

Curriculum Vitae

Jonathan M. Fraser

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Research Interests

I am primarily interested in the dimension theory and geometry of fractal sets and measures and aspects of ergodic theory. Particular topics include: self-affine constructions, non-conformal dynamical systems, scenery flows and fractal curves and surfaces. I am also interested in finding links between ergodic theory and other areas of mathematics including: real and complex analysis, geometric measure theory, probability theory, topology, Fourier analysis and hyperbolic geometry.

Employment

September 2014 – : Lecturer in Pure Mathematics, The University of Manchester.

July 2013 – August 2014: EPSRC funded Research Fellow, The University of Warwick.

Working with Professor Mark Pollicott on grant EP/J013560/1 *Thermodynamic formalism and flows on moduli spaces*.

Education

September 2009 – June 2013: PhD in Pure Mathematics, The University of St Andrews.

Fully funded by the EPSRC.

Thesis: *Dimension theory and fractal constructions based on self-affine carpets*.

Supervisors: Professor Kenneth Falconer and Professor Lars Olsen.

Prizes: • *Best Postgraduate Tutor* at the (university wide) Students' Association Teaching Awards (2012–13).

- *EPSRC prize fellowship* to fund a one year research fellowship commencing September 2013 (not taken up because I accepted a position at Warwick).

September 2005 – May 2009: M.Math (with Hons), First Class, The University of St Andrews.

Dissertation: *Multifractals and irregular measures on the middle third Cantor set*.

Honours Average: 19/20

Prizes: • *Sir Arthur Hinton Reid Memorial Prize* for best student in senior honours class in pure mathematics (2008–9).

- *Class Medal* for best student in 4th/5th level M.Math mathematics (2008–9).

- *Alexander Stewart Prize* for best student in junior honours class in pure mathematics (2007–8).

- *Class Medal* for best student in 3rd level M.Math mathematics (2007–8).

Publications

Submitted

- (19) Some results in support of the Kakeya conjecture, 11pp.
(with E. J. Olson and J. C. Robinson).
Submitted.
- (18) Dimensions of self-affine carpets with overlaps, 16pp, arXiv:1405.4919, (with P. Shmerkin).
Submitted.
- (17) On the Assouad dimension of self-similar sets with overlaps, 22pp, arXiv:1404.1016.
(with A. M. Henderson, E. J. Olson and J. C. Robinson).
Submitted.
- (16) First and second moments for self-similar couplings and Wasserstein distances, 14pp,
arXiv:1401.1443v2.
Submitted.
- (15) Remarks on the analyticity of subadditive pressure for products of triangular matrices, 9pp,
arXiv:1310.8480v2.
Submitted.
- (14) Scaling scenery of $(\times m, \times n)$ invariant measures, 26pp, arXiv:1307.5023v2,
(with A. Ferguson and T. Sahlsten).
Submitted.
- (13) Inhomogeneous self-affine carpets, 19pp, arXiv:1307.5474v2.
Submitted.

Accepted

- (12) On the L^q -spectrum of planar self-affine measures, 35pp, arXiv:1310.1789v2.
Transactions of the American Mathematical Society (to appear).
- (11) A note on the 1-prevalence of continuous images with full Hausdorff dimension, 8pp,
arXiv:1203.0548v2, (with J. T. Hyde).
Journal of Mathematical Analysis and Applications (to appear).
- (10) Assouad type dimensions and homogeneity of fractals, 40pp, arXiv:1301.2934.
Transactions of the American Mathematical Society (to appear).
- (9) Dimension and measure for typical random fractals, 27pp, arXiv:1112.4541v2.
Ergodic Theory and Dynamical Systems (to appear).

Published

- (8) On Fourier analytic properties of graphs (with T. Orponen and T. Sahlsten).
International Mathematics Research Notices, (2014), 2730–2745.
- (7) Dimension and measure for generic continuous images (with R. Balka, Á. Farkas and J. T. Hyde).
Annales Academiæ Scientiarum Fennicæ Mathematica, **38**, (2013), 389–404.
- (6) The visible part of plane self-similar set (with K. J. Falconer).
Proceedings of the American Mathematical Society, **141**, (2013), 269–278.
- (5) Inhomogeneous self-similar sets and box dimensions.
Studia Mathematica, **213**, (2012), 133–156.

