

Nathan Lawrence

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Education

- 2023 **Ph.D. in Mathematics**, *The University of British Columbia*
Thesis: *Deep reinforcement learning agents for industrial control system design*
Advisors: Philip Loewen, Bhushan Gopaluni
- 2018 **M.S. in Mathematics**, *Portland State University*
- 2016 **B.A. in Mathematics**, *Portland State University Honors College*
summa cum laude

Employment

- 2025-present **Reinforcement Learning Engineer (consulting)**, *Hammerhead AI*, Redwood City, CA
- 2024-present **Postdoctoral Scholar**, *Chemical & Biomolecular Engineering*, UC Berkeley
- 2023-2024 **Postdoctoral Research Fellow**, *Mathematics*, UBC

Publications

Click title for arXiv preprint.

[[Google Scholar](#)]

Preprints

1. Why Goal-Conditioned Reinforcement Learning Works: Relation to Dual Control
Nathan P. Lawrence and Ali Mesbah
arXiv (Submitted to IFAC World Congress) 2025

Peer Reviewed Journal Articles

1. A View on Learning Robust Goal-Conditioned Value Functions: Interplay between RL and MPC
Nathan P. Lawrence, Philip D. Loewen, Michael G. Forbes, R. Bhushan Gopaluni, and Ali Mesbah
Annual Reviews in Control 2025
2. Machine learning for industrial sensing and control: A survey and practical perspective
Nathan Lawrence, Seshu Kumar Damarla, Jong Woo Kim, Aditya Tulsyan, Faraz Amjad, Kai Wang, Benoit Chachuat, Jong Min Lee, Biao Huang, and Bhushan Gopaluni
Control Engineering Practice 2024
3. Stabilizing reinforcement learning control: A modular framework for optimizing over all stable behavior
Nathan Lawrence, Philip Loewen, Shuyuan Wang, Michael Forbes, and Bhushan Gopaluni
Automatica 2024

4. Automated deep reinforcement learning for real-time scheduling strategy of multi-energy system integrated with post-carbon and direct-air carbon captured system
Tobi Michael Alabi, **Nathan Lawrence**, Lin Lu, Zaiyue Yang, and Bhushan Gopaluni
Applied Energy 2023
5. Meta-reinforcement learning for the tuning of PI controllers: An offline approach
Daniel McClement, **Nathan Lawrence**, Johan Backström, Philip Loewen, Michael Forbes, and Bhushan Gopaluni
Journal of Process Control 2022
6. Deep reinforcement learning with shallow controllers: An experimental application to PID tuning
Nathan Lawrence, Michael Forbes, Philip Loewen, Daniel McClement, Johan Backström, and Bhushan Gopaluni
Control Engineering Practice 2022
7. Toward self-driving processes: A deep reinforcement learning approach to control
Steven Spielberg, Aditya Tulsyan, **Nathan Lawrence**, Philip Loewen, and Bhushan Gopaluni
AIChE Journal 2019

Peer Reviewed Conference Proceedings

1. Local-Global Learning of Interpretable Control Policies: The Interface between MPC and Reinforcement Learning
Thomas Banker, **Nathan P. Lawrence**, and Ali Mesbah
American Control Conference 2025
2. MPCritic: A Plug-and-Play MPC Architecture for Reinforcement Learning
Nathan P. Lawrence, Thomas Banker, and Ali Mesbah
Conference on Decision and Control 2025
3. Deep Hankel matrices with random elements
Nathan Lawrence, Philip Loewen, Shuyuan Wang, Michael Forbes, and Bhushan Gopaluni
Learning for Dynamics & Control Conference 2024
4. Guiding Reinforcement Learning with Incomplete System Dynamics
Shuyuan Wang, Jingliang Duan, **Nathan P Lawrence**, Philip D Loewen, Michael G Forbes, R Bhushan Gopaluni, and Lixian Zhang
IROS 2024
5. A modular framework for stabilizing deep reinforcement learning control
Nathan Lawrence, Philip Loewen, Shuyuan Wang, Michael Forbes, and Bhushan Gopaluni
IFAC World Congress 2023
6. Reinforcement learning with partial parametric model knowledge
Shuyuan Wang, Philip Loewen, **Nathan Lawrence**, Michael Forbes, and Bhushan Gopaluni
IFAC World Congress 2023
7. Meta-reinforcement learning for adaptive control of second order systems
Daniel McClement, **Nathan Lawrence**, Michael Forbes, Philip Loewen, Johan Backström, and Bhushan Gopaluni
IEEE International Symposium on Advanced Control of Industrial Processes 2022
8. A meta-reinforcement learning approach to process control
Daniel McClement, **Nathan Lawrence**, Philip Loewen, Michael Forbes, Johan Backström, and Bhushan Gopaluni
IFAC Symposium on Advanced Control of Chemical Processes 2021 (Keynote)

9. Almost surely stable deep dynamics
Nathan Lawrence, Philip Loewen, Michael Forbes, Johan Backström, and Bhushan Gopaluni
NeurIPS 2020 ([Spotlight](#))
10. Optimal PID and antiwindup control design as a reinforcement learning problem
Nathan Lawrence, Gregory Stewart, Philip Loewen, Michael Forbes, Johan Backström, and Bhushan Gopaluni
IFAC World Congress 2020
11. Modern machine learning tools for monitoring and control of industrial processes: A survey
Bhushan Gopaluni, Aditya Tulsyan, Benoit Chachuat, Biao Huang, Jong Min Lee, Faraz Amjad, Seshu Kumar Damarla, Jong Woo Kim, and **Nathan Lawrence**
IFAC World Congress 2020
12. Reinforcement learning based design of linear fixed structure controllers
Nathan Lawrence, Gregory Stewart, Philip Loewen, Michael Forbes, Johan Backström, and Bhushan Gopaluni
IFAC World Congress 2020

