

# ABOLFAZL HASHEMI

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## CURRENT POSITION

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### Assistant Professor

Purdue University

August 2021 – present

Elmore Family School of Electrical and Computer Engineering

- Communications, Networking, Signal and Image Processing (CNSIP)
- Computer Engineering (Artificial Intelligence)

### Affiliations

- Director of Machine Intelligence and Networked Data Science Group (MINDS)
- Center for Innovation in Control, Optimization, and Networks (ICON)
- The Center for Education and Research in Information Assurance and Security (CERIAS)

## RESEARCH DESCRIPTION

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My research interests include:

- Signal Processing
- Distributed Learning
- Machine Learning
- Online Learning

The goal of my research is to enhance the performance and capabilities of the networked decision-making systems characterized by limited communication budget and data scarcity. In doing so, I design efficient algorithms with mathematical guarantees to render practical deployment of collaborative systems possible in applications including bioinformatics, reinforcement learning, supervised and self-supervised learning, and dynamical systems.

## EDUCATION

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**Doctor of Philosophy (Ph.D.)**, Electrical and Computer Engineering

2016 – 2020

University of Texas at Austin, Austin, Texas, USA

Dissertation: EFFICIENT ALGORITHMS FOR STRUCTURED INFERENCE AND COLLABORATIVE LEARNING

Advisor: Prof. Haris Vikalo

Committee: Prof. Alex Dimakis, Prof. Gustavo de Veciana, Prof. Sujay Sanghavi, Prof. Qiang Liu

**Master of Science in Engineering (M.S.E.)**, Electrical and Computer Engineering

2014 – 2016

University of Texas at Austin, Austin, Texas, USA

Advisor: Prof. Haris Vikalo

**Bachelor of Science (B.S.)**, Electrical Engineering

2010 – 2014

Sharif University of Technology, Tehran, Iran

Thesis: VISION-BASED GAIT ANALYSIS VIA EXPLOITING HUMAN BODY-PARTS PROPORTION

Advisor: Prof. Babak H. Khalaj

## PREVIOUS POSITIONS

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### Postdoctoral Fellow

University of Texas at Austin

2020 – 2021

Oden Institute for Computational Engineering and Sciences

Advisors: Prof. Inderjit Dhillon, Prof. Rachel Ward, Prof. Ufuk Topcu

- Adversarial training strategies for robust inverse reinforcement learning
- Communication-efficient and optimal stochastic optimization algorithms for federated learning and multi-agent reinforcement learning
- Scalable algorithms and communication strategies for robust distributed optimization in adversarial environments
- Online learning algorithms for sequential decision making and Stackelberg games with time-varying tasks in adversarial environments
- Structure-aware function approximation and identification of governing equations using sparse random Fourier features

### **Graduate Research Assistant**

University of Texas at Austin

2014 – 2020

Department of Electrical and Computer Engineering

Advisor: Prof. Haris Vikalo

- Efficient communication strategies for network optimization
- Submodular observation selection and information gathering for collaborative sensing systems
- Evolutionary self-expressive models for subspace clustering with applications to real-time motion segmentation and formation of ocean water masses
- Sparse tensor decomposition algorithms for haplotype assembly and study of genetic variations
- Greedy schemes for sparse reconstruction and sparse learning

### **Data Scientist Intern**

Cognitive Scale, Austin, Texas

Summer 2017

Mentor: Dr. Suyog Dutt Jain

Project: Relation extraction for clinical text data using attention-based deep recurrent neural networks

### **Undergraduate Research Intern**

Hong Kong University of Science and Technology

Summer 2013

Department of Electrical and Computer Engineering

Host: Prof. Daniel Palomar

Project: Robust estimation of covariance matrices from heavy-tailed distributions

