

**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

As the new academic year commences, there seems to be plenty going in the UK numerical analysis community. We have news of a number of prestigious prizes that have been awarded in recent months, a brief overview of the forthcoming EPSRC International Review of Mathematical Sciences that many of you will have already contributed to, an article on the numerical analysis activities in Cardiff as well as a report on the Durham symposium that was held in July (with thanks to Marco Marletta and Melina Freitag, respectively).

The Oxford Numerical Analysis Group, which is part of the Mathematical Institute, has moved location. It is now based at the Gibson Building, Radcliffe Observatory Quarter. Further details may be found at <http://www.maths.ox.ac.uk/groups/numerical-analysis>

A new webpage that may be of interest to readers is that of the UK and Republic of Ireland SIAM Section. This may be found at <http://www.personal.reading.ac.uk/~sp900945/siamukie/#Welcome>

The copy date for the next Newsletter will be **Friday 17th December**. As always, contributions from individuals as well as groups/departments are very welcome. Please use the newsletter as an opportunity to tell the community about NA-related activities in the UK.

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## 2 International Review of Mathematical Sciences 2010

EPSRC is conducting an International Review of Mathematical Sciences to be held in December 2010. The review is being guided by a Steering Committee chaired by Professor Tim Pedley. The review comprises two key stages: information and data collection and a review week during which an International Panel to be chaired by Professor Margaret Wright (Courant Institute, New York University) will meet with some of the leading mathematical scientists from over 40 leading institutions in the UK. These institutions and other key stakeholders have been invited to submit evidence directly; in addition, contributions from other groups/individuals/interested parties were invited via the EPSRC website.

International reviews are intended to help EPSRC to benchmark UK research activity in a discipline or area of study against the rest of the world, and to highlight any gaps or missed opportunities. Each international review provides a broad perspective on the research activity and is undertaken with the relevant learned institutions and other research councils as appropriate. The information provided from international reviews is used in developing our business and investment plans.

The mathematics review is being overseen by a Steering Committee which appointed the Chair and selected members of the International Panel from among the names submitted through a public nomination process between December 2009 and February 2010. The panel members are recognised leading international experts in the field and were selected to ensure sufficient breadth of expertise within the Panel to cover the full range of Mathematical Sciences under review.

The Steering Committee agreed the scope and terms of reference for the review, as well as the Evidence Framework which sets out the questions the Panel is asked to address and provides a structured basis on which evidence is assembled for the review. Following the review week, the Panel will prepare a written report, the findings of which will be presented at a Town Meeting for the research community in January 2011. Subsequently EPSRC will develop an action plan in conjunction with stakeholders. Further information is available on the EPSRC webpages.

### 3 Prizes and awards

#### De Morgan Medal

Warm congratulations to Bill Morton, who has won the 2010 De Morgan Medal. The De Morgan Medal is the most prestigious prize of the London Mathematical Society. Professor Morton's work concerns understanding the flow of liquids and his results have influenced a wide range of fields, from weather forecasting to the design of power stations and from the development of aircraft engines to the growth of scientific computing.

LMS president Professor Angus MacIntyre FRS, said, "A hallmark of Professor Morton's work is the creation of original, elegant mathematics in the service of real-world applications. The London Mathematical Society is proud to honour a mathematician who has changed the way we look at the numerical analysis of partial differential equations through his world-leading research results, his vision and his dynamic leadership qualities."

#### Humboldt Research Award

On 22 June 2010 at a ceremony in the Schloss Charlottenburg, Berlin, Professor Charlie Elliott from the University of Warwick was a recipient of the Humboldt-Forschungspreis (Humboldt Research Award) from the Alexander von Humboldt Foundation in Germany.

The award is granted in recognition of a researcher's lifetime achievements to academics whose fundamental discoveries, new theories, or insights have had a significant impact on their own discipline and who are expected to continue producing cutting-edge achievements in the future. Elliott was cited for his outstanding contributions to the analysis and numerical analysis of nonlinear partial differential equations, proving first existence and uniqueness results, developing and analysing new numerical schemes and applying his theoretical results to practically relevant problems from material science, fluid dynamics, theoretical biology and others. Award winners are invited to cooperate on research projects of their own choice with colleagues at a research institution in Germany. Elliott plans to visit Prof H. Garcke (Regensburg), Prof. K-H Hoffmann (TU Munich) and Prof R. Kornhuber (Free University Berlin).

#### Whitehead Prize

Dr Françoise Tisseur of the University of Manchester has been awarded a Whitehead Prize for outstanding research achievements in numerical linear algebra, including polynomial eigenvalue and structured matrix problems. Françoise has also been awarded a highly prestigious EPSRC Leadership Fellowship to work on "Nonlinear Eigenvalue Problems: Theory and Numerics". Nonlinear eigenvalue problems arise in a wide variety of science and engineering applications, and present many mathematical challenges. The project will explore new research directions in this area, bringing in ideas from geometric algebra and control theory. With the help of the research team, Françoise will develop theory and methods that enable the solution of new classes of emerging eigenproblems (e.g., rational) and more efficient and more accurate solution of existing problems.

#### The Bill Morton Prize

A feature of the ICFD 2010 meeting was the sixth award of The Bill Morton Prize for a paper on CFD by a young research worker (within 5 years of obtaining their PhD). Five of the submitted papers were shortlisted and their authors then gave talks at the meeting, which was held at the University of Reading in April. The winners were announced at the conference dinner. This year, the prize committee decided to award two first prizes and three second prizes as follows:

- First Prize: Sue Thorne (Rutherford Appleton Laboratory) and Joris Verschaeve (Norwegian University of Science).
- Second Prize: Michele Giordano (Universita del Salento, Italy), Marcel Gurrus (Dortmund University of Technology) and Maarten van Reeuwijk (Imperial).

#### SIAM Richard C. DiPrima Prize

Colin MacDonald of the University of Oxford has been awarded the 2010 Richard C. DiPrima Prize for his dissertation entitled "The Closest Point Method for Time-Dependent Processes on Surfaces".

## 4 Leslie Fox Prize

### 15th Leslie Fox Prize

The Fifteenth Leslie Fox Prize meeting will take place on 27 June 2011, in the Manchester Institute for Mathematical Sciences at The University of Manchester.

Entries for the Fifteenth Leslie Fox Prize competition should be submitted by 31 January 2011. Any person who is less than 31 years old on 1 January 2011 and has not already won a first prize is eligible. Each entry should consist of a paper, describing some of the candidate's research, that is suitable for a 40 minute lecture at a numerical analysis meeting.

The entries will be considered by an Adjudicating Committee comprising Mark Ainsworth (Strathclyde), Nick Gould (Rutherford Appleton Laboratory) and Nick Higham (Manchester, Chairman).

