

TUOMAS SAHLSTEN

Curriculum Vitae

CONTACT AND GENERAL INFORMATION

Date and place of birth: 25th of May, 1987 in Vantaa, Finland

Nationality: Finnish

Language skills: Finnish, English (fluent), Swedish (fair)

Current work address:

School of Mathematics

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ACADEMIC POSITIONS

- Sep 2017 – **Lecturer in Pure Mathematics**, School of Mathematics, University of Manchester, UK
- Sep 2015 – Aug 2017 **Marie Curie Research Fellow**, European Union (based in the UK)
- Jan 2014 – Aug 2015 **Research Fellow**, Einstein Institute of Mathematics, The Hebrew University of Jerusalem, Israel
- Jan 2013 – Dec 2013 **Research Associate**, Department of Mathematics, University of Bristol, UK
- Sep 2012 – Dec 2012 **Project Researcher**, Department of Mathematical Sciences, University of Oulu, Finland
- Jul 2009 – Jun 2012 **Doctoral Student**, Department of Mathematics and Statistics, University of Helsinki, Finland

EDUCATION

- Jul 2009 – Nov 2012 **PhD in Mathematics**, University of Helsinki, Finland,
Advisor: Prof Pertti Mattila. Research focused on Mathematical Analysis, especially tangent measures, dimension theory and local distribution of measures.
PhD Thesis: *"Fine Structure of Measures"*
- Aug 2006 – Jun 2009 **BSc and MSc in Mathematics**, University of Helsinki, Finland,
Advisor: Prof Pertti Mattila. Studies focused on Mathematical Analysis. Minor subjects on Computer Science and Statistics. Includes Finnish military service during 2007. MSc Thesis: *"Porosity and Dimensions"* and BSc Thesis: *"Porous Sets"*

GRANTS AND FUNDING

- February 2015 **Marie Skłodowska-Curie Actions**, European Union, awarded a €183,455 MSCA-IF Grant *"Large Deviations and Measure Rigidity in Dynamics"* (LDMRD), nr. 655310, under the Horizon 2020 Programme.
• Principal Investigator for the grant. Duration: 1.9.2015 - 31.8.2017.
- March 2013 **European Research Council**, European Union, postdoctoral fellowship in the Hebrew University of Jerusalem, Israel, between 1.1.2014 - 31.8.2015 from Michael Hochman's ERC Starting Grant *"Fractal geometry, algebraic dynamics, and metric number theory"* (FractalsAndMetricNT), nr. 306494, under the 7th Framework Programme.

- March 2013 **Jenny and Antti Wihuri Foundation**, Finland, via “*Post doc pool*”
 • Awarded a grant (€38,000) for postdoctoral research in the University of Bristol, UK, for the year 2014 (**unused**: declined due to accepting another fellowship for 2014, see above)
- April 2010, -11, -12 **Emil Aaltonen Foundation**, Finland.
 • Three grants (€22,300, €23,000 and €23,000) awarded for PhD studies in University of Helsinki, Finland, for 2010-2012 and for postdoctoral research in the University of Bristol, UK, for the year 2013
- Jul 2009 – Dec 2013 **Academy of Finland**, “*The Finnish Centre of Excellence in Analysis and Dynamics Research*” project led by Antti Kupiainen.
 • Additional compensating financial support for PhD studies in the Universities of Helsinki and Oulu, Finland, and for postdoctoral research in the University of Bristol, UK, for the year 2013

RESEARCH INTERESTS

- **Ergodic theory and dynamical systems** (Countable Markov shift and large deviation theory with applications to Fourier analysis and differentiability. Measure rigidity for toral automorphisms and connections to ergodic theory of the scenery flow and CP chains)
- **Fourier analysis** (Fourier transforms of invariant measures for dynamical systems and group actions. Connections to stochastic analysis, additive combinatorics and equidistribution theory)
- **Geometric measure theory, conformal geometry and fractal geometry** (Developing the applications of dynamics of the scenery flow to these fields)
- **Quantum chaos and microlocal analysis** (Developing connections to hyperbolic dynamics and multifractal analysis)

A more detailed exposition available on the homepage:

<http://sahlsten.org/research.html>

LIST OF PUBLICATIONS

———— *Accepted for publication* ————

11. **Quantum ergodicity and Benjamini-Schramm convergence of hyperbolic surfaces**
 with *Etienne Le Masson*
 Duke Mathematical Journal (2017), <http://arxiv.org/abs/1605.05720>

