Dr. Majid Mazouchi

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Current Position

- **Michigan State University**
  Postdoctoral Research Associate (Full-time) *May 2019 - Present*

Technical Skills

- **Research Interest**: Safety-Critical Systems, Reinforcement Learning for Control Systems, Safe Reinforcement Learning, Resilient Control, Multi-agent systems, Distributed Control, Game Theory, Learning for dynamics, Formal Methods-based Control, Autonomous Vehicle.
- **Control Engineering**: Linear and Non-linear control, Optimal control, Neural network control, Adaptive and Robust control, Model Predictive Control, Kalman Filter, Convex Optimization, Networked and Embedded Control Systems.
- **Machine Learning**: Reinforcement Learning, Deep Learning, Gaussian Process Regression, Optimization, Neural Network, RTAB 3D mapping navigation, PCL 3D point cloud, SLAM mapping navigation.
- **Programming Languages**: Python, Matlab, C/C++, Julia.
- **Software/Hardware**: Simulink, LabView, ROS1, ROS2, Webots, Gazebo, CoppeliaSim, Raspberry Pi, Jetson Nano, Arduino.

Researches and Projects

- **Supported by Ford Motor Company - Michigan State University Alliance**: May 2019 - Augest 2021
  - **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 the Office of Naval Research**: March 2022 - Present
  - **Data-driven Robust LQR with Multiplicative Noise via System Level Synthesis**: I developed a data-driven method for solving the closed-loop state-feedback control of a discrete-time LQR problem for systems affected by multiplicative norm bounded model uncertainty.
  - **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.
- **Supported by Michigan State University**: May 2019 - Present
  - **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.

Education

- **Ferdowsi University of Mashhad** Mashhad, Iran
  Ph.D. Degree in Electrical Engineering in the field of control
  Dissertation: Online Sub-optimal Cooperative Control of Multi Agent Systems: Reinforcement Learning Approach
- **Ferdowsi University of Mashhad** Mashhad, Iran
  M.Sc. Degree in Electrical Engineering in the field of control
  Dissertation: Adaptive Probabilistic Fuzzy Controller in Evolutionary Algorithms for Non-Stationary Environment
- **K. N. Toosi University of Technology** Tehran, Iran
  B.Sc. Degree in Electrical Engineering in the field of control
  Dissertation: Designing and producing a sensor for measuring The Coriolis Effect

Publications

- **Journal Paper: (Submitted to IEEE Transactions on Control Systems Technology)**: Mazouchi, M., Nageshrao, S. and Modares, H., 2021. A Risk-Averse Preview-based Q-Learning Algorithm: Application to Highway Driving of Autonomous Vehicles. arXiv preprint arXiv:2112.03232. (*Supported by Ford Motor Company*)
- **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*)
- **Journal Paper: (Submitted to International Journal of Robust and Nonlinear Control)**: Mazouchi, M. and Modares, H., 2022. Data-driven Safe Control via Finite-Time Koopman Identifier. (*Supported by the Office of Naval Research*)
- **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*)
- **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.
- **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*)
- **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*)
- **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.
- **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: (Submitted to 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*)
- **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: (Accepted)**: 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.
- **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.
- **Conference Paper: (Accepted)**: 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*)
- **Conference Paper: (Accepted)**: 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).
- **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*)

Honors and Awards

- Best Paper Award- 6th IFAC Conference on Intelligent Control and Automation Sciences (ICONS2022).

Service to Society

- **Guest Associate Editor and Topic Editor**
  Frontiers in Control Engineering: Adaptive, Robust and Fault Tolerant Control section
- **Reviewer of various journal papers including IEEE TAC, IEEE TNNLS,...**
  https://publons.com/wos-op/researcher/1634547/majid-mazouchi/
- **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)