Full details of the prize, and the submission procedure, may be found at <http://www.mims.manchester.ac.uk/events/workshops/FOX2011>

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### Leslie Fox Prize Fund

The Leslie Fox Prize is a prestigious international prize in numerical analysis, awarded based on a submitted paper and a lecture. The Prize was set up in 1985 to honour Professor Leslie Fox, who founded the Oxford University Computing Laboratory in 1957 and was the Professor of Numerical Analysis at Oxford from 1963 to 1983. It is open to young numerical analysts worldwide. The next prize will be awarded in 2011 (see above).

The funding for the prize has been obtained by private donations but the interest from the prize fund, particularly with current rates, comes nowhere near covering the cost of the prizes, even though these are far lower than appropriate for such a significant honour. In view of the close relationship of the Prize to IMAJNA, the IMA has agreed to underwrite the Prize but it is nevertheless important for us to build the fund to a self-sustaining level.

Further donations to the Prize Fund are hereby solicited. To make a donation please complete the Donation Form (and, if appropriate, a Gift Aid Declaration form), available from the Fox Prize website (<http://www.mims.manchester.ac.uk/events/workshops/FOX2011/donations.php>). Any donations, or correspondence, should be sent to the Leslie Fox Prize Fund, c/o Institute of Mathematics and its Applications, 16 Nelson Street, Southend-on Sea, Essex SS1 1EF.

## 5 Meet the Numerical Analysis Group ... Cardiff

Numerical analysis in Cardiff has had a fragmented history. When the School of Computing Mathematics was founded under Bob Churchouse it contained no traditional numerical analysis group, and eventually evolved into the School of Computer Science. Alan Cohen in Mathematics (now retired) was the only numerical analyst, working on singular quadrature formulae for many years.

In recent years there have, however, been big changes, and computational mathematics in Cardiff is thriving. We now participate in the Postgraduate NA Day Meetings with Bath, Brunel, Imperial, Oxford and Reading; we hosted the 2006 AGM of SIAM UKIE; and we hold other short meetings sponsored by the LMS and by WIMCS, the Welsh Institute of Mathematical and Computational Sciences. The establishment of WIMCS has formalized a lot of the connections between Cardiff and other computational mathematicians in Wales, through the Computational Modelling Cluster ([http://www.wimcs.ac.uk/clusters/comp\\_modelling/index.html](http://www.wimcs.ac.uk/clusters/comp_modelling/index.html))

Chris Davies, Russell Davies, Marco Marletta and Tim Phillips all work in very different areas of mathematics, but make extensive use of computational methods and are interested in the mathematics behind their development.

Chris Davies undertakes research in theoretical and computational fluid dynamics, much of it concerned with disturbance development in boundary layers and flow control for the purpose of skin-friction drag

reduction. Some of this work involves the modelling and simulation of flow-structure interactions. He has made extensive use of a new velocity-vorticity formulation of the Navier-Stokes equations (Davies and Carpenter, JCP 2001) to conduct computationally demanding numerical simulations, usually at large Reynolds numbers. The formulation involves the use of integral conditions to constrain the evolution of the vorticity, thus allowing the no-slip conditions to be imposed in a mathematically rigorous manner, avoiding the ad hoc numerical procedures that are common in other velocity-vorticity methods. The high-order numerical schemes that have been developed and validated to date involve both spectral (mapped Chebyshev and Fourier series) and compact finite-difference discretisations for the spatial variation.

Russell Davies works in the area of computational and theoretical rheology, particularly inverse problems in linear viscoelasticity. After completing his DPhil at the Computing Laboratory in Oxford, he was elected to the Atlas Research Fellowship in Mathematics, a joint appointment at Pembroke College and the Rutherford Appleton Laboratory. During this period he developed novel resolution enhancement methods in the imaging of crystallographic structure in proteins and other macromolecules. More recently, he has made contributions to the analysis of corner singularities for viscoelastic models, the determination of the relaxation spectrum for viscoelastic materials and the construction of relationships between the relaxation spectrum and wave dispersion data. He is currently Head of the School of Mathematics at Cardiff University.

Marco Marletta works both in applied and pure analysis. Since his PhD, substantially financed by NAG Ltd in Oxford, he has worked on numerical methods for spectral problems involving differential operators. He has particular interest in methods that avoid the bane of spectral pollution and, in recent years, has studied dissipative operators and developed a new approach to operators with band-gap spectra based on dissipative perturbation, which can be combined with all the usual numerical methods (finite difference, variational) and gives a simpler approach to non-reflecting boundary conditions for problems on infinite domains. He is also interested in Dirichlet-Neumann maps and inverse problems, and is the coordinator of the EPSRC Network on Matrix and Operator Pencils, MOPNET: see <http://mopnet.cf.ac.uk>

Tim Phillips works mainly in the area of non-Newtonian fluid mechanics. After completing his DPhil thesis on the numerical solution of elliptic partial differential equations, he has gradually become interested in the development of mathematical and computational models for problems in fluid mechanics. Applications include journal bearing lubrication, polymer extrusion, sedimentation, filament stretching, bubble dynamics and spray atomisation. The numerical methods used in this work include spectral elements, boundary elements, lattice Boltzmann methods and smoothed particle hydrodynamics. He is also interested in the development of mathematical models for studying mantle convection and compressible viscoelastic fluids. He was one of the investigators on the EPSRC Portfolio Partnership award on Complex Fluids and Complex Flows.

Marco Marletta

## 6 LMS Durham Symposium on the Numerical Analysis of Multiscale Problems

In July this year, over 100 delegates from 15 different countries gathered at the University of Durham for an LMS-EPSRC Durham Symposium on the Numerical Analysis of Multiscale Problems organised by Ivan Graham (Bath), Thomas Hou (Caltech) and Rob Scheichl (Bath). The aim of the meeting was to bring together scientists and industrialists working in the following research areas:

- Numerical Analysis for Multiscale PDEs,
- Multiscale Wave Propagation Problems,
- Stochastic Problems,
- Efficient Solvers and Computational Aspects,
- Application Areas.

The meeting drew a stellar, international crowd, including L. Borcea (Rice), L. Durlovsky (Stanford), B. Engquist (Austin), P. Monk (Delaware), I. Sloan (Sydney), E. Suli (Oxford) and R. Tempone (KAUST).

Six plenary speakers, who are experts in their respective research areas, each gave a series of three lectures on one of the highlighted research topics. These introductory lectures were designed to provide the mixed audience with the necessary background knowledge. They were given by Todd Arbogast (Austin), Patrick Jenny (ETH Zurich), Mitchell Luskin (Minnesota), Markus Melenk (TU Vienna), Christoph Schwab (ETH Zurich) and Andrew Stuart (Warwick).

