

INDRANIL GHOSH

School of Mathematics and Statistics • University College Dublin • Belfield Dublin 4, V1W8

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WORK EXPERIENCE

Postdoctoral Fellow, Mathematical Neuroscience
University College Dublin

August 2025 – Present
Dublin, Ireland-D04 V1W8

Postdoctoral Fellow, Applied Mathematics
Massey University

Feb 2024 – August 2025
Palmerston North, New Zealand-4442

EDUCATION

Ph.D., Applied Mathematics [Awarded: 21st August, 2024]
Massey University

Jan 2021 – May 2024
Palmerston North, New Zealand-4442

M.Sc., Physics
Jadavpur University

2018 – 2020
Kolkata, India-700032

B.Sc., Physics
Jadavpur University

2015 – 2018
Kolkata, India-700032

AWARDS & HONORS

1. Cold Spring Harbour: Asia Teaching Assistance Fellowship for the School of Computational and Cognitive Neuroscience, China [June - July 2026]
2. Postdoctoral fellowship contract managed by the Science Foundation Ireland (SFI), Ireland [August 2025 - Present].
3. ANZIAM travel grant, managed by the Tasmanian branch, to visit the University of Tasmania, Australia [November 2024].
4. Postdoctoral fellowship contract (Marsden project) MAU2209, managed by the Royal Society Te Apārangi, New Zealand [Feb 2024 - August 2025].
5. Highly Commended Student Presentation award, NSW ANZIAM Mid Year Meeting [2023].
6. KiwiPycon Student Travel & Accommodation Grant [2023].
7. Prestigious **Red Sock** award for the best poster presentation, SIAM Conference on Applications of Dynamical Systems (DS23) [2023].
8. KiwiPycon Student Travel Grant [2022].
9. Marsden Ph.D. Grant contract MAU1809, managed by Royal Society Te Apārangi, New Zealand [Jan 2021 - Dec 2023].
10. “Top 40” new CRAN packages under the category Computational Methods for the R package QGameTheory [June 2020]

THESIS

[T1] *Indranil Ghosh, Robust chaos in piecewise-linear maps. Ph.D. Thesis, 2024. <https://mro.massey.ac.nz/handle/10179/69704>*

JOURNAL PUBLICATIONS

- [J1] **Indranil Ghosh***, Hammed Olawale Fatoyinbo and Sishu Shankar Muni, **Time series analysis of coupled slow-fast neuron models: From Hurst exponent to Granger causality.** *Chaos*, 35:103136, 2025. <https://doi.org/10.1063/5.0291493>
- [J2] **Indranil Ghosh*** and David J.W. Simpson, **Robust chaos in $\mathbb{R}^n$.** *Nonlinearity*, 38:095013, 2025. <https://iopscience.iop.org/article/10.1088/1361-6544/ae0114>
- [J3] **Indranil Ghosh*** and Hammed Olawale Fatoyinbo, **Fractional order induced bifurcations in Caputo-type denatured Morris-Lecar neurons.** *Commun. Nonlinear Sci. Numer. Simul.*, 150:108984, 2025. <https://doi.org/10.1016/j.cnsns.2025.108984>
- [J4] **Indranil Ghosh**, Hammed Olawale Fatoyinbo*, and Sishu Shankar Muni, **Comprehensive analysis of slow-fast denatured Morris-Lecar neurons.** *Phys. Rev. E*, 111(4):044204, 2025. <https://doi.org/10.1103/PhysRevE.111.044204>
- [J5] **Indranil Ghosh***, Robert I. McLachlan, and David J.W. Simpson, **Robust chaos in orientation-reversing and non-invertible two-dimensional piecewise-linear maps.** *J. Nonlinear Sci.*, 35:16, 2025. <https://doi.org/10.1007/s00332-024-10113-8>
- [J6] Anjana S. Nair, **Indranil Ghosh***, Hammed Olawale Fatoyinbo, and Sishu Shankar Muni, **On the higher-order smallest ring-star network of Chialvo neurons under diffusive couplings.** *Chaos* 34:073135, 2024. <https://doi.org/10.1063/5.0217017>
- [J7] **Indranil Ghosh***, Anjana S. Nair, Hammed Olawale Fatoyinbo, and Sishu Shankar Muni, **Dynamical properties of a small heterogeneous chain network of neurons in discrete time.** *Eur. Phys. J. Plus*, 139:545, 2024. <https://doi.org/10.1140/epjp/s13360-024-05363-0>
- [J8] **Indranil Ghosh***, Robert I. McLachlan, and David J.W. Simpson, **The bifurcation structure within robust chaos for two-dimensional piecewise-linear maps.** *Commun. Nonlinear Sci. Numer. Simul.*, 134:108025, 2024. <https://doi.org/10.1016/j.cnsns.2024.108025>
- [J9] **Indranil Ghosh***, Sishu Shankar Muni, and Hammed Olawale Fatoyinbo, **On the analysis of a heterogeneous coupled network of memristive Chialvo neurons.** *Nonlinear Dyn.*, 111:17499–17518, 2023. <https://doi.org/10.1007/s11071-023-08717-y>
- [J10] **Indranil Ghosh** and David J. W. Simpson*, **Renormalisation of the two-dimensional border-collision normal form.** *Int. J. Bifurcation Chaos* 32(12):2250181, 2022. <https://doi.org/10.1142/S0218127422501814>
- [J11] Sishu Shankar Muni*, Hammed Olawale Fatoyinbo, and **Indranil Ghosh**, **Dynamical effects of electromagnetic flux on Chialvo neuron map: nodal and network behaviors.** *Int. J. Bifurcation Chaos* 32(09):2230020, 2022. <https://doi.org/10.1142/S0218127422300208>
- [J12] **Indranil Ghosh** and David J. W. Simpson*, **Robust Devaney chaos in the two-dimensional border-collision normal form.** *Chaos* 32, 043120 (2022). <https://doi.org/10.1063/5.0079807>
- [J13] **Indranil Ghosh***, **Quantum Game Theory - I. Resonance** 26, 671–684 (2021). <https://doi.org/10.1007/s12045-021-1168-2> . **Quantum Game Theory - II. Resonance** 26, 791–812 (2021). <https://doi.org/10.1007/s12045-021-1180-6>. **Quantum Game Theory - III. Resonance** 26, 939–951 (2021). <https://doi.org/10.1007/s12045-021-1193-1>.

