Majid Mazouchi

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Professional Experiences

- **Department of EE at Michigan State University**
  Postdoctoral Research Associate (Full-time) *January 2023 - Present*
- **Department of ME at Michigan State University**
  Postdoctoral Research Associate (Full-time) *May 2019 - December 2022*

Technical Skills

- **Programming Languages**: Matlab, Python, C, C++.
- **Software/Hardware**: Simulink, Simulink Coder, Stateflow, Simscape, CarSim, CARLA, LabView, Allen-Bradley Programmable Logic Controller (PLC), PLC Programming (ST, FBD, Ladder), Human Machine Interface (HMI), Arduino, and Raspberry Pi / Jetson Nano.
- **Machine Learning**: Reinforcement learning (RL), Optimization algorithms, Neural networks, Gaussian Process regression, Temporal logic, Supervised learning algorithms such as linear and logistic regression, and time-series analysis.
- **Research Interest and Work Experiences**: Process Control, Instrumentation, Optimal, adaptive and robust control, Model Predictive Control, System Identification, Multi-agent systems, Distributed Control, Advanced Driver Assistance Systems (ADAS), Vehicle Dynamics Control, Electric Vehicle, Autonomous Vehicle, Self-driving Vehicles, Robotics, and Wind Turbine.

Research and Projects

- **Supported by Ground Vehicle Systems Center**:
  - **Active learning preview-augmented MPC active suspension system**: I developed a learning preview-augmented MPC active suspension system, which uses MPC plus preview information to predict predicted states, so that changes in the vehicle and future road conditions can be anticipated proactively. Additionally, I used Gaussian Process regression to build online dynamics for unmodeled suspension systems. The proposed control scheme was evaluated and validated by using CarSim and HiL experimental setups.
  - **Design motion controllers for a lightweight vehicle on rough terrain**: I developed yaw stability and anti-rollover controllers for a lightweight vehicle operating on rough terrain which integrates longitudinal, lateral, and vertical dynamics in order to enhance the vehicle's stability. The proposed control scheme was evaluated and validated by using CarSim software.
- **Supported by Ford Motor Company - Michigan State University Alliance**:
  - **Conflict-aware Safe Reinforcement Learning: A Meta-cognitive Learning Framework**: I worked with Ford Motor Company to develop an assured autonomous control framework by empowering RL algorithms with metacognitive learning capabilities to guarantee performance while assuring satisfaction of safety constraints across variety of circumstances.
  - **Automating Vehicles by Risk-Averse Preview-based Q-Learning Algorithm**: I worked with Ford Motor Company to develop a risk-averse high-level planner for the navigation of autonomous vehicles between lanes around static and moving obstacles.
- **Supported by Michigan State University**:
  - **Data-Driven Dynamic Multiobjective Optimal Control: An Aspiration-Satisfying Reinforcement Learning Approach**: I developed an iterative data-driven algorithm for solving dynamic multiobjective optimal control problems arising in control of nonlinear continuous-time systems.
  - **Fully-Heterogeneous Containment Control of a Network of Leader-Follower Systems**: I developed a distributed solution to the fully-heterogeneous containment control problem, for which not only the followers' dynamics but also the leaders' dynamics are non-identical.
  - **Finite-time and Fixed-Time System Identification Using Concurrent Learning**: I developed a novel adaptive update law with discontinuous gradient flows of the identification errors, which leverages concurrent learning to guarantee the learning of uncertain nonlinear dynamics in a fixed time.
  - **Secure Event-Triggered Distributed Kalman Filters for State Estimation over Wireless Sensor Networks**: I developed an information-theoretic approach to detect attacks and designed a meta-Bayesian approach in terms of confidence and trust values to mitigate the effect of attacks.
- **Supported by the Office of Naval Research**:
  - **Data-driven Safe Control via Finite-Time Koopman Identifier**: I developed a novel data-driven invariant-based safe control scheme for control of a nonlinear vehicle. The core idea was to use notions from set invariance theory to design a safe feedback controller directly by using an identified lifted-states linear system that approximately represents the nonlinear system model in a predefined subspace.

