

UKIE Applied Mathematicians Meet in Manchester and Sheffield
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by Ivan Graham and Nicholas J. Higham

The 2004 Annual Meeting of the SIAM United Kingdom and Republic of Ireland Section was held at the University of Sheffield on Friday 9th January 2004. Over the next 2 days a weekend workshop New Frontiers in Computational Mathematics was held 60 miles away at the Chancellors Hotel and Conference Centre, University of Manchester. Coincidentally, both meetings had 63 participants, and a number of people took advantage of the juxtaposition to attend both meetings.

After opening remarks by SIAM Section President Martin Stynes (Cork), the first Sheffield talk was presented by David Thomson (UK Met Office), who spoke on Monte Carlo methods for modelling atmospheric flows and dispersion. David demonstrated that, although most commonly occurring flows are characterised as deterministic, they often possess a genuinely stochastic character. He then presented various examples where subgrid modelling can be used to enhance standard deterministic codes, referring as an example to the problems of weather and climate prediction.

The next talk was by Lucy Wyatt (University of Sheffield), and concerned inverse methods for ocean surface measurements using HF radar. Lucy presented examples of various configurations of radar transmitters and receivers which are used to measure wave characteristics at distant points on the ocean surface in real time. She went on to describe the mathematical basis of the measurements, which involves the solution of a nonlinear ill-posed integral equation using band-limited radial basis function approximations as part of a regularised iterative method.

The first talk after lunch was by Alastair Fitt (University of Southampton) and concerned the mathematics of human eyes. Alastair aimed to employ simple mathematical models to understand how eyes work. Using fluid and solid mechanical techniques, and analytic and asymptotic

solution methods, he found solutions to various modelling problems, including the growth of hyphema, the use of the Imbert-Fick principle for measuring intraocular pressure and the investigation of the purpose of REM sleep. The section on the Imbert-Fick principle was accompanied by hair-raising pictures of eye surgery.

Following Alastair was Pat Fitzpatrick (University College Cork), who talked on algebraic aspects of coding theory. Pat explained how error correcting codes are essential to the extraction of signal from noise in modern digital communication media such as mobile phones, CDs and DVDs. He then went on to give the audience a crash course in the algebra of finite fields and explained various efficient decoding algorithms, in particular the class of alternant codes in which decoding involves computing a Padé approximant over a finite field. Pat finished by urging an increase in the algebra content of undergraduate engineering curricula.

The final speaker was Jack Dongarra (University of Tennessee/ORNL), who spoke about self-adapting numerical software. Jack explained that, although we will soon have laptops which can achieve teraflop speed, our ability to achieve the theoretical peak speed for floating-point intensive computations is still limited by our ability to adapt algorithms to the given memory hierarchy. Self-adaptive software aims to provide the user with automatic procedures for producing optimised code for any given machine. Jack gave various examples of recent implementations of this philosophy, including LFC (LAPACK for clusters), and explained how in the relatively near future, users can expect to be able to program in a language like MATLAB and have their code automatically optimised and run on a specialist machine such as a cluster.

The meeting finished with a vote of thanks for the local organising team, headed by Philip Chatwin.

The SIAM Section is going from strength to strength, its membership having expanded from 187 in 1996 to 279 today. The next Annual meeting will be held at University College Cork in the Republic of Ireland, provisionally scheduled for January 7, 2005.

The Manchester workshop was organized by Nick Higham, Tony Shardlow, Françoise Tisseur (University of Manchester) and David Silvester (UMIST) under the auspices of the Manchester Centre for Computational Mathematics, with financial support from the University of Manchester, The London Mathematical Society, the UK and Republic of Ireland SIAM section, the Royal Society and the Wolfson Foundation. The workshop focused on four cutting edge, interdisciplinary research areas of computational mathematics, with each area having a keynote speaker and other contributed talks and posters. Just the briefest highlights are reported here. For more details, see the conference web site (<http://www.maths.man.ac.uk/MCCM/frontiers.html>), which contains photographs and links to many of the presentations.

Jack Dongarra opened the workshop with a talk "Trends in High Performance Computing and the Grid" in which he discussed the evolution of computational power and how it is measured, and showed how the power is being exploited in diverse computational applications ranging from grid computing to Google. Mikel Lujan (University of Manchester) described how the OoLaLa project is using object technology in the design of high performance linear algebra libraries in order to reduce the number of specialized interfaces, and hence the coding effort, while having minimal impact on performance. Len Freeman (University of Manchester) described a feedback-guided parallel loop scheduling algorithm that was motivated by a collaboration with the UK Meteorological Office.

A diverse session on mathematical biology was opened by Mark Chaplain (University of Dundee), with a fascinating survey of the modelling of cancer cells, and particularly angiogenesis, by describing the

evolution of networks of blood vessels. Of interest both for the mathematics and the insight into the workings of our bodies, this session also offered a computational study of airway closure by Andrew Hazel (University of Manchester), (one of the conclusions: keep breathing!), computational models of pattern formation on butterfly wings from Andrew Wathen (Oxford University), and work on the little studied "mathematical modelling of micturation" by urologist C. P. Arun (University College, London). Arun gets the award for the most striking title: "Bladder contraction is rocket science!".

Per Christian Hansen (Technical University of Denmark) lead the session on inverse problems and ill-posed problems, with a talk "Large-Scale Methods for Linear Inverse Problems". Via numerous practical examples, he emphasized the importance of regularization and the advantages of exploiting structure in large-scale problems. Also in this session, Bill Lionheart (UMIST) discussed inverse problems in electromagnetics, including in electrical impedance tomography in medical diagnosis, and described a number of interesting PDE and optimization problems that arise.

The final session on image processing and computer vision was opened by Tony Chan (UCLA), who discussed partial differential equation methods. He treated, among many other things, the "inpainting" problem of filling in an occluded subject in an image---something of interest to all those of us whose thumb tends to get in front of our camera lens without us noticing it until after the picture is taken. Ke Chen (Liverpool) discussed multigrid techniques for solving the PDEs of imaging. Stephen Marsland (University of Manchester), explained the advantages of using diffeomorphisms in image registration, illustrating with the geodesic clamped spline and examples drawn from brain scans.

A notable feature of the meeting was the high standard of the 18 posters, which were professionally produced and very readable.

Overlapping with this meeting was a one and a half day workshop celebrating the 60th birthdays of numerical analysts Jim Varah, Alan George, and Michael Saunders, held at Stanford University, January 9-10, 2004 and organized by Gene Golub (Stanford), Michael Friedlander (Argonne National Laboratory), Chen Greif (University of British Columbia), and Esmond Ng (Lawrence Berkeley National Laboratory). Written greetings from attendees at the New Frontiers meeting were faxed across to Stanford, including best wishes for many more productive years.

In his concluding remarks, David Silvester remarked that this workshop had delimited the frontiers of knowledge in the four areas of computational mathematics considered---an ample result for a weekend's work---and that he hoped that a future more lengthy Manchester workshop would *extend* the boundaries.

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