Andrew Stuart gave an introduction into multiscale modelling for inverse problems, based on a Bayesian viewpoint, where he illustrated his ideas throughout in the context of simple models for groundwater flow. Patrick Jenny presented applications of transported probability density function (PDF) methods for multi-scale and uncertainty problems in turbulent flow and subsurface transport. Mitch Luskin covered in his lectures the relation between atomistic and continuum models and the formulation and analysis of coupling methods with a focus on the quasicontinuum method.

During the second week, Christoph Schwab gave three lectures on recent ground-breaking mathematical results on the design and numerical analysis of efficient schemes for elliptic and parabolic PDEs with random inputs. Todd Arbogast gave introductory lectures on mixed multiscale methods for heterogeneous elliptic problems which included recent work on methods that incorporate information from homogenization theory and effective domain decomposition. Markus Melenk presented a survey of several methods currently employed for Helmholtz problems at large wavenumbers, a problem that despite its apparent simplicity is still extremely challenging computationally.

The introductory lectures were complemented by more than forty research presentations on various topics related to the theme of the meeting, highlighting the timeliness of the topic and the vibrant research activity in the field worldwide. In addition, an excellent poster presentation took place during the first week of the meeting, where PhD students and young researchers showed and discussed their work. In the spirit of LMS Durham symposia, ample time was left in the lunch breaks and in the evenings for research collaborations and further discussions (although on some evenings the finals of the Football World Cup in South Africa drew bigger crowds!)

Following the success in 2008 at the LMS Symposium on “Computational Linear Algebra for PDEs”, the Friday of the first week was devoted to an Industry Day. The talks focused on industrial applications of multiscale methods, with speakers from Schlumberger, the UK Met Office, BAE Systems, Chevron, Exxon Mobile, Institut Francais du Petrole, and the Institute for Cancer Research giving presentations about the challenges and approaches employed in their respective areas.

A full list of participants, the programme, and both video recordings and slides in pdf format of the talks are available online at <http://www.maths.dur.ac.uk/events/Meetings/LMS/2010/NAMP/talks.html>

Melina Freitag and Robert Scheichl (Bath)

## 7 Who’s Visiting Whom

### Cambridge

Dr Karolina Kropielnicka, University of Gdansk, is visiting for the academic year 2010/11. Her interests are in delay differential equations and high oscillation. Contact: A. Iserles (A.Iserles@damtp.cam.ac.uk).

### Oxford

Prof. Andre Weideman, University of Stellenbosch, South Africa.

Prof. Toby Driscoll, University of Delaware, USA.

Mr. Andreas Potschka, University of Heidelberg, Germany.

All three are visiting Prof. Nick Trefethen in November 2010 for a week or two.

Ivo Panayotov and David Titley-Peloquin, both from McGill University, Canada are visiting post-docs for 1 year (Panayotov) / 2 years (Titley-Peloquin), starting in October 2010. They will be working with Dr. Andy Wathen and Prof. Nick Trefethen.

## 8 Technical Reports

### University of Bath

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

- 09/10 Eigenvalues in Spectral Gaps of Differential Operators.  
Marco Marletta and Robert Scheichl.
- 08/10 Iterative methods for neutron transport eigenvalue problems Fynn Scheben and Ivan G. Graham.
- 07/10 From a large-deviations principle to the Wasserstein gradient flow: a new micro-macro passage.  
Stefan Adams, Nicolas Dirr, Mark A. Peletier and Johannes Zimmer.
- 06/10 Adaptive finite element methods for computing band gaps in photonic crystals.  
S. Giani and I. G. Graham.
- 05/10 Bayesian latent variable modelling in studies of air pollution and health.  
Ruth Salway, Duncan Lee, Gavin Shaddick and Stephen Walker.
- 04/10 Quasi-Monte Carlo methods for computing flow in random porous media.  
I. G. Graham, F. Y. Kuo, D. Nuyens, R. Scheichl, and I. H. Sloan.

### Brunel University

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

### University of Cambridge

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

- NA2010/07 B. Adcock and A. C. Hansen.  
A Generalized Sampling Theorem for Reconstructions in Arbitrary Bases.
- NA2010/06 B. Adcock.  
On the convergence of expansions in polyharmonic eigenfunctions.
- NA2010/05 M. Condon, A. Deano and A. Iserles.  
Asymptotic solvers for oscillatory systems of differential equations.
- NA2010/04 M.J.D. Powell.  
Beyond symmetric Broyden for updating quadratic models in minimization without derivatives.

### Cardiff University

- 10/01 P. C. Bollada and T. N. Phillips.  
On the mathematical modelling of a compressible viscoelastic fluid.
- 10/02 G. Russo and T. N. Phillips.  
Spectral element predictions of die-swell for Oldroyd B fluids.
- 10/03 S. J. Lind and T. N. Phillips.  
Bubble collapse in compressible viscoelastic fluids using a spectral element marker particle method.
- 10/04 T. N. Phillips and G. W. Roberts.  
Lattice Boltzmann models for non-Newtonian flows.

- 10/05 S. J. Lind and T. N. Phillips.  
The effect of viscoelasticity on the dynamics of gas bubbles near free surfaces.

### University of Edinburgh

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

### University of Liverpool

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

- NA10/04 Multigrid Algorithm for High Order Denoising.  
Carlos Brito and Ke Chen.

- NA10/05 Fast Numerical Algorithms for Euler's Elastica Inpainting Model.  
Carlos Brito and Ke Chen.

### University of Manchester

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

Preprints with AMS Mathematics Subject Classification 65: Numerical Analysis.

- 2010.78: P.E. Kloeden, G.J. Lord, A. Neuenkirch and T. Shardlow.  
The exponential integrator scheme for stochastic partial differential equations:  
Pathwise error bounds.
- 2010.77: P.E. Kloeden and T. Shardlow.  
The Milstein Scheme for Stochastic Delay Differential Equations Without Anticipative Calculus.
- 2010.75: Howard Elman, Milan Mihajlovic and David Silvester.  
Fast iterative solvers for buoyancy driven flow problems.
- 2010.63: Awad H. Al-Mohy.  
Algorithms for the Matrix Exponential and its Frechet Derivative. PhD thesis, University of  
Manchester.
- 2010.47: Norbert Mller and Margarita Korovina.  
Making big steps in trajectories. Electronic Proceedings in Theoretical Computer Science, 24.  
pp. 106-119. ISSN 2075-2180.
- 2010.37: David J. Silvester and Valeria Simoncini.  
EST\_MINRES: An Optimal Iterative Solver for Symmetric Indefinite Systems stemming from  
Mixed Approximation.
- 2010.36: D. Steven Mackey, Niloufer Mackey, Christian Mehl and Volker Mehrmann.  
Smith Forms of Palindromic Matrix Polynomials.
- 2010.35: William R. B. Lionheart and Kyriakos Paridis.  
Finite Elements and Anisotropic EIT reconstruction. In: 14th International Conference on  
Electrical Bioimpedance and the 11th Conference on Biomedical Applications of EIT, 4-8 Apr 2010,  
Gainesville, FL, USA.
- 2010.34: Kyriakos Paridis and William R. B. Lionheart.  
Shape corrections for 3D EIT. In: 14th International Conference on Electrical Bioimpedance and  
the 11th Conference on Biomedical Applications of EIT, 4-8 Apr 2010, Gainesville, FL, USA.

