

**THE INSTITUTE OF MATHEMATICS AND ITS
APPLICATIONS**

IMANA NEWSLETTER

**Newsletter of the Numerical Analysis Group of the
Institute of Mathematics and its Applications**

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1 Comments

In this issue of the Newsletter, we continue our series of articles that aim to introduce the members, interests and activities of NA groups in the UK, this time focusing on the group in Manchester (with thanks to Nick Higham). We also report on the recent IMA Conference on Numerical Linear Algebra and Optimisation. I hope that, in future, readers will offer their own brief reviews of conferences that they feel will interest others.

As I mentioned in the last couple of issues of the Newsletter, we would like to save paper and printing and postage costs by offering readers the opportunity to receive the Newsletter electronically. However, a large number of copies are currently still sent out by mail to those who have, at some time in the past (possibly many years ago), expressed an interest in receiving news of the NA community. Using the recent questionnaire (which is still available on the IMA website at www.ima.org.uk/learned_soc/interestgroups.htm), some readers have indicated that they would like to continue to receive a paper copy of the Newsletter. We are very happy to send paper copies to these IMA members but are anxious that we may be also sending to those who are no longer interested in the Newsletter or who may no longer live at the supplied address. Since we all dislike receiving unwanted mail, our intention is that this will be the last Newsletter that will be automatically sent by post to the pre-2007 readership list. If you would still like to receive the Newsletter (by post or email) and you have **not** already indicated your preference some time during this year, let me know (phone, email or send a short note to the address below) and I will be very pleased to include you on the new readership list. Note that all are welcome and encouraged to join the list and that membership of the IMA is not needed to receive the Newsletter by email. No action is needed if you have already completed a questionnaire.

The copy date for the next Newsletter will be **Monday 17th December**. Regular or one-off contributions from individuals and from NA groups are very welcome.

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2 Meet the Numerical Analysis Group ... Manchester

The Numerical Analysis Group in the School of Mathematics at the University of Manchester comprises 9 permanent members of staff,

- Professor Jack Dongarra,
- Professor Nick Higham, FRS,
- Dr Chris Paul,
- Dr Catherine Powell,
- Dr Tony Shardlow,
- Professor David Silvester,
- Dr Ron Thatcher,
- Dr Ruth Thomas,
- Dr Françoise Tisseur,

along with 1 emeritus professor (Professor Christopher Baker), 2 Senior Honorary Research Fellows (Professor Sven Hammarling, Professor Peter Lancaster), and 2 Research Associates (Dr Timo Betcke, Dr Marta Betcke—also a member of the Inverse Problems group led by Professor Bill Lionheart).

This is an exciting time for numerical analysis in Manchester, for two reasons. First, Jack Dongarra has recently accepted a part-time chair appointment held jointly between the Schools of Mathematics and Computer Science, which strengthens our presence in high-performance numerical computing and will facilitate increased collaboration between the two Schools. Second, in July 2007 the School of Mathematics moved into a new, centrally-located and purpose-built building, the Alan Turing Building. The dedicated research facilities belonging to the Manchester Institute for Mathematical Sciences (MIMS) provide an excellent environment for hosting visitors and organizing workshops and conferences.

The numerical analysis group is one of the largest in the School of Mathematics, which has about 80 permanent lecturing staff. Its roots date back to the 1950s, when research in mathematical computing started in Manchester following the pioneering work led by F. C. Williams and T. Kilburn on the Manchester Mark 1 computer (1948, the world's first stored program computer) and the ensuing Mark 2 (prototype Mercury, 1954) and Atlas (1962).

The group engages in various activities:

In addition to publishing papers and books, the group has always been pro-active in producing technical reports/preprints, initially through the Numerical Analysis Report series (for a history of which see IMANA 31(1), October 2006) and now through the MIMS EPrints archive (<http://www.manchester.ac.uk/mims/eprints>).

Conferences and workshops are regularly organized in Manchester. The most recent events were the “Workshop on Numerical Analysis of Stochastic PDEs”, organized by Catherine Powell and Tony Shardlow and the “Workshop on Large Graphs and Networks: Matrix Algorithms and Applications”, organized by Nick Higham, both held in September 2007.

Masters training has been provided in numerical analysis continuously since 1959. Over the last 5 years the EPSRC MTP/CTA-funded MSc in Applied Numerical Computing has educated around 50 students. From September 2007 a new CTA-funded MSc in Mathematics and Computational Science is being run jointly by the numerical analysis group and colleagues in the School of Computer Science, with the aim of providing training in both numerical analysis and high-performance computing (see <http://www.maths.manchester.ac.uk/postgraduate/pgadmission/msc-mcs.html>). The Numerical Algorithms Group, Ltd. (NAG) generously supports a prize for the best performing student.

Software development has been a long-standing effort in Manchester, going back to the early involvement in the NAG Library. More recent contributions include to LAPACK, ScaLAPACK, the NAG Library and core MATLAB, as well as the IFISS MATLAB Toolbox and PIFISS extension (Silvester and Powell) and the Oomph-Lib C++ finite element library (Hazel and Heil).

Both long and short-term visitors are hosted in MIMS, with financial support from EPSRC, the LMS, MIMS, or the University (e.g., through its Simon Industrial and Professional Fellowships).

The research interests of the group fall broadly into two areas: numerical linear algebra and differential equations, covering theory, algorithms and software development. Space allows only a very brief description here, so we concentrate on some current efforts. Building on the group's expertise in finite element theory, work is in progress on the stochastic finite element method (Silvester, Powell) in collaboration with Ernst and Ullmann in Freiberg. Nonlinear and structured eigenvalue problems continue to be a major area of interest (M. Betcke, T. Betcke, Hammarling, Higham, Lancaster, Tisseur), with both theory and algorithms developed. Long-term work on matrix functions has led to a research monograph “Functions of Matrices: Theory and Computation” (Higham, to be published by SIAM in 2008). Stochastic differential equations are also an important area of study, with research into reaction diffusion equations with stochastic forcing (Shardlow).

More information and links to the group's work can be found on our web site at <http://www.mims.manchester.ac.uk/research/numerical-analysis/>

Nicholas J. Higham (Nick.Higham@manchester.ac.uk)

3 Conference report

IMA Conference on Numerical Linear Algebra and Optimisation 13 - 15 September 2007

In the late summer sunshine, over 70 delegates from at least 15 different countries gathered at the University of Birmingham for the First IMA Conference on Numerical Linear Algebra and Optimisation. The aim of the meeting was the bringing together of members from the numerical linear algebra

and optimisation communities to find and communicate points and topics of common interest: large-scale optimisation heavily relies on effective tools of numerical linear algebra, whilst many problems in numerical linear algebra lead to optimisation problems.

