

**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 Introduction: request for news and contributions

At the start of the new academic year, welcome to the autumn IMA NA Newsletter. Many thanks to the small but regular band of contributors (see Acknowledgements). Please could I put in a plea for more of our readers to contribute to the newsletter. Regular or one-off contributions from individuals and from NA groups are very welcome, including reports on conferences and workshops, book reviews, details of new software etc. If you have any suggestions for an article that you feel would be of interest to readers, please send me an email or give me a call.

The copy date for the next Newsletter will be **Thursday 17th December**.

Jennifer Scott (jennifer.scott@stfc.ac.uk)  
Group Leader, Numerical Analysis Group  
Rutherford Appleton Laboratory, Didcot, Oxfordshire OX11 0QX

## 2 J Ll Morris 1943 - 2009

I am sorry to have to pass on the sad news that John Morris passed away on the 25th April 2009, after a battle of more than two years against oesophageal cancer. John is perhaps best known to numerical analysts as the key organiser who set up and ran the early Dundee Numerical Analysis conferences in the late 1960s and 1970s under the directorship of Ron Mitchell. Together Ron and John contributed greatly to the promotion and advancement of numerical analysis in the UK and beyond. Subsequently John spent over 10 years at the University of Waterloo in Canada before returning to Dundee, and then, more recently, becoming Professor of Mathematics at Kingston University in the UK. John retired from Kingston University in February this year, and was recently appointed Emeritus Professor. John is survived by his wife Sylvie, their three children, and grandchildren. Many will remember the special Welsh/Scottish hospitality offered by John and Sylvie to many numerical analysis visitors in the UK and Canada.

Sandy Gourlay (a.gourlay985@btinternet.com)

## 3 Change of address

The Univeristy of Oxford Numerical Analysis Group is officially transferring from the Computing Laboratory to the Mathematical Institute on 1 October 2009. The whole Group is also moving offices shortly afterwards. The physical address will then be 3 Worcester Street, and the postal address for all members of the Group will be:

Mathematical Institute  
24-29 St Giles'  
Oxford OX1 3LB

## 4 Prizes

### Fourteenth Leslie Fox Prize Meeting

The 14th Leslie Fox Prize Competition was held at Warwick University on Monday June 29th 2009. This prize, which is awarded every two years, recognizes the work of researchers, under the age of 31 at the submission date, based on the evaluation of a single paper and, for those who make the final round, the presentation of that paper in a 40 minute talk. From around 20 high quality submissions, the following 6 speakers made it to the final round and delivered talks as follows:

- Stefano Giani (Nottingham University)  
A convergent adaptive method for elliptic eigenvalue problems.
- Daan Huybrechs (Katholieke Universiteit Leuven)  
On the Fourier extension of non-periodic functions.

- Armin Lechleiter (Ecole Polytechnique)  
The factorization method is independent of transmission eigenvalues.
- Colin B. Macdonald (Mathematics, UCLA)  
The implicit closest point method for the numerical solution of partial differential equations on surfaces.
- Brian D. Sutton (Randolph-Macon College)  
Computing the Complete CS Decomposition.
- Liuqiang Zhong (Xiangtan University)  
Optimal multilevel and adaptive finite element methods for time-harmonic Maxwell equations.

The prize committee comprised Andrew Stuart (Warwick, Chair), Mark Ainsworth (Strathclyde) and Nick Higham (Manchester). Brian Sutton was awarded a first prize, and the remaining speakers were all awarded a second prize. The 15th Leslie Fox Prize competition will take place in Manchester in 2011.

The prize was established in 1985 by the (UK) Institute for Mathematics and Its Applications. It is sponsored by Cambridge University Press, Oxford University Press, Princeton University Press, SIAM and Springer.

Further details may be found at <http://www.warwick.ac.uk/~masdr/fox/>

### **23rd Biennial Conference on Numerical Analysis**

At the 23rd Biennial Conference on Numerical Analysis which was held at the University of Strathclyde, student prizes were awarded to:

Jaroslav Fowkes, University of Oxford

Hafiz Abdul Wajid, University of Strathclyde,

who were judged to have given the two best student talks.

Due to the overall high quality, the committee also awarded a small number of certificates of merit to students who gave excellent presentations at the conference. A full list of winners is available at <http://www.numerical.rl.ac.uk/people/hsd/ukiesiam/prizes.html>

## **5 ESPRC Network: MOPNET**

The new EPSRC Network on Matrix and Operator Pencils, MOPNET, coordinated by Cardiff University, recently held its first two-day meeting in Reading. Speakers included:

- Timo Betcke (Reading),
- Marko Lindner (Chemnitz),
- Lyonell Boulton (Heriot Watt),
- Robin Tucker (Lancaster),
- Eugene Shargorodsky (University College, London),
- Pedro Freitas (Lisbon),
- Joanne Foster (Loughborough),
- Bo Kagstrom (Umea).

This was the first EPSRC-funded meeting, following MOPNET Zero in March, which was sponsored by the Wales Institute of Mathematical and Computational Sciences.

MOPNET is an interdisciplinary collaboration between engineers, mathematicians and physicists, financing workshops and visitor programs. The network is still open to new members and expressions of interest.

For enquiries, full details of the network's activities, as well as slides from all talks, please go to <http://mopnet.cf.ac.uk>

## 6 Who's Visiting Whom

### Oxford

Dr Joris van Deun, University of Antwerp, 1 October - 31 December 2009.

Dr Pedro Gonnet, ETH Zurich, 1 October 2009 - 30 September 2010.

Prof. Andre Weideman, University of Stellenbosch, South Africa,  
15 November - 6 December 2009.

The host for these visitors is Nick Trefethen.

