Erik Miehling

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education

University of Michigan	*Ann Arbor, MI*
Ph.D. – Electrical Engineering & Computer Science	**Sept 2011 – Dec 2017**
University of British Columbia	*Vancouver, BC*
M.A.Sc. – Electrical & Computer Engineering	**Sept 2009 – Aug 2011**
B.A.Sc. – Electrical Engineering	**Sept 2006 – May 2009**

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work experience

IBM Research   *Dublin, Ireland*
Research Scientist (AI)   **Aug 2022** – *present*

- Pioneered and prototyped new approaches for studying algorithmic amplification of bias in RL and ML pipelines
- Developed recommender system simulators to study dynamic fairness in online advertising domains
- Played a key role in seeking government funding through involvement in research ideation and proposal writing

University of Illinois at Urbana–Champaign   *Urbana, IL*
Postdoctoral Research Associate   **Feb 2018 – Aug 2022**

- Advised 10 Ph.D. students and published 15 peer-reviewed articles in multi-agent reinforcement learning and game theory spanning five federally funded projects (total research funding: $39 500 000 USD)
- Made foundational contributions to multi-agent reinforcement learning in both cooperative domains (RNN-based information embeddings) and adversarial domains (online attacker intent inference for defense)
- Co-wrote a successful NSF grant valued at $500 000 USD which funded a three year research program on modeling, learning, and control of epidemic processes

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research experience

C3.ai: Algorithms and Software Tools for Testing and Control of COVID-19   **Dec 2020 – Aug 2022**

- Initiated an interdisciplinary collaboration with epidemiologists to construct data-driven models for explaining the spread of COVID-19.
- Developed control-theoretic models for efficient allocation of testing kits in epidemics.

NSF: A Comprehensive Approach to Modeling, Learning, Analysis and Control of Epidemic Processes Over Time-Varying and Multi-Layer Networks   **Oct 2020 – Aug 2022**

- Employed mean-field game theory to construct an agent-based behavioral model for describing asymptomatic viral spread.

ARO: A Multimodal Approach to Network Information Dynamics   **Sept 2020 – Aug 2022**

- Constructed game-theoretic models describing how misinformation/disinformation emerges, spreads, and is sustained.

ARL: Internet of Battlefield Things Collaborative Research Alliance   **Feb 2019 – Aug 2022**

- Employed recurrent neural networks (RNNs) to discover low-dimensional summaries of sufficient information for decentralized partially observable Markov decision processes.

- Developed game-theoretic conflict models for large-scale, uncertain, and time-critical battle-field environments.

ONR: An Analytical Framework for Actionable Defense against Advanced Persistent Threats (ADAPT)   Feb 2018 – Jun 2021

- Designed provably-convergent reinforcement learning algorithms for cooperative and non-cooperative multi-agent decision problems.
- Developed game-theoretic models for online intent inference in adversarial domains.

ARO: Adversarial and Uncertain Reasoning for Adaptive Cyber Defense   Jan 2014 – Dec 2017

- Design and analysis of sequential decision-making models under both probabilistic and non-probabilistic uncertainty.
- Application to the development of dynamic defense schemes for large-scale networks.
- Extended the theory of structural results in partially observable Markov decision processes.

NSF: Foundations of Resilient Cyber-Physical Systems (FORCES)   Jan 2013 – Dec 2017

- Developed provably convergent algorithms for a class of non-convex problems.
- Application to the design of decentralized electricity market mechanisms.

Information State Embedding in Partially Observable Multi-Agent Reinforcement Learning   Aug 2020

https://github.com/xizeroplus/marl-embedding

- Aided in the development of an RNN-based model for learning near-optimal representations of information for cooperative multi-agent reinforcement learning settings.
- *Python packages:* pytorch, scikit-learn

