Alexander Mundey

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EDUCATION

PhD(Mathematics) – University of Wollongong, Australia 2020
Noncommutative Dynamics and Topology of Iterated Function Systems
- Supervisor: Adam Rennie
- Cosupervisor: Snr. Prof. Aidan Sims

BMathAdv(hons.) – University of Wollongong 2015
Bott Periodicity in Operator K-theory: A Selection of Proofs
- Supervisor: Assoc. Prof. Adam Rennie
- First-class honours and university medal

BSc(Physics) – University of Wollongong 2014

EMPLOYMENT

Associate Research Fellow – University of Wollongong Dec 2020–Ongoing
Funded by ARC Discovery Project DP200100155 under Snr. Prof. Aidan Sims. Research position with teaching responsibilities including online delivery during COVID-19 pandemic.

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

I have a broad interest in the interplay between dynamical systems and operator algebras with my research focusing on C^*-algebraic approaches to analysing self-similar topological and algebraic dynamical systems. I am driven towards constructing dynamical invariants that arise from C^*-algebraic constructions—for example via KK-theory or KMS-states—and how these invariants manifest as classifying invariants of the underlying dynamical systems. At the same time, I am also interested in the way that homological invariants of dynamical systems give rise to new classes of C^*-algebras via twisted constructions.

I have extensive experience with C^*-algebraic constructions arising from both C^*-correspondences and groupoids, as well as experience using them to model a range of dynamical systems including iterated function systems, dynamical systems arising from graphs, self-similar actions, and more general actions of groups on trees.

Publications

[1] Mundey A. *A Closed Graph Theorem for hyperbolic iterated function system*, 2022
To appear in: Journal of Fractal Geometry, Preprint: https://arxiv.org/abs/2107.11940

[2] Mundey A. and Rennie A. *A Cuntz-Pimsner model for the C^*-algebra of a graph of groups*, 2021
Journal of Mathematical Analysis and Applications , **496**, no. 2,
https://doi.org/10.1016/j.jmaa.2020.124838

[3] Brownlowe N., Mundey A., Pask D., Spielberg J., and Thomas A. *C^*-algebras associated to graphs of groups*, 2017
Advances in Mathematics, **316**, pp. 114-186,
http://dx.doi.org/10.1016/j.aim.2017.05.022

Current Projects

Working titles only.
▷ *Equilibrium states for C^*-algebras associated to interated function systems with large overlap* – with Nicholas Seaton and Michael Mampusti.

▷ *Twisted C^*-algebras associated to self-similar groupoid actions* – with Aidan Sims.

▷ *Graph moves for Cuntz-Pimsner algebras* – with Adam Rennie and Kevin Brix.

▷ *Extending the Enchilada category using completely positive maps* – with Adam Rennie and Kevin Brix.

▷ *Groupoid constructions for topological graph algebras* – solo author.

▷ *The lacunary algebra of an iterated function system* – solo author.

Recent Talks

"Perfecting noncommutative topology" — Dec 2021
Australian Mathematical Society Annual Conference, University of Newcastle

"Attaining perfection in noncommutative topology" — Nov 2021
University of Wollongong Operator Algebras and Noncommutative Geometry Seminar

"From Bass-Serre Theory to Cuntz-Pimsner Algebras" — Jan 2021
Arizona State University C^*-seminar.

"From Bass-Serre Theory to Cuntz-Pimsner Algebras" — Dec 2020
Australian Mathematical Society Annual Conference, University of New England

"A Cuntz-Pimsner Model for the C^*-algebra of a Graph of Groups" — Oct 2019
University of Wollongong Operator Algebras and Noncommutative Geometry Seminar

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TEACHING

I have a strong passion for mathematics education and a wealth of teaching experience ranging over a wide variety of subjects. I have taught service courses, proof-based courses, and even coding-heavy courses. I have experience coordinating subjects and also developing new subjects. I also have experience with supervision at both an undergraduate and postgraduate level. I am a strong believer in technology assisted learning, and strive to provide—where appropriate—engaging visualisation for students to assist in their learning.

Teaching Experience

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

- ▷ MATH222 - Real Analysis (2022, 2021)
- ▷ MATH205 - Numerical Methods (2021, 2020): coordinated the subject and undertook significant course development.
- ▷ MATH201 - Multivariate and Vector Calculus (2020): coordinated the subject.
- ▷ 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, 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–Ongoing
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

Undergraduate supervision

- ▷ Jamieson Bell & Alex Pavior - "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)

Additional Teaching Experience

Educational Programs

- I organised a Winter school program advanced undergraduate students at the University of Wollongong aiming to teach them metric spaces with applications to fractal geometry. (2021)

Content creation

- I assisted in developing 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)

Competition Coaching

- 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)

SERVICE

Seminar Convenor – University of 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 also 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.

EVENTS ORGANISED

Special SessionOorganiser - Australian Mathematical Society Annual Conference 2022
I am on the organisation team for the Operator Algebras & Noncommutative Geometry special session for the 2022 Australian Mathematical Society Annual Conference.

Graduate Seminar Convener 2017–2018
Organising the fortnightly graduate seminar for the School of Mathematics and Applied Statistics at the University of Wollongong.

Head of Organisational Committee - AMSSC2017 2017
An annual conference run by graduate students for graduate students. Approximately 50 in attendance. Duties included: running committee meetings; budget management; securing funding from university and government agencies (approx. AU$10,000); organising catering; talk timetabling; and designing and implementing the conference website, conference booklet, and advertising poster. https://www.amssc.org/2017/

AWARDS & FUNDING

RevITAlising (RITA) Research Grant – University of Wollongong 2021–Ongoing
Project: *A quantum approach to the emergence of self-similarity*
Funding: $\$15,532.00$

Australian Government Research Training Program Scholarship 2017–2019

Australian Postgraduate Award 2016–2017

University Medal – University of Wollongong 2015

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 REFERENCES

Assoc. Prof. Adam Rennie
School of Mathematics and Applied Statistics, University of Wollongong
- Email: renniea@uow.edu.au
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Dr. Nathan Brownlowe
School of Mathematics and Statistics, University of Sydney
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[*Compiled on 2022-04-23*]