## 7 Technical Reports

### University of Bath

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

- 04/09 On the bottom of the spectrum in a double-contrast periodic model.  
Natalia O. Babych.
- 05/09 On an extension of the space of bounded deformations.  
M. Kruzik and J. Zimmer.
- 06/09 Convergence analysis of planewave expansion methods for  
Schrodinger operators with discontinuous periodic potentials.  
R. Norton and R. Scheichl.
- 07/09 Analysis of FETI methods for multiscale PDEs Part II: Interface variation.  
C. Pechstein and R. Scheichl.
- 08/09 Existence of subsonic heteroclinic waves for the Frenkel-Kontorova model with  
piecewise quadrature-site potential.  
Carl-Friedrich Kreiner and Johannes Zimmer.
- 09/09 Existence of dynamic phase transitions in a one-dimensional lattice model with  
piecewise quadratic interaction potential.  
Hartmut Schwetlick and Johannes Zimmer.
- 10/09 Parallel GeometricMultigrid for Global Weather Prediction.  
S.D. Buckeridge and R. Scheichl.
- 11/09 Spectra of Modular Random Graphs.  
Gler Ergn and Reimer Khn.

### Brunel University

Reports available from [http://people.brunel.ac.uk/~icsrsss/bicom/tech\\_rep.html](http://people.brunel.ac.uk/~icsrsss/bicom/tech_rep.html)

- BICOM 09/1 John A. Leach and Simon Shaw.  
An initial-boundary value problem for the Korteweg-de Vries equation on the  
negative quarter-plane.

BICOM 09/2 Simon Shaw.  
Finite element approximation of a non-local problem in non-Fickian polymer diffusion.

### University of Cambridge

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

- NA2009/07 M. Condon, A. Deano and A. Iserles.  
On second order differential equations with highly oscillatory forcing terms.
- NA2009/06 M.J.D. Powell.  
The BOBYQA algorithm for bound constrained optimization without derivatives.
- NA2009/05 M. Condon, A. Deano and A. Iserles.  
On asymptotic-numerical solvers for differential equations with highly oscillatory forcing terms.
- NA2009/04 Daan Huybrechs, Arieh Iserles and Syvert Nørsett.  
From high oscillation to rapid approximation V: The equilateral triangle.
- NA2009/03 Hermann Brunner, Arieh Iserles and Syvert Nørsett.  
The spectral problem for highly oscillatory Fredholm operators.
- NA2009/02 Alfredo Deao and Nico M. Temme.  
Analytical and numerical aspects of a generalization of the complementary error function.
- NA2009/01 Marianna Khanamirian.  
Quadrature methods for highly oscillatory linear and nonlinear systems of ordinary differential equations: Part II.

### Cardiff University

- 09/01 G. M. Leonenko and T. N. Phillips.  
The prediction of plane Couette flow for a FENE fluid using a reduced basis approximation of the Fokker-Planck equation.
- 09/02 G. Russo and T. N. Phillips.  
Physical interpretation of the die-swell phenomenon for a Newtonian fluid.
- 09/03 S. J. Lind and T. N. Phillips.  
The influence of viscoelasticity on the collapse of cavitation bubbles near a rigid boundary.
- 09/04 G. Russo and T. N. Phillips.  
Numerical simulation of unsteady plane die swell for a Newtonian fluid using the spectral element method.
- 09/05 D. Oldham, J. H. Davies and T. N. Phillips.  
Generic polyhedron grid generation for solving partial differential equations on spherical surfaces.
- 09/06 G. Russo and T. N. Phillips.  
Numerical prediction of extrudate swell behaviour of branched polymer melts.

### University of Edinburgh

Reports available from <http://www.maths.ed.ac.uk/ERGO/preprints.html>

- ERGO 09-003 M. Colombo, A. Grothey, J. Hogg, K. Woodsend and J. Gondzio.  
A structure-conveying modelling language for mathematical and stochastic programming.
- ERGO 09-004 C. Cartis, N.I.M. Gould and Ph.L. Toint.  
An adaptive cubic regularisation algorithm for nonconvex optimization with convex constraints and its function-evaluation complexity.
- ERGO 09-005 J.D. Blanchard, C. Cartis and J. Tanner.  
Compressed sensing: how sharp is the restricted isometry property?.
- ERGO 09-006 A. Grothey and X. Yang.  
Top percentile traffic routing by dynamic programming.
- ERGO 09-007 M. Colombo and A. Grothey.  
A multi-step interior point warm-start approach for large-scale stochastic linear programming.
- ERGO 09-008 M. Colombo and A. Grothey.  
A decomposition-based warm-start method for stochastic programming.
- ERGO 09-009 S. Bellavia, J. Gondzio and B. Morini.  
Computational experience with numerical methods for nonnegative least-squares problems.
- ERGO 09-010 J.D. Blanchard, C. Cartis, J. Tanner and A. Thompson.  
Phase transitions for greedy sparse approximation algorithms.
- ERGO 09-011 J.D. Blanchard and A. Thompson.  
On support sizes of restricted isometry constants.

### University of Liverpool

Reports available from [http://www.liv.ac.uk/~cmchenke/na\\_liverpool.htm](http://www.liv.ac.uk/~cmchenke/na_liverpool.htm)

### University of Manchester

MIMS EPrints from <http://www.manchester.ac.uk/mims/eprints> Preprints with AMS Mathematics Subject Classification 65: Numerical Analysis.

- 2009.52: Nicholas J. Higham, Christian Mehl and Franoise Tisseur (2009).  
The Canonical Generalized Polar Decomposition.
- 2009.51: Laurence Grammont, Nicholas J. Higham and Franoise Tisseur (2009).  
A Framework for Analyzing Nonlinear Eigenproblems and Parametrized Linear Systems.
- 2009.50: Timo Betcke and Daniel Kressner (2009).  
Perturbation, Computation and Refinement of Invariant Subspaces for Matrix Polynomials.
- 2009.31: Awad H. Al-Mohy and Nicholas J. Higham (2009).  
The Complex Step Approximation to the Frechet Derivative of a Matrix Function.
- 2009.26: H. Fassbender, D. S. Mackey, N. Mackey and C. Schroder (2009).  
Structured Polynomial Eigenproblems Related to Time-Delay Systems.
- 2009.25: Fernando De Teran, Froilan Dopico and D. Steven Mackey (2009).  
Linearizations of Singular Matrix Polynomials and the Recovery of Minimal Indices.

**University of Oxford**

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

- NA-09/03 S Olver.  
GMRES for oscillatory matrix-valued differential equations.
- NA-09/02 S Olver.  
Fast, numerically stable computation of oscillatory integrals with stationary points.

