Ryley McConkey PhD, P.Eng. rmcconke@mit.edu

Google Scholar | Personal Website | LinkedIn

EDUCATION

2020–2024 **PhD in Mechanical and Mechatronics Engineering**
University of Waterloo, Canada
Thesis: Machine Learning Methods for Turbulence Closure Modelling (link)
Supervisors: Fue-Sang Lien, Eugene Yee

2022 (6 months) **Visiting PhD Student**
University of Manchester, UK
Project: Machine Learning-Augmented Simulation of Massively Separated 3D Flows
Supervisors: Alistair Revell, Alex Skillen

2019–2020 **Master of Applied Science in Mechanical Engineering** (direct transfer to PhD)
University of Waterloo, Canada
Thesis: Numerical Simulation of Turbulent Vortex-Induced Vibration
Supervisors: Fue-Sang Lien, William Melek

2014–2019 **Bachelor of Science in Mechanical Engineering (Co-op Program) with Distinction**
University of Alberta, Canada
Cumulative GPA of 3.9/4.0; ranked 4th of 229

RESEARCH INTERESTS

- Computational fluid dynamics
- Fluid mechanics, aerodynamics, and geophysical fluid dynamics
- Machine learning for computational fluid dynamics and turbulence modelling

RESEARCH AND PROFESSIONAL EXPERIENCE

2024–Present **Postdoctoral Fellow, Massachusetts Institute of Technology**
PI: Tess Smidt
- Designing equivariance-preserving machine learning architectures for various problems in physics, with a focus on fluid mechanics
- Implementing machine learning pipeline for massive 27 TB ocean dataset on HPC system
- Working with various differentiable Python-based CFD simulation codes
- Utilizing models for numerical simulations in ocean modelling, turbulence modelling, and aerodynamics
- Multidisciplinary collaborations with researchers in atmospheric science, aerospace, materials science, and computer science

2023 (4 months) **Research Scientist, Rowan Williams Davies Irwin (RWDI) Consulting**
- 4-month internship at a major Canadian wind engineering firm focused on applying techniques from PhD to real-world simulation problems
- Successfully adapted academic techniques to work with “real-world” data
- Implemented custom OpenFOAM (C++) solver to interact with Python-based machine learning pipeline
- Communicated research results and complex techniques to various audiences

2020–2024 **Doctoral Researcher, University of Waterloo**

- Focused primarily on using machine learning models to replace traditional eddy viscosity models in RANS simulations
- Implemented end-to-end data handling and machine learning pipeline, including data generation from numerical simulation, preprocessing, model training, hyperparameter optimization, and evaluations on high-performance GPU computing systems.
- Substantially modified OpenFOAM turbulence models and solver codes to incorporate machine learning model predictions
- Expanded knowledge through supplementary projects including Bayesian optimization to calibrate RANS model coefficients (turbo-RANS), simulation of ice accretion on an aircraft, aeroacoustics of vortex-induced vibration, unsupervised learning for clustering wake flow patterns, and small nuclear reactor (SMR) modelling using a 1D systems code

2021–2022 **Software Developer, RWDI/Orbital Stack**

- Utilized automated simulation workflows with custom OpenFOAM-based wind engineering scripts
- Proposed and demonstrated new machine learning algorithms within existing service lines, including flow field reconstruction from experimental measurements, building energy usage estimation, and experimental data augmentation
- Led evaluation and testing of a new machine learning based service line (Orbital Stack AI), which is a surrogate model for traditional CFD simulation

2019–2021 **Simulation and Design Engineer, MACH32**

- Designed lifesaving autoinjectors for in-situ emergency trauma treatment
- Conducted several engineering analyses of design components using CFD
- Rapidly invented a new negative-pressure containment device as a response to hospital staff needs during the COVID-19 pandemic
- Applied for two currently pending patents covering design novelties

2019–2020 **Masters Researcher, University of Waterloo**

- Analyzed and optimized performance of a wind energy harvesting device based on extracting power from vortex-induced vibrations
- Utilized open-source computational fluid dynamics (CFD) software OpenFOAM extensively, including implementing new time-integration schemes into a fluid-structure interaction (FSI) solvers
- Employed numerous CFD techniques for FSI, including deforming mesh, overset mesh, and immersed boundary method

2017–2018 (12 months) **Turnaround Co-op Student, Imperial Oil**

- Conducted engineering analyses, managed fabrication of new equipment, and developed mechanical and piping repair specifications for 2018 Spring Turnaround
- Created drawings and designs for piping modifications, welding repairs, and alterations to pressure vessels

