Raymond (Hao) Xu

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EDUCATION

- **University of Alberta**

  Master of Science (M.Sc.) in Civil Engineering — *Expected: Jul 2027*
  - Program start: January 2026; Cumulative GPA: 3.96/4.00
  - Supervisor: Dr. Renato Macciotta Pulisci
  - Research areas:
    - ML-assisted automated detection of slow-moving landslides from satellite InSAR data using heuristic and machine learning methods
    - ML-assisted automated detection and monitoring of beaver ponds near railway tracks with remote sensing
    - Bayesian Inference for Rock Scour Parameter Calibration using Markov Chain Monte Carlo Inference and Machine Learning Surrogates

  Master of Engineering (M.Eng.) in Civil Engineering — *2022 - 2025*
  - Cumulative GPA: 3.97/4.00 across twelve graduate-level courses, completed part-time over three years while employed full time
  - 3 peer-reviewed conference papers and 2 conference presentations

  Bachelor of Science (B.Sc.) in Civil Engineering (Co-operative Program) — *2016 - 2021*
  - First-class standing; Honours Math Stream

PROFESSIONAL LICENSES

- Professional Engineer (P.Eng.), Association of Professional Engineers and Geoscientists of Alberta, Canada
- Professional Engineer (P.E.), Board of Professional Engineers and Land Surveyors, State of Nevada, U.S.A.

HONORS AND AWARDS

- CGS Student Design Competition, Winner — *2026*
- Falling Walls Lab Edmonton, Finalist — *2026*
  - Selected as one of thirteen finalists, drawn from three Canadian universities, in a competitive research-pitch competition, for the development of automated landslide detection framework.
- Alberta Machine Intelligence Institute (amii) AI for Earth Program Scholarship — *2026*
  - Competitive scholarship recognising graduate research applying artificial intelligence to environmental and earth-system problems.
- University of Alberta Graduate Entrance Scholarship — *2026*
  - Awarded on a competitive basis on entry to the MSc program at the University of Alberta.

- Dean's Research Award, third consecutive award *2019, 2020, 2021*
  - Faculty of Engineering, University of Alberta. Awarded for undergraduate research contributions in ice-breakup prediction, climate-change impacts on river winter regimes, and geostatistical accident-frequency analysis.
- First Place, Civil Geotechnical Capstone Design (CIV E 489) *2021*
  - Top-ranked design among all competing teams for an off-stream earthen dam project in Alberta.
- Dr. Karel Puffer Civil Engineering Award *2017*
  - Awarded for academic excellence in civil engineering, University of Alberta.
- Undergraduate Academic Excellence Award *2017*
  - Faculty of Engineering, University of Alberta.

RESEARCH EXPERIENCE

- **Graduate Research Assistant** – University of Alberta *Jan 2026 - Present*
  Supervisor: Dr. Renato Macciotta Pulisci
- **Graduate Student Researcher (part-time)** – University of Alberta *2022 - 2025*
  Independently developed a research portfolio in machine learning for civil engineering while employed full time in industry.
- **Undergraduate Researcher** – University of Alberta *2019 - 2021*
  Dean's Research Award Program
  Supervisors: Dr. Yuntong She; Dr. Tae J. Kim

INDUSTRY EXPERIENCE

- **Data Scientist (On-call)** - BGC Engineering Inc. *Feb 2026 - Present*
  - Developing, streamlining and maintaining python tools for two-dimensional stream-power erosion simulation.
  - Developing Bayesian inference framework for calibrating engineering parameters with machine learning.
- **Civil Engineer (Full-time)** - BGC Engineering Inc. *Nov 2023 - Feb 2026*
  - Applied machine-learning-powered index methods for hydrology and climate-change assessments to determine design flood frequency.
  - Developed and maintained Python automation tools for geotechnical data processing and two-dimensional stream-power erosion simulation, improving reproducibility and reducing manual computation across project teams.
  - Conducted slope stability, seepage, and dam-breach modelling (SLIDE2/3, SEEP/W, SIGMA/W) for tailings storage facility design; led instrumentation planning for feasibility studies.
  - Delivered hydrotechnical hazard assessments and pipeline crossing designs for natural gas and bitumen pipelines. Projects in Canada, the United States, and the Dominican Republic.
- **Engineer-in-Training (Full-time)** - Northwest Hydraulic Consultants Ltd. *Oct 2022 - Nov 2023*
  - Assembled and calibrated HEC-RAS hydraulic models for hydrotechnical hazard assessments and stream stabilisation projects across Alberta, Manitoba, and the Northwest Territories.
  - Developed PCSWMM flood-routing models to evaluate municipal drainage network performance under storm scenarios; conducted wave-runup and shore-protection stability analyses.

