Mayank Baranwal

CONTACT INFORMATION

Senior Scientist
Tata Consultancy Services Research
Data and Decision Sciences
Mumbai, India

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https://www.sc.iitb.ac.in/∼mayank/

Adjunct Assistant Professor
Indian Institute of Technology, Bombay
Systems & Control Engineering
Mumbai, India

Guest Faculty
Indian Institute of Management
Analytics and Data Science
Mumbai, India

RESEARCH INTERESTS

Optimization, Control and Machine Learning: scalable optimization algorithms, combinatorial optimization, distributed optimization, graph cuts, resource allocation, dynamic programming, integer programming, unit commitment, traveling salesman problem and its variants, dynamical modeling, decentralized decision making, robust control, energy systems, control of power electronics, mean-field learning, graphical models, mean-field graph clustering, drug discovery, graph neural networks

EDUCATION

University of Illinois, Urbana-Champaign, IL

Ph.D., Mechanical Science and Engineering, April 2018

- Thesis Topic:
  (a) Combinatorial Optimization Problems: Maximum Entropy Principle Approach
  (b) Grid and Microgrid of the Future: Robust Control Framework
- Adviser: Professor Srinivasa M. Salapaka

M.S., Mathematics, May 2015

M.S., Mechanical Science and Engineering, August 2014

- Thesis Topic: *Application of field programmable analog arrays (FPAAs) to fast scanning probe microscopy*
- Adviser: Professor Srinivasa M. Salapaka

Indian Institute of Technology, Kanpur (**Silver Medalist**)

B.Tech., Mechanical Engineering, May 2011

POSTDOCTORAL RESEARCH EXPERIENCE

Electrical Engineering & Computer Science, University of Michigan, Ann Arbor
August 2018-July 2020
◇ Mentor: **Dr. Alfred O. Hero**

ONGOING RESEARCH PROJECTS

Refinery Management: Scheduling, Transportation & Defragmentation
⋆ The project aims at developing novel, yet tractable ILP models for refinery management in presence of various practical constraints. Our ILP models significantly outperform various baseline heuristics, including reinforcement learning based approaches.
◇ Collaborator(s): **Dr. Aditya Paranjape**

Deep Q-learning with Delays
⋆ Observation and action delays degrade the performance of reinforcement learning (RL) in many real-world systems. We explore a model-free RL framework that can incorporate both deterministic, as well as stochastic delays into the into the learnt system models.
◇ Collaborator(s): **Dr. Harshad Khadilkar**

Inventory Optimization

⋆ Large-scale inventory optimization involving multiple-products and multiple-stores is one of the most challenging and sought-after problems in operations research. Objectives, such as, uncertainty in demands, multi-lead times, storage capacities, shelf-lives and inter-product constraints must be considered simultaneously from practical standpoint. We employ a robust-LP formulation that can address multiple objectives simultaneously.

◇ Collaborator(s): **Dr. Harshad Khadilkar**

Control of Microbial Communities

⋆ Microbial communities are highly complex and exhibit spatial and temporal variability. Generalized predator-prey models that have been used extensively to learn and infer complex interactions in large communities suffer from computational tractability, poor predictability, as well as combinatorial constraints. We employ several machine learning tools to alleviate these issues. Our models are not only most accurate, they can also simulate nearly 33 million communities in less than 30 minutes, thereby enabling researchers to control complex communities in real-time.

◇ Collaborator(s): **Dr. Alfred O. Hero**, **Dr. Ophelia. Venturelli**

Accelerated Optimization Algorithms

⋆ We exploit the dynamical systems viewpoint of optimization algorithms, and develop novel accelerated algorithms by redesigning the associated vector fields. Using the recently developed notion of fixed-time stability, our continuous-time algorithms for optimization and control are guaranteed to converge to equilibrium points within a settling time pre-specified by the user. The theory is developed in full generality for proximal dynamical systems.

