BEHDAD CHALAKI

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Google Scholar ⋄ Researchgate ⋄ LinkedIn ⋄ Github

EMPLOYMENT

Honda Research Institute (HRI) August 2022 - Present
Robotics Engineer *Ann Arbor, MI*

- Conducting research on automated vehicle mobility and robotics topics
- Implementing and integrating robotics algorithms into software
- Designing and developing simulator environment
- Supporting software development, prototyping, and research application projects

University of Delaware August 2017 - July 2022
Graduate Research Assistant *Newark, DE*

Decentralized Optimal Coordination Framework for Connected and Automated Vehicles

- Developed optimal control frameworks for coordination of connected and automated vehicles in different traffic scenarios such as intersections, merging roadways, and roundabouts to improve traffic throughput and passenger safety.
- Formulated the motion planning of vehicles as a scheduling problem and solved it using mixed-integer linear programming in IBM CPLEX.
- Established receding horizon control frameworks to generate safe and optimal trajectories for vehicles at different traffic scenarios.
- Simulated and analyzed different traffic scenarios in microscopic traffic flow simulation software (VISSIM, PreScan).

Experimental Validation of Connected and Automated Vehicles at Scaled Environment

- Built a scaled smart city with 50+ in-house designed robotic cars to study emerging mobility systems in a safe and controlled environment.
- Developed the object-oriented software of the scaled smart city in C++ and python.
- Created a digital replica of our scaled smart city in the Unity game engine.
- Conducted numerous experiments to assess the performance of different control frameworks for connected and automated vehicles in real-time.
- Implemented logistic problems such as last-mile delivery, shared mobility, routing problems, and complex missions involving the collaboration of aerial vehicles and ground vehicles.
- Transferred different reinforcement learning policies in the scaled experimental testbed.
- Mentored and trained more than 10 high-school students, 20 undergraduate and 10 master students.
- Consulted and supervised a mechanical engineering senior design team consisting of 10 undergraduate students to design and build 25 scaled vehicles.
- Designed a software development project for a computer science senior design team at the University of Delaware consisting of 6 undergraduate students in order to interact with the routing algorithm in our scaled smart city.

Employing Machine Learning Techniques to Improve Transportation Efficiency

- Modeled coordination of CAVs at a signal-free intersection as a decentralized reinforcement learning problem and solved it using Q-learning.

· Employed Gaussian process to learn the deviation from the nominal trajectory in motion planning of connected and automated vehicles.
· Collaborated with a master student to develop a decentralized, multi-agent reinforcement learning-based framework for coordinating CAVs through a highway merging scenario using a multi-agent deep deterministic policy gradient approach.

Zagross June 2016 - May 2017
Intern in R&D section *Tehran, Iran*

· Designed and implemented a data acquisition system for monitoring temperatures and power consumption of refrigerators to improve the speed of testing in the quality control sector.
· Developed an optimization software in Matlab to improve the performance of water dispensers.
· Analyzed and developed a defrosting system for industrial freezers and refrigerators.
· Modeled and simulated evaporators for frost-free commercial vertical freezers; conducted thermodynamic and mathematical modeling of the system; adjusted the developed model through experimental work.

Turbine Machine Middle-East June 2014 - September 2014
Intern in R&D section *Tehran, Iran*

· Created CAD models of different gas turbine components in CATIA.
· Created bill of materials for different sub-systems of a gas turbine.
· Operated with a point-cloud scanner to create a CAD model of complex components.

EDUCATION

University of Delaware, Newark, DE 2017 - 2022
Ph.D. in Mechanical Engineering, August 2022
Dissertation title: *A Real-time Motion Planning Framework for Connected and Automated Vehicles: From Theory to Scaled Experiments*
M.Sc. in Mechanical Engineering, May 2021

University of Tehran, Tehran, Iran 2012 - 2017
B.Sc in Mechanical Engineering, February, 2017

JOURNAL ARTICLES

1. Armijos, A.S.C., Li, A., Cassandras, C.G., Al-Nadawi, Y.K., Araki, H., Chalaki, B., Moradi-Pari, E., Mahjoub, H.N. and Tadiparthi, V., 2022. Cooperative Energy and Time-Optimal Lane Change Maneuvers with Minimal Highway Traffic Disruption, arXiv:2211.08636, 2022, (in review).

