Zakhar Shumaylov

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Last update on December 16, 2024

Education

University of Cambridge — Cambridge, UK
PhD in Mathematics of Information — *2022 – 2026*
Supervised by: Prof Carola-Bibiane Schönlieb
Awarded the *Trinity Henry Barlow Scholarship* ($£81,000$) at Christs College.
Funded by Christs College Bursary ($£15,000$) and CCIMI ($£50,000$).

University of Cambridge — Cambridge, UK
Mathematics BA/MMath (1st Class/Distinction) — *2018 – 2022*
Awarded the *Cambridge Trust Scholarship*($£40,000$) to read Mathematics at Churchill College.
Courses included: Quantum Field Theory, General Relativity, Statistical Field Theory, Black Holes, Cosmology.

Brighton College — Brighton, UK
A-Level(5A*) STEP 2,3 (S,S) — *2016 – 2018*

Governor's Physics and Mathematics Lyceum 30 — St-Petersburg, Russia
Year 9 - Year 11 (4.53/5) — *2013 – 2016*

Publications and Preprints

Deep Learning

Z. Shumaylov*, I. Shumailov*, Y. Zhao, Y. Gal, N. Papernot, R. Anderson (2023).
AI models collapse when trained on recursively generated data.
Nature (2024); Nature
Selected as cover.
Ranked 21st / 300k of articles.
Covered on the front page of New York Times.
One of the most influential articles of the year per State of AI report.
Publicity: New Scientist; Independent; The Atlantic; MIT tech; Financial Times; New York Times; Wall Street Journal; Bloomberg; The Register; AI Magazine; Cosmos;

I. Shumailov, **Z. Shumaylov**, D. Kazhdan, Y. Zhao, N. Papernot, M. Erdogdu, R. Anderson (2021).
Manipulating SGD with data ordering attacks.
NeurIPS (2021); arxiv

Geometric Deep Learning

Z. Shumaylov*, P. Zaika*, J. Rowbottom, F. Sherry, M. Weber, C. Schönlieb (2024).
Lie Algebra Canonicalization: Equivariant Neural Operators under arbitrary Lie Groups
Under review; arxiv

W. Diepeveen*, G. Batzolis*, **Z. Shumaylov**, C. Schönlieb (2024).
Score-based pullback Riemannian geometry
Under review; arxiv

P. Canizares, D. Murari, C. Schönlieb, F. Sherry, **Z. Shumaylov** (2024).
Hamiltonian Matching for Symplectic Neural Integrators
Oral at NeurIPS 2024 Workshop on Symmetry and Geometry in Neural Representations; arxiv

P. Canizares, D. Murari, C. Schönlieb, F. Sherry, **Z. Shumaylov** (2024).
Symplectic Neural Flows
Under review;

Inverse Problems

M. Kiss, A. Biguri, **Z. Shumaylov**, F. Sherry, J. Batenburg, C. Schönlieb, F. Lucka (2024).
Benchmarking Learned Algorithms for Computed Tomography Image Reconstruction Tasks
Under review; arxiv

Z. Shumaylov, J. Budd, S.Mukherjee, C. Schönlieb (2024).
Weakly Convex Regularisers for Inverse Problems: Convergence of Critical Points & Primal-Dual Optimisation.
ICML (2024); arxiv

S. Mukherjee, S. Dittmer, **Z. Shumaylov**, S. Lunz, O. Öktem, C. Schönlieb (2020).
Data-Driven Convex Regularizers for Inverse Problems.
Oral at IEEE ICASSP (2024); arxiv

Z. Shumaylov, J. Budd, S.Mukherjee, C. Schönlieb (2023).
Provably Convergent Data-Driven Convex-Nonconvex Regularization.
Oral at NeurIPS Workshop on Deep Learning and Inverse Problems (2023); arxiv

Cosmology

Z. Shumaylov*, M. Letey*, F. Agocs, W. Handley, M. Hobson, A. Lasenby (2022).
Quantum Initial Conditions for Curved Inflating Universes.
Physical Review D (2024); arxiv

Z. Shumaylov, W. Handley (2021).
Primordial power spectra from k-inflation with curvature.
Physical Review D (2022); arxiv

Work Experience

Apple — Cambridge, UK
ML Research Intern — *Dec 2024 - Now*
ML research on model compression.