———— *Published in a journal* ————

10. **Fourier transforms of Gibbs measures for the Gauss map**
 with *Thomas Jordan*
 Mathematische Annalen (2016) Vol 364 (3): 983-1023
9. **Intermediate β -shifts of finite type**
 with *Bing Li* and *Tony Samuel*
 Discrete and Continuous Dynamical Systems Series A (2016) Vol 36 (1): 323-344
8. **Dynamics of the scenery flow and geometry of measures**
 with *Antti Käenmäki* and *Pablo Shmerkin*
 Proceedings of the London Mathematical Society (2015) Vol 110 (5): 1248-1280
7. **Structure of distributions generated by the scenery flow**
 with *Antti Käenmäki* and *Pablo Shmerkin*
 Journal of the London Mathematical Society (2015) Vol 91 (2): 464-494
6. **Scaling scenery of $(\times m, \times n)$ invariant measures**
 with *Andrew Ferguson* and *Jonathan Fraser*
 Advances in Mathematics (2015) Vol 268: 564-602
5. **Tangent measures of typical measures**
 Real Analysis Exchange (2015) Vol 40 (1): 1-27

4. **On Fourier analytic properties of graphs**
with *Jonathan Fraser* and *Tuomas Orponen*
International Mathematics Research Notices IMRN (2014): 2730-2745
3. **Dimension, entropy, and the local distribution of measures**
with *Pablo Shmerkin* and *Ville Suomala*
Journal of the London Mathematical Society (2013) 87 (1): 247-268
2. **Tangent measures of non-doubling measures**
with *Tuomas Orponen*
Mathematical Proceedings of the Cambridge Philosophical Society (2012) 152: 555-569
1. **Radial projections of rectifiable sets**
with *Tuomas Orponen*
Annales Academiæ Scientiarum Fennicæ Mathematica (2011) 36: 677-681

Preprints

- **Pointwise perturbations of countable Markov maps**
with *Thomas Jordan* and *Sara Munday*
Preprint (2016), <http://arxiv.org/abs/1601.06591>
- **On the Fourier analytic structure of the Brownian graph**
with *Jonathan Fraser*
Preprint (2015), <http://arxiv.org/abs/1506.03773>

Books

- **Fine Structure of Measures**
Ph.D. thesis, University of Helsinki (2012), ISBN:978-952-10-8273-3

PROFESSIONAL AND ORGANISATIONAL ACTIVITIES

- Co-organised and was awarded funding from the LMS and Heilbronn Institute for the conference **Projection and Slicing Theorems in Fractal Geometry**, held in 17 – 18. July 2014 at the University of Bristol, UK.
Website: <http://www.maths.bris.ac.uk/~matmj/projections.html>
- Local organiser in Michael Hochman's **Workshop on Fractals**, held in 8 – 12. June 2014 at the Hebrew University of Jerusalem, Israel.
Website: <http://math.huji.ac.il/~mhochman/workshop2014/>
- Co-organising the **Ergodic Theory and Dynamical Systems seminar** at the School of Mathematics at the University of Bristol since Fall 2015
- Organised the **Fractals etc. Seminar** in the Einstein Institute of Mathematics at the Hebrew University of Jerusalem during Spring 2014
- Co-organised the **Students' Seminar** in the Department of Mathematics at the University of Helsinki during Sep 2009 - Jun 2010
- **Reviewer** for the international mathematical journals
 - *Advances in Mathematics*
 - *Ann. Acad. Sci. Fenn. Math.*
 - *Ergodic Theory and Dynamical Systems*
 - *Journal of Fractal Geometry*
 - *Nonlinearity*
 - *Proceedings of the London Mathematical Society*
 - *Real Analysis Exchange*
 - *Transactions of the American Mathematical Society*
 and several others.
- **Vice member** (elected) of the Board of the Department of Mathematics and Statistics at University of Helsinki during the period Jan 2010 - Jun 2012. This included occasional board meetings on deciding the appointments, accepting Master of Science level theses and allocation of funding in the department.

