

- Personal Details** 10.23 Worsley Building,
University of Leeds,
Leeds, LS2 9JT
DOB: 1st March 1990
- www.samrelton.com
s.d.relton@leeds.ac.uk
Nationality: British
- Education**
- The University of Manchester** Sept 2011 – Sept 2014
– PhD in Numerical Analysis Supervisor: Nicholas J. Higham FRS
– Developing theory and devising algorithms for functions of matrices
– Algorithms used in MATLAB, the NAG library, and in SciPy
– Funded by ERC Advanced Grant MATFUN (267526)
- The University of Manchester** Sept 2008 – July 2011
– First class BSc in Mathematics
– Graduated top of year group (around 350 students)
– Third year course marks ranging from 84% – 99%
- Professional Experience**
- The University of Leeds, Research Fellow** July 2017 – Present
– Analysis of NHS health data
– Use of statistical modelling and machine learning
- The University of Manchester, Postdoctoral Researcher** March 2016 – June 2017
– Design and implementation of high-performance linear algebra software to improve performance on extreme scale machines.
– Involves parallel programming, OpenMP, MPI, GPUs, and runtime systems for distributed memory computing.
– Funded by Horizon 2020 Project NLAFFET (671633).
- The University of Manchester, Postdoctoral Researcher** Oct 2014 – March 2016
– Developing theory and algorithms relating to functions of matrices.
– Ongoing interdisciplinary projects with Cheminformatics and Statistics groups in Machine Learning, Data Analysis, and Epidemiology.
– Funded by ERC Advanced Grant MATFUN (267526).
- Prozone, Statistical Modelling Project** Dec 2014 – Dec 2015
– Developing models and metrics to analyze performance in football with Ian McHale (Chair of Statistics in Sports at the Royal Statistical Society).
– Handling large data sets with high performance software in Python.
– Presenting technical ideas to a non-specialist audience.
- MathWorks, Software Consultancy Project** Oct 2014 – Dec 2014
– Replaced a number of MATLAB functions with state-of-the-art, high performance alternatives based on my research.
– Project delivered well documented software that was incorporated into MATLAB 2015b onwards.
- British Government** Summer 2010 and 2011
– Worked on stream data mining and geographical data visualisation involving mathematical analysis, high performance computer code and rigorous testing.
– Developed prototype software for end-users.
– Performed scalability analysis to increase data throughput.
- Grants awarded** Awarded an NVIDIA GPU grant for one Titan Xp GPU to be used in my research on machine learning and healthcare analytics in August 2017.

Awarded an NVIDIA GPU grant for one Titan X GPU to be used in my research on high-performance computing and deep learning in July 2016.

Honours and Awards	SIAM Student Chapter Certificate of Recognition	2013
	– Awarded for outstanding contributions to the SIAM Student Chapter Programme by pioneering the SIAM National Student Chapter Conference in the UK	
	The University of Manchester Outstanding Academic Achievement Award	2011
	– Awarded to 5 students from the Electronic and Physical Sciences faculty for outstanding undergraduate performance	
Professional Activities	IMA Award for Undergraduate Achievement	2011
	– Awarded for best undergraduate degree in the School of Mathematics	
	The University of Manchester John Dalton Scholarship	2009 and 2010
	– Attained best average exam score in the School of Mathematics each year	
Professional Activities	Seminar Organiser: Numerical Analysis and Scientific Computing	2015 – 2017
	– Responsible for inviting and entertaining seminar speakers	
	– Budget management required for reimbursing travel and entertaining the speakers	
	Manchester SIAM Student Chapter President	2011 – 2014
	– Organised the inaugural SIAM National Student Chapter Conference (SNSCC12)	
	– Arranged an annual conference in Manchester each year	
– Ran an afternoon of talks with guest speaker Prof. J. Dongarra		
– Managed our annual budget and helped secure funding from NAG and the department		
Authored Software	Blog (URL: blog.samrelton.com)	2013 – Present
	– Summary of conferences I've attended and repository of useful information	
	– Approximately 20 viewers per day	
	Github (URL: github.com/sdrelton)	2014 – Present
	– Contains open source code I have wrote that others may want to use	
	– Core developer of the reference implementation of Batched BLAS (Basic Linear Algebra Subprograms) to be released imminently.	
– Core developer of the PLASMA linear algebra project targeting multi-core systems.		
– Functions for the matrix square root, logarithm, and exponential, incorporated into MATLAB 2015b onwards.		
– Computation of the matrix logarithm, its derivatives, and condition number, MATLAB File Exchange.		
– Computation of the matrix sine and cosine functions, Github.		
– Function to generate performance profile graphs in Python, Github.		
Programming Languages	– Very familiar with MATLAB and Python for use in scientific computing, data analysis, and machine learning applications.	
	– Familiar with C and CUDA for high-performance computing.	
	– Comfortable using HTML and CSS to produce websites from scratch.	
	– Previous experience using Java, C++, Perl, and Javascript during my work with the British government.	
Publications	[1] Ian McHale, and Samuel D. Relton. <i>Identifying Key Players in Soccer Teams using Network Analysis and Pass Difficulty</i> . European Journal of Operational Research, 2018.	