**Rutherford Appleton Laboratory**

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

- RAL-TR-2009-017 H. S. Dollar.  
Properties of linear systems in PDE-constrained optimization. Part I: Distributed control.
- RAL-TR-2009-016 I. S. Duff and B. Ucar.  
Combinatorial problems in solving linear systems.
- RAL-TR-2009-015 J. K. Reid and J. A. Scott.  
Partial factorization of a dense symmetric indefinite matrix.
- RAL-TR-2009-014 M. Arioli and D. Ruiz.  
Flexible deflation in Krylov methods with Chebyshev-based polynomial filters.
- RAL-TR-2009-013 I. S. Duff and D. Mijuca.  
On accurate and time efficient solution of primal-mixed finite element equations in multiscale solid mechanics.

**8 Diary of Seminars (October 2009 - December 2009)**

**BATH Numerical Analysis Seminars:** Seminars take place on Fridays at 12:15pm in Department of Mathematical Sciences, Building 1 West, Room 1W3.6. The timetable is available at <http://people.bath.ac.uk/cn229/naseminars/>

**BATH BICS series:** Seminars take place at 1:15pm in Department of Mathematical Sciences, Building 1 West, Room 1W3.6. A timetable is available at <http://www.bath.ac.uk/math-sci/bics/seminars/>

**BATH CNM Seminars:** Seminars take place on Tuesdays at 1:15pm in the Department of Mathematical Sciences, Building 1 West, Room 1W3.6. The timetable is available at <http://www.bath.ac.uk/cnm/>

**BATH CNM series:** Seminars take place on Tuesdays at 1:15pm in the Department of Mathematical Sciences, Building 1 West, Room 1W3.6. The timetable is available at <http://www.bath.ac.uk/cnm/>

**BIRMINGHAM :** The Optimisation and Numerical Analysis seminar at Birmingham run on Thursdays, between 12-1pm in Arts Lecture Room 6, Edgbaston Campus at the University of Birmingham. The programme can be found at <http://web.mat.bham.ac.uk/loghin/onaseminars.html>

**BRUNEL :** Two seminar series are held in the Department of Mathematical Sciences, John-Crank Building, Room M128. The Applied Mathematics Research Seminars take place on Mondays at 14:00, and the Seminars on Mathematical Physics and Random Matrices are held on Tuesdays at 16:00. More details are available at <http://www.brunel.ac.uk/about/acad/siscm/math/events>

**CARDIFF** : Seminars take place on Tuesdays at 4pm in School of Mathematics room M/2.06. Contact: Tim Phillips (phillipstn@cardiff.ac.uk).

**CAMBRIDGE** : There are three relevant seminar series in Cambridge which are held in MR14, Pavilion F, Centre for Mathematical Sciences: Applied and Computational Analysis Seminars (up-to-date details at <http://talks.cam.ac.uk/show/index/9811>), Numerical Analysis Seminars (up-to-date details at <http://www.damtp.cam.ac.uk/user/na/seminars.html>), and ACA Graduate Seminars (up-to-date details at <http://talks.cam.ac.uk/show/index/15177>).

**EDINBURGH** : The Edinburgh Research Group in Optimization (ERGO) runs seminars on Optimization and Numerical Analysis. Seminars are usually on Wednesdays at 3.30pm in Room 6206 of the James Clerk Maxwell Building. More details are available from: <http://www.maths.ed.ac.uk/ERGO/seminars.html>

**LIVERPOOL** : Seminars are normally held on Wednesdays at 4pm, in the Whittaker Room (211), Mathematical Sciences Building.  
See <http://www.liv.ac.uk/math/Applied/Research/Seminars/index.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** : Unless stated otherwise, seminars take place on Thursdays at 2pm in the NA Group Seminar Room, 3 Worcester Street. For further information contact Lotti Ekert (Lotti.Ekert@maths.ox.ac.uk). A timetable and abstracts are available from <http://www.maths.ox.ac.uk/events/seminars/>

**RAL** : Seminars are held in the Atlas Centre, Rutherford Appleton Laboratory and start at 2pm.  
Contact: sue.dollar@stfc.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 or email [b.calderon@reading.ac.uk](mailto:b.calderon@reading.ac.uk) to confirm the programme before attending.

Please note that, at the time of writing, not many people had fully sorted out their seminar series for this coming term so you are advised to check the given websites for details of titles and of further seminars as they become available.

## OCTOBER 2009

OCTOBER 07 : EDINBURGH. Jacek Gondzio (Edinburgh). Factorization-free interior point method.

OCTOBER 08 : CAMBRIDGE. Henrik Shahgholian (KTH Stockholm). An unstable free boundary problem.

OCTOBER 08 : OXFORD (at Comlab, Lecture Theatre A). Colin Macdonald (Oxford). Solving partial differential equations on surfaces with the closest point method.

OCTOBER 09 : BATH. Richard Akinola (Bath). The block elimination method.

OCTOBER 09 : READING. Uwe Thiele (Loughborough). Modelling sitting, sliding, depinning and vibrated drops.

OCTOBER 15 : OXFORD ((location TBC). Gitta Kutyniok (Osnabruck). Sparsity,  $l_1$  minimization, and the geometric separation problem.

OCTOBER 16 : BATH. Sofiane Soussi (Limerick). Title TBA.

OCTOBER 21 : LIVERPOOL. John Ockendon (OCCAM, Oxford). Industry-driven theoretical mechanics.

OCTOBER 22 : EDINBURGH (at 13.00, JCMB 6206). Simon Foucart (Pierre and Marie Curie University, Paris). Title TBA.

OCTOBER 22 : OXFORD. Charalambos Makridakis (Crete). Mesh redistribution algorithms and error control for time-dependent PDEs.

OCTOBER 23 : BATH. Melina Freitag (Bath). The calculation of the distance to instability by the computation of a Jordan block.

OCTOBER 28 : EDINBURGH. Stein Wallace (Lancaster). Stochastic problems.

OCTOBER 29 : OXFORD. Wayne Hayes (UC Irvine / Imperial College London). Is the outer solar system chaotic?

