Ahmad Droobi

Scientific Machine Learning — Uncertainty Quantification — Lagrangian Data Assimilation — Tracer Modeling — Dynamical Systems — Time Series
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Professional Summary

Highly motivated and accomplished Mechanical Engineering MSc candidate at the University of Calgary with a strong foundation in computer engineering, scientific machine learning, and uncertainty quantification. Specializing in Lagrangian data assimilation for turbulent flow modeling, I have developed novel hybrid filtering techniques that bridge high-dimensional dynamical systems with real-world applications in atmospheric and oceanic sciences. My expertise spans advanced computational methods, high-performance computing, and algorithm design, demonstrated through a peer-reviewed publication and participation in the WCCM 2024 conference. With a proven track record in both academic research and industry roles, I excel in translating complex data into actionable insights, driving innovation in predictive modeling and system optimization.

Education

University of Calgary Calgary, Alberta, Canada **Master of Science - Mechanical Engineering** Sep 2023 – Jun 2025
Specialization: Computer Science and Applied Mathematics

- **Thesis:** Data-Driven Filtering Techniques for Turbulent Flow Models (A Lagrangian Data Assimilation Approach)
- **Description:** Pioneered a hybrid filtering approach combining Ensemble Kalman Filter (EnKF) and Particle Filter (PF) to reconstruct turbulent flow fields from partial, noisy Lagrangian tracer measurements in quasi-geostrophic (QG) systems. Enhanced simulation accuracy for high-dimensional systems (over 16,000 states) by addressing nonlinearity, stochasticity, and turbulence, with applications in atmospheric and oceanic modeling.
- **Key Contributions:**
  - Developed a novel framework for Lagrangian data assimilation, enabling accurate recovery of Eulerian energy spectra from sparse tracer data.
  - Implemented numerical simulations of QG equations to establish ground truth for high-dimensional dynamics.
  - Advanced predictive capabilities for complex systems, improving efficiency in state and parameter estimation.
- **Keywords:** State estimation, parameter estimation, time series, Scientific Machine Learning, tracer modeling, Lagrangian Data Assimilation, dynamical systems, Uncertainty Quantification
- **Relevant Courses:**
  - ENME 633: Partial Differential Equations (PDEs) – Mastered analytical and numerical solutions for PDEs governing fluid dynamics.
  - ENME 618: Uncertainty Quantification & Scientific Machine Learning – Developed expertise in probabilistic modeling and neural network applications.
  - ENME 615: Sensors, Data, and Signal Analysis – Enhanced skills in data processing and sensor integration for dynamic systems.
  - STAT 601.28: Topics in Probability and Statistics (Deep Learning) – Applied deep learning techniques to time-series and predictive modeling.
  - ENMF 517: Experimental Design and Analysis – Designed robust experiments for validating computational models.
- **Activities:** Competitive swimmer, contributing to team leadership and discipline.

An Najah National University Nablus, West Bank **Bachelor of Science - Computer Engineering** Jan 2019 – Dec 2022

Specialization: Software and Hardware Systems

- **Thesis Projects:**
  - **Hardware:** Electrical Circuit Builder (P&P CNC) – Designed and implemented a CNC-based circuit builder, optimizing hardware integration and control systems.
  - **Software:** Cookoverflow – Developed a full-stack web application for recipe sharing, leveraging databases and user interface design.
- **Relevant Courses:**
  - **Programming and Software:** C++, Object-Oriented Programming, Databases, Web Development, Software Engineering, Digital Image Processing, Data Structures and Algorithms – Built robust software solutions for diverse applications.
  - **Hardware:** Digital Circuits Design (1, 2, 3), Electronics (1, 2), Signals, Computer Networking (1, 2), Microprocessors, Operating Systems, Computer Organization & Architecture (1, 2), Microcontrollers – Designed and tested hardware systems for real-time applications.
  - **Mathematics:** Calculus (1, 2, 3), Differential Equations, Discrete Mathematics, Probability and Statistics, Engineering Numerical Analysis – Established a strong mathematical foundation for computational modeling.
  - **Electives:** Machine Learning, Artificial Intelligence, Algorithms and Computational Complexity, Security, Wireless – Gained advanced knowledge in AI and system optimization.
  - **Faculty of Honors:** Communication Skills, Learning and Research Resources, Leadership Skills, English Language Skills, Community Service – Developed soft skills for professional collaboration.
- **Pre-Professional Program:** Medical Doctor (MD) Preparatory Program (2017–2018) – Strengthened analytical and problem-solving skills.