PhD students

- Shubham Aggarwal (with T. Başar): mean-field games   2021 – 2022
- Raj Kiriti Velicheti (with T. Başar): misinformation, multi-agent RL   2021 – 2022
- Xiaoqi Bi (with C. Beck): epidemics, stochastic control   2020 – 2022
- S. Yagiz Olmez (with P. G. Mehta): epidemics, game theory   2020 – 2022
- Jameson Mori (with R. L. Smith): epidemics   2020 – 2021
- Weichao Mao (with T. Başar): multi-agent RL   2019 – 2022
- Kaiqing Zhang (with T. Başar): multi-agent RL   2018 – 2020
- Xiangyuan Zhang (with T. Başar): multi-agent RL, game theory   2018 – 2022
- Aneeq Zaman (with T. Başar): mean-field games   2018 – 2022
- Muhammed Sayin (with T. Başar): security, game theory   2018 – 2019

Masters students

- Danilo Dordevic (ETH Zürich, with M. Hudoba de Badyn): math finance   2022

University of Illinois at Urbana–Champaign   *Urbana, IL*

ECE 486 - Control Systems, *Guest Lecturer*   **Apr 2019**

University of Michigan, College of Engineering   *Ann Arbor, MI*

EECS 215 - Introduction to Electronic Circuits, *Discussion Lecturer*   **Winter 2013**

EECS 216 - Signals and Systems, *Laboratory Lecturer*   **Fall 2012**

US Department of Energy, Oak Ridge National Laboratory *Oak Ridge, TN*
Advanced Short-Term Research Opportunity **May 2013 – Sept. 2013**

Defense Research & Development Canada, Radar Systems Group *Ottawa, ON*
Summer Internship **May 2010 – Sept. 2010**

Broadcom Canada, Centre for Audio Excellence *Richmond, BC*
Summer Internship **May 2008 – Sept. 2008**

"Mixed Signals: Information Disclosure in Persuasion, Security, and Value Alignment"
IBM Research, Dublin, Ireland *April 2022*

"Estimation, Modeling, and Active Testing of Uncertain Epidemic Processes"
C3.ai Digital Transformation Institute Research Symposium, Miami, FL *Mar 2022*

"Optimal Transport and Boundary-Constrained Control"
Internet of Battlefield Things (IoBT) Research Presentation (remote) *Feb 2022*

"Secure Contingency Prediction and Response for Cyber-Physical Systems"
4th IEEE Conf. on Control Technology and Applications, Montreal, QC, Canada (remote) *Aug 2020*

"Strategic Inference With a Single Private Sample"
58th IEEE Conf. on Decision and Control, Nice, France *Dec 2019*

"Optimal Switching Strategies for System Obfuscation"
Internet of Battlefield Things (IoBT) Bootcamp, Chicago, IL *Jul 2019*

"Online Planning for Decentralized Stochastic Control with Partial History Sharing"
American Control Conf. (ACC) 2019, Philadelphia, PA *Jul 2019*

"Strategic Inference Under Private Sampling"
EC 2019 Workshop: Learning in the Presence of Strategic Behavior, Phoenix, AZ *Jun 2019*
8th Midwest Workshop on Control and Game Theory, St. Louis, MO *Apr 2019*

"A Bayesian Multi-armed Bandit Approach for Identifying Human Vulnerabilities"
Decision and Game Theory for Security (GameSec 2018) *Oct 2018*

"Monotonicity Properties of Optimal Policies for POMDPs on Partially Ordered Spaces"
Department of Electrical Engineering, University of Washington, Seattle, WA *Apr 2018*
   Host: Lillian Ratliff

Stanford Intelligent Systems Laboratory Seminar, Stanford University *Jan 2018*
   Hosts: Katherine Driggs-Campbell, Mykel J Kochenderfer

"A Dependency Graph Formalism for the Dynamic Defense of Cyber Networks"
5th IEEE Global Conf. on Signal and Information Processing (GlobalSIP 2017) *Nov 2017*

"A Stochastic Control Approach to Dynamic Defense of Large-Scale Cyber Networks"
ECE Systems & Control Seminar, University of New Mexico *Nov 2017*
   Host: Meeko Oishi

"A Dependency Graph Formalism for the Dynamic Defense of Large-Scale Cyber Networks"
3rd Multidiscip. Conf. on Reinforcement Learning & Decision Making (RLDM 2017) *Jun 2017*

"A Decentralized Mechanism for Computing Competitive Equilibria in Deregulated
   Electricity Markets"
American Control Conf. (ACC 2016) *Jul 2016*