Patents

1. Application of simple random search approach for reinforcement learning to controller tuning parameters
Nathan Lawrence, Philip Loewen, Bhushan Gopaluni, and Gregory Stewart
US Patent 11,307,562 2022
2. Method and system for directly tuning PID parameters using a simplified actor-critic approach to reinforcement learning
Nathan Lawrence, Philip Loewen, Bhushan Gopaluni, and Gregory Stewart
US Patent 11,500,337 2022
3. Process controller with meta-reinforcement learning
Daniel McClement, **Nathan Lawrence**, Philip Loewen, Bhushan Gopaluni, Michael Forbes, and Johan Backström
US Patent App. 17/653,175 2022

Theses

1. Deep reinforcement learning agents for industrial control system design
Nathan Lawrence
The University of British Columbia 2023
2. Convex and nonconvex optimization techniques for the constrained Fermat-Torricelli problem
Nathan Lawrence
Portland State University 2016

Honors & Awards

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| 2022 | Graduate Research Award – Applied mathematics
Doctoral; UBC mathematics departmental award |
| 2022 | FIPSE Graduate Student Participation Award
1 of 5 graduate students invited to attend Future Innovations in Process Systems Engineering in Crete, Greece |
| 2020–2023 | Alexander Graham Bell Canada Graduate Scholarship
Doctoral; National scholarship awarded by NSERC; Ranked 5th of 107 |

2017 F.S. Cater Prize
Master's; Departmental scholarship at PSU

Talks

Invited

- 2024 \A reinforcement learning perspective on industrial model predictive control"
Upper Bound, Edmonton
- 2023 \Deep reinforcement learning agents for industrial control"
Math department colloquium, UBC
- 2021 \How to make a professional website"
Workshop fascilitator, Institute of Applied Mathematics, UBC

Organizer

- 2025 \Learning Interpretable Control Policies: Unifying Reinforcement Learning, Di erentiable Program-
ming and Bayesian Optimization"
Tutorial session, ACC, Denver, CO
- 2022 \Making reinforcement learning a practical technology for industrial control"
Workshop organizer, AdCONIP, Vancouver, BC

Conference

- 2025 \Local-global interface of reinforcement learning and model predictive control"
NorCal Control Workshop, UC Davis
- 2024 \Stability-by-design for industrial reinforcement learning"
TrustML Workshop, UBC
- 2023 \A modular framework for stabilizing deep reinforcement learning control"
SIAM PNW biennial meeting, Western Washington University, Bellingham, WA
- 2023 \A modular framework for stabilizing deep reinforcement learning control"
IFAC World Congress, Yokohama, Japan
- 2022 \Reinforcement learning for maintenance-free control"
Canadian Society for Chemical Engineering annual event, Vancouver, BC
- 2022 \Deep reinforcement learning for real-world control"
Institute of Applied Mathematics retreat, UBC
- 2022 \Reinforcement learning for maintenance-free control"
Systems and Control Webinar (remote)
- 2020 \Almost surely stable deep dynamics"
NeurIPS Spotlight, Vancouver, BC (remote)
- 2020 \Reinforcement learning based PID tuning"
BC Universities Systems and Control Meeting, University of Victoria (remote)
- 2020 \Reinforcement learning based design of linear xed-structure controllers"
IFAC World Congress, Berlin, Germany (remote)
- 2020 \Optimal PID and antiwindup control design as a reinforcement learning problem"
IFAC World Congress, Berlin, Germany (remote)

Teaching

Instructor of Record

Intermediate algebra

Winter 2018

Introductory College Mathematics II

Fall 2016, Winter 2017

Calculus II

Summer 2017, Spring 2018

Calculus III

Spring 2017, Fall 2017

Mentor

UBC:

Daniel McClement

M.Sc. 2020-2022

Kenekukwu Ene

B.Sc. 2022

Leo Wei, James Penfold, Aniket
Chakraborty, Farbod Chamanian

B.Sc. 2020

Related Experience

2018-2019 Teaching Assistant, Department of Mathematics, UBC

2018-2019 Mathematics tutor, The Math Learning Centre, UBC

2014-2016 Mathematics tutor, The Learning Center, PSU

Research Experience

2018-2023 **Graduate Research Assistant**, UBC, with Philip Loewen, Bhushan Gopaluni
Deep reinforcement learning, industrial process control
R&D with Honeywell Process Solutions

2018 **Research Assistant**, PSU, with Gerardo Lafferriere
Urban traffic simulation, networked control systems

2017-2018 **Research Assistant**, PSU, with Dacian Daescu
Low-dimensional characterization of human faces from gappy data

2015-2016 **Research Assistant**, PSU, with Mau Nam Nguyen
Convex analysis and optimization

Professional Activities

Reviewing: Automatica, Computers & Chemical Engineering, Scientific Reports, Control Engineering Practice, IEEE, IFAC

Member: Society for Industrial and Applied Mathematics (SIAM)

2020-2021 Organizer: DAIS research lab

2017-2018 Vice-president: SIAM, PSU Chapter

Skills

Programming: Python, Julia

Frameworks: PyTorch, TensorFlow, Stable-Baselines3, Spinning Up, Pandas, SciPy, Flux.jl, ReinforcementLearning.jl

Tools: Matlab, git, LaTeX

References

Ali Mesbah



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Philip Loewen



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Bhushan Gopaluni



✉ bhushan.gopaluni@ubc.ca

Michael Forbes



✉ Michael.Forbes@Honeywell.com