

SANMUKH RAO KUPPANNAGARI

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PROFESSIONAL PREPARATION

University of Southern California

Present

Post-Doctoral Training in Computer Engineering
Ming Hsieh Department of Electrical and Computer Engineering

University of Southern California

Summer 2018

PhD in Computer Engineering
Ming Hsieh Department of Electrical and Computer Engineering

Thesis Title: Discrete Optimization for Supply Demand Matching in Smart Grids

Thesis Advisor: Dr Viktor Prasanna, Professor - Electrical and Computer Engineering

GPA: 3.79/4.00

Indian Institute of Technology, Guwahati

May 2011

Bachelor of Technology, Computer Science and Engineering

Overall CPI: 8.20/10.00

RESEARCH INTERESTS

- *Accelerating AI on Heterogeneous Platforms:* Develop an Application Specific Processor (ASP) to enable high throughput and low latency FPGA implementations of state-of-the-art Deep Reinforcement Learning algorithms.
- *Data Driven Modeling and Optimization for Smart Energy Systems:* Develop data driven combinatorial optimizations, approximation algorithms and Reinforcement Learning algorithms to minimize the cost of smart grid operations.

APPOINTMENTS

- Post Doctoral Scholar - Research Associate, University of Southern California, Los Angeles, Fall '18 - present.
- Intern, US Army Research Laboratory, Playa Vista, CA, Summer '17.
- Intern, MathWorks Inc., Natick, MA, Summer '14.
- Member Technical Staff, Adobe Systems Inc., India, Summer '11 - Summer '13.

FUNDED PROPOSALS

- U.S. National Science Foundation, "CNS Core: Small: AccelRITE: Accelerating ReInforcement Learning based AI at the Edge Using FPGAs". PI: Viktor K. Prasanna, **Co-PI: Sanmukh R. Kuppannagari**
- U.S. National Science Foundation - 1911229, "OAC Core: Small: Scalable Graph Analytics on Emerging Cloud Infrastructure". PI: Viktor K. Prasanna, **Co-PI: Sanmukh R. Kuppannagari**
- U.S. Army Research Office - W911NF1910362, "Graph Theoretic Approaches for Cyber Physical Security in Networks". PI: Viktor K. Prasanna, **Co-PIs: Sanmukh R. Kuppannagari, Ning Xie, S.S. Iyengar.**

RESEARCH EXPERIENCE

Department of ECE, University of Southern California

September, 2018 - present

PostDoctoral Scholar - Research Associate

Los Angeles, CA

- Accelerating Reinforcement Learning on Heterogeneous CPU-FPGA nodes [[FPGA20](#), [RAW20](#), [FCCM20](#)].
- Data Driven Analytics and Optimization for Increased Solar Penetration [[ISGT20](#), [SUST20](#), [EEN-ERGYW19](#), [EENERGY19](#), [IoTDI19](#), [SGCOMM18](#), [LOCS19](#), [SUST18a](#)].
- Safety and Robustness in Reinforcement Learning for Smart Building Control [[BuildSys19](#)].
- Accelerating Graph Analytics on Cloud Platforms with Heterogeneous CPU-FPGA nodes [[HPEC19](#), [ParFPGA19](#), [ISC20](#)].

Department of ECE, University of Southern California

August, 2013 - August, 2018

Research Assistant

Los Angeles, CA

- PhD Dissertation: Discrete Optimization for Supply Demand Matching in Smart Grids [[Thes18](#)]
- Optimal Net Load Balancing in Smart Grids with High DER penetration [[TOSN18](#), [ISGT18](#), [BuildSys17](#)]
- Optimal Customer Selection for Dynamic Demand Response in SmartGrids [[ICCS16](#), [CSCI15](#)]
- Lead developer of the DR software which is used to implement Demand Response event in USC SmartGrid for the joint demonstration project between LADWP and USC [[IJCAI16](#)]
- Cyber Physical Security in Smart Grids [[SUST18b](#), [SUST16](#)].

Army Research Lab

June 2017 - August 2017

Summer Intern

Playa Vista, CA

- Risk-Aware Sequential Decision Making under Model Uncertainties: Applications in Smart Grids [[ISGT18](#)].