- [2] Peter Kandolf, and Samuel D. Relton. *A Block Krylov Method to Compute the Action of the Fréchet Derivative of a Matrix Function on a Vector with Applications to Condition Number Estimation*. SIAM J. Sci. Comput., 39(4):A1416–A1434, 2017.
- [3] Jack Dongarra, Sven Hammarling, Nicholas J. Higham, Samuel D. Relton, and Mawussi Zounon. *Optimized Batched Linear Algebra for Modern Architectures* Proceedings of Euro-Par 2017, Spain, 511–522, 2017.
- [4] Jack Dongarra, Sven Hammarling, Nick Higham, Samuel Relton, Pedro Valero-Lara, and Mawussi Zounon. *The Design and Performance of Batched BLAS on Modern High-Performance Computing Systems*. Proceedings of ICCS 2017, Switzerland.
- [5] Ian G. McHale, and Samuel D. Relton. *Player Ratings in Soccer* Handbook of Statistical Methods and Analyses in Sports. Chapter 19, 2017.
- [6] Nicholas J. Higham and Samuel D. Relton. *Estimating the Largest Elements of a Matrix*. SIAM J. Sci. Comput., 38(5):C584–C601, 2016.
- [7] Jack Dongarra, Iain Duff, Mark Gates, Azzam Haidar, Sven Hammarling, Nicholas J. Higham, Jonathon Hogg, Pedro Valero-Lara, Samuel D. Relton, Stanimire Tomov, and Mawussi Zounon *A Proposed API for Batched Basic Linear Algebra Subproblems*. MIMS EPrint 2016.25
- [8] Edvin Deadman and Samuel D. Relton. *Taylor’s Theorem for Matrix Functions with Applications to Condition Number Estimation*. Linear Algebra Appl., 504:354–371, 2016.
- [9] Wayne Arter, J. Guy Morgan, Samuel D. Relton, and Nicholas J. Higham. *Ranking the Importance of Nuclear Reactions for Activation and Transmutation Events*. Nuclear Science and Engineering, 2015.
- [10] A. H. Al-Mohy, Nicholas J. Higham, and Samuel D. Relton. *New Algorithms for Computing the Matrix Sine and Cosine Separately or Simultaneously*. SIAM J. Sci. Comput., 37(1):A456–A487, 2015.
- [11] Nicholas J. Higham and Samuel D. Relton. *Estimating the Condition Number of the Fréchet Derivative of a Matrix Function*. SIAM J. Sci. Comput., 36(6):C617–C634, 2014.
- [12] Nicholas J. Higham and Samuel D. Relton. *Higher Order Fréchet Derivatives of Matrix Functions and the Level-2 Condition Number*. SIAM J. Matrix Anal. Appl., 35(3):1019–1037, 2014.
- [13] A. H. Al-Mohy, Nicholas J. Higham, and Samuel D. Relton. *Computing the Fréchet Derivative of the Matrix Logarithm and Estimating the Condition Number*. SIAM J. Sci. Comput., 35(4):C394–C410, 2013.