A wide variety of topics were covered during the conference. For example, there were talks on railway vehicle-track dynamic interactions, developments in trust-region methods, and global optimization in the chebfun system. Large-scale optimization frequently requires the solution of very large indefinite systems known as saddle-point or KKT problems: the efficient solution of such systems using direct and iterative methods formed one of the main themes of the conference.

One of the highlights was Jorge Nocedal's plenary talk 'Matrix-free methods for constrained optimisation.' Very large optimisation problems where the Hessian and Jacobian matrices cannot be formed were considered. Jorge discussed the iterative linear solution of the systems that arise from such problems and the choice of stopping criteria for these methods. The aim was to limit the number of iterations carried out whilst continuing to guarantee global convergence. At the end of this beautiful talk, a challenge was given to the community to derive an iterative method with a minimisation property that reflects the functions used within the stopping criteria.

I believe that a lot of fruitful work will arise as a result of this conference and I very much look forward to attending similar meetings in the future.

Sue Dollar, Rutherford Appleton Laboratory.

4 Who's Visiting Whom

Prof. Y. Ya-Xiang (Chinese Academy of Sciences, Beijing). CAMBRIDGE (Host: Arieh Iserles email: ai@damtp.cam.ac.uk).

Dr A. Deaño (Universidad Carlos III, Madrid). CAMBRIDGE (Host: Arieh Iserles email: ai@damtp.cam.ac.uk).

Both the above will be visiting for one year.

Prof. Toby Driscoll (University of Delaware). OXFORD (Host: Nick Trefethan email: LNT@comlab.ox.ac.uk). January - June 2008.

5 Technical Reports

University of Bath

BICS reports: Available from <http://www.bath.ac.uk/math-sci/bics/preprints/>

- 6/07 A convergent adaptive method for elliptic eigenvalue problems. Stefano Giani and Ivan Graham.
- 5/07 Evolutionary problems in non-reflexive spaces Martin Kruzik and Johannes Zimmer.
- 4/07 Coefficient-explicit Condition Number Bounds for Overlapping Additive Schwarz. Ivan G. Graham and Robert Scheichl.
- 3/07 An introduction to random matrix theory. Gler Ergün.
- 2/07 Separation of a large eigenvalue from the bulk of the spectrum. Gler Ergün.
- 1/07 Smooth boundary based optimisation using fixed grid. Caroline S. Edwards, H. Alicia Kim and Christopher J. Budd.

Brunel University

http://people.brunel.ac.uk/~icsrsss/bicom/tech_rep.html

- BICOM 07/3 The hp-version of the boundary element method with quasi-uniform meshes for weakly singular operators on surfaces. Alexei Bespalov and Norbert Heuer.
- BICOM 07/4 A direct coupling of local discontinuous Galerkin and boundary element methods. Gabriel N Gatica, Norbert Heuer and Francisco-Javier Sayas.
- BICOM 07/5 Crouzeix-Raviart boundary elements. Norbert Heuer and Francisco-Javier Sayas.

University of Cambridge

Reports available from <http://www.damtp.cam.ac.uk/user/na/reports.html>

- NA2007/02 On the convergence rate of a modified Fourier series. Sheehan Olver.
- NA2007/03 A view of algorithms for optimization without derivatives. M.J.D. Powell.
- NA2007/04 Operator theory and C^* -algebras in infinite dimensional numerical linear algebra. Anders Hansen.
- NA2007/05 Developments of NEWUOA for unconstrained minimization without derivatives. M.J.D. Powell.
- NA2007/06 Interpolation in special orthogonal groups. T. Shingel.

Cardiff University

- 07/01 P. C. Bollada and T. N. Phillips, On the effects of a compressible viscous lubricant on the load-bearing capacity of a journal bearing.
- 07/02 R. S. Anderssen, A. R. Davies, F. de Hoog, On the sensitivity of interconversion between relaxation and creep.
- 07/03 N. J. Inkson, T. N. Phillips and R. G. M. van Os, Numerical simulation of flow past a cylinder using models of XPP type.
- 07/04 T. Reis and T. N. Phillips, A modified lattice Boltzmann model for axisymmetric flows.
- 07/05 N. J. Inkson and T. N. Phillips, Unphysical phenomena associated with the extended pom-pom model in steady flow.
- 07/06 T. N. Phillips, B. A. Snigerev and A. J. Williams, A conservative high-order semi-Lagrangian finite volume method for incompressible Newtonian flows.
- 07/07 M. I. Gerritsma and T. N. Phillips, On the characteristics and compatibility equations for the UCM Model fluid.
- 07/08 F. Bierbrauer and T. N. Phillips, The numerical prediction of droplet deformation and break-up using the Godunov marker-particle projection scheme.
- 07/09 P. C. Bollada and T. N. Phillips, A physical decomposition of the stress tensor for complex flows.
- 07/10 T. Reis and T. N. Phillips, An alternative approach to the solution to the dispersion equation for a generalized lattice Boltzmann equation.
- 07/11 T. Reis and T. N. Phillips, Numerical validation of a consistent axisymmetric lattice Boltzmann model.

- 07/12 P. C. Bollada and T. N. Phillips, An anisothermal compressible piezoviscous model for journal bearing lubrication.
- 07/13 R. S. Anderssen, A. R. Davies, F. R de Hoog, On the interconversion integral for relaxation and creep.

University of Liverpool

Reports available from http://www.liv.ac.uk/~cmchenke/chen_pub.html

- 07/03 Iterative methods for solving the dual formulation arising from image restoration.
Tony F Chan, Ke Chen and Jamylle L Carter.
- 07/02 Multilevel algorithm for a poisson noise removal model with total variation regularization.
Raymond H Chan and Ke Chen.

University of Manchester

MIMS EPrints from <http://www.manchester.ac.uk/mims/eprints>

- 2007.64: On the Definition of Two Natural Classes of Scalar Product.
D. Steven Mackey, Niloufer Mackey and Francoise Tisseur.
- 2007.93: Limitations of the PlayStation 3 for High Performance Cluster Computing.
Alfredo Buttari, Jack Dongarra and Jakub Kurzak .
- 2007.94: Using Mixed Precision for Sparse Matrix Computations to Enhance the Performance while Achieving 64-bit Accuracy.
Alfredo Buttari, Jack Dongarra, Jakub Kurzak, Piotr Luszczek and Stanimire Tomov.
- 2007.95: Solving Systems of Linear Equations on the CELL Processor Using Cholesky Factorization.
Jakub Kurzak, Alfredo Buttari and Jack Dongarra.
- 2007.97: Notes on Hyperbolic Matrix Polynomials and Definite Linearizations.
Nicholas J. Higham, D. Steven Mackey and Franoise Tisseur.
- 2007.103: Computing A^α , $\log(A)$ and Related Matrix Functions by Contour Integrals.
Nicholas Hale, Nicholas J. Higham and Lloyd N. Trefethen.
- 2007.107: Stability and Convergence of the Method of Fundamental Solutions for Helmholtz problems on analytic domains. A. H. Barnett and T. Betcke.

