Alexander Mundey

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Education

Doctor of Phillosopy (Mathematics) — University of Wollongong 2020
Title: *Noncommutative Dynamics and Topology of Iterated Function Systems*
- Supervisor: Prof. Adam Rennie
- Cosupervisor: Prof. Aidan Sims

Bachelor of Mathematics Advanced (Honours) — University of Wollongong 2015
Title: *Bott Periodicity in Operator K-theory: A Selection of Proofs*
- Supervisor: Prof. Adam Rennie
- University medal and first class honours

Bachelor of Science (Physics) — University of Wollongong 2014

Employment

Research Fellow — University of Wollongong Aug 2022–Ongoing
Funded by ARC Discovery Project DP220101631 under Prof. Aidan Sims. Research position with teaching responsibilities.

Associate Research Fellow — University of Wollongong Dec 2020–Aug 2022
Funded by ARC Discovery Project DP200100155 under Prof. Aidan Sims. Research position with teaching responsibilities.

Associate Lecturer — University of Wollongong Jan 2020–Dec 2020
Combined teaching and research position. Heavy teaching workload due to the onset of the COVID-19 pandemic. Included subject coordination and development of a new subject.

Tutor/Teaching Assistant — University of Wollongong 2013–2020
Performing duties including running tutorials, marking, exam supervision, updating course notes, writing quizzes, and answering student emails.

Research

ORCiD: 0000-0002-7791-4383
arXiv: arxiv.org/a/mundey_a_1.html
Web of Science ID: KHT-9337-2024

Research Statement

I am broadly interested in the interplay between dynamical systems and operator algebras. My research focuses on C^*-algebraic approaches to studying topological and algebraic dynamical systems, often by computing invariants and determining how these invariants help to understand the underlying dynamics.

On the dynamical side of things, the systems I look at tend to be "self-similar" in one way or another. This includes—but is not limited to—iterated function systems, (topological) graph dynamics, self-similar actions (and more general actions of groups on trees) and semigroups. On the C^*-algebraic side of things I use groupoids and C^*-correspondences to provide noncommutative models of dynamical systems, and use invariants of the associated algebras to understand properties of the dynamics.

Publications

Note: In pure mathematics authors are ordered alphabetically and assumed to have equal contribution.

[1] A. Mundey and A. Sims, *Homology and twisted C^*-Algebras for self-similar actions and Zappa–Szép products*, Results Math. **80**, 9 (2025). DOI: 10.1007/s00025-024-02264-7

[2] K.A. Brix, A. Mundey and A. Rennie, *Splittings for C^*-correspondences and strong shift equivalence*, Math. Scand. **130** (2024), no. 1, 101–148. DOI: 10.7146/math.scand.a-142308

[3] A. Mundey, *A Closed Graph Theorem for hyperbolic iterated function systems*, J. Fractal Geom. **9** (2022), no. 3–4, 325–336. DOI: 10.4171/JFG/116

[4] A. Mundey and A. Rennie, *A Cuntz-Pimsner model for the C^*-algebra of a graph of groups*, J. Math. Anal. Appl. **496** (2022), no. 2, 124838. DOI: 10.1016/j.jmaa.2020.124838

[5] N. Brownlowe, A. Mundey, D. Pask, J. Spielberg and A. Thomas, *C^*-algebras associated to graphs of groups*, Adv. Math. **316** (2017), 114–186. DOI: 10.1016/j.aim.2017.05.022

Accepted

[1] K.A. Brix, A. Mundey and A. Rennie, *Morphisms of Cuntz-Pimsner algebras from completely positive maps*, To appear in: J. Aust. Math. Soc., Preprint: arXiv:2311.16600 [math.OA]

Preprints

[1] A. Mundey and A. Sims, *Self-similar groupoid actions on k-graphs, and invariance of K-theory for cocycle homotopies*, Preprint: arXiv:2411.09939 [math.OA]

Recent Talks

[1] "Cohomology for self-similar actions and Zappa–Szép products"
Willis Fest 2024, Tocal Agricultural College (Novemeber 2024)

