

Amir Reza Peimani

Machine Learning / AI Researcher & University Instructor

Ontario, Canada | amir.peimani@utoronto.ca

github.com/AmirRezaPeimani | Google Scholar

Profile

Machine learning researcher and university instructor working on neural time series, LLM post-training, AI evaluation, and computational neuroscience. Research combines controlled experiments, signal processing, statistical learning, and reliable evaluation. Teaching experience since 2015 spans computer science, statistics, data science, engineering, and AI, from introductory programming to graduate machine learning.

Education

PhD, Biomedical Engineering & Neuroscience 2018–2026
University of Toronto

MASc, Mechanical Engineering 2015–2017
York University

BASc, Mechanical Engineering 2011–2015
Isfahan University of Technology

Research Experience

PhD Researcher, Machine Learning & Neural Engineering 2018–2026
University of Toronto & University Health Network Toronto, Canada

- Led the main thesis analysis of post-stimulation neural dynamics in **309 complete five-region recordings from 10 animals**. Built the analysis from stimulation timing and preprocessing through spectral analysis, cross-frequency coupling, directional analysis, and animal-level statistics.
- Found a reproducible early-to-later decline in signal magnitude and 1–55 Hz power: SD decreased in **all 10 animals** and power in **9 of 10**. Compared phase-slope index with **15 additional directional methods** and found that stimulation-region-linked temporal organization was strongest near stimulation offset and weakened later.
- Extended the analysis to **412 five-region recordings from 12 animals**. Established kindling was associated with approximately one additional involved region per event, broader multiregion activity, and stronger baseline-normalized LFP modulation.
- Built cross-animal evaluation for repeated recordings, with preprocessing, feature scaling, model fitting, and calibration estimated from training animals only. Repeated recordings were reduced within animal rather than counted as independent samples.
- Worked across experimental design, multichannel neural and physiological recording, data organization, algorithm development, statistical analysis, figures, and manuscript preparation.
- Wrote a review of brainstem seizure involvement covering seizure spread, respiratory and cardiovascular dysfunction, arousal, imaging, experimental models, SUDEP, biomarkers, and treatment.
- Developed and compared machine-learning models for temporal and graph-structured data, including classical classifiers, CNNs, RNNs, TCNs, BiGRUs, GNNs, graph transformers, and self-supervised models.

MITACS Accelerate Research Fellow 2020–2022
Neureka.ai & University Health Network Toronto, Canada

- Developed the computational analysis for an industry-sponsored study combining hippocampal, cortical, brainstem, and cerebellar LFP with breathing rate, SpO₂, and heart rate during controlled 4-AP and isoflurane experiments.
- Built Python workflows for recordings with different sampling rates, gains, channel coverage, durations, and protocols. Paired within-animal analysis found approximately **197% higher hippocampal power** when isoflurane was lowered from 2.5% to 1.5%, while increasing it to 4.5% reduced parietal-cortex power by approximately **64%**.

AI & Machine Learning Research

Rows Are Not Evidence Units: Evidence-Unit Invariance in Weak Temporal Localization

Solo author / Manuscript in preparation (ICLR 2027 submission)

- Found that changing how the same weak supervision is stored in rows can alter preprocessing, training weights, checkpoint selection, and predictions even though no new evidence has been added. Across **7 temporal datasets**, ordinary row materialization changed segment F1 by up to **0.23 absolute**.
- Built quotient learning, which groups repeated storage of the same underlying evidence before preprocessing and training. Tested with TCN and BiGRU models; the resulting pipeline stayed unchanged under the tested row duplications and table transformations.

Cross-View Contamination Inflates Reward-Model Validation Accuracy

Solo author / Submitted to Language Resources and Evaluation, 2026

- Matched related examples across different HelpSteer3 views using shared context, responses, feedback, and edits. Among 163 validation records, complete-row matching found none, while cross-view analysis found exact training-context matches for **123**.
- Tested whether those relationships actually changed model evaluation. A word-based reward model showed a **14.3 percentage-point** target-minus-clean effect, a character model showed a smaller effect, and Qwen2.5-1.5B showed no comparable effect in the same experiment.

Training on Broken Contexts: Source Loss and Repair in Tool-Augmented LLM Post-Training

Solo author / Submitted to Journal of Intelligent Information Systems, 2026

- Checked the final tokenized training sequences produced after chat templating, masking, truncation, and packing. At a 512-token budget, boundary-breaking packing left **38.7%** of verified ToolACE targets without the tool output associated with their answer.
- Built a packing method that retained **95.3%** of verified ToolACE targets while eliminating duplicated source tokens, and identified a multi-batch packing bug in TRL 1.9.2.

