Viplove Arora

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Education

Purdue University
West Lafayette, Indiana

PhD, School of Industrial Engineering
August 2014 - December 2019

- **PhD Thesis:** A Generalized Framework for Representing Complex Networks
- **Advisory Committee:** Mario Ventresca (supervisor), Joaquín Goñi, Jennifer Neville, Shreyas Sundaram
- **Concentration:** Computational Science and Engineering

Indian Institute of Technology, Delhi
New Delhi, India

B. Tech, Production and Industrial Engineering
August 2010 - May 2014

- **Bachelors Thesis:** Development of multi-agent system for maintenance planning of production equipment
- **Supervisor:** Makarand S. Kulkarni (ME)

Work Experience

Purdue University
West Lafayette, IN

Postdoctoral Research Assistant
March 2020 - Present

- Identify common design principles and constraints that have shaped the evolution of networked systems
- Develop models at the intersection of network science and machine learning for applications in neuroscience

Research Assistant
August 2015 - December 2019

- Designed networks capable of maintaining sufficient performance when subjected to adverse circumstances
- Formulated centralized and decentralized approaches for enabling better-informed network design decisions
- Devised a framework for designing individual incentives for agents in strategic network formation games
- Automated mechanism design to devise player incentives to achieve global design goals

Mentor, Undergraduate Research
May 2016 - May 2019

- Mentored a project for the development of a gradient-based optimization algorithm during the SURF 2016
- Mentored an independent study investigating viability of Blockchains in the organic produce certification process
- Mentored three undergraduates during their research endeavors in network science and machine learning

Teaching Assistant
January 2015 - May 2018

- Delivered a lecture to a class of 150 students explaining the role of probability models in the 2008 financial crisis
- **Graduate-level courses:** Nature Inspired Computing (IE 59000), Industrial Application of Statistics (IE 53300)
- **Undergraduate-level courses:** Engineering Economics (IE 34300), Work Analysis & Design II (IE 48600)

Manufacturing System Insights
Chennai, India

Summer Intern
May 2013 - July 2013

- Developed a web-based user interface to simulate and stream large amounts of machine event data
- Received Letter of Appreciation from the CTO for showing exceptional technical and project management skills

Publications

Journal Publications

- **V. Arora**, D. Guo, K. D. Dunbar, M. Ventresca, *Quantifying the Variability in Network Populations and its role in Generative Models*, Network Science (2020)
- S. R. Hunter, E. A. Applegate, **V. Arora**, B. Chong, K. Cooper, O. Rincon-Guevara, C. Vivas-Valencia, *An Introduction to Multi-Objective Simulation Optimization*, ACM Transactions on Modeling and Computer Simulation (2019)
- **V. Arora**, M. Ventresca, *Modeling topologically resilient supply chain networks*, Applied Network Science (2018)
- **V. Arora**, M. Ventresca, *Action-based Modeling of Complex Networks*, Scientific Reports (2017)

Conference Papers

- **V. Arora**, M. Ventresca, *Evaluating the Natural Variability in Generative Models for Complex Networks*, International Workshop on Complex Networks and their Applications, 2018
- **V. Arora**, M. Ventresca, *Action-Based Model for Topologically Resilient Supply Networks*, International Workshop on Complex Networks and their Applications, 2017
- D. Guo, **V. Arora**, E. Amico, J. Goñi, M. Ventresca, *Dynamic Generative Model of the Human Brain in Resting-State*, International Workshop on Complex Networks and their Applications, 2017
- **V. Arora**, M. Ventresca, *The inverse problem of discovering complex network generators*, ICIPE, 2017
- **V. Arora**, M. Ventresca, *A Multi-objective Optimization Approach for Generating Complex Networks*, GECCO, 2016

In Preparation

- **V. Arora**, M. Ventresca, *Action-based Representation of Complex Networks: Theory and Inference*, Journal
- **V. Arora**, E. Amico, J. Goñi, M. Ventresca, *Investigating cognitive ability using action-based models of structural brain networks*, Journal
- **V. Arora**, M. Ventresca, *Domain adaptation and generalizability in generative network models*, Conference
- M. Ventresca, **V. Arora**, *Quantifying complex system entropy: an action-based perspective*, Journal
- **V. Arora**, M. Ventresca, *Action-based model for reconstruction and link prediction in networks*, Conference
- Xinqi Gao, **Viplove Arora**, and Mario Ventresca, *Combining micro and macro generative models: Action-based stochastic block model*, Journal