[2] "Cohomology of self-similar actions and Zappa-Szép products"
Wollongong OANCG Seminar (November 2024)

[3] "Twisting representations of self-similar groupoid actions"
Semigroups, groupoids and C^*-algebras, KIAS Seoul (July 2024)

[4] "Treating a splitting headache"
Mathematics Faculty Seminar, University of Białystok (November 2023)

Awards & Funding

Grants

[1] **AEGiS: CONNECT Research Grant – University of Wollongong (2023–2024)**
Project: *Fractals Unleashed: Discovering New Invariants through Operator Algebras*
Funding: AU$12,270.00 Lead CI: Alexander Mundey Other CIs: Adam Rennie

[2] **RevITAlising (RITA) Research Grant – University of Wollongong (2022)**
Project: *A quantum approach to the emergence of self-similarity*
Funding: AU$15,532.00 Lead CI: Alexander Mundey

Awards

- Australian Government Research Training Program Scholarship (2016–2019)
- University Medal — University of Wollongong (2015)
- Alumni Bookshop Prize — University of Wollongong (2014)
- Austin Keane Summer Research Scholarship — University of Wollongong (2014)
- AMSI Summer Vacation Research Scholarship (2013)

Service

Organisation

- **Convener – Wollongong Operator Algebra & Noncommutative Geometry Seminar (2021—Ongoing)**
I organise a weekly seminar with frequent international speakers and a steady international audience. I am responsible for scheduling, inviting speakers, and logistics. My role as convener has helped maintain the cohesiveness of the University of Wollongong operator algebras group through the COVID- 19 pandemic, and broadcast the strengths of the research group internationally. I also maintain the seminar website: https://oancg.org.
- **Special Session Organiser – Australian Mathematical Society Annual Conference (Dec 2022)**
Organiser of the Functional Analysis, Operator Algebras & Noncommutative Geometry special session.
- **Convener – Wollongong Maths & Stats Graduate Seminar (2017–2018)**
- **Head of Organisational Committee – AMSSC2017 (2017)**
National annual conference run by graduate students for graduate students. Ran committee meetings, managed budgets, secured funding from university and government agencies (approx. AU$10,000), organised catering, designed and implemented the conference website, conference booklet, and advertising poster.

Refereeing

- I have refereed for Documenta Mathematica, Banach Journal of Mathematical Analysis, Journal of Operator Theory, Bulletin of the London Mathematical Society, and Acta Scientiarum Mathematicarum.

Governance

- I have worked on a hiring committees at the University of Wollongong for departments outside of mathematics.

Teaching

I am deeply passionate about mathematics education and bring extensive teaching experience across a broad range of subjects, including service courses, proof-based courses, and coding-intensive courses. My expertise includes subject coordination, curriculum development, and supervision at both undergraduate and postgraduate levels. I am a strong advocate for technology-assisted learning, leveraging visualizations and interactive tools to enhance student understanding and engagement wherever appropriate. I achieve consistently high results in teaching evaluations.

Teaching Experience

Lecturing – University of Wollongong Dec 2020–Ongoing
Subjects taught:

- ▷ MATH322 - Abstract Algebra (2024)
- ▷ MATH203 - Linear Algebra and Groups (2024)
- ▷ MATH205 - Numerical Methods (2024, 2023, 2022, 2021, 2020): coordinated the subject and undertook significant course development.
- ▷ MATH201 - Multivariate and Vector Calculus (2023, 2020): coordinated the subject.
- ▷ MATH222 - Real Analysis (2022, 2021)
- ▷ MATH141 - Foundations of Engineering Mathematics (2020)

Tutor/Teaching Assistant – University of Wollongong 2013–2019
Subjects taught:

