

# Rahul Singh

<https://rahulsinghchandraul.github.io>

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## EDUCATION

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- **Georgia Institute of Technology** Atlanta, GA  
*PhD in Machine Learning* August 2018-present
- **Iowa State University** Ames, IA  
*Master of Engineering in Electrical Engineering* December 2018
- **Indian Institute of Space Science and Technology** Trivandrum, India  
*Master of Technology in Digital Signal Processing* July 2015
- **KIIT University** Bhubaneswar, India  
*Bachelor of Technology in Electronics and Telecomm. Engineering* July 2013

## RESEARCH EXPERIENCE

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- **Intel AI** San Diego, CA  
*Intern* May 2022 - August 2022
  - Graph Neural Networks (GNNs) for molecular property prediction.
- **Mitsubishi Electric Research Lab (MERL)** Boston, MA  
*Intern* May 2021 - August 2021
  - Reinforcement Learning (RL) for partial differential equation (PDE) control.
  - Design of heating, ventilating, air conditioning (HVAC) control policy based on RL algorithms.
- **Georgia Institute of Technology** Atlanta, GA  
*Graduate Research Assistant* August 2018 - Present
  - Research and publications on (i) generative modeling including probabilistic graphical models (PGMs) and generative adversarial networks (GANs), (ii) learning for graph structured data, (iii) graph neural networks (GNNs).
  - Proposed graph neural networks for signed graphs with positive as well as negative links.
  - Multi-marginal optimal transport (MOMT) approach for development of fast and convergent algorithms for inference from aggregate population-level data generated by a PGM.
  - Proposed convergent algorithms for learning hidden Markov models (HMMs) from aggregate population-level data.
  - Utilized GANs for learning actor-critic algorithms in distributional reinforcement learning (DRL) framework resulting in robust and sample efficient policies.
- **Iowa State University** Ames, IA  
*Graduate Research Assistant* August 2016 - July 2018
  - Research and publications on machine vision assisted electrohydrodynamic printing (E-jet) and manifold learning.
  - Real-time information extraction (diameter and tilt-angle) from the images of the filament in the air.
- **Indian Institute of Space Science And Technology** Trivandrum, India  
*Senior Project Fellow* August 2015 - July 2016
  - Research and publications on signal processing over complex networks.
  - Redefined Graph Fourier Transform (GFT) by utilizing the eigendecomposition of the directed Laplacian of a graph.
  - Proposed a new centrality measure (GFT-C) for complex networks using frequency analysis of signals defined on graphs.

## AWARDS & RECOGNITION

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- Teaching excellence award, Iowa State University, Ames, IA. (May 2018)
- Best paper award, International Conference on Signal Processing and Communications. (2016)
- Graduate study scholarship from Department of Space, Government of India. (August 2013 - June 2016)

## RELEVANT COURSES

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- Statistical Machine Learning, Convex Optimization, Digital Signal Processing, Image Processing, Computer Vision, Statistical Inference, Deep Learning, Data Science, Information Theory, Reinforcement Learning.

## TEACHING

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- 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.

## SKILLS

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Python, MATLAB, TensorFlow, PyTorch, Git

## SELECTED PUBLICATIONS

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### • Book

- B. S. Manoj, A. Chakraborty, and **Rahul Singh**, “Complex Networks: A Networking and Signal Processing Perspective,” *Prentice Hall PTR, New Jersey, USA*, 2018. (<https://complexnetworksbook.github.io/>)

### • Journals

- **Rahul Singh** and Yongxin Chen, “Signed Graph Neural Networks: A Frequency Perspective,” *Transactions on Machine Learning Research*, 2022. (submitted)
- **Rahul Singh** and Yongxin Chen, “Learning Gaussian Hidden Markov Models From Aggregate Data,” *IEEE Control Systems Letters*, 2023.
- **Rahul Singh**, Isabel Hassler, Qinsheng Zhang, Johan Karlsson, and Yongxin Chen, “Inference with Aggregate Data in Probabilistic Graphical Models: An Optimal Transport Approach,” *IEEE Transaction on Automatic Control*, 2022.
- **Rahul Singh**, Qinsheng Zhang, and Yongxin Chen, “Filtering for Aggregate Hidden Markov Models with Continuous Observations,” *IEEE Control Systems Letters*, 2022.
- **Rahul Singh**, Qinsheng Zhang, and Yongxin Chen, “Learning Hidden Markov Models from Aggregate Observations,” *Automatica*, 2022.
- **Rahul Singh**, Isabel Hassler, Qinsheng Zhang, Johan Karlsson, and Yongxin Chen, “Multi-marginal Optimal Transport and Probabilistic Graphical Models,” *IEEE Transaction on Information Theory*, 2021.
- **Rahul Singh**, Isabel Haasler, Qinsheng Zhang, Johan Karlsson, Yongxin Chen, “Incremental Inference of Collective Graphical Models,” *IEEE Control Systems Letters*, 2021.
- **Rahul 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

- **Rahul Singh**, Keuntaek Lee, and Yongxin Chen, “Sample-based Distributional Policy Gradient,” *4<sup>th</sup> Conference on Learning for Dynamics and Control (L4DC)*, 2022.
- **Rahul Singh** and Yongxin Chen, “Inference of Collective Gaussian Hidden Markov Models,” *IEEE Conference on Decision and Control (CDC)*, 2021.
- **Rahul Singh**, Qinsheng Zhang, and Yongxin Chen, “Improving Robustness via Risk Averse Distributional Reinforcement Learning,” *2<sup>nd</sup> Conference on Learning for Dynamics and Control (L4DC)*, 2020.
- Songtao Lu, **Rahul Singh**, Xiangyi Chen, Yongxin Chen, and Mingyi Hong, “Alternating Gradient Descent Ascent for Nonconvex Min-Max Problems in Robust Learning and GANs,” *53<sup>rd</sup> Asilomar Conference on Signals, Systems, and Computers*, 2019.
- **Rahul Singh**, A. Chakraborty, and B. S. Manoj, “Graph Fourier Transform based on Directed Laplacian,” *11<sup>th</sup> International Conference on Signal Processing and Communications (SPCOM)*, 2016. [**BEST paper award**]

## REVIEW SERVICE

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IEEE Transactions on Signal Processing, IEEE Transactions on Automatic Control, IEEE Transactions on Signal and Information Processing over Networks, IEEE Conference on Decision and Control (CDC), American Control Conference (ACC), International Symposium on Mathematical Theory of Networks and Systems (MTNS), SIAM Journal on Imaging Sciences, NIPS, ICML, ICLR.