Education

- **Ferdowsi University of Mashhad** Mashhad, Iran
  Ph.D. Degree in Electrical Engineering in the field of control
- **Ferdowsi University of Mashhad** Mashhad, Iran
  M.Sc. Degree in Electrical Engineering in the field of control
- **K. N. Toosi University of Technology** Tehran, Iran
  B.Sc. Degree in Electrical Engineering in the field of control

Publications

- **Journal Paper: (Published)**: Mazouchi, M., Nageshrao, S. and Modares, H., 2021. A Risk-Averse Preview-based Q-Learning Algorithm: Application to Highway Driving of Autonomous Vehicles. IEEE Transactions on Control Systems Technology. (*Supported by Ford Motor Company*) https://ieeexplore.ieee.org/abstract/document/10056416
- **Journal Paper: (Published)**: Mazouchi, M., Nageshrao, S. and Modares, H., 2021. Conflict-aware safe reinforcement learning: A meta-cognitive learning framework. IEEE/CAA Journal of Automatica Sinica. (*Supported by Ford Motor Company*) https://ieeexplore.ieee.org/abstract/document/9646175
- **Journal Paper: (Published)**: Mustafa, A., Mazouchi, M., Nageshrao, S. and Modares, H., 2021. Assured learning-enabled autonomy: A metacognitive reinforcement learning framework. International Journal of Adaptive Control and Signal Processing. (*Supported by Ford Motor Company*) https://onlinelibrary.wiley.com/doi/full/10.1002/acs.3326
- **Journal Paper: (Submitted to JMRL)**: Mazouchi, M., Nageshrao, S. and Modares, H., 2021. Finite-time Koopman Identifier: A Unified Batch-online Learning Framework for Joint Learning of Koopman Structure and Parameters. arXiv preprint arXiv:2105.05903. (*Supported by Ford Motor Company*) https://arxiv.org/abs/2105.05903
- **Journal Paper: (Provisionally Accepted in Automatica)**: Han, Y., Mazouchi, M., Nageshrao, S. and Modares, H., 2021. A Convex Programming Approach to Data-Driven Risk-Averse Reinforcement Learning. arXiv preprint arXiv:2103.14606. (*Supported by Ford Motor Company*) https://arxiv.org/abs/2103.14606
- **Conference Paper: (Published)**: Han, Y., Mazouchi, M., Nageshrao, S. and Modares, H., 2021, December. A One-shot Convex Optimization Approach to Risk-Averse Q-Learning. In 2021 60th IEEE Conference on Decision and Control (CDC). (*Supported by Ford Motor Company*) https://ieeexplore.ieee.org/abstract/document/9682984
- **Conference Paper: (Published)**: Mazouchi, M., Nageshrao, S. and Modares, H., 2021. Automating Vehicles by Risk-Averse Preview-based Q-Learning Algorithm, 6th IFAC ICONS'22. (*Won the Best Paper Award*) (*Supported by Ford Motor Company*) https://www.sciencedirect.com/science/article/pii/S2405896322010278
- **Journal Paper: (Submitted to International Journal of Adaptive Control and Signal Processing)**: Mazouchi, M. and Modares, H., 2022. Data-driven Robust LQR with Multiplicative Noise via System Level Synthesis. arXiv preprint arXiv:2204.02883. (*Supported by the Office of Naval Research*) https://arxiv.org/abs/2204.02883
- **Journal Paper: (Published)**: Mazouchi, M., Tatari, F., Kiumarsi, B. and Modares, H., 2021. Fully-Heterogeneous Containment Control of a Network of Leader-Follower Systems. IEEE Transactions on Automatic Control.
- **Journal Paper: (Published)**: Tatari, F., Mazouchi, M. and Modares, H., 2021. Fixed-Time System Identification Using Concurrent Learning. IEEE Transactions on Neural Networks and Learning Systems.
- **Journal Paper: (Published)**: Li, Z., Mazouchi, M., Modares, H., Wang, X. and Sun, J., 2021. Finite-time adaptive output synchronization of uncertain nonlinear heterogeneous multi-agent systems. International Journal of Robust and Nonlinear Control. https://onlinelibrary.wiley.com/doi/full/10.1002/rnc.5779