Publications

Data-Driven Filtering Techniques for Turbulent Flow Models (A Lagrangian Data Assimilation Approach) July 2025

- **Author:** Droobi, Ahmad
- **Citation:** Droobi, A. (2025). Data-Driven Filtering Techniques for Turbulent Flow Models (A Lagrangian Data Assimilation Approach) (Master's thesis, University of Calgary, Calgary, Canada). Retrieved from https://hdl.handle.net/1880/122341.
- **Description:** Developed a novel hybrid filter combining Ensemble Kalman Filter (EnKF) and Particle Filter (PF) to reconstruct turbulent quasi-geostrophic flow fields from sparse Lagrangian tracer measurements. The work advances state estimation and uncertainty quantification for high-dimensional dynamical systems, with applications in atmospheric and oceanic sciences.

Conferences

World Congress on Computational Mechanics (WCCM 2024) July 2024

- **Role:** Presenter
- **Contribution:** Presented research on Lagrangian data assimilation for turbulent flow modeling, showcasing advancements in hybrid filtering techniques for quasi-geostrophic systems.
- **Impact:** Engaged with global experts in computational mechanics, contributing to discussions on data-driven approaches for complex systems.

Professional Experience

University of Calgary Calgary, Alberta, Canada **Graduate Research Assistant** Sep 2023 – Present
Full-time *On-site*

- **Project Focus:** Led cutting-edge research on uncertainty quantification and Lagrangian data assimilation for turbulent flow modeling, focusing on quasi-geostrophic (QG) equations.
- **Key Responsibilities:**
  - Designed and implemented a hybrid EnKF-PF filter to reconstruct high-dimensional turbulent flow fields from partial, noisy tracer data.
  - Conducted numerical simulations of QG equations using Python and MATLAB, leveraging high-performance computing (HPC) for large-scale data processing.
  - Developed algorithms for state and parameter estimation, improving predictive accuracy for stochastic dynamical systems.
  - Documented findings using LaTeX and managed references with Zotero, ensuring high-quality research outputs.
- **Technical Toolkit:** Python, MATLAB, HPC, Linux, LaTeX, Zotero, VS Code
- **Soft Skills:** Effective communication, collaborative problem-solving, and negotiation in interdisciplinary research teams.

Teaching Assistant Sep 2024 – Dec 2024
Part-time *On-site*

- **Course:** ENME 600: Introduction to Numerical Methods for Engineers
- **Responsibilities:** Delivered tutorials, graded assignments, and supported students in mastering numerical methods for engineering applications, including finite difference and finite element methods.
- **Skills:** Teaching, Microsoft Excel, technical communication

Student Teaching Assistant Jan 2024 – Apr 2024
Part-time *On-site*

- **Course:** ENME 505: Robotics
- **Responsibilities:** Assisted in lab sessions, provided programming support in Python, and facilitated hands-on robotics projects, enhancing student understanding of control systems and automation.
- **Skills:** Programming, Microsoft Excel, mentorship

ITG Software, Inc. Cincinnati, Ohio, United States **Python Engineer** Feb 2023 – Aug 2023
Full-time *Remote*

- **Responsibilities:** Developed and optimized Python-based software solutions for data processing and automation, improving operational efficiency for client workflows.
- **Achievements:** Streamlined data pipelines, reducing processing time by 20
- **Skills:** Python, software development, problem-solving

