Suzan Farhang-Sardroodi, PhD

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Computational scientist with a systems-level perspective, holding a Ph.D. in Physics with specialization in **evolutionary dynamics on complex networks and stochastic processes**.

Extensive experience in developing **mechanistic mathematical models** of complex biological systems, including immune dynamics, cancer cachexia, and pharmacological processes, combined with strong expertise in **data-driven modeling, statistical inference, and quantitative analysis**.

Currently focused on **integrating multi-omic and clinical data using computational approaches** to translate genomic associations into **biologically meaningful and clinically relevant therapeutic targets for neuropsychiatric disorders**.

- Mechanistic modeling of biological systems (ODEs, stochastic processes)
- Statistical genetics and large-scale genomic data analysis (GWAS, multi-trait analysis [MTAG], and integrative functional genomics for gene prioritization and therapeutic target identification)
- Predictive modeling and machine learning in biomedical datasets
- **Pharmacokinetics (PK):** Noncompartmental analysis (NCA) and population PK (PopPK) modeling using nonlinear mixed-effects (NLME) approaches
- Programming: Python, Julia, R

Technical Skills

Statistical Genetics & Bioinformatics: GWAS, MTAG, fine-mapping, colocalization, PRS calculation, TWAS (including joint/conditional TWAS), integrative multi-omic annotation, single-cell genomic analysis, advanced computational workflows in psychiatric genetics

Single-Cell Analysis & Genomic Annotation: UMAP, SCNET-based single-cell regulatory analysis, FUMA, FIVEx, LocusZoom (web and R), Manhattan, Miami, QQ plots, Venn diagrams

Pharmacokinetics (PK): Phoenix NLME 8.5.2.4 (nonlinear mixed-effects modeling, compartmental analysis), Phoenix WinNonlin 8.5.2.4 (noncompartmental analysis, NCA)

Machine Learning: predictive modeling in biomedical datasets, supervised learning, feature selection, classification models, simulation-based data generation, PCA and clustering; **familiarity with biology-informed neural networks (BINNs) for parameter estimation**

Programming: Python (NumPy, Pandas, SciPy, Scikit-learn, TensorFlow, matplotlib); Julia (DifferentialEquations.jl, Plots.jl, DataFrames.jl, GLM.jl, LsqFit.jl); R; C++

Other Tools: MATLAB, Mathematica, LaTeX, Microsoft Office, CorelDRAW

Professional Experience

Research Associate *Jan 2024 – Present*
University of Toronto — Department of Pharmacology & Toxicology

- Led multi-trait genomic analyses (MTAG) integrating schizophrenia and smoking behaviour

GWAS, identifying **novel risk loci** for CigDay and smoking cessation; performed **statistical fine-mapping and eQTL colocalization** to prioritize candidate genes (e.g., SYNDIG1L, TMEM163) and conducted integrative analyses linking genetic findings to **psychiatric drug targets and biological pathways**.
- Developed and validated **population pharmacokinetic (PopPK) models** of nicotine in African green monkeys using nonlinear mixed-effects (NLME) modeling (Phoenix NLME), incorporating **noncompartmental analysis (NCA)** and covariate modeling (age, sex, body weight) to quantify interindividual variability in nicotine disposition.

Postdoctoral Researcher *Mar 2022 – Jan 2024*
University of Manitoba & Université de Montréal

- Developed **mechanistic mathematical models** of B cell and antibody dynamics following primary and secondary SARS-CoV-2 infections using **ODE-based frameworks**, modeling germinal center B cells, plasma cells, memory B cells, and antibody kinetics; calibrated models to clinical data to quantify **antibody production, waning immunity, and variant-specific neutralization**; and performed simulation studies to evaluate immune response dynamics and predict protection following reinfection or vaccination.

Postdoctoral Researcher *Sep 2020 – Feb 2022*
York University

- Developed **machine learning models** in collaboration with the National Research Council Canada (NRCC) to distinguish COVID-19 and influenza, leveraging synthetic datasets generated from **mechanistic viral infection models** for supervised learning and feature selection.
- Built **compartmental epidemiological models** incorporating vaccination, behavioural dynamics, and waning immunity to reproduce COVID-19 transmission in Ontario.
- Modeled **immune response to adenovirus-based vaccines** using ODE systems to evaluate dosing strategies and immunological outcomes.