Executable Scientific Contracts for Research Auditing

Solo author / Under review at the NeurIPS 2026 Workshop on AI-Native Academia: Authorship, Peer Review, and Conference Governance under AI

- Built executable tests that check research claims against the corresponding code and released results. Evaluated **25 checks across five public AI repositories** and detected all **30 study-specific test mutations**.

State-Complete Replay: Validity Conditions for Counterfactual Evaluation of Interactive Agents

Solo author / Under review at the Workshop on Evaluation of Interactive Agents @ NeurIPS 2026

- Showed that counterfactual replay can give the wrong result even when the visible interaction is reproduced exactly because relevant environment state may still be missing. In one controlled setting, visible-only replay reproduced all **20 of 20** branch views but gave wrong intervention effect in **3 of 20**; restoring full state removed those errors.

Neuroscience & Neural Engineering Manuscripts

- Amir Reza Peimani et al. *Multiscale Temporal Dynamics of Local and Interregional LFP Organization after Amygdala Stimulation*. Manuscript in preparation.
- Amir Reza Peimani et al. *Amygdala Rapid Kindling Reorganizes Multiregion Seizure-Like LFP Activity across Limbic, Cortical, Brainstem, and Cerebellar Circuits*. Manuscript in preparation.
- Amir Reza Peimani et al. *Effects of Isoflurane on Multiregional Seizure-Like LFP Activity, Functional Connectivity, and Cardiorespiratory Function after Intrahippocampal 4-AP in Rats*. Manuscript in preparation.
- Amir Reza Peimani et al. *Brainstem Seizure Involvement: Evidence, Circuits, Mechanisms, and Clinical Consequences*. Manuscript in preparation.
- Amir Reza Peimani et al. *Forecasting Hippocampal LFP Responses from Neural State and Isoflurane Dose Changes*. Manuscript in preparation, 2026.

Peer-Reviewed Publications & Book Chapter

- Amir Reza Peimani et al. Phenotypic chemical and mutant screening of zebrafish larvae using an on-demand response to electric stimulation. *Integrative Biology*, 2019.
- Amir Reza Peimani et al. A microfluidic device to study electrotaxis and dopaminergic system of zebrafish larvae. *Biomicrofluidics*, 2018.
- Amir Reza Peimani et al. Miniaturized sensors and actuators for biological studies on small model organisms of disease. In *Environmental, Chemical and Medical Sensors*, Springer, 2018.
- Amir Reza Peimani et al. A microfluidic device for quantitative investigation of zebrafish larvae's rheotaxis. *Biomedical Microdevices*, 2017.
- Amir Reza Peimani et al. A microfluidic device for partial immobilization, chemical exposure and behavioural screening of zebrafish larvae. *Lab on a Chip*, 2017.

Conference Presentations

- Amir Reza Peimani et al. Time course and semiology of brainstem seizure invasion in amygdala rapid kindling. *American Epilepsy Society Annual Meeting*, 2023.
- Amir Reza Peimani et al. Neural network dynamics in amygdala kindled seizures. *Society for Neuroscience Annual Meeting*, 2023.

Teaching Experience

Course Instructor

University of Toronto

May 2025–Present

Toronto, Canada

- **CSCB63H3: Design and Analysis of Data Structures**

Solo instructor, ~70 students

Designed and delivered the complete course covering asymptotic analysis, priority queues and heaps, balanced search trees, hashing, amortized analysis, disjoint sets, graph representations, and graph algorithms. Developed and administered assessments, managed course communication and student support, and held regular office hours.

- **CSC236H1: Theory of Computation**

~700 students across sections; taught ~150

Taught mathematical induction, recursive and iterative algorithm correctness, recurrence relations, asymptotic reasoning, and introductory automata and formal languages. Developed instructional problems, assessments, and structured support material.

- **GGR376H5: Spatial Data Science II**

100+ students

Teach spatial statistics, geospatial data analysis, spatial modeling, and predictive analysis of physical, social, and environmental datasets using modern data-science and machine-learning workflows.