- ▷ MATH321 - Numerical Analysis (2019)
- ▷ MATH205 - Numerical Methods (2019)
- ▷ MATH201 - Multivariate and Vector Calculus (2019, 2018, 2017, 2016)
- ▷ MATH203 - Linear Algebra (2018)
- ▷ MATH202 - Differenital Equations 2 (2017)
- ▷ MATH179 - Introductory Business Mathematics (2016)
- ▷ MATH121 - Discrete Mathematics (2015, 2014, 2013)
- ▷ MATH283 - Adv. Engineering Mathematics & Statistics (2015, 2013)
- ▷ MATH151 - General Mathematics (2014)

Supervision Experience

PhD supervision

Angus Alexander - "Levinson's Theorem and mathematical scattering theory" 2020–2024
Principal Supervisor: Adam Rennie
Cosupervisor: Alexander Mundey

Thomas Pedersen - "Equilibrium states of C^*-algebras associated to graphs of groups" 2020–2022
Principal Supervisor: Adam Rennie
Cosupervisor: Alexander Mundey

Masters & honours supervision

Alex Pavior - "Some mathematical aspects of quantum field theory" 2024–Ongoing
Principal Supervisor: Adam Rennie
Cosupervisor: Alexander Mundey

Isaac Bankier - "Equivariant sheaf cohomology for Zappa–Szép products of categories" 2024–Ongoing
Supervisors: Alexander Mundey & Aidan Sims

Undergraduate project supervision

- ▷ Naomi Reed - "Cuntz–Pimsner algebras" (2024)
- ▷ Isaac Bankier - "Introduction to Homology" (2024)
- ▷ Naomi Reed - "Clifford Algebras and the Hopf Fibration" (2023)
- ▷ Jamieson Bell & Alex Paviour - "Chern Weil Theory in Geometry and Algebraic Topology" AMSI Vacation Research Scholarship (2022)
- ▷ Kai Buckman - "Visualising Groups with Cayley Graphs" (2021)
- ▷ Alex Paviour - "Facts are Relative: The extended Wigner's friend experiment" AMSI Vacation Research Scholarship (2021)
- ▷ Dean Noble - "Introduction to Homotopy Theory" (2020)

University of Wollongong HDR New Supervisor Induction May 2022

Additional Teaching Experience

- I organised a Winter school program for advanced undergraduate students at the University of Wollongong aiming to teach them metric spaces with applications to fractal geometry (2021, 2023).
- I developed course materials for a new undergraduate course, "MATH100: Introduction to Mathematics", at the University of Wollongong. This was funded by the university. (2018)
- I scripted, filmed, and edited a series of videos designed to help both advanced undergraduate students and graduate students learn differential geometry. This was funded by the University of Wollongong. (2018)
- I assisted in coaching the University of Wollongong team in the Simon Marais Mathematics Competition. I ran problem solving sessions and supervised the exam. (2017–2019)

Additional Skills

Coding Experience
I have extensive knowledge of both software and hardware. I take pride in my ability to quickly adapt to new software environments and emerging technologies. I have coding experience, predominantly for scientific applications (numerical methods, symbolic computation, data scraping, and data analysis). I also have experience teaching programming to mathematics students.

- ▷ I have coded in: C++, Python, Julia, Haskell, MATLAB, Mathematica, Maple
- ▷ I have markup experience in: LaTeX, HTML, CSS, XML

Mathematical Art
I have skills in the creation of mathematical art and visualisations of numerical algorithms. I won first place at the 2021 CARMA Maths Art Competition.

Contactable Referees

Prof. Adam Rennie — PhD advisor
School of Mathematics and Applied Statistics, University of Wollongong
- Email: renniea@uow.edu.au
- Phone: +61 4 0637 7200

Dist. Prof. Aidan Sims — Postdoc mentor
School of Mathematics and Applied Statistics, University of Wollongong
- Email: asims@uow.edu.au
- Phone: +61 2 4221 5003

Dr. Nathan Brownlowe — Collaborator
School of Mathematics and Statistics, University of Sydney
- Email: nathan.brownlowe@sydney.edu.au

Assoc. Prof. Bartosz Kwaśniewski — Collaborator
Faculty of Mathematics, University of Białystok
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