- 2010.33: Fernando De Teran, Froilan M. Dopico and D. Steven Mackey.  
Structured Linearizations for Palindromic Matrix Polynomials of Odd Degree.

### University of Oxford

Reports available from <http://eprints.maths.ox.ac.uk/view/groups/nag/>

- NA-10/02 Ricardo Pachon, Pedro Gonnet, and Joris Van Deun.  
Fast and Stable Rational Interpolation in Roots of Unity and Chebyshev points.
- NA-10/03 Joris Van Deun and Lloyd N Trefethen.  
A robust implementation of the Caratheodory-Fejer method.
- NA-10/04 Tyrone Rees and Andrew J Wathen.  
Preconditioning iterative methods for the optimal control of the Stokes equations.
- NA-10/05 Sheehan Olver.  
A general framework for solving Riemann-Hilbert problems numerically.
- NA-10/07 Jennifer Pestana and Andrew J Wathen.  
On choice of preconditioner for minimum residual methods for nonsymmetric matrices.
- NA-10/08 Sheehan Olver.  
Computation of equilibrium measures

### University of Reading

Preprints available from <http://www.reading.ac.uk/math-and-stats/research/math-preprints.aspx>

- MPS\_2010\_05 Numerical estimation of coercivity constants for boundary integral operators in acoustic scattering.  
T. Betcke and E.A. Spence.
- MPS\_2010\_06 Model order reduction for discrete unstable control systems using a balanced truncation approach.  
C. Boess, N.K. Nichols and A. Bunse-Gerstner.
- MPS\_2010\_07 A note on the analysis error associated with 3D-FGAT.  
A.S. Lawless.
- MPS\_2010\_08 Eigenvalue problem meets Sierpinski triangle: computing the spectrum of a non-self-adjoint random operator. Simon N. Chandler-Wilde, Ratchanikorn Chonchaiya and Marko Lindner.
- MPS\_2010\_09 Models for Evolving Networks: with Applications in Telecommunication and Online Activities.  
Peter Grindrod and Desmond J. Higham.
- MPS\_2010\_10 Breakdown of hydrostatic balance at convective scales in the forecast errors in the Met Office Unified Model.  
Sanita Vetra-Carvalho, Mark Dixon, Stefano Migliorini, Nancy K. Nichols and Susan P. Ballard.
- MPS\_2010\_11 Correlations of control variables in variational data assimilation.  
D. Katz, N.K. Nichols, A.S. Lawless, M.J.P. Cullen and R.N. Bannister.
- MPS\_2010\_12 Mathematical Modelling for the Digital Society.  
Peter Grindrod.
- MPS\_2010\_13 Four-dimensional variational data assimilation for high resolution nested models.  
G.M. Baxter, S.L. Dance, A.S. Lawless and N.K. Nichols.
- MPS\_2010\_14 Regularization Techniques for Ill-posed Inverse Problems in Data Assimilation.

M.A. Freitag, N.K. Nichols and C.J. Budd.

- MPS\_2010\_15 State estimation using model order reduction for unstable systems.  
C. Boess, A.S. Lawless, N.K. Nichols and A. Bunse-Gerstner.
- MPS\_2010\_16 Conditioning and Preconditioning of the Variational Data Assimilation Problem.  
S.A. Haben, A.S. Lawless and N.K. Nichols.
- MPS\_2010\_17 A hybrid data assimilation scheme for model parameter estimation: application to morphodynamic modelling. Polly J. Smith, Sarah L. Dance, Nancy K. Nichols.
- MPS\_2010\_18 State Estimation using the Particle Filter with Mode Tracking.  
J.A. Pocock, S.L. Dance and A.S. Lawless.
- MPS\_2010\_19 Ensemble data assimilation in the presence of cloud.  
S. Vetra-Carvalho, S. Migliorini, N.K. Nichols.
- MPS\_2010\_20 Flow-Dependent Balance Conditions for Incremental Data Assimilation: Elliptic Operators.  
S.J. Fletcher, N.K. Nichols and I. Roulstone.
- MPS\_2010\_21 Condition number estimates for combined potential integral operators in acoustics and their boundary element discretisation.  
T. Betcke, S.N. Chandler-Wilde, I.G. Graham, S. Langdon and M. Lindner.
- MPS\_2010\_22 Conditioning of incremental variational data assimilation, with application to the Met Office system. S.A. Haben, A.S. Lawless and N.K. Nichols.
- MPS\_2010\_27 moving mesh approach to ice sheet modelling.  
D. Partridge and M.J. Baines.

### **Rutherford Appleton Laboratory**

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

- RAL-TR-2010-027 P. R. Amestoy, I. S. Duff, Y. Robert, F.-H. Rouet, and B. Ucar.  
On computing inverse entries of a sparse matrix in an out-of-core environment.
- RAL-TR-2010-026 C. L. Farmer, J. M. Fowkes and N. I. M. Gould.  
Optimal multilateral well placement.
- RAL-TR-2010-022 F. W. Wubs and J. Thies.  
A robust two-level incomplete factorization for (Navier-)Stokes saddle point matrices.
- RAL-TR-2010-019 E. E. Ovtchinnkov and J. K. Reid.  
A preconditioned block conjugate gradient algorithm for computing extreme eigenpairs of symmetric and Hermitian problems.
- RAL-TR-2010-016 H. S. Thorne.  
Distributed control and constraint preconditioners.
- RAL-TR-2010-013 M. Arioli, I.S. Duff, N.I.M. Gould, J.D. Hogg, and H.S. Thorne.  
Guidelines for development of Matlab interfaces for HSL packages.
- RAL-TR-2010-011 J. D. Hogg and J. A. Scott.  
An indefinite sparse direct solver for large problems on multicore machines.
- RAL-TR-2010-007 J. D. Hogg and J. A. Scott. A note on the solve phase of a multicore solver.

## 9 Diary of Seminars (October - December 2010)

**BATH Numerical Analysis Seminars:** Seminars take place on Fridays at 12:15pm in Department of Mathematical Sciences, Building 4 West, Room 4W1.7 (Wolfson Lecture Theatre). The timetable is available at <http://people.bath.ac.uk/~mamamf/naseminar.html>

**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](mailto:phillipstn@cardiff.ac.uk)).

**CAMBRIDGE :** There are two relevant (usually fortnightly) Cambridge seminars: the Numerical Analysis seminar and the Applied and Computational Analysis seminars, usually on Thursdays at MR14 (Pavilion F). Up-to-date list of ACA seminars lives at <http://talks.cam.ac.uk/show/index/9811> .

