

## Aretha Leonore Teckentrup

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### PERSONAL INFORMATION

**Date of birth**

29 January 1986

**Nationality**

German

### EMPLOYMENT

**Lecturer in Mathematics of Data Science**

University of Edinburgh (UK), October 2016 - present

**Postdoctoral Research Associate**

University of Warwick (UK), September 2014 - September 2016

With Professor Andrew Stuart, funded by EPSRC grant EP/K034154/1

**Postdoctoral Research Associate**

Florida State University (USA), July 2013 - July 2014

With Professor Max Gunzburger, funded by AFOSR grant FA9550-11-1-0149

### EDUCATION

**PhD Mathematics, *Multilevel Monte Carlo Methods and Uncertainty Quantification***

University of Bath (UK), October 2009 - June 2013

Supervisor: Professor Robert Scheichl

**MMath Mathematics (*with first class honours*)**

University of Bath (UK), October 2005 - June 2009

**International Baccalaureate Diploma**

St. Olav Videregående Skole (Stavanger, Norway), August 2003 - June 2005

### RESEARCH INTERESTS

- Problems at the Interface of Numerical Analysis and Statistics
- Bayesian Approach to Inverse Problems governed by Differential Equations
- Numerical Analysis of Differential Equations with Random Input Data
- Multilevel Sampling Methods
- Multivariate Interpolation and Approximation
- Gaussian Process Regression

### RESEARCH EXPERIENCE

**Postdoctoral Research Associate, University of Warwick**

My research at the University of Warwick was concerned with Gaussian processes and Bayesian inverse problems. Particular topics included the use of Gaussian process emulators to approximate the forward model in a Bayesian inverse problem and the study of ratio estimators based on multilevel Monte Carlo and Quasi-Monte Carlo to compute posterior expectations.

### **Postdoctoral Research Associate, Florida State University**

My research at Florida State University was concerned with topics in high dimensional interpolation and stochastic collocation methods for partial differential equations with random input data. Main achievements include a convergence and complexity analysis of a multilevel sparse grid collocation method, together with an algorithm for its practical implementation, and the development and implementation of an algorithm for computing multivariate point sets with minimal Lebesgue constant, which are of interest in total degree polynomial interpolation in multiple dimensions.

### **PhD Mathematics, University of Bath**

My doctoral research focused on the development and convergence analysis of multi-level Monte Carlo methods for partial differential equations with random coefficients, with particular focus on coefficients which are not uniformly coercive and bounded with respect to the random parameter. A fundamental part of my research was a detailed regularity analysis of such equations, and the new regularity results were then applied to give a rigorous and extensive convergence analysis of multilevel Monte Carlo methods based on finite element or finite volume spatial discretisations. For model problems which exhibit fine scale features, we provided an improved multi-level method with convergence properties independent of the characteristic length scale. We further developed a new multilevel version of a Markov chain Monte Carlo method, and provided a full convergence analysis and practical implementation. Theoretical results were always complemented by thorough numerical investigations.

## **TEACHING AND SUPERVISION EXPERIENCE**

### **Lecturer**

University of Edinburgh (UK), Academic year 2016/17, Second year undergraduate course entitled *Facets of Mathematics*

University of Warwick (UK), Academic years 2014/15, 2015/16, Third year undergraduate course entitled *Matrix Analysis and Algorithms*

### **Instructor**

Conference on Multi-scale Inverse Problems (Loka Brunn, Sweden), August 2016, Short course on "Introduction to the Bayesian Approach to Inverse Problems", taught jointly with Dr Claudia Schillings

### **Co-supervisor of PhD project**

University of Warwick (UK), Academic year 2015/16, PhD project of Neil Chada, supervised jointly with Professor Andrew Stuart

### **Research Study Group Leader**

University of Warwick (UK), Academic year 2014/15, Postgraduate research study group on *Reduced Order Models in Uncertainty Quantification*, supervised jointly with Dr Claudia Schillings

### **Co-supervisor of Masters Project**

University of Warwick (UK), Academic year 2014/15, Final year undergraduate Masters (MMath) project of Erlend Skaldehaug Riis, entitled *Bayesian Inverse Problems for Non-Linear Partial Differential Equations*, supervised jointly with Professor Andrew Stuart

**Teaching Assistant**

University of Bath (UK), Academic years 2008/09 through 2012/13, Tutorials for first and second year undergraduate courses on discrete mathematics, numerical analysis and MATLAB

