Mahdi Taheri

Ph.D. Electrical and Computer Engineering

Pasadena, CA

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Research Interests

Learning-based control; vision-based control; causal inference for reasoning and resilient autonomy; actuator and sensor fault diagnosis and recovery; cyber-attack detection and secure cyber-physical systems; robotics and autonomous vehicles.

Employment

California Institute of Technology (Caltech) *Pasadena, CA*

Postdoctoral Research Scholar in Aerospace *Nov. 2024 - Present*

- Developing real-time fault detection, identification, and recovery (FDIR) methods for spacecraft and autonomous robots by integrating machine learning, control theory, and causal inference.
- Developing a counterfactual reasoning method for fault diagnosis in perception systems under algorithmic errors and physical faults.
- Designing neural network–based controllers using adaptive control and causal inference, with selective layer adaptation for fault recovery.
- Designing neural network–based observers using mirror descent-based adaptation and contraction theory to guarantee fault identification under actuator and sensor faults.
- Testing and validating FDIR methodologies for robotic perception faults and spacecraft attitude control, using both physical robotic systems and high-fidelity simulators such as Isaac Sim.

GlobVision Inc. *Montreal, QC*

System Engineer *Nov. 2021 - May 2024*

- Physics-based and data-driven diagnosis, prognosis, and health monitoring (DPHM) solutions for primary control surfaces of Bombardier Global 7500 private jets (i.e., Aileron, Elevator, and Rudder) using Aircraft Health Management System (AHMS).
- Time series analysis and health monitoring for the Samuel De Champlain bridge in Montreal.
- System identification and ML-based structural health monitoring for Expansion Joints in cable-stayed bridges.
- Power-spectral-density (PSD) analysis for 1-D, 2-D, and 3-D accelerometers in cable-stayed bridges using FFT and Welch's methods.

GlobVision Inc. *Montreal, QC*

System Engineer *May 2018 - May 2019*

- Developed DPHM methodologies for Multi-Function Spoilers (secondary control surfaces) in Flight Control Systems.

Education

Concordia University *Montreal, QC, Canada*

Ph.D. Electrical and Computer Engineering *Sep. 2017 - May 2024*

- Advisor: Prof. Khashayar Khorasani
- Dissertation Title: Cyber-Attack Detection Methodologies for Cyber-Physical Systems: A System Theoretic Approach

Isfahan University of Technology *Isfahan, Iran*

M.Sc. Electrical Engineering-Control Systems *Sep. 2013 - Apr. 2016*

- Advisor: Prof. Farid Sheikholeslam
- Thesis Title: Consensus Control in Nonlinear Multi-Agent System

Ilam University *Ilam, Iran*

B.Sc. Electrical Engineering-Power Systems *Sep. 2009 - Aug. 2013*

- Project Title: A Model Predictive Control Method for Optimal Load Shedding and Under Frequency Control in Power Systems

Publications

Under Review

H. Han*, **M. Taheri***, SJ. Chung, and F. Y. Hadaegh, "A Counterfactual Reasoning Framework for Fault Diagnosis in Robot Perception Systems," in *IEEE International Conference on Robotics and Automation (ICRA) 2026*. (*Co-first authors)

M. Taheri, H. Han, SJ. Chung, and F. Y. Hadaegh, "Geometric Fault Identification via Mirror Descent Learning," in *IFAC World Congress 2026*.

J. Ibrahim, **M. Taheri**, H. Han, SJ. Chung, and F. Y. Hadaegh, "Data-Driven Probabilistic Fault Detection and Identification via Density Flow Matching," in *IFAC World Congress 2026*.

Journal Papers (Published/Accepted)

M. Taheri, SJ. Chung, and F. Y. Hadaegh, "Closing the Loop Inside Neural Networks: Causality-Guided Layer Adaptation for Fault Recovery Control," in *IEEE Control Systems Letters*. (To Appear)

M. Taheri, K. Khorasani, and N. Meskin, "On Covert Cyber-Attacks in Cyber-Physical Systems and Dynamic Coding Schemes as their Countermeasures," in *Automatica*. (Accepted as a Regular Paper)

M. Taheri, K. Khorasani, I. Shames, and N. Meskin, "Cyberattack and Machine-Induced Fault Detection and Isolation Methodologies for Cyber-Physical Systems," in *IEEE Transactions on Control Systems Technology*, vol. 32, no. 2, pp. 502-517, March 2024.

M. Taheri, K. Khorasani, and N. Meskin, "On Zero Dynamics and Controllable Cyber-Attacks in Cyber-Physical Systems and Dynamic Coding Schemes as their Countermeasures," in *IEEE/CAA Journal of Automatica Sinica*, vol. 11, no. 11, pp. 2191-2203, November 2024.