Publications Submitted

Publications in Preparation

- [1] Antti Koskella, and Samuel D. Relton. *Fast Sampling of Linear Stochastic Differential Equations with Additive Noise using the Matrix Exponential*
- [2] Peter Kandolf, Antti Koskella, Samuel D. Relton, and Marcel Schweitzer. *Two-sided Lanczos Methods for Computing $L_f(A, E)b$* .
- [3] Thomas House, and Samuel D. Relton. *Using Matrix Functions to Accelerate Markov-Chain Monte-Carlo Methods*.
- [4] Samuel D. Relton. *Computing Matrix Functions, their Fréchet Derivatives, and Condition Numbers using Approximate Diagonalization*.
- [5] Samuel D. Relton. *Extending the Block 1-norm Estimator to Compute Multiple Columns with an Application to Matrix Functions*.

- [6] Edvin Deadman, Nicholas J. Higham, and Samuel D. Relton. *Componentwise Conditioning of Matrix Functions*.
- [7] Douglas Kell, Andrew Doig, Stephen O'Hagan, Nicholas J. Higham, Edvin Deadman, and Samuel Relton. *Matrix Encoding and the Procrustes Problems for Cheminfomatics*.
- [8] Ian McHale and Samuel Relton. *Modelling Shot Quality in Football using Spatial and Temporal Data*.
- [9] Alex Bishop, Thomas House, and Samuel Relton. *Large Scale Household Models of Intestinal Worms*.

Teaching Experience

The University of Manchester Semester 1, 2015/16, 2016/17.
 – Designed and delivered lectures on linear algebra for electronic engineering students (around 250 registered). Also ran a weekly tutorial session, wrote the course exam, and marked it.

The University of Manchester Sept 2011 – Sept 2014
 – Ran tutorial sessions for around 20 students of MATH10202 (Linear Algebra) revising course material and working through examples they find difficult on the blackboard. This also involved regularly marking their work and giving them personal feedback.

The University of Manchester Sept 2011 – Sept 2014
 – Postgraduate helper for MATH10001 (Math Workshop) supporting students in learning MATLAB and performing various group exercises. This involved regular marking of their group projects and giving feedback to each individual on how their mathematical writing could be made more eloquent.

Conferences Organised

Annual Manchester SIAM Student Chapter Conference 2014, 2nd May 2014, University of Manchester.

Annual Manchester SIAM Student Chapter Conference 2013, 20th May 2013, University of Manchester.

SIAM National Student Chapter Conference 2012 (SNSCC12), 18th May 2012, University of Manchester.

An afternoon of talks with Jack Dongarra and David Silvester, 3rd Aug 2012, University of Manchester.

Minisymposia Organised

SIAM Conference on Computational Science and Engineering 2017, *Batched Linear Algebra on Multi/Many-Core Architectures*, 27 Feb – 3 March 2017, Atlanta, Georgia, USA.

SIAM Conference on Computational Science and Engineering 2017, *Recent Advances in Matrix Functions and Applications*, 27 Feb – 3 March 2017, Atlanta, Georgia, USA.

SIAM Conference on Applied Linear Algebra 2015, *Recent Advances in Matrix Functions*, 26–30 October 2015, Atlanta, Georgia, USA.

IMA Numerical Linear Algebra and Optimization 2014, *Modern directions in matrix analysis and applications*, 4th September, 2014, University of Birmingham.

Invited Talks

Machine Learning Forum, 5th December 2017, University of Leeds, Leeds. Title: *Advances in Batched Linear Algebra for Machine Learning*

Computational Science and Engineering Seminar, 17th November 2017, University of Leeds, Leeds. Title: *The History (and Future!) of BLAS*

ARC-HPC User Group Meeting, 17th October 2017, University of Leeds, Leeds. Title: *Task-based Linear Algebra on the Intel KNL*

Data in Applied Health Research Seminar, 27th September 2017, University of Leeds, Leeds. Title: *HPC and Machine Learning in Healthcare Research*

Applied Mathematics Seminar, 6th October 2016, ETH Stockholm, Sweden. Title: *Estimating the Largest Elements of a Matrix.*

Computational Mathematics and Applications Seminar, 12th May 2016, RAL STFC, Oxford. Title: *Estimating the Largest Elements of a Matrix.*

**Conferences
Participated**

SIAM Computational Science and Engineering, 27 Feb – 3 March, 2017, Atlanta, Georgia, USA. Talk: *On the Computation of the Action of the Fréchet Derivative.*

Workshop on Batched, Reproducible, and Reduced Precision BLAS, 23–25 February, 2017, Georgia Tech, Atlanta, Georgia, USA. Talk: *Standardizing the Batched BLAS API and Memory Layout.*