PUBLICATIONS IN CONFERENCE PROCEEDINGS

- [C1] Hammed Olawale Fatoyinbo*, Sishu Shankar Muni, **Indranil Ghosh**, Ibrahim Olatunji Sarumi, and Afeez Abidemi, **Numerical bifurcation analysis of improved denatured Morris-Lecar neuron model.** *2022 International Conference on Decision Aid Sciences and Applications (DASA)*. <https://doi.org/10.1109/DASA54658.2022.9765094>

[C2] Sarath Babu*, *Indranil Ghosh*, and B. S. Manoj, **Effort: A New Metric for Roadside Unit Placement in 5G Enabled Vehicular Networks.** *5GWF'2020 Proceedings*. <https://doi.org/10.1109/5GWF49715.2020.9221228>

PREPRINTS

[P1] Hammed Olawale Fatoyinbo*, and *Indranil Ghosh*, **Collective Phase Reorganization and Cluster Synchronization in Networks of Coupled Gumowski–Mira Maps.** <https://arxiv.org/abs/2607.03686>

[P2] David J.W. Simpson*, and *Indranil Ghosh*, **Resonant grazing bifurcations revisited.** <https://arxiv.org/abs/2602.22797>

[P3] *Indranil Ghosh**, and David J.W. Simpson, **The VIVID function for numerically continuing periodic orbits arising from grazing bifurcations of hybrid dynamical systems.** <https://arxiv.org/abs/2510.16218>

[P4] Yusuf Olatunji Tijani, *Indranil Ghosh*, Shina D. Oloniju, and Hammed Olawale Fatoyinbo*, **Disrupting the scammer lifecycle: A dynamically-consistent numerical analysis of a compartment model for scam-victim dynamics.** <https://arxiv.org/abs/2508.19817>

[P5] Hammed Olawale Fatoyinbo*, Parul Tiwari, Peter Olamide Olanipekun, and *Indranil Ghosh*, **A mathematical model of HPAI transmission between dairy cattle and wild birds with environmental effects.** <https://arxiv.org/abs/2508.12201>

[P6] Costas J. Efthimiou*, Gregory DeCamillis, and *Indranil Ghosh*, **A physics-driven study of dominance space in soccer.** <https://arxiv.org/abs/2202.00414>