2. Mahbub, A.M., **Chalaki, B.** and Malikopoulos, A. A., "A Constrained Optimal Control Framework for Vehicle Platoons with Delayed Communication," *Networks and Heterogeneous Media* (to appear).

3. **Chalaki, B.**, Beaver, L. E., Mahbub, A. M., Bang, H., and Malikopoulos, A. A., "A Research and Educational Robotic Testbed for Real-time Control of Emerging Mobility Systems: From Theory to Scaled Experiments," *IEEE Control Systems Magazine*, 42(6), pp.20-34, 2022.

4. Bang, H., **Chalaki, B.**, and Malikopoulos, A. A., "Combined Optimal Routing and Coordination of Connected and Automated Vehicles," *IEEE Control Systems Letters*, 2022 (in press).

5. **Chalaki, B.** and Malikopoulos, A. A., "Time-Optimal Coordination for Connected and Automated Vehicles at Adjacent Intersections," *IEEE Transactions on Intelligent Transportation Systems* vol. 23, no. 8, pp. 13330-13345, 2022.

6. **Chalaki, B.** and Malikopoulos, A. A., "Optimal Control of Connected and Automated Vehicles at Multiple Adjacent Intersections," *IEEE Transactions on Control Systems Technology*, vol. 30, no. 3, pp. 972-984, 2022.

7. **Chalaki, B.** and Malikopoulos, A. A., "A Priority-Aware Replanning and Resequencing Framework for Coordination of Connected and Automated Vehicles," *IEEE Control Systems Letters*, vol. 6, pp. 1772-1777, 2022.

8. Beaver, L. E., **Chalaki, B.**, Mahbub, A. M., Zhao, L., Zayas, R., and Malikopoulos, A. A., "Demonstration of a Time-Efficient Mobility System Using a Scaled Smart City," *Vehicle System Dynamics*, 58, 5, 787— 804, 2020.

CONFERENCE PUBLICATION

1. **Chalaki, B.** and Malikopoulos, A. A., "A Barrier-Certified Optimal Coordination Framework for Connected and Automated Vehicles," *Proceedings of the 61st IEEE Conference on Decision and Control* (to appear).

2. Zayas, R., Beaver, L. E., **Chalaki, B.**, Bang, H., and Malikopoulos, A. A., "A Digital Smart City for Emerging Mobility Systems," *Proceedings of the 2nd IEEE conference on Digital Twin and Parallel Intelligence,* (to appear), 2022, **Best Paper Award**.

3. Ratnagiri, M., O'Dwyer C., Beaver, L. E., Bang, H., **Chalaki, B.**, and Malikopoulos, A. A., "A Scalable Last-Mile Delivery Service: From Simulation to Scaled Experiment," *Proceedings of the 25th IEEE International Conference on Intelligent Transportation Systems*, pp. 4163-4168, 2022.

4. **Chalaki, B.** and Malikopoulos, A. A., "Robust Learning-Based Trajectory Planning for Emerging Mobility Systems," *Proceedings of the 2022 American Control Conference*, pp. 2154-2159, 2022.

5. Nakka S. K. S., **Chalaki, B.** and Malikopoulos, A. A., "A Multi-Agent Deep Reinforcement Learning Coordination Framework for Connected and Automated Vehicles at Merging Roadways," *Proceedings of the 2022 American Control Conference*, pp. 3297-3302, 2022.

6. **Chalaki, B.** and Malikopoulos, A. A., "A Priority-Aware Replanning and Resequencing Framework for Coordination of Connected and Automated Vehicles," *Proceedings of 2022 American Control Conference, 2022* see IEEE Control Systems Letters, vol. 6, pp. 1772-1777, 2022.

7. **Chalaki, B.** and Malikopoulos, A. A., "A Hysteretic Q-learning Coordination Framework for Emerging Mobility Systems in Smart Cities," *Proceedings of the 2021 European Control Conference*, pp. 17-22, 2021.

8. **Chalaki, B.**, Beaver, L. E., and Malikopoulos, A. A., "Experimental Validation of a Real-Time Optimal Controller for Coordination of CAVs in a Multi-Lane Roundabout," *Proceedings of 31st IEEE Intelligent Vehicles Symposium*, pp. 504-509, 2020.