University of Oxford

Reports available from <http://web.comlab.ox.ac.uk/oucl/publications/natr/index.html>

- 07/12 Monte Carlo evaluation of sensitivities in computational finance. M Giles.
- 07/11 Combination preconditioning and self-adjointness in non-standard inner products with application to saddle point problems. M Stoll, A Wathen.
- 07/10 Variational Convergence of IP-DGFEM. A Buffa, C Ortner.
- 07/09 Nonlinear programming without a penalty function or a filter N I M Gould, Ph L Toint.
- 07/08 A Block-Lanczos Method for Computing the Leading Singular Values and Vectors of a Large Column-Distributed Matrix. R Hauser, D Goodman.

Rutherford Appleton Laboratory

Reports available from <http://www.numerical.rl.ac.uk/reports/reports.html>

RAL-TR-2007-006 Analysis of the out-of-core solution phase of a parallel multifrontal approach.
P. Amestoy, I. S. Duff, A. Guermouche, and T. Slavova.

6 Diary of Seminars

BATH : Seminars take place on Fridays at 12:15pm in Department of Mathematical Sciences, Building 1 West, Room 1W3.6. The timetable has not been finalised yet, but will be available at <http://www.maths.bath.ac.uk/~jvl20/na-seminars>

BATH BICS series: Seminars take place at 1:15pm in Department of Mathematical Sciences, Building 1 West, Room 1W3.6. The timetable has not been finalised yet, but will be available at <http://www.bath.ac.uk/math-sci/bics/seminars/>

CARDIFF : Seminars take place on Mondays at 3pm in School of Mathematics room M/2.06. Contact: Tim Phillips (phillipstn@cardiff.ac.uk).

CAMBRIDGE : Two seminar series will be held in Cambridge on alternating Thursdays at 3pm, Meeting Room 14, Centre for Mathematical Sciences: seminars in numerical analysis (organised by Alexei Shadrin) and seminars in applied and computational analysis (organised by Thanasis Fokas, Arieh Iserles and Peter Markowich). Up-to-date information will be presented at <http://www.damtp.cam.ac.uk/user/na/seminars.html> and <http://www.damtp.cam.ac.uk/user/na/ACA/> respectively.

EDINBURGH : The Edinburgh Research Group in Optimization (ERGO) (<http://www.maths.ed.ac.uk/ERGO/>) runs seminars on Optimization and Numerical Analysis. Unless stated otherwise, seminars are held at 3.30pm. More details are available from: <http://www.maths.ed.ac.uk/ERGO/ERGOSeminars.html>

MANCHESTER : Numerical Analysis and Scientific Computing Seminars 2007/08 The seminars are held in the Alan Turing Building, Frank Adams Room 1, at 3pm. For more details and abstracts, see <http://www.mims.manchester.ac.uk/events/seminars/numerical-analysis.php>

OXFORD : Seminars take place on Thursdays at 2pm in the Lecture Theatre of Oxford University Computing Laboratory, Wolfson Building, Parks Road. A timetable and abstracts are available from <http://web.comlab.ox.ac.uk/oucl/news/>

RAL : Seminars are held in the Atlas Centre, Rutherford Appleton Laboratory and start at 2:15pm. Contact: s.dollar@rl.ac.uk

READING : Seminars take place on Fridays promptly at 3pm in room 113 of the Mathematics Department. External audiences are advised to contact Brigitte Calderon on 0118 378 5002 (afternoons) or email b.calderon@reading.ac.uk to confirm the programme before attending.

SEPTEMBER 2007

SEPTEMBER 25 : RAL. 6th Annual Bath - RAL Numerical Analysis Day (10.30am to 5pm). See www.numerical.rl.ac.uk/people/marioli/timetable.shtml for details. All welcome.

SEPTEMBER 27 : MANCHESTER. Daniel Loghin (Birmingham). Matrix square-roots with applications.

OCTOBER 2007

OCTOBER 3 : EDINBURGH. Tibor Illes (Strathclyde). Title not yet available.

- OCTOBER 3 : MANCHESTER (at 2pm). Iain Duff (RAL). The use of hybrid techniques for the solution of large scale problems.
- OCTOBER 4 : OXFORD. Etienne de Klerk (Tilburg University, Netherlands). On the computational complexity of optimization over a simplex, hypercube or sphere.
- OCTOBER 11 : OXFORD. Omar Lakkis (Sussex). Explicit A Posteriori Error Analysis for Evolution Equation's Finite Element Approximation.
- OCTOBER 12 : READING. Arieh Iserles (Cambridge). Modified Fourier expansions in a cube and beyond.
- OCTOBER 17 : EDINBURGH. Natalia Issaeva (Edinburgh). Title not yet available.
- OCTOBER 18 : OXFORD. Peter Benner (University of Chemnitz, Germany). Model Reduction in Control and Simulation: Algorithms and Applications.
- OCTOBER 19 : READING. Jerome Monnier (INRIA, Grenoble). On variational data assimilation for river hydraulics.
- OCTOBER 22 : CARDIFF. Andrew Rees (Bath). Microscopic modelling of heat transport in porous media.
- OCTOBER 25 : OXFORD. Daniel Robinson (Oxford). A Primal-Dual Augmented Lagrangian.
- OCTOBER 26 : MANCHESTER. Sue Dollar (RAL). Title not yet available.
- OCTOBER 31 : EDINBURGH. Coralia Cartis (Edinburgh). Title not yet available.

NOVEMBER 2007

- NOVEMBER 1 : RAL. Laura Grigori (INRIA). Communication avoiding algorithms for dense LU and QR factorizations.
- NOVEMBER 2 : READING. Holger Dullin (Loughborough). Volume Preserving Maps.
- NOVEMBER 8 : OXFORD. Daan Huybrechs (KU Leuven, Belgium). On the benefits of Gaussian quadrature for oscillatory integrals.
- NOVEMBER 9 : READING. Jacek Gondzio (Edinburgh). Exploiting block-sparsity in very large scale optimization with interior point methods.
- NOVEMBER 9 : MANCHESTER. Christian Mehl (Birmingham). Title not yet available.
- NOVEMBER 13 : EDINBURGH (at 4pm). Roger Fletcher (Edinburgh). Title not yet available.
- NOVEMBER 15 : RAL. Jan Magnus (Tilburg University, Netherlands). Title not yet available.
- NOVEMBER 16 : READING. Alexei Likhtman (Reading). Title not yet available.
- NOVEMBER 19 : CARDIFF. David Silvester (Manchester). Stochastic finite elements and fast iterative solvers.
- NOVEMBER 21 : EDINBURGH. Chris Dent. Title not yet available.
- NOVEMBER 22 : OXFORD. Stefan Ulbrich (TU Darmstadt, Germany). Adaptive multilevel methods for PDE-constrained optimization
- NOVEMBER 23 : MANCHESTER. Evelyn Buckwar (Heriot-Watt University). Title not yet available.
- NOVEMBER 23 : READING. Hayder Salman (Cambridge). Title not yet available.
- NOVEMBER 21 : EDINBURGH. Daniel Kuhn (Imperial). Title not yet available.
- NOVEMBER 29 : OXFORD. Rodrigo Platte (Oxford). Polynomials and potential theory for Gaussian radial basis function interpolation.