### **Undergraduate Research Assistant**

Sharif University of Technology

2013 – 2014

Department of Electrical Engineering

Advisor: Prof. Babak H. Khalaj

Project: Vision-based gait analysis via exploiting human body-parts proportion

## **SCHOLASTIC HONORS**

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- 1 of 4 selected as an invited student speaker at 15th CSL conference at UIUC, Machine Learning for Signal Processing session, February 2020
- Top 33% Reviewer of ICML 2020, August 2020
- Selected as the Schmidt Science Fellows Award nominee from UT Austin, 2019
- Best student paper award finalist, American Control Conference, June 2018
- 1 of 4 selected as an invited student speaker at 12th CSL conference at UIUC, Bioinformatics and Computational Genomics session, February 2017
- Travel awards for ICML 2019, ACC 2019, ACC 2018, CNB-MAC 2017, ICASSP 2017, GlobalSIP 2016

- Inclusive Classrooms Leadership Certificate, UT Austin, February 2015
- Professional Teaching Assistant Certificate, UT Austin, August 2014
- Qualified as an Exceptional Talent eligible to enter Graduate Studies without entrance exam, Sharif University of Technology, 2013
- Ranked 79th among more than 277,000 participants in the Nationwide University Entrance Exam for B.Sc. degree, 2010
- Recipient of Iranian National Elite Foundation fellowship, 2010-2014

## TEACHING EXPERIENCE

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### **Purdue University**

#### **Elmore Family School of Electrical and Computer Engineering**

Instructor

- ECE 20001: Electrical Engineering Fundamental I Spring 2022
- ECE 20001: Electrical Engineering Fundamental I Fall 2021

### **University of Texas at Austin**

#### **Department of Electrical and Computer Engineering**

Graduate Teaching Assistant

- Statistical Machine Learning Fall 2019
- Estimation Theory Fall 2017
- Digital Signal Processing Spring 2015
- Digital Signal Processing Fall 2014

### **Sharif University of Technology**

#### **Department of Electrical Engineering**

Undergraduate Teaching Assistant

- Digital Signal Processing Fall 2013
- Communication Systems Fall 2013
- Principles of Electronics Fall 2013
- Principles of Electronics Spring 2013
- Computer Architecture Spring 2013
- Logic Circuits Spring 2013
- Analog Circuits Spring 2013
- Electromagnetism Fall 2012

## ADVISING

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### **Current M.Sc. Students**

- Antesh U (since December 2021), Topic: Distributed Online Learning
- Sravani Ramishetty (since December 2021), Topic: Federated Optimization

### **Current B.Sc. Students**

- John Stanwick (since October 2021), Topic: Decentralized Finance
- Alexander Zimbalist (since October 2021), Topic: Decentralized Finance

## OTHER ADVISING ROLES

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### Service on M.Sc./Ph.D. Thesis Committees

- Henry Su Wang (Ph.D. student, Purdue)
- Zhan-Lun Chang (Ph.D. student, Purdue)
- Yiyue Chen (Ph.D. student, UT Austin)

### Mentees

- Rudrajit Das (Ph.D. student, UT Austin): Communication-efficient and privacy-preserving federated learning, since Summer 2020
- Anish Acharya (Ph.D. student, UT Austin): Robust federated learning and distributed optimization in high dimensions, since Summer 2020
- Yiyue Chen (Ph.D. student, UT Austin): Distributed optimization over resource-constrained networks, since Fall 2019
- Niklas Lauffer (Undergrad, UT Austin): No-Regret Learning in Dynamic Stackelberg Games (now at UC Berkeley), 2021
- Émilie Thomé (Intern at Oden Institute, UT Austin): Communication-efficient multi-task learning and sequential decision making, Spring 2021
- Bobby Shi (Ph.D. student, UT Austin): Sparse random features for function approximation and identification of dynamical systems, 2020
- Hussain Almattar (Visiting undergrad from KAUST, UT Austin): Distributed vs. federated learning: Exploring the trade-offs in collaborative learning schemes, Summer 2019
- Banghua Zhu (Visiting undergrad from Tsinghua, UT Austin): Sparse tensor decomposition for haplotype assembly (now at UC Berkeley), Fall 2017

### Other Roles

- Faculty advisor for Purdue RoboMaster Club, since December 2021
- COMPES: Coaching and Mentoring for Purdue ECE Students, since October 2021
- Faculty advisor for Plurimos LLP, since October 2021