**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 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 Seminar Room RI.0.48, Gibson Building. For further information contact Lotti Ekert ([Lotti.Ekert@maths.ox.ac.uk](mailto: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.thorne@stfc.ac.uk](mailto:sue.thorne@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. Timetable available at <http://www.reading.ac.uk/math/news/AppMathsNumAnalSeminars.aspx>

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 2010

OCTOBER 8 : BATH. Alastair Spence, University of Bath. The use of Cramer's Rule to compute Jordan blocks.

OCTOBER 9 : READING. Uwe Thiele, Loughborough University. Modelling sitting, sliding, depinning and vibrated drops.

- OCTOBER 14 : OXFORD. Klaus Boehmer, Philipps University Marburg. On the application/analysis of meshless methods for (nonlinear elliptic) PDEs.
- OCTOBER 14 : CAMBRIDGE. Richard Ward, Durham University. Doubly-periodic monopoles – a 3D integrable system.
- OCTOBER 21 : OXFORD. Axel Voigt, Dresden University of Technology. Diffuse interface models for two-phase flow.
- OCTOBER 22 : BATH. Adian Hill, University of Bath. Iterative matrix analysis by an ODE guy.
- OCTOBER 26 : CARDIFF. Timon Rabczuk, Bauhaus-University Weimar. Title TBA.
- OCTOBER 26 : CAMBRIDGE. Philippe Laurencot, Institut de Mathematiques de Toulouse. Mathematical models of receptor-mediated transport of morphogens.
- OCTOBER 28 : OXFORD. Yvan Notay, Universite Libre de Bruxelles. Algebraic multigrid with guaranteed convergence rate.
- OCTOBER 28 : CAMBRIDGE. Klaus Bohmer, Philipps University Marburg. A nonlinear discretization theory with applications to meshfree methods.
- OCTOBER 30 : READING. Valerio Lucarini, University of Reading. Response theory for non-equilibrium systems

#### **NOVEMBER 2010**

- NOVEMBER 4 : OXFORD. Eric de Sturler, Virginia Tech. Title TBA.
- NOVEMBER 6 : READING. Yaroslav Kurylev, University College London. Mathematics of Invisibility
- NOVEMBER 11 : OXFORD. Jean-Paul Berrut, Universite de Fribourg. Title TBA.
- NOVEMBER 12 : BATH. Ray Millward, University of Bath. Title TBA.
- NOVEMBER 13 : READING. Sarah Hallerberg, University of Dresden. Title TBA.
- NOVEMBER 16 : CARDIFF. Endre Suli, Oxford University. Existence and equilibration of global weak solutions to kinetic models for dilute polymers.
- NOVEMBER 18 : OXFORD. Andreas Potschka, University of Heidelberg. Optimization with time-periodic PDE constraints: Numerical methods and applications.
- NOVEMBER 19 : BATH. Catherine Powell, University of Manchester. Title TBA.
- NOVEMBER 20 : READING. Euan Spence, University of Bath. From Green to Lax via Fourier.
- NOVEMBER 28 : CAMBRIDGE. Sina Ober-Bloebaum, University of Paderbor. A variational approach for modelling and simulating electrical circuits.
- NOVEMBER 25 : RAL. Vanessa Styles, University of Sussex. Primal-dual active set methods for solving non-local Allen-Cahn systems.
- NOVEMBER 27 : READING. Sheehan Olver, University of Oxford. Solving nonlinear, oscillatory ODEs globally.

#### **DECEMBER 2010**

- DECEMBER 2 : RAL. Julian Hall, University of Edinburgh. A high performance dual revised simplex solver.
- DECEMBER 3 : BATH. Phil Browne, University of Bath. Title TBA.
- DECEMBER 4 : READING. Peter Cameron, Queen Mary, University of London. Synchronization.
- DECEMBER 17 : BATH. Aretha Teckentrup, University of Bath. Title TBA.

## 10 Forthcoming Meetings and Conferences

### OCTOBER 2010

**Summer School on Applied Analysis, October 4 - 8.**

Chemnitz, Germany. <http://www.tu-chemnitz.de/~potts/cms/>

### NOVEMBER 2010

**OPTEC Workshop on Large-Scale Quadratic Programming, November 25 - 26.**

Leuven, Belgium. <http://www.kuleuven.be/optec/qpworkshop2010>

### DECEMBER 2010

**Model Reduction for Complex Dynamical Systems, December 2 - 3.**

TU Berlin, Germany. <http://www3.math.tu-berlin.de/modred2010>

**3rd International Conference of the ERCIM WG on Computing and Statistics (ERCIM'10),  
December 10 - 12.**

Senate House, University of London. <http://www.cfe-csda.org/ercim>

### JANUARY 2011

**Numerical Analysis and Optimization: Theory, Algorithms, Applications and Technology  
Transfer, January 3 - 6.**

Sultan Qaboos University, Muscat, Oman.

<http://www.squ.edu.om/Portals/87/Conference/Conference2011/index.htm>

### FEBRUARY 2011

**SIAM Conference on Computational Science and Engineering (CSE11),  
February 28 - March 4.**

Grand Sierra Resort and Casino, Reno, Nevada, USA. <http://www.siam.org/meetings/cse11/>

### MARCH 2011

**Copper Mountain Conference on Multigrid Methods, March 27 - April 1.**

Copper Mountain, Colorado. <http://grandmaster.colorado.edu/~copper/2011/>

### APRIL 2011

**19th High Performance Computing Symposium (HPC 2011), April 3 - 7.**

Boston, USA. <http://www.cs.vt.edu/hpc2011/>

**7th International Conference on Modelling in Industrial Maintenance and Reliability,  
April 17 - 19.**

Cambridge. [http://www.ima.org.uk/Conferences/7th\\_mimar/index.html](http://www.ima.org.uk/Conferences/7th_mimar/index.html)

### MAY 2011

**7th International Conference on Preconditioning Techniques (Precond'2011),  
May 16 - 18.**

Bordeaux, France. <http://precond11.bordeaux.inria.fr>

**SIAM Conference on Optimization, May 16 - 19.**

Darmstadt, Germany. <http://www.siam.org/meetings/op11/>

**PCO'11 Parallel Computing and Optimization, May 16 - 20.**

Anchorage, Alaska. <http://www.ipdps.org>

**Fifth SIAM Workshop on Combinatorial Scientific Computing, May 19 - 21.**  
Darmstadt, Germany. <http://www.siam.org/meetings/csc11/>

#### JUNE 2011

**Seventh International Conference on Large-Scale Scientific Computations, June 6 - 10.**  
Sozopol, Bulgaria. <http://parallel.bas.bg/Conferences/SciCom11.html>

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

**24th Biennial Conference on Numerical Analysis, June 28 - July 1.**  
Strathclyde University, Glasgow. <http://www.mathstat.strath.ac.uk/naconf>

