

Wael Bahsoun

Curriculum Vitae

Personal Data

Full Name: Wael Bahsoun
Date of Birth: 30 October 1975
Citizenship: British
Marital Status: Married, have two children

Contact Details

Dr. Wael Bahsoun
School of Mathematics
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(I) Current Position and Academic History

Current Position and Employment History

(2013-present) Senior Lecturer in Mathematics, Loughborough University, UK.
(2008-2013) Lecturer in Mathematics, Loughborough University, UK.
(2006-2008) Samuel Gratrix Fellow, University of Manchester, Manchester, UK.
(2004-2006) PIMS Postdoctoral Fellow, University of Victoria, Victoria, Canada.

Education

(2000-2004) PhD in Mathematics, Concordia University, Montreal, Canada.
(1998-2000) MSc in Mathematics, Concordia University, Montreal, Canada.
(1994-1998) BSc in Mathematics, American University of Beirut, Lebanon.

Research Interests

- Ergodic Theory and Dynamical Systems.
- Random Dynamical Systems.
- Random Dynamics in Economics and Finance.

(II) Administrative Duties

(01.09.15-present) Deputy Head of Department;
(01.01.17-present) Research Coordinator;
(01.09.15-30.08.16) Equality and Diversity Coordinator;
(01.02.15-01.09.15) Director of the joint programmes with the Business School;
(29.11.2013-30.01.15) Director of the University Foundation Programmes;
(2010-2013) Programme tutor for Financial Mathematics, Mathematics with Economics.

(III) Teaching Awards and Teaching Experience

I have received 3 teaching awards voted by students at the School of Science at Loughborough. 2 of which in 2013-2014, and 1 in 2014-2015. I have a lecturing experience, at the university level, in the UK and Canada since 2001. I also have a certificate from the HEA.

(IV) Postdocs, PhD and MSc Supervision

- Research Associate: Marks Ruziboev (May 2016-present).
- PhD students: Xiaoxuan Ding (01.10.16-present); Xiaolong Niu (Oct 2012-March 2016); Yuejiao Duan (Oct 2010-Sept 2013); Çisem Bektur (Oct 2009-Sept 2012).
- 17 completed MSc projects (2008-2015).

(V) Editorial Work

- Associate Editor in Chaos Solitons & Fractals, January 2017-to date.
- Ergodic Theory, Open Systems, and Coherent Structures. Editors W. Bahsoun, C. Bose and G. Froyland. Springer PROM, 2014.

(VI) PI on External Grants

- **PI** and **Coordinator** on proposal 765254, H2020-MSCA-ITN-2017, value €3.6M. Pending.
- The Leverhulme Trust RPG-2015-346, value £126,818 (01 May 2016-30 April 2019, Research Grant).
- LMS Grant 41450 Scheme 4, value £1080 (to partially support a research visit of WB to Victoria, Canada, 28 August-05 September 2015).
- The Leverhulme Trust IN-2014-021, value £58,830 (01 October 2014-30 September 2017, network grant, Bahsoun (**PI**), Galatolo, Pollicott, Saussol, Vaienti).
- LMS 150th Celebratory Activity (ref. RMC-150-01) value £350 (to celebrate the the LMS 150th anniversary during LMS-CMI Research School (RS-10) at Loughborough, 15 April 2015).
- LMS-CMI Research School (RS-10), value £31,000 (support to organise a school for research students and early career researchers at Loughborough, 13-17 April 2015).
- LMS Grant 41357, Scheme 4, value £370 (to support a research visit of WB to ICTP Trieste , 20-26 July 2014).
- IMA SGS08/13, Small Grant, value £300 (to partially support participations in Limit Theorems for Dynamical Systems, Lausanne, 03-07 June 2013).
- LMS Grant 41216, Scheme 4, value £840 (to support the research visit of Stefano Galatolo to Loughborough, 26 April-03 May 2013).
- LMS Grant 41132, Scheme 4, value £700 (to support a research visit of WB to Marseille, 20-27 Sept 2012).