Apple — Cambridge, UK
ML Research Intern — *June 2024 - Sept 2024*
ML research on model compression using tensor networks.

GSK — Cambridge, UK
Project collaboration — *June 2022 - Sept 2022*
Project collaboration on 'Self-discovery of mechanistic equations for a data-driven smart simulator' as part of CMI programme with Dr Matthieu Duvinage.

University of Cambridge — Cambridge, UK
Supervisor for University of Cambridge Undergraduates — *Oct 2022 - Now*
Supervising undergraduate students in a variety of courses.
(2022/2023): Part IA Vectors and Matrices: 18 students (48h)
(2023/2024): Summer Project Supervision: 2 students

Ryff AI — Cambridge, UK
Summer Research Intern — *July 2022 - Sept 2022*
Work under supervision of Dr Mike Roberts. During the internship I worked on the problem of unsupervised video motion segmentation. During the project, I used variational and learned methods from the optical flow literature for foreground-background separation using motion signals.

University of Cambridge: Institute of Astronomy — Cambridge, UK
Summer Internship Programme — *August 2021 - Sept 2021*
Work under supervision of Dr Amy Bonsor (IoA): "Gas disk imaging around white dwarves"
During the internship I investigated gas disk light curve imaging around white dwarves, by modelling gas geometry. Funded by the Institute of Astronomy.

University of Cambridge: Kavli Institute for Cosmology — Cambridge, UK
Summer Research Intern — *June 2021 – August 2021*
Work under supervision of Dr Will Handley (KICC):"Primordial power spectra from k-inflation with curvature"
During the internship I investigated the problem of interplay between inflationary sound speed and primordial curvature using analytical approximations. Funded by the CMP.

University of Cambridge: Department of Applied Mathematics and Theoretical Physics — Cambridge, UK
Summer Research Assistant — *June 2020 – Sept 2020*
Work under supervision of Prof Carola Schonlieb (DAMTP), Prof Ozan Oktem (KTH) and Prof Par Kurlberg (KTH): "3DEM: Representation of atomic models"
During the internship I investigated the problem of protein fitting inside of atomic volumes acquired via cryo electron microscopy. During the project I used learned techniques and variational methods to obtain protein reconstructions. Funded by the CSRIM.

University of Cambridge: Department of Applied Mathematics and Theoretical Physics — Cambridge, UK
Summer Research Assistant — *June 2019 – Sept 2019*
Work under supervision of Prof Carola Schonlieb (DAMTP).
During the internship I worked primarily in the field of inverse problems. In particular, I researched how Deep Learning can be used to help solve physics-based inverse imaging problems. This led to a joint work "Learned convex regularizers for inverse problems". Funded by the CSRIM and the Tizard Fund.

Cambridge Coding Academy — Cambridge, UK
Teaching Assistant — *July 2018*
Supporting and leading coding sessions of the 'Coding++' course, covering the basics of AI using python and the pygame library.

Brighton College — Brighton, UK
After-school Teaching Assistant — *Sept 2017 – June 2018*
Tutoring Year 9 - Year 13 students during after-school Mathematics classes.

University Of Sussex — UK

Research Assistant to Professor Madzvamuse — *July 2017 - August 2017*

I reviewed and extended the one-dimensional cell model of Shenoy(2016) by modelling cell contractility and strain with partial differential equations in Matlab.

Talks and Conferences

TU Berlin — Berlin, Germany
Invited to present on "AI Models collapse when trained on recursively generated data."

Tubingen AI Center — Tubingen, Germany
Invited to present on "The Future of Synthetic Data: Model Collapse and Equivariant Neural Operators"

Oberwolfach workshop on "Deep Learning for PDE-based Inverse Problems" — Oberwolfach, Germany
Invited to present on "Lie Algebra Canonicalization: Equivariant Neural Operators under arbitrary Lie Groups"

European Congress of Mathematics 2024 — Seville, Spain
Invited to present on "Weakly convex regularizers in inverse problems"

KTH SciML workshop — Stockholm, Sweden
Invited to present on "Weakly convex regularizers in inverse problems"

AI Precision Health Institute — Hawaii, USA
Invited to present on "What happens if we use synthetic data without any curation"

SIAM Imaging 2024 — Atlanta, USA
Invited to present on "Weakly convex regularizers in inverse problems"