Lead TA, Head TA & Teaching Assistant

University of Toronto

Sep 2018–Present

Toronto, Canada

- **Machine Learning, Deep Learning & Artificial Intelligence:** Lead TA for **CSC311: Introduction to Machine Learning** (W24, W25, W26); teaching staff for **CSC413/CSC2516: Neural Networks and Deep Learning** across repeated undergraduate and graduate offerings; additional teaching in **STA414: Statistical Methods for Machine Learning II**, **APS360: Applied Fundamentals of Deep Learning**, **ECE324: Machine Intelligence, Software and Neural Networks**, **CSC490: Machine Learning for Vision**, **CSCD84: Artificial Intelligence**, **CHL5230: Applied Machine Learning for Health Data**, and **BME1510: Data Science for Bioengineers**.
- Led tutorials, office hours, assignment and project development, grading coordination, technical debugging, and student mentoring in Python, NumPy, scikit-learn, and PyTorch. Supported projects involving supervised learning, neural networks, computer vision, generative models, probabilistic ML, and healthcare applications.
- **Algorithms, Theory & Mathematical Computer Science:** Head TA for **CSC165: Mathematical Expression and Reasoning for Computer Science**; teaching staff for **CSC236: Theory of Computation**, **CSC373: Algorithm Design, Analysis and Complexity**, **CSC363: Computational Complexity and Computability**, **CSC338: Numerical Methods**, and **CSCC37: Numerical Algorithms for Computational Mathematics**.
- Taught proof construction, induction, recurrences, algorithm correctness, asymptotic analysis, computability, complexity, numerical algorithms, optimization, and rigorous mathematical problem solving.
- **Programming, Data Structures & Systems:** taught or supported **CSC108: Introduction to Python**, **CSCA08: Introduction to Computer Science I**, **CSC111: Foundations of Computer Science II**, **CSC148: Introduction to Computer Science**, **CSCA20: Introduction to Programming**, **CSC358: Principles of Computer Networks**, and **ECE1779: Introduction to Cloud Computing**.
- **Engineering, Scientific Computing & Bioinformatics:** supported **ECE448: Biocomputation**, **BME1478: Coding for Bioengineers**, **MIE1628: Big Data Science**, **MIE334: Numerical Methods**, **MAT185: Linear Algebra II**, **MAT291: Mathematical Physics**, and **ECE311: Introduction to Control Systems**.

Teaching Experience (continued)

Part-Time Professor

Seneca Polytechnic

2024–2026

Ontario, Canada

- Taught statistics, text mining, predictive analytics, applied data mining, and business computing across BAN100, BAN200, BAN210, BAN230, and HST420; developed course materials, assignments, and assessments.

Teaching Assistant

Northeastern University

Sep 2022–Sep 2024

Toronto, Canada

- Supported graduate analytics courses including **ALY6010: Probability Theory and Introductory Statistics**, **ALY6020: Predictive Analytics**, **ALY6140: Python and Analytics Systems Technology**, **ALY6130: Risk Management Analytics**, **ALY6110: Data Management and Big Data**, and **ITC6000: Database Management Systems**.
- Led labs and student support in probability, regression, predictive modeling, Python/R analytics, SQL, data management, big-data systems, and risk analytics.

Teaching Assistant

University of Waterloo

May 2018–Sep 2018

Waterloo, Canada

- **MATH118: Calculus II**: led tutorials covering integration techniques, ordinary differential equations, parametric and polar curves, infinite series, convergence, and Taylor expansions.

Teaching Assistant

York University

Sep 2015–May 2018

Toronto, Canada

- Taught and supported undergraduate mechanical-engineering courses spanning dynamics, mechanics of materials, machine-element design, vibrations and actuators, engineering design, CAD/SolidWorks, professionalism, and technical communication.
- Guided laboratory work, problem-solving sessions, engineering-design projects, technical reports, and student teams across introductory and upper-year engineering courses.

Teaching Training & Pedagogical Development

- **Advanced University Teaching Preparation Certificate**, University of Toronto, 2025. Training in course design, assessment, inclusive teaching, active learning, and university teaching practice.
- **Microteaching II: Effective Lesson Planning and Delivery**, University of Toronto Teaching Assistants' Training Program, 2018. Practice in lesson planning, classroom delivery, peer feedback, and reflection.

Technical Skills

Machine learning: PyTorch, scikit-learn, transformers, CNNs, RNNs, TCNs, BiGRUs, GNNs, graph transformers, self-supervised learning, classification, regression, PCA, clustering

Time series & signal processing: multivariate time series, digital filtering, multirate resampling, FFT/Welch spectral estimation, wavelets, cross-frequency coupling, connectivity, directional analysis, graph-based representations

LLMs & evaluation: Transformers/Hugging Face, supervised fine-tuning, LoRA, reward modeling, tool-use training, agent evaluation, post-training data, benchmark evaluation

Statistics & experimentation: group-held-out evaluation, permutation and randomization tests, bootstrap inference, repeated-measures analysis, ablations, model selection, sensitivity analysis

Programming & tools: Python, C/C++, CUDA, NumPy, pandas, SciPy, SQL/SQLite, Linux, Git, Docker

Teaching & curriculum: course planning, learning objectives, lecture development, labs and assignments, assessment design, rubrics, project-based learning, mentoring, student feedback

Additional research tools: MATLAB, R, Jupyter, LaTeX, Playwright, JSON Schema