Alireza Poshtkohi

Lecturer in Computer Science · University of Hertfordshire

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Research profile

Computational neuroscientist and mathematical scientist developing theories and research software across ion-channel biophysics, glial signalling, nonassociative algebra and scientific computing. Research connects the published generalised Hodgkin–Huxley framework, the General Theory of Gating, experimental–computational glial programmes and Pentarnion mathematics.

Academic and research experience

Lecturer in Computer Science, University of Hertfordshire

2023–present

Research, undergraduate/postgraduate teaching, and BSc/MSc supervision.

Doctoral Researcher, Ulster University

2019–2023

Computational neuroscience and biophysics; human microglial electrophysiology and calcium dynamics.

High-Performance Computing Centre, Shahed University

2008–2019

HPC-centre administration; research in modelling languages, simulation, compilers and engineering computation.

Research Director, Parallel & Distributed Systems Lab, Sharif University of Technology

2013–2018

Laboratory development within the EPCA group; parallel-computing research and training.

Education and qualifications

PhD, Computer Science / Computational Neuroscience — Ulster University, 2023.
Thesis: *Computational Modelling of Plasma Membrane Electrophysiology and Calcium Dynamics in Microglia.*

MSc, Electrical and Electronics Engineering — Shahed University, 2011.
BSc, Electrical and Electronics Engineering — Azad University of Qazvin, 2006.
PGCert, Learning and Teaching in Higher Education — University of Hertfordshire, 2024.
Fellow of the Higher Education Academy (FHEA).
Award: Vice Chancellor’s Research Scholarship, Ulster University.

Selected peer-reviewed publications

1. Alireza Poshtkohi and Brian D. Gulbransen (2026). **Generalised Hodgkin–Huxley model captures human P2X and AMPA receptor currents.** *The Journal of Physiology 604(1), 214–246*. 10.1113/JP288880.
2. Alireza Poshtkohi, John Wade, Liam McDaid, Junxiu Liu, Mark L. Dallas and Angela Bithell (2024). **Mathematical Modeling of PI3K/Akt Pathway in Microglia.** *Neural Computation 36(4), 645–676*. 10.1162/neco_a_01643.
3. Alireza Poshtkohi, John Wade, Liam McDaid, Junxiu Liu, Mark L. Dallas and Angela Bithell (2021). **Mathematical modelling of human P2X-mediated plasma membrane electrophysiology and calcium dynamics in microglia.** *PLOS Computational Biology 17(11), e1009520*. 10.1371/journal.pcbi.1009520.
4. Alireza Poshtkohi, M. B. Ghaznavi-Ghoushchi and Kamal Saghafi (2019). **Optimistic Modeling and Simulation of Complex Hardware Platforms and Embedded Systems on Many-Core HPC Clusters.** *IEEE Transactions on Parallel and Distributed Systems 30(2), 428–444*. 10.1109/TPDS.2018.2860014.
5. Alireza Poshtkohi, M. B. Ghaznavi-Ghoushchi and Kamal Saghafi (2019). **PSML: Parallel System Modeling and Simulation Language for Electronic System Level.** *The Journal of Supercomputing 75, 2691–2724*. 10.1007/s11227-018-2682-1.
6. Alireza Poshtkohi, M. B. Ghaznavi-Ghoushchi and Kamal Saghafi (2017). **The Parvicursor Infrastructure to Facilitate the Design of Grid and Cloud Computing Systems.** *Computing 99(10), 979–1006*. 10.1007/s00607-017-0541-1.

Book

Poshtkohi, A. & Ghaznavi-Ghoushchi, M. B. (2023). *Implementing Parallel and Distributed Systems.* CRC Press / Taylor & Francis. DOI: 10.1201/9781003379041.

Mathematical preprints and submitted manuscripts

1. Alireza Poshtkohi and Susanne Pumplün (2026). **From Quaternions to Pentarnions I: Algebra, geometry, and a spin model.** arXiv:2610.31485 · Submitted for publication. Preprint.
2. Alireza Poshtkohi and Susanne Pumplün (2026). **From Quaternions to Pentarnions II: quadratic differential equations.** arXiv:2610.34201 · Submitted for publication. Preprint.
3. Alireza Poshtkohi and Susanne Pumplün (2026). **A Five-Dimensional Nonassociative Algebra: Elliptic Integrability and Bracketing-Dependent Dynamics.** arXiv:2610.34202 · Submitted for publication. Preprint.

GTG manuscripts in preparation

- *The General Theory of Gating: a compositional theory of human ion-channel dynamics.* In preparation, 2026.
- *GTG Cell Studio: a language and compiler framework for ion-channel modelling.* In preparation, 2026.

Current research programmes

General Theory of Gating (GTG)

Leading the mathematical framework and computational realisation through a modelling language, compiler and GTG Cell Studio. Collaboration with Professor Mark L. Dallas (University of Reading) and Dr Moza Al-Owais (University of Leeds).

Human microglia

Leading computational development in an ongoing experimental–computational programme with Professor Mark L. Dallas, building on published microglial electrophysiology and calcium-signalling models and collaboration with Professor Volker Steuber at the University of Hertfordshire.

Enteric glia

Developing data-constrained models of spatiotemporal calcium signalling with Professor Brian D. Gulbransen (University of Nevada, Reno), connecting receptor dynamics to cellular and planned spatial models.

Pentarnions

Mathematical research with Dr Susanne Pumplün (University of Nottingham) on nonassociative algebra and nonlinear dynamics, arising from investigations motivated by Hodgkin–Huxley generalisation.

Selected research software

GTG Cell Studio: native Windows research preview; compiled-application distribution, installation key required. gtgcell.com.
Pentarnion Studio: scientific programming environment; first-party source under Apache 2.0. pentarnion.com. Software DOI: 10.5281/zenodo.23857836.
Published model implementations: gHH and computational-neuroscience repositories.
Computing infrastructure: PSML, Parvicursor/PADS, DotGrid and parallel simulation. github.com/poshtkohi.

Teaching, supervision and service

Undergraduate and postgraduate teaching in programming, software engineering, cloud computing, algorithms, operating systems, modelling and parallel computation. BSc/MSc project supervision and research training. Selected workshops include mathematical and computational models in biology (Hertfordshire, 2024) and numerical solution of differential equations (Ulster, 2023).

Journal reviewing across computer science, simulation and biomedical modelling, including IEEE Access, The Journal of Supercomputing, Simulation Modelling Practice and Theory, and Computers in Biology and Medicine.