IEEE ICASSP 2024 — Seoul, South Korea
Invited to present on "Data-Driven Convex Regularizers for Inverse Problems"

NeurIPS @ Cambridge — Cambridge, UK
Presented on "The Curse Of Recursion: Generated Data Makes Models Forget"

Workshop: Integrating acquisition and AI in tomography — Leiden, Netherlands
Presented on "Learned reconstruction methods in inverse problems"

ICIAM 2023 — Tokyo, Japan
Invited to present on "Learned weakly convex regularizers in inverse problems"

C.I.M.E. School on 'Machine Learning: From Data to Mathematical Understanding' — Cetraro, Italy
Received full grant and prepared lecture notes to be published in the C.I.M.E. Springer series.

Subject Olympiads

British Physics Olympiad Round 2 — UK, 2018
Gold Award (Top 15).
Invited to the University of Oxford Training Camp to compete for a spot on the UK IPhO team.

British Astronomy and Astrophysics Olympiad — UK, 2018
Gold Award.

British Physics Olympiad Round I — UK, 2017
Gold Award (Top 50).

British Mathematics Olympiad Round I — UK, 2017
Certificate of Distinction.

British Physics Olympiad Round I & AS Physics Challenge — UK, 2016
Gold Awards.

Senior Mathematics Challenge — UK, 2016
Gold Award (100%).

School Mathematics Olympiad — Russia, 2016
Winner of the inter-school team challenge.

Russian Computer Science & Physics Olympiads — Russia, 2015
Winner of the district challenges.

Russian Computer Science Olympiad — Russia, 2014
Winner of the district challenge.

Positions of Responsibility

NeurIPS at Cambridge meetup — Cambridge
Organised the NeurIPS 2024 at Cambridge meetup

NeurIPS at Cambridge meetup — Cambridge
Organised the NeurIPS 2023 at Cambridge meetup

Treasurer and Membership officer — Cambridge University Astronomical Society
Keeping proper accounts of the income and expenditure of the Society.

Deputy Head of School House — Brighton College
Coordinating and overseeing the House Prefects, attending and ensuring smooth running of House events.

Founder and President of Brighton College STEM Society — Brighton College
Promoting an active interest in natural sciences, technology, engineering and mathematics at Brighton College.

Leader of the House Chess Team — Brighton College
I have been practicing chess for 7 years and became a part of the House Chess Team.

Awards

C.I.M.E. full grant — Italy, 2023
Awarded $1,000$€ grant to attend the C.I.M.E. School 'Machine Learning: From Data to Mathematical Understanding'.

Trinity Henry Barlow Scholarship — UK, 2022
Awarded £$81,000$ scholarship to pursue PhD in Mathematics of Information at University of Cambridge.

Cambridge Christs Bursary — UK, 2022
Awarded £$15,000$ to pursue PhD in Mathematics of Information at University of Cambridge.

CCIMI — UK, 2022
Awarded £$50,000$ to pursue PhD in Mathematics of Information at University of Cambridge.

Churchill College Prize Scholarship — UK, 2021
Awarded £120 in recognition of excellent academic performance.

Churchill College Honorary Scholarship — UK, 2020
Awarded £100 in recognition of excellent academic performance.

Churchill College Prize Scholarship — UK, 2019
Awarded £120 in recognition of excellent academic performance.

Cambridge Trust Scholarship — UK, 2018
Awarded £$40,000$ to read Mathematics at University of Cambridge.

Brighton College Governors Award for Independent Study — UK, 2018
Awarded £500 for a piece of work outside of the A-Level curriculum.

Brighton College Physics Prize: Bayliss-Smith prize — UK, 2018
Prize to recognise sustained excellence and scientific endeavor.

Brighton College Science Essay Competition 2018 — UK, 2018
Winning essay: "The Tale of Cell Modelling".

Brighton College Science Prize: Newton's Cup — UK, 2017
Prize to recognise sustained excellence and scientific endeavor.

Brighton College Science Essay Competition 2017 — UK, 2017
Winning essay: "Brief History of Exoplanets".

Skills

Programming languages: Python . C

Software packages: pyTorch . odl . Matlab . Maple . Mathematica . LaTeX

OS & computing: Linux, MacOS, unix, bash, slurm, HPC, vim

Languages: English, Russian