

ERIK MIEHLING

mail: emiehling@gmail.com

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

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

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.

**coding
projects**

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

Analysis, Validation, and Identification of COVID-19 Models May 2020

<https://github.com/yagizolmez/Covid19>

- Aided in the development of statistical analysis and predictive modeling tools using epidemiological data (viral states) from 30 000+ people from the US, China, and South Korea.
- *Python packages:* pandas, datetime

**research
advising**

PhD students

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| ▪ 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

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| ▪ Danilo Dordevic (ETH Zürich, with M. Hudoba de Badyn): math finance | 2022 |
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teaching experience	University of Illinois at Urbana–Champaign	Urbana, IL
	ECE 486 - Control Systems, <i>Guest Lecturer</i>	Apr 2019
	University of Michigan, College of Engineering	Ann Arbor, MI
	EECS 215 - Introduction to Electronic Circuits, <i>Discussion Lecturer</i>	Winter 2013
	EECS 216 - Signals and Systems, <i>Laboratory Lecturer</i>	Fall 2012
internships	US Department of Energy, Oak Ridge National Laboratory	Oak Ridge, TN
	<i>Advanced Short-Term Research Opportunity</i>	May 2013 – Sept. 2013
	Defense Research & Development Canada, Radar Systems Group	Ottawa, ON
	<i>Summer Internship</i>	May 2010 – Sept. 2010
	Broadcom Canada, Centre for Audio Excellence	Richmond, BC
	<i>Summer Internship</i>	May 2008 – Sept. 2008
talks & presentations	“Mixed Signals: Information Disclosure in Persuasion, Security, and Value Alignment”	
	<i>IBM Research, Dublin, Ireland</i>	April 2022
	“Estimation, Modeling, and Active Testing of Uncertain Epidemic Processes”	
	<i>C3.ai Digital Transformation Institute Research Symposium, Miami, FL</i>	Mar 2022
	“Optimal Transport and Boundary-Constrained Control”	
	<i>Internet of Battlefield Things (IoBT) Research Presentation (remote)</i>	Feb 2022
	“Secure Contingency Prediction and Response for Cyber-Physical Systems”	
	<i>4th IEEE Conf. on Control Technology and Applications, Montreal, QC, Canada (remote)</i>	Aug 2020
	“Strategic Inference With a Single Private Sample”	
	<i>58th IEEE Conf. on Decision and Control, Nice, France</i>	Dec 2019
	“Optimal Switching Strategies for System Obfuscation”	
	<i>Internet of Battlefield Things (IoBT) Bootcamp, Chicago, IL</i>	Jul 2019
	“Online Planning for Decentralized Stochastic Control with Partial History Sharing”	
	<i>American Control Conf. (ACC) 2019, Philadelphia, PA</i>	Jul 2019
	“Strategic Inference Under Private Sampling”	
	<i>EC 2019 Workshop: Learning in the Presence of Strategic Behavior, Phoenix, AZ</i>	Jun 2019
	<i>8th Midwest Workshop on Control and Game Theory, St. Louis, MO</i>	Apr 2019
	“A Bayesian Multi-armed Bandit Approach for Identifying Human Vulnerabilities”	
	<i>Decision and Game Theory for Security (GameSec 2018)</i>	Oct 2018
	“Monotonicity Properties of Optimal Policies for POMDPs on Partially Ordered Spaces”	
	<i>Department of Electrical Engineering, University of Washington, Seattle, WA</i>	Apr 2018
	Host: Lillian Ratliff	
	<i>Stanford Intelligent Systems Laboratory Seminar, Stanford University</i>	Jan 2018
	Hosts: Katherine Driggs-Campbell, Mykel J Kochenderfer	
	“A Dependency Graph Formalism for the Dynamic Defense of Cyber Networks”	
	<i>5th IEEE Global Conf. on Signal and Information Processing (GlobalSIP 2017)</i>	Nov 2017
	“A Stochastic Control Approach to Dynamic Defense of Large-Scale Cyber Networks”	
	<i>ECE Systems & Control Seminar, University of New Mexico</i>	Nov 2017
	Host: Meeko Oishi	
	“A Dependency Graph Formalism for the Dynamic Defense of Large-Scale Cyber Networks”	
	<i>3rd Multidiscip. Conf. on Reinforcement Learning & Decision Making (RLDM 2017)</i>	Jun 2017
	“A Decentralized Mechanism for Computing Competitive Equilibria in Deregulated Electricity Markets”	
	<i>American Control Conf. (ACC 2016)</i>	Jul 2016
	“A Formal Model for the Dynamic Defense of Cyber Networks”	

academic
service

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)

publications

Journal

- A. Zaman, E. Miehling, and T. Başar. Reinforcement Learning for Non-Stationary Discrete-Time Linear-Quadratic Mean-Field Games in Multiple Populations. Under review at *Dynamic Games and Applications*, 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 Spread-ing 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.
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