SOFTWARES/REPOSITORIES

[S1] *Indranil Ghosh**, **vrfcd: van Rossum Functional Community Detection (v0.1.2).** PyPI, (2026). <https://github.com/indrag49/vrfcd>

[S2] *Indranil Ghosh**, and David J.W. Simpson, **VIVID.** *Github*, 2025. <https://github.com/indrag49/VIVID>

[S3] Yusuf Olatunji Tijani, *Indranil Ghosh*, Shina D. Oloniju, and Hammed Olawale Fatoyinbo, **Phising.** *Github*, 2025. <https://github.com/hamfat/Phishing>

[S4] Hammed Olawale Fatoyinbo, Parul Tiwari, Peter Olamide Olanipekun, and *Indranil Ghosh*, **HPAI-Cattle_Wildlife_Environment.** *Github*, 2025. https://github.com/hamfat/HPAI-Cattle_Wildlife_Environment

[S5] *Indranil Ghosh*, Hammed Olawale Fatoyinbo and Sishu Shankar Muni, **TS-SlowFast-dML.** *Github*, 2025. <https://github.com/indrag49/TS-SlowFast-dML>

[S6] *Indranil Ghosh* and David J.W. Simpson, **Robust-Chaos-In-Rn.** *Github*, 2025. <https://github.com/indrag49/Robust-Chaos-In-Rn>

[S7] *Indranil Ghosh* and Hammed Olawale Fatoyinbo, **Coupled-dML.** *Github*, 2025. <https://github.com/indrag49/Coupled-dML>

[S8] *Indranil Ghosh* and Hammed Olawale Fatoyinbo, **fractional-Order-dML.** *Github*, 2025. <https://github.com/indrag49/fractional-Order-dML>

[S9] *Indranil Ghosh*, **QGameTheory: Quantum Game Theory Simulator (v0.1.2).** *CRAN Repository*, 2020. <https://cran.r-project.org/web/packages/QGameTheory/index.html>

BLOGS

Indranil Ghosh, Introduction to Mathematical Optimization (with Python). <https://indrag49.github.io/Numerical-Optimization/>

Indranil Ghosh, Introductory Football Data Analysis. <https://realsoccerexpand.netlify.app/>

PAST WORK EXPERIENCE

Sirpi Products and Services Pvt. Ltd., Bangalore, India August 2020-December 2020.
Research Lead and SHEAR Project Lead (Remote)

Indian Institute of Space Science and Technology, Kerala, India. May 2019-June 2019.
Computer Science Intern

TEACHING/MARKING

Tutor in 2025 for Applied Programming in C++ (159.101) and Engineering Mathematics (228.271).
Guest Lecturer in 2024 for Calculus (160.101).

Tutor in 2024 for Calculus (160.101) and Engineering Mathematics (228.271).

Marking assistant in 2023 for Calculus (160.101) and Algebra (160.102).

SUPERVISION

Eoin Kenny November–April 2026
Discovering Governing Equations for Neural Dynamics using PySINDy *B.Sc. thesis*

CONFERENCE PRESENTATIONS

GPU computing using JAX. July 2026
Cold Spring Harbour summer school in Computational and Cognitive Neuroscience, 2026 *Tutorial*

Neuronal and network dynamics. June 2026
Cold Spring Harbour summer school in Computational and Cognitive Neuroscience, 2026 *Tutorial*

Scientific Python + AI assisted coding. June 2026
Cold Spring Harbour summer school in Computational and Cognitive Neuroscience, 2026 *Tutorial*

Community detection in van Rossum network. June 2026
International Conference on Mathematical Neuroscience 2026 *Poster*

Community detection in van Rossum network. May 2026
3rd British NetSci Symposium 2026 *Talk*

Time series analysis for coupled neurons. December 2025
Pydata Global 2025 *Tutorial*

Robust chaos in piecewise-linear maps. December 2025
Euromech Colloquium 2025: Recent advances in non-smooth dynamics *Talk*

Time series analysis for coupled neurons. November 2025
Pycon Ireland 2025 (flagship conference) *Tutorial*