NOVEMBER 30 : READING. Karima Khusnutdinova (Loughborough). Nonlinear waves in coupled waveguides.

DECEMBER 2007

DECEMBER 3 : EDINBURGH. Nick Gould (Oxford and RAL). Title not yet available.

DECEMBER 4 : EDINBURGH (at 10am). Philippe Toint (Namur). Title not yet available.

DECEMBER 7 : MANCHESTER. Stephen Langdon (University of Reading). Title not yet available.

DECEMBER 7 : READING. Andrew Willmott (Proudman Oceanographic Laboratory, Liverpool) (NRTB). The dynamics of seiches in stratified semi-enclosed seas.

DECEMBER 10 : CARDIFF. Jitesh Gajjar (Manchester). Global stability calculations of separated flows.

7 Forthcoming Meetings and Conferences

OCTOBER 2007

SIAM Conference on Mathematics for Industry: Challenges and Frontiers, October 9-11

Philadelphia, Pennsylvania. <http://www.siam.org/meetings/mi07/>

CERFACS Anniversary Meeting, October 11-12

Toulouse, France. <http://www.cerfacs.fr>

Symposium on the birth of numerical analysis, October 29-30

Leuven, Belgium. <http://www.cs.kuleuven.be/~ade/WWW/WOG/history/>

Workshop on Computer Aspects of Numerical Algorithms (CANA'07), October 15-17

Wisla, Poland. <http://www.cana.imcsit.org>

Workshop on Optimization in Finance, October 26-27

Coimbra, Portugal. <http://www.mat.uc.pt/tt2005/follow-up>

NOVEMBER 2007

Joint AARMS-CRM Workshop on Recent Advances in Functional and Delay Differential Equations, November 1-5

Dalhousie University, Halifax, Nova Scotia, Canada. http://www.crm.math.ca/AARMS07/index_e.shtml

SC07: 20th International Conference for High-Performance Computing, Networking, Storage and Analysis, November 12-16

Reno, Nevada. <http://sc07.supercomputing.org>

Sixth European Workshop on Automatic Differentiation, 15-16 November

INRIA Sophia-Antipolis, France. <http://www.autodiff.org/euroad/6>

DECEMBER 2007

SIAM Conference on Analysis of Partial Differential Equations (PD07), December 10-12

Hilton Phoenix East/Mesa, Mesa, Arizona. <http://www.siam.org/meetings/pd07>

Nonconvex Programming: Local and Global Approaches (NCP07), December 17-21

National Institute for Applied Sciences, Rouen, France. <http://ncp07.insa-rouen.fr/>

JANUARY 2008

International Workshop on Recent Advances in Numerical Methods for Eigenvalue Problems 2008 (RANMEP2008), January 4-8
National Tsing Hua University, Taiwan. <http://math.cts.nthu.edu.tw/Mathematics/RANMEP2008.htm>

Winter School on Computational Science (WSCS 2008), January 7-11
The University of Texas at El Paso. http://www.math.utep.edu/wscs_2008/

MARCH 2008

SIAM Conference on Parallel Processing for Scientific Computing, March 12-14.
Atlanta, Georgia. <http://www.siam.org/meetings/pp08/>

GAMM 2008, March 31- April 4.
Bremen, Germany. <http://www.zarm.uni-bremen.de/gamm2008/>

APRIL 2008

Tenth Copper Mountain Conference on Iterative Methods, April 6-11.
Copper Mountain, Colorado. <http://amath.colorado.edu/faculty/copper/>

International Parallel and Distributed Processing Symposium (IPDPS08), April 14-18.
Miami, Florida. <http://www.ipdps.org>

First Workshop on Parallel and Distributed Computing in Finance (PDCoF08-Computational Finance), April 18.
Miami, Florida. <http://www.cs.umanitoba.ca/pdcof>

SIAM International Conference on Data Mining (SDM08), April 24-26.
Atlanta, Georgia. <http://www.siam.org/meetings/sdm08/>

MAY 2008

SIAM Conference on Optimization, May 10-13.
Boston, Massachusetts. <http://www.siam.org/meetings/op08/>

PARA'08, Workshop on State-of-the-Art in Scientific and Parallel Computing, May 13-16.
Trondheim, Norway. <http://www.idi.ntnu.no/~elster/para2008/>

JUNE 2008

Householder Symposium XVII, June 1-6
Zeuthen, Germany. http://www3.math.tu-berlin.de/householder_2008/

International Symposium on Finite Volumes for Complex Applications, June 8-13.
Aussois, France. <http://www.latp.univ-mrs.fr/fvca5/>

JULY 2008

SIAM Conference on Imaging Science (IS08), July 7-9.
San Diego, California. <http://www.siam.org/meetings>

SIAM Annual Meeting, July 7-11.
San Diego, California. <http://www.siam.org/meetings>

London Mathematical Society Durham Symposium: Computational Linear Algebra for Partial Differential Equations, July 14-24.
Durham, UK. <http://maths.dur.ac.uk/events/Meetings/LMS/2008/CLAPDE/>

AUGUST 2008

Fifth International Conference on Automatic Differentiation, August 11-15.
Bonn, Germany. <http://www.autodiff.org/ad08/>

8 Highlighted Conferences

Sparse Days at CERFACS ... CERFACS 20th Anniversary Meeting 10-12 October 2007. Toulouse, France

The Parallel Algorithms Team at CERFACS this year has split its annual ‘‘Sparse Days at CERFACS’’ between the Preconditioning 2007 meeting, held in July, and the CERFACS 20th Anniversary meeting, to be held October 10-12.

The Parallel Algorithms Team will hold a Sparse Days meeting on Wednesday 10th and the morning of Thursday 11th and a one-day meeting on Friday 12th. There will be general CERFACS activities on the afternoon and evening of Thursday 11th with talks by Algo related people including Gene Golub, Gerard Meurant, Philippe Toint and Alan Edelman.