TEACHING EXPERIENCE

- EE 457 - Computer Systems Organization. Fall 2014, Spring 2015, Fall 2015, Fall 2016. Instructor: Prof Gandhi Puvvada (gandhi@usc.edu)
- EE 451 - Parallel and Distributed Computing. Spring 2016, Spring 2017. Instructor: Prof Viktor K. Prasanna (prasanna@usc.edu)

SYNERGISTIC ACTIVITIES

Organization

- Publicity Chair; Web chair; 27th IEEE/ACM International Conference on High Performance Computing, (HiPC) 2020.
- Program Committee Member; 23rd IEEE International Symposium On Real-Time Distributed Computing - poster/demo track.
- Program Committee Chair; First Workshop on DataScience for Future Energy Systems, HiPC 2019.
- Program Committee Member; The 9th International Workshop on Computing and Networking for IoT and Beyond, ICDCN Workshop 2020.
- Program Committee Member; 1st International Workshop on Societal Computing for the Internet of Things & You (SoCIeTY), ICDCN Workshop 2020.
- Publicity Chair; Web chair; 26th IEEE/ACM International Conference on High Performance Computing, (HiPC) 2019.
- Web chair; 25th IEEE/ACM International Conference on High Performance Computing, (HiPC) 2019.

Reviewer Experience

- Reviewer: Transactions on Cloud Computing, 2020.
- Reviewer; IEEE BigData, 2019.
- Reviewer; Sustainable Energy, Grids and Network, 2019.
- Reviewer; Methods of Information in Medicine, 2019.
- Reviewer; Transactions on Sustainable Computing (TSUC), 2019.
- Judge; EE Research Festival, University of Southern California, 2019.
- Reviewer; IEEE Access, 2018.
- Reviewer; Transactions on Sustainable Computing (TSUC), 2018.

MENTORING EXPERIENCE

PhD

- Chi Zhang - Reinforcement Learning for Safety in Smart Grids.
- Chung Ming Chueng - Data Analytics, Smart Grids.
- Rachit Rajat - Acceleration of Reinforcement Learning on Edge FPGA Devices.
- Yuan Meng - Acceleration of Reinforcement Learning on Edge FPGA Devices.
- Sasindu Wijeratne - Accelerating Graph Analytics on Cloud Platforms with FPGAs.
- Tian Ye - Accelerating Privacy Preserving Deep Neural Networks on FPGAs.
- Athanasios Rompokos - Mobile Energy Storage Scheduling for Smart Grid Management.

Masters/Bachelors

- Yang Yang - Accelerating Hash Table on FPGA.
- Nivedita Suresh - Discrete Optimization for Net-Load Balancing in Smart Grids.
- Xiangchong Liu - Live Energy Map for Visualization of Energy in Smart Grids.
- Stefan Binna - Cyber Physical Security in Smart Grids.
- Akshit Goel - Parallel Graph Sampling on FPGAs.

AWARDS

- USC Ming Hsieh Institute (MHI) Ph.D. Scholar Finalist, Fall 2017.
- USC Ming Hsieh Department of Electrical Engineering Charles L. Weber Outstanding Teaching Assistant Honorable Mention, Spring 2017.
- USC Ming Hsieh Department of Electrical Engineering, Best Research Poster - Honorable Mention, 7th Annual EE Research Festival, Fall 2016.