◇ Collaborator(s): **Dr. Alfred O. Hero**, **Kunal Garg**

Graph Convolutional Networks

⋆ We explore the fundamental limitations of the recently popular graph convolutional networks (GCNs) for representing graph-structured data. In particular, we demonstrate that in the large graph limits, the representation power of GCNs drops significantly with deeper GCNs - a phenomenon that was observed empirically by other researchers. We also develop novel graph representation of chemical compounds.

◇ Collaborator(s): **Dr. Abram Magner**, **Dr. Alfred O. Hero**

Accelerating Response to Biothreats

⋆ We harness novel machine learning approaches to enable the design of nanoparticles to control microbiome communities. Using a unique approach based on physical models and experimental data on nanomaterial synthesis and biological experiments, the ML model classifies and quantifies the relationships between nanoparticle characteristics and antimicrobial responses, providing hypotheses on the mechanisms of interactions between NPs and microorganisms.

◇ Collaborator(s): **Dr. Alfred O. Hero**, **Dr. Angela Violi**

Reduction of Chemical Networks

⋆ This project aims at developing theory and algorithms for network inference in the physical sciences and engineering with particular emphasis on dynamical chemical and biological reaction networks. Hybrid methods using machine learning (black-box) and mechanistic state space modeling (white-box) are of special interest. The project involves developing sparse learning algorithms for discovering new principles for predicting network dynamics.

◇ Collaborator(s): **Dr. Alfred O. Hero**, **Dr. Angela Violi**

Fixed-Time Distributed Optimization

⋆ We investigate the fixed-time distributed convex optimization problem for continuous time multi-agent systems under time-varying topology. A novel type of nonlinear protocol coupled with tools from Lyapunov theory is proposed to minimize the sum of convex objective functions of each agent in fixed-time, independent of initial conditions.

◇ Collaborator(s): **Kunal Garg**, **Dr. Alfred O. Hero**, **Dr. Dimitra Panagou**

Past Research Projects

Combinatorial Problems on Graphs

- ⋆ Several combinatorial optimization problems on graphs, when viewed under the unifying umbrella of resource allocation problem, reveal interesting similarities among them. This project aims at exploiting the *resource allocation* viewpoint to address hard problems on graphs, such as, *multiway graph-cuts, graph coloring, normalized cuts, maximum independent set* and *traveling salesman problems*.
- ◇ Collaborator(s): **Dr. Srinivasa M. Salapaka**

Clustering of Large Power Networks

- ⋆ Two key aspects of this project include - (i) Formulate a notion of *electrical distance* between two buses in a network, (ii) Develop a large-scale graph clustering algorithm for identification of *similar* buses. The project aims at subsequent management of power grids resulting from the above topological analysis.
- ◇ Collaborator(s): **Dr. Srinivasa M. Salapaka**

Control of Power Electronic Systems

- ⋆ This project aims at bridging the gap between the standard control theory and the theory of power electronics. Several power electronics systems can be efficiently controlled using a systems view point. We have obtained very interesting results, comprising of *ripple minimization, ripple distribution from multiple DC sources, average power distribution from multiple DC sources*, etc. Moreover, we provide a network-level analysis of a microgrid system with guaranteed performance in a perfectly *decentralized* setting.
- ◇ Collaborator(s): **Dr. Srinivasa M. Salapaka**, **Dr. Murti V. Salapaka**, Alireza Askarian

Vehicle Routing Problem with Time-Windows

- ⋆ This project aims at developing a computationally efficient heuristic for solving VRPTW with capacity and service-time constraints.
- ◇ Collaborator(s): **Dr. Srinivasa M. Salapaka**, **Dr. Lavanya Marla**, **Dr. Carolyn L. Beck**

Fast and Accurate Nanopositioning Systems

- ⋆ This project was my Masters work with **Dr. Srinivasa M. Salapaka**. We had implemented *fast* and *robust* 2DOF analog controllers using Field Programmable Analog Arrays (FPAAs) to achieve a $\sim 200\%$ improvement in tracking bandwidth of the nanopositioning stage in an MFP-3D AFM.

