

OCIAM Report

2008-2009

Oxford Centre for Industrial and Applied Mathematics

The aims of OCIAM are:

- To pursue collaborative research with industry and with other disciplines, in the widest sense.
- To pursue basic research in applied mathematics.
- To train graduates to work in applications of mathematics.
- To act as a focus for research and dissemination of information in Industrial and Applied Mathematics in the UK and to provide links with similar activities worldwide.

The means by which these aims are achieved include:

- Organizing and participating in regular workshops, industrial visits and study group meetings.
- Providing suitable teaching and other training for industrial and applied mathematicians via Masters courses and short courses.
- Obtaining funding/support from research councils, industry, EC, etc.
- Collaborating, along with many other Universities, with the Knowledge Transfer Network for Industrial Mathematics.

STAFF 2008-2009

Director Professor S J Chapman

Deputy Director Dr C J W Breward

Research Director Professor J R Ockendon

Graduate Admissions Co-ordinator Dr I M Moroz

Faculty
Dr P Dellar
Dr A C Fowler
Dr B M Hambly
Dr K C Hannabuss
Dr P D Howell
Professor S D Howison
Dr A Muench
Dr J Norbury
Dr J M Oliver
Dr M A Porter
Dr S Waters
Dr R Whittaker

Schlumberger Visiting Professor Professor L Mahadevan (Harvard)

Post Doctoral Research Assistants
Dr P Pathmanathan Dr C Voyce
Dr H Gramberg Dr I Griffiths
Dr G W Jones Dr M Ptashnyk
Dr P McSharry

Visiting Research Fellows
Dr J Aitchison
Mr P Bond (Peleton Partners)
Dr G Sander (Loughborough)

Emeritus
Professor J E Allen
Dr H Ockendon

Smiths Institute Director Dr R A Leese

Technology Translator Dr D J Allwright

OCIAM 2008-2009

Arrived

Andreas Muench Appointed as Reader in Applied Mathematics (OCIAM, Mathematical Institute) and Tutor at St Catherine's College.

Left

Christpher Bell Left for a Postdoctoral position at Imperial College.

Honours and Awards

Sam Howison was on the panel of RAE2008.

Andrew Stewart won the prize for Postgraduate Student Talk at BAMC2009.

VISITORS 2008-2009 (In order of stay)

Amit Acharya
Dr Roger Cropp
Michael Mackey
William Parnell
Shuli Guo

Carnegie Mellon University, Pittsburgh, USA
Griffith University, Queensland, Australia
McGill University, Montreal, Canada
University of Manchester, UK
Beijing Institute of Technology, China

JOURNALS

European Journal of Applied Mathematics

Editors in Chief: Prof S D Howison, Prof A A Lacey & Prof M J Ward

This journal, founded in OCIAM in 1990, promotes publication of papers on mathematics applied to the real world.

Applied Mathematics Finance

Editors in Chief: Drs B Hambly & W T Shaw

This journal aims to encourage novel and innovative ideas in financial mathematics.

Members of Editorial Boards

Jon Chapman	SIAM Journal on Applied Mathematics, Quarterly Journal of Mechanics and Applied Mathematics, Confluentes Mathematici.
Andrew Fowler	Journal of Geophysical Research (Solid Earth).
Ben Hambly	Bulletin, Journal and Proceedings of the London Mathematical society.
Sam Howison	SIAM Journal on Applied Mathematics, Applied Mathematical Finance, Revista Mexicana de Economica y Finanzas. SIAM journal on Financial Mathematics.
Hilary Ockendon	Mathematical Scientist, SIAM Review, Mathematics in Industry Case Studies.
John Ockendon	Applied Mathematics Letters, Advances in Mathematical Sciences and Applications, European Journal of Applied Mathematics, Interfaces and Free Boundaries.