OCTOBER 30 : BATH. Sheehan Olver (Oxford). Solving nonlinear, oscillatory ODEs globally.

OCTOBER 30 : READING. Valerio Lucarini Response theory for non-equilibrium systems.

### NOVEMBER 2009

NOVEMBER 03 : CARDIFF. P. Ricco (Kings College London). Title TBA.

NOVEMBER 04 : EDINBURGH (joint with NAIS). Stefania Bellavia (University of Florence, Italy). Affine scaling methods for bound-constrained nonlinear systems.

NOVEMBER 05 : OXFORD. Joris van Deun (Antwerp / Oxford). On rational interpolation.

NOVEMBER 06 : READING. Yaroslav Kurylev (UCL). Mathematics of invisibility.

NOVEMBER 11 : EDINBURGH. Burak Buke (Edinburgh). Stochastic optimization.

NOVEMBER 12 : RAL. Leigh Lapworth (Rolls Royce). CFD in the Gas Turbine Industry.

NOVEMBER 13 : READING. Sarah Hallerberg (Dresden). Title TBA.

NOVEMBER 13 : MANCHESTER. Paul Houston (Nottingham). Title TBA.

NOVEMBER 18 : EDINBURGH. Martin Lotz (Oxford). Probabilistic analysis of condition numbers in linear and conic programming.

NOVEMBER 19 : OXFORD. Pedro Gonnet (ETH Zurich / Oxford). Title TBA.

NOVEMBER 20 : BATH. Martin Stoll (Oxford). Title TBA.

NOVEMBER 20 : READING. Euan Spence (Bath). From Green to Lax via Fourier.

NOVEMBER 24 : CARDIFF. R. Poole (Liverpool). Title TBA.

NOVEMBER 26 : RAL. Timo Betcke (Reading). Invariant pairs of matrix polynomials.

NOVEMBER 27 : MANCHESTER. Nancy K. Nichols (Reading). Title TBA.

NOVEMBER 27 : READING. Sheehan Olver (Oxford). Solving nonlinear, oscillatory ODEs globally.

### DECEMBER 2009

DECEMBER 03 : OXFORD. Andre Weideman (Stellenbosch). Rational Approximations to the Complex Error Function.

DECEMBER 04 : MANCHESTER. Gabriel R. Barrenechea (Strathclyde). Title TBA.

DECEMBER 04 : READING. Peter Cameron (QMUL). Synchronization.

DECEMBER 18 : MANCHESTER. Jochen Voss (Leeds). Title TBA.

## 9 Forthcoming Meetings and Conferences

### OCTOBER 2009

**SIAM Conference on Mathematics for Industry: Challenges and Frontiers (MI09), October 5-8.** San Francisco, USA. <http://www.siam.org/meetings/mi09/>

**Woudschoten Numerical Analysis Conference, October 7-9.**

Woudschoten Conference Centre, Zeist, The Netherlands.

<http://wsc.project.cwi.nl/conferentieE.php>

**SIAM Conference on Applied Linear Algebra (LA09), October 26-29.**

Seaside, California. <http://www.siam.org/meetings/la09>

**SIAM Combinatorial Scientific Computing (CSC09), October 29-31.**

Seaside, California. <http://www.siam.org/meetings/cs09>

### DECEMBER 2009

**International Conference on Advances in Scientific Computing, December 6-8.**

Brown University, Providence, Rhode Island. <http://www.cfm.brown.edu/people/jansh/DavidGottlieb/>

**SIAM Conference on Analysis of Partial Differential Equations (PD09), December 7-9.**

Miami, Florida. <http://www.siam.org/meetings/pd09/>

### JANUARY 2010

**UK and Republic of Ireland SIAM Section Annual Meeting 2010, January 8.**

Heriot-Watt University, Edinburgh. <http://www.numerical.rl.ac.uk/people/hsd/ukiesiam/>

### FEBRUARY 2010

**PDP 2010 - 18th Euromicro International Conference on Parallel, Distributed and Network-Based Computing, February 17-19.**

Pisa, Italy. <http://www.pdp2010.org/> Special session: Parallel Algorithms and Software for Sparse Linear Algebra Computations. <http://www.na.icar.cnr.it/pdp2010/psla.html>

**SIAM Conference on Parallel Processing and Scientific Computing (PP10), February 24-26.**

Hyatt Regency Seattle, Seattle. <http://www.siam.org/meetings>

### MARCH 2010

**Facing the Multicore-Challenge. Conference for Junior Researchers, March 17-19.**

Heidelberg Academy of Sciences, Germany. <http://www.multicore-challenge.org>

**Optimization for tensor decompositions, March 29 - April 2.**

American Institute of Mathematics, Palo Alto, California.

<http://www.aimath.org/ARCC/workshops/comptensor.html>

### APRIL 2010

Eleventh Copper Mountain Conference on Iterative Methods, April 4-9.

Copper Mountain, Colorado. <http://grandmaster.colorado.edu/copper/2010>

**ICFD Numerical Methods for Fluid Dynamics, April 12-15.**

Reading, UK. <http://www.icfd.reading.ac.uk/ICFD2010>

**European Workshop on Mixed Integer Nonlinear Programming, April 12-16.**Marseilles, France. <http://sites.google.com/site/ewminlp/>**Third International Workshop on Parallel and Distributed Computing in Finance, April 23.**Atlanta, USA. <http://www.cs.umanitoba.ca/~pdcof>**MAY 2010****European Finite Element Fair (EFEF), May 20-21.**

University of Warwick.