Conference Presentations and Posters

- B. Chong, **V. Arora**, M. Ventresca, *Decentralized Local Robustness Optimization Leads to Global Robustness*, NetSci, 2019
- M. Ventresca, **V. Arora**, *Quantifying complex system entropy: an action-based perspective*, NetSci, 2019
- **V. Arora**, E. Amico, J. Goñi, M. Ventresca, *Investigating cognitive ability using action-based models of structural brain networks*, NetSci, 2019
- **V. Arora**, M. Ventresca, *Action-based Modeling of Complex Networks*, NetSci, 2019
- **V. Arora**, M. Ventresca, *Action-based model for network data with errors*, SIAM WNS, 2019
- **V. Arora**, M. Ventresca, *Action-based Modeling of Complex Networks*, Complex Systems @ Purdue, 2019
- **V. Arora**, *A Generalized Framework for Representing Complex Networks*, INFORMS Purdue Chapter, 2019
- **V. Arora**, *A Generalized Framework for Representing Complex Networks*, CIGP Symposium, Spring 2019
- **V. Arora**, M. Ventresca, *Empirical Evaluation of Generative Network Models to Approximate Ground Truth System*, SINM Satellite @ NetSci, 2018
- **V. Arora**, M. Ventresca, *Automated Modeling and Design of Complex Networks*, NetSci, 2017
- **V. Arora**, M. Ventresca, *Action-based Network Generators*, INFORMS Annual Meeting, 2015

Selected Projects

Action-based Modeling of Complex Networks *May 2015 - July 2018*

- Devised a generative model that utilizes first principles to synthesize realistic networks
- Combined various decision processes for localized node interactions to synthesize realistic network topologies
- Formulated the problem of parameterizing action-based network generators as a non-linear inverse problem
- Utilized the action-based framework to design resilient supply chain networks in a centralized fashion
- Combined geometric and non-geometric wiring rules to explain topological organization of the connectome

Action-based Stochastic Block Model *January 2020 - Present*

- Devising a generative model that can accommodate the micro and macro-level structures of networks
- Combine Bayesian inference in SBM with the action-based model in a hierarchical manner

Generative Modeling and Variability in Network Populations *March 2018 - December 2019*

- Highlighted the need for evaluating and incorporating natural variability in generative models for networks
- Developed data-driven entropy measures for explicit quantification of variability in network populations
- Developing alternative formulations for statistical inference from multiple network observations

Network Reconstruction and Link Prediction *January 2019 - May 2019*

- Developed an action-based approach that reconstructs networks from noisy edge measurement data
- Used distributed optimization within an expectation-maximization algorithm to learn model parameters

Technical Skills

- **(Programming)** R, Python, MATLAB, C++, Java| **(Writing)** Latex | **(Simulation)** AnyLogic | **(Optimization)** Gurobi

Relevant Courses

Industrial Engineering

- Operations Research, Simulation Design, Stochastic Processes, Linear Programming, Introduction to Probability, Real Analysis, Matrix Analysis, Structure and Dynamics of Networks, Simulation Optimization, Bayesian Decision Theory, Inference and Synthesis of Complex Networks, Nature-Inspired Computation

Computer Science

- Stochastic Optimization and Machine Learning, Artificial Intelligence, Algorithm Design and Analysis, Data Structures, Computer Architecture

Extra-Curricular Activities

Reviewer: Journal of Combinatorial Optimization (Springer) *December 2019 - Present*

Program Committee, Poster Session, Complex Systems @ Purdue *May 2019*

Reviewer: Network Science (Cambridge University Press) *January 2019 - Present*

President, INFORMS Chapter Purdue *August 2017 - April 2018*

- Lead a team of 8 members to organize different events including research talks, social events and industry tours
- Successfully invited speakers from Industries and received funding from Graduate Student Association
- The chapter got a Cum-laude award in INFORMS Annual meeting

Vice President, Finance Committee, INFORMS Chapter Purdue *August 2016 - April 2017*

- Successfully obtained financial support for industry tour and organizing bi-weekly seminars
- The chapter won the Summa-Cum-Laude award at INFORMS Annual meeting 2017

Vice President, Industry Relations, INFORMS Chapter Purdue *August 2014 - April 2016*

- Successfully organized four industry visits, one every semester

Long distance Running *July 2012 - Present*

- Completed 1 full marathon, 6 half-marathons and multiple 10k and 5k runs

Robotics, IIT Delhi *July 2010 - May 2013*

- Represented IIT Delhi at Robocon 2011 and 2012, annual national robotics competition
- Awarded first position in an image processing robotics competition at TRYST 2013, IIT Delhi
- Made a Bluetooth-controlled image processing robot for Techfest 2013, IIT Bombay and received Pearls Award

Travel Grants

2019	**Financial support from School of Industrial Engineering,** SIAM WNS and NetSci 2019	*USA*
2018	**Financial support from School of Industrial Engineering,** Complex Networks 2018	*Cambridge, UK*
2017	**Financial support from School of Industrial Engineering,** Complex Networks 2017	*Lyon, France*
2016	**GECCO Student Travel Grant,** GECCO 2016	*Denver, USA*

References

1. **Dr. Mario Ventresca,** mventresca@purdue.edu
2. **Dr. Joaquín Goñi,** jgonicor@purdue.edu
3. **Dr. Susan R. Hunter,** susanhunter@purdue.edu