Speakers at the Sparse Days meeting will include

- Didier Henrion (LAAS). Semidefinite programming for polynomial optimization and robust control
- Jennifer Scott (RAL). The out-of-core challenge for large-scale problems
- Phil Knight (Strathclyde). A fast algorithm for matrix balancing
- Michel Dayde (ENSEEIH).
- Dimitri Komatitsch (Univ of Pau). Large-scale parallel simulations of earthquakes at high frequency: the SPEC-FEM3D project.
- Alex Pothen (Old Dominion). The CSCAPES Project
- Tim Davis (Florida). The history of UMFPACK and AMD ... back to CERFACS Days.
- Valerie Fraysse. Du canard au Black Duck
- Jean-Claude Dunyach. How to write a successful European proposal using science-fiction techniques
- Alan Edelman. Interactive supercomputing with star-p in MATLAB(r) and PYTHON
- Jean-Christophe Rioual. NEC and the Algo experience
- Osni Marques (LBNL). Eigensolvers for large electronic structure calculations
- Lars Lundin. ASCI blue mountain
- Yann Herve De Roeck. Modelling for the coastal environment
- Oleg Burdakov. Monotonic data fitting and interpolation

Please consult our web site www.cerfacs.fr/algor/ for updated information. If you wish to attend, you should contact Nicole Boutet (boutet@cerfacs.fr) or Iain Duff (i.s.duff@rl.ac.uk).

Sixth European Workshop on Automatic Differentiation 15-16 November 2007 INRIA Sophia-Antipolis, France

This 2-day workshop continues the series of the EuroAD Automatic Differentiation workshops, taking place twice a year. EuroAD workshops are organized jointly by the University of Hertfordshire, UK, Cranfield University in Shrivenham, UK, RWTH Aachen University, Germany, and INRIA Sophia-Antipolis, France. These workshops provide a forum for the presentation of theoretical developments in and applications of Automatic Differentiation (AD) and adjoint methods. The workshop is informal and presentations on subjects such as work in progress, problem areas for AD, or possible application areas, as well as completed work are welcome. We particularly encourage PhD students and those new to the field to attend and present their work.

We welcome every researcher who presents their work on AD theory, AD tools, or applications of AD. However, a particular emphasis at the 6th Workshop will be put on applications of AD to Earth Sciences. This involves topics such as adjoints of unsteady simulations, variational data assimilation, interactions between 4Dvar data assimilation and other methods, applications to meteorology or oceanography.

Further details: <http://www.autodiff.org/euroad/6>

UK contact: Shaun Forth (S.A.Forth@cranfield.ac.uk)

FIFTH INTERNATIONAL CONFERENCE ON AUTOMATIC DIFFERENTIATION
11-15 August 2008
Bonn-Aachen International Center for Information Technology

The Fifth International Conference on Automatic Differentiation (AD) will take place from at the Bonn-Aachen International Center for Information Technology (b-it center), Bonn (Germany) and will be held in cooperation with SIAM.

Invited speakers are:

- Mike Giles (Oxford University)
- Wolfgang Marquardt (RWTH Aachen University)
- Arnold Neumaier (Vienna University)
- Alex Pothen (Old Dominion University)
- Eelco Visser (Delft University)

Further details: <http://www.autodiff.org/ad08/>

UK contact: Shaun Forth (S.A.Forth@cranfield.ac.uk)

9 HPC Courses

The following High Performance Computing courses will run at the University of Manchester, 15-19 October.

- Fortran 90 (2 1/2 days)
- Introduction to HPC (1/2 day)
- OpenMP (1 day)
- Introduction to MPI (1 day)

You can book each course individually or the “Introduction Week” (all 5 days) at a discount. For further details, please see: <http://www.rcs.manchester.ac.uk/courses/hpc>

10 13th Leslie Fox Prize Competition Results

Seven finalists were chosen to present a 40-minute lecture at this one-day numerical analysis symposium which was held on Friday, 22 June 2007 at Oxford University Computing Laboratory. The finalists were:

- Timo Betcke (University of Manchester)
A GSVD formulation of a domain decomposition method for planar eigenvalue problems.
- Laurent Demanet (Stanford University)
Wave atoms and time upscaling of wave equations.
- Ioana Dumitriu (University of Washington)
Toward accurate polynomial evaluation in rounded arithmetic.
- Daniel Kressner (University of Zagreb and Umea University)
The effect of aggressive early deflation on the convergence of the QR algorithm.
- Emre Mengi (University of California at San Diego)
On the estimation of the distance to uncontrollability for higher-order systems.
- Yoichiro Mori (University of British Columbia)
Convergence proof of a Stokes flow immersed boundary method.
- Sheehan Olver (University of Cambridge)
Numerical approximation of highly oscillatory integrals.

First prize was awarded jointly to Yoichiro Mori and Ioana Dumitriu; the other finalists were each awarded a second prize. Photos are available at <http://users.comlab.ox.ac.uk/andre.suli/fox/>

11 Theses

Cardiff University

Claire Heaney. Numerical Simulation of Wavepackets in a Transitional Boundary Layer. July 2007.

Tim Reis. The Lattice Boltzmann Method for Complex Flows. August 2007.

University of Reading

Details of recent MSc dissertations are available at <http://www.maths.rdg.ac.uk/>

12 Recent Appointments

University of Cambridge

Peter Markowich, formerly from University of Vienna, is joining DAMTP as the new Professor of Applied Mathematics. Peter is among his many talents also a prominent numerical analyst of PDEs.

University of Cardiff

- Frank Bierbrauer, Research Associate.
- Peter Bollada, Research Associate.
- Nathanael Inkson, Research Associate.
- Anna Leonenko, Research Associate.
- David Oldham, Research Associate.
- Christian Thomas, Research Associate.

University of Edinburgh

Dr Coralia Cartis joined the School of Mathematics on 1 September. Dr Cartis has interests in the theory and performance of linear and nonlinear optimization algorithms (interior point methods, trust-region methods, etc). Her recent interests also include signal processing applications involving optimization.

Dr Jared Tanner joined the School of Mathematics on 1 August. Dr Tanner has interests in digital signal processing. He has been working on complexity regularized algorithms for inverse problems and a new paradigm which was put forth in sampling theory (compressed sensing) where the number of measurements made of a signal is related to its information content, rather than to the overall bandwidth containing a signal class.

13 Vacant positions and studentships

Cardiff University:

School of Earth, Ocean and Planetary Sciences/School of Mathematics

We are seeking to appoint a research associate to work on an interdisciplinary project entitled ‘Plate Tectonics and Mantle Convection funded by the Welsh Institute of Mathematical and Computational Sciences. The principal aim of the project is to advance modelling of mantle convection to simulate plate tectonic behaviour in spherical geometry. You should have a PhD, or be close to completion, in geophysics, applied mathematics, engineering or equivalent. The ability to write numerical software is essential. This post is fixed-term 2 years and 2 months.

Information about the position and application procedures can be found at <http://www.cf.ac.uk/jobs/academic/20070660-171007.html>

Salary: 21,682 25,135 GBP per annum.

