

# Yoseph Tereda

Machine Learning | Numerical Simulation Specialist

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## Profile Summary

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Machine Learning and Numerical Simulation Specialist with dual M.Sc. degrees in Mathematics and Computer Science, and hands-on experience in Python-based modeling, data analysis, and algorithm development. Strong background in applied mathematics and scientific computing, with expertise in simulating complex systems. Motivated to translate theoretical models into scalable, practical solutions.

## Technical Skills

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### Programming & Machine Learning

Python, MATLAB, C++, R, SQL (MySQL, PostgreSQL)

TensorFlow, PyTorch

CNNs, LSTMs, BiLSTMs

scikit-learn, Git / GitHub

Linux, Matplotlib, Jupyter

### Computational & Systems

Numerical linear algebra

FEM / FDM, PDE modeling

Parallel computing, GPU acceleration

Numerical optimization

Computational mechanics

## Projects

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### Hybrid CNN–BiLSTM for Reservoir Outflow Forecasting

*Global Water Futures (GWF), University of Saskatchewan 2019–2021; extended independently in 2025*

- Developed machine learning models to forecast reservoir outflows using large-scale multivariate time-series data from the Waterton Reservoir (Southern Alberta), consisting of over 21 years of hourly observations (January 1998–January 2019).
- Designed and trained LSTM and BiLSTM models (2019–2021) to capture nonlinear temporal dependencies in reservoir dynamics.
- Extended the original GWF work in 2025 by developing a hybrid CNN–BiLSTM architecture for automated feature extraction and long-range temporal modeling.
- Achieved improved predictive performance with the CNN–BiLSTM model ( $MAE = 4.86$ ,  $RMSE = 8.74$ ,  $R^2 = 0.828$ ), outperforming LSTM and BiLSTM baselines.
- Improved peak-flow and extreme-event prediction accuracy, increasing robustness under extreme hydrological conditions.

### Fuzzy Logic Controller for Physical Distance Detection

2019–2020

University of Saskatchewan, Saskatoon, Canada

- Designed an interpretable AI system based on fuzzy logic to estimate physical distance in simulated pandemic scenarios.
- Formulated a rule-based inference engine using linguistic variables, membership functions, and IF–THEN rules.
- Implemented fuzzy membership functions and centroid-based defuzzification for control and decision-making.
- Analyzed core components of fuzzy systems, including knowledge bases, inference mechanisms, and working memory.
- Demonstrated fuzzy logic as an alternative to data-driven ML approaches under limited labeled data conditions.

## Selected Experience

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### Machine Learning Researcher / Numerical Simulation Engineer

2019–2021

University of Saskatchewan, Saskatoon, Canada

*Fast Simulations of Cardiac Electrophysiology Models*

- Designed high-performance computational pipelines for large-scale numerical simulation of cardiac electrophysiology using coupled ODE–PDE models.
- Developed an automated, stability-aware optimization framework that reduced simulation runtime by 40–60%, analogous to hyperparameter tuning in ML workflows.
- Implemented and benchmarked multiple time-integration solvers (Runge–Kutta, SSP, and RKC) using systematic evaluation pipelines analogous to ML model selection.
- Applied Jacobian eigenvalue analysis and numerical linear algebra to improve solver stability, convergence, and scalability across 1D, 2D, and 3D simulations.
- Built reproducible experimentation frameworks in Python and MATLAB, conducting large-scale benchmarking across 37 validated models with strict accuracy constraints ( $<5\%$  error).

### Machine Learning Researcher / Numerical Simulation Engineer

2018–2021

Global Water Futures (GWF), Saskatoon, Canada

*Invertible Approximations of the Standard Normal CDF*

- Developed high-accuracy, explicitly invertible mathematical models for approximating the standard normal CDF, enabling efficient stochastic simulation.
- Formulated parameter estimation as a least-squares optimization problem over the full input domain.
- Solved large-scale nonlinear optimization problems using deterministic global optimization (BARON) and multi-start global search strategies.
- Achieved state-of-the-art accuracy with maximum absolute error  $2.73 \times 10^{-5}$ , outperforming existing invertible approximations.
- Built reproducible benchmarking and sensitivity-analysis pipelines to evaluate accuracy, robustness, and runtime performance in Monte Carlo simulations.