DEGREES AWARDED 2008-2009

DPhil

<u>Name</u>	<u>Supervisor</u>	<u>Thesis title</u>
Ashley Pitcher	JRO	Mathematical Modelling and Optimal Control of Constrained Systems
Rebecca Shipley	SJC	Multiscale Modelling of Fluid and Drug Transport in Vascular Tumors
Richard Booth	CF/JRO	Miscible flow through porous media
MSc by Research		
Marriane Nodale	ACF	Mathematical Modelling of Ice Sheets & Ice Shelf Dynamics

MSc in Mathematical Modelling and Scientific Computing

Asgeir Biriksson	Automatic Differentiation and Nonlinear Boundary Value Problems in the Chebfun System
Matthew Bond	Discontinuous Galerkin Finite Element Approximation of the Sedov Blast Wave Problem (AWE)
Michael Byrne	Nonlinear Waves in Granular Lattices
James Dean	Continuum Modelling of a Two-Dimensional Bistable Liquid Crystal Device
Benjamin Franz	Synchronization Properties of an Agent-Based Animal Behaviour Model
Laura Gallimore	Mathematical Modelling of Cell Motility
Wojciech Gryc	Modelling Cabinet Networks in Parliamentary Democracies
Owen Jackson	Growth of Ice: Macroscopic and Microscopic
Lina Joseph	Mathematical Modelling of Avascular-Tumour Growth
Iakovos Kakouris	Time Series Analysis of Meteorological Data
Joanna Majkowski	Upscaling by Homogenization for Oil Reservoir Thermal Simulation (Schlumberger)
Elizabeth Monahan	Validity of the Tangent Plane Approximation for Transmission through Doubly Curved Shells (Thales)
Hana Moore	Microscopic and Macroscopic Modelling of Water Purification
Neil Papworth	Finite Element Solution of the Bidomain Equations
John Pearson	Computation of Hypergeometric Functions (NAG)
John Platt	Finding the Equations of State for Lead under High Stress (AWE)
Mark Richardson	Approximation Divergent Functions in the Chebfun System
Claudio Amos Ruiz Richard	Erdős-Rényi to Barabási-Albert: On the Properties of Two Graph Models

LECTURES

The Alan Tayler Lecture
Sponsored by The Smith Institute
Professor Alfio Quarteroni (l'École Polytechnique Fédérale de Lausanne)
[Mathematical Modeling In Medicine, Sports and Technology](#)
Monday 24th November, 2008

OCIAM RESEARCH REPORTS 2008-2009

These papers have been added to the list during the academic year 2008-2009 and some from 2007 which were missed from the 2007-2008 report. Some of them have already appeared and the others have been accepted for publication.

Allen, J.E. and Annaratone, B.M., Comment on “A nonlinear global model of a dual frequency capacitive discharge” [Phys. Plasmas, 13, 083501,(2006)], 2007, Phys. Plasmas, 14, 014701.

Allen, J.E. Transient pinched plasmas and strong hydrodynamic waves, Magnetohydrodynamics, eds. S.Molokov, R.Moreau and H.K.Moffatt, (Springer, 2007).

Zimmermann, T.M.G., Coppins, M. and Allen J.E., Limiting behaviour of a magnetized presheath, 2007, Proc. XVIII ICPIG, 1P04-03.

Allen, J.E., Response to “Comment on “Comment on magnetic field effects in gas discharge plasmas””, [Phys. Plasmas, 14, 094703 (2007).

Allen, J.E., “On the drag on an object immersed in a flowing plasma: the control surface approach”, 2007, J.Plasma.Phys., 73, 773 (published online 9 February 2007).

Martin, J.D., Bacharis, M., Coppins.M., Counsell, G.F., and Allen, J.E., Modelling dust transport in tokamaks, 2008, Europhysics Letters, 83, 65001 (published on line 15 September 2008).

Allen, J.E., Comment on “Magnetic field effects on gas discharge plasmas” [Phys. Plasmas, 13, 063511, 2006], 2007, Phys. Plasmas, 14, 024701.

Allen, J.E., The plasma boundary in a magnetic field, 2008, Contrib. Plasma Phys., 48, 400 (published online 13 June 2008).

Zimmermann, T.M.G., Coppins, M. and Allen, J.E., 2008, Fluid model of the boundary of a one-dimensional plasma under the influence of an oblique magnetic

field for a wide range of collisionality, 2008, *Phys. Plasmas*, 15, 072301 (published online 8 July 2008).

