

IRA J. S. SHOKAR

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PROFILE

Second Year PhD Candidate at the University of Cambridge's Department of Applied Mathematics and Theoretical Physics and Centre for Doctoral Training in the Application of Artificial Intelligence for Environmental Risk, researching emulation of atmospheric fluid flows and stochastically driven systems using Deep Learning.

Research Areas: Fluid Dynamics, Geophysical Fluid Dynamics, Turbulence, Chaotic Systems, Stochastic Dynamical Systems, Deep Learning, Reduced Order Models, Generative Models.

EDUCATION

Pembroke College, University of Cambridge Oct 2021 – Sep 2025 (Expected)

PhD Applied Mathematics - Application of Artificial Intelligence

Topic: Using Deep Learning to develop reduced-order-models of stochastically forced partial differential equations, enabling insight into the underlying system's dynamics.

Co-Supervised by Professors [Peter Haynes](#) & [Rich Kerswell](#) at [DAMTP](#).

Pembroke College, University of Cambridge Oct 2020 – Sep 2021

MRes Physical Sciences - Environmental Data Science

Thesis: 'Deep learning to predict dynamics on an inertial manifold of mid-latitude jet systems'.

Co-Supervised by Professors [Peter Haynes](#) & [Rich Kerswell](#) at [DAMTP](#).

University College, University of London Sep 2017 – Jul 2020

BSc Physical Sciences - Theoretical Physics - First Class Honours

Thesis: 'Deep Learning Classifier Robustness for Neutrino Event Detection using Domain Adversarial Neural Networks'.

Supervised by Dr Chris Backhouse, formally of UCL.

Tiffin School - Secondary Education

4 A-Levels : **A*** in Mathematics and Further Mathematics; **A** in Economics and Physics.

2 AS-Levels: **A** in History and Physical Education. **10 GCSEs:** **6A*** & **4A** grades.

PUBLICATIONS

Journal Publications:

3. Shokar, I., Kerswell, R., and Haynes, P.: Stochastic Latent Transformer to Model Zonal Jets, (In preparation, expected submission: Aug 2023).

Presentations at Conferences and Workshops:

2. Shokar, I., Haynes, P., and Kerswell, R.: Learning Stochastic Dynamics with Probabilistic Neural Networks to study Zonal Jets, EGU General Assembly 2023, Vienna, Austria, doi.org/10.5194/egusphere-egu23-9121 (2023).

1. Shokar, I., Haynes, P., and Kerswell, R.: Learning Stochastic Dynamics with Neural Networks to study Zonal Jets, UK Fluids Network Workshop on Data-Driven Methods in Fluid Dynamics, Leeds, UK, fluids.leeds.ac.uk/2023/workshop-data-driven-methods-in-fluid-dynamics (2023).

PRIZES AND AWARDS

UK Fluids Network Workshop on Data-Driven Methods in Fluid Dynamics - Best Presentation (2023)

- Title: 'Learning Stochastic Dynamics with Neural Networks to Study Zonal Jets' - [slides](#).

Smith–Knight & Rayleigh–Knight Prizes - Essay Prize (2023)

- Annual prize for research by a graduate student in mathematics at the University of Cambridge.

UKRI EPSRC Scholarship - Master's & Doctoral Full Studentship (2020)

- Full funding to study at the [CDT in the Application of Artificial Intelligence for Environmental Risks](#).

UCL Data Science Society Hackathon - Winning Team (2019)

Arm Holdings, Applied Machine Learning Insight Challenge - Winning Team (2019)

ORGANISED WORKSHOPS

Cambridge Centre for Climate Science - Machine Learning for Climate Science Workshop. (Mar 2022)

- Organised with 2 other graduate students a workshop introducing Machine Learning to researchers in the atmospheric sciences.

- Included with 3 interactive sessions & a hackathon implementing ML on in situ atmospheric data.

- In-person attendance reached capacity with 40 attendees, along with 8 virtual attendees.

- Resources can be found [here](#).

TEACHING

Deep Neural Networks - Part II Computer Science, University of Cambridge

- Example Classes (Lent Term 2022 & Lent Term 2023)

SUMMER SCHOOLS

Institute of Computing for Climate Science, Cambridge, 2023

- Organisation Volunteer and speaker - talk title: 'Learning Zonal Jet Dynamics with Stochastic Latent Transformers'.

Institute of Computing for Climate Science, Cambridge, 2022

- Attendee.

ACADEMIC MACHINE LEARNING RESEARCH

Stochastic Latent Transformer *Paper in Preparation*: A deep learning method for producing reduced-order models of stochastically forced nonlinear partial differential equations. This approach is applied to model atmospheric zonal jets, where turbulent eddies are stochastically parameterised. The deep learning model achieves a six-order-of-magnitude speed-up compared to traditional numerical methods.

Data-Driven Exploration of Mid-Latitude Weather. *MRes Thesis*: Developed an Autoencoder to explore whether a Beta-plane turbulence model of tropospheric mid-latitude circulation lay on an internal manifold, with the reduced form leading to a reconstruction error two orders of

magnitude smaller than PCA. We also explored the variability of the system due to its stochastic parameterisation scheme.

Assessing Temporal Change In The Exposure Of Informal Settlements Through Repeat Satellite Observation. *MRes Team Research Project:* Developed a settlement classifier with a change detection model to repeat satellite imagery, to identify the growth or contraction of informal settlements, from which we quantify exposure variation to natural hazards with available socio-economic data.

Deep Learning Classifier Robustness for Neutrino Event Detection using Domain Adversarial Neural Networks. *BSc Thesis:* Implemented a Adversarial Neural Network to improve the performance of a Convolutional Neural Network to classify neutrino interactions, for the analysis of neutrino oscillations, by training the model to be invariant to the differences in production mechanisms between the data sources: simulated data and the detector data.

TECHNICAL WORK EXPERIENCE

Data Science & Analytics Summer Intern

Jul 2019 – Aug 2019

FTI Consulting

Aldersgate St, City of London

- Created a relationship and transaction graph network in [Python] using [Neo4j] to produce a screening tool that determined key players and clusters within money laundering schemes that required investigation.
- This was used in conjunction with bank records in implementing fuzzy token matching in addition to anomaly detection models.

SERVICE AND COMMITTEE POSITIONS

Institute of Computing for Climate Science, Cambridge

- Summer School organisation volunteer (Jul 2023).

Graduate Parlour, Pembroke College, University of Cambridge

- Housing Officer (May 2022 – Present).
- President (May 2021 – May 2022).
- Events Officer (Nov 2020 – May 2022).

Pembroke College, University of Cambridge

- Library invigilator (Sep 2021 – Present).

CDT in the Application of Artificial Intelligence for Environmental Risks

- Academic Representative (Sep 2021 – Aug 2022).

Lillian-Penson Hall, University of London

- Resident Advisor (Aug 2019 – Aug 2020).

Department of Physics & Astronomy, University College, University of London

- Undergraduate Academic Mentor (Sep 2018 – Dec 2018).

Junior Common Room, Nutford House, University of London

- Events Officer (Sep 2017 – Jun 2018).

TECHNICAL SKILLS

- *Languages*: Python, MATLAB, C++ & Julia; slurm & bash; HTML & CSS.
- *Machine Learning Frameworks*: PyTorch & TensorFlow.
- Git & L^AT_EX.