#### JULY 2011

**Foundations of Computational Mathematics, July 4 - 14.**  
Budapest. <http://www.damtp.cam.ac.uk/user/na/FoCM11/>

**IMA Conference on Nonlinearity and Coherent Structures, July 6 - 8.**  
Reading, UK. <http://www.ima.org.uk/Conferences/ncs/index.html>

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

**Optimization 2011, July 24 - 27.**  
Lisbon (Caparica), Portugal. <http://www.fct.unl.pt/optimization2011>

**SIAM Conference on Control and Its Applications (CT11), July 25 - 27.**  
Baltimore, Maryland, USA. <http://www.siam.org/meetings/ct11/>

**Mathematical and Numerical Aspects of Waves Propagation (WAVES 2011), July 25 - 29.**  
Vancouver, BC, Canada. <http://www.sfu.ca/WAVES>

#### AUGUST 2011

**ILAS Conference Pure and Applied Linear Algebra: The New Generation, August 22 - 26.**  
Braunschweig, Germany. <http://www.ilas2011.de>

#### MARCH 2012

**5th International Conference on High Performance Scientific Computing, March 5 - 9.**  
Vietnam Academy of Science and Technology, Hanoi. <http://hpssc.iwr.uni-heidelberg.de/HPSCHanoi2012>

## 11 Highlighted Conferences

Open Mathematical Problems from Industry and Elsewhere  
Mathematical Institute, Oxford  
9 December 2010

This one day meeting will both mark John Ockendon's retirement and also celebrate his 70th birthday. The idea of this one day meeting is to give participants the opportunity to air the 'problem you never solved'. This might be either a problem you have never had time to work on or one that has defeated you. There will be plenty of time for discussion and maybe a few problems will be solved during the day! (Alternatively, the meeting may provide John with a source of problems to work on during his retirement.)

The programme starts with coffee at 10.00am and finishes with a reception and dinner in St Anne's College. If you would like to give a talk on an unsolved problem please fill in the registration form which will ask for a brief abstract (two or three sentences) and also offer a range of time slots. In order to maximise the number of problems included, we hope that participants will choose the shortest time compatible with getting the information across clearly. The organising committee will accept as many talks as they can and do their best to create an interesting and varied programme.

Full details are available at <https://www.maths.ox.ac.uk/groups/occam/forthcoming-events/open-mathematical-problems-industry-and-elsewhere> or send an email to [occam@maths.ox.ac.uk](mailto:occam@maths.ox.ac.uk) The deadline for registration and payment is 15 November.

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24th Biennial Conference on Numerical Analysis  
(formerly Dundee Biennial Conference on Numerical Analysis)  
June 28th to July 1st 2011, Strathclyde University, Glasgow, Scotland.

The conference is open to researchers in all areas of numerical analysis, and contributed talks by younger researchers, post-docs and research students are very welcome. Proposals for mini-symposia are particularly welcome and can be submitted on-line.

The following distinguished researchers have accepted invitations to deliver plenary lectures at the conference:

- Oscar Bruno (Caltech),
- Jack Dongarra (University of Tennessee),
- Chris Johnson (University of Utah)
- James Nagy (Emory University)
- Jorge Nocedal (Northwestern University)
- Djordje Peric (Swansea University)
- Alfio Quarteroni (EPF de Lausanne)
- Robert Schaback (Universitat Gottingen)
- Robert Skeel (Purdue University)
- Raul Tempone (KAUST)
- Nick Trefethen (University of Oxford)
- Barbara Wohlmuth (TU Munchen)

The A.R. Mitchell lecture will be presented by Prof. Quarteroni, and the after dinner speaker will be Prof. David Silvester (University of Manchester).

Early registration and booking is advised as on-campus accommodation is limited.

Further information and on-line registration may be found at <http://www.mathstat.strath.ac.uk/naconf>

## 12 Summer Schools and Other Events

Computational Challenges in PDEs  
Swansea, 4th-8th April 2011.

The research programme on Computational Challenges for Partial Differential Equations was held at the Isaac Newton Institute (INI) in Cambridge between January and July in 2003. The programme resulted in important contributions in the fields of adaptivity and error control, the construction and mathematical analysis of multiscale numerical algorithms, the approximation of high-dimensional PDEs and the mathematical analysis of numerical algorithms for general PDEs.

Building on the success of this programme, the INI and the Wales Institute of Mathematical and Computational Sciences (WIMCS) are jointly organising a one week follow-up meeting in 2011. The

meeting will consist of 32 invited contributions in the areas of multiscale modelling, interface modelling, PDEs on surfaces and geometric evolution problems, biomedical applications, computational rheology, atomistic to continuum passage, low order modelling and uncertainty modelling.

Further information may be found at [http://www.wimcs.ac.uk/INI\\_Meeting.html](http://www.wimcs.ac.uk/INI_Meeting.html)

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**10th Dobbiaco Summer School in Numerical Analysis**  
**12-17 June 2011**  
**Bolzano, Italy**

The topic of this summer school will be: Approximation Theory, Spectral Methods and Chebfun. Two leading specialists in the field Nick Trefethen (Oxford University) and Toby Driscoll (University of Delaware) will present a series of 90 minute-long lectures. The school is intended for PhD students and young researchers.

For pre-registration and further information, see <http://www.dmi.units.it/dobbiaco/> Please note that the number of participants is limited to 60.

Organizers: Alfredo Bellen (Trieste, Italy; [bellen@units.it](mailto:bellen@units.it)) Alexander Ostermann (Innsbruck, Austria)

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**Special Semester on Multiscale Simulation and Analysis in Energy and the Environment**  
**Johann Radon Institute for Computational and Applied Mathematics (RICAM)**  
**Linz, October 3-December 16, 2011**

Technological advances have greatly improved our quality of life. However, they bring with them a huge surge in energy requirements which in turn puts at risk our entire bio-sphere. It is of paramount importance to predict these risks and to develop better solutions for the future. One of the central tasks is the accurate simulation of multiphase flow above and under ground. The risk analysis and uncertainty quantification, as well as the assimilation of data require statistical tools and efficient solvers for stochastic and deterministic PDEs as well as for the associated inverse problems. The key features that make it extremely hard to predict these physical phenomena accurately are the multiple time and length scales that arise, as well as the lack of and uncertainty in data. Because of the highly varying scales involved, the resolution of all scales is currently impossible even on the largest supercomputers. While there is a fairly long history of empirically successful robust computational techniques for certain multiscale problems, the rigorous (numerical) analysis of such methods is of extremely high current interest.