<http://www2.warwick.ac.uk/fac/sci/math/research/events/2009-2010/workshops/efef10/>**Applied Linear Algebra - in honor of Hans Schneider, May 24-28.**Novi Sad, Serbia. <http://www.dmi.uns.ac.rs/events/ala2010>**Tenth International Conference on Computational Science (ICSS 2010), May 31 - June 2.**Amsterdam, The Netherlands. <http://www.iccs-meeting.org/iccs2010>**JUNE 2010****16th Conference of the International Linear Algebra Society (ILAS), June 21-25.**Pisa, Italy. <http://www.dm.unipi.it/~ilas2010>**BIT 50th Anniversary Conference, June 17-20.**Lund, Sweden. <http://www.csc.kth.se/BIT/>**9th International Meeting on High Performance Computing for Computational Science (VECPAR 2010), June 22-25.**Lawrence Berkeley National Laboratory, CA. <http://vecpar.fe.up.pt/2010/>**6th International workshop on Parallel Matrix Algorithms and Applications (PMAA), June 30 - July 2.**Basel, Switzerland. <http://www.pmaa10.unibas.ch/>**JULY 2010****Boundary and Interior Layers (BAIL 2010), July 5-9.**University of Zaragoza, Spain. <http://www.bail2010.unizar.es/>**2010 SIAM Annual Meeting (AN10), July 12-16.**The David L. Lawrence Convention Center, Pittsburgh, Pennsylvania. <http://www.siam.org/meetings>**Numerical Linear Algebra: Perturbation, Performance, and Portability - A conference in honor of G.W. (Pete) Stewart, July 19-20.**University of Texas at Austin, USA. <http://z.cs.utexas.edu/wiki/stewart2010.wiki/>**SEPTEMBER 2010****Second IMA Conference on Numerical Linear Algebra and Optimisation, September 13-15.**University of Birmingham. [http://www.ima.org.uk/Conferences/2nd\\_numerical\\_linear\\_algebra.html](http://www.ima.org.uk/Conferences/2nd_numerical_linear_algebra.html)**European Multigrid Conference EMG 2010, September 19-23.**Isola d'Ischia (Napoli), Italy. <http://www.emg2010.unisannio.it/>**10th International Conference on Parametric Optimization, September 20-24.**Karlsruhe, Germany. <http://www.ior.kit.edu/paraoptX.php>**JUNE 2011**

**Householder Symposium XVIII, June 12-17.**  
Tahoe City, California. <http://crd.lbl.gov/SCG/HH11/>

**JULY 2011**

**ICIAM 2011, July 18-22.**  
Vancouver, BC, Canada. <http://www.iciam2011.com/>

## 10 Highlighted Conferences and Workshops

Annual Meeting of UK and Republic of Ireland SIAM Section  
8 January 2010, National e-Science Centre, Edinburgh

Confirmed speakers:

- Douglas Arnold (SIAM President)
- Ivan Graham (Bath)
- Matthias Heil (Manchester)
- Philip Maini (Oxford)
- Volker Mehrmann (Berlin)
- Barbara Niethammer (Oxford)
- Michael Tretyakov (Leicester)

Cost: 10 GBP for SIAM Members, 15 GBP for non-SIAM members (this covers the cost of refreshments and lunch).

Full details available at <http://www.numerical.rl.ac.uk/people/hsd/ukiesiam/>

To register, send an email to [sue.dollar@stfc.ac.uk](mailto:sue.dollar@stfc.ac.uk)  
Please advise of any special requirements.

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THE INSTITUTE FOR COMPUTATIONAL FLUID DYNAMICS (ICFD)  
Conference on Numerical Methods for Fluid Dynamics  
12 - 15 April 2010, University of Reading.

This is the tenth international conference on CFD organised by the ICFD (Institute for Computational Fluids Dynamics), a joint research organisation at the Universities of Oxford and Reading. The aim of the conference, as in previous years, is to bring together mathematicians, engineers and other scientists in the field of computational fluid dynamics to review recent advances in mathematical and computational techniques for modelling fluid flows.

Invited Speakers include:

- Michael Edwards (Swansea)
- Bengt Fornberg (Colorado)
- Emmanuel Hanert (Universit Catholique de Louvain)
- Peter Jan van Leeuwen (Reading)
- Jan Dirk Jansen (Delft)
- Patrick Jenny (ETH)
- Dean Oliver (Oklahoma)
- Volker Schultz (Trier)
- Mikhail Shashkov (LANL)
- Jaap Van der Vegt (Twente)
- Tim Warburton (Rice)
- Andy Wathen (Oxford)

**CALL FOR PAPERS:** Two page abstracts for contributed papers should be submitted via the website (see below) by 30 November 2009, stating a preference for oral or poster presentation. Notification of acceptance will be given by 24 January 2010. All accepted papers (including those for posters) will be required at the meeting for distribution immediately after the Conference on CD. All accepted papers will be refereed for inclusion in the Proceedings which will be published, as at the previous Conference, in a Special Issue of the International Journal for Numerical Methods in Fluids.

**WORKSHOP ON OPTIMIZATION IN COMPUTATIONAL FLUID DYNAMICS:** Incorporated within the ICFD 2010 meeting will be a workshop on Optimization in Computational Fluid Dynamics, sponsored by the European Science Foundation OPTPDE (Optimization with PDE Constraints) Network. Three speakers will give invited talks as part of the workshop. Contributed presentations are also invited and funding is available to support a limited number of contributors at the conference presenting papers on the theory and applications of optimization in CFD.

**THE BILL MORTON PRIZE:** A feature of the meeting will be the sixth award of The Bill Morton Prize for a paper on CFD by a young research worker.

For further information see [www.icfd.reading.ac.uk/ICFD2010](http://www.icfd.reading.ac.uk/ICFD2010)

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Integral Methods in Science and Engineering (IMSE2010)  
July 12 - 15 2010, University of Brighton.

The eleventh international conference on Integral Methods in Science and Engineering will be held at the University of Brighton from 12-15 July 2010. IMSE2010 will provide an international forum for communicating recent advances in research work which promotes the link between mathematics and the applied sciences and engineering. The conference will also provide an opportunity for delegates to exchange information and ideas that support their work.

The deadline for the submission of abstracts is Friday 2nd April 2010. Authors will be notified of acceptance by Friday 23rd April 2010.

Further details may be found at <http://www.cmis.brighton.ac.uk/imse2010/> or by contacting Paul Harris at [imse2010@brighton.ac.uk](mailto:imse2010@brighton.ac.uk).

## 11 Summer Schools

Gene Golub SIAM Summer School 2010  
International Summer School on Numerical Linear Algebra (ISSNLA)  
Fasano (Bari), Italy. 7-18 June 2010

The first Gene Golub SIAM Summer School will take place at the Centro Internazionale Alti Studi Universitari (CIASU), in Fasano (Bari), Italy. The following four courses will be given during the two weeks 7-18 June 2010.