Physics based Modeling of Natural Bodies

- ⋆ This project is related to my work with **Dr. Marco B. Quadrelli** at Jet Propulsion Laboratory (JPL), NASA, during a three-months summer internship program. We had derived equations of motion for a general variable mass system in a *coordinate-free* form and developed several benchmarks involving balloon dynamics, motion of a double pendulum, asteroid dynamics, etc. We had also developed statistical shape models for asteroids that could explain the various light scattering phenomena.

Summer Internships

Jet Propulsion Laboratory (JPL), NASA, May 2012-August 2012

- ⋆ Project: Physics based Modeling of Natural Bodies
- ◇ Mentor: **Dr. Marco B. Quadrelli**

University of British Columbia, Vancouver, May 2010-August 2010

- ⋆ Project: Abnormal motion detection in real-time using surveillance camera
- ◇ Mentor: **Dr. Clarence W. de Silva**

Refereed Journal Publications

[1] Karambelkar, K. and Baranwal, M., 2024. Deep Learning Enables Early-Stage Prediction of Preterm Birth Using Vaginal Microbiota. *Microbiota and Host*. doi:10.1530/MAH-23-0024

[2] Baranwal, M., Saldinger, J., Kim, D., Elvati, P., Hero, A. and Violi, A., 2024. SPIN: A Data-Driven Model to Reduce Large Chemical Reaction Networks. *Fuel*, 367, p.131299. doi:10.1016/j.fuel.2024.131299

[3] Baranwal, M., Selukar, M., Lotti, R., Paranjape, A. A., Majumder, S. and Rocher, J. (2023). A scalable optimization framework for refinery operation and management. *Elsevier Computers & Chemical Engineering*. doi:10.1016/j.compchemeng.2023.108242

[4] Garg, K., Baranwal, M., Gupta, R. and Benosman, M. Fixed-Time Stable Proximal Dynamical System for Solving MVIPs. *IEEE Transactions on Automatic Control*. doi:10.1109/TAC.2022.3214795

[5] Baranwal, M., Magner, A., Saldinger, J., Turali-Emre, E., Elvati, P., Kozarekar, S., VanEpps, J., Kotov, N., Violi, A. and Hero, A.O. Struct2Graph: A graph attention network for structure based predictions of protein-protein interactions. *BMC Bioinformatics*. doi:10.1186/s12859-022-04910-9

[6] Baranwal, M., Marla, L., Beck, C. and Salapaka, S. A Unified Maximum Entropy Principle Approach for a Large Class of Routing Problems. *Elsevier Computers & Industrial Engineering*. doi:10.1016/j.cie.2022.108383

[7] Baranwal, M., Clark, R.L., Thompson, J., Sun, Z., Hero, A.O. and Venturelli, O. Recurrent Neural Networks Enable Design of Multifunctional Synthetic Human Gut Microbiome Dynamics. *eLife*. doi:10.7554/eLife.73870

[8] Paranjape, A., Baranwal, M., Wagle, S., Lotti, R., Majumder, S. and Bulliere, A.L., 2022. Optimal Schedule Generation for Single-Channel Crude Transfer Using a Multi-Model Approach. *Elsevier Computers & Chemical Engineering*. doi:10.1016/j.compchemeng.2022.107732

[9] Magner, A., Baranwal, M. and Hero, A.O., 2021. Fundamental Limits of Deep Graph Convolutional Networks for Graph Classification. *IEEE Transactions on Information Theory*. doi:10.1109/TIT.2022.3145847

[10] Baranwal, M., Krishnan, S., Oneka, M., Frankel, T. and Rao, Arvind, 2021. CGAT: Cell Graph ATtention Network for Grading of Pancreatic Disease Histology Images. *Frontiers in Immunology*. doi:10.3389/fimmu.2021.727610

[11] Meisheri, H., Sultana, N.N., Baranwal, M., Baniwal, V., Nath, S., Verma, S., Ravindran, B. and Khadilkar, H., 2021. Scalable Multi-Product Inventory Control with Lead Time Constraints using Reinforcement Learning. *Neural Computing and Applications*. doi:10.1007/s00521-021-06129-w