- LMS Grant 41032, Scheme 4, value £700 (to support the research visit of Sandro Vaienti to Loughborough, 31 July-05 August 2011).
- IMA SGS08/11, Small Grant, value £500 (to partially support participations in ICIAM 2011 in Vancouver, 18-22 July 2011).
- Royal Society TG101937, Travel Grant, value: £2441 (to support the research visit of Chris Bose to Loughborough, 19 June-09 July 2011).
- LMS Grant 41014, Scheme 4, value £260 (to support the research visit of Andrew Ferguson to Loughborough, 21-25 March 2011).

(VII) Speaker at International Conferences/Workshops

- Statistical properties for random intermittent maps, Statistical Properties of Dynamical Systems 7-9 September 2016, Porto, Portugal.
- Linear response for non-uniformly expanding maps, Statistical Properties of Non-Equilibrium Dynamical Systems Conference 27 July -02 August 2016, SUSTC Shenzhen, China.
- Mixing rates and limit theorems for random intermittent maps, Thermodynamic Formalism and Mixing 25-29 April 2016, Erwin Schrödinger Institute, Vienna, Austria.
- Linear response: formulae and rigorous approximations, Computations in Dynamics, 4-8 April , 2016, ICERM, Brown University USA.
- Mixing rates and limit theorems for random intermittent maps, Mini-workshop on Ergodic Theory and Dynamical Systems 11-12 June 2015, Leiden University, Netherlands.
- Approximation of isolated eigenvalues of transfer operators and escape rates of open systems, 2 lectures during School on Computation and Computability in Dynamics, 21 July-2 August 2014, ICTP, Trieste, Italy.
- Escape rates formulae and metastability for randomly perturbed maps, Limit Theorems for Dynamical Systems, 03-07 June 2013, Centre interfacultaire Bernoulli, Lausanne, Switzerland.
- Rigorous and computable approximations of escape rate formulae, ICIAM 2011, July 18-22, Vancouver, Canada.
- Nash equilibrium strategies in evolutionary models of asset markets, Journées internationales intérêts comparatifs et problèmes des simulations en sciences exactes et sciences humaines 2010, June 4-5, Marseille, France.
- Quasi-invariant measures and escape rates, 8th AIMS conference 2010, May 25-28, Dresden, Germany.
- SRB measures for certain Markov processes, 8th AIMS conference 2010, May 25-28, Dresden, Germany.

- Capital growth under transaction costs: an analysis based on the von Neumann-Gale model, SPA 2009, July 27-31, Berlin, Germany.
- Deterministic representation for position dependent random maps, New Directions in: Probabilistic Aspects of Skew-Product Dynamics, 2008, September 10-11, University of Manchester, UK.
- Evolutionary models of financial markets, June 1-5, Second Canada-France Meeting, 2008, UQAM, Montreal, Canada.
- Rigorous numerical approximation of escape rates, Measurable Dynamics: Theory and Applications, 2006, August 5-10, BIRS, Banff, Canada.
- Deterministic representation for position dependent random maps, CMS Winter meeting, December 9-12, 2005, Victoria, Canada.
- Absolutely continuous invariant measures for random maps and their applications in finance, Young Mathematicians Conference in PDE and Dynamical Systems 2004, January 31 - February 1, The Fields Institute, Toronto, Canada.
- Weakly convex and concave random maps, CMS summer meeting, 2003, June 14-16, University of Alberta, Edmonton, Canada.
- Exact and dissipative inner functions, ISM Graduate Students Conference, May 10-12, 2002, Concordia University, Montreal, Canada.

(VIII) External Seminar Talks

- Mixing rates and limit theorems for random intermittent maps, One Day Ergodic Theory Meeting, Queen Mary University, UK, 7 December 2016.
- Mixing rates and limit theorems for random intermittent maps, Dynamical Systems Seminar, University of Manchester, UK, 21 April 2015.
- Decay of correlation for random intermittent maps, Dynamics Seminar, Imperial College, UK, 22 January 2015.
- Decay of correlation for random intermittent maps, séminaire d'Analyse et Probabilités, Laboratoire de Mathématiques de Brest, France,, 18 December 2014.
- Decay of correlation for random intermittent maps, Dynamics Seminar, University of Warwick, UK, 21 January 2014.
- Decay of correlation for random intermittent maps. During the programme 'Mathematics of Fluid Earth', Isaac Newton Institute, Cambridge, UK, 25 November 2013.
- Metastable interval maps, Dynamics Seminar, University of Victoria, Canada, April 03, 2012.
- Metastability of intermittent and randomly perturbed maps, Dynamical Systems and Statis-

tical Physics, Queen Mary University of London, Oct 18, 2011.