- **Engineer-in-Training (Full-time)** - Wood E&I Solutions *Jan 2020 - Sep 2022*
  - Managed 300+ geotechnical instruments and laboratory orders for major tailings and mine-waste structures in Northern Alberta oil sands projects.
  - Performed geotechnical data analysis and modelling for tailings dam and mine-waste dump design; delivered monthly performance memoranda to clients and the Alberta Energy Regulator.
- **Intern Project Engineer (Full-time)** - EPCOR Drainage Services *Apr - Aug 2019*
  - Optimised project-delivery processes and capital budget frameworks; developed management-of-change and risk-management milestone strategies.

RESEARCH PROJECTS

- **SLIDE: Automated InSAR Screening for Slow-moving Landslide Detection** *2026 - Present*

  Slow-moving landslides threaten transportation corridors, pipelines, and communities across Western Canada, contributing to landslide-related costs of up to $450 million annually, yet the terrain most at risk is remote and largely unmonitored by ground-based methods. SLIDE is a modular, automated workflow that converts satellite Interferometric Synthetic Aperture Radar (InSAR) ground-displacement measurements into actionable landslide detections at regional scale.

  The workflow proceeds in three stages: candidate generation from InSAR displacement data using fixed thresholding, statistical outlier detection, and image-processing techniques; contextualisation of each candidate against terrain semantics (slope, aspect, and curvature derived from a digital elevation model) to separate genuine slope movement from noise; and screening and verification against a reference inventory of known landslides. Performance is quantified using accuracy, precision, recall, and F1-score.

  Applied to a pilot study area in the Thompson River Valley, British Columbia, the workflow achieved high accuracy and recall within a regional dataset containing millions of individual measurement points. This is the first automated InSAR-based landslide detection workflow developed and validated for Canadian conditions; existing tools have been developed and validated only in Europe and China.

  Industry collaboration: BGC Engineering Inc. Dissemination: GeoQuebec 2026 conference paper; Geohazards Connection Conference 2026 presentation; journal manuscript under review.

- **Automated Beaver Pond Identification along Railway Corridors** *2026 - Present*

  Ponded water behind beaver dams is an under-recognised but costly cause of railway track flooding and washouts. Operators currently locate and monitor dams through helicopter overflights and ground surveys, which are expensive, intermittent, and difficult to scale.

  This project assembles and manually verifies a beaver dam dataset from optical satellite imagery across North America, develops machine learning based framework that identifies beaver ponds, monitors their extent over time and classifies their hazard risk to adjacent infrastructure. Principal methodological challenges are imagery resolution compatibility with beaver dam dimensions, high temporal variability of dam features, and discrimination between beaver ponds and natural ponded water.

  Industry collaboration: Canadian National Railway; Canadian Pacific Kansas City Railway. Framework tested along active rail corridors across several study areas.

- **Bayesian Inference for Rock Scour Parameter Calibration with Machine Learning** *2026 - Present*

  Rock scour prediction depends on parameters that cannot be measured directly and are only weakly identified by the observations available, so a deterministic calibrated value can misrepresent what is actually known. This work utilises the Bayesian Markov Chain Monte Carlo (MCMC) algorithm to infer

probable distribution of parameters and evaluate relations between rock materials, propagating observational and model uncertainty into the parameter posterior. Each forward evaluation of the physical scour model can be computationally expensive to embed directly within a sampling algorithm in MCMC. Machine learning models are used as surrogates for the physics-based simulation models to reduce computation cost and ultimately render full posterior sampling tractable.

