Mohammad R. **Rezaei**

Machine Learning · Latent Dynamical Models

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Education

University of Toronto — *Toronto, Canada*

Ph.D. in Biomedical Engineering — *Sep 2020 - Sep 2024*

- **Project**: Deep generative models for latent dynamics inference from neural and behavioral signals in patients with brain disorders
- **Supervisors**: Drs. Milos R. Popovic and Milad Lankarany

Isfahan University of Technology (IUT) — *Isfahan, Iran*

M.S. in Electrical Engineering (Communication Systems) — *2016 - 2019*

- **Project**: Deep neural networks for neural decoding
- **Supervisors**: Drs. Saeed Sadri, Behzad Nazari, and Ali Yousefi

Isfahan University of Technology (IUT) — *Isfahan, Iran*

B.S. in Electrical Engineering (Electronics) — *2012 - 2016*

- **Project**: Design and Development of a Wide-band Frequency Synthesizer(Top 3 Undergraduate Research Project)

Research Interests

Generative models, Large Language models, Bayesian Statistics, Diffusion-based models

Experience

Visiting Researcher, Massachusetts General Hospital(MGH)- Harvard medical school — *USA, Boston*

Area of Focus: — *Dec. 2022 - Jun. 2023*

- Speech decoding from ECoGs using large-scale language models
- Online speech-driven event detection for closed-loop neuromodulation

Research intern, iHerb Inc — *USA, Irvine, remote*

Research Focus: — *Jul. 2021 - Jun. 2022*

- Graph-based deep generative models for product-product and customer-product interaction modeling in e-commerce data
- Representational learning for e-commerce data

Machine Learning Engineer, Ortho BioMed Inc. part-time — *Toronto, Canada*

Research Focus: — *Apr. 2020 - Dec. 2022*

- Design and implementation of Bayesian deep neural networks for organ transplantation
- Interpretable AI for decision-making for organ transplantation

Research Assistant, Krembil & Toronto Rehabilitation Research Institutes — *Toronto, Canada*

Research Focus: — *Sep. 2020 - Present*

- Design and implementation of Bayesian models for latent brain state inference from both neural activity and behavioral signals

Research Assistant, Isfahan University of Technology, Laboratory of Digital Signal Processing — *Isfahan, Iran*

Research Focus: — *Aug. 2016 - Exp. Apr. 2019*

- Recurrent neural networks for estimating 2-D movement trajectory of a rat using spiking activities in hippocampus place cells
- Encoder-decoder models for real-time neural decoding using Gaussian mixture models
- Deep neural networks for removing eye blink artifact from single-channel EEG recordings from Healthy Subjects in Coma State
- Deep neural networks for classifying steady state visually evoked potential (SSVEP) signals

Publications

- **Mohammad R. Rezaei**, Milos R Popovic, Milad Lankarany, Ali Yousefi "Deep Discriminative Direct Decoders for High-dimensional Time-series Analysis", accepted, NBDT journal, 2022
- **Mohammad R. Rezaei**, Haseul Jeoung, Ayda Gharamani, Utpal Saha, Venkat Bhat, Milos R Popovic, Ali Yousefi, Robert Chen, Milad Lankarany"Inferring Cognitive State Underlying Conflict Choices in Verbal

Stroop Task Using Heterogeneous Input Discriminative-Generative Decoder Model", , Journal of Neural Engineering, Jul, 2023

