

Michael Felix Adamer

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RESEARCH INTERESTS

My research is in the intersection of applied algebra, data science and chemical reaction network theory. In particular, I develop practical algebraic methods and algorithms to analyse data coming from problems in statistics, systems biology, chemical reaction networks and Turing's theory of pattern formation.

EMPLOYMENT

Max Planck Institute for Mathematics in the Sciences, Leipzig, Germany
Postdoctoral Researcher.

Short Summary: I am working on adapting the holonomic gradient descent algorithm for its use in statistics. Holonomic gradient descent is an optimisation procedure which uses the theory of D-modules to convert gradients into matrix multiplications, with the benefit of increasing the efficiency of gradient descent methods.

EDUCATION

University of Oxford, Oxford, UK
Doctor of Philosophy, Mathematical Institute and
Doctoral Training Centre, Systems Biology, October 2019.

Thesis title: *Algebraic Methods for Chemical Reaction Networks with Extrinsic Noise*,
Supervisors: Heather Harrington, Thomas Woolley, Eamonn Gaffney.

Short Summary: Chemical reaction networks are a prime example of the emergence of polynomial equations in the natural sciences. The equations are usually heavily parameterised, typically one parameter per reaction which cannot be derived from first principles, and often the parameters cannot be measured. In my thesis I develop techniques to investigate networks with random parameters, both constant parameters sampled from a uniform distribution and parameters evolving in time according to a given stochastic process. These stochasticity assumptions render the systems under study polynomial systems with random coefficients. The methods I use to investigate these models draw from results in algebraic geometry, intersection theory, graph theory and applied stochastic processes.

Master of Physics, June 2015 (4-year integrated masters),
First Class Honours, Supervisor: Julia Yeomans.

PROFESSIONAL ACTIVITIES (PARTICIPANT OR VISITOR, NOT LISTED IN TALKS)

Jul 2019: Organiser, minisymposium on Stochastic Chemical Reaction Networks, SIAM AG19, Bern, Switzerland
Oct 2018: Advances in Chemical Reaction Network Theory, ESI, Vienna, Austria
Jun 2018: Macaulay2 Workshop, Leipzig, Germany
Sept 2017: Co-organiser, Applied Algebra and Geometry Research Network UK, Third Meeting, Oxford, UK
Jul 2017: Macaulay2 Workshop, Atlanta, GA, USA
Mar 2017: Stochastic PDEs: Analysis and Computation, University of Warwick, UK
Mar 2017: Modelling of Tissue Growth and Form, MBI, Columbus, OH
Nov 2016: MPI für Mathematik in den Naturwissenschaften, Leipzig, Germany

AWARDS AND FELLOWSHIPS

Jul 2018: Poster Prize at the European Conference for Mathematical Biology, Lisbon
May 2018: Doctoral Training Centre Short Project Publication Prize
Oct 2015: EPSRC Scholarship (DPhil Funding)

Jun 2015: First Class Honours in Physics
Oct 2014: Exhibitioner, Merton College
Jan 2012: Fowler Prize, Merton College (multiple times)

PAPERS

5. **MF Adamer**, M Helmer. *Steady state invariants and multistationarity for families of toric Reaction Networks* (preprint), arXiv:1906.03931.
4. **MF Adamer**, HA Harrington, EA Gaffney, TE Woolley. *Coloured noise from stochastic inflows in reaction-diffusion systems* (preprint), arXiv:1810.12663.
3. **MF Adamer**, M Helmer. *Complexity of model testing for toric dynamical systems*, Advances in Applied Mathematics 110, 42-75.
2. **MF Adamer**, TE Woolley, HA Harrington. *Graph-facilitated resonant mode counting in stochastic interaction networks*, J. R. Soc. Interface 2017 14 20170447, doi: 10.1098/rsif.2017.0447.
1. A Doostmohammadi, **MF Adamer**, SP Thampi, JM Yeomans. *Stabilization of active matter by flow-vortex lattices and defect ordering*, Nat Commun, 7, 2016, doi:10.1038/ncomms10557.

TALKS

Jul 2019: SIAM Conference on Applied Algebraic Geometry, Bern, Switzerland.
Jul 2018: ECMTB Conference, Lisbon, Portugal (Poster).
Jun 2018: Macaulay2 Workshop, Leipzig, Germany.
May 2018: Applied Topology and Algebra Seminar, Mathematical Institute, University of Oxford.
Nov 2017: Junior Applied Topology and Algebra Seminar, Mathematical Institute, University of Oxford.
Aug 2017: SIAM Conference on Applied Algebraic Geometry, Atlanta, GA, USA.
Nov 2016: Max Planck Institut, Leipzig.
Jul 2016: SIAM Annual General Meeting (joint with SIAM Conference on the Life Sciences), Boston, MA, USA.
Dec 2014: ETH Zurich, Esslinger Group (internal seminar).

TEACHING

University of Oxford (2016-present):
 General Relativity (Class Tutor)
 Introduction to Programming (Demonstrator, Doctoral Training Centre module)
 Statistics (Demonstrator, Doctoral Training Centre module)
 Further Mathematical Biology (TA)
 Stochastic Modelling for Mathematical Biology (TA, Revision Tutor)
 Mathematical Biology Short Option (Tutor)
 Geometry and Dynamics (Revision Tutor)
 Marker for College examinations and admissions tests
 Graduate Mentor in Physics and Mathematics (Merton College)

SERVICE AND ACTIVITIES

Dec 2018: Christmas Lecture at the Natural History Museum, Oxford
Nov 2018: Reviewer for Bulletin of Mathematical Biology
Apr 2016 - present: Co-organiser, group meetings of the Wolfson Centre for Mathematical Biology.
Oct 2016 - present: Mentor, Project Access.
May 2017 - May 2018: President, Oxford University Mountaineering Club.
Feb 2016 - Feb 2017: President, Oxford University Austrian Society.

PROFESSIONAL MEMBERSHIPS **Society for Industrial and Applied Mathematics** (2016 - present), activity groups:
Algebraic Geometry, Life Sciences
London Mathematical Society (2016 - present)
Society for Mathematical Biology (2017 - present)

SKILLS

Programming Skills:

- Python/SageMath: main programming language
- Macaulay2: a niche, functional programming language for algebraic geometry
- C/C++: basic user, coded previous projects in C
- Matlab: coded some small projects in Matlab
- R: basic knowledge

Languages Spoken:

- German: native language
- English: fluent
- Spanish: basic knowledge
- French: basic knowledge
- Portuguese: basic knowledge

HOBBIES

Rock climbing, mountaineering and skiing
Playing the guitar: acoustic and electric
Travelling: visited 5 continents