[12] Garg, K. and Baranwal, M., 2020. CAPPA: Continuous-Time Accelerated Proximal Point Algorithm for Sparse Recovery. *IEEE Signal Processing Letters*. doi:10.1109/LSP.2020.3027490

[13] Baranwal, M., Garg, K., Panagou, D. and Hero, A.O., 2020. Robust Distributed Fixed-Time Economic Dispatch under Time-Varying Topology. *IEEE Control Systems Letters*, 5(4), pp.1183-1188. doi:10.1109/LCSYS.2020.3020248

[14] Harirchi, F., Kim, D., Khalil, O., Liu, S., Elvati, P., Baranwal, M., Hero, A. and Violi, A., 2020. On sparse identification of complex dynamical systems: A study on discovering influential reactions in chemical reaction networks. *Fuel*, 279, p.118204. doi:10.1016/j.fuel.2020.118204

[15] Baranwal, M., Magner, A., Elvati, P., Saldinger., J., Violi, A. and Hero, A.O., 2019. A deep learning architecture for metabolic pathway prediction. *Bioinformatics*, 36(8), pp.2547-2553. doi:10.1093/bioinformatics/btz954

[16] Baranwal, M. and Salapaka, S.M., 2019. Clustering and Supervisory Voltage Control in Power Systems. *International Journal of Electrical Power & Energy Systems*, 109, pp.641-651. doi:10.1016/j.ijepes.2019.02.025

[17] Baranwal, M., Askarian, A., Salapaka, S.M. and Salapaka, M.V., 2018. Distributed Architecture for Robust and Optimal Control of DC Microgrids. *IEEE Transactions on Industrial Electronics*, 66(4), pp.3082-3092. doi:10.1109/TIE.2018.2840506

[18] Baranwal, M., Gorugantu, R.S. and Salapaka, S.M., 2016. Robust atomic force microscopy using multiple sensors. *Review of Scientific Instruments*, 87(8), p.083704. doi:10.1063/1.4960714

[19] Baranwal, M., Gorugantu, R.S. and Salapaka, S.M., 2015. Fast and robust control of nanopositioning systems: Performance limits enabled by field programmable analog arrays. *Review of Scientific Instruments*, 86(8), p.085004. doi:10.1063/1.4929379

[20] Baranwal, M., Khan, M.T. and De Silva, C.W., 2011. Abnormal motion detection in real time using video surveillance and body sensors. *International Journal of Information Acquisition*, 8(02), pp.103-116. doi:10.1142/S0219878911002379

Refereed Conference Publications

[21] Khan, S., Baranwal, M. and Sukumar, S., 2024. Decentralized Safe Control for Multi-Robot Navigation in Dynamic Environments with Limited Sensing. *In Proceedings of the International Conference on Autonomous Agents and Multi-Agent Systems (AAMAS), 2024*.

[22] Garg, K. and Baranwal, M., 2023. Accelerating Distributed Optimization via Fixed-Time Convergent Flows. *IFAC-PapersOnLine*, 56(2), pp.1235-1240. doi:10.1016/j.ifacol.2023.10.1745

[23] Chauhan, A., Baranwal, M. and Basumatary, A., 2023. PowRL: A Reinforcement Learning Framework for Robust Management of Power Networks. *In Proceedings of the AAAI Conference on Artificial Intelligence, 2023*. AAAI. [**Acceptance Rate - 19.2%**] doi:10.1609/aaai.v37i12.26724

[24] Garg, K. and Baranwal, M., 2022, December. Fixed-Time Convergence for a Class of Nonconvex-Nonconcave Min-Max Problems. In *2022 Eighth Indian Control Conference (ICC)* (pp. 19-24). IEEE. doi:10.1109/ICC56513.2022.10093480

