Amirmahdi Mostofinejad

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Summary

I am a Ph.D. candidate at the University of Toronto. My background is in mathematical abstraction, formulation, and model inference for biological processes, with my master's on tumor-induced angiogenesis and my Ph.D. on population dynamics of induced pluripotent stem cells (iPSCs), focusing on their differentiation towards lung progenitors. This includes performing model selection between multiple biologically informed models using sparse experimental data. I also spent a Summer at Genentech working on translational QSP modeling of drug effects on non-small lung cancer cells. There, I developed and validated a pharmacokinetics-pharmacodynamics model for two small molecule drugs undergoing FDA approval, leveraging predictive modeling and simulation tools to optimize drug efficacy and safety. I have extensively utilized Python, Julia, and MATLAB throughout my projects for model preprocessing, numerical solvers, optimization, and visualization, demonstrating a strong ability to adapt quickly and learn new tools.

Skills

Concepts	Mathematical modeling, model inference, experimental design, optimization, machine learning, deep learning, CI/CD, cloud computing, data science, data analysis, visualization, version control, ETL
Languages	Julia, Python, MATLAB, R, SQL, C/C++
Libraries	SciML, SciPy, PyTorch, TensorFlow, SimBiology, scikit-learn, Turing.jl
Solvers	COMSOL Multiphysics, FEniCS, Ansys, Abaqus FEA
Misc.	ParaView, MeshLab, Solidworks, AutoCAD, gmsh, Git, Linux, LaTeX

Education

Ph.D., Mechanical Engineering, University of Toronto Sep 2019 - Nov 2024

- Developed three mathematical models for BEAS-2Bs, induced pluripotent stem cells (iPSCs), and anterior foregut endoderm population dynamics using global optimization and parameter identifiability supervised by Prof. Cristina Amon.
- Developed a methodology for inferring unique biologically-informed mathematical models and applying it to *in vitro* cell population dynamics.
- Optimized state-of-the-art experimental protocols for cell culture using the developed models.
- Instructed tutorials, held office hours, and graded exams, reports, and projects (details in the Teaching section).

M.A.Sc., Civil Engineering, University of Waterloo Sep 2016 - May 2019

- Modeled tumor-induced angiogenesis by modeling the migration of the endothelial cells and their interaction with the extracellular matrix, supervised by Prof. Adil Al-Mayah.
- Solved a system of partial differential equations describing the biochemical, mechanical, and vasculature using nonlinear finite element analysis in MATLAB.

B.Eng, Civil Engineering, Sharif University of Technology Sep 2011 - Sep 2015

Experience

Genentech | Quantitative systems pharmacology intern June 2023 – Sept. 2023

- Translational quantitative systems pharmacology (QSP) modeling of drug effects on KRAS-G12C alkylation and MAPK pathway inhibition for supporting clinical development.
- Developed a QSP model for the effect of two non-small cell lung cancer drugs on MAPK cascade and their effect on tumor growth in humans and mice using MathWorks SimBiology and Julia, supervised by Dan Lu.
- Performed statistical analysis on longitudinal data to inform candidate models.
- Developed a toolbox to facilitate data flow between different phases of model development previously done manually. This toolbox performed clinical data cleaning, made publication-ready visualizations and tables, and identified previous human errors in data processing.

Projects

Physics-informed deep learning for inference in dynamical systems Report

Developed a TensorFlow code for parameter estimation of stochastic differential equations using noisy synthetic data.

SIMPLE solver for the lid-driven cavity problem Report
Developed a Python solver from scratch to solve the Navier-Stokes equations using "SIMPLE" method.

ATP production in cancer cells
Developed a mathematical model for investigating the three different methods for ATP production in cells.

Effects of matrix degradation on pressure-diameter curves in vessels
Investigated effects of different matrix densities on the pressure-diameter curve of the common iliac artery.

Publications & Presentations

Mostofinejad, A., D.A. Romero, D. Brinson, A.E. Marin-Araujo, et al. (2024). "In silico model development and optimization of in vitro lung cell population growth". In: *PLOS ONE* 19.5, e0300902. DOI: 10.1371/journal.pone.0300902.

Mostofinejad, A., D.A. Romero, D. Brinson, T.K. Waddell, et al. (2024a). "In silico model development of in vitro directed differentiation of induced pluripotent stem cells to definitive endoderm". In: *Submitted*.

– (2024b). "In silico model development of induced pluripotent stem cells differentiation to definitive endoderm". In: pp. 315–316. DOI: 10.1089/ten.tea.2024.06979.abs.

– (2024c). "In silico modeling of induced pluripotent stem cell population dynamics towards airway epithelium". In: Presented at ISSCR 2024.

– (2023). "In silico model development of induced pluripotent stem cells differentiation to definitive endoderm". In: Presented at Medicine by Design Symposium 2023.

Mostofinejad, A., A.E. Marin Araujo, et al. (2022). "In silico model development for in vitro lung cell population dynamics". In: vol. 28. S2, pp. 47–48. DOI: 10.1089/ten.tea.2022.29030.abstracts.

– (2021). "In silico modeling of lung cell proliferation". In: Presented at Medicine by Design Symposium 2021.

Honors & Awards

Barbara and Frank Milligan Graduate Fellowship Oct. 2020
William Dunbar Memorial Scholarship Apr. 2020
MIE Fellowship May 2019
Ontario Graduate Scholarship July 2018
President's Graduate Scholarship July 2018

Leadership

Director of Academic & Professional Development AMIGAS, UofT
Member of Executive Committee ISAW, UWaterloo
Vice President of Scientific Activities Civil Engineering Student Association, Sharif
VP of Entrepreneurship Green Tomorrow, Sharif

Teaching

University of Toronto
MIE334, Numerical Methods I (x4),
MIE1625, Data Science & Quantitative Analysis (x4),
BME1478, Coding for Biomedical Engineers (x2),
CSC111, Foundations of Computer Science II.
CSC108, Computer Fundamentals (x4),
APS105, Intro to Computer Programming (x2),
CSC110, Foundations of Computer Science I.,

University of Waterloo
Statics,
Mechanics of Solids II.
Structural Concrete Design I,

Courses

Artificial intelligence, Nonlinear modeling of biological systems, Mathematical cell biology, Cancer mechanics, Finite element analysis, Continuum mechanics, Computational fluid mechanics, Probabilistic modeling.