2018–2019 **Undergraduate Researcher,** University of Alberta

- Used STAR-CCM+ to simulate flow over an airfoil to predict lift and drag in ground effect

2016–2017 (8 months) **Project Management Co-op Student, Enbridge Pipelines**

- Analyzed cost, risk, and code compliance for large pipeline projects

2016 **Undergraduate Researcher,** University of Alberta

- Studied welding heat transfer by comparing theoretical predictions to experimental results from a FANUC welding robot

TEACHING EXPERIENCE AND DEVELOPMENT

2025 **Kaufman Teaching Certificate Program,** Massachusetts Institute of Technology

Winter 2024 **Sessional Instructor,** University of Waterloo
ME 351: Fluid Mechanics (97 Students)
- Managed a team of 3 teaching assistants to deliver core engineering science class
- Redesigned course tutorials and project to incorporate group-based and experiential learning activities
- Proposed and organized field trip to external experimental facility
- Developed teaching skills by attending CEEA *Institute for Engineering Teaching*
- Achieved a **mean instructor rating of 4.9/5.0** (56 student responses)

2024 **Institute for Engineering Teaching Program,** Canadian Engineering Education Association (affiliated with Canadian Engineering Accreditation Board)

2023 **Teaching Assistant**, University of Waterloo (MTE 202: Ordinary Differential Equations)

2022 **Teaching Assistant**, University of Waterloo (MTE 202: Ordinary Differential Equations)

2021 **Fundamentals of University Teaching Program**, University of Waterloo

2021 **Teaching Assistant**, University of Waterloo (ME 564: Aerodynamics)

2020 **Teaching Assistant**, University of Waterloo (ME 564: Aerodynamics)

RESEARCH SUPERVISION AND MENTORSHIP

2024 Massachusetts Institute of Technology
- **Certificate in Research Mentorship**
- **4 Undergraduate Research Projects:**
  - Equivariant machine learning of stochastic subgrid scale closure models for quasi-geostrophic ocean flows
  - Investigating implicit data augmentation in 3D isotropic and anisotropic turbulence (summer internship)
  - Superresolution of 2D turbulence with equivariance as an inductive bias
  - Stochastic rounding for Lattice Boltzmann Method simulations with single precision floating point representations

2023 University of Manchester
- **2 Undergraduate students**: Machine learning-based correction of discretization errors in Rayleigh-Bernard convection

2020 University of Waterloo
- **Capstone Design Team**: Designing a vortex-induced vibration energy harvester

PUBLICATIONS

PREPRINTS

[1] N. Kalia**, R. McConkey**, E. Yee, F. S. Lien, “Bayesian Optimization of the GEKO Turbulence Model for Predicting Flow Separation over a Smooth Surface,” arXiv, ID: 2502.11218 (2025). Link: https://arxiv.org/abs/2502.11218

PEER-REVIEWED JOURNAL ARTICLES

[9] **R. McConkey,** N. Kalia, E. Yee, F. S. Lien, “Realisability-Informed Machine Learning for Turbulence Anisotropy Mappings,” *Journal of Fluid Mechanics*, 1019:A49 (2025).

[8] N. Kalia**, R. McConkey**, E. Yee, F. S. Lien, “Kolmogorov-Arnold Networks for Turbulence Anisotropy Mapping,” *Physics of Fluids* 37, 085140 (2025).

[7] **R. McConkey**, N. Kalia, E. Yee, F. S. Lien, “Turbo-RANS: Straightforward and Efficient Bayesian Optimization of Turbulence Model Coefficients,” *International Journal of Numerical Methods for Heat and Fluid Flow* Vol. Vol. 34 No. 8, pp. 2986-3016 (2024).

[6] **R. McConkey**, E. Yee, F. S. Lien, “On the Generalizability of Machine-Learning-Assisted Anisotropy Mappings for Predictive Turbulence Modelling,” *International Journal of Computational Fluid Dynamics* 36, 555-577 (2023).

[5] Z. Cheng, **R. McConkey**, E. Yee, F. S. Lien, “Numerical investigation of noise suppression and amplification in forced oscillations of single and tandem cylinders in high Reynolds number turbulent flows,” *Applied Mathematical Modelling* 117, 652-686 (2023).

[4] M. Cann, **R. McConkey**, F. S. Lien, W. Melek, E. Yee “A Data-Driven Approach for Generating Vortex-Shedding Regime Maps for an Oscillating Cylinder,” *Energies* 16 (2023).

[3] **R. McConkey**, E. Yee, F. S. Lien, “Deep Structured Neural Networks for Turbulence Closure Modelling,” *Physics of Fluids* 34, 035110 (2022).