[25] Deshpande, A.U. and Baranwal, M., 2022, December. A Hierarchical Framework for Optimal and Scalable Process Scheduling in Plant Operations. In *2022 Eighth Indian Control Conference (ICC)* (pp. 13-18). IEEE. doi:10.1109/ICC56513.2022.10093603

[26] Budhraja, P., Baranwal, M., Garg, K. and Hota, A., 2022. Breaking the Convergence Barrier: Optimization via Fixed-Time Convergent Flows. *In Proceedings of the AAAI Conference on Artificial Intelligence, 2022*. AAAI. [**Acceptance Rate - 15%**] doi:10.1609/aaai.v36i6.20559

[27] Nath, S., Baranwal, M. and Khadilkar, H., 2021, November. Revisiting State Augmentation methods for Reinforcement Learning with Stochastic Delays. In *Proceedings of the ACM International Conference on Information and Knowledge Management (CIKM), 2021*. ACM. [**Acceptance Rate - 21.7%**] doi:10.1145/3459637.3482386

[28] Garg, K., Baranwal, M., Hero, A. and Panagou, D., 2020, December. A Fixed-Time Convergent Distributed Algorithm for Strongly Convex Function in a Time-Varying Network. In *2020 IEEE 59th Conference on Decision and Control (CDC), 2020* (4405-4410). IEEE. doi:10.1109/CDC42340.2020.9303778

[29] Magner, A., Baranwal, M. and Hero, A., 2020, June. The Power Of Graph Convolutional Networks To Distinguish Random Graph Models. In *International Symposium on Information Theory (ISIT), 2020* (2664-2669). IEEE. doi:10.1109/ISIT44484.2020.9174092

[30] Baranwal, M., Srivastava, A. and Salapaka, S.M., 2019, December. Multiway k-Cut in Static and Dynamic Graphs: A Maximum Entropy Principle Approach. In *2019 IEEE 58th Conference on Decision and Control (CDC), 2019* (3948-3953). IEEE. doi:10.1109/CDC40024.2019.9029914

[31] Srivastava, A., Baranwal, M. and Salapaka, S.M., 2019, January. On the Persistence of Clustering Solutions and True Number of Clusters in a Dataset. In *Proceedings of the AAAI Conference on Artificial Intelligence, 2019* (Vol. 33, pp. 5000-5007). AAAI. [**Acceptance Rate - 16.2%**] doi:10.1609/aaai.v33i01.33015000

[32] Askarian, A., Baranwal, M. and Salapaka, S.M., 2018, December. Droopless Active and Reactive Power Sharing in Parallel Operated Inverters in Islanded Microgrids. In *Conference on Decision and Control (CDC), 2018* (3427-3432). IEEE. doi:10.1109/CDC.2018.8619290

[33] Baranwal, M. and Salapaka, S.M., 2018, January. Weighted-Kernel Deterministic Annealing: A Maximum-Entropy Principle Approach for Shape Clustering. In *Indian Control Conference (ICC), 2018* (1-6). IEEE. doi:10.1109/INDIANCC.2018.8307944

[34] Baranwal, M. and Salapaka, S.M., 2017, May. Clustering of Power Networks: An Information Theoretic Perspective. In *American Control Conference (ACC), 2017* (3323-3328). IEEE. doi:10.23919/ACC.2017.7963460

[35] Baranwal, M., Roehl, Brian and Salapaka, S.M., 2017, May. Multiple Traveling Salesmen and Related Problems: A Maximum-Entropy Principle based Approach. In *American Control Conference (ACC), 2017* (3944-3949). IEEE. doi:10.23919/ACC.2017.7963559

[36] Baranwal, M., Askarian, A., Salapaka, S.M. and Salapaka, M.V., 2017, May. A Robust Scheme for Distributed Control of Power Converters in DC Microgrids with Time-Varying Power Sharing. In *American Control Conference (ACC), 2017* (1413-1418). IEEE. doi:10.23919/ACC.2017.7963151