Investigating robust chaos in piecewise-linear maps. UCD Applied and Computational mathematics seminar series	October 2025 <i>Talk</i>
Time series analysis for coupled neurons. Python Ireland meetup	October 2025 <i>Talk</i>
Time series analysis for coupled neurons. SciPy India community call	October 2025 <i>Invited Talk</i>
Resonant Grazing Bifurcations in Simple Impacting Systems. 30th International Conference on Difference Equations and Applications, 2025	July 2025 <i>Invited Talk</i>
Robust Chaos in Piecewise-Linear Maps. 30th International Conference on Difference Equations and Applications, 2025	July 2025 <i>Invited Talk</i>
Resonant Grazing Bifurcations in Simple Impacting Systems. SIAM Conference on Applications of Dynamical Systems (DS25), 2025	May 2025 <i>Invited Talk</i>
Dynamical aspects of denatured Morris-Lecar neurons. Seminar Series, Phuket Rajabhat University, Thailand (SS25), 2025	April 2025 <i>Invited Talk</i>
Advances in bifurcations and dynamics of low-dimensional maps. Oberseminar Dynamics, Technische Universität München, 2025	March 2025 <i>Invited Talk</i>
Resonant grazing bifurcations in simple impacting systems. The 14th AIMS Conference, 2024	December 2024 <i>Talk</i>
Robust Chaos in Piecewise Linear Maps. Joint meeting of the NZMS, AustMS and AMS, 2024	December 2024 <i>Talk</i>
Robust Chaos in Piecewise Linear Maps. ANZIAM Seminar Series, University of Tasmania, 2024	November 2024 <i>Invited Talk</i>
Robust Chaos in Piecewise Linear Maps. Applied Mathematics Seminar, University of Auckland, 2024	August 2024 <i>Invited Talk</i>
Dynamical Properties of Neuron Models - Nodal and Collective Behaviours. 2024 Mathematical Modelling and Analytics Research Centre (MMARC) - Seminar, Auckland University of Technology, 2024	August <i>Invited Talk</i>
Understanding the Topology of Chaotic Attractors for Piecewise-Linear Maps using Renormalisation. New Zealand Mathematical Society Colloquium, 2023	December 2023 <i>Talk</i>
Bifurcation structure of robust chaos in a generalised setting of piecewise-linear maps. December 2023 New Zealand Mathematical Society Colloquium, 2023	<i>Poster</i>
Understanding the Topology of Chaotic Attractors for Piecewise-Linear Maps using Renormalisation. New Zealand Mathematics and Statistics Postgraduate Conference, 2023	December 2023 <i>Talk</i>

Chaos, Robust Chaos and Applications. Café Scientifique	October 2023 <i>Talk</i>
Python: A career changing/shaping language. PyGotham TV, 2023	October 2023 <i>Talk</i>
Python: from the perspective of an applied mathematician. Kiwi Pycon XII, 2023	September 2023 <i>Talk</i>
Understanding the bifurcation structure of robust chaos in piecewise-linear maps using renormalisation. ICDEA 2023	July 2023 <i>Talk</i>
Bifurcation Structure within Robust Chaos for Piecewise-Linear Maps. NSW ANZIAM Mid Year Meeting 2023	June 2023 <i>Talk</i>
The Bifurcation Structure Within Robust Chaos of Piecewise-Linear Maps SIAM Conference on Applications of Dynamical Systems (DS23)	May 2023 <i>Poster</i>
Introduction to mathematical optimization using Python Python Delhi User Group Meetup, 2023	February 2023 <i>Tutorial</i>
Bifurcation structure of robust chaos in two-dimensional piecewise-linear maps 2022 New Zealand Mathematical Society Colloquium, 2022	December <i>Talk</i>
Bifurcation structure of robust chaos in 2D piecewise-linear maps Dynamical Systems in NZ - Castaways, 2022	November 2022 <i>Invited Talk (E-poster)</i>
Unconstrained Numerical Optimization using Python Kiwi Pycon XI, 2022	August 2022 <i>Tutorial</i>
Dynamical Effects of Electromagnetic Flux on Chialvo Neuron Map: Nodal and Network Behaviors SIAM Conference on the Life Sciences, 2022	July 2022 <i>Talk</i>
Renormalisation of the Two-Dimensional Border-Collision Normal Form SIAM Annual Meeting, 2022	July 2022 <i>Talk</i>
Renormalisation of the Two-Dimensional Border-Collision Normal Form NSW ANZIAM 2022 Mid-Year Conference, 2022	July 2022 <i>Talk</i>
Dynamical effects of electromagnetic flux on Chialvo neuron map: nodal and network behaviors BAMC, 2022	April 2022 <i>Talk</i>
Renormalisation of the Two-Dimensional Border-Collision Normal Form ANZIAM Annual Conference, 2022	February 2022 <i>Talk</i>
Learn Football Data Analysis with Python PyCode Conference, 2021	December 2021 <i>Talk</i>