## INVITED TALKS

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1. AI at Scale: Robustness and Security in Adversarial Environments, *The Center for Education and Research in Information Assurance and Security, Purdue University*, Oct. 2021.
2. Structured and Resource-Constrained Collaborative Learning, *Center for Innovation in Control, Optimization, and Networks, Purdue University*, Sep. 2021.
3. Structured and Resource-Constrained Collaborative Learning, *Department of Computer Science, Purdue University*, Sep. 2021.
4. Weak Submodular Optimization: Theory, Algorithm, Application, *Department of Computer Science at UIUC*, Feb. 2020.
5. Progressive Stochastic Greedy Sparse Reconstruction and Support Selection, *15th CSL student conference at UIUC*, Feb. 2020.
6. Tutorial on Submodular Maximization, *The Oden Institute for Computational Engineering and Sciences at UT Austin*, Nov. 2019.

7. Tutorial on Submodular Minimization, *The Oden Institute for Computational Engineering and Sciences at UT Austin*, Oct. 2019.
8. Sparse Tensor Decomposition for Haplotype Assembly of Diploids and Polyploids, *12th CSL student conference at UIUC*, Feb. 2017.

## PUBLICATIONS

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### Preprints

1. Lauffer, N., Savas, Y., Ghasemi, M., Hashemi, A., Topcu, U., “No-Regret Learning in Dynamic Stackelberg Games,” *Submitted*, 2021.
2. Memarian, F., Hashemi, A., Niekum, S., Topcu, U., “Robust Generative Adversarial Imitation Learning via Local Lipschitzness,” *Submitted*, 2021.
3. Das, R., Hashemi, A., Sanghavi, S., Dhillon, I., “DP-NormFedAvg: Normalizing Client Updates for Privacy-Preserving Federated Learning,” *Submitted*, 2021.
4. Hashemi\*, A., Schaeffer\*, H., Shi\*, B., Tran\*, G., Ward\*, R., “Generalization Bounds for Sparse Random Feature Expansions,” *Submitted*, 2021.
5. Das, R., Hashemi\*, A., Acharya\*, A., Sanghavi, S., Dhillon, I., Topcu, U., “Faster Non-Convex Federated Learning via Global and Local Momentum,” *Submitted*, 2021.
6. Ghasemi, M., Hashemi, A., Vikalo, H., Topcu, U., “Learning in Markov Decision Processes with Varying Rewards: High Probability Regret Bounds under Bandit Feedback and Unknown Horizon,” *Submitted*, 2021.
7. Hashemi, A., Vikalo, H., de Veciana, G., “Performance-Complexity Tradeoffs in Greedy Weak Submodular Maximization with Random Sampling,” *Submitted*, 2021.

### Journal Papers

1. Hashemi, A., Shafipour, R., Vikalo, H., Mateos, G., “Towards Accelerated Greedy Sampling and Reconstruction of Bandlimited Graph Signals,” *Signal Processing*, 2022.
2. Hashemi, A., Acharya\*, A., Das\*, R., Vikalo, H., Sanghavi, S., Dhillon, I., “On the Benefits of Multiple Gossip Steps in Communication-Constrained Decentralized Federated Learning,” *IEEE Transactions on Parallel and Distributed Systems, Special Section on Parallel and Distributed Computing Techniques for AI, ML, and DL*, 2022.
3. Chen, Y., Hashemi, A., Vikalo, H., “Communication-Efficient Variance-Reduced Decentralized Stochastic Optimization over Time-Varying Directed Graphs,” *IEEE Transactions on Automatic Control*, 2022.
4. Hashemi, A., Ghasemi, M., Vikalo, H., Topcu, U., “Randomized Greedy Sensor Selection: Leveraging Weak Submodularity,” *IEEE Transactions on Automatic Control*, Jan. 2021.
5. Hashemi, A. and Vikalo, H., “Evolutionary Self-Expressive Models for Subspace Clustering,” *IEEE Journal of Selected Topics in Signal Processing, Special Issue on Data Science: Robust Subspace Learning and Tracking*, vol. 12, no. 6, pp. 1534–1546, Dec. 2018.
6. Hashemi, A. and Vikalo, H., “Accelerated Orthogonal Least-Squares for Large-Scale Sparse Reconstruction,” *Digital Signal Processing*, vol. 82, pp. 91–105, Nov. 2018.
7. Hashemi, A., Zhu, B., Vikalo, H., “Sparse Tensor Decomposition for Haplotype Assembly of Diploids and Polyploids,” *BMC Genomics*, vol. 19, no. 4, pp. 1–15, Mar. 2018.