The goal of the special semester is to provide a stimulating environment for civil engineers, hydrologists, meteorologists and other environmental scientists to address together with mathematicians working at the cutting edge of rigorous numerical analysis for multiscale (direct and inverse) problems the emerging challenges in the quantitative assessment of the risks and uncertainties of atmospheric and subsurface flow, focusing in particular on

- Simulation of Flow in Porous Media and Applications in Waste Management and CO<sub>2</sub> Sequestration
- Large-Scale Inverse Problems and Applications in the Earth Sciences
- Data Assimilation and Multiscale Simulation in Atmospheric Flow
- Wave Propagation and Scattering, Direct and Inverse Problems and Applications in Energy and the Environment
- Multiscale Numerical Methods and their Analysis and Applications in Energy and the Environment
- Stochastic Modelling of Uncertainty and Numerical Methods for Stochastic PDEs

More details can be found at <http://www.ricam.oeaw.ac.at/specsem/specsem2011/>

## 13 Software News

### News from NAG

Our AGM was held on Friday 24 September, 2010. Brian Smith was re-elected to serve for another term on the NAG Board and Bill Burke's co-option endorsed by the meeting for another 3 years. The CEO was able to report on a successful trading year in which NAG's HECToR involvement played a significant part.

The key-note speaker this year was Prof Nicholas J. Higham from the University of Manchester who spoke on "How and How Not to Compute the Exponential of a Matrix". The talk interested numerical analysts and non-numerical analysts alike. He outlined the historical figures of the past who had worked on the topic and gave examples of how the need for a matrix exponential arises. Finally, he described the computational procedures that had been proposed and highlighted some of their shortcomings. He concluded by describing his algorithm which is used by NAG. F01ECF is a Fortran routine that is in our Mark 22 Fortran Libraries and f01acc entered the NAG C library at Mark 9. Naturally, the algorithm may be accessed by users of the NAG Toolbox for *MATLAB*.

The talk was video recorded and an announcement about where it may be accessed will be published by NAG within the next few days.

Other news: we have taken advice from Philip Gill, Joerg Fliege, Nick Gould, Michal Kocvara and Arnold Neumaier, with the aim of producing a road-map for the development of the optimisation chapters. NAG would like to record its thanks to all those experts who took time to assist us. More generally, we are grateful for all the help we have received and continue to receive from the research community throughout NAG's lifetime.

On a sad note, we have to record the deaths of two NAG stalwarts. From the U.S. office we lost Erwin Ruppenthal whose brain tumour reappeared with fatal consequences. In the U.K. we were saddened to hear that Michael Richardson, who was one of the first new employees at NAG when it moved to Oxford, had finally succumbed to cancer. Both will be missed by family, friends and colleagues.

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

### HECToR Training courses

HECToR training courses are provided by the NAG CSE team. The schedule for the next three months is:

- September 27 - October 1. University of Warwick. Core Algorithms for High Performance Scientific Computing
- October 13 NAG Manchester. XT6 Workshop.
- October 18-20. University of Warwick. Fortran 95.
- October 18. NAG Manchester Debugging with DDT.
- October 20-21. NAG Manchester. DL\_POLY.
- October 28. University of Reading. Scientific Visualisation.
- November 8-9. University of Warwick. Debugging, Profiling and Optimising.
- November 8-10. University of Edinburgh. Parallel Programming with MPI.
- November 11-12. University of Edinburgh. OpenMP
- December 6. University of Warwick. Parallel IO.
- December 13-15. University College London. Parallel Programming with MPI.

Details are available at <http://www.hector.ac.uk/cse/training/>

## 14 PhD Theses

Sean Buckeridge (University of Bath)

*Numerical solution of weather and climate systems: elliptic solvers.*

Ben Adcock (University of Cambridge)

*Modified Fourier expansions: Theory, construction and applications.*

Giancarlo Russo (Cardiff University)

*Spectral element methods for predicting the die-swell of Newtonian and viscoelastic fluids.*

Steven Lind (Cardiff University)

*A numerical study of the effect of viscoelasticity on cavitation and bubble dynamics.*

Noppadol Chumchob (University of Liverpool)

*A Study of Effective Variational Models and Efficient Numerical Methods for Image Registration.*

Awad H. Al-Mohy. (University of Manchester)

*Algorithms for the Matrix Exponential and its Fréchet Derivative.*

## 15 Recent appointments

### University of Cambridge

Dr Carola-Bibiane Schoenlieb, Lecturer in Applied and Computational Analysis.

## 16 Vacant positions and studentships

### Universities of Bath and Nottingham: 2 Postdoctoral Positions, Multilevel Monte Carlo

This project entitled “Multilevel Monte Carlo methods for elliptic PDEs with applications to radioactive waste disposal” is a collaborative initiative involving the Universities of Bath (Dr Rob Scheichl), Nottingham (Prof Andrew Cliffe) and Oxford (Prof Mike Giles) and is supported by a recent UK EPSRC research grant (Mathematics and Energy Mission Programmes). There are 2 positions available, one in Bath and the other in Nottingham:

- Research Officer (Dept Mathematical Sciences, University of Bath)
- Research Associate (School Mathematical Sciences, University of Nottingham)

The positions are available from **1 January 2011** and should be filled by **31 March 2011**. The successful applicants should hold (or be close to completing) a PhD in Mathematics (or equivalent), and preferably have significant experience of programming and implementation of numerical methods. A strong background in numerical analysis and a good knowledge of the fundamentals of probability theory are essential.

Experience in some of the following areas will be a distinct advantage: numerical methods for PDEs with random inputs; infinite dimensional stochastic analysis; quasi-Monte Carlo methods for high-dimensional integration; groundwater flow modelling; development of scientific software on modern (multi-processor) architectures; C++, MPI, GPU programming.

Informal enquiries regarding the respective positions may be addressed to: Dr Rob Scheichl (R.Scheichl@bath.ac.uk, +44 (0)1225 386989) or Prof Andrew Cliffe (Andrew.Cliffe@Nottingham.ac.uk, +44 (0)115 8468287). For more details and/or to apply on-line please access: <http://www.bath.ac.uk/jobs/JK257> for the post at the University of Bath (please quote reference number JK257) and <http://jobs.nottingham.ac.uk/jobs/currentvacancies/ref/SCI903> for the post at the University of Nottingham (please quote reference number SCI/903.)

Applicants who are interested in being considered for either post are encouraged to do so. Please submit separate applications at both institutions. The closing date is **24 October 2010**.

### University of Cambridge

Cambridge Centre for Analysis is open again for applications for a 4-year course of PhD studies. We are looking for top candidates, typically with either a First in either a four-year undergraduate degree or a Distinction in an MSc-level degree in mathematical sciences. Prospective candidates should contact Emma Hacking, the CCA administrator, at [cca@maths.cam.ac.uk](mailto:cca@maths.cam.ac.uk)

### Durham University: Reader/Lecturer in Applied Mathematics

The successful candidate will have an excellent research record in an area of Applied Mathematics other than theoretical particle physics or general relativity. Preference may be given to candidates with research

interests which mesh with existing ones in the department: continuum mechanics, computational applied mathematics, partial differential equations, mathematical biology/medicine, applied dynamical systems. He or she will be expected to undertake and publish original research of the highest level, to contribute to the research activities of the Applied Mathematics research unit and of the department as a whole, and to undertake teaching and administrative duties as assigned by the Head of Department of Mathematical Sciences. For appointment as Reader candidates must have a substantial record of excellent publications at internationally leading level, experience with postgraduate supervision, and ideally substantial teaching experience at University level. A record of successful generation of external funding for research projects is highly desirable. We would especially welcome applications from holders of research fellowships.