- (4) On the packing dimension of box-like self-affine sets in the plane.
Nonlinearity, **25**, (2012), 2075–2092.
- (3) The Hausdorff dimension of graphs of prevalent continuous functions (with J. T. Hyde).
Real Analysis Exchange, **37**, (2011/2012), 333–352.
- (2) Multifractal spectra of random self-affine multifractal Sierpiński sponges in \mathbb{R}^d (with L. Olsen).
Indiana University Mathematics Journal, **60**, (2011), 937–984.
- (1) The horizon problem for prevalent surfaces (with K. J. Falconer).
Mathematical Proceedings of the Cambridge Philosophical Society, **151**, (2011), 355–372.

Non-research publications

- Fractals in Lagganlia.
The Scottish Mathematical Council Journal, invited article (to appear), (2014).

Talks at conferences and workshops

- The Assouad dimension of self-similar sets with overlaps: 09/06/14, Workshop on Fractals, Jerusalem, Israel.
- Scaling scenery of $(\times m, \times n)$ invariant measures: 23/05/14, Numbers in Ergodic Theory, Leiden, The Netherlands.
- On the analyticity of Falconer’s subadditive pressure function: 12/05/14, Conference in honour of Kenneth Falconer’s 60th birthday, INRIA, Paris, France.
- Inhomogeneous iterated function systems: 26/03/14, Fractal Geometry and Stochastics V, Tabarz, Germany.
- Fourier transforms of measures supported on graphs: 24/01/14, Ergodic Theory and Dynamical Systems mini-workshop, Jagiellonian University, Krakow, Poland.
- Modified singular value functions and self-affine carpets: 11/12/12, Advances in Fractals and Related Topics, Chinese University of Hong Kong, Hong Kong.
- Dimension and measure for typical random fractals: 16/04/12, EPSRC Workshop, Warwick, UK.
- The Hausdorff dimension of graphs of prevalent continuous functions : 16/06/11, Fractals and Related Fields II, Porquerolles Island, France.
- The horizon problem for prevalent surfaces: 19/04/11, EPSRC Workshop, Warwick, UK.
- Random self-affine multifractal Sierpiński sponges in \mathbb{R}^d : 14/10/10, CODY Workshop, Warsaw, Poland.
- The visibility conjecture: 09/03/10, Winter School, Siegmundsburg, Germany.

Invited seminar talks

- Fourier transforms of measures supported on graphs: 12/08/14, Cornell University, USA.
- The Assouad dimension of self-similar sets with overlaps: 11/03/14, The University of St Andrews, UK.
- On the L^q -spectrum of planar self-affine measures: 19/11/13, The University of Manchester, UK.
- Assouad type dimensions and homogeneity of fractals: 01/04/13, The University of Edinburgh, UK.
- Assouad type dimensions and homogeneity of fractals: 21/02/13, The University of Bristol, UK.
- Generic dimensions of graphs and images: 07/12/12, East China Normal University, Shanghai, China.

- The visible part of fractal sets: 03/03/10, The University of Bremen, Germany.

Educational and outreach presentations

- A brief introduction to fractals: 09/11/13, Highland Senior Maths Weekend, Lagganlia, UK.
- Fractal geometry and problem solving in mathematics: 19/07/13, International Science Summer School lecture, St Andrews, UK.
- Fractals and other fun mathematics: 03/07/13, Sutton Trust lecture, St Andrews, UK.
- Fractal geometry and dimension theory: 01/11/12, Research in the UK afternoon, Cambridge, UK.
- Furstenberg's proof of the infinitude of the primes: 25/10/12, St Andrews University Mathematics Society lecture, UK.

Research visits

- The University of St Andrews, UK, (hosts: Professor Kenneth Falconer and Dr Tom Kempton) 10/03/14 – 14/03/14.
- The University of Bristol, UK, (hosts: Dr Andy Ferguson and Dr Tuomas Sahlsten) 20/02/13 – 22/02/13. This visit led to the paper (13).
- East China Normal University, China, (host: Dr Jun Jie Miao) 03/12/12 – 07/12/12.
- The University of Bremen, Germany, (host: Professor Bernd Stratmann) 01/03/10 – 05/03/10.