### Conference Papers

1. Acharya, A., Hashemi, A., Jain, P., Sanghavi, S., Dhillon, I., Topcu, U., “Robust SGD via Block coordinate Geometric Median Descent,” *International Conference on Artificial Intelligence and Statistics (AISTATS)*, 2022. **(Acceptance rate: 29.2%)**

2. Ghasemi\*, M., Hashemi\*, A., Vikalo, H., Topcu, U., “No-Regret Learning with High-Probability in Adversarial Markov Decision Processes,” *Conference on Uncertainty in Artificial Intelligence (UAI)*, 2021. **(Acceptance rate: 26.5%)**
3. Ghasemi, M., Hashemi, A., Topcu, U., Vikalo, H., “Online Learning with Implicit Exploration in Episodic Markov Decision Processes,” *American Control Conference (ACC)*, 2021.
4. Savas, Y., Hashemi, A., Vinod, AP., Sadler, BM., Topcu, U., “Physical-Layer Security via Distributed Beam-forming in the Presence of Adversaries with Unknown Locations,” *International Conference on Acoustics, Speech and Signal Processing (ICASSP)*, 2021.
5. Chen, Y., Hashemi, A., Vikalo, H., “Decentralized Optimization on Time-Varying Directed Graphs under Communication Constraints,” *International Conference on Acoustics, Speech and Signal Processing (ICASSP)*, 2021.
6. Hashemi, A. , Vikalo, H., de Veciana, G., “On the Performance-Complexity Tradeoff in Stochastic Greedy Weak Submodular Optimization,” *International Conference on Acoustics, Speech and Signal Processing (ICASSP)*, 2021.
7. Ghasemi, M., Hashemi, A., Vikalo, H., Topcu, U., “Identifying Low-Dimensional Structures in Markov Chains: A Nonnegative Matrix Factorization Approach,” *American Control Conference (ACC)*, 2020.
8. Ghasemi\*, M., Hashemi\*, A., Vikalo, H., Topcu, U., “On Submodularity of Quadratic Observation Selection in Constrained Networked Sensing Systems,” *American Control Conference (ACC)*, 2019.
9. Shafipour, R., Hashemi, A., Mateos, G., Vikalo, H., “Online Topology Inference from Streaming Stationary Graph Signals,” *Data Science Workshop (DSW)*, 2019.
10. Hashemi, A., Ghasemi, M., Vikalo, H., Topcu, U., “Submodular Observation Selection and Information Gathering for Quadratic Models,” *International Conference on Machine Learning (ICML)*, June 2019. **(Acceptance rate: 22.6%)**
11. Hashemi, A. and Vikalo, H., “Evolutionary Subspace Clustering: Discovering Structure In Self-expressive Time-series Data,” *International Conference on Acoustic, Speech and Signal Processing (ICASSP)*, 2019.
12. Consul, S., Hashemi, A., Vikalo, H., “A MAP Framework for Support Recovery of Sparse Signals Using Orthogonal Least Squares,” *International Conference on Acoustic, Speech and Signal Processing (ICASSP)*, Brighton, 2019.
13. Hashemi\*, A., Kilic\*, O.F., Vikalo, H., “Near-Optimal Distributed Estimation for a Network of Sensing Units Operating Under Communication Constraints,” *Conference on Decision and Control (CDC)*, 2018.
14. Hashemi, A., Shafipour, R., Vikalo, H., Mateos, G., “A Novel Scheme for Support Identification and Iterative Sampling of Bandlimited Graph Signals,” *Global Conference on Signal and Information Processing (GlobalSIP)*, 2018.
15. Hashemi, A., Ghasemi, M., Vikalo, H., Topcu, U., “A Randomized Greedy Algorithm for Near-Optimal Sensor Scheduling in Large-Scale Sensor Networks,” *American Control Conference (ACC)*, 2018. **(Best student paper award finalist)**
16. Hashemi, A., Shafipour, R., Vikalo, H., Mateos, G., “Sampling and Reconstruction of Graph Signals via Weak Submodularity and Semidefinite Relaxation,” *International Conference on Acoustic, Speech and Signal Processing (ICASSP)*, 2018.
17. Hashemi, A., Zhu, B., Vikalo, H., “Sparse Tensor Decomposition for Haplotype Assembly of Diploids and Polyploids,” *International Workshop on Computational Network Biology: Modeling, Analysis, Control (CNB-MAC)*, 2017.
18. Hashemi, A. and Vikalo, H., “Sparse Recovery via Branch and Bound Least-Squares,” *International Conference on Acoustic, Speech and Signal Processing (ICASSP)*, 2017.

