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. I am interested in data science problems arising in personalised medicine and biomedical applications such as time series anomaly detection and image segmentation. I further 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

ETH Zürich, Machine Learning and Computational Biology Lab, Basel, Switzerland
Postdoctoral Researcher, September 2020 - .

Short Summary: As part of the Department Department of Biosystems Science and Engineering, I am working on early prediction of sepsis using machine learning and image segmentation for ophtalmology image data.

Compulsory Austrian Army Service, Innsbruck, Austria, January 2020 - July 2020.

Max Planck Institute for Mathematics in the Sciences, Leipzig, Germany
Postdoctoral Researcher, August 2019 - December 2019.

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 2015 - 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, October 2011 - 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 Reasearch 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 2019: SIAM Travel Award for the SIAM AG19 Conference (declined)

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

6. **MF Adamer**, AC Lőrincz, A-L Sattelberger, B Sturmfels, *Algebraic Analysis of Rotation Data* (accepted at Algebraic Statistics), arXiv:1912.00396.
5. **MF Adamer**, M Helmer. *Families of toric chemical reaction networks*, J. Math. Chem. (2020), https://doi.org/10.1007/s10910-020-01162-x.
4. **MF Adamer**, HA Harrington, EA Gaffney, TE Woolley. *Coloured noise from stochastic inflows in reaction-diffusion systems*, Bull. Math. Biol. 82(4), 1-28.
3. **MF Adamer**, M Helmer. *Complexity of model testing for toric dynamical systems*, Adv. Appl. Math. 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.
1. A Doostmohammadi, **MF Adamer**, SP Thampi, JM Yeomans. *Stabilization of active matter by flow-vortex lattices and defect ordering*, Nat. Commun., 7, 2016.

TALKS

Nov 2019: Applied Mathematics Department Seminar, University of Tokyo, Tokyo, Japan.

Nov 2019: Probability / Statistics / Matrix Workshop, Tachikawa, Toyko, Japan.

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.

Nov2017: 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