Dheeraj Narasimha

Post Doctoral Scholar ·

INRIA at Grenoble, Bâtiment IMAG, 700 Av. Centrale, 38401 Saint-Martin-d'Hères

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Experience

INRIA at Grenoble *Grenoble*

Post-Doctoral Fellow

Supervisor: Dr. Nicolas Gast *October 2023 - July 2025*

- Duties:
- Finite horizon LP solutions to RMAB problems without constraint relaxation.
- Efficient updates for LP solutions to RMAB.

Texas A & M University *College Station Texas*

Post-Doctoral Fellow

Supervisor: Dr.Srinivas Shakkottai *July 2021 - September 2023*

- Duties:
- Online and distributed learning problems
- Teaching Fundamentals of Networking

Education

Arizona State University *Tempe, Arizona*

PhD Electrical Engineering *August 2015 - July 2021*

- Advisor: Dr. Lei Ying and Dr. Gautam Dasarathy

Birla Institute of Technology *Zuarinagar, Goa*

BE honors Electronics and Instrumentation Engineering *August 2011 - May 2015*

- Honors thesis - Scheduling in Ad Hoc Networks : Dr. Rahul Vaze, TIFR

Profile:

My doctoral thesis was centered around mean field games and their applications to communication networks. My works on this topic have received runner-up, best paper awards at prestigious conferences including ACM MobiHoc and IEEE INFOCOM. This line of work looks to use the tools of *mean fields* to simplify the interaction of many particles allowing us to compute easy and tractable solutions to many game theoretical problems in communication systems with relatively low information. Over my years as a postdoctoral scholar, I have looked to broaden the scope of my work to more general interaction processes between particles including potential games, online resource allocation and most recently weak coupling of actions in Markov decision processes. A central focus of my research is on a class of dynamic decision-making problems (heavily instrumental in the constrained reinforcement learning literature) known as Restless Multi-Armed Bandits (RMABs). These arise in situations where one must repeatedly choose among competing options—whether allocating medical treatments, managing communication channels, or testing interventions—while the underlying environment evolves over time, even when left untouched.

Unlike classical bandit problems, RMABs can reflect real-world systems where inaction also has consequences. This makes them more widely applicable and mathematically challenging. Through my research I will develop tractable, easy to implement and provable algorithms for this important sub-class of problems. Speaking to my

expertise in this area, my work over the last (roughly) year and a half has resulted in two landmark results in RMABs.

1. We demonstrated that Model Predictive Control-based algorithms can achieve near-optimal performance in some of the most general RMAB settings studied to date. This paper has been accepted at COLT 2025 and the latest version is available on Arxiv titled "Model Predictive Control is Almost Optimal for Restless Multi-Armed Bandits".
2. We greatly generalized these results to a setting of heterogeneous weakly coupled Markov decision processes. We are currently in the process of drafting this result for submission.

My second major area of research focuses will be on Mean Field Games (MFGs), a framework for understanding and optimizing the behavior of large-scale systems involving many interacting agents. These models are often used to model interactions in communication systems and traffic management, where centralized control quickly becomes infeasible as the number of agents grow large. MFGs offer an elegant solution: they reduce complex multi-agent interactions to a simplified problem between a single particle interacting with a continuum distribution called the "mean-field". The agent then looks to find a simple control strategy against this "mean-field" independent of the other agents in the system.

My early work in this area, rooted in communication networks, has demonstrated that MFG models can yield efficient, decentralized algorithms with strong performance guarantees. We showed, for instance, that distributed scheduling in ultra-dense wireless systems can be modeled using MFGs, leading to protocols with provably low inefficiency (low 'price of anarchy'). This line of research has been recognized with awards at international conferences (ACM MobiHoc and IEEE Infocom) and has been the subject of multiple invited talks.

Publications

Published

Dheeraj Narasimha, Nicolas Gast "Model Predictive Control is almost optimal for Restless Multi-armed bandits" *COLT 2025*

Jeremy Carlton, Prathik Vijaykumar, Divyanshu Saxena, **Dheeraj Narasimha**, Srinivas Shakkottai, Aditya Akela. "CONGO: Compressive Online Gradient Optimization with Application to Microservices Management" *ICLR 2025*

Dheeraj Narasimha, Parimal Parag, Srinivas Shakkottai, Srinivas Nomula "The Power of Two in Large Service-Marketplaces" **Best Paper finalist and fast tracked for Transactions on networking**, *IEEE INFOCOM 2025*

Dheeraj Narasimha, Srinivas Shakkottai, Dileep Kalathil "Meta-Learning for Fast Adaption in Caching Networks" *IEEE Transactions on Networking 2024*

Nouman Khan, Ujwal Dinesh, Subrahmanyam Arunachalam, **Dheeraj Narasimha**, Srinivas Shakkottai, Vijay Subramanium . "A Multi-Agent View of Wireless Video Streaming with Delayed Client-Feedback" *IEEE INFOCOM 2024*