For further details contact Professor T N Phillips, School of Mathematics, tel: 029 2087 4194 or email: PhillipsTN@cardiff.ac.uk

Closing Date: 17 October 2007.

CERFACS: Senior researcher and postdoc position

A senior researcher and a postdoc position are available at CERFACS to work in the Parallel Algorithms Team led by Iain Duff. The senior position is a permanent post and the postdoc position is for one year,

normally renewable for a second year. The positions are available from 1st November 2007, but a later start date would be possible.

The Parallel Algorithms Team is looking for bright, motivated people with a good research record and the ability to supervise research projects and students. The applicant would be expected to join existing projects in numerical optimization and linear algebra as well as showing initiative in pursuing new research directions.

Additional benefits include a competitive salary, travel opportunities, access to state-of-the-art computational facilities (including both SMP/MPP parallel architectures and high-performance workstations). A particular strength of CERFACS is its access to real-life applications through strong and well developed academic/industrial collaborations within a very active research program in advanced scientific computing.

Relevant information on the application procedure can be found at:

<http://www.cerfacs.fr/Admin/rules.html>

Please note that a one-page summary of your research plan at CERFACS is highly recommended.

Details of the Parallel Algorithms Project at CERFACS are available at: <http://www.cerfacs.fr/algorithm>

For information about Toulouse, the city where CERFACS is located, see:

<http://www.cerfacs.fr/Links/index.html>

Applications should be sent before October 12, 2007 to Xavier Vasseur (vasseur@cerfacs.fr)

14 IMA Journal of Numerical Analysis

Contents of Volume 27, Number 3

R. K. Beatson, M. J. D. Powell, and A. M. Tan.

Fast evaluation of polyharmonic splines in three dimensions. pp 427-450.

Timo Betcke.

A GSVD formulation of a domain decomposition method for planar eigenvalue problems. pp 451-478

H. Lamba, J. C. Mattingly, and A. M. Stuart.

An adaptive Euler-Maruyama scheme for SDEs: convergence and stability. pp 479-506

J. A. Mackenzie and W. R. Mekwi.

An analysis of stability and convergence of a finite-difference discretization of a model parabolic PDE in 1D using a moving mesh. pp 507-528

Rajen Kumar Sinha and Bhupen Deka.

An unfitted finite-element method for elliptic and parabolic interface problems. pp 529-549

Dugald B. Duncan and Yiqi Qiu.

Overlapping grids for the diffusion equation. pp 550-575

Natalia Kopteva.

Maximum norm a posteriori error estimates for a 1D singularly perturbed semilinear reaction-diffusion problem. pp 576-592

Frieder Lrcher and Claus-Dieter Munz.

Lax-Wendroff-type schemes of arbitrary order in several space dimensions. pp 593-615

V. A. Titarev and E. F. Toro.

Analysis of ADER and ADER-WAF schemes pp 616-630

For further details see: www.imanum.oupjournals.org

15 Software News

NAG

If you haven't tried our "NAG Toolbox for Matlab" yet then I would encourage you to do so, whilst it is freely available as a beta version. This new product brings the full functionality of the NAG Mark 21 Fortran Library to the Matlab user, enabling all of these routines to be called from within Matlab in a natural manner. Online documentation is included, again in the Matlab style, and, as is customary with NAG Library products, example programs are provided. These may be copied and pasted into the Matlab Command Window.

More details, including how to obtain your free beta copy of the Matlab Toolbox, may be found on: www.nag.co.uk/numeric/MB/start.asp

There is no doubt that Matlab is heavily used within the UK academic community, so we are hopeful that this new product will enable researchers to continue to use their favourite NAG routines but with the ease that Matlab affords. Our developers at NAG have seen at first hand the influence of Matlab. Academics submitting their latest research for inclusion in the library would do so in Fortran, now it is often Matlab script, as this offers a fast way to develop their ideas.

Incorporation of these algorithms into the NAG library involves translation into the NAG 'Engine' house style. This is essentially extended Fortran 77 code that is efficient to run, but with enriched documentation, from which we can generate other language versions, such as our C and .NET libraries. Efficiency is gained by careful use of memory, use of BLAS and LAPACK routines whenever possible and of course careful memory access. In the case of our SMP library we would make use of any relevant highly tuned routines.

From the original contribution we thus have efficient production code available in our Fortran, SMP, C and .Net libraries. For our Mark 22 library we have developed some global optimisation software and a nearest correlation matrix algorithm, based on an original algorithm by Qi and Sun, in this manner.

One of NAG's earliest contributors, in the pre-Matlab era, was Jim Wilkinson and I have many fond memories of linear algebra development meetings at NPL. Here Jim would explain his latest discoveries in very clear, simple terms and then recommend routines for the library before handing over software developed by his colleague, Gwen Peters. It is natural then, that NAG should wish to honour Jim's contribution to the field of numerical software. Together with the Argonne National Laboratory and the National Physical Laboratory, the Numerical Algorithms Group awards a numerical software prize every 4 years. The 2007 Wilkinson Prize for Numerical Software was awarded to Wolfgang Bangerth of Texas AM University, Ralf Hartmann of DLR Germany and Guido Kanschat of Texas A&M University for the software package deal.II. deal.II is a C++ program library targeted at adaptive finite elements and error estimation. It uses state-of-the-art programming techniques of the C++ programming language to offer a modern interface to the complex data structures and algorithms required for adaptivity. It makes available a variety of finite elements in one, two, and three space dimensions and also addresses time-dependent problems.

To find out more about deal.II, and the Wilkinson prize, please visit www.nag.co.uk/other/wilkinsonprize.asp

David Sayers (David.Sayers@nag.ac.uk)

HSL 2007

The numerical analysis group at the Rutherford Appleton Laboratory is pleased to announce that the next release of the mathematical software library, HSL 2007, will be available shortly. Highlights of HSL 2007 include:

- A new symmetric eigensolver, designed for very large-scale problems (written in collaboration with Eugene Ovtchinnikov, University of Westminster)
- Sparse direct linear system solvers that optionally hold the matrix and factor data out-of-core, allowing much larger systems to be solved.
- A new code for the direct solution of sparse Hermitian systems of equations

- An algebraic multigrid code (written in collaboration with Jonathan Boyle, University of Manchester)
- Preconditioners for saddle-point problems
- Efficient orderings and scalings for sparse symmetric systems
- Efficient estimates of rank and independent subblocks for unsymmetric and rectangular sparse systems
- Matlab interfaces to two key sparse direct solvers: MA57 and MA48

All HSL codes are freely available to UK academics for research and teaching purposes. Full details of the contents of the Library and how to obtain the software are available at <http://www.cse.scitech.ac.uk/nag/hsl/hsl.shtml> (or contact Jennifer Scott email: j.a.scott@rl.ac.uk)

16 Mathematics and Poetry

Mike Bartholomew-Biggs (University of Hertfordshire) has recently written a pamphlet called *Uneasy Relations* which contains poems – mainly in haiku form – playing with ideas from computational mathematics and optimization.