**PUBLICATIONS****Journal Publications**

- A.M. Stuart and A.L. Teckentrup. *Posterior Consistency for Gaussian Process Approximations of Bayesian Posterior Distributions*. Submitted, available as preprint arXiv:1603.02004. To appear in Mathematics of Computation.
- T.J. Dodwell, C. Ketelsen, R. Scheichl, A.L. Teckentrup. *A Hierarchical Multilevel Markov Chain Monte Carlo Algorithm and Applications to Uncertainty Quantification in Subsurface Flow*. SIAM/ASA Journal on Uncertainty Quantification 3(1):1075-1108, 2015.
- A.L. Teckentrup, P. Jantsch, C.G. Webster, M. Gunzburger. *A Multilevel Stochastic Collocation Method for Partial Differential Equations with Random Input Data*. SIAM/ASA Journal on Uncertainty Quantification, 3(1):1046-1074, 2015.
- A.L. Teckentrup, R. Scheichl, M.B. Giles and E. Ullmann. *Further Analysis of Multilevel Monte Carlo Methods for Elliptic PDEs with Random Coefficients*. Numerische Mathematik, 125(3):569-600, 2013.
- J. Charrier, R. Scheichl and A.L. Teckentrup. *Finite Element Error Analysis of Elliptic PDEs with Random Coefficients and its Application to Multilevel Monte Carlo Methods*. SIAM Journal on Numerical Analysis, 51(1):322-352, 2013.
- K.A. Cliffe, M.B. Giles, R. Scheichl and A.L. Teckentrup. *Multilevel Monte Carlo Methods and Applications to Elliptic PDEs with Random Coefficients*. Computing and Visualization in Science, 14(1):3-15, 2011.

**Refereed Conference Proceedings**

- A.L. Teckentrup. *Multilevel Monte Carlo Methods for Highly Heterogeneous Media*. Proceedings of the Winter Simulation Conference 2012 (WSC'12). Available electronically at <http://informs-sim.org/>.

**Preprints**

- R. Scheichl, A.M. Stuart and A.L. Teckentrup. *Quasi-Monte Carlo and Multilevel Monte Carlo Methods for Computing Posterior Expectations in Elliptic Inverse Problems*. Submitted, available as preprint arXiv:1602.04704.
- M. Park and A.L. Teckentrup. *Improved Multilevel Monte Carlo Methods for Finite Volume Discretisations of Flow in Randomly Layered Media*. Submitted, available as preprint arXiv:1506.04694.
- M. Gunzburger, A.L. Teckentrup. *Computing Approximate Optimal Point Sets for Total Degree Polynomial Interpolation in Moderate Dimensions*. Submitted, available as preprint arXiv:1407.3291.

## Theses

- A.L. Teckentrup. *Multilevel Monte Carlo Methods and Uncertainty Quantification*. PhD thesis, University of Bath, June 2013.

## MINI-SYMPOSIUM AND INVITED CONFERENCE/SEMINAR PRESENTATIONS

- Dec 2016* (**Invited talk**) Numerical Analysis and Scientific Computing seminar series, University of Manchester (UK).
- Nov 2016* (**Invited talk**) Numerical Analysis and Scientific Computing seminar series, University of Strathclyde (UK).
- Sep 2016* Dagstuhl Seminar on Uncertainty Quantification and High Performance Computing, Schloss Dagstuhl (Germany).
- Sep 2016* (**Invited talk**) Workshop on Numerical Analysis of Stochastic PDEs (NASPDE'16), Göteborg (Sweden).
- Aug 2016* (**Invited short course**) Conference on Multi-scale Inverse Problems, Loka Brunn (Sweden).
- Aug 2016* 12th International Conference on Monte Carlo and Quasi-Monte Carlo methods in Scientific Computing (MCQMC'16), Stanford University (USA).
- Jun 2016* 15th Conference on the Mathematics of Finite Elements and Applications (MAFELAP '16), Brunel University (UK).
- May 2016* (**Invited talk**) Uncertainty Quantification workshop, Institut Mittag-Leffler (Sweden).
- Apr 2016* (**Invited talk**) UK-Russia workshop on Uncertainty Quantification in Inverse Modelling, Novosibirsk (Russia).
- Apr 2016* SIAM Conference on Uncertainty Quantification (SIAM UQ '16), Lausanne (Switzerland).
- Mar 2016* (**Invited talk**) Annual Jamboree of the Centre of Doctoral Training in the Mathematics of Planet Earth, University of Reading (UK).
- Mar 2016* (**Invited talk**) Probability, Stochastic modelling and Financial mathematics seminar series, University of Leeds (UK).
- Jan 2016* 4th SRI Uncertainty Quantification Workshop, King Abdullah University of Science and Technology (Saudi Arabia).
- Sep 2015* International Conference on Scientific Computation And Differential Equations 2015 (SCICADE '15), Potsdam (Germany).
- Sep 2015* (**Invited talk**) 2nd GAMM AGUQ Workshop on Uncertainty Quantification, TU Chemnitz (Germany).
- Aug 2015* 8th International Congress on Industrial and Applied Mathematics (ICIAM '15), Beijing (China).
- Apr 2015* (**Invited talk**) Probability, Stochastic modelling and Financial mathematics seminar series, University of Leeds (UK).
- Mar 2015* SIAM Conference on Computational Science and Engineering (SIAM CSE '15), Salt Lake City (USA).
- Mar 2015* (**Invited talk**) Scientific Computation seminar series, University of Nottingham (UK).
- Feb 2015* (**Invited talk**) Annual meeting of "Porous media: Processes and Mathematics" (PMPM) network 2015, Edinburgh (UK).

