

School of Mathematics  
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# Mary Aprahamian

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## Research Interests

**Numerical analysis:** I am interested in both theoretical and computational problems. During my PhD, in particular, I have worked on various aspects of functions of matrices, ranging from rigorous theoretical definitions to the construction of stable and reliable algorithms for their computation.

**Complex networks:** I have been involved with the analysis of networks arising from various fields such as social media, biological and chemical modelling, and linguistics, to name a few. I have also been interested in the efficient computation of centrality measures, node rankings, and other metrics, for both static and dynamic networks.

**Scientific computing:** I have designed and prototyped algorithms for both small, and large and sparse problems, with special consideration to the efficiency and accuracy of floating point computations. I support reproducible research and have implemented open source software.

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## Professional Experience

Since Oct 2015 **Postdoctoral Research Associate**, *The University of Manchester*  
My postdoc position is based in the Numerical Linear Algebra group at the School of Mathematics. It involves teaching duties, as well as research in functions of matrices and their applications to the analysis of complex networks.

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## Education

2011–2015 **PhD in Numerical Analysis**, *The University of Manchester*

- Thesis title: *Theory and Algorithms for Periodic Functions of Matrices, with Applications*. I successfully defended my thesis on 25th Nov 2015.
- Supervisor: Prof. Nicholas J. Higham.
- Funding: European Research Council MATFUN grant.

As part of my doctoral training, I completed courses in numerical linear algebra, numerical optimisation, and scientific computing, all with Distinction. I also completed courses developing both my **technical and transferable skills**. For example, I participated in a NATCOR course on convex optimisation and operations research, and a Software Carpentry workshop. I also undertook Teaching Assistant training and participated in a number of workshops on creativity.

- 2007–2011 **MA with Honours Mathematics**, *The University of Edinburgh*  
I was awarded a First Class Honours degree.
- Courses: Linear Algebra, Numerical Algorithms, Algebra, Nonlinear Optimization, Financial Mathematics, Economics, Stochastic Modelling, Statistics, Probability, and others.
  - Honours project title: *Resolution of Gibbs Phenomenon*.
  - Supervisor: Prof. Jared Tanner.

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## Publications and Preprints

- 2016 **Matrix Inverse Trigonometric and Inverse Hyperbolic Functions: Theory and Algorithms.** *M. Aprahamian and N. J. Higham.* MIMS Eprint 2016.4, available online at <http://eprints.ma.man.ac.uk/2432>.
- 2015 **Matching Exponential-Based and Resolvent-Based Centrality Measures.** *M. Aprahamian, D. J. Higham, and N. J. Higham.* Journal of Complex Networks Advance Access, June 2015.
- 2014 **The Matrix Unwinding Function, with an Application to Computing the Matrix Exponential.** *M. Aprahamian and N. J. Higham.* SIAM J. Matrix Anal. Appl. 35 (1): 88–109, 2014.

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## Awards and Achievements

- Sep 2014 **Participation (by invitation only) at the 2nd Heidelberg Laureate Forum**
- May 2014 **SIAM Student Chapter Certificate of Recognition** for my contributions to the Manchester SIAM Student Chapter.
- Mar 2014 **Participation (by invitation only) at SET for Britain series of poster competitions and exhibitions; as a successful applicant, I was invited to present my research in the House of Commons.**
- Sep 2013 **Poster prize at the Manchester Research Students' Conference**
- July 2013 **Participation (by invitation only) at the Gene Golub SIAM Summer School on *Matrix Functions and Matrix Equations*** at Fudan University in Shanghai, China.
- June 2013 **Certificate in recognition of an excellent talk at the 25th Biennial Numerical Analysis Conference**, held at The University of Strathclyde.
- July 2011 **Participation (by invitation only) at the Gene Golub SIAM Summer School on *Waves and Imaging*** at the University of British Columbia in Vancouver, Canada.
- June 2010 **Vacation Research Project Scholarship**, awarded by the School of Mathematics, The University of Edinburgh, for a research project entitled *Decay of Waves*, which was supervised by Dr. Pieter Blue.