- Metastability of certain intermittent maps, One day Ergodic Theory Meeting, 2011, March 04, University of Surrey, UK.
- Invariant densities and escape rates: rigorous and computable approximations in the L^∞ -norm, séminaire d'Analyse et Probabilités, Laboratoire de Mathématiques de Brest, France, Feb 03, 2011.
- Rigorous and computable pointwise approximations of invariant densities and escape Rates, Ergodic Theory and Dynamical Systems Seminar, University of Bristol, UK, Oct 21, 2010.
- Invariant densities and escape rates: rigorous and computable approximations in the L^∞ -norm, Dynamics Seminar, University of Warwick, UK, Oct 19, 2010.
- Quasi-invariant measures and escape rates, Seminaire propriétés statistiques des systèmes dynamiques, Marseille, France, June 03, 2010.
- Quasi-invariant measures and escape rates, Dynamics Seminar, University of Victoria, Canada, April 15, 2010.
- Random maps, skew-products and existence of invariant measures, Dynamics Seminar, Imperial College, UK, Oct 27, 2009.
- Skew-product representation for position dependent random maps, Dynamics Seminar, University of Warwick, UK, Oct 14, 2008.
- Evolutionary dynamics of financial markets, Colloquium, University of Victoria, July 12, 2007.
- Rigorous numerical approximation of escape rates, Dynamics Seminar, University of Manchester, UK, March 14, 2007.
- Rigorous numerical approximation of escape rates, One day Ergodic Theory Meeting, 2006, November 02, Queen Mary University of London, UK.
- Rigorous numerical approximation of escape rates, Dynamics Seminar, Imperial College London, UK, February 23, 2006.
- Chaotic dynamical systems: a probabilistic approach, Two Lectures, Dynamics Seminar, University of Victoria, Jan. 13 and 20, 2006.
- Open dynamical systems: escape rates and conditionally invariant measures, Operator Theory Seminar, University of Victoria, March 23, 2005.
- Random dynamics, Two Lectures, Operator Theory Seminar, University of Victoria, Feb 7 and 9, 2005.
- Measurable dynamics, Three Lectures, Operator Theory Seminar, University of Victoria, November 8, 15 and 23, 2004.

- Position dependent random maps and generalized skew products, Discrete Math. Seminar, University of British Columbia, November 16, 2004.
- Deterministic representation for position dependent random maps, Dynamical Systems Seminar, Concordia University, 21 October, 2004.
- Random dynamics and applications to finance, Applied Math Seminar, University of Victoria, September 14, 2004.
- Position dependent random maps in one and higher dimensions, CRM, October 2002.
- Weakly convex and concave random maps with position dependent probabilities, ISM Graduate Students Seminar, Concordia University, January, 2003.
- Absolutely continuous invariant measures for position dependent random maps, Concordia Graduate Students Seminar, February 2003.
- Julia set and ergodicity of inner functions, ISM Graduate Students Seminar, McGill University, November 2001.
- Weierstrass φ -function and Lattes example, Concordia Graduate Students Seminar, July 2001.
- The Poincare recurrence theorem and smooth Julia sets, Concordia Graduate Students Seminar, May 2001.
- The goals of dynamical systems, ISM Graduate Students Seminar, McGill University, November 2000.