### Teaching Assistant

2017–2018

University of Saskatchewan, Saskatoon, Canada

- Assisted in undergraduate courses including Linear Algebra, Calculus, Applied Mathematics, and Abstract Algebra.
- Used Python and MATLAB to demonstrate numerical methods, simulations, and the link between theory and computation.
- Developed computational examples and simulations to illustrate mathematical modeling and quantitative reasoning.
- Led tutorial and problem-solving sessions; evaluated assignments and exams with constructive feedback.

### Teaching Assistant

2016–2017

King Fahd University of Petroleum & Minerals (KFUPM), Dhahran, Saudi Arabia

- Supported undergraduate instruction in Numerical Methods for ODEs, PDEs, Calculus, Complex Analysis, Abstract Algebra, and Applied Mathematics for Engineering.
- Used Python and MATLAB to demonstrate numerical solutions of ODEs and to connect theory with computational experiments.
- Developed simulations to illustrate convergence, stability, and error behavior of numerical methods.
- Led tutorials and problem-solving sessions; evaluated assignments and examinations.

### Graduate Researcher

2014–2016

King Fahd University of Petroleum & Minerals (KFUPM), Dhahran, Saudi Arabia

*Numerical Solutions for Sub-Diffusion Problems*

- Conducted research on numerical solvers for time-fractional sub-diffusion equations arising in anomalous transport phenomena.
- Developed finite element spatial discretizations coupled with time-stepping schemes for fractional

PDEs.

- Analyzed stability, convergence, and error behavior of numerical methods for nonlocal fractional operators.
- Implemented numerical experiments and applied numerical linear algebra techniques to validate theory and improve solver robustness.

#### **Numerical Simulation Researcher**

2015–2016

King Fahd University of Petroleum & Minerals (KFUPM), Dhahran, Saudi Arabia

*Particle Pair Diffusion of Inertial Particles such as Dust in the Atmosphere*

- Developed mathematical and computational models for inertial particle dynamics in turbulent flows using Lagrangian formulations.
- Implemented large-scale numerical simulations of stochastic particle trajectories based on the Maxey–Riley framework.
- Conducted parametric studies over Stokes number and turbulence scales to characterize dispersion regimes and scaling behavior.
- Applied ensemble-based statistical analysis and regression to quantify particle separation, diffusivity, and nonlinear growth dynamics.
- Implemented kinematic simulation methods to model multiscale turbulent velocity fields and assess nonlocal diffusion effects.

### **Earlier Experience**

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#### **Sessional Lecturer**

2006–2014

Arba Minch University, Arba Minch, Ethiopia

- Taught undergraduate courses in Numerical Analysis, Partial Differential Equations (PDEs), Applied Mathematics, and Mathematical Modeling.
- Integrated MATLAB-based computational laboratories to translate mathematical theory into numerical algorithms and simulations.
- Supervised undergraduate projects involving numerical simulation, optimization, and model validation.

#### **Database Developer**

2009–2013

Arba Minch University, Arba Minch, Ethiopia

- Designed and maintained relational databases supporting academic, administrative, and research data systems.
- Optimized T-SQL queries, stored procedures, and indexing strategies to improve data retrieval performance and reliability.
- Implemented data integrity, validation, and testing procedures to ensure accuracy and consistency of database-driven workflows.

### **Publications**

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- Lipoth, J., Tereda, Y., Papalexiou, S. M., & Spiteri, R. J. (2022). A new very simple explicitly invertible approximation for the standard normal cumulative distribution function. *AIMS Mathematics*, 7(7), 11635–11646. doi:10.3934/math.2022648.
- Malik, N., Tereda, Y., & Usama, S. (2016). Particle pair diffusion of inertial particles such as dust in the atmosphere. Presentation at the EGU General Assembly 2016 (EGU2016-7264). ADS Abstract.

### **Education**

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#### **M.Sc. in Computer Science**

2019 – 2021

University of Saskatchewan, Saskatoon, Canada

#### **M.Sc. in Mathematics**

2014 – 2016

King Fahd University of Petroleum & Minerals (KFUPM), Dhahran, Saudi Arabia

**B.Sc. in Mathematics**

2002 – 2006

Hawassa University, Hawassa, Ethiopia

**Honors & Awards**

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- Graduate Teaching Assistantship Scholarship, University of Saskatchewan.
- Full-Time Student Scholarship, King Fahd University of Petroleum & Minerals (KFUPM).