[37] Baranwal, M., Askarian, A. and Salapaka, S.M., 2017, May. A Decentralized Scalable Control Architecture for Islanded Operation of Parallel DC/AC Inverters with Prescribed Power Sharing. In *American Control Conference (ACC), 2017* (1419-1424). IEEE.
doi:10.23919/ACC.2017.7963152

[38] Askarian, A., Baranwal, M. and Salapaka, S.M., 2017, May. DC Bus Voltage Regulation Using Photovoltaic Module: A Non-Iterative Method. In *American Control Conference (ACC), 2017* (4099-4104). IEEE.
doi:10.23919/ACC.2017.7963584

[39] Baranwal, M. and Salapaka, S.M., 2017, January. Clustering with capacity and size constraints: A deterministic approach. In *Indian Control Conference (ICC), 2017* (pp. 251-256). IEEE.
doi:10.1109/INDIANCC.2017.7846483

[40] Baranwal, M., Parekh, P.M., Marla, L., Salapaka, S.M. and Beck, C.L., 2016, July. Vehicle Routing Problem with Time Windows: A Deterministic Annealing approach. In *American Control Conference (ACC), 2016* (pp. 790-795). IEEE.
doi:10.1109/ACC.2016.7525010

[41] Baranwal, M., Salapaka, S.M. and Salapaka, M.V., 2016, July. Robust decentralized voltage control of dc-dc converters with applications to power sharing and ripple sharing. In *American Control Conference (ACC), 2016* (pp. 7444-7449). IEEE.
doi:10.1109/ACC.2016.7526848

[42] Quadrelli, M.B., Cameron, J., Balaram, B., Baranwal, M. and Bruno, A., 2014, August. Modeling and Simulation of Flight Dynamics of Variable Mass Systems. In *AIAA/AAS Astrodynamics Specialist Conference* (pp. 4-7).
doi:10.2514/6.2014-4454

OTHER CONFERENCE TALKS

[43] Meisheri, H., Nath, S., Baranwal, M. and Khadilkar, H., 2022, September. A Learning Based Framework for Handling Uncertain Lead Times in Multi-Product Inventory Management. In: *15th European Workshop on Reinforcement Learning (EWRL)*, September 19–21, 2022.

[44] Garg, K. and Baranwal, M., 2022, July. Accelerated Methods for Distributed Optimization Problems using Fixed-time Stability of Continuous-time Dynamical Systems. In: *39th International Conference on Machine Learning (ICML)*, July 17–23, 2022.

[45] Baranwal, M., Marla L., Salapaka, S.M. and Beck, C., 2017, July. A Novel Statistical Algorithm for Very Large-scale Vehicle Routing Problems with Time Windows. In: *2017 INFORMS Transportation Science and Logistics (TSL) Conference*, July 26–29, 2017.

[46] Baranwal, M. and Salapaka, S.M., 2016, July. Determining Clusters with Similar Electrical Influences in a Power Network: A Deterministic Annealing based Approach. In: *22nd International Symposium on Mathematical Theory of Networks and Systems (MTNS)*, July 12–15, 2016.

OTHER PUBLICATION(S)

[47] Baranwal, M., *Entropy-Based Framework for Combinatorial Optimization Problems; and Enabling the Grid of the Future*. PhD thesis, University of Illinois, Urbana-Champaign, IL, 2018.

[48] Baranwal, M., *Application of field programmable analog arrays (FPAAs) to fast scanning probe microscopy*. Master's thesis, University of Illinois, Urbana-Champaign, IL, 2014.