Harri Ramallah, West Bank **Machine Learning Engineer** Jan 2022 – Jan 2023
Internship *On-site*

- **Responsibilities:** Built and deployed machine learning models for time-series forecasting, contributing to predictive analytics for business applications.
- **Achievements:** Achieved a 15
- **Skills:** Machine learning, forecasting, data science

Clemson University Clemson, South Carolina, United States **Machine Learning Research Intern** Oct 2021 – May 2022
Full-time *Remote*

- **Project:** Future Computing Technologies Lab (Creative Inquiry)
- **Responsibilities:** Conducted research on machine learning applications for predictive modeling, focusing on algorithm design and performance optimization.
- **Skills:** Research, machine learning, data analysis

Palestine Telecommunications Company - Paltel Nablus, West Bank **Software Engineer** Jan 2022 – Mar 2022
Full-time *On-site*

- **Responsibilities:** Developed software solutions for telecommunications systems, enhancing network performance and user experience.
- **Achievements:** Secured position through LinkedIn networking, demonstrating strong professional communication skills.
- **Skills:** Software engineering, networking

Apple Rawabi, West Bank **Software Engineer** May 2021 – Oct 2021
Part-time *On-site*

- **Project:** Data Stream Interface
- **Responsibilities:** Designed and implemented Python-based data streaming solutions, ensuring efficient real-time data processing.
- **Skills:** Python, computer science, system design

Selected Projects

Shortest Path Finding Algorithms Optimization in Constrained Environments Nov 2024 – Dec 2024

- **Context:** University of Calgary, ENMF 517 Final Project
- **Description:** Optimized shortest path algorithms using deep learning for random process predictability in constrained environments, improving computational efficiency for real-time applications.

Can I Read Your Brain? Jun 2024

- **Context:** University of Calgary, STAT 601.28 Course Project
- **Description:** Developed a deep learning model to predict emotional states from functional connectivity (FC) brain networks, achieving high accuracy in emotion classification.

Reproduce "Neural Ordinary Differential Equations" Paper Oct 2023 – Dec 2023

- **Context:** University of Calgary, Uncertainty Quantification and Scientific Machine Learning Course
- **Description:** Reimplemented neural ODEs for modeling continuous-time dynamics, enhancing understanding of scientific machine learning applications.

Real Time Facial Emotional Recognition Sep 2021 – Jan 2022

- **Description:** Built a real-time emotion recognition system using deep learning (CNN) with Tensorflow, OpenCV, and Dlib on Google Colab. Achieved 97% training accuracy and 59.89% testing accuracy on a Kaggle dataset with seven emotions.
- **Technologies:** Python, Tensorflow, OpenCV, Dlib, Haar cascade

PayMe Sep 2021 – Dec 2021

- **Purpose:** Developed an e-Wallet platform for university students and businesses, enabling secure and efficient transactions for fees, subscriptions, and purchases.
- **Technologies:** Web development, databases, payment systems

Licenses & Certifications

Manara-Certified Software Engineer May 2023

- Issued by Manara

Applied Data Institute Dec 2022

- Issued by Equitech Futures
- Credential ID: https://www.equitechfutures.com/alumnisos?id=5

Volunteering

Competitive Programming Jan 2020 – Jan 2023

- **Event:** ICPC - International Collegiate Programming Contest
- **Description:** Participated in competitive programming challenges, honing algorithm design and problem-solving skills under time constraints.

Skills

- Scientific Machine Learning
- Uncertainty Quantification
- Lagrangian Data Assimilation
- Turbulent Flow Modeling
- Python (Programming Language)
- MATLAB
- High Performance Computing (HPC)
- Linux
- Algorithm Design
- Data Science
- Deep Learning
- Time Series Analysis
- LaTeX
- Microsoft Excel