- Dec 2014* 8th International Conference on Foundations of Computational Mathematics (FoCM '14), Universidad de la Republica, (Uruguay).
- May 2014* (**Invited talk**) NAIS workshop on Spatial Statistics and Uncertainty Quantification on Supercomputers, University of Bath (UK).
- May 2014* (**Invited talk**) Reading-Warwick Data Assimilation meeting, University of Warwick (UK).
- Apr 2014* 11th International Conference on Monte Carlo and Quasi-Monte Carlo methods in Scientific Computing (MCQMC'14), Katholieke Universiteit Leuven (Belgium).
- Apr 2014* SIAM Conference on Uncertainty Quantification (SIAM UQ '14), Savannah (USA).
- Oct 2013* (**Invited talk**) Computer Science and Mathematics Division seminar series, Oak Ridge National Laboratory (USA).
- Sep 2013* (**Invited talk**) Workshop on Numerical Analysis of Stochastic PDEs (NASPDE'13), INRIA Rennes (France).
- Jun 2013* 14th International Conference on the Mathematics of Finite Elements and its Applications (MAFELAP '13), Brunel University (UK).
- May 2013* (**Invited talk**) Data Assimilation Research Centre (DARC) seminar series, University of Reading (UK).
- Dec 2012* Winter Simulation Conference '12 (WSC '12), Berlin (Germany).
- Feb 2012* 10th International Conference on Monte Carlo and Quasi-Monte Carlo methods in Scientific Computing (MCQMC'12), University of New South Wales (Australia).
- Sep 2011* (**Invited talk**) Center for Applied Scientific Computing (CASC) seminar series, Lawrence Livermore National Laboratory (USA).
- Jun 2011* 8th International Conference on Large-Scale Scientific Computations (LSSC'11), Sozopol (Bulgaria).
- May 2010* (**Invited talk**) ICMS workshop on Uncertainty Quantification, Edinburgh (UK).

## FUNDING AND AWARDS

- Funded research visit to Professor Clayton Webster at the Oak Ridge National Laboratory (1 week in October 2013)
- Funded research visits to Professor Panayot Vassilevski at the Lawrence Livermore National Laboratory (2 weeks in September 2011 and 4 weeks in July 2012)
- Funded participation in the *RICAM Special Semester on Multiscale Simulation & Analysis in Energy and the Environment* at the RICAM in Linz (Austria), October 3-December 16, 2011
- Funded participation in the British Council Researcher Links workshop on Uncertainty Quantification in Inverse Modelling in Novosibirsk (Russia), April 25-27, 2016
- Invited to organise a Young Researcher minisymposium on *Computational Techniques for Bayesian Inverse Problems* at the 88th GAMM annual meeting 2017
- Finalist for the *Ede and Ravenscroft prize for the best postgraduate research student 2013* at the University of Bath

## PROFESSIONAL ACTIVITIES

- **Reviewer** for international peer-reviewed journals, including BIT Numerical Mathematics, Computers and Mathematics with Applications, Discrete and Continuous Dynamical Systems - series A, Foundations of Computational Mathematics, Numerical Linear Algebra with Applications, SIAM/ASA Journal on Uncertainty Quantification, SIAM Journal on Numerical Analysis, SIAM Journal on Scientific Computing and Stochastic Partial Differential Equations: Analysis and Applications.
- **Co-organiser** of the MIR@W day (1 day workshop) on *Reduced Order Models in Uncertainty Quantification*, University of Warwick, November 2014.
- **Co-organiser** of the minisymposium *Large-Scale PDE-constrained Bayesian Inverse Problems*, SIAM Conference on Uncertainty Quantification, April 2016.
- **Co-organiser** of the EQUIP lunch seminar, academic year 2015/16.

## PROGRAMMING SKILLS

Programming in MATLAB (advanced), Fortran90/95, C/C++, R (basic).  
Experience with MPI, OpenMP, CUDA C.

## REFERENCES

Max Gunzburger  
Department of Scientific Computing  
Florida State University  
400 Dirac Science Library  
Tallahassee, FL 32306-4120, USA  
[mgunzburger@fsu.edu](mailto:mgunzburger@fsu.edu)

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Department of Mathematical Sciences  
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