4th Workshop on Sustainable Software for Science: Practice and Experiences, 12–14 September, 2016, The University of Manchester. Talk: *Creating a Standardised Set of Batched BLAS Routines.*

IMA Numerical Linear Algebra and Optimization 2016, 7–9 September, 2016, University of Birmingham. Talk: *A Block Krylov Method for the Fréchet Derivative of $f(A)b$.*

SIAM Conference on Applied Linear Algebra, 26–30 October, 2015, Atlanta, USA. Talk: *Taylor's Theorem for Matrix Functions and Pseudospectral Bounds on the Condition Number.*

New Directions in Numerical Computing, 25–28 August, 2015, University of Oxford, England. Talk: *Componentwise and Mixed Condition Numbers for Matrix Functions.*

26th Biennial Numerical Analysis Conference, 23–26 June 2015, University of Strathclyde, Glasgow, Scotland. Talk: *Taylor's Theorem for Matrix Functions and Pseudospectral Bounds on the Condition Number*

SIAM Conference on Computational Science and Engineering 2015, 14–18 March 2015, Salt Lake City, Utah. Poster: *Componentwise Sensitivity of Matrix Functions and Applications*

IMA Numerical Linear Algebra and Optimization 2014, 3–5 September 2014, University of Birmingham. Talk: *Fréchet Derivatives of Matrix Functions and Applications*

Prague SIAM Student Chapter Meeting 2014, 21st March 2014, Prague, Czech Republic. Talk: *The Elementwise Sensitivity of Matrix Functions*

SIAM Gene Golub Summer School 2013, July 2013, University of Shanghai. Talk: *Higher Order Fréchet derivatives of a Matrix Function and Applications*

SIAM Annual Meeting 2013, 9th July 2013, San Diego, USA. Talk: *Higher Fréchet Derivatives of Matrix Functions and some Applications*

SIAM National Student Chapter Conference 2013, 10th May 2013, University of Warwick. Talk: *Higher Fréchet Derivatives of Matrix Functions and some Applications* Poster: *Computing the Matrix Logarithm and its Condition Number (Awarded best poster prize)*

FUN13: Advances in Matrix Functions and Matrix Equations, 10–12 April 2013, University of Manchester. Talk: *Higher Fréchet Derivatives of Matrix Functions and some Applications* Poster: *Computing the Matrix Logarithm and its Condition Number*

Cardiff SIAM Student Chapter Day, 21st Jan 2013, University of Cardiff. Poster: *Computing the Matrix Logarithm and its Condition Number*

SIAM UKIE Annual Meeting, 8th Jan 2013, University of Reading. Poster: *Computing the Matrix Logarithm and its Condition Number*

IMA 3rd Conference on Numerical Linear Algebra and Optimization, 10–12 Sept 2012, University of Birmingham. Talk: *An Algorithm to Compute the Matrix Logarithm and its Fréchet Derivative for use in Condition Number Estimation*

SIAM Conference on Applied Linear Algebra, 18–22 June 2012, University of Valencia. Talk: *An Algorithm to Compute the Matrix Logarithm and its Fréchet Derivative for use in Condition Number Estimation*

Refereeing

I have refereed for the following journals:

- Electronic Journal of Linear Algebra
- Internet Mathematics
- Linear Algebra and its Applications
- Numerical Algorithms
- SIAM Journal of Matrix Analysis and its Applications
- SIAM Journal of Scientific Computing

Memberships

I am a member of the following professional bodies:

- SIAM Postdoctoral Member
- IMA Associate Member
- ILAS Student Member

Courses Attended

Python and TAU (Tuning and Analysis Utilities) for HPC, 2nd July 2015, University of Manchester.

Beginner and Intermediate Fortran (Online courses), University of Manchester.

Software Carpentry Bootcamp, 14th January 2014, University of Manchester.

Introduction to OpenMP, 15th November 2013, University of Manchester.

SIAM Gene Golub Summer School on Matrix Functions and Matrix Equations, 22 July – 2 August 2013, Fudan University, Shanghai. *Attendance by application only with funding provided by the organizing committee.*

NATCOR PhD Course on Convex Optimization, 28th June – 2nd July 2012, Brunel University.