Omar Mrani-Zentar, MSc

PhD Candidate, Applied Mathematics
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Research Interests

- **Stochastic control:** robustness and learning in complex systems
- **Machine learning:** reinforcement learning, data-driven control and learning, adaptive control
- **Decentralized stochastic control:** multi-agent problems with partial information and information structures
- **Probability theory and applications:** kernel topologies, non-linear filter stability in multi-agent systems

Education

Queen's University 2022–Present
PhD in Applied Mathematics (Supervisor: Prof. Serdar Yüksel)
Research in stochastic control, probability, and reinforcement learning.

University of British Columbia 2017–2019
MSc in Mathematics
Thesis: *Low-dimensional Lie algebras and control theory.*

University of British Columbia 2013–2017
BSc in Honours Mathematics, Minor in Commerce

Publications

Articles Published in Peer-Reviewed Journals

[1] **Mrani-Zentar, O.**, & Yüksel, S. (2026). Approximations and learning for decentralized stochastic control and near optimal finite window policies. Under second review at *IEEE Transactions on Automatic Control*. arXiv:2605.00160

[2] Bluman, G. W., **Mrani-Zentar, O.**, & Finlay, D. (2018). Composition of Lie Group Elements from Basis Lie Algebra Elements. *Journal of Nonlinear Mathematical Physics*, 25(4), 528–557. doi:10.1080/14029251.2018.1503398

Articles Under Revision in Peer-Reviewed Journals

[3] **Mrani-Zentar, O.**, & Yüksel, S. (2026). Kernel Metrics and Learning for Borel MDPs: Identifiability and Adaptive Control. Under second review at *SIAM Journal on Control and Optimization*. arXiv:2503.11058

[4] **Mrani-Zentar, O.**, Simpson, R., et al. (2025). Non-sequential decentralized stochastic control revisited: Causality and static reducibility. Under revision at *IEEE Transactions on Automatic Control*. arXiv:2211.03949

Conference Proceedings (Peer-Reviewed)

[5] **Mrani-Zentar, O.**, & Yüksel, S. (2024). Decentralized stochastic control in Borel spaces: Centralized MDP reductions, near optimality of finite window local information, and Q-learning. In *Proceedings of the 63rd IEEE Conference on Decision and Control (CDC)*, pp. 8435–8440, Milan, Italy, December 16–19, 2024. IEEE. IEEE Xplore

Preprints

[6] **Mrani-Zentar, O.**, & Yüksel, S. (2025). Centralized reduction of decentralized stochastic control models and their weak-Feller regularity. arXiv:2408.13828

Thesis

[7] **Mrani-Zentar, O.** (2019). *Low-dimensional Lie algebras and control theory* (Master's thesis). University of British Columbia. UBC Library

Talks and Presentations

Conference and Workshop Presentations

- **Mrani-Zentar, O.** (2025, May). Existence, Approximations, and Q-learning for Decentralized Stochastic Control with Standard Borel Spaces. *10th Meeting on System and Control Theory (MSCT)*, HEC Montréal, Montréal, Québec, Canada, May 7–9, 2025. Poster presentation.
- **Mrani-Zentar, O.** (2024, December). Decentralized stochastic control in Borel spaces: Centralized MDP reductions, near optimality of finite window local information, and Q-learning. *63rd IEEE Conference on Decision and Control (CDC)*, Milan, Italy. Oral presentation.
- **Mrani-Zentar, O.** (2024, December). Learning and Approximations for Multi-Agent Team Problems with Borel Spaces under Decentralized Information. *Large Population Teams: Control, Equilibria & Learning*, 2024 CDC full-day workshop. Oral presentation.

Seminar Talks

- **Mrani-Zentar, O.** (2026, September). Data-Driven Empirical and Bayesian Learning for Control of MDPs with Borel Spaces: Identifiability and Near Optimal Design. *Stochastic control and related fields seminar*, Queen's University.
- **Mrani-Zentar, O.** (2026, May). Lift, Metrize, Quantize, and Learn: A framework for learning in complex stochastic control problems. *Stochastic control and related fields seminar*, Queen's University.
- **Mrani-Zentar, O.** (2025, November). White noise representation of stochastic processes. *Stochastic control and related fields seminar*, Queen's University.
- **Mrani-Zentar, O.** (2025, October). Non-sequential decentralized stochastic control: Causality and static reducibility. *Stochastic control and related fields seminar*, Queen's University.
- **Mrani-Zentar, O.** (2025, June). Existence and finite memory approximations in decentralized stochastic control without information sharing among agents. *Stochastic control and related fields seminar*, Queen's University.
- **Mrani-Zentar, O.** (2025, May). Q-learning for POMDPs with compression of the history process. *Stochastic control and related fields seminar*, Queen's University.
- **Mrani-Zentar, O.** (2025, April). On near optimality of stationary and finite memory policies in decentralized stochastic control. *Stochastic control and related fields seminar*, Queen's University.