- **Journal Paper: (Published)**: Mazouchi, M., Yang, Y. and Modares, H., 2021. Data-driven dynamic multiobjective optimal control: An aspiration-satisfying reinforcement learning approach. IEEE Transactions on Neural Networks and Learning Systems. https://ieeexplore.ieee.org/abstract/document/9411709
- **Journal Paper: (Published)**: Yang, Y., Mazouchi, M. and Modares, H., 2021. Hamiltonian-driven adaptive dynamic programming for mixed H_2/H_∞ performance using sum-of-squares. International Journal of Robust and Nonlinear Control.
- **Journal Paper: (Published)**: Vahidi-Moghaddam, A., Mazouchi, M. and Modares, H., 2020. Memory-augmented system identification with finite-time convergence. IEEE Control Systems Letters.
- **Journal Paper: (Published)**: Tatari, F., Vamvoudakis, K.G. and Mazouchi, M., 2019. Optimal distributed learning for disturbance rejection in networked non-linear games under unknown dynamics. IET Control Theory & Applications.
- **Journal Paper: (Published)**: Mazouchi, M., Naghibi-Sistani, M.B., Hosseini Sani, S.K., Tatari, F. and Modares, H., 2019. Observer-based adaptive optimal output containment control problem of linear heterogeneous Multiagent systems with relative output measurements. International Journal of Adaptive Control and Signal Processing.
- **Journal Paper: (Published)**: Mustafa, A., Mazouchi, M. and Modares, H., 2019. Secure Event-Triggered Distributed Kalman Filters for State Estimation over Wireless Sensor Networks. Transactions on SMC: Systems.
- **Journal Paper: (Published)**: Mazouchi, M., Naghibi-Sistani, M.B. and Sani, S.K.H., 2017. A novel distributed optimal adaptive control algorithm for nonlinear multi-agent differential graphical games. IEEE/CAA Journal of Automatica Sinica.
- **Journal Paper: (Published)**: Tatari, F., Akbarzadeh T, M.R. and Mazouchi, M., 2014. A self-organized multi agent decision making system based on fuzzy probabilities: the case of aphasia diagnosis. Iranian Journal of Fuzzy Systems. https://ijfs.usb.ac.ir/
- **Journal Paper: (Published)**: Tatari, F. and Mazouchi, M., 2017. Hourly Wind Speed Prediction using ARMA Model and Artificial Neural Networks. International Journal of Smart Electrical Engineering. https://ijsee.ctb.iau.ir/
- **Conference Paper: (Published)**: Performance Analysis of Event-Triggered Consensus Control for Multi-agent Systems under Cyber-Physical Attacks. 61th IEEE Conference on Decision and Control (CDC) 2022.
- **Conference Paper: (Published)**: Yang, Y., Mazouchi, M. and Modares, H., 2020, August. Data-Driven Solutions to Mixed H_2/H_∞ Control: A Hamilton-Inequality-Driven Reinforcement Learning Approach. In 2020 IEEE Conference on Control Technology and Applications (CCTA). https://ieeexplore.ieee.org/abstract/document/9206320

Honors and Awards

- Best Paper Award- 6th IFAC Conference on Intelligent Control and Automation Sciences (ICONS2022).
- Honored graduate (Ferdowsi University of Mashhad). Ranked: Top Five

Service to Society

- **Guest Associate Editor and Topic Editor**
  Frontiers in Control Engineering: Adaptive, Robust and Fault Tolerant Control section
- **Reviewer**: various journal papers including IEEE TAC, Automatica, IEEE TNNLS,...
- **Lecturer**: School of Electrical Engineering, College of Engineering, University of Semnan; Khorasan Institute of Higher Education
  - **Instrumentation, Digital Control, Signal and Systems, System Identification, ...**: (2012 - 2018)