Accelerating Graph Analytics/AI

- [RAW20] Yuan Meng, Sanmukh R. Kuppannagari, Rachit Rajat, Ajitesh Srivastava, Rajgopal Kannan, and Viktor K Prasanna. “QTAcel: Generic FPGA Design for Q-Table based Reinforcement Learning Accelerators”. In: *Proceedings of the 27th Reconfigurable Architectures Workshop (RAW)*. IEEE. 2020.
- [FCCM20] Yuan Meng, Sanmukh R Kuppannagari, and Viktor K Prasanna. “Accelerating Proximal Policy Optimization on CPU-FPGA Heterogeneous Platforms”. In: *Proceedings of the 28th IEEE International Symposium on Field-Programmable Custom Computing Machines (FCCM)*. IEEE. 2020.
- [FPGA20] Rachit Rajat, Yuan Meng, Sanmukh R Kuppannagari, Ajitesh Srivastava, Rajgopal Kannan, and Viktor K Prasanna. “QTAcel: Generic FPGA Design for Q-Table based Reinforcement Learning Accelerators”. In: *Proceedings of the 2020 ACM/SIGDA International Symposium on Field-Programmable Gate Arrays*. Abstract Only. ACM. 2020.
- [ISC20] Yang Yang, Sanmukh R Kuppannagari, Ajitesh Srivastava, Rajgopal Kannan, and Viktor K Prasanna. “FASTHash: FPGA-based High Throughput Parallel Hash Table”. In: *ISC High Performance 2020*. 2020.
- [ParFPGA19] Akshit Goel, Sanmukh R Kuppannagari, Yang Yang, Ajitesh Srivastava, and Viktor K Prasanna. “Parallel Totally Induced Edge Sampling on FPGAs”. In: *Parallel Computing with FPGAs (ParFPGA2019)*. 2019.
- [HPEC19] Sanmukh R Kuppannagari, Rachit Rajat, Rajgopal Kannan, Aravind Dasu, and Viktor K Prasanna. “IP Cores for Graph Kernels on FPGAs”. In: *2019 IEEE High Performance Extreme Computing Conference (HPEC)*. IEEE. 2019.
- [FPGA15] Sanmukh R Kuppannagari and Viktor K Prasanna. “Efficient Generation of Energy and Performance Pareto Front for FPGA Designs”. In: *Proceedings of the 2015 ACM/SIGDA International Symposium on Field-Programmable Gate Arrays*. Abstract Only. ACM. 2015, pp. 273–273.
- [HPEC14] Sanmukh R Kuppannagari, Ren Chen, Andrea Sanny, Shreyas G Singapura, Geoffrey Phi C Tran, Shijie Zhou, Yusong Hu, Stephen P Crago, and Viktor K Prasanna. “Energy performance of fpgas on perfect suite kernels”. In: *2014 IEEE High Performance Extreme Computing Conference (HPEC)*. IEEE. 2014, pp. 1–6.
- [IGCC14] Sanmukh R Kuppannagari, Yusong Hu, and Viktor K Prasanna. “High level performance model based design space exploration for energy-efficient designs on fpgas”. In: *International Green Computing Conference*. IEEE. 2014, pp. 1–6.

Data Driven Optimization for Smart Grids

- [SUST20] Chung Ming Cheung, Sanmukh Rao Kuppannagari, Rajgopal Kannan, and Viktor K Prasanna. “Disaggregation of Behind-The-Meter Solar Generation and Energy Storage Resources”. In: *2020 IEEE Conference on Technologies for Sustainability (SusTech)*. 2020.
- [ISGT20] Chung Ming Cheung, Sanmukh Rao Kuppannagari, Rajgopal Kannan, and Viktor K Prasanna. “Load Demand User Profiling in Smart Grids with Distributed Solar Generation,” in: *2020 IEEE Power & Energy Society Innovative Smart Grid Technologies Conference (ISGT)*. IEEE. 2020.
- [EENERGYW19] Chung Ming Cheung, Sanmukh Rao Kuppannagari, Rajgopal Kannan, and Viktor K Prasanna. “Towards Improved Real-Time Observability of Behind-Meter Photovoltaic Systems: A Data-Driven Approach”. In: *Proceedings of the Tenth ACM International Conference on Future Energy Systems*. ACM. 2019, pp. 447–455.