Postdoctoral Researcher *Sep 2018 – Aug 2020*
Toronto Metropolitan University

- Developed **mechanistic models of cancer cachexia** capturing interactions between tumor cells, muscle cells, and satellite cells, to characterize tumor–host dynamics.
- Modeled chemotherapy-induced muscle wasting and **nonlinear dose–response relationships** for 5-fluorouracil treatment, to evaluate treatment-induced toxicity and optimize dosing strategies.

Education

Ph.D. in Physics (Evolutionary Graph Theory) **Sep 2014– Jun 2018**
University of Zanjan, Zanjan, Iran
Thesis: **Evolutionary Dynamics on Complex Networks**
Summary: Studied evolutionary dynamics in structured populations using network-based models, with applications to biological systems such as tumour microenvironments.
Supervisors: Dr. Amir Hossein Darooneh (University of Zanjan); Dr. Mohammad Kohandel (University of Waterloo)
Collaborator: Dr. Natalia L. Komarova (UC San Diego)
Visiting Ph.D. Researcher (Exchange), University of Waterloo, Canada, 2017–2018

M.Sc. in Physics (High-Energy Particle Physics) **Sep 2009– Jan 2012**
Azarbaijan Shahid Madani University, Tabriz, Iran
Thesis: **Nambu Structures on Four-Dimensional Real Lie Groups**

B.Sc. in Physics **2005–2008**
University of Tabriz, Tabriz, Iran

Selected Publications

- **Farhang-Sardroodi, S.**, Chang, C., Pouget, J.G., Tyndale, R.F., and Chenoweth, M.J. (2025). Genome-wide multi-trait genomic and transcriptomic analyses of smoking behaviours and schizophrenia reveal new biological insights and opportunities for drug repurposing. *European Neuropsychopharmacology*, 99, 245. DOI: 10.1016/j.euroneuro.2025.08.431
- **Farhang-Sardroodi, S.**, Ghaemi, M.S., Craig, M., Ooi, H.K., and Heffernan, J.M. (2022). A machine learning approach to differentiate between COVID-19 and influenza infection. *Mathematical Biosciences and Engineering*. DOI: 10.3934/mbe.2022272
- **Farhang-Sardroodi, S.**, La Croix, M.A., and Wilkie, K.P. (2022). Chemotherapy-induced cachexia and model-informed dosing to preserve lean mass in cancer treatment. *PLoS Computational Biology*. DOI: 10.1371/journal.pcbi.1009505
- Korosec, C.S., **Farhang-Sardroodi, S.**, Dick, D.W., Gholami, S., Ghaemi, M.S., Moyles, I.R., Craig, M., Ooi, H.K., and Heffernan, J.M. (2022). Long-term durability of immune responses to the BNT162b2 and mRNA-1273 vaccines based on dosage, age and sex. *Scientific Reports*. DOI: 10.1038/s41598-022-25134-0
- Gholami, S., Korosec, C.S., **Farhang-Sardroodi, S.**, Dick, D.W., Craig, M., Ghaemi, M.S., Ooi, H.K., and Heffernan, J.M. (2023). A mathematical model of protein subunits COVID-19 vaccines. *Mathematical Biosciences*. DOI: 10.1016/j.mbs.2023.108970
- **Farhang-Sardroodi, S.**, Korosec, C.S., Gholami, S., Craig, M., Moyles, I.R., Ghaemi, M.S., Ooi, H.K., and Heffernan, J.M. (2021). Analysis of host immunological response of adenovirus-based COVID-19 vaccines. *Vaccines*. DOI: 10.3390/vaccines9080861
- Molla, J., **Farhang-Sardroodi, S.**, Moyles, I.R., and Heffernan, J.M. (2023). Pharmaceutical and non-pharmaceutical interventions for controlling the COVID-19 pandemic. *Royal Society Open Science*. DOI: 10.1098/rsos.230621

