 2021.*
4. **R. Singh**, Q. Zhang, and Y. Chen, "Improving Robustness via Risk Averse Distributional Reinforcement Learning," *2^{nd} Conference on Learning for Dynamics and Control (L4DC), 2020.*
3. S. Lu, **R. Singh**, X. Chen, Y. Chen, and M. Hong, "Alternating Gradient Descent Ascent for Nonconvex Min-Max Problems in Robust Learning and GANs," *53^{rd} Asilomar Conference on Signals, Systems, and Computers, 2019.*
2. **R. Singh**, A. Chakraborty, and B. S. Manoj, "Graph Fourier Transform based on Directed Laplacian," *11^{th} International Conference on Signal Processing and Communications (SPCOM)*, 2016. [**BEST paper award**]
1. **R. Singh**, A. Chakraborty, and B. S. Manoj, "On Spectral Analysis of Node Centralities," *IEEE International Conference on Advanced Networks and Telecommunications Systems (ANTS)*, 2016.

Research Support

Wu Tsai Postdoctoral Fellowship *Fellowship* 7/1/2023 – 6/30/2026
Wu Tsai Institute for Neuroscience, Yale University $210,000
"Multimodal Data Fusion for Neuroimaging and Behavioral modalities."
Role: PI/Fellow (grant writing and editing; research design; preliminary work; planning and coordination)

2206576 *Extramural Grant* 9/1/2022 – 8/31/2025
NSF – DMS $239,999
"Graphical Optimal Transport: Theory, Algorithms, and Applications"
Role: Trainee (preliminary work)

Teaching and Mentorship

Summer 2024: Mentor at London Geometry and Machine Learning (LOGML) - mentored a group of 4 PhD students on the project "Spectral Signed GNNs for fMRI Connectomes."

Summer 2024: Co-organized workshop on "A Primer on Topological Data Analysis and Graph Signal Processing for Neuroimaging Data" as part of MAPs program at Yale University.

Summer 2024: Lead organizer of workshop on "Understanding Human Brain" as part of Yale Pathways to science program - group of 16 high school students.

Fall 2021: TA for AE 3530 - System Dynamics and Vibration, Georgia Institute of Technology.

Spring 2019: TA for AE 4610- Dynamics and Control Laboratory, Georgia Institute of Technology.

Fall 2016, Spring 2017: TA for EE 224 - Signals and Systems I, Iowa State University.

Fall 2017: TA for EE 324 - Signals and Systems II, Iowa State University.

Poster Presentations

SIAM Conference on Mathematics of Data Science, Atlanta, GA **Oct 2024**

Society for Neuroscience (SfN), Chicago, IL **Oct 2024**

Society for functional near-infrared spectroscopy (SfNIRS) , Birmingham, UK **Sep 2024**

Review Service

IEEE Transactions on Signal Processing

IEEE Transactions on Automatic Control

IEEE Transactions on Signal and Information Processing over Networks

SIAM Journal on Imaging Sciences

Transactions on Machine Learning Research

IEEE Conference on Decision and Control

American Control Conference

International Symposium on Mathematical Theory of Networks and Systems (MTNS)

International Conference on Learning Representations (ICLR)

Conference on Neural Information Processing Systems (NeuRIPS)

International Conference on Machine Learning (ICML)

International Conference on Acoustics, Speech, and Signal Processing (ICAASP)

Membership

Institute of Electrical and Electronics Engineers (IEEE)

Society for Industrial and Applied Mathematics (SIAM)

Society for Neuroscience (SfN)

References

Available upon request.