- [EENERGY19] Sanmukh Kuppannagari, Rajgopal Kannan, and Viktor K Prasanna. "Approximate Scheduling of DERs with Discrete Complex Injections". In: *Proceedings of the Tenth ACM International Conference on Future Energy Systems*. ACM. 2019, pp. 204–214.
- [LOCS19] Ajitesh Srivastava, Sanmukh R Kuppannagari, Rajgopal Kannan, and Viktor K Prasanna. "Minimizing Cost of Smart Grid Operations by Scheduling Mobile Energy Storage Systems". In: *IEEE Letters of the Computer Society 2.3* (2019), pp. 20–23.
- [BuildSys19] Chi Zhang, Sanmukh R Kuppannagari, Rajgopal Kannan, and Viktor K Prasanna. "Building HVAC Scheduling Using Reinforcement Learning via Neural Network Based Model Approximation". In: *Proceedings of the 6th ACM International Conference on Systems for Energy-Efficient Built Environments*. ACM. 2019.
- [IoTDI19] Chi Zhang, Sanmukh R Kuppannagari, Chuanxiu Xiong, Rajgopal Kannan, and Viktor K Prasanna. "A cooperative multi-agent deep reinforcement learning framework for real-time residential load scheduling". In: *Proceedings of the International Conference on Internet of Things Design and Implementation*. ACM. 2019, pp. 59–69.
- [SUST18b] Stefan Binna, Sanmukh R Kuppannagari, Dominik Engel, and Viktor K Prasanna. "Subset Level Detection of False Data Injection Attacks in Smart Grids". In: *2018 IEEE Conference on Technologies for Sustainability (SusTech)*. IEEE. 2018, pp. 1–7.
- [ISGT18] Sanmukh R Kuppannagari, Rajgopal Kannan, and Viktor K Prasanna. "NO-LESS: Near optimal curtailment strategy selection for net load balancing in micro grids". In: *2018 IEEE Power & Energy Society Innovative Smart Grid Technologies Conference (ISGT)*. IEEE. 2018, pp. 1–5.
- [TOSN18] Sanmukh R Kuppannagari, Rajgopal Kannan, and Viktor K Prasanna. "Optimal Discrete Net-Load Balancing in Smart Grids with High PV Penetration". In: *ACM Transactions on Sensor Networks (TOSN)* 14.3-4 (2018), p. 24.
- [Thes18] Sanmukh Rao Kuppannagari. "Discrete Optimization for Supply Demand Matching in Smart Grids". PhD thesis. University of Southern California, 2018.
- [SUST18a] Athanasios A Rompokos, Sanmukh R Kuppannagari, Rajgopal Kannan, and Viktor K Prasanna. "Minimizing Cost of Load Matching in Multiple Micro-Grids Using MESS". In: *2018 IEEE Conference on Technologies for Sustainability (SusTech)*. IEEE. 2018, pp. 1–7.
- [SGCOMM18] Chi Zhang, Sanmukh R Kuppannagari, Rajgopal Kannan, and Viktor K Prasanna. "Generative adversarial network for synthetic time series data generation in smart grids". In: *2018 IEEE International Conference on Communications, Control, and Computing Technologies for Smart Grids (SmartGridComm)*. IEEE. 2018, pp. 1–6.
- [BuildSys17] Sanmukh R Kuppannagari, Rajgopal Kannan, and Viktor K Prasanna. "Optimal net-load balancing in smart grids with high PV penetration". In: *Proceedings of the 4th ACM International Conference on Systems for Energy-Efficient Built Environments*. ACM. 2017, p. 27.
- [IJCAI16] Sanmukh R Kuppannagari, Rajgopal Kannan, Charalampos Chelmiss, and Viktor K Prasanna. "Implementation of Learning-Based Dynamic Demand Response on a Campus Micro-Grid". In: *The 25th International Joint Conference on Artificial Intelligence*. IJCAI-Demo Track. 2016.
- [ICCS16] Sanmukh R Kuppannagari, Rajgopal Kannan, Charalampos Chelmiss, Arash S Tehrani, and Viktor K Prasanna. "Optimal Customer Targeting for Sustainable Demand Response in Smart Grids". In: *Procedia Computer Science* 80 (2016), pp. 324–334.
- [SUST16] Charith Wickramaarachchi, Sanmukh R Kuppannagari, Rajgopal Kannan, and Viktor K Prasanna. "Improved protection scheme for data attack on strategic buses

in the smart grid”. In: *2016 IEEE Conference on Technologies for Sustainability (SusTech)*. IEEE. 2016, pp. 96–101.

- [CSCI15] Sanmukh R Kuppannagari, Rajgopal Kannan, and Viktor K Prasanna. “An ILP based Algorithm for Optimal Customer Selection for Demand Response in Smart-Grids”. In: *The 2015 International Conference on Computational Science and Computational Intelligence (CSCI)*. 2015.