- June 2009 **James Murray Brown Bequest in Mathematics**, awarded by the School of Mathematics, The University of Edinburgh, for a research project entitled *Probing the Origins of Chaos in Nonlinear Differential Equations*, which was supervised by Prof. Ben Leimkuhler.
- June 2008 **John Lang Scholarship for excellent exam results**, awarded by the School of Mathematics, The University of Edinburgh.

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## Conferences

I have delivered both **invited and contributed presentations** at national and international conferences, a selection of which are given below. As a Treasurer of the Manchester SIAM Student Chapter from 2011–2014, I took a **leading role in the organisation** of the annual Manchester SIAM Student Chapter conferences and the inaugural SIAM National Student Chapters Conference. I have conducted a **research visit** to ETH Zürich, and have planned visits and ongoing **collaborations** with researchers at Università degli Studi di Perugia, Italy, and École Polytechnique Fédérale de Lausanne, Switzerland, and The University of Strathclyde.

### Selected Presentations

- Oct 2015 **SIAM Conference on Applied Linear Algebra**, Atlanta, GA, USA, invited talk at a featured minisymposium, an audio recording of which is available at [https://www.pathlms.com/siam/courses/1697/sections/2317/video\\_presentations/20524](https://www.pathlms.com/siam/courses/1697/sections/2317/video_presentations/20524).
- Jan 2015 **London Mathematical Society 150th Anniversary Launch**, in London; invited poster presentation.
- Nov 2014 **Zürich Colloquium in Applied and Computational Mathematics** at ETH Zürich; invited by Prof. Siddhartha Mishra.
- Sep 2014 **4th IMA Conference on Numerical Linear Algebra and Optimisation** at University of Birmingham; minisymposium organiser.
- July 2014 **SIAM Annual Meeting**, Chicago, IL, USA; minisymposium organiser.
- Mar 2014 **SET for Britain**, House of Commons in London; invited poster presentation.
- July 2013 **SIAM Annual Meeting**, San Diego, CA, USA; invited minisymposium talk, an audio recording of which is available at [https://live.blueskybroadcast.com/bsb/client/cl\\_default.asp?client=975312&ma\\_id=43416](https://live.blueskybroadcast.com/bsb/client/cl_default.asp?client=975312&ma_id=43416).
- June 2013 **25th Biennial Numerical Analysis Conference** at The University of Strathclyde; contributed talk.
- May 2013 **SIAM National Student Chapter Conference** at The University of Warwick; contributed talk.
- Apr 2013 **Advances in Matrix Functions and Matrix Equations** at The University of Manchester; invited talk.
- Jan 2013 **SIAM Chapter Day** at Cardiff University; contributed poster.

- Dec 2012 **7th Annual Meeting of the Bulgarian Section of SIAM** at the Institute of Mathematics and Informatics, Bulgaria; contributed talk.
- Sep 2012 **3rd IMA Conference on Numerical Linear Algebra and Optimisation** at University of Birmingham; contributed talk.

### Organisation of conferences

- May 2014 **Annual Manchester SIAM Student Chapter Conference** at The University of Manchester.
- May 2013 **Annual Manchester SIAM Student Chapter Conference** at The University of Manchester.
- May 2012 **SIAM National Student Chapters Conference** at The University of Manchester.

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## Teaching

- 2015–16 **Mathematics 0F2 Foundation Studies**, tutorials at The University of Manchester.
- 2015–16 **Mathematics 1E1 for Electrical and Electronic Engineering**, tutorials at The University of Manchester.
- 2011–16 **Calculus and Applications A/B**, supervision classes at The University of Manchester.
- 2012–16 **Complex Analysis**, demonstrator role at The University of Manchester.
- 2012–13 **Numerical Analysis I**, demonstrator role at The University of Manchester.

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## Memberships and Service

- Since 2009 **Member of SIAM, ILAS, IMA.**
- Sep 2011–14 **Treasurer of the Manchester SIAM Student Chapter.** I have applied for and received funding from the Institute of Mathematics and its Applications (IMA), and Manchester Institute for Mathematical Science (MIMS) for the organisation of one national and two local conferences.

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## Programming

I have produced freely available **MATLAB** implementations of all algorithms I have developed. Implementations of my programs in **Python** are also available upon request. I have an ongoing collaboration, aiming to produce a complex networks test collection for use in **Julia**. I have worked with **C++** as part of taught course units.

January, 2016, Manchester