

INDRANIL GHOSH

School of Mathematical and Computational Sciences • Massey University • Palmerston North, 4442
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WORK EXPERIENCE

Postdoctoral Fellow, Applied Mathematics Massey University	Feb 2024 – Present Palmerston North, New Zealand-4442
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EDUCATION

Ph.D., Applied Mathematics 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. Postdoctoral fellowship contract (Marsden project) MAU2209, managed by Royal Society Te Apārangi, New Zealand [Feb 2024 - Present].
2. Highly Commended Student Presentation award, NSW ANZIAM Mid Year Meeting [2023].
3. KiwiPycon Student Travel & Accomodation Grant [2023].
4. Prestigious **Red Sock** award for the best poster presentation, SIAM Conference on Applications of Dynamical Systems (DS23) [2023].
5. KiwiPycon Student Travel Grant [2022].
6. Marsden Ph.D. Grant contract MAU1809, managed by Royal Society Te Apārangi, New Zealand [Jan 2021 - Dec 2023].
7. “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, **Comprehensive analysis of slow-fast denatured Morris-Lecar neurons**. *Phys. Rev. E*, 111(4):044204, 2025. <https://doi.org/10.1103/PhysRevE.111.044204>

[J2] *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>

[J3] 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>

- [J4] **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>
- [J5] **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, 2024. <https://doi.org/10.1016/j.cnsns.2024.108025>
- [J6] **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>
- [J7] **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>
- [J8] 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>
- [J9] **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>
- [J10] **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] **Indranil Ghosh*** and Hammed Olawale Fatoyinbo, **Fractional order induced bifurcations in Caputo-type denatured Morris-Lecar neurons.** <https://arxiv.org/abs/2502.17798>
- [P2] **Indranil Ghosh*** and David J.W. Simpson, **Robust chaos in \mathbb{R}^n .** <https://arxiv.org/abs/2410.22563>
- [P3] Costas J. Efthimiou*, Gregory DeCamillis, and **Indranil Ghosh**, **A physics-driven study of dominance space in soccer.** <https://arxiv.org/abs/2202.00414>

SOFTWARES

- [S1] **Indranil Ghosh** and Hammed Olawale Fatoyinbo, **Coupled-dML.** *Github*, 2025. <https://github.com/indrag49/Coupled-dML>
- [S2] **Indranil Ghosh** and Hammed Olawale Fatoyinbo, **fractional-Order-dML.** *Github*, 2025. <https://github.com/indrag49/fractional-Order-dML>

[S3] *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).

CONFERENCE PRESENTATIONS

Resonant Grazing Bifurcations in Simple Impacting Systems. May 2025
SIAM Conference on Applications of Dynamical Systems (DS25), 2025 *Invited Talk*

Dynamical aspects of denatured Morris-Lecar neurons. April 2025
Seminar Series, Phuket Rajabhat University, Thailand (SS25), 2025 *Invited Talk*

Advances in bifurcations and dynamics of low-dimensional maps. March 2025
Oberseminar Dynamics, Technische Universität München, 2025 *Invited Talk*

Resonant grazing bifurcations in simple impacting systems. December 2024
The 14th AIMS Conference, 2024 *Talk*

Robust Chaos in Piecewise Linear Maps. December 2024
Joint meeting of the NZMS, AustMS and AMS, 2024 *Talk*

Robust Chaos in Piecewise Linear Maps. November 2024
ANZIAM Seminar Series, University of Tasmania, 2024 *Invited Talk*

Robust Chaos in Piecewise Linear Maps. August 2024
Applied Mathematics Seminar, University of Auckland, 2024 *Invited Talk*

Dynamical Properties of Neuron Models - Nodal and Collective Behaviours. August 2024
Mathematical Modelling and Analytics Research Centre (MMARC) - Seminar, Auckland University of Technology, 2024 *Invited Talk*

Understanding the Topology of Chaotic Attractors for Piecewise-Linear Maps using Renormalisation.	December 2023
New Zealand Mathematical Society Colloquium, 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.	December 2023
New Zealand Mathematics and Statistics Postgraduate Conference, 2023	<i>Talk</i>
Chaos, Robust Chaos and Applications.	October 2023
Café Scientifique	<i>Talk</i>
Python: A career changing/shaping language.	October 2023
PyGotham TV, 2023	<i>Talk</i>
Python: from the perspective of an applied mathematician.	September 2023
Kiwi Pycon XII, 2023	<i>Talk</i>
Understanding the bifurcation structure of robust chaos in piecewise-linear maps using renormalisation.	July 2023
ICDEA 2023	<i>Talk</i>
Bifurcation Structure within Robust Chaos for Piecewise-Linear Maps.	June 2023
NSW ANZIAM Mid Year Meeting 2023	<i>Talk</i>
The Bifurcation Structure Within Robust Chaos of Piecewise-Linear Maps	May 2023
SIAM Conference on Applications of Dynamical Systems (DS23)	<i>Poster</i>
Introduction to mathematical optimization using Python	February 2023
Python Delhi User Group Meetup, 2023	<i>Tutorial</i>
Bifurcation structure of robust chaos in two-dimensional piecewise-linear maps	December 2022
New Zealand Mathematical Society Colloquium, 2022	<i>Talk</i>
Bifurcation structure of robust chaos in 2D piecewise-linear maps	November 2022
Dynamical Systems in NZ - Castaways, 2022	<i>Invited Talk (E-poster)</i>
Unconstrained Numerical Optimization using Python	August 2022
Kiwi Pycon XI, 2022	<i>Tutorial</i>
Dynamical Effects of Electromagnetic Flux on Chialvo Neuron Map: Nodal and Network Behaviors	July 2022
SIAM Conference on the Life Sciences, 2022	<i>Talk</i>
Renormalisation of the Two-Dimensional Border-Collision Normal Form	July 2022
SIAM Annual Meeting, 2022	<i>Talk</i>
Renormalisation of the Two-Dimensional Border-Collision Normal Form	July 2022
NSW ANZIAM 2022 Mid-Year Conference, 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 2021 <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 2021 <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 2020 <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
Lightning talk

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
Poster

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
SciPy India

December 2018
Talk

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

October 2018
Poster

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

June 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

SKILLS

Softwares	Expert: Python, MATLAB, R, Fortran, git, L ^A T _E X, HTML, Markdown
Social	Twitter: @indraghosh314, Github: https://github.com/indrag49 ,

REFERENCES

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