- Minimizing communication in numerical linear algebra, James Demmel, University of California at Berkeley, USA
- Nonlinear eigenvalue problems: analysis and numerical solution, Volker Mehrmann, Technische Universitaet Berlin, Germany.
- From Matrix to Tensor: The Transition to Computational Multilinear Algebra, Charles Van Loan, Cornell University, Ithaca, New York, USA.
- Linear Algebra and Optimization, Margaret H. Wright, Courant Institute, New York University, USA

The summer school is geared towards doctoral students. There will be a limit of 50 students. There will be no registration fee. Funding for local accommodations and/or local expenses will be available for some of the participants. Limited travel funds may also be available. Watch the website for announcement of application deadline and procedures. For more information see: <http://www.ba.cnr.it/ISSNLA2010>

This summer school is the second ISSNLA organized by the SIAM Activity group on Linear Algebra. The first took place in 2008 (<http://www.simumat.es/SIAGLA2008>).

## 12 Software News

### New HECToR Courses

NAG is pleased to announce four new HPC courses free for UK researchers and running in the next few months.

**Quad Core Training** - We are now firmly in the multi-core age. The HECToR service has just been upgraded to AMD Opteron quad core chips, and users have new opportunities for exploiting this system, but also face new challenges in getting the best performance. In this 2 day course the new architecture will be described in detail, and its impact on performance will be examined by use of the profiling tools available on HECToR. We shall also examine the use of mixed mode OpenMP/MPI as a programming paradigm, and also briefly introduce the use of System V shared memory segments.

**Parallel I/O** - Input and Output (I/O) is often an under-considered part of a code but can severely limit its scalability. This course will present MPI-IO which allows a program to read and write to a single file from multiple processes. We will also take a look at the NetCDF and HDF5 libraries.

**Best Practice in HPC Software Development** - The course is designed for those with parallel programming experience who are embarking on a major software development project. It is a five day course and covers hardware, compilers and optimization, tools for the programmer including debugging and profiling, parallel I/O, testing and benchmarking code and portability and maintainability issues. All aspects of the course will be backed up with hands on exercises.

**Core Algorithms for High Performance Scientific Computing** - This course addresses the fact that many scientific calculations involve computational linear algebra and optimization. We will develop a solid grounding in the mathematics of these algorithms; discuss the efficient implementation in a range of standard libraries and demonstrate their effective use.

NAG provides Computational Science and Engineering (CSE) support for HECToR, the UK Supercomputing Service. You are eligible for training, for which there is no charge, if you are a HECToR user or your work is covered by the remit of either EPSRC, BBSRC or NERC. We provide a regular schedule of courses that cover Fortran 95, general HPC topics, such as MPI and OpenMP, as well material specific to HECToR. We can also provide training tailored to your specific requirements and deliver courses at your institution.

For further information and our current training schedule and locations please see:

<http://www.hector.ac.uk/cse/training/>

A full list of available courses and contact details are here:

<http://www.hector.ac.uk/cse/training/courselist/>

For more information about NAG, HECToR and the CSE service please see the following links:

<http://www.nag.co.uk>

<http://www.hector.ac.uk/>

<http://www.hector.ac.uk/cse/>

[Craig.Lucas@nag.co.uk](mailto:Craig.Lucas@nag.co.uk)

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### NAG

Darn! I am just back from Leuven and Eindhoven having been invited to give one of NAG's training courses on the NAG Toolbox for MATLAB. I would have liked to demonstrate the new content of

the latest release: the new wavelet chapter (C09), the global optimisation chapter (E05), the nearest correlation matrix routine and of course the derivative pricing routines in the S chapter. My colleagues would have wanted me to mention the new statistical content in the G01, G02, G03 and G13 chapters too, but anyone who knows me would have realised that I would have been particularly bad at discussing anything statistical. When I flew out the latest Toolbox wasn't quite ready, so I based my presentations on the existing Toolbox for 32-bit Windows. Not that choosing from 1500 routines was THAT restrictive but it would have been nice to show something brand new. The day I got back, just 4 days later, I was told that the Windows 32-bit Toolbox was 'ready'. I think it still needs to be packaged but by the time you read this I expect it will be available for download. It was a prime example of someone's law in action ....

Luckily Unix users of the NAG Toolbox for MATLAB already have access to Mark 22. Please see [http://www.nag.co.uk/numeric/MB/product\\_availability.asp](http://www.nag.co.uk/numeric/MB/product_availability.asp) For an up-to-date listing of available implementations.

Of course many Fortran users have been able to access Mark 22 libraries for some time now and my colleague, Sven Hammarling, would think it remiss of me not to mention additions to the linear algebra chapters in that context. Most noteworthy is, perhaps, the matrix exponential routine in the F01 chapter but the F02 chapter has also been augmented with a routine for obtaining leading terms in the singular value decomposition of a general real matrix.

SMP and C library implementations of this new content will be forthcoming over the next few months.

Meanwhile we have the exciting prospect of planning new content for future libraries. As ever, we welcome your feedback on what additional routines you would like us to include and what areas of the library you think we should strengthen. If you have any comment please let us know on: [support@nag.co.uk](mailto:support@nag.co.uk)

## 13 PhD Theses

### Brunel University

Harry Hill. Adaptive finite elements for viscoelastic deformation problems. Available from [http://people.brunel.ac.uk/~icsrssi/bicom/tech\\_rep.html](http://people.brunel.ac.uk/~icsrssi/bicom/tech_rep.html)

## 14 MSc Theses

### Cardiff University

R. Adams. Reduced Basis Function Methods for Partial Differential Equations.

## 15 Recent Appointments

### University of Oxford

Holger Wendland takes up his position as Professor of Numerical Analysis and Fellow of Exeter College on 1 October 2009.

### University of Bath

Jonathan Dawes, Reader in Applied Mathematics and Royal Society University Research Fellow has joined the University of Bath from the University of Cambridge.