- **Farhang-Sardroodi, S.** and Wilkie, K.P. (2020). Mathematical model of muscle wasting in cancer cachexia. *Journal of Clinical Medicine*. DOI: 10.3390/jcm9072029
- **Farhang-Sardroodi, S.**, Komarova, N.L., Michelen, M., and Pemantle, R. (2021). Success probability for selectively neutral invading species in the line model with a random fitness landscape. *Studies in Applied Mathematics*. DOI: 10.1111/sapm.12373
- **Farhang-Sardroodi, S.**, Darooneh, A.H., Kohandel, M., and Komarova, N.L. (2019). Environmental spatial and temporal variability and its role in non-favoured mutant dynamics. *Journal of the Royal Society Interface*. DOI: 10.1098/rsif.2018.0781
- **Farhang-Sardroodi, S.**, Darooneh, A.H., Nikbakht, M., Komarova, N.L., and Kohandel, M. (2017). The effect of spatial randomness on the average fixation time of mutants. *PLoS Computational Biology*. DOI: 10.1371/journal.pcbi.1005864
- **Farhang-Sardroodi, S.**, Rezaei-Aghdam, A., and Sedghi-Ghadim, L. (2015). Nambu structures on four-dimensional real Lie groups and related superintegrable systems. *Theoretical and Mathematical Physics*. DOI: 10.1007/s11232-015-0288-9

Awards

- **GSK Pharmaceutical Industry Fellowship**, 2024–2026
- **HQP Travel Support Award**, Canadian Applied and Industrial Mathematics Society (CAIMS), 2024
- **Landahl Travel Grant**, Society of Mathematical Biology (SMB) Annual Meeting, 2023
- **Travel Award**, IMO Workshop: Cancer Communities, Moffitt Cancer Center, 2022
- **FOS Dean's Research Fund Travel Award**, Toronto Metropolitan University, 2019

Selected Conference Presentations

- Virtual Talk, *Population Pharmacokinetic Modelling of Nicotine in the African Green Monkey*, CAMH Addiction Research Rounds, Toronto, Canada, Feb 2026
- Virtual Talk, *Genome-Wide Multi-Trait Analysis of Smoking Behaviours and Schizophrenia Identifies Novel Loci and Therapeutic Targets*, CAMH Addiction Research Rounds, Apr 2025
- Poster, *Genome-Wide Multi-Trait Genomic and Transcriptomic Analyses of Smoking Behaviours and Schizophrenia*, World Congress of Psychiatric Genetics (WCPG), 2025
- Poster, *Genome-Wide Multi-Trait Analysis of Smoking Behaviours and Schizophrenia*, Society of Biological Psychiatry (SOBP), 2025
- Poster, *Multi-Trait Genome-Wide Association Analysis of Psychiatric Traits*, American Society of Human Genetics (ASHG), 2024
- Poster, *Genetic Risk Factors for Concurrent Tobacco Use and Schizophrenia*, Pharmacogenomics Global Research Network (PGRN), 2024

Conference Organization

- Organizer, Mini-symposium: *Advancing Health and Medicine through Scientific Computing: Mechanistic Modelling, Machine Learning, and Quantitative Systems Pharmacology*, CAIMS Annual Meeting, 2024
- Organizer, Mini-symposium: *AI for Enhancing Public Health and Healthcare in Canada*, CAIMS Annual Meeting, 2024

- Organizer, Mini-symposium: *Mathematical and Computational Approaches to Modelling Immunology*, CMPD6 Workshop, 2023

Professional Service

- Poster Judge, World Congress of Psychiatric Genetics (WCPG), 2025
- Poster Judge, Visions in Pharmacology (VIP) Research Day, University of Toronto, 2025

Professional Service & Memberships

- Peer reviewer for Frontiers in Immunology, PLOS Computational Biology, and Mathematical Biosciences.
- Steering Committee Member, Centre for Mathematical Medicine, Fields Institute (2025–2028).
- Affiliate Member, Acceleration Consortium, University of Toronto.
- Member, T-CAIREM (Temerty Centre for AI Research and Education in Medicine).

Additional

Languages: English, Turkish, Persian