

Dr Nicholas (Nick) Hale

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RESEARCH AREAS	Numerical analysis and scientific computing; in particular development of Chebfun (an open-source software project that bridges the gap between numerical and symbolic computing), spectral methods for differential equations, numerical solution of fractional differential equations, and numerical complex analysis.	
EDUCATION	University of Oxford , Oxford, UK DPhil in Numerical Analysis <ul style="list-style-type: none">Thesis title: <i>On the use of Conformal Maps to Speed Up Numerical Computations</i>Supervisor: Prof. L. N. Trefethen FRS Imperial College London , London, UK MSci Mathematics (Hons) - 1st Class	October 2006 – October 2009 October 2002 – June 2006
PROFESSIONAL EXPERIENCE	University of Stellenbosch , Stellenbosch, South Africa <i>Senior Lecturer (with Y1 NRF rating)</i> <i>Post-doctoral Research Fellowship</i> <ul style="list-style-type: none">NM262 Numerical methods (Engineering)TW244 Applied Differential Equations (Mathematics)TW324 Numerical methods (Mathematics)TW776 Numerical linear algebra (Mathematics) Oxford Center for Collaborative Applied Mathematics , Oxford, UK <i>Director of the Chebfun Project</i> <ul style="list-style-type: none">Funded by The MathWorks, Inc. (Producers of MATLAB) <i>Postdoctoral Research Assistant</i> <ul style="list-style-type: none">Research project: <i>Adaptive Spectral Methods in 1D and 2D</i> University of Oxford Numerical Analysis Group , Oxford, UK <i>Lecturer</i> <i>Teaching Assistant</i> <ul style="list-style-type: none">Practical Numerical Analysis. (Lecturer)Introduction to MATLAB for new DPhil/MSc students. (Lecturer)Winter Enrichment Program course at KAUST, Saudi Arabia. January 2010 & 2014. (Lecturer)DRWA13 Summer workshop, September 2013. (Lecturer)Scientific Computing for DPhil Students. (TA/Marker)Part A Numerical Analysis. (Marker) St Hugh's College , Oxford, UK <i>Non-stipendiary Lecturer of Mathematics</i> <i>Tutor</i> Undergraduate courses <ul style="list-style-type: none">Part A (Complex) AnalysisPart A Numerical Analysis Merton College , Oxford, UK <i>Tutor (Part A Numerical Analysis)</i>	January 2015 – Present March 2014 – December 2015 April 2011 – February 2014 October 2009 – April 2011 October 2009 – February 2014 October 2007 – June 2009 October 2008 – February 2014 October 2007 – October 2008 January 2013 – February 2014

SELECTED
PUBLICATIONS

- [0] N. Hale & S. Olver, A fast and spectrally convergent algorithm for fractional integral and differential equations with half-integer order terms, *SIAM J. Sci. Comp.*, (submitted 2016).
- [1] N. Hale & J. A. C. Weideman, Contour integral solution of elliptic PDEs in cylindrical domains, *SIAM J. Sci. Comp.*, 2015.
- [2] N. Hale & A. Townsend, A fast FFT-based discrete Legendre transform, *IMA J. Num. Anal.*, 2015
- [3] N. Hale & K. Xu, Explicit construction of rectangular differentiation matrices, *IMA J. Num. Anal.*, 2015.
- [4] T. Driscoll & N. Hale, Rectangular spectral collocation, *IMA J. Num. Anal.* 2015.
- [5] T. Driscoll, N. Hale, & L. N. Trefethen, Chebfun Guide (1st edition), *Pafnuty Publications*, (2014).
- [6] N. Hale & A. Townsend, An algorithm for the convolution of Legendre series, *SIAM J. Sci. Comp.*, 2014.
- [7] N. Hale & A. Townsend, A fast, simple, and stable Chebyshev–Legendre transform using an asymptotic formula, *SIAM J. Sci. Comp.*, 2014.
- [8] N. Hale & A. Townsend, Fast and accurate computation of Gauss–Legendre and Gauss–Jacobi quadrature nodes and weights, *SIAM J. Sci. Comp.*, 2013.
- [9] N. Hale & L. N. Trefethen, Chebfun and numerical quadrature, *Science in China*, 2012.
- [10] K. Burrage, N. Hale & D. Kay, An efficient FEM implementation for fractional-in-space reaction-diffusion equations, *SIAM J. Sci. Comp.*, 2012.

SHORT
RESEARCH
OUTLINE

From 2002 to 2006 I undertook my undergraduate studies at Imperial College London. Imperial had a very strong numerical analysis programme and I was fortunate enough to write a second year project with Prof Jeff Cash on numerical solutions for initial value problems. Later, for my masters project, I worked on modifying the well-known MATLAB code `bvp4c` (originally written by Kierzenka and Shampine) to be sixth order accurate by using a higher-order interpolant derived earlier that year by Cash and Moore. The resulting code, `bvp6c`, remains competitive with the built-in MATLAB boundary value problem solvers. My current research interests in numerical analysis and software development can be traced back to these experiences.

In 2006 I began my doctoral work (DPhil) with Prof Nick Trefethen at the University of Oxford. My thesis focused on transplanted quadrature and adaptive spectral methods for the numerical solution of PDEs, combining ideas from complex analysis, barycentric interpolation, spectral methods, matrix functions, and conformal mapping. During this time I became interested in Chebfun. Chebfun is a software system written in object-oriented MATLAB and extends familiar powerful methods of numerical computation to continuous or piecewise-continuous functions. One of its key aims is to provide a link between symbolic and numeric computing. More recently, it has become a powerful tool for the numerical solution of ordinary and partial differential equations, an aspect to which I contributed heavily. Following the submission of my thesis I became more involved in the project, and was lead developer of version 3. For two years (2011-2013) I was then part-funded by The MathWorks as director of the project. By now, Chebfun has been downloaded thousands of times and is used by hundreds of academics, researchers, and students around the world. To find out more about Chebfun, see www.chebfun.org.

In 2014 I moved to start a two year postdoctoral position at Stellenbosch University under the supervision of Prof Weideman, whose research interests overlap mine in a number of areas (spectral methods, complex analysis, matrix functions, ...) and a number of interesting joint research projects are already underway and published. In 2015 I was appointed Senior Lecturer at Stellenbosch, starting in March 2016. In the past year, in addition to my teaching and research duties, I have: supervised two teams of our undergraduates in an international math modelling competition (MCM); helped our honours students form a SIAM student chapter with the aim of furthering student interest in applied mathematics; strengthened ties with the African Institute for Mathematics Sciences (AIMS) through supervising and examining projects and attendance (with our honours students) at the MISG study group in 2017; and organised the South African Symposium for Numerical and Applied Mathematics (SANUM2016). Stellenbosch will host SANUM2018 next year, and I will again be the lead organiser. I applied for an NRF rating in 2016 and was awarded a Y1 rating in early 2017. Weideman and I are in the process of forming a new research theme “Numerical and Applied Mathematics” as part of the Wits University-based Centre of Excellence in Mathematical and Statistical Sciences (CoE-MaSS).

REFEREES

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