[2] Y. Wu, Z. Cheng, **R. McConkey**, E. Yee, F. S. Lien, “Modelling of flow-induced vibration of bluff bodies: A comprehensive survey and future prospects,” *Energies* 15 (2022).

[1] **R. McConkey**, E. Yee, F. S. Lien, “A curated dataset for data-driven turbulence modelling,” *Nature: Scientific Data* 8, 1-14 (2021).

PATENTS

[2] M. Curial, C.Terriff, W. Comeau, W. Comeau, **R. McConkey** (2022) “Devices, systems and methods for medicament delivery.” World Intellectual Property Organization, No. WO2023077225A1

[1] M. Curial, C.Terriff, W. Comeau, W. Comeau, **R. McConkey** (2020) “Devices, systems and methods for medicament delivery.” World Intellectual Property Organization, No. WO2021087607A1.

PATENTS PENDING

[3] M. Curial, C. Terriff, W. Comeau, **R. McConkey** (2022) “Devices, Systems and Methods for Medicament Delivery.” U.S. Patent. No. US-20220370718-A1.

[2] M. Curial, C. Terriff, W. Comeau, **R. McConkey** (2022) “Portable Negative Pressure Isolation Unit.” U.S. Patent. No. US-20220104982-A1.

[1] M. Curial, C.Terriff, W. Comeau, B. Koravankudi, W. Comeau, **R. McConkey** (2022) “IMSAFE: A Novel Large-Volume Intramuscular Autoinjector.” World Intellectual Property Organization, PCT No. PCT/CA2022/050057.

INVITED TALKS

[3] **R. McConkey**, A. Backour, J. Balla, E. Hofgard, J. Nigam, T. Smidt, “Rotational equivariance as an inductive bias in machine learning for fluids,” in *Data Science and Artificial Intelligence Seminar Series*, Chalmers University of Technology (2025).

[2] **R. McConkey**, “Turbulence modelling using machine learning: key challenges and recent progress,” in *Modelling and Simulation Seminar Series*, University of Manchester (2022).

[1] **R. McConkey**, “Hands-on data-driven turbulence modelling with PyTorch,” in *Modelling and Simulation Seminar Series*, University of Manchester (2022).

CONFERENCE PAPERS, POSTERS, AND PRESENTATIONS

[13] J. Balla, J. Bailey, A. Backour, E. Hofgard, T. Jaakkola, T. Smidt, **R. McConkey** (presenter), “Implicit Augmentation from Distributional Symmetry in Turbulence Super-Resolution”, in *Machine Learning and the Physical Sciences, NeurIPS*, San Diego, USA (2025).

[12] **R. McConkey** (presenter), J. Balla, E. Hofgard, T. Smidt, “Equivariant Machine Learning of Sub-Grid Scale Closure Models for Large Eddy Simulation”, in *APS Division of Fluid Dynamics Annual Meeting*, Houston, USA (2025).

[11] **R. McConkey** (presenter), S. Peng, S. Snider, S. Silvestri, T. Smidt, A. Bodner, “Multi-Scale Ocean Turbulence with Euclidean Neural Networks,” in Gordon Research Conference: *Machine Learning for Actionable Climate Science*, Rhode Island, USA (2025).

[10] **R. McConkey** (presenter), A. Backour, J. Balla, E. Hofgard, J. Nigam, T. Smidt, “The role of local rotational symmetries and equivariance in data-driven fluid mechanics,” in *33rd Annual Conference of the Computational Fluid Dynamics Society of Canada*, Montreal, Canada (2025)

[9] **R. McConkey** (presenter), A. Backour, J. Balla, E. Hofgard, J. Nigam, T. Smidt, “On rotational equivariance as an inductive bias in machine learning for fluids,” in *ERCOFTAC Workshop on Data-Driven Fluid Mechanics*, London, UK (2025).

[8] F. S. Lien, E. Yee, D. Orchard, C. Li, Z. Cheng, Y. Wu, H. H. Huang, **R. McConkey** (presenter), J. Wang, L. H. Chen, J. Yi, N. Kalia, “Development of a Simulation Environment for the Assessment of Urban Air Mobility Vehicles: Energy Efficiency, Noise, and Icing,” in *Sustainable Aeronautics Summit of the Waterloo Institute for Sustainable Aeronautics*, Waterloo, Canada (2023)

[7] **R. McConkey** (presenter), A. Mole, A. Skillen, A. Revell, E. Yee, F. S. Lien, “Machine Learning Augmented Turbulence Modelling for Massively Separated Three-Dimensional Flows,” in *Computational Fluids Conference*, Cannes, France (2023).