(IX) Conferences/Workshops Organisation

- W. Bahsoun (main organiser), A. Archer, W. Bahsoun, G. El, A. Neishtadt, A. Veselov, H. Zhao. *Dynamics Days Europe*, Loughborough, 3-7 September 2018.
- W. Bahsoun and M. Pollicott, *Ergodic Theory, Algorithms and Rigorous Computations*, Warwick, 3-7 April 2017.
- S. Van Strien, S. Türelı, N. Karaliolios, T. Clark, S. Luzzatto, K. War, W. Bahsoun, M. Ruziboev, *Aspects of Dynamical Systems*, Imperial 16-18 March 2017.
- W. Bahsoun, LMS-CMI School, *Statistical Properties of Dynamical Systems*, Loughborough, 13-17, 2015.
- W. Bahsoun, C. Bose and G. Froyland, *Open Dynamical Systems: Ergodic Theory, Probabilistic Methods and Applications*, BIRS, Banff, 08-13 May, 2012.
- W. Bahsoun, C. Bose and G. Froyland, *Transport and Metastability in Open and Time-dependent Dynamical Systems*, Contributed Minisymposium at ICIAM2011, Vancouver, 18-22

July, 2011.

- W. Bahsoun, K. T. Santhar and K. Loeschner, *ISM Graduate Students Conference*, ISM, Montreal, 10-12 May, 2002.

(X) Other Research, Academic and Professional Activities

Research Visits

- Visiting Fellow of the Isaac Newton Institute for Mathematical Sciences, to participate in the programme Mathematics for the Fluid Earth. This programme, from 21 October to 20 December 2013.
- Università di Pisa, Italy, (03-08 July 2013. Then Frequently since December 2014 to collaborate with Stefano Galatolo).
- Centre de Physique Théorique , Marseille, France, (Frequently, since June 2010, to collaborate with Sandro Vaienti).
- Laboratoire de Mathématiques de Brest, France, (01-04 Feb 2011. Then Frequently since December 2014 to collaborate with Benoît Saussol).
- University of Victoria, Canada, (Frequently, since July 2007, to collaborate with Chris Bose).
- University of British Columbia, Canada, (15-17 Nov 2004).
- York University, Canada, (15-21 Oct 2004).

Service and Memberships

- I have refereed articles for the following journals:

Communications in Mathematical Physics; Decisions in Economics and Finance; Discrete and Continuous Dynamical Systems-A; Dynamical Systems; Ergodic Theory and Dynamical Systems; International Journal of Bifurcation and Chaos; Journal of Computational Dynamics; Journal of Applied Mathematics and Stochastic Analysis; Journal of Physics A, Nonlinearity.

- I write reviews of articles for *Mathematical Reviews*.
- 2012-present, I am a member of the London Mathematical Society.
- 2013-present I am a member of the Institute of Mathematics and Its Applications (IMA).
- During 2001-2002, I was the *Mathematics and Statistics Graduate Students' Representative*, Concordia University, Montreal.

Conferences/Workshops Attended as Participant

- Analytical Methods in Classical and Quantum Dynamical Systems, Centro De Giorgi, Pisa, 27 June-2 July 2016, Italy.

- Extreme Value Theory and Laws of Rare Events, 14th-18th July 2014, CIRM, Marseille, France.
- Hyperbolicity and Dimension, 02-06 December 2013, CIRM, Marseille, France.
- Ergodic Theory and Dynamical Systems: Perspectives and Prospects, 2012, April 16-17, University of Warwick, UK.
- Piecewise and low-dimensional dynamics, 2011, July 04-06, University of Warwick, UK.
- Statistical properties of rare events, 2010, Sep. 27-28, University of Exeter, UK.
- MITACS-IFM2 Workshop on Recent Advances in Financial and Insurance Risk Management: Stochastic and Statistical Models, 2008, June 2-3, UQAN, Montreal, Canada.
- Workshop on Ergodic Theory and Geometry, 2008, April 1-4, University of Manchester, UK.
- Northwest Dynamics Symposium, 2005, Aug 15-19, University of Victoria, Canada.
- PIMS Summer School in Aperiodic Order, 2005, Aug 8-13, University of Victoria, Canada.
- Mathematical Issues in Molecular Dynamics, 2005, June 4-9, BIRS, Banff, Canada.
- Conference in Honor of Paul Koosis, October 2003, CRM Montreal Canada.
- Holomorphic Iteration, Non-Uniform Hyperbolicity, May 22-25, 2002, Banach Center, Warsaw Poland.
- Adrien Douady's 60th Birthday, 20-21 October 2000, CRM, Montreal Canada.
- Canadian Mathematical Society Meeting, 2000, McMaster University, Hamilton Canada.
- Holomorphic Dynamics, Conformal and Invariant Measures, November 22-27, 1999, Banach Center, Warsaw Poland.