"A Formal Model for the Dynamic Defense of Cyber Networks"
2nd Moving Target Defense Quantification Workshop (MTDQ) *Jun 2016*

"Optimal Defense Policies for Partially Observable Spreading Processes on Bayesian Attack Graphs"
2nd ACM Workshop on Moving Target Defense (MTD) *Oct 2015*

Organizational & Outreach

- IBM Research – speaker at Technical Vitality Day 2022
- NSF – grant review panelist, Spring 2022 session
- CDC 2021 – session co-organizer (modeling, prediction, and control of epidemic processes)
- CDC 2020 – session co-chair (epidemics)
- CDC 2019 – session co-chair (machine learning in complex networks II)
- Allerton 2019 – session assistant (performance, reliability, and security)
- ACC 2019 – volunteer
- SPS 2019 – technical program committee member
- CDC 2018 – volunteer
- GameSec 2018 – session chair (advanced persistent threats)
- Allerton 2018 – session assistant (dynamic games); tutorial session assistant (real time optimization for estimation and control)
- ACC 2018 – volunteer

Reviewer

- ACM/IEEE International Conference on Cyber-Physical Systems
- ACM Transactions on Cyber-Physical Systems
- ACM Workshop on Moving Target Defense
- American Control Conference (ACC)
- Computers & Security
- Dynamics Games and Applications (Springer)
- IEEE Conference on Decision and Control (CDC)
- IEEE International Workshop on Signal Processing Advances in Wireless Communications
- IEEE Power & Energy Society General Meeting
- IEEE Transactions on Information Forensics & Security
- IEEE Transactions on Power Systems
- IEEE Transactions on Reliability
- IEEE/PES Transmission and Distribution Conference and Exposition
- Indian Control Conference (ICC)
- Springer/Birkhäuser
- Systems & Control Letters

Professional Membership

- Institute of Electrical and Electronics Engineers (IEEE)

Journal

- A. Zaman, **E. Miehling**, and T. Başar. Reinforcement Learning for Non-Stationary Discrete-Time Linear-Quadratic Mean-Field Games in Multiple Populations. *Dynamic Games and Applications*, vol. 13, no. 1, 2022.

- **E. Miehling** and D. Teneketzis. Monotonicity Properties for Two-Action Partially Observable Markov Decision Processes on Partially Ordered Spaces. *European Journal of Operational Research*, vol. 282, no. 3, pp. 936-944, 2019.

- **E. Miehling**, M. Rasouli and D. Teneketzis. A POMDP Approach to the Dynamic Defense of Large-Scale Cyber Networks. *IEEE Transactions on Information Forensics and Security*, vol. 13, no. 10, pp. 2490–2505, 2018.

- V. Krishnamurthy, R.R. Bitmead, M. Gevers, and **E. Miehling**. Sequential Detection with Mutual Information Stopping Cost. *IEEE Transactions on Signal Processing*, vol. 60, no. 2, pp. 700–714, 2012.

Conference & Workshop

- X. Bi, **E. Miehling**, C. Beck, T. Başar. Approximate Testing in Uncertain Epidemic Processes. In *Conference on Decision and Control (CDC 2022)*, pp. 4339-4344. IEEE, 2022.

- S. Y. Olmez, S. Aggarwal, J. W. Kim, **E. Miehling**, T. Başar, M. West, and P. G. Mehta. Modeling Presymptomatic Spread in Epidemics via Mean-Field Games. In *American Control Conference (ACC 2022)*, pp. 3648-3655. IEEE, 2022.

- M. H. de Badyn, **E. Miehling**, D. Janak, Behçet Açıkmeşe, Mehran Mesbahi, T. Başar, J. Lygeros, R. S. Smith. Discrete-Time Linear-Quadratic Regulation via Optimal Transport. In *Conference on Decision and Control (CDC 2021)*, pp. 3060-3065. IEEE, 2021.

- S. Y. Olmez, J. Mori, **E. Miehling**, T. Başar, R. L. Smith, M. West, and P. G. Mehta. A Data-Informed Approach for Analysis, Validation, and Identification of COVID-19 Models. In *American Control Conference (ACC 2021)*, pp. 3138-3144. IEEE, 2021.