Equality Constraints

To walk a tightrope
is hard. So how much harder
to walk several?
Spiders manage it
spinning sticky contour plots
which aren't safety nets.

Non-specialists may simply choose to murmur these poems as zen-like meditations – but, for those of a curious disposition, notes are provided that may be no less informative than those at the end of *The Waste Land*. The poems do not confine themselves narrowly to mathematical themes but touch upon myth and fable, astronomy, the arts of prediction and preventive maintenance, entomology, hill-walking, financial portfolio theory and the works of Edgar Allan Poe. There is also a hint of sexual politics.

Uneasy Relations is published by Hearing Eye. Copies may be obtained by sending 3 pounds (plus 50p post and packing) to: Hearing Eye, Box 1, 99 Torriano Avenue, London NW5 2RX, UK.

17 Postgraduate Courses

University of Bath

New MSc in Mathematical Biology

The MSc will combine taught core units in mathematics, biology and biochemistry with training in research methods and an individual project.

Students will be members of the Centre for Mathematical Biology, taught and supervised jointly by staff in the Department of Mathematical Sciences and the Department of Biology and Biochemistry. Both departments have strong research portfolios and have demonstrated excellence in teaching over many years.

The MSc is a one year full time programme. It can be used as the first year of an Integrated PhD or as a component of the Graduate School provision for PhD students in mathematical biology.

Fully funded studentships are available to suitably qualified individuals. These have been made available by the BBSRC and the University of Bath.

For details, see <http://www.bath.ac.uk/cmb/msc/>

MSc in Modern Application of Mathematics

Study full time for one year to obtain an MSc degree in Modern Applications of Mathematics at the Department of Mathematical Sciences, University of Bath. (RAE grade 5* for research, QAA grade 24/24 for teaching quality.) This programme is suitable for anyone interested in using mathematics in industry. There are EPSRC Studentships for highly qualified UK and EU applicants only. Applications from

appropriately qualified overseas students are strongly encouraged. Financial support is available to pay tuition fees for selected EU applicants. Information on scholarships for study in the UK is available from British Council Scholars. Information on potential funding for students from commonwealth countries is also available from the Association of Commonwealth Universities. Neutron density distribution in a nuclear reactor

- Learn the latest techniques in applied mathematics and scientific computing
- Examine case studies drawn from industrial problems
- Undertake a supervised project with an optional industrial placement
- Modules in interdisciplinary subjects and key skills
- Individualised study programme

For details, see <http://www.bath.ac.uk/math-sci/courses/msc-mam.html>

Graduate School: The list of available graduate level courses is available from <http://www.bath.ac.uk/math-sci/postgrad/graduate-school/>

This will include the semester two course Advanced finite element methods (given by Ivan Graham)

University of Birmingham

The School of Mathematics offers a twelve-month MPhil course in Mathematics and an MSc in Mathematical Finance, which is run jointly with the Department of Economics. In addition, the School offers a standard three-year PhD programme. The MPhil is an ideal preparation for entry into the PhD programme.

More details are available at <http://www.mat.bham.ac.uk/Postgraduate/mphil.htm>

Cranfield University (DCMT Shrivenham)

The Applied Mathematics and Scientific Computing Group runs an MSc in Scientific Computation which may be taken in either full- or part-time mode. In either mode, students must complete 8 modules and a dissertation. Each module is delivered in a one week intensive format, ideal for those in employment, followed by assessed work and an examination. Modules include: Introduction to Numerical Methods, Scientific Programming with Fortran 95, High Performance and Parallel Computing. For more details see <http://www.cranfield.ac.uk/dcmt/postgraduatestudy/esd/scicompmsc.jsp> Most modules may also be taken as standalone, professional development courses, and details of these together with our other professional development courses (with particular strengths in Fortran and Matlab) may be found under <http://www.cranfield.ac.uk/dcmt/shortcourses/index.jsp>

Brunel University

The School of Information Systems, Computing and Mathematics offers a 1-year M.Sc course in Computational Mathematics with Modelling, which is designed to acquaint Honours graduates in Mathematics or a related discipline such as Engineering or Physics, with up-to-date numerical analysis. The course is mathematically oriented, but the use of computers is emphasized throughout.

Topics covered include the numerical solution of partial differential equations with focus on the finite element method, integral equations, linear algebra, functional analysis, approximation theory, stochastic models, mathematical finance, and modelling.

Further information is available from <http://www.brunel.ac.uk/about/acad/siscm/maths/postgrad/msc>

University of Edinburgh

The School of Mathematics offers a 1-year Dip/MSc course in Operational Research. The programme has themes in: Risk, Finance and Computational Optimization. EPSRC funding is available for suitably qualified UK/EU candidates.

More details are available from <http://www.maths.ed.ac.uk/~ormsc/>

University of Greenwich

The School of Computing and Mathematical Sciences offers a one-year full time MSc Programme in Applied Mathematical Modelling and Scientific Computing. This is a completely new programme sponsored by EPSRC in the area of applied mathematical modelling with emphases on the use of computer and algorithms development. This programme intends to provide interdisciplinary background

with very focused applications chosen by the students to suit their interests. EPSRC bursaries are available for suitably qualified candidates.

The programme is also offered on a two-year part-time basis and to students who may wish to enroll and start in January.

For full details see <http://cse.gre.ac.uk>

Enquiries may be sent to: Professor Choi-Hong Lai, School of Computing and Mathematical Sciences, University of Greenwich (c.h.lai@gre.ac.uk).

Heriot-Watt University

We offer taught MSc courses and PhD by research. Our Applied Mathematical Sciences MSc provides modern mathematical and numerical skills geared to careers in both research and industry. To achieve this we offer a solid theoretical and practical foundation through a broad range of modules. We have a related MSc in Applied Mathematical Sciences with Biological and Ecological Modelling which offers specialisation in the life sciences.

These MSc courses are available as a 1 year full-time MSc as well as on a part-time basis. Some EPSRC financial support is available for suitably qualified home/EU students.