## 16 Vacant positions and studentships

### Vacancy for a Lecturer in Mathematics at the University of Chester

The Department of Mathematics is seeking to appoint a Lecturer to teach at all levels within the undergraduate and postgraduate Mathematics curricula and to undertake research. This post offers an excellent opportunity to contribute to all aspects of the work of our compact and successful department.

You must possess a PhD in Mathematics. Experience of teaching University Mathematics and a record of publications will be an advantage. Salary is in the range 30,594 - 33,432 GBP per annum.

Further details, see <http://www.chester.ac.uk/jobs/>

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### Lecturer in Mathematical Optimization, University of Birmingham

Applications are invited for a Lecturer post in Mathematical Optimization. The successful candidate will have a PhD in an area of Mathematical and Computational Optimization with a strong research track record in discrete, nonlinear, multi-disciplinary or computational optimization, or a related area, and a genuine commitment to teaching, along with excellent presentation, communication and interpersonal skills. Starting salary will be in the range of 36,532 - 43,622 GBP a year (potential progression on performance once in post to 49,096 GBP)

Informal enquiries can be directed to Professor Michal Kocvara (tel. 0121 414 6598, email [M.Kocvara@bham.ac.uk](mailto:M.Kocvara@bham.ac.uk)) or Professor Stephen Decent (tel. 0121 414 7566, email [S.P.Decent@bham.ac.uk](mailto:S.P.Decent@bham.ac.uk)).

### Lecturer in Applied Mathematics, University of Birmingham

Applications are invited for a Lecturer post in Applied Mathematics. To design, develop and deliver a range of programmes of study within Mathematics in line with the School's teaching strategy. To undertake and deliver research programmes in line with the research strategy of the School of Mathematics and the College of Engineering and Physical Sciences. The successful candidate will have PhD in an area of Applied Mathematics and a strong research track record in applied analysis, computational mathematics or fluid mechanics, or a related area, and a genuine commitment to teaching, along with excellent presentation, communication and interpersonal skills. Starting salary will be in the range of 36,532 - 43,622 GBP a year (potential progression on performance once in post to 49,096 GBP)

Informal enquiries can be directed to Professor David Needham (tel. 0121 414 6593, email [D.J.Needham@bham.ac.uk](mailto:D.J.Needham@bham.ac.uk)) or Professor Stephen Decent (tel. 0121 414 7566, email [S.P.Decent@bham.ac.uk](mailto:S.P.Decent@bham.ac.uk)).

**Closing for both posts:** 8th October 2009. Further details at <http://www.mat.bham.ac.uk/>

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### Analysis of Nonlinear Partial Differential Equations, University of Oxford

The Mathematical Institute proposes to appoint a University Lecturer in The Analysis of Nonlinear Partial Differential Equations, with effect from 1 January 2010 or at an agreed date thereafter. The successful candidate will be appointed to a tutorial fellowship at Lincoln College, under arrangements described in the further particulars. The salary will be on a scale up to 56,917 GBP per annum.

The successful candidate will be expected to have a Ph.D. in Mathematics or a related discipline and a record in demonstrating a high standard of research ability in analysis and its applications to nonlinear partial differential equations. The appointee will also be expected to have the ability to teach effectively over a wide range of topics in the undergraduate mathematics syllabus at Oxford, not exclusively in the area of his or her research expertise, and including most topics in pure mathematics in the syllabus of the first and second year undergraduate mathematics course.

Further details: <http://www.maths.ox.ac.uk/notices/vacancies>. Closing date: 30 October 2009.

Please quote the reference number: BK/09/020.

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## 2 Postdoc positions, University of Reading in Numerical Analysis/Scientific Computing

**Position 1:** Two-year Postdoctoral Research Fellow post in Boundary Integral Equation Methods for High Frequency Scattering Problems Supported by a UK EPSRC research grant, the successful applicant will form a collaborative team with investigators Prof Simon Chandler-Wilde and Dr Steve Langdon (Reading), Prof Ivan Graham and Prof Valery Smyshlyaev (Bath), several international visitors and four industrial/research bodies. Further details: see the links from <http://www.reading.ac.uk/~sms03sl/>

**Position 2:** Three-year Postdoctoral Research Fellow post in Next generation finite element methods for wave problems Supported by a UK EPSRC Career Acceleration Fellowship of Dr Timo Betcke the successful applicant will work jointly with Betcke and an industrial partner on novel finite element methods for wave problems. Further details: see the links from <http://www.reading.ac.uk/~sp900945/>

For both positions the successful applicant should have (or be close to completing) a PhD in mathematics (or equivalent), ideally in numerical analysis, and preferably have significant experience of programming and implementation of numerical methods, in particular boundary integral equation methods (Position 1) and finite element methods (Position 2). Applicants may apply to both positions simultaneously.

Position 1 informal enquiries: Professor Simon Chandler-Wilde (email: [s.n.chandler-wilde@reading.ac.uk](mailto:s.n.chandler-wilde@reading.ac.uk), phone: +44 (0)118 378 5017) or Dr Steve Langdon (email [s.langdon@reading.ac.uk](mailto:s.langdon@reading.ac.uk), phone: +44 (0)118 378 5021). Position 2 informal enquiries: Dr Timo Betcke (email: [t.betcke@reading.ac.uk](mailto:t.betcke@reading.ac.uk), phone: +44 (0)118 378 8992)

Closing date: 12 October 09.

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## Research Positions at CERFACS

Research positions are available at CERFACS to work in the Parallel Algorithms Team led by Iain Duff. Positions are now available as a postdoc or senior position starting at a date to be agreed with the successful candidates. The level of the appointments will depend on experience but you should state in the application which level you feel to be appropriate.

The Parallel Algorithms Team is looking for a bright, motivated person 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 of the position include a gross salary in the range 2,900 to 3,100 euros per month, excellent travel support, opportunities for supplementary income from teaching or consultancy, access to state-of-the-art computational facilities (high-performance workstations and both SMP/MPP parallel architectures, including our in-house IBM BG/L computer with 4096 cores). 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.