Industry collaboration: BGC Engineering Inc. An abstract submitted to the 79th ICLOD annual meeting conference.

- **Systematic Evaluation of LSTM Models for Daily Streamflow Forecasting** *2024 - 2025*

  Accurate streamflow forecasting in snowmelt-dominated headwaters is critical for flood mitigation, reservoir operations, and water resource management, yet remains challenging due to non-linear interactions among snowmelt dynamics, meteorological forcing, and watershed hydrology. This study evaluates Long Short-Term Memory (LSTM) models for daily streamflow prediction in three watersheds of southwestern Alberta and systematically examines the sensitivity of model performance to key configuration decisions including timestep selection, feature engineering, seasonal period, adjacent gauge inclusion, weather forecasting, and attention mechanisms.

  Results demonstrate high predictive accuracy of up to 0.98 NSE for typical daily streamflow when the models are optimally configured. However, all models substantially underpredicted a 1995 extreme flood event by 44–78%, reflecting the inherent challenge of predicting rare events with imbalanced training data. The extreme-event underprediction was found to be masked by aggregate evaluation metrics over a typical flow period, necessitating a need for a separate evaluation with the extreme event in LSTM performance evaluation. These findings provide guidance for configuring LSTM models for small watersheds and highlight data augmentation and uncertainty quantification as future directions for improving extreme event predictions.

  Study area: Oldman Reservoir Basin, Southwestern Alberta. Presented at the Canadian Water Resources Association 2025 National Conference; journal manuscript submitted.

- **Machine Learning Prediction on Wildfire Occurrence Prediction in Alberta** *2024*

  Wildfire occurrence prediction is a severely class-imbalanced, spatially structured classification problem in which the choice of evaluation metric materially determines which model appears to perform best. This collaborative project, developed with mechanical engineering graduate students and extended beyond its originating coursework, compared machine learning algorithms for Alberta wildfire occurrence prediction and evaluated their performance systematically rather than reporting a single aggregate score.

  Presented at Upperbound 2024, Alberta's artificial intelligence conference, Edmonton.

PROFESSIONAL SERVICE

Professional Society Service

- **Elected Graduate Student Representative** - Engineering Faculty Council, UAlberta *Sep 2026 - Present*
  - Participating in faculty discussions to advocate for the specific academic, research, and welfare needs of Master's and Ph.D. students.
- **Vice President, Communications** - Geotechnical Society of Edmonton *Aug 2025 - Present*
  - Setting newsletter strategy and producing Society newsletters; managing social media and event promotion; serving as the primary communication link between the Society and its members.

- **Networking Subcouncil Chair** - ENGGYAC, University of Alberta *Aug 2023 - Nov 2025*
  - Led a five-person volunteer team delivering alumni engagement events, including the Beers and Engineers series; founded and launched the ENGGYAC Connect podcast supporting young professionals transitioning into industry.

Conference Organisation

- **Member of the Organising Committee** - Geohazards 9 *Jan - Jun 2026*
  - Reviewed a subsection of abstracts and paper submissions, responded to attendee inquiries, and coordinated with presenters for smooth proceeding of the conference.

TEACHING EXPERIENCE

- **Teaching Assistant — CIV E 489 (Geotechnical Capstone)** *Jan - Apr 2026*
  Department of Civil & Environmental Engineering, University of Alberta
  Lead: Prof. Renato Macciotta
- **Grading Assistant — CIV E 270** *Sept - Dec 2019*
  Department of Civil & Environmental Engineering, University of Alberta
- **Grading Assistant — ENGG 130** *Jan - Apr 2019*
  Faculty of Engineering, University of Alberta

PUBLICATIONS AND PRESENTATIONS

A total of five refereed conference publications as first or co-author, and three journal manuscripts in preparation. Names in bold indicate the author of this curriculum vitae.