In Media

- Interviewed by INDIAai (The National AI Portal of India)
- Work on Fixed-Time Optimization named among most intriguing AI developments
- Work on microbiomes featured in the NextByte Podcast

Awards & Scholarships

- Certificate of Merit, Adoption of Artificial Intelligence, Machine Learning and Robotic Solutions, India Smart Grid Forum (ISGF), 2024
- Third prize, L2RPN-Delft Challenge, 2023
- Gold Award, Best Technology in Transmission, India Smart Grid Forum (ISGF), 2023
- Young Scientist Award, TCS, 2022
- Student Travel Award, AAAI Conference on Artificial Intelligence, 2019
- MechSE Outstanding Publication Award, UIUC, 2018
- Finalist, **Best Student Paper Award**, Indian Control Conference, 2018
- December - **Video Of The Month**, Coordinated Science Laboratory, UIUC, 2017
- Student Travel Award, American Control Conference, 2017
- September - **Video Of The Month**, Coordinated Science Laboratory, UIUC, 2016
- Best Session Presentation (twice), American Control Conference, 2016
- Certified LabVIEW Associate Developer, 2015
- ME Outstanding Teaching Assistant Award, 2015
- General Proficiency Medal, Department Rank 1, 2011
- Shri Rajnath Singh Scholarship, 2011
- BANCO Foundation Prize, 2011
- Academic Excellence Award, 2008-2009, 2009-2010
- MITACS Globalink Internship Award, 2010
- University of Tokyo-IIT Undergraduate Scholarship, 2009

Teaching Experience

Instructor

[1] SC 646 (Distributed Optimization and Machine Learning), Spring 2022, Spring 2023, Spring 2024, IITB.

[2] SC 648 (Stochastic Processes in Engineering and Natural Systems), Autumn 2021, IITB.

[3] Reinforcement Leaning: Theory and Applications, Module-IV, 2023, IIM Mumbai.

[4] Deep Learning and Industrial Applications, Module-III, 2023, IIM Mumbai.

[5] Data Science for Managerial Decisions, Module-I, 2022, IIM Mumbai.

[6] Business Applications of AI/ML Techniques, Module-II, 2022, IIM Mumbai.

[7] Business Research Methods, Module-III, 2023, 2024, IIM Mumbai.

[8] TAM 412 (Intermediate Dynamics), Spring 2014, UIUC.

[9] ME 340 (Dynamics of Mechanical Systems), Summer 2012, UIUC.

Graduate Teaching Assistant

[10] ME 340 (Dynamics of Mechanical Systems), Fall 2011, Spring 2012, UIUC.

[11] ME 461 (Computer Control of Mechanical Systems), Fall 2012, 2013, 2014, 2015, UIUC.

[12] ECE 515 (Control System Theory & Design), Spring 2018, UIUC.

Advising and Mentoring

Graduate Research

- **Param Budhraja** (Boston University)
  BTech-MTech dual degree student in Electrical Engineering, Indian Institute of Technology, Kharagpur. Analysis of fixed-time convergent optimization algorithms. Primary adviser: Ashish Hota. 2021-2022.

- **Vishal Raj** (Nutanix)
  BTech-MTech dual degree student in Electrical Engineering, Indian Institute of Technology, Kharagpur. Fixed-time convergent optimization algorithm for GANs. Primary adviser: Ashish Hota. 2021-2022.

Undergraduate Research

- **Nageswar Venkata Sai Gangadhar** (Carnegie Mellon University)
  BTech student in Mechanical Engineering, Indian Institute of Technology, Bombay. Adaptive sampling and Deep-TFC PINNs for solving optimal control problems. 2022-2023.
- **Won Dong Shin** (University of Illinois) and **Qian Wang** (Stanford University)
  Undergraduate students in Mechanical Science and Engineering, University of Illinois at Urbana-Champaign. Simulated platform for implementation of high-speed controllers on *NI-LabVIEW FPGA*. Primary adviser: Srinivasa M. Salapaka. 2015-2016.
- **Dong Woo Shin** (University of California, Berkeley)
  Undergraduate student in Mechanical Science and Engineering, University of Illinois at Urbana-Champaign. Relaxation osciallator for high-speed capacitance measurement. Primary adviser: Srinivasa M. Salapaka. 2015-2016.
- **Alex Hrabski** (University of Michigan, Ann Arbor)
  Undergraduate student in Mechanical Science and Engineering, University of Illinois at Urbana-Champaign. Design and implementation of robust *MPPT* algorithm. Primary adviser: Srinivasa M. Salapaka. 2016-2017.