Seminar Organisation

- Local organiser of the *One-Day Ergodic Theory Meetings*, 20, November, 2013, 20 January 2017, Loughborough University, UK.
- 2003-2004, *ISM Graduate Students Seminar*, ISM, Montreal.
- 2001-2002, *Concordia Graduate Students Seminar*, Concordia University, Montreal.

(XI) List of Publications

Articles published in refereed journals

1. Bahsoun, W., Saussol, B., *Linear Response in the Intermittent Family: Differentiation in a Weighted C^0 -Norm*, Discrete Contin. Dynam. Systems-A. 2016, 12, 6657-6668.
2. Bahsoun, W., Galatolo, S., Nisoli, I. and Niu, X. *Rigorous Approximation of Diffusion Coefficients for Expanding Maps*, Journal of Statistical Physics, 2016, 6, 1486-1503.
3. Bahsoun, W. and Bose, C., *Mixing Rates and Limit Theorems for Random Intermittent Maps*, Nonlinearity, 2016, 29, 1417-1433.
4. Bahsoun, W., Bose, C. and Duan, Y. *Rigorous Pointwise Approximations For Invariant Densities of Nonuniformly Expanding Maps*, Ergodic Theory and Dynamical Systems, 2015, 35, 1028-1044.
5. Bahsoun, W., Schmelling, J. and Vaienti, S., *On Transfer Operators and Maps with Random Holes*, Nonlinearity, 2015, 28, 713-727.
6. Bahsoun, W., Bose, C. and Duan, Y. *Decay of Correlations for Random Intermittent Maps*, Nonlinearity, 2014, 27, 1543-1554.
7. Bahsoun, W., Hu, H. and Vaienti, S., *Pseudo-Orbits, Stationary Measures and Metastability*, Dynamical Systems, 2014, 29, no. 3, 322-336.
8. Bahsoun, W. and Vaienti, S., *Escape Rates Formulae and Metastability for Randomly Perturbed Maps*, Nonlinearity, 2013, 26, 1415-1438.
9. Bahsoun, W. and Vaienti, S., *Metastability of certain intermittent maps*, Nonlinearity 2012, vol. 25, 107-124.
10. Bahsoun, W. and Bose, C., *Invariant Densities and Escape Rates: Rigorous and Computable Approximations in The L^∞ -norm*, Nonlinear Analysis, 2011, vol. 74, 4481-4495.
11. Bahsoun, W. and Góra, P., *SRB Measures for Certain Markov Processes*, Discrete Contin. Dynam. Systems, 2011, vol. 30, no. 1, 17-37.
12. Bahsoun, W., Evstigneev, I. and Xu, L., *Almost sure Nash equilibrium strategies in evolutionary models of asset markets*, Math. Methods Oper. Res., 2011, vol. 73, 235-250.