Interviews expected to take place 27 October 2010. The closing date is 4 October 2010.

Contact details: Professor Brian Straughan (0191 3343102 [brian.straughan@durham.ac.uk](mailto:brian.straughan@durham.ac.uk)) or Professor Paul Mansfield (0191 3343104 [p.r.w.mansfield@durham.ac.uk](mailto:p.r.w.mansfield@durham.ac.uk))

### **University of Liverpool**

A late PhD vacancy for recent MSc and BSc graduates has become available, following the award by EPSRC for an industrial CASE project. Please forward this to colleagues and former students who might be interested. Details for this fully-funded EPSRC CASE studentship can be found from <http://www.liv.ac.uk/~cmchenke/advert2010.htm> - the post remains open till filled.

The project is entitled “Blind Deblurring Techniques for Retinal Imaging”, essentially involving the numerical solution of PDEs in an inverse problem context in collaboration with the Royal Liverpool and Broadgreen University Hospital. It will be for 3.5 years (starting £13,570 pa + annual EPSRC increment). Contact email: [safrell@liverpool.ac.uk](mailto:safrell@liverpool.ac.uk) or phone 0151 7944043, fax 0151 794 4061.

## **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/>

## University of Cambridge

### Master of Mathematics (the old Cambridge Part III)

Part III of the Mathematical Tripos, is a one-year course which might most simply be described as a taught Master's course in mathematics. However, this description of Part III (there are also Parts IA, IB, and II in the undergraduate course), is possibly inadequate for the culmination of the oldest and most famous mathematics examination in the world! Students from Cambridge take it as the last year of a four year course and obtain a BA/M Math. Students from outside Cambridge take it as a one year course and obtain the MAST (Master of Advanced Study) degree in Mathematics. Details are available at <http://www.maths.cam.ac.uk/postgrad/mathiii/>

### Cambridge Centre for Analysis, an EPSRC Centre for Doctoral Training in Analysis

The Cambridge Centre for Analysis (CCA) offers a four-year PhD programme spanning pure, stochastic, computational and applied analysis. See <http://www.maths.cam.ac.uk/postgrad/cca/>

## Cranfield University

MSc/PgDip/PgCert in Scientific Computation (full/part time). This programme is suitable for graduates or experienced professionals who wish to gain an understanding of the processes through which good software is developed for applications in science and engineering, and of the numerical methods involved in the computer solution of such problems. Potential students should have a reasonable knowledge of mathematics and some experience of elementary computer programming.

The modular program includes:

- 8 Standard Modules, e.g. Introduction to Numerical Methods, Introduction to Scientific Programming in Fortran, Computational Methods for ODEs, Computer Graphics, High performance and Parallel Computing.
- 4 Advanced Modules, e.g. Advanced Programming in Fortran 95, Advanced Methods for ODEs.
- Dissertation.

Many modules may also be taken as standalone short courses.

See <http://www.cranfield.ac.uk/students/courses/page1813.html> for further information.

## 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))

### **Oxford University**

Oxford's M.Sc. in Mathematical Modelling and Scientific Computing aims to train graduates with a strong mathematical background to develop and apply their skills to the solution of real problems. By the end of the course students should be able to formulate a well posed problem in mathematical terms from a possibly sketchy verbal description, carry out appropriate mathematical analysis, select or develop an appropriate numerical method, write a computer program which gives sensible answers to the problem, and present and interpret these results for a possible client. Particular emphasis is placed on the need for all these parts in the problem solving process, and on the fact that they frequently interact and cannot be carried out sequentially.

For further details, see <http://www.maths.ox.ac.uk/current-students/graduates/courses/mscmmssc>

### **University of Reading**

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

- An MSc in Mathematics of Scientific and Industrial Computation.
- An MSc in the 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). Both courses are available on a part-time basis over two years.

For further details, 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](mailto:s.davis@reading.ac.uk) or see <http://www.reading.ac.uk/math>s

Reading also offers a **new MSc in Data Assimilation and Inverse Methods in Geosciences**. Data assimilation combines fundamental mathematics with applications in all fields of the geosciences, including atmosphere, ocean, land surface, cryosphere, hydrology, and the oil and gas sector. This is the first MSc course in data assimilation for geosciences worldwide.

Students with a strong background in mathematics (mathematics, physics, engineering, environmental science with strong mathematics), and a keen eye for applications of mathematics in the geosciences are welcome to the programme. A few studentships for students from the UK/EU are available. See <http://www.reading.ac.uk/math>s for details.

## 18 IMA Journal of Numerical Analysis

Contents of Volume 30, Number 3 (see <http://imajna.oxfordjournals.org/>)

- 595-628 Alexei Bepalov and Norbert Heuer.  
Natural p-BEM for the electric field integral equation on screens.
- 629-653 M. Eigel, E. George, and M. Kirkilionis.  
A mesh-free partition of unity method for diffusion equations on complex domains.
- 654-676 Alfredo Bermdez, Carlos Reales, Rodolfo Rodrguez, and Pilar Salgado.  
Numerical analysis of a finite-element method for the axisymmetric eddy current model of an induction furnace.
- 677-701 Bangti Jin and Jun Zou.  
Numerical estimation of the Robin coefficient in a stationary diffusion equation.
- 702-730 Norbert Bauermeister and Simon Shaw.  
Finite-element approximation of non-Fickian polymer diffusion.
- 731-750 Gang Xie and Thomas P.-Y. Yu.  
Smoothness equivalence properties of interpolatory Lie group subdivision schemes.
- 751-776 Veerle Ledoux, Marnix Van Daele, and Guido Vanden Berghe.  
Efficient numerical solution of the one-dimensional Schrodinger eigenvalue problem using Magnus integrators.
- 777-798 Susanne C. Brenner, Thirupathi Gudi, and Li-yeng Sung.  
An a posteriori error estimator for a quadratic C0-interior penalty method for the biharmonic problem.
- 799-831 R. Bermejo and J. Carpio.  
A semi-LagrangianGalerkin projection scheme for convection equations.
- 832-856 Martin Sauter and Christian Wieners.  
Robust estimates for the approximation of the dynamic consolidation problem.
- 857-869 Eskil Hansen and Alexander Ostermann.  
Dimension splitting for quasilinear parabolic equations.
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