

# INDRANIL GHOSH

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## WORK EXPERIENCE

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

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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

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1. Postdoctoral fellowship contract (Marsden project) MAU2209, managed by Royal Society Te Apārangi, New Zealand [2024-2025].
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 [2021-2023].
7. “Top 40” new CRAN packages under the category Computational Methods for the R package QGameTheory [June 2020]

## THESIS

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

## JOURNAL PUBLICATIONS

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- [J1] 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>
- [J2] *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>
- [J3] *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>

[J4] **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>

[J5] **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>

[J6] 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>

[J7] **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>

[J8] **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

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[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

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[P1] **Indranil Ghosh\*** and David J.W. Simpson, **Robust chaos in  $\mathbb{R}^n$ .** <https://arxiv.org/abs/2410.22563>

[P2] **Indranil Ghosh\***, Robert I. McLachlan, and David J.W. Simpson, **Robust chaos in orientation-reversing and non-invertible two-dimensional piecewise-linear maps.** <https://arxiv.org/abs/2307.05144>

[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

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[S1] **Indranil Ghosh**, **QGameTheory: Quantum Game Theory Simulator (v0.1.2).** *CRAN Repository*, 2020. <https://cran.r-project.org/web/packages/QGameTheory/index.html>

## BLOGS

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

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

## PAST WORK EXPERIENCE

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**Sirpi Products and Services Pvt. Ltd.**, Bangalore, India  
*Research Lead and SHEAR Project Lead (Remote)*

August 2020-December 2020.

**Indian Institute of Space Science and Technology**, Kerala, India.  
*Computer Science Intern*

May 2019-June 2019.

## CONFERENCE PRESENTATIONS

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**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 *Talk*

**Bifurcation structure of robust chaos in a generalised setting of piecewise-linear maps.** December 2023  
New Zealand Mathematical Society Colloquium, 2023 *Poster*

**Understanding the Topology of Chaotic Attractors for Piecewise-Linear Maps using Renormalisation.** December 2023  
New Zealand Mathematics and Statistics Postgraduate Conference, 2023 *Talk*

**Chaos, Robust Chaos and Applications.** October 2023  
Café Scientifique *Talk*

**Python: A career changing/shaping language.** October 2023  
PyGotham TV, 2023 *Talk*

**Python: from the perspective of an applied mathematician.** September 2023  
Kiwi Pycon XII, 2023 *Talk*

**Understanding the bifurcation structure of robust chaos in piecewise-linear maps using renormalisation.** July 2023  
ICDEA 2023 *Talk*

**Bifurcation Structure within Robust Chaos for Piecewise-Linear Maps.** June 2023  
NSW ANZIAM Mid Year Meeting 2023 *Talk*

**The Bifurcation Structure Within Robust Chaos of Piecewise-Linear Maps** May 2023  
SIAM Conference on Applications of Dynamical Systems (DS23) *Poster*

**Introduction to mathematical optimization using Python** February 2023  
Python Delhi User Group Meetup, 2023 *Tutorial*