- R. Dong, **E. Miehling**, and C. Langbort. Protecting Consumers Against Personalized Pricing: A Stopping Time Approach. Extended abstract in *The Symposium on Foundations of Responsible Computing (FORC 2020)*.

- W. Mao, K. Zhang, **E. Miehling**, and T. Başar. Information State Embedding in Partially Observable Cooperative Multi-Agent Reinforcement Learning. In *59th Conference on Decision and Control (CDC 2020)*, pp. 6124-6131. IEEE, 2020.

- A. Zaman, K. Zhang, **E. Miehling**, and T. Başar. Reinforcement Learning in Non-Stationary Discrete-Time Linear-Quadratic Mean-Field Games. In *59th Conference on Decision and Control (CDC 2020)*, pp. 2278-2284. IEEE, 2020.

- **E. Miehling**, C. Langbort, and T. Başar. Secure Contingency Prediction and Response for Cyber-Physical Systems. In *4th IEEE Conference on Control Technology and Applications (CCTA 2020)*, pp. 998-1003. IEEE, 2020.

- A. Zaman, K. Zhang, **E. Miehling**, and T. Başar. Approximate Equilibrium Computation for Discrete-Time Linear-Quadratic Mean-Field Games. In *American Control Conference (ACC)*, pp. 333-339. IEEE, 2020.

- X. Zhang, K. Zhang, **E. Miehling**, and T. Başar. Non-cooperative Inverse Reinforcement Learning. In *Advances in Neural Information Processing Systems (NeurIPS)*, pp. 9482-9493. 2019.

- **E. Miehling**, R. Dong, C. Langbort, and T. Başar. Strategic Inference with a Single Private Sample, In *58th Conference on Decision and Control (CDC)*, arXiv:1909.06057. IEEE, 2019.

- K. Zhang, **E. Miehling**, and T. Başar. Online Planning for Decentralized Stochastic Control with Partial History Sharing. In *American Control Conference (ACC)*, pp. 3544–3550. IEEE, 2019.

- **E. Miehling**, B. Xiao, R. Poovendran, and T. Başar. A Bayesian Multi-armed Bandit Approach for Identifying Human Vulnerabilities. In *Decision and Game Theory for Security (GameSec)*, pp. 521–539. Springer, 2018.

- **E. Miehling** and D. Teneketzis. A Decentralized Mechanism for Computing Competitive Equilibria in Deregulated Electricity Markets. In *American Control Conference (ACC)*, pp. 4107–4113. IEEE, 2016.

- **E. Miehling**, M. Rasouli, D. Teneketzis. Optimal Defense Policies for Partially Observable Spreading Processes on Bayesian Attack Graphs. In *Proceedings of the Second ACM Workshop on Moving Target Defense*, pp. 67–76. ACM, 2015.

- **E. Miehling** and D. Teneketzis. Multilateral Trades in Interconnected Power Systems: A Local Public Goods Approach. In *Proceedings of the 3rd International Conference on High Confidence Networked Systems*. ACM, 2014.

- M. Rasouli, **E. Miehling**, D. Teneketzis. A Supervisory Control Approach to Dynamic Cyber-Security. In *Decision and Game Theory for Security*, pp. 99–117. Springer, 2014.

Book Chapters

- **E. Miehling**, M. Rasouli, and D. Teneketzis. Control-Theoretic Approaches to Cyber-Security. In *Adversarial and Uncertain Reasoning for Adaptive Cyber Defense* (Sushil Jajodia, George Cybenko, Peng Liu, Cliff Wang, Michael Wellman; Editors), pp. 12–28. Springer/Birkhäuser, 2019.

- M. Rasouli, **E. Miehling**, D. Teneketzis. A Scalable Decomposition Method for the Dynamic Defense of Cyber Networks. In *Game Theory for Security Risk Management – From Theory to Practice* of *Static & Dynamic Game Theory: Foundations and Applications* (Tamer Başar, Series Editor), pp. 75–98. Springer/Birkhäuser, 2017.