[6] **R. McConkey**, A. Mole (presenter), A. Skillen, A. Revell, E. Yee, F. S. Lien, “XGBoost-augmented RANS closure modelling of complex 3D flows,” in *Workshop: Data-Driven Methods for Fluid Mechanics at the Leeds Institute for Fluid Dynamics*, Leeds, UK (2023).

[5] **R. McConkey**, E. Yee, F.S. Lien “Deep Learning-Based Turbulence Closure with Improved Optimal Eddy Viscosity Prediction,” *Proceedings of the 29th Annual Conference of the Computational Fluid Dynamics Society of Canada* (2021).

[4] M. Cann, **R. McConkey**, F.S. Lien, W. Melek, E. Yee, “Mode classification for vortex shedding from an oscillating wind turbine using machine learning,” *Journal of Physics: Conference Series* 2141(1) (2021).

[3] **R. McConkey**, L. Long, A. Komrakova, J. G. Wong, “Evaluation of RANS Turbulence Models and Boundary Conditions for CFD Simulations of a Finite Wing in Ground Effect,” in *Okanagan Fluid Dynamics Meeting*, Canmore, Alberta (2019).

[2] **R. McConkey** (presenter), L. Long, A. Komrakova, J. G. Wong, “3D Simulations of a Finite Wing in Ground Effect,” in *Undergraduate Research Symposium*, University of Alberta (2019).

[1] **R. McConkey** (presenter), L. Long, A. Komrakova, J. G. Wong, “Simulations of a 2D NACA 0012 airfoil in Ground Effect,” in *Undergraduate Research Symposium*, University of Alberta (2018).

AWARDS

2024–2026 NSERC Postdoctoral Fellowship

2023 Mitacs Accelerate Research Internship Award

2022–2025 NSERC Postgraduate Scholarship (Doctoral)

2020–2024 University of Waterloo President's Graduate Scholarship

2022 Ontario Graduate Scholarship (offered but declined)

2021 Best Student Paper at Computational Fluid Dynamics Society of Canada Annual Conference

2021 Computational Fluid Dynamics Society of Canada Graduate Scholarship

2021 Mitacs Globalink Research Award - UK Research and Innovation

2020–2022 Ontario Graduate Scholarship

2019 Tyler Lewis Clean Energy Research Foundation Grant

2019 University of Waterloo Engineering Dean's Entrance Award

2019 University of Alberta Dean's Research Award for Undergraduate Research

2019 University of Alberta Engineering Economics in Design Award for Capstone Project

2018 University of Alberta Undergraduate Research Conference: "Student's Choice" Award

2016 University of Alberta Green and Gold Student Leadership & Professional Development Grant

2016 University of Alberta Dean's Research Award for Undergraduate Research

2014–2017 University of Alberta Jason Lang Scholarship

ACADEMIC SERVICE

PEER REVIEW ACTIVITY (2022–Present)

Journal of Fluid Mechanics (1 article)
Physical Review Fluids (1 article)
Nature Machine Intelligence (1 article)
Physics of Fluids (5 articles)
Computers and Fluids (2 articles)
International Journal of Heat and Fluid Flow (1 article)
International Journal of Computational Fluid Dynamics (1 article)
Aerospace Science and Technology (1 article)

ADMINISTRATIVE AND COMMITTEE ACTIVITY

2024 **Graduate Student Representative**, Department Chair Appointment Committee
University of Waterloo
- Sole graduate student representative on faculty committee
- Gathered graduate student feedback and participated in committee meetings as part of chair re-nomination procedure

2023–2024 **Engineering Director**, Board of Directors, Graduate Studies Endowment Fund
University of Waterloo
- Reviewed applications for graduate student initiative funding on a monthly basis, collaborated with other board members, and provided funding recommendations

2022–2023 **Engineering Representative**, Project Review Committee, Graduate Studies Endowment Fund
University of Waterloo

2018–2019 **Senior Design Lead**, SAE Aero Design Team, University of Alberta

2016–2017 **President**, Students for Learning High School Tutoring Team, University of Alberta

EQUITY, DIVERSITY, AND INCLUSION

2023 Bisexual Inclusion at Work, Pride at Work Canada

2023 Pathways for Addressing Disclosures of Racism, University of Waterloo

2023 Intersectionality within the 2SLGBTQIA+ community, Pride at Work Canada

VOLUNTEERING AND OUTREACH

2024 Volunteer Photographer, Canadian Cancer Society Run for the cure

2023 Volunteer Photographer, Toronto Beaches Jazz Festival

2021 Volunteer Mechanical Design Judge, Canadian Hyperloop Competition

2021 Volunteer Robot Design Judge, First Robotics Canada (STEM outreach program)