- **Mrani-Zentar, O.** (2025, January). Topologies on kernels, their approximations and learning, and optimal adaptive control. *Stochastic control and related fields seminar*, Queen's University.
- **Mrani-Zentar, O.** (2024, November). Data-driven non-parametric model learning and adaptive control of MDPs with Borel spaces: Identifiability and near optimal design. *Stochastic control and related fields seminar*, Queen's University.
- **Mrani-Zentar, O.** (2024, October). Decentralized stochastic control in standard Borel spaces: Centralized MDP reductions and near optimality of finite window local agent information. *Stochastic control and related fields seminar*, Queen's University.
- **Mrani-Zentar, O.** (2024, July). Continuity of the optimal cost in the transition kernel for average reward problems. *Stochastic control and related fields seminar*, Queen's University.
- **Mrani-Zentar, O.** (2024, May). An overview of alternatives to the standard Q-learning algorithm. *Stochastic control and related fields seminar*, Queen's University.
- **Mrani-Zentar, O.** (2024, March). Finite memory approximations and quantized Q-learning for decentralized stochastic team problems. *Stochastic control and related fields seminar*, Queen's University.
- **Mrani-Zentar, O.** (2023, November). Decentralized stochastic control with delayed and periodic information sharing. *Stochastic control and related fields seminar*, Queen's University.
- **Mrani-Zentar, O.** (2023, March). Applications of Lie theory to control theory. *Dynamics seminar*, Queen's University.

Teaching Experience

Queen's University, Kingston, ON

Instructor Winter 2026
MATH/MTHE 337: Introduction to Stochastic Operations Research

- Sole instructor for an undergraduate course covering optimization, Markov chains, continuous-time Markov chains, queueing models, and Markov decision processes with applications to operations research.
- Prepared and delivered lectures; developed course notes, examples, assignments, quizzes, and examinations.
- Incorporated computational examples and applications to illustrate mathematical concepts and methods.
- Held office hours, provided individual assistance, and graded with written feedback on students' mathematical reasoning.

Teaching Assistant Sept 2022–Present
Undergraduate mathematics and statistics courses

- Led tutorials and problem-solving sessions and assisted students with course materials.
- Graded assignments and examinations and provided written feedback.

University of British Columbia, Vancouver, BC

Teaching Assistant Sept 2016–May 2019
Mathematics Learning Centre

- Facilitated mathematics workshops and provided academic support to more than 200 students.
- Assisted students with calculus, linear algebra, differential equations, and probability.

- Provided individual and small-group instruction, adapting explanations to different levels of preparation.

Mathematics Tutor Jan 2021–Present
Undergraduate and high school students

- Tutor students in calculus, linear algebra, probability, ordinary and partial differential equations, stochastic processes, and applied mathematics.

Research Experience

Research Assistant Sept 2022–Present
Queen's University, Kingston, ON

- Conduct research in stochastic control, probability, reinforcement learning, and decentralized decision-making.
- Develop mathematical and computational methods for modeling, optimization, and learning in stochastic systems.

Research Assistant May 2016–July 2019
University of British Columbia, Vancouver, BC

- Conducted research in control theory and mathematical modeling; co-authored a peer-reviewed journal article.

Awards and Honors

- Frank E. Smith Fellowship
- UBC Faculty of Science Graduate Student Award
- Dean's Honour List (multiple years)
- Golden Key International Honour Society

Technical Skills

- **Mathematics:** probability, statistics, stochastic processes, optimization, operations research, Markov chains, queueing theory, Markov decision processes, linear algebra, calculus, differential equations
- **Programming:** MATLAB, Python, R, Java, C++
- **Software:** LaTeX, Linux/Unix, Git, Bash

Service to the Community

Peer Review

- **Journals:** *SIAM Journal on Control and Optimization*; *Systems & Control Letters*; *IEEE Transactions on Automatic Control*; *Journal of Computational and Applied Mathematics*
- **Conferences:** IEEE Conference on Decision and Control (CDC); American Control Conference (ACC); International Symposium on Mathematical Theory of Networks and Systems (MTNS)