Dheeraj Narasimha, Srinivas Shakkottai, Lei Ying "Age-Dependent Distributed MAC for Ultra-Dense Wireless Networks ", *IEEE Transactions on Networking 2022*

Dheeraj Narasimha, Kiyeob Lee, Srinivas Shakkottai, Dileep Kalathil. "Multi-Agent Learning via Markov Potential Games in Marketplaces for Distributed Energy Resources", *CDC 2022*

Dheeraj Narasimha, Srinivas Shakkottai, Lei Ying "Age-Dependent Distributed MAC for Ultra-Dense Wireless Networks ", *IEEE INFOCOM 2021*

Dheeraj Narasimha, Srinivas Shakkottai, Lei Ying. "A Mean Field Game Analysis of Distributed MAC in Ultra-Dense Multichannel Wireless Networks", *IEEE Transactions on Networking 2020*

Dheeraj Narasimha, Srinivas Shakkottai, Lei Ying. "A Mean Field Game Analysis of Distributed MAC in Ultra-Dense Multichannel Wireless Networks", *ACM MobiHoc 2019*, **Best Paper Finalist**

Rahul Vaze, Srikant Iyer **Dheeraj Narasimha**. "AutoRegressive Cascades on Random Networks". Physica A: Statistical Mechanics and its Applications 2015.

Dheeraj Narasimha, Parimal Parag, Srinivas Shakkottai, Srinivas Nomula "The Power of Two in Large Service-Marketplaces", *in submission IEEE Transactions on Networking (Fast Track)*

Dheeraj Narasimha, Nicolas Gast "Model Predictive Control is almost optimal for Heterogeneous Weakly Coupled MDPs" *In draft for Mathematics of Operations Research*

SaratT Chandra Bobbili, Ujwal Dinesha, **Dheeraj Narasimha**, Srinivas Shakkottai "PITA: Preference-Guided Inference-Time Alignment for LLM Post-Training", *In draft for submission to ICLR*

Presentations

Invited Talks

Conference talks:

- "Model Predictive Control is almost optimal for Restless Multi-armed bandits" *COLT 2025*
- "Multi-Agent Learning via Markov Potential Games in Marketplaces for Distributed Energy Resources". *Presented at CDC 2022*.
- "Age-Dependent Distributed MAC for Ultra-Dense Wireless Networks". *Presented at INFOCOM 2021.*
- "Mean Field Game Analysis for Distributed MAC". *Presented at ACM MobiHoc 2019*.

Invited talks:

- "Model Predictive Control is almost optimal for Restless Multi-armed bandits" *Workshop Sigmetrics 2025, presented by Nicolas Gast*
- Mean Field Game Analysis for Distributed MAC. *Presented by Prof Lei Ying*. Invited talk: Allerton. 2019
- *Mean Field Games for MAC*. Invited Talk, IIT Dharwad 2023.

Seminar Talks:

- Featured in: *Toward learning-based Approximately Optimal Control in (Constrained) Decentralized Dynamic Systems*. Online Seminar for Stochastic Networks, Applied Probability and Performance (SNAPP), delivered by Prof. Vijay Subramanian. April 2024
- Featured in: *Mean Field Models, Stein's Method and State Space concentration: A trident for understanding Large-Scale Stochastic Systems*. (SNAPP), delivered by Prof. Lei Ying. November 2023
- Mean Field Games for Wireless MAC. *Presented by Prof Lei Ying*. Seminar Talk, Department of Electrical Engineering, Tsinghua University

Teaching Experience

Texas A & M University

Fundamentals of Computer Networks, Course Instructor	*Spring 2022*

Arizona State University

Introduction to Computers, Teaching Assistant	*Fall 2015*
Signals and Systems 1, Laboratory Assistant	*Spring 2017*
Communication Systems, Teaching Assistant/ Laboratory Assistant	*Fall 2018 - 2019*
Digital Design, Teaching Assistant	*Fall 2020*
Circuits 1, Teaching Assistant	*Spring 2021*

Thesis and Reports

Arizona State University *Tempe, Arizona*

Advisors: Dr. Lei Ying and Dr. Gautam Dasarathy *2015 - 2021*

- Dissertation: "Mean Field Games for Continuous Time Density Dependent Markov Chains"

Tata Institute of Fundamental Research *Mumbai, Maharashtra*

Advisor: Dr. Rahul Vaze *2014*

- Undergraduate Thesis: "Scheduling in Ad-Hoc Networks"

Birla Institute of Technology *Zuarinagar, Goa*

Supervisors: Dr. K.R. Anupama and Dr. Sarang Dhongdi *2013*

- Project: “Time synchronization in Underwater Wireless Networks”

Fellowships, & Grants

2015 **J.N.Tata Grant**, J.N. Tata Trust
2016 **Dorabji Tata Grant**, Dorabji Tata Trust
2016 **Graduate Research Fellowship**, Arizona State University
2018 **Graduate Research Fellowship**, Arizona State University
2020 **Graduate Research Fellowship**, Arizona State University
2021 **Graduate Research Fellowship**, Arizona State University