**Bifurcation structure of robust chaos in two-dimensional piecewise-linear maps** December 2022

New Zealand Mathematical Society Colloquium, 2022	<i>Talk</i>
<b>Bifurcation structure of robust chaos in 2D piecewise-linear maps</b> Dynamical Systems in NZ - Castaways, 2022	November 2022 <i>Invited Talk (E-poster)</i>
<b>Unconstrained Numerical Optimization using Python</b> Kiwi Pycon XI, 2022	August 2022 <i>Tutorial</i>
<b>Dynamical Effects of Electromagnetic Flux on Chialvo Neuron Map: Nodal and Network Behaviors</b> SIAM Conference on the Life Sciences, 2022	July 2022 <i>Talk</i>
<b>Renormalisation of the Two-Dimensional Border-Collision Normal Form</b> SIAM Annual Meeting, 2022	July 2022 <i>Talk</i>
<b>Renormalisation of the Two-Dimensional Border-Collision Normal Form</b> NSW ANZIAM 2022 Mid-Year Conference, 2022	July 2022 <i>Talk</i>
<b>Dynamical effects of electromagnetic flux on Chialvo neuron map: nodal and network behaviors</b> BAMC, 2022	April 2022 <i>Talk</i>
<b>Renormalisation of the Two-Dimensional Border-Collision Normal Form</b> ANZIAM Annual Conference, 2022	February 2022 <i>Talk</i>
<b>Learn Football Data Analysis with Python</b> PyCode Conference, 2021	December 2021 <i>Talk</i>
<b>Football (soccer) data analysis: A Pedagogic introduction</b> PyCon Taiwan, 2021	October 2021 <i>Talk</i>
<b>An introduction to hands-on football data analysis in Python</b> PyCon Espana, 2021	October 2021 <i>Talk</i>
<b>Football (soccer) data analysis: A pedagogic introduction</b> PyConline AU, 2021	September 2021 <i>Talk</i>
<b>Introduction to Soccer Pass Network Analysis with Python</b> PyOhio, 2021	July 2021 <i>Thunder Talk</i>
<b>Introducing a blog: Introductory Football Data Analysis</b> EuroPython Conference, 2021	July 2021 <i>Lightning Talk</i>
<b>Using Python to start learning Unconstrained Numerical Optimization Algorithms</b> 2021 Pycon Colombia, 2021	June 2021 <i>Talk</i>
<b>QGameTheory: An R package for teaching quantum computing and quantum game theory to students</b> International Series of Online Research Software Events (SORSE)	April 2021 <i>Poster + Talk</i>
<b>QGameTheory: A Quantum Game Theory Simulator written in R for teaching quantum computing and game theory to starting programmers and undergraduate students</b>	March

2021

APS March Meeting 2021

*Poster*

**Develop and Document Your First R Package**

Sirpi Products and Services Pvt. Ltd.

December 2020

*Talk*

**Learn Lambda Calculus with Python**

Pycode Conference 2020

December 2020

*Talk*

**Teaching quantum computing and game theory with QGameTheory package**  
2020

September

Why R? 2020 Conference

*Talk*

**Introducing Lambda Calculus with Python**

Pycon Australia

September 2020

*Talk*

**Quantum Game Theory with Julia: A computational analysis**

JuliaCon

July 2020

*Poster*

**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**

September 2019

Flatlands and beyond (2019) – A meet on 2D materials

*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*

## TEACHING/MARKING

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**Guest Lecturer** in 2024 for Calculus (160.101).

**Teaching assistant** in 2024 for Calculus (160.101).

**Teaching assistant** in 2024 for Engineering Mathematics (228.271).

**Marking assistant** in 2023 for Calculus (160.101).

**Marking assistant** in 2023 for Algebra (160.102).

## JOURNAL REFEREE

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- 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

## SKILLS

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**Softwares**      Expert: Python, MATLAB, R, Fortran, git, L<sup>A</sup>T<sub>E</sub>X, HTML, Markdown  
**Social**          Twitter: **@indraghosh314**,  
                      Github: <https://github.com/indrag49>,

## REFERENCES

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- [R1] *David J. W. Simpson* (Ph.D. Supervisor, Postdoc host). *Email: [d.j.w.simpson@massey.ac.nz](mailto:d.j.w.simpson@massey.ac.nz)*  
<https://www.massey.ac.nz/~djwsimps>
- [R2] *Robert McLachlan* (Ph.D. Co-supervisor). *Email: [r.mclachlan@massey.ac.nz](mailto:r.mclachlan@massey.ac.nz)* <https://www.massey.ac.nz/~rmclachl/>
- [R3] *Tammy Lynch* (PDF Manager, Deputy Head of the School of Mathematical and Computational Sciences). *Email: [t.a.lynch@massey.ac.nz](mailto:t.a.lynch@massey.ac.nz)*