13. Bahsoun, W. and Bose, C., *Quasi-Invariant Measures, Escape Rates and The Effect of The Hole*, Disc. Cont. Dynam. Sys. A, 2010, vol. 27, no. 3, 1107-1121.
14. Bahsoun, W., Bose, C. and Quas, A., *Deterministic Representation of Position Dependent Random Maps*, Disc. Cont. Dynam. Sys. A, 2008, vol. 22, no. 3, 529-540.
15. Bahsoun, W., Evstigneev, I. and Taksar, M., *Rapid Paths in the von-Neumann-Gale Dynamical Systems*, Stochastics, 2008; vol. 80, no. 2-3, 129-141.
16. Bahsoun, W., Góra, P., Mayoral S., and Morales, M., *Random Dynamics and Finance: Constructing Implied Binomial Trees from a Predetermined Stationary Density*, Appl. Stochastic Models Bus. Ind., 2007; vol. 23, no. 3, 181-212.
17. Bahsoun, W., *Rigorous Numerical Approximation of Escape Rates*, Nonlinearity, 2006, vol. 19, 2529-2542.
18. Bahsoun, W. and Góra, P., *Invariant Densities For Position Dependent Random Maps on the Real Line: Existence, Approximation and Error Bounds*, Stochastics and Dynamics, 2006, vol. 6, no. 2, 155-172.
19. Góra, P., Boyarsky, A., Islam, S. and Bahsoun, W., *Absolutely Continuous Invariant Measures That Cannot Be Observed Experimentally*, SIAM J. App. Dynam. Sys., 2006, vol. 5, no. 1, 84-90.
20. Bahsoun, W. and Góra, P., *Invariant Measures for Position Dependent Random Maps of an Interval With Holes*, IJBC, 2006, vol. 16, no. 2, 437-444.
21. Góra, P., Boyarsky, A. and Bahsoun, W., *Folding Maps and Functional Equations*, Dynam. Sys., 2006, vol. 21, no. 2, 235 - 243.
22. Bahsoun, W. and Góra, P. *Random β -transformations*, IJBC, 2006, vol. 16, no. 4, 1079-1081.
23. Bahsoun, W., Góra, P. and Boyarsky A., *Markov Switching for Position Dependent Random Maps with Application to Forecasting*, SIAM J. App. Dynam. Sys., 2005, vol 4, no. 2, 391-406.
24. Bahsoun, W. and Góra, P., *Position Dependent Random Maps in One and Higher Dimensions*, Studia Math., 2005, 166, 271-286.

25. Bahsoun, W. and Góra, P., *Dissipative and Exact Inner Functions*, Complex Var., 2004, vol. 49, no. 5, 331-338
26. Bahsoun, W., Góra, P. and Boyarsky A., *Small Stochastic Perturbations of Random Maps with Position Dependent Probabilities*, Stochastic Anal. Appl., 2004, vol 22, no. 4, 1121-1130.
27. Thirulogasanthar, K. and Bahsoun, W., *Frames Built on Fractal Sets*, J. Geom. Phy., 2004, vol. 50, 79-98.
28. Thirulogasanthar, K. and Bahsoun, W., *Continuous and Discrete Frames on Julia Sets*, J. Geom. Phy., 2004, vol. 51, 183-195.
29. Bahsoun, W., Góra, P. and Boyarsky A., *Stochastic Perturbations of Position Dependent Random Maps*, Stochastics and Dynamics, 2003, vol. 3, no. 4, 545-557.
30. Bahsoun, W., Góra, P., Boyarsky A. and Ebrahimi, M., *Filtering Entropy*, Physica D., 2003, vol. 183, no. 3-4, 260-272
31. Bahsoun, W. and Góra, P., *Weakly Convex and Concave Random Maps with Position Dependent Probabilities*, Stoch. Anal. App., 2003, vol. 21, no. 5, 983 - 994.
32. Bahsoun, W., *Julia Set and Ergodicity of Meromorphic Functions*, Adv. Stud. in Cont. Math, 4, 2002, no. 2, 103-109.

Articles submitted for publication in refereed journals

- Bahsoun, W., Ruziboev, R. *On the Stability of Statistical Properties of Lorenz Attractors with $C^{1+\alpha}$ -Stable Foliation*, submitted.
- Bahsoun, W., Galatolo, S., Nisoli, I. and Niu, X. *A Rigorous Computational Approach to Linear response*, submitted.

Books

- Ergodic Theory, Open Systems, and Coherent Structures, Edited by W. Bahsoun, C. Bose and G. Froyland. Springer PROM, 2014.

Chapters in books

- Bahsoun, W., Evstigneev, I. and Taksar, M., *Growth-optimal investments and numeraire portfolios under transaction costs*, Handbook of the Fundamentals of Financial Decision Making (S. Browne, L.C. MacLean and W.T. Ziemba, eds.), 2013.