Electrical & Computer Engineering

S E M I N A R

Louisiana State University

Learning, Dynamics, and Incentives in Multi-Agent Networks

Rohit Parasnis

Massachusetts Institute of Technology

Abstract—Dynamical processes in multi-agent networks—ranging from distributed machine learning in networks of mobile devices to belief evolution in social networks—pose significant analytical challenges arising from uncertainties in network topology and the cognitive and behavioral non-idealities of human agents. These are accompanied by design challenges associated with balancing multiple performance objectives, such as energy-efficiency and training speed. In this two-part talk, I argue that such challenges can be addressed by using tools from networked control, optimization, and game-theoretic incentive design, and by developing new tools where necessary.

The first part focuses on an analysis problem: can we establish convergence guarantees for averaging-based distributed algorithms operating over time-varying networks with uncertain, poor, or aperiodic connectivity? We answer this affirmatively by generalizing the eigenvector assertions of the Perron-Frobenius theorem, a cornerstone of matrix analysis, to stochastic matrix sequences. These results have implications beyond distributed learning and control.

The second part addresses a design problem: in resource-based industries, how can we design economic incentives to align environmental sustainability with producer well-being? Using a coupled-activity network game model, we formulate this question as a non-convex welfare maximization problem. We show that when incentive adjustment bandwidth and maximum feasible penalties are jointly sufficient, we can improve both welfare and sustainability without reducing any agent's equilibrium utility. When joint sufficiency fails, a convex relaxation of the original problem provides a useful solution, which we interpret through node centralities.

Bio—Rohit Parasnis is a Postdoctoral Associate in the Laboratory for Information and Decision Systems (LIDS) at the Massachusetts Institute of Technology (MIT). He obtained his Ph.D. in Electrical Engineering from the University of California San Diego and dual degrees (B.Tech. in Electrical Engineering and M.Tech. in Applied Mechanics) from the Indian Institute of Technology Madras.

His interests span network analysis and control, optimization, and game theory, with applications to distributed learning in multi-agent systems, social learning, and sustainability in natural and engineered systems. His work has appeared in venues such as Towards Explainable, Reliable, and Sustainable Machine Learning (a Special Issue of the IEEE Journal on Selected Topics in Signal Processing, 2024), the ACM International Conference on Mobile Ad Hoc Networking and Computing (2023), and in the IEEE Transactions on Automatic Control (2022, 2025).

He received the Henry Booker Award from UC San Diego for socially responsible research in 2021, and he has mentored and co-authored work that received the Outstanding Undergraduate Research Award from the MIT Schwarzman College of Computing in 2023 and the Best Student Poster Award in the Applications category at the MIT Generative AI Impact Consortium Symposium in September 2025.

When: Tuesday, **3 February 2026,** 10:30 - 11:30
Where: Room 3285 Patrick F. Taylor Hall
Info: `https://www.lsu.edu/eng/ece/seminar`