Participation in conferences and workshops

- Projection and Slicing Theorems in Fractal Geometry: 17/07/14 – 18/07/14, The University of Bristol, UK.
- Workshop on Fractals: 08/06/14 – 12/06/14, The Hebrew University of Jerusalem, Israel.
- Numbers in Ergodic Theory: 23/05/14, Leiden, The Netherlands
- Conference in honour of Kenneth Falconer's 60th birthday: 12/05/14 – 14/05/14, Paris, France.
- Fractal Geometry and Stochastics V: 24/03/14 – 29/03/14, Tabarz, Germany.
- Ergodic Theory and Dynamical Systems mini-workshop: 24/01/14 – 28/01/14, Jagiellonian University, Krakow, Poland.
- Warwick-Keio Ergodic Theory meeting: 08/01/14 – 10/01/14, The University of Warwick, UK.
- Advances in Fractals and Related Topics: 10/12/12 – 14/12/12, The Chinese University of Hong Kong, Hong Kong.
- Symposium on Ergodic Theory and Dynamical Systems: 16/04/12 – 20/04/12, The University of Warwick, UK.
- Fractals and Related Fields II: 12/06/11 – 17/06/11, Porquerolles Island, France.
- EPSRC Workshop on Dynamical Systems and Dimension Theory: 18/04/11 – 21/04/11, The University of Warwick, UK.
- CODY Autumn Workshop on Fractals in Deterministic and Random Dynamics: 11/10/10 – 16/10/10, Warsaw, Poland.
- Winter School on Operators and Fractals: 08/03/10 – 12/03/10, Siegmundsburg, Germany.

Selected additional academic responsibilities and achievements

- Referee for the journals:
Advances in Mathematics

Nonlinearity

Annales Academiæ Scientiarum Fennicæ Mathematica

Proceedings of the Edinburgh Mathematical Society

Fractals

Bulletin Mathématique de la Société des Sciences Mathématiques de Roumanie

Chaos Solitons and Fractals.

- 2012– : Reviewer for the *American Mathematical Society Mathematical Reviews*.
- 2013– : Contributor to the Highland Senior Mathematics Weekend.
- 2011–13 : Managed the Analysis group web page in St Andrews.
- 2012: Chosen to represent St Andrews at the Cambridge University *Research in the UK afternoon*, which involved visiting Cambridge, giving a presentation on my research interests and speaking to potential graduate students about St Andrews.
- 2011–12: Organised an interdisciplinary reading group aimed at bringing together the Algebra and Analysis research groups. This was a great success with both PhD students and faculty regularly attending and contributing talks.
- 2011: In charge of the final two weeks of the Analysis Summer School in St Andrews. This involved leading a group of six motivated undergraduates through a small research project on ‘dimensions of random Takagi surfaces’.
- 2009–10: As part of the first year of my PhD studies, completed three *Scottish Mathematical Sciences Training Centre* modules (Probability Theory, Pure Analysis and Algebra) all at grade A.
- 2008: Awarded a *Carnegie Scholarship* to fund a six week summer research project at the University of St Andrews.
- 2005: Awarded the *UK Offshore Operators Association Prize* for outstanding performance in the 2005 Scottish Advanced Higher mathematics paper.
- 2004–05: *School Captain* of Dornoch Academy.
- 2004: *Dux* of Dornoch Academy, including the top prize in Maths, Physics, Chemistry, English and History.
- 2002, ‘03, ‘04, ‘05: Achieved a *gold award* in the Scottish Mathematical Challenge.

Teaching

I have always loved teaching and relish future opportunities to teach at a variety of levels. I have always been able to relate to students very well and have always received excellent student feedback. This is probably best reflected in the fact that I was awarded Best Postgraduate Tutor at the (university wide) Students’ Association Teaching Awards in my final year as a PhD student in St Andrews. Specific experience includes:

- 2013–14 (Warwick): Covered several undergraduate lectures and examples classes for the modules MA131 (Analysis I) and MA427 (Ergodic Theory). I am currently a Personal Tutor to 13 undergraduates at a variety of stages. This role requires me to meet regularly with my students to discuss their progress and any issues. Also, for the 4 second year students, it involves me supervising the writing of their second year essay.
- 2009–13 (St Andrews): I always took on a large tutoring load (3–5 contact hours per week) and was keen to teach a wide variety of courses. These included: MT4513 (Fractal Geometry), MT3503 (Complex Analysis), MT3501 (Linear Mathematics), MT2002 (Algebra and Analysis), MT1003 (Pure and Applied Mathematics) and MT1002 (Introductory Mathematics).

- 2011–12: Personal tutor for two secondary school students studying Higher and Advanced Higher maths respectively. Both were struggling to get the grade they needed to get in to University (Aberdeen and Oxford), but both ultimately achieved the necessary grade. I also tutored a very strong 1st year high school student focusing on Mathematical Olympiad type problems.
- 2010–11: (St Andrews) Tutor for the *SALTIRE tutoring programme* (now *CAPOD*) which provided help with mathematics to students across the university. Typically this involved 2–3 hours per week.

Non-mathematical interests

Outside of mathematics I am heavily involved in sport and in particular golf (handicap 8), table tennis and badminton. I also enjoy playing the acoustic guitar and hold a full clean UK driving license.

For a list of references, see the next page.

References

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