Conference Proceedings (peer-reviewed)

C1. **Xu, R.**, George, M. F., Annandale, W. G., Macciotta, R. (2026) "Calibrating Rock Scour Rate Parameters using Bayesian Markov Chain Monte Carlo." The 95th ICOLD Annual Meeting, Daejeon, South Korea. [Abstract submitted]

C2. **Xu, R.**, Macciotta, R., Engelbrecht, J. (2026) "Automating InSAR Data Processing for Slow-moving Landslide Detection Using Machine Learning: A Progress Update." Proc. GeoQuebec 2026, Quebec City, Canada.

C3. **Xu, R.**, Chen, J., Jeong, C.-G., Liu, F. (2025) "Critical State Line Database and Meta-analysis for Tailings Materials." Proc. Tailings and Mine Waste 2025, Banff, Canada.

C4. **Xu, R.**, Morita, L., Khasravian, P., Itani, A. (2025) "Scaled-Down Simulation and Analysis of On-site Robotic Fabrication and Construction." Proc. 42nd International Symposium on Automation and Robotics in Construction (ISARC), Montreal, Canada.

C5. Kidanu, R., **Xu, R.**, Davies, E. G. R., Ilich, N. (2025) "Short-Term Streamflow Forecasts Using Machine Learning: ANN, SVR and Feature Analysis." Proc. CSCE 2025 Hydrotechnical Specialty Conference, Winnipeg, Canada.

Journal Manuscripts (*in preparation/pending peer review)

J1*. **Xu, R.**, Davies, E. G. R., Grover, P. (2026) "Configuration Over Architecture: Deep Learning Models for Daily Streamflow Forecasting in Snowmelt-Dominated Headwater Watersheds of Southwestern Alberta." *Hydrology*. (journal submission pending)

J2*. **Xu, R.**, Sharifi, S., Macciotta, R., Engelbrecht, J. (2026) "SLIDE-H: Automating InSAR-derived Displacement Data Processing for Landslide Detection using A Heuristic Approach." *IEEE Transactions on Geoscience and Remote Sensing*. (currently under industry partner review)

J3*. Ji, B., **Xu, R.**, Macciotta, R., Adeeb, S. (2026) "Automated Digital Twin Framework Integrating InSAR-Based Landslide Monitoring and Pipeline Integrity Assessment." *Automation in Construction*. (internal review in progress)

Presentations

P1. "Slow-moving Landslide InSAR Detection Engine (SLIDE): Automating InSAR data processing for slow-moving landslide detection with a heuristic workflow", GeoQuebec - The 79th Canadian Geotechnical Society Conference, Quebec City, QC, 2026.

P2. "Slow-moving Landslide InSAR Detection Engine (SLIDE): Automating InSAR data processing for slow-moving landslide detection with a heuristic workflow", The Geotechnical Connection Conference, Online, 2026.

P3. "Case Studies of Recent Civil/Geotechnical Highlights in Asia - Singapore Thomson East-coast Line at Marina Bay", UAlberta Geotechnical Seminar, Edmonton, AB, 2025.

P4. "Riding the AI Wave: Deploying Deep Learning Models for Short-term Streamflow Prediction within the Oldman Reservoir Basin in Alberta", Canadian Water Resources Association National Conference, Penticton, BC, 2025.

P5. "Machine Learning Algorithms for Alberta Wildfire Occurrence Prediction and Performance Evaluation", Upperbound 2024, Edmonton, AB, 2024.

P6. "On-Site Robotic Fabrication and Construction", Alberta Robotics & Intelligent Systems Expo 2024, Edmonton, AB, 2024.

P7. "Impact of Climate Change on the Winter Regime of Albertan Rivers", University of Alberta Dean's Research (Undergraduate) Award Presentation, Edmonton, AB, 2021.

P8. "Artificial Neural Network Application in Ice-breakup Timing Prediction", University of Alberta Dean's Research (Undergraduate) Award Presentation, Edmonton, AB, 2020.