9. **Chalaki, B.**, Beaver, L. E., Remer, B., Jang, K., Vinitsky, E., Bayen, A., and Malikopoulos, A. A., "Zero-Shot Autonomous Vehicle Policy Transfer: From Simulation to Real-World via Adversarial Learning," *Proceedings of IEEE 16th International Conference on Control and Automation*, pp. 35-40, 2020, **Best Student Paper (finalist)**.

10. **Chalaki, B.** and Malikopoulos, A. A., "An Optimal Coordination Framework for Connected and Automated Vehicles in two Interconnected Intersections," *Proceedings of IEEE Conference on Control Technology and Applications*, pp. 888-893, 2019.

11. Jang, K., Vinitsky, E., **Chalaki, B.**, Remer, B., Beaver, L. E., Malikopoulos, A. A., and Bayen, A., "Simulation to scaled city: zero-shot policy transfer for traffic control via autonomous vehicles," *Proceedings of the 10th ACM/IEEE International Conference on Cyber-Physical Systems*, pp. 291-300, 2019.

HONORS AND AWARDS

Best Paper Award, Winner, IEEE 2022
Our paper entitled *"A Digital Smart City for Emerging Mobility Systems"* won the best paper award at IEEE Digital Twins and Parallel Intelligence 2022.

Graduate Student Travel Award, University of Delaware Graduate College 2022
Awarded to support the participation in the American Control Conference (ACC).

IAAP Scholarship Award, Iranian American Academics and Professionals 2022
Selected as a recipient of the IAAP scholarship based on academic achievements and services to the Iranian and Iranian American communities.

Shabahang Scholarship Award, Iranian cultural society of America 2021
Selected as a recipient of the second prize of Shabahang's Scholarship award by the Iranian cultural society of America (Shabahang).

COE Award for Excellence in Research, Nominee, University of Delaware 2021
Nominated by the mechanical engineering department in recognition of excellence in originality, innovation, and significance of the research.

Graduate Achievement Award, University of Delaware 2021
Awarded by the mechanical engineering department in recognition of excellent scholarship and creativity in engineering, as recommended by the faculty.

University Doctoral Fellowship Award, Nominee, University of Delaware 2021
Nominated by the mechanical engineering department.

IEEEXtreme Programming Competition, 84^{th} percentile, IEEE 2020
Finished 329/2157 in the world and 14/77 in the USA in a 24-hour programming competition.

Best Student Paper Award, Finalist, IEEE 2020
Our paper entitled *"Zero-Shot Autonomous Vehicle Policy Transfer: From Simulation to Real-World via Adversarial Learning"* was selected as a finalist for the best student paper award at ICCA 2020.

Student Travel Award, IEEE 2020 - 2021
Awarded for ACC 2020-2022, CDC 2020 by IEEE.

Travel Grant for East Coast Optimization Meeting, George Mason University 2019 - 2020

Best Poster Presentation Award, University of Delaware 2019
Awarded first place award in the poster presentation at the mechanical engineering graduate research showcase for prospective students.

Exempted from the Entrance Exam for Graduate Study, University of Tehran 2016
Awarded to students who graduated in the top 10% of class.

Second place in the Final Project of the Course, University of Tehran Science and Technology Park 2016
Prototyped an Arduino-based pressure and temperature calibration chamber for *Measurement System and Instrumentation* course.

Ranked Third in the Competition of Building a Solar Water Cooler, Iran 2016
Awarded a $2,500 prize for third place among 15 teams participating in the national competition of building a solar water cooler.

First Place in the Conceptual Design of a Solar Water Cooler, Iran 2015
Ranked first among 24 teams participating in the national competition of building a solar water cooler.

Full Scholarship to Study MEEG at the University of Tehran, Iran 2012

Ranked in the top 0.15% among more than 300,000 participants in the nationwide universities entrance exam in mathematics and physics field for B.Sc. degree.

LEADERSHIP EXPERIENCE

Computer Science Senior Design Team, Stakeholder 2021-2022
Designed a software development project for a computer science senior design team at the University of Delaware consisting of 6 undergraduate students aimed at interacting with routing algorithm in our scaled smart city; Oversaw the project progress by organizing weekly meetings; Created software specifications, use cases, and user stories.

Mechanical Engineering Graduate Association (MEGA), Secretary 2020 - 2021
Assisted in organizing and planning events to improve graduate students' engagement in the department; Documented meetings and events to enhance communication within the team.