PROFESSIONAL SERVICE

Referee Service

- *IJCAI International Joint Conference on Artificial Intelligence*
- *AAAI Conference on Artificial Intelligence*
- *IEEE Conference on Decision and Control (CDC)*
- *IEEE American Control Conference (ACC)*
- *IEEE ASian Control Conference (ASCC)*
- *IEEE Indian Control Conference (ICC)*
- *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*
- *IEEE International Conference on Robotics and Automation (ICRA)*
- *AIP Review of Scientific Instruments*
- *AIP Journal of Renewable and Sustainable Energy*
- *ASME Journal of Dynamic Systems, Measurement, and Control*
- *Elsevier Automatica*
- *IEEE Transactions on Automatic Control*
- *IEEE Transactions on Mechatronics*
- *IEEE Transactions on Control Systems Technology*
- *IEEE Control System Letters*
- *IEEE Transactions on Industrial Electronics*
- *IEEE Transactions on Energy Conversion* (Star Reviewer for 2017)
- *IEEE Transactions on Systems, Man and Cybernetics: Systems*
- *Bioinformatics*
- *Elsevier Ultramicroscopy*
- *MDP Energies*
- *Hindawi Mathematical Problems in Engineering*

Conference Service

- **Chair: Best Student Paper Award**, 2023 Indian Control Conference (ICC 2023), GITAM, Visakhapatnam.
- **Chair: Best Student Paper Award**, 2022 Indian Control Conference (ICC 2022), IIT-Madras.

- Co-Chair: Session on Networked Control, 2018 Indian Control Conference (ICC 2018), IIT-Kanpur.
- Co-Chair: Session on Power Electronics, 2017 American Control Conference (ACC 2017), Seattle, Washington.

HARDWARE AND SOFTWARE SKILLS

Analog and Digital Electronics:
- Bipolar and FET implementations of continuous and switched amplifiers, modulators, converters, and filters

Embedded and Real-time Systems:
- Software and hardware development with several MCU and DSP platforms (e.g., ATMEL ATmega MCU's, Texas Instruments MSP MCU's, Texas Instruments Delfino DSP's, Anadigm FPAA development boards, NI-LabVIEW FPGAs, Raspberry-Pi, Beagleboard, and others)

Computer Programming:
- C, C++, Java, Python, PyTorch, Tensorflow, MATLAB, HTML, CSS, and others

Other Professional Software Skills:
- Simulink, LabVIEW, Eagle, TEX(LATEX, BIBTEX)

RELEVANT COURSES

Mathematics:
- Real Analysis, Differentiable Manifolds, Game Theory, Vector Space Optimization, Abstract Algebra, Advanced Dynamical Systems, Random Processes

Control Theory and Engineering:
- Linear and Nonlinear Systems Theory, Robust Control, Nonlinear and Robust Adaptive Control, Stochastic Control, Geometric Control, Hybrid Control, Optimal Control

Computer Science and Engineering:
- Statistical Learning Theory, Reinforcement Learning, Integer Programming, Optimization in Computer Vision

OTHER SCHOLASTIC ACHIEVEMENTS

- AIEEE 2007, All India Rank 578 - among more than 600,000 candidates
- IIT JEE 2007, All India Rank 614 - among more than 240,000 candidates
- Science Olympiad, Techkriti, IIT Kanpur, 2006 - 1st place
- Regional Mathematics Olympiad (RMO), 2006 - 11th place
- Junior High-School Examination, 2005 - 17th place among more than 1,000,000 candidates

LEADERSHIP & ACTIVITIES

- **Organizer**, Coordinated Science Laboratory Social Hour, Fall 2015 - Spring 2017
- **Coordinator**, The Mall, Antaragni, Annual Cultural Festival, IIT Kanpur, 2009
- **Invited Participant**, CSIR Program on Youth for Leadership in Science, 2005
- **National Cadet Corps**: Air Wing ('A' certificate), Army Wing ('A' certificate)