Further details may be found at <http://www.ma.hw.ac.uk/mscapmasc/>

Enquiries should be addressed to: Allison Kerr (amase@ma.hw.ac.uk)

University of Liverpool

Starting in September 2007, the Department of Mathematical Sciences at the University of Liverpool is running an MSc in Mathematical Sciences that provides training in Mathematics with options of specialisations in any subjects at the project stage. Applications to the usual DTA awards are also welcome from potential candidates – for further details and other studentships, check http://www.liv.ac.uk/math/Prosp_PG/index.html

Enquiries should be addressed to: Frances Poole (Frances.Poole@liverpool.ac.uk)

University of Manchester

Starting September 2007, the Schools of Mathematics and Computer Science at the University of Manchester are jointly running an MSc in Mathematics and Computational Science that provides training in applied mathematics, numerical analysis, and computational science. It is suitable for students wishing to enter PhD programmes in mathematics, computer science, or the applied sciences. Two streams run within the MSc, depending on whether a student wishes to focus on mathematics or on computation. The programme develops many skills valued by industry and it is possible to complete an MSc dissertation with an industrial partner.

A number of bursaries are available for highly qualified students.

The course starts in September and lasts one year. It comprises lectures and coursework, with exams in January and June, followed by a dissertation that is submitted in September. The dissertation counts for one half of the credits and is chosen from a range of available projects, including projects suggested by industrial partners.

Further information is available at

<http://www.maths.manchester.ac.uk/postgraduate/pgadmission/msc-mcs.html>

Enquiries should be addressed to: Programme Director Tony Shardlow (shardlow@maths.man.ac.uk)

Admissions Officer: Len Freeman (len.freeman@manchester.ac.uk)

University of Nottingham

From September 2007 the University of Nottingham will be offering a suite of seven MSc courses in Scientific Computation:

- MSc in Scientific Computation;
- MSc in Scientific Computation with Computational Fluid Dynamics (CFD);
- MSc in Scientific Computation with Electromagnetics;
- MSc in Scientific Computation with Finance;
- MSc in Scientific Computation with Industrial Mathematics;
- MSc in Scientific Computation with Mathematical Medicine and Biology;
- MSc in Scientific Computation with Solids and Structures.

These courses offer a solid grounding in advanced scientific computation that will prepare students for either a career in business or industry, or for research in an area where computational techniques play a significant role. All seven MSc degree courses are centred around a common taught core comprising the following modules: Variational Methods, Computational Linear Algebra, and Algorithm Design and Operational Research. Optional topics can be selected from the general areas of Computational Fluid Dynamics, Electromagnetics, Finance, Industrial Mathematics, Mathematical Medicine and Biology, and Solids and Structures. In addition to the taught modules, students will undertake a three month summer project.

The courses will be taught by mathematicians, computer scientists, engineers and staff from the Nottingham Business School, fully reflecting the multidisciplinary nature of scientific computation.

Further details can be found at <http://www.maths.nottingham.ac.uk>

Enquiries should be addressed to: Andrew Cliffe (andrew.cliffe@nottingham.ac.uk)

University of Oxford

Oxford University Computing Laboratory and the Mathematical Institute offer a one-year full time M.Sc. course in Mathematical Modelling and Scientific Computing. This course aims to provide training in the applications of mathematics to a wide range of problems in science and technology. It is intended for graduates in mathematics or related disciplines wishing to pursue a career in industrial or commercial research or in academia.

The course consists of both taught courses and a dissertation. Topics covered include analytical and numerical solution of ordinary and partial differential equations, numerical linear algebra, numerical optimisation, mathematical ecology and biology, fluid dynamics and mathematical physiology.

The course is supported by EPSRC with 10-12 studentships being available each year.

For further details see <http://www.comlab.ox.ac.uk/oucl/courses/grad/mmsc>

Enquiries may be addressed to the Graduate Admissions Secretary, Oxford University Computing Laboratory, Wolfson Building, Parks Road, Oxford, OX1 3QD, Email: MMSC-Admissions@comlab.ox.ac.uk.

University of Plymouth

The School of Mathematics and Statistics offers one-year full-time MSc/MRes courses in Applied and Computational Mathematics. The courses provide in-depth knowledge and advanced skills that are of broad relevance for careers in a wide range of areas, including technology, finance and consulting. Students will be able to develop a critical awareness of the application of modern mathematical techniques to a variety of problems and the ability to use a range of computational tools and packages. Modules studied are chosen from - Mathematical Modelling I: Discrete and Continuous Dynamical Systems; Mathematical Modelling II: Random Systems and Systems Control; Financial Mathematics and Statistics; Nonlinear Systems; Partial Differential Equations; Personal and Professional Skills; Research Skills and Project Development; Project.

Applicants should have a good honours degree, or equivalent, in Mathematics or a numerate discipline such as Engineering.

Further information is available from www.plymouth.ac.uk or contact Dr Tom Heinzl, School of Mathematics and Statistics, University of Plymouth, Drake Circus, Plymouth, Devon, PL4 8AA, UK. Tel: +44 (0)1752 232754, Fax: +44 (0)1752 232780, e-mail: Thomas.Heinzl@plymouth.ac.uk

University of Reading

The Department of Mathematics at the University of Reading offers two one-year taught Masters postgraduate training courses, commencing on 1 October. An MSc in the Mathematics of Scientific and Industrial Computing (formerly Numerical Solution of Differential Equations) is running as a new course in the Department of Mathematics. An MSc in the Mathematical and Numerical Modelling of the Atmosphere and Oceans, is run jointly with the Meteorology Department, which is fully funded by NERC. Applications are invited from candidates holding, or expecting to obtain, a minimum of a lower second class honours degree in mathematics or joint degree with mathematics, physics or engineering (with a significant mathematical content). Most qualified UK students would be eligible to receive funding of fees and stipend from the relevant research council, and most qualified EU students would be eligible for funding of fees. Both courses are available on a part-time basis over two years.

For further details see <http://www.maths.rdg.ac.uk/> or contact Sue Davis, Postgraduate Secretary, Department of Mathematics, The University of Reading, Whiteknights PO Box 220, Reading RG6 6AX, UK. Tel: 0118 378 8991, email: S.Davis@reading.ac.uk

University of Strathclyde

The Department of Mathematics offers 1-year MPhil and 3-year PhD research degrees. A PhD takes 4 years when linked to a Graduate Teaching Assistantship.

Research within the Department of Mathematics covers a wide range of applied and applicable mathematics with a prominent commitment to nonlinear mathematics and the solution of industrial problems reflecting current emphasis within EPSRC. The main research activities are grouped into four sections: Applied Analysis, Continuum Mechanics, Industrial Mathematics and Numerical Analysis. The Numerical Analysis Group is the largest and one of the strongest in the UK. Research interests are diverse, including the construction and analysis of methods for numerical solution of nonlinear differential equations, and on computational solution of problems of practical interest. There is also related research activity in several aspects of numerical linear algebra and approximation theory.

Funding is obtained from several sources, including EPSRC, Graduate Teaching Assistantships, University Awards, Carnegie Trust, Overseas Research Student Awards Scheme, UK industry and the EU.

For further information contact Dr Oleg Davydov (oleg.davydov@strath.ac.uk)
<http://www.maths.strath.ac.uk/applying/postgraduate/>

18 Acknowledgements

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