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

For detailed information about the Parallel Algorithms Project at CERFACS: <http://www.cerfacs.fr/algor>

For more information about Toulouse, the city where CERFACS is located: <http://www.toulouse.fr/>

Applications should be sent before October 9, 2009 to Xavier Vasseur ([vasseur@cerfacs.fr](mailto:vasseur@cerfacs.fr))

## 17 Postgraduate Courses

### University of Bath

#### MSc in Mathematical Sciences

Study full time for one year (12 months) or part time for two years to obtain a Masters Degree in Mathematical Sciences. A broad range of units is available in Pure and Applied Mathematics, Probability and Statistics.

Requirements: First or Upper Second Class Honours Degree in Mathematics, or equivalent. Applications from appropriately qualified overseas students are strongly encouraged.

See <http://www.bath.ac.uk/math-sci/postgraduate/taught/msc-math-sci/>

#### 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.

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.

- 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

See <http://www.bath.ac.uk/math-sci/postgraduate/taught/msc-modern-app/>

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

### Cardiff University

#### MSc in Computing in the Physical Sciences

The aim of this course is to offer knowledge and expertise for the cross-disciplinary field of scientific computing, preparing graduates for careers in the development of computer models for industrial or academic applications. The course caters for a range of backgrounds by offering introductory material on either computing and mathematics or the physical sciences. Options allow specialisation in Mathematics and Computing or Chemistry and the Physical Sciences. Part-funded studentships are available which cover fees and make a contribution to living expenses for UK-resident EU citizens. The course is taught jointly by the schools of Chemistry, Mathematics and Computer Science. Special Features of this course include hands-on experience of mathematical programming and atomistic chemical simulation

software packages; in-depth treatment of the mathematical basis of simulation and its implementation from specialists research-active in the field; and transferable skills of programming and algorithm design.

The course is suitable for graduates in Mathematics, Computing, Chemistry, Physics or related disciplines: e.g. engineering, Pharmacy and Biochemistry. Applicants should have a First or Second Class UK Honours degree, or equivalent. Applicants whose first language is not English will be required to pass either IELTS or TOEFL exams. Contact Name: Dr James Platts (Tel: +44(0)2920874950, Email: [platts@cardiff.ac.uk](mailto:platts@cardiff.ac.uk))

For further details see <http://courses.cardiff.ac.uk/Postgraduate/course/detail/952.html>

### **University of Edinburgh**

The Operations Research Group at the University of Edinburgh is offering a one-year MSc programme in Operations Research that has been successfully running since 2002. The current intake is 55 students, and applications for entry in 2009 are already being accepted. For more information and how to apply, please see [www.maths.ed.ac.uk/ormsc/](http://www.maths.ed.ac.uk/ormsc/)

### **University of Manchester**

The Schools of Mathematics and Computer Science at the University of Manchester jointly run 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](mailto:shardlow@maths.man.ac.uk))  
Admissions Officer: Len Freeman ([len.freeman@manchester.ac.uk](mailto:len.freeman@manchester.ac.uk))

### **University of Oxford**

The Mathematical Institute offers 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.

We also offer a DPhil in Computer Science or Numerical Analysis.

For further details see <http://www.maths.ox.ac.uk/prospective-students/graduate/courses>

### **University of Reading**

The Department of Mathematics at the University of Reading offers two one-year taught postgraduate training courses, commencing on 1st October:

**Mathematics of Scientific and Industrial Computation** (formerly Numerical Solution of Differential Equations) is running as a new course in the Department of Mathematics.

**Mathematical and Numerical Modelling of the Atmosphere and Oceans**, run jointly with the Meteorology Department, which is fully funded by the 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.

Four PhD funded places available for January start (see maths website for further details).

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@rdg.ac.uk

## 18 IMA Journal of Numerical Analysis

**Contents of Volume 29, Number 3** (see <http://imajna.oxfordjournals.org/>)

- 467-485 Gene Golub and Frank Uhlig.  
The QR algorithm: 50 years later its genesis by John Francis and Vera Kublanovskaya and subsequent developments.
- 486-507 Gradimir V. Milovanovic, Miodrag M. Spalevic, and Miroslav S. Pranic.  
Error estimates for Gauss-Turan quadratures and their Kronrod extensions.
- 508-538 L. Angela Mihai and Alan W. Craig.  
Alternate slice-based substructuring in three dimensions.
- 539-572 Holden, K. H. Karlsen, and N. H. Risebro.  
A convergent finite-difference method for a nonlinear variational wave equation.
- 573-594 Emmanuil H. Georgoulis and Paul Houston.  
Discontinuous Galerkin methods for the biharmonic problem.
- 595-605 J. M. Sanz-Serna.  
Modulated Fourier expansions and heterogeneous multiscale methods.
- 606-631 Istvan Farago and Robert Horvath.  
Continuous and discrete parabolic operators and their qualitative properties.
- 632-650 M. C. De Bonis and G. Mastroianni.  
Nyström method for systems of integral equations on the real semiaxis.
- 651-689 C. M. Elliott and S. A. Smitheman.  
Numerical analysis of the TV regularization and  $H^1$  fidelity model for decomposing an image into cartoon plus texture.
- 690-711 P. E. Kloeden and J. Valero.  
Attractors of set-valued partial differential equations under discretization.
- 712-730 R. K. Dunne, E. O'Riordan, and G. I. Shishkin.  
Fitted mesh numerical methods for singularly perturbed elliptic problems with mixed derivatives.
- 731-745 Tatiana Shingel.  
Interpolation in special orthogonal groups.
- 746-759 Orizon P. Ferreira.  
Local convergence of Newton's method in Banach space from the viewpoint of the majorant principle.
- 760-772 Philipp Grohs.  
Smoothness of interpolatory multivariate subdivision in Lie groups.

- 773-789 Michael J. Johnson.  
A symmetric collocation method with fast evaluation.
- 790-805 J.-L. Guermond.  
The LBB condition in fractional Sobolev spaces and applications.
- 806-813 Christian Rasch and Thomas Satzger.  
Remarks on the  $\mathcal{O}(N)$  implementation of the fast marching method.
- 814-825 Wanyou Cheng and Dong-Hui Li.  
A derivative-free nonmonotone line search and its application to the spectral residual method.

For further details see: [www.imanum.oupjournals.org](http://www.imanum.oupjournals.org)

## 19 Acknowledgements

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Tim Phillips (Cardiff)  
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