M. Taheri, M. Najafi, F. Sheikholeslam, and M. Zekri, "Consensus in first-order nonlinear multi-agent systems with state time delays using adaptive fuzzy wavelet networks," in *Transactions of the Institute of Measurement and Control*, vol. 41, pp. 3021-3032, 2019.

M. Taheri, F. Sheikholeslam, M. Najafi, and M. Zekri, "Adaptive fuzzy wavelet network control of second order multi-agent systems with unknown nonlinear dynamics," in *ISA Transactions*, vol. 69, pp. 89-101, 2017.

Conference Papers (Published/Accepted)

M. Taheri, K. Khorasani, and N. Meskin, "A Dynamic Coding Scheme to Prevent Covert Cyber-Attacks in Cyber-Physical Systems," 2025 *IEEE 64th Conference on Decision and Control (CDC)*. (To Appear)

M. Taheri, K. Khorasani, and N. Meskin, "A Dynamic Coding Scheme for Preventing Controllable Cyber-Attacks in Cyber-Physical Systems," 2024 *IEEE 63rd Conference on Decision and Control (CDC)*, Milan, Italy, 2024, pp. 3831-3838.

M. Taheri, M. Nematollahi, and K. Khorasani, "Detection, Identification, and Resilient Control of Cyber-Attacks on Rudder Servo Systems in Marine Vessels," *2024 10th International Conference on Control, Decision and Information Technologies (CoDIT)*, Vallette, Malta, 2024, pp. 360-366.

M. Taheri, K. Khorasani, "Dual State and Parameter Estimation for Diagnosis, Prognosis, and Health Monitoring of Electro-Mechanical Actuators," 2024 *IEEE International Systems Conference (SysCon)*, Montreal, QC, Canada, 2024, pp. 1-6.

M. Taheri, K. Khorasani, and N. Meskin, "The Security Requirement to Prevent Zero Dynamics Attacks and Perfectly Undetectable Cyber-Attacks in Cyber-Physical Systems," 2023 *62nd IEEE Conference on Decision and Control (CDC)*, Singapore, Singapore, 2023, pp. 7067-7072.

M. Taheri, M. Nematollahi, and K. Khorasani, "Detection and Identification of GNSS Spoofing Cyber-Attacks for Naval Marine Vessels," 2023 *IEEE International Symposium on Inertial Sensors and Systems (INERTIAL)*, Lihue, HI, USA, 2023, pp. 1-4.

M. Taheri, K. Khorasani, and N. Meskin and I. Shames, "Data-Driven Koopman Operator Based Cyber-Attacks for Nonlinear Control Affine Cyber-Physical Systems," 2022 *61st IEEE Conference on Decision and Control (CDC)*, Cancun, Mexico, 2022, pp. 6769-6775.

M. Taheri, K. Khorasani, I. Shames, and N. Meskin, "Data-Driven Covert-Attack Strategies and Countermeasures for Cyber-Physical Systems," 2021 *60th IEEE Conference on Decision and Control (CDC)*, Austin, TX, USA, 2021, pp. 4170-4175.

M. Taheri, K. Khorasani, I. Shames, and N. Meskin, "Towards Privacy Preserving Consensus Control in Multi-Agent Cyber-Physical Systems Subject to Cyber Attacks," 2021 *European Control Conference (ECC)*, Delft, Netherlands, 2021, pp. 939-945.

M. Taheri, K. Khorasani, I. Shames, and N. Meskin, "Undetectable Cyber Attacks on Communication Links in Multi-Agent Cyber-Physical Systems," 2020 *59th IEEE Conference on Decision and Control (CDC)*, Jeju, Korea (South), 2020, pp. 3764-3771.

M. Taheri, K. Khorasani, I. Shames, and N. Meskin, "Mitigation and Resiliency of Multi-Agent Systems Subject to Malicious Cyber Attacks on Communication Links," 2020 *IEEE Conference on Control Technology and Applications (CCTA)*, Montreal, QC, Canada, 2020, pp. 857-862.

Patents & Intellectual Property

M. Taheri, M. Nematollahi, and A. Riasati, "Control-Aware Digital Twin For Cybersecurity of Cyber-Physical Systems," U.S. Provisional Patent Application (Technology Disclosure No. 63/889,389), filed 09/2025

M. Taheri, SJ. Chung, and F. Y. Hadaegh, "Causality-Guided Selective Neural Network Layer Adaptation for Real-Time Fault Recovery Control," U.S. Provisional Patent Application (Technology Disclosure No. CIT-9441-P), filed 12/2025.