- **Mohammad R. Rezaei**, Alex E. Hadjinicolaou, Sydney S. Cash, Uri T. Eden, Ali Yousefi, "Direct Discriminative Decoder Models for Analysis of High-Dimensional Dynamical Neural Data", Journal of Neural Computation, May, 2022, (cover paper)
- **Mohammad R. Rezaei**, Reza Saadati Fard, Ebrahim Pourjafari, Navid Ziaei, Amir Sameizadeh, Mohammad Shafiee, Mohammad Alavinia, Mansour Abolghasemian, Nick Sajadi "Reverse Survival Model (RSM): A Pipeline for Explaining Predictions of Deep Survival Models", Applied Intelligence , Apr., 2023
- **Mohammad R. Rezaei** , Kensuke Aria, Loren M. Frank, Uri T. Eden, Ali Yousefi, "Real-Time Point Process Filter for Multidimensional Decoding Problems", Journal of Neuroscience Methods, Dec, 2020
- **Mohammad R. Rezaei** , Milos R. Popovic, Milad Lankarany, "A Time-Varying Information Measure for Tracking Dynamics of Neural Codes in a Neural Ensemble", Entropy, Aug, 2020
- **Mohammad R. Rezaei**, Milos R. Popovic, Steven A. Prescott, Milad Lankarany, "Synchrony-Division Neural Multiplexing: An Encoding Model", Entropy, March 2023
- Navid Hasanzadeh,**Mohammad R. Rezaei** , Milos R. Popovic, Milad Lankarany, "Necessary Conditions for Reliable Propagation of Slowly Time-Varying Firing Rate", Frontiers in Computational Neuroscience, Jul, 2020
- Aman Bhargava, **Mohammad R. Rezaei**, Milad Lankarany, "Gradient-Free Neural Network Training via Synaptic-Level Reinforcement Learning", Appliedmath-MDPI(cover paper), Apr, 2022
- **Mohammad R. Rezaei**, Anna K Gillespie, Jennifer A. Guidera, Behzad Nazari, Saeid Sadri, Loren M. Frank, Uri T. Eden, Ali Yousefi, "A Comparison Study of Point-Process Filter and Deep Learning Performance in Estimating Rat Position Using an Ensemble of Place Cells", 40^{th} International Conference of the IEEE Engineering in Medicine and Biology Science (EMBC 2018), Hawaii, USA, Jul 2018
- Ebrahim Pourjafari, Navid Ziaei, **Mohammad R. Rezaei**, Amir Sameizadeh, Mohammad Shafiee, Mohammad Alavinia, Mansour Abolghasemian, Nick Sajadi "Survival Seq2Seq: A Survival Model based on Sequence to Sequence Architecture", Machine Learning for Healthcare(MLHC), 2022
- Bahador, Nooshin, Josh Saha, **Mohammad R. Rezaei**, Utpal Saha, Ayda Ghahremani, Robert Chen, and Milad Lankarany. "Robust Removal of Slow Artifactual Dynamics Induced by Deep Brain Stimulation in Local Field Potential Recordings using SVD-based Adaptive Filtering.", bioRxiv, 2023, biorxiv
- **Mohammad R. Rezaei**, Ali Yousefi, Behzad Nazari, Saeid Sadri, Loren M. Frank, Uri T. Eden, "Deep Recurrent Neural Network and Point Process Filter Approaches in Multidimensional Neural Decoding Problems", biorxiv

Patents

- OrthoBiomed Inc., Identification of organ donors for transplantation among potential donors, International Bureau of WIPO, Ref:254-PCT008, filed January 10- 2022, Pending

Abstracts

- S. Mohseni, O. Olang, D. Yuen, K. Tinckam, D J. Treleaven, N. Selzner, N. Sajadi, E. Pourjafari, **M. R. Rezaei**, A. Samiezadeh, M. Alavinia, M. Aarabi, Shafiee M."Novel Artificial Intelligence Algorithm Using Donor/Recipient Factors Outperforms Existing Methods in Predicting Kidney Transplant Outcome: A Study of 142,971 Transplants from the SRTR", Accepted, Banff-CST, 2022
- O. Olang, S. Mohseni, K. Tinckam, D. Treleaven, L. Hawryluck, L. Chia Wei, N. Sajadi, E. Pourjafari, **M. R. Rezaei**, A. Samiezadeh, M. Alavinia, M. Aarabi, A. Sabet, M. Shafiee "Deep neural network model to define and rank predictors of failure time in kidney transplantation in young population (aged $\leq$ 18)", Accepted, Banff-CST, 2022

Academic Service

Reviewer Sensors and Entropy Journals from MDPI, 2021-2023
Student Member Canadian Association for Neuroscience, 2021-2022

Conferences & Seminars

Brain Engineering & Computational Neuroscience Conference *Tehran, Iran*

Point-Process Filter vs Deep Learning in Estimating Rat Position Using an Ensemble of Place Cells *Feb. 2018*

- A Comparison Study of Point-Process Filter and Deep Learning Performance in Estimating Rat Position Using an Ensemble of Place Cells

Seminar of deep learning applications in medical imaging *Isfahan, Iran*

Deep neural networks (DNNs) in segmentation of medical images *Oct. 2017*

- RCNN, fast-RCNN, faster-RCNN, YOLO, SegNet, Mask R-CNN

Honors & Awards

2022 **Research Award,** The Mitacs Globalink Research Award (GRA) *Toronto, Canada*

2020-2021 **Fellowship,** Graduate school of engineering fellowship from University of Toronto *Toronto, Canada*

2016 **Top 1%,** Ranked 150 (top 0.5%) among 35,000 participants in National University Entrance Exam for Graduate Studies *Iran*

Skills

Programming Python, Matlab, C, C++
Software Tensorflow, Pytorch, LangChain, Git, Azure DevOps, AWS
Languages English , Farsi

Teaching Experience

University of Toronto *Toronto, Canada*

Teaching assistant: MIE350H1 - Design and Analysis of Information Systems *Fall 2021*

- Instructor: Dr. Michael Gruninger

Toronto, Canada

Teaching assistant: MAT188H1F Linear Algebra *Fall 2021*

- Instructor: Dr. Camelia Karimian pour

Toronto, Canada

Teaching assistant: CSC165H1 Mathematical Expression and Reasoning for Computer Science *Winter 2022*

- Instructor: Dr. François Pitt