19. Hashemi, A. and Vikalo, H., “Sparse Linear Regression via Generalized Orthogonal Least-Squares,” *Global Conference on Signal and Information Processing (GlobalSIP)*, 2016.

## SERVICES AT THE PURDUE UNIVERSITY

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- Member of the graduate admissions committee, CNSIP and CE areas December 2021 – present
- Co-organizer of ICON Seminar Series December 2021 – present

## PROFESSIONAL MEMBERSHIPS AND SERVICES

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### Technical Program Committees

- IEEE International Workshop on Signal Processing Advances in Wireless Communications 2020
- International Multi-Conference on Computing in the Global Information Technology 2019
- International Conference on Mobile, Hybrid, and Online Learning 2019
- International Conference on Advanced Engineering Computing and Applications in Sciences 2018
- International Multi-Conference on Computing in the Global Information Technology 2018

### Memberships

- Institute of Electrical and Electronics Engineers (IEEE), Signal Processing Society 2016 – present
- Society for Industrial and Applied Mathematics (SIAM) 2016 – 2020

### Journal Reviews

- IEEE Signal Processing Magazine
- IEEE Transactions on Signal Processing
- IEEE Signal Processing Letters
- IEEE Transactions on Signal and Information Processing over Networks
- Elsevier Signal Processing
- IET Signal Processing
- IEEE Transactions on Robotics
- IEEE Transactions on Automatic Control
- Automatica
- IEEE Transactions on Wireless Communications
- IEEE Transactions on Communications
- IEEE Transactions on Cybernetics
- IEEE Journal of Selected Areas in Information Theory
- IEEE Access
- Information Sciences
- SIAM Journal on Scientific Computing
- Nature Scientific Reports
- PLOS One
- Taylor and Francis Journal on Forensic Sciences Research

## Conference Reviews

- International Conference on Artificial Intelligence and Statistics (AISTATS) 2021
- International Conference on Machine Learning (ICML) 2020, 2021, 2022
- Conference on Neural Information Processing Systems (NeurIPS) 2020
- American Control Conference (ACC) 2020, 2021, 2022
- International Symposium on Information Theory (ISIT) 2020
- International Workshop on Signal Processing Advances in Wireless Communications (SPAWC) 2020
- Conference on Decision and Control (CDC) 2018

## SHORT BIO

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Abolfazl Hashemi received the B.Sc. degree in Electrical Engineering from the Sharif University of Technology, Iran, in July 2014, and the M.S.E. and Ph.D. degrees in Electrical and Computer Engineering from the University of Texas at Austin, USA, in May 2016 and August 2020, respectively. From August 2020 to August 2021 he was a Postdoctoral Scholar at the Oden Institute for Computational Engineering and Sciences at the University of Texas at Austin. Since August 2021, he has been an Assistant Professor at the Elmore Family School of Electrical and Computer Engineering at Purdue University. Abolfazl was the 2019 Schmidt Science Fellows Award nominee from UT Austin, and the recipient of the Iranian national elite foundation fellowship and a best student paper award finalist at the 2018 American Control Conference. His research interests include distributed machine learning, signal processing, and control.

**Last Update: 11<sup>th</sup> Feb, 2022**