H. Han, **M. Taheri**, SJ. Chung, and F. Y. Hadaegh, "A Counterfactual Reasoning Framework for Fault Diagnosis in Robot Perception Systems," U.S. Provisional Patent Application (Technology Disclosure No. CIT 9445-P), filed 12/2025.

Research Experience

California Institute of Technology - TII *Pasadena, CA*

PI: Prof. Fred Y. Hadaegh *Dec. 2024 - Present*

- Developing learning-based and data-driven real-time fault detection, identification, and recovery (FDIR) control methodologies for space robotics systems.

Concordia University - Department of National Defence of Canada *Montreal, QC*

PI: Prof. Khashayar Khorasani *Sep. 2021 - Sep. 2023*

- Developed cyber-attack detection and identification solutions for marine vessels subject to spoofing and false data injection attacks in their guidance, navigation, and control systems.
- Implemented a hardware-in-the-loop (HIL) simulation testbed using Raspberry Pis and the OPAL-RT real-time simulator.

Concordia University - Department of National Defence of Canada *Montreal, QC*

PI: Prof. Khashayar Khorasani *Feb. 2021 - Aug. 2021*

- Developed AI/ML-based diagnosis, prognosis, and health monitoring (DPHM) methodologies for electro-mechanical actuators and unmanned aerial vehicles (UAVs).

Teaching Experience

2025	**Aerospace Control Systems**, Guest Lecturer, California Institute of Technology (Caltech)
2018-2022	**Linear Systems**, Teaching Assistant, Concordia University
2020	**Principles of Electrical Engineering**, Teaching Assistant, Concordia University
2020-2021	**Applied Advanced Calculus**, Teaching Assistant, Concordia University
2018-2024	**Math Tutoring**, Concordia University Student Success Center

Mentoring

2025-Present	**Haeyoon Han**, "Fault Diagnosis in Perception Systems", Ph.D. Student	*Caltech*
2025-Present	**Joshua Ibrahim**, "Fault Diagnosis in Density Spaces", Ph.D. Student	*Caltech*
2025-Present	**Joudi Hajar**, "Robust Control of Nonlinear Systems", Ph.D. Student	*Caltech*
2025-Present	**Baaqer Farhat**, "Recovery Control in the Presence of Perception System Faults", SURF Undergraduate Student	*Caltech*
2025-Present	**Priyanka Supraja Balaji**, "Generative AI for Fault Diagnosis in Perception Systems", Undergraduate Student	*Caltech*

Skills

- C, C++ (OOP), Python, MATLAB (OOP), Simulink
- Robot Operating System (ROS) 1, ROS 2
- Hardware-in-the-loop (HIL), OPAL-RT, Monte-Carlo simulations
- Isaac Sim (Omniverse), MuJoCo

Presentations

"Data-driven koopman operator based cyber-attacks for nonlinear control affine cyber-physical systems." Oral presentation: 2022 61st IEEE Conference on Decision and Control (CDC), Cancun, Mexico.

"Data-driven covert-attack strategies and countermeasures for cyber-physical systems." Online presentation: 2021 60th IEEE Conference on Decision and Control (CDC), Austin, TX, USA.

"Towards Privacy Preserving Consensus Control in Multi-Agent Cyber-Physical Systems Subject to Cyber Attacks." Online presentation: 2021 European Control Conference (ECC), Delft, Netherlands.

"Undetectable cyber attacks on communication links in multi-agent cyber-physical systems." Online presentation: 2020 59th IEEE Conference on Decision and Control (CDC), Jeju, Korea (South).

"Mitigation and resiliency of multi-agent systems subject to malicious cyber attacks on communication links." Online presentation: 2020 IEEE Conference on Control Technology and Applications (CCTA), Montreal, QC, Canada.

Service

Journal Reviewer: IEEE Transactions on Automatic Control (since 2025), Automatica (since 2025), IEEE Transactions on Control Systems Technology (since 2025), IEEE Transactions on Control of Network Systems (since 2023), IEEE Control Systems Letters (since 2023), Journal of Guidance, Control, and Dynamics (since 2024), IEEE Transactions on Systems, Man and Cybernetics: Systems (since 2019), ISA Transactions (since 2016), IEEE/CAA Journal of Automatica Sinica (since 2021), Nonlinear Dynamics (since 2025), IEEE Transactions on Cybernetics (since 2023), SoftwareX (since 2023), Measurement (since 2024), Reliability Engineering & System Safety (since 2025)

Conference Reviewer: IEEE Conference on Decision and Control (CDC) (2021, 2023, 2024, 2025), IFAC World Congress (2026), European Control Conference (ECC) (2021), International Conference on Control, Decision and Information Technologies (CoDIT) (2024)