Mechanical Engineering Senior Design Team, Graduate Mentor 2018 - 2019
Consulted and supervised a mechanical engineering senior design team consisting of 10 undergraduate students to design and build 25 connected autonomous vehicles (1:25).

UD K12 Engineering Outreach, Graduate Mentor 2018 - present
Mentored and trained more than 10 high-school students; Designed several personalized hardware and software projects based on the needs of the lab and skillets of high-school interns; Monitored students' progress by organizing regular meetings.

UD Undergraduate and Master Students Outreach, Graduate Mentor 2018 - present
Defined specific projects varying from software/hardware development to research-based work based on the interest of the lab and interns; Advised and coached more than 20 undergraduate and 10 master students; Collaborated with several students to publish their findings in peer-reviewed conferences.

The 21st Iranian Conference on Mechanical Engineering, Committee Member 2013
Organized and planned poster sessions and workshops at the conference.

TEACHING EXPERIENCE

Graduate Teaching Assistant, University of Delaware 2017-2018
Fluid Mechanics 1 and Fluid Mechanics 2

Teaching Assistant, University of Tehran 2015-2016
Optimization of Thermal Systems

Educational Counsellor, Tehran, Iran 2012-2017
Provided academic and advising support to K12 students preparing for nationwide universities entrance exam.

Tutor, Tehran, Iran 2012-2017
Taught physics, calculus, and algebra to high-school students.

SEMINAR/CONFERENCE TALKS

- The SIAM Conference on Control and Its Applications (CT21), USA July 19-21, 2021
- The 32nd IEEE IVS workshop, Japan July 11-12, 2021
- The 2021 European Control Conference, Rotterdam, Netherlands June 29- July 2, 2021
- The 31st IEEE IVS, Las Vegas, USA October 20-23, 2020
- The 16th IEEE ICCA, Japan October 9-11, 2020
- The 3rd IEEE CCTA, Hong Kong August 19-21, 2019

· The 8th Annual Graduate Students' Forum, University of Delaware — May 10, 2019
· East Coast Optimization Meeting, George Mason University — April 4-5, 2019
· Mechanical Engineering Graduate Research Showcase, University of Delaware — March 14, 2019

PROFESSIONAL SERVICE

Reviewer

· IEEE Conference on Decision and Control (CDC)
· IEEE American Control Conference (ACC)
· IFAC Symposium on Control in Transportation Systems
· European Control Conference (ECC)
· IEEE Conference on Control Technology and Applications (CCTA)
· IEEE International Conference on Automation Science and Engineering
· IEEE Intelligent Vehicles Symposium (IV)
· Automatica
· IEEE Transactions on Intelligent Transportation Systems
· IEEE Transactions on Automatic Control
· IEEE Transactions on Intelligent Vehicles
· IEEE Control Systems Letters
· SAE International Journal of Connected and Automated Vehicles
· IEEE Transactions on Vehicular Technology
· Vehicle System Dynamics
· Transportation Research Part C: Emerging Technologies
· IEEE International Conference on Robotics and Automation (ICRA)

PROFESSIONAL AFFILIATION

· Student Member, American Association for the Advancement of Science — 2021 - present
· Student Member, American Society of Mechanical Engineers (ASME) — 2021 - present
· Member, IEEE CSS Technical Committee on Smart Cities — 2020 - present
· Student Member, Society for Industrial and Applied Mathematics (SIAM) — 2018 - present
· Student Member, IEEE Control Systems Society — 2018 - present
· Student Member, IEEE Young Professionals — 2018 - present

CERTIFICATIONS

Self-Driving Cars Specialization — *University of Toronto*
· Introduction to Self-Driving Cars — January, 2022

Applied Data Science with Python Specialization — *University of Michigan*
· Applied Machine Learning in Python — February, 2022
· Applied Plotting, Charting & Data Representation in Python — December, 2021
· Introduction to Data Science in Python — November, 2021

TECHNICAL SKILLS

Research	Optimal control, Autonomous vehicles, Machine learning, Gaussian process
Programming	C++, MATLAB /Simulink, Python, C#, SQL, HTML
Machine Learning	Scikit-learn, TensorFlow, PyTorch, GPML
Data Analytics	Pandas, Matplotlib, seaborn
Control and Robotics	ROS, Arduino
Traffic Simulation	PreScan, PTV VISSIM
General	Git, LaTeX, Mathematica, Unity Game Engine, UML, Linux, Windows