Football (soccer) data analysis: A Pedagogic introduction PyCon Taiwan, 2021	October 2021 <i>Talk</i>
An introduction to hands-on football data analysis in Python PyCon Espana, 2021	October 2021 <i>Talk</i>
Football (soccer) data analysis: A pedagogic introduction PyConline AU, 2021	September 2021 <i>Talk</i>
Introduction to Soccer Pass Network Analysis with Python PyOhio, 2021	July 2021 <i>Thunder Talk</i>
Introducing a blog: Introductory Football Data Analysis EuroPython Conference, 2021	July 2021 <i>Lightning Talk</i>
Using Python to start learning Unconstrained Numerical Optimization Algorithms 2021 Pycon Colombia, 2021	June <i>Talk</i>
QGameTheory: An R package for teaching quantum computing and quantum game theory to students International Series of Online Research Software Events (SORSE)	April 2021 <i>Poster + Talk</i>
QGameTheory: A Quantum Game Theory Simulator written in R for teaching quantum computing and game theory to starting programmers and undergraduate students 2021 APS March Meeting 2021	March <i>Poster</i>
Develop and Document Your First R Package Sirpi Products and Services Pvt. Ltd.	December 2020 <i>Talk</i>
Learn Lambda Calculus with Python Pycode Conference 2020	December 2020 <i>Talk</i>
Teaching quantum computing and game theory with QGameTheory package 2020 Why R? 2020 Conference	September <i>Talk</i>
Introducing Lambda Calculus with Python Pycon Australia	September 2020 <i>Talk</i>
Quantum Game Theory with Julia: A computational analysis JuliaCon	July 2020 <i>Poster</i>
Build Your Own Quantum Simulator With R The European R Users Meeting	June 2020 <i>Lightning talk</i>
A Computational Study of Sequential Deposition: A Dynamic Monte Carlo Process in Statistical Physics Flatlands and beyond (2019) – A meet on 2D materials	September 2019 <i>Poster</i>
A Python implementation of Quantum Evolutionarily Stable Strategy Game, an interdisciplinary study of Quantum Computation and Game Theory in population biology	

February 2019
SLAS Conference

Poster

Analysis of Quantum Game Theoretic Models with a Python Simulator December 2018
SciPy India *Talk*

Analysis of Chaos Game Simulator in Pygame October 2018
International Conference on Complex Dynamical Networks, 2018 *Poster*

Computation of Analytic Structure Factor for Macromolecules June 2018
Research Topic of Statistical Physics to young Physicists, 2018 *Poster*

JOURNAL REFEREE

Chaos: An Interdisciplinary Journal of Nonlinear Science,
Nonlinear Dynamics: An International Journal of Nonlinear Dynamics and Chaos in Engineering Systems,
Communications in Theoretical Physics,
IEEE Transactions on Cybernetics,
Scientific Reports,
Communications in Nonlinear Science and Numerical Simulation,
Physica D: Nonlinear Phenomena,
The European Physical Journal Special Topics,
Advanced Quantum Technologies,
Applied Mathematical Modelling,
Chinese Journal of Physics,
International Journal of Bifurcation and Chaos,
4OR: A Quarterly Journal of Operations Research,
Physica A: Statistical Mechanics and its Applications,
IEEE Transactions on Automatic Control (TACON).

SKILLS

Softwares	Expert: Python, MATLAB, R, Fortran, git, L ^A T _E X, HTML, Markdown
Social	Github: https://github.com/indrag49 , LinkedIn: https://www.linkedin.com/in/indranil-ghosh-ph-d-1390a5299/ .

REFERENCES

- [R1] *Áine Byrne* (Postdoc host). *Email:* aine.byrne@ucd.ie <https://people.ucd.ie/aine.byrne>
- [R2] *David J. W. Simpson* (Ph.D. Supervisor, Postdoc host). *Email:* d.j.w.simpson@massey.ac.nz <https://www.massey.ac.nz/~djwsimps>
- [R3] *Robert I. McLachlan* (Ph.D. Co-supervisor). *Email:* r.mclachlan@massey.ac.nz <https://www.massey.ac.nz/~rmclachl/>
- [R4] *Bruce V. Brunt* (Teaching Mentor). *Email:* b.vanbrunt@massey.ac.nz