TEACHING EXPERIENCE

I enjoy teaching in various levels (graduate, undergraduate and schools):

- Spring 2016 **Lecturer** for a term long graduate course "*Additive Combinatorics and Ergodic Methods in Fractals*", in the School of Mathematics, University of Bristol, UK. Includes also preparing the lecture notes.
 • Website: <http://sahlsten.org/courses/adderg.html>
- Aug - Sep 2014 **Lecturer** for two minicourses on "*Magnification dynamics in geometry and arithmetics*", in the Department of Mathematics, South China University of Technology, Guangzhou, China, and in the Chinese University of Hong Kong, Hong Kong, China (SAR)
- December 2013 **Lecturer** for a minicourse on "*An Invitation to Geometric and Diophantine Fourier Analysis*", which gave an introduction to Fourier analytic techniques in geometry, Diophantine approximation and dynamical systems at the Department of Mathematics, University of York, UK
- Sep - Oct 2011 Took lessons on **University Pedagogics** (5 ECTS) in Department of Mathematics, University of Helsinki, Finland as a part of doctoral training, which involved theoretical and practical studies on teaching guidelines and methods in universities
- Jan 2010 - Dec 2011 **Teaching Assistant & Substitute Lecturer** for undergraduate courses in the Department of Mathematics, University of Helsinki, Finland. TA for undergraduate courses
 - *Introduction to Discrete Mathematics*
 - *Topology*
 - *Measure and Integration* (twice)
 - *Real Analysis I* (twice)
 - *Real Analysis II*

This included preparing model solutions and leading the tutoring groups of roughly 15-20 students. Gave substitute lectures a number of times in the Real Analysis II (with 20-30 students) and Measure and Integration (with 50-60 students) courses when the lecturer was absent. Moreover, also prepared the lecture notes for the *Riemannian Geometry* course together with the lecturer I. Holopainen
- Jan 2010 - Dec 2011 **Teaching Tutor** for two terms in "*Ratkomo*" (roughly "*Solution Workshop*" in English) in the Department of Mathematics and Statistics, Helsinki, Finland, where students discuss and ask the tutor for tips and personal help to solve exercises on undergraduate courses currently running in the department.
- Dec 2007 – Jan 2008 **Mathematics Teacher** at Jokela Highschool, Finland. Taught three whole courses on mathematics:
 - *Differential Calculus* (basic syllabus)
 - *Geometry* (advanced syllabus)
 - *Matriculation examination (i.e. A-levels) preparation course in mathematics* (advanced syllabus)

Each course had 5 hours of teaching per week (over 8 weeks) and the course sizes were between 20-30 students. Planned the classes/lectures, exercises and the final exams
- November 2007 **Substitute Mathematics Teacher**, Mäntsälä Upper Secondary School, Finland. This included a total of 50 hours of teaching on school level mathematics courses for around 20 students, which was planned to me by the teacher in absent

EXAMINATION EXPERIENCE

- Summer 2015 **PhD examiner** (with D-J. Feng and J. Fraser) of Eino Rossi's PhD thesis
"Local structure of fractal sets: tangents and dimension"
 presented in the University of Jyväskylä, Finland

INVITED TALKS

— International conferences —

- March 2016 **Stability and perturbations of countable Markov maps**, *27th Nordic Congress of Mathematicians*, Institut Mittag-Leffler and Stockholm University, Sweden
- January 2016 **Quantum ergodicity for hyperbolic surfaces with large injectivity radius**, *Finnish Mathematical Days*, University of Turku, Finland
- June 2015 **Fourier transforms of fractal measures**, *Workshop on Fractals*, The Hebrew University of Jerusalem, Israel
- July 2014 **Fourier transforms of measures invariant under the Gauss map**, *Dynamics and Numbers*, The Max Planck Institute, Bonn, Germany
- August 2013 **Magnification dynamics and non-conformality**, *XXII Rolf Nevanlinna Colloquium*, University of Helsinki, Finland

— Seminars —

- May 2016 **Quantum ergodicity and Benjamini-Schramm convergence of hyperbolic surfaces**, *DynamIC seminar* at the Imperial College London, UK
- May 2016 **Quantum ergodicity and Benjamini-Schramm convergence of hyperbolic surfaces**, *Ergodic Theory and Statistical Mechanics seminar* at the Princeton University, New Jersey, USA
- March 2016 **Quantum ergodicity and Benjamini-Schramm convergence of hyperbolic surfaces**, *Functional Analysis seminar* at the University of Helsinki, Finland
- November 2015 **Fuchsian groups and Fourier transforms**, *Pure Mathematics Colloquium*, University of St Andrews, UK, and at the *Dynamical Systems and Analysis seminar* at the University of Manchester, UK.
- April 2015 **Fourier series of singular functions**, gave the talk three times at the respective seminars at the University of Helsinki, Jyväskylä and Oulu, Finland
- Aug - Sep 2014 **Magnification dynamics in geometry and arithmetics**, a mini-course given twice at South China University of Technology, Guangzhou, China and the Chinese University of Hong Kong, Hong Kong, China (SAR)
- May 2014 **Fourier transforms of invariant measures**, *Groups, Dynamics and Related Topics seminar*, Technion, Haifa, Israel
- March 2014 **Fourier transforms of invariant measures**, *Dynamics and Probability seminar*, The Hebrew University of Jerusalem, Israel
- December 2013 **An Invitation to Geometric and Diophantine Fourier Analysis**, a week-long mini-course, University of York, UK
- October 2013 **Ergodic flows and geometric measure theory**, *Ergodic Theory and Dynamical Systems seminar*, University of Warwick, UK
- May 2013 **Beyond greedy and lazy beta-expansions**, *Séminaire Automates*, Université Paris Diderot-Paris 7, France
- May 2013 **Brownian motion and round sets**, *The Most Informal Probability Seminar*, Leiden University, Netherlands
- April 2013 **The Brownian graph is not round**, *Mathematics Seminar*, The Open University, UK
- February 2013 **Fourier analysis of the graph of fractional Brownian motion**, *Analysis Seminar*, University of Bristol, UK

- December 2012 **A Bernoulli-type measure related to β -expansions**, *Mathematics Seminar*, South China University of Technology, Guangzhou, China
- April 2011 **Asymptotic non-doubling and tangent measures**, *Geometric Analysis Seminar*, University of Helsinki, Finland
- April 2010 **Tangent measures and fractals**, *Fractal Seminar*, University of Jyväskylä, Finland
- January 2010 **Porous measures and their tangents**, *Pure Mathematics Colloquium*, University of St. Andrews, UK

RESEARCH VISITS

11. – 18. May 2016 **San Francisco State University**, California, USA (hosts Yitwah Cheung and Chun-Kit Lai)
10. – 11. May 2016 **Princeton University**, New Jersey, USA (host Ilya Vinogradov)
4. – 14. Jan 2016 **University of Helsinki**, Finland (host Antti Kupiainen)
10. – 20. Oct 2015 **The Hebrew University of Jerusalem**, Jerusalem, Israel (host Michael Hochman)
17. – 21. Apr 2015 **University of Manchester**, UK (host Jonathan Fraser)
30. Mar – 12. Apr 2015 **University of Helsinki**, **University of Jyväskylä** and **University of Oulu**, Finland (hosts Pertti Mattila, Antti Käenmäki and Maarit Järvenpää)
- 1.– 12. Sep 2014 **The Chinese University of Hong Kong**, China (SAR) (host De-Jun Feng)
- 21.– 29. Aug 2014 **South China University of Technology**, Guangzhou, China (host Bing Li)
- 18.– 29. Apr 2014 **University of Bristol**, England (host Thomas Jordan)
- 1.– 6. Dec 2013 **University of York**, England (host Alan Haynes)
- 21.– 23. Oct 2013 **University of Warwick**, England (host Jonathan Fraser)
- 22.– 26. May 2013 **Université Paris Diderot**, France (hosts Lingmin Liao and Timo Jolivet)
- 13.– 18. May 2013 **Leiden University**, Netherlands (host Charlene Kalle)
- 4.– 6. Apr 2013 **University of Surrey**, England (host Pablo Shmerkin)
- 15.– 18. Dec 2012 **South China University of Technology**, Guangzhou, China (host Bing Li)
- 15.– 27. Aug 2011 **University of Oulu**, Finland (host Ville Suomala)
- 23.– 25. Jul 2010 **Zhejiang University**, Hangzhou, China (host Huo-Jun Ruan)
- 12.– 18. Jul 2010 **The Chinese University of Hong Kong**, China (SAR) (host De-Jun Feng)
- 22.– 26. Mar 2010 **University of Jyväskylä**, Finland (host Ville Suomala)
- 11.– 28. Jan 2010 **University of St. Andrews**, Scotland (hosts Tony Samuel and Sara Munday)

REFERENCES

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