Annaratone, B.M. and Allen, J.E., The electronegative plasma pre-sheath in magnetic field and extraction of negative ions, 2009, *Negative Ions, Beams and Sources*, AIP Conference Proceedings 1097, 31.

Allen, J.E., Comment on "Electron collection by a negatively charged sphere in a collisionless plasma" [*Phys. Plasmas* 14, 062111 (2007)], 2009, *Phys. Plasmas*, 16, 014701 (published online 14 January 2009).

Zimmermann, T.M.G., Coppins, M. and Allen, J.E., The effect of a magnetic field on a cylindrical object in a plasma, 2009, *Phys. Plasmas*, 16, 043501 (published online 2 April 2009).

Allen, J.E., The plasma-sheath boundary: its history and Langmuir's definition of the sheath edge, 2009, *Plasma Sources: Sci. Technol.*, 17, 014004 (published on line 14 November 2008).

Chapman SJ, Kozyreff G. Exponential asymptotics of localised patterns and snaking bifurcation diagrams *PHYSICA D* 238(3) Feb 2009.

Pathmanathan P, Chapman SJ, Gavaghan DJ. Inverse membrane problems in elasticity. *Q J MECH APPL MATH* 62(1) Feb 2009.

Pathmanathan P, Cooper J, Fletcher A, Mirams G, Murray P, Osborne J, Pitt-Francis J, Walter A, Chapman SJ. A computational study of discrete mechanical tissue models. *Phys Biol* 6(3) 2009.

Voskoboinikov RE, Chapman SJ, McLeod JB, Ockendon JR. Asymptotics of Edge Dislocation Pile-Up against a Bimetallic Interface *MATH MECH SOLIDS* 14(1-2) Jan 2009.

Aguareles M, Chapman SJ, Witelski T. Interaction of Spiral Waves in the Complex Ginzburg-Landau Equation *PHYS REV LETT* 101(22) Art. No. 224101 28 Nov 2008.

Chapman SJ, Shipley RJ, Jawad R. Multiscale modeling of fluid transport in tumors. *Bull Math Biol* 70(8) Nov 2008.

Pathmanathan P, Gavaghan DJ, Whiteley JP, Chapman SJ, Brady JM. Predicting Tumor Location by Modeling the Deformation of the Breast *IEEE T BIO-MED ENG* 55(10) Oct 2008.

Dellar, P.J. Moment equations in magnetohydrodynamics *J. Stat. Mech.* (2009) P06003 (22 pages).

Stewart, A. L. and Dellar P. J. (2009) "Two-Layer Shallow Water Equations with Complete Coriolis Force and Topography" to appear in the Springer Mathematics in Industry book series, ECMI 2008 proceedings. (in press)

Evatt, G.W. and A.C. Fowler 2007 Cauldron subsidence and subglacial floods. *Ann. Glaciol.* 45, 163-168.

Zammett, R.J. and A.C. Fowler 2007 Katabatic winds on ice sheets: a refinement of the Prandtl model. *J. Atmos. Sci.* 64, 2,707-2,716.

J.G. Rodríguez-González, M. Santillán, A.C. Fowler and M.C. Mackey 2007 The segmentation clock in mice: interaction between the Wnt and Notch signalling pathways. *J. Theor. Biol.* 248, 37-47.

Marguerite Robinson, A.C. Fowler, A.J. Alexander and S.G.B. O'Brien 2008 Waves in Guinness. *Phys. Fluids* 20, 067101.

I.J. Hewitt and A.C. Fowler 2008 Partial melting in an upwelling mantle column. *Proc. R. Soc. Lond. A*464 (2097), 2,467-2,491. doi:10.1098/rspa.2008.0045.

Tiina Roose and Andrew C. Fowler 2008 Network development in biological gels: role in lymphatic vessel development. *Bull. Math. Biol.* doi: 10.1007/s11538-008-9324-3.

I.J. Hewitt and A.C. Fowler 2008 Seasonal waves on glaciers. *Hydrological processes* 22 (19), 3919-3930.

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Fowler, A.C., O. Clary and Tiina Roose 2009 A dynamic model of annual foliage growth and carbon uptake in trees. *J. R. Soc. Interface*, doi:10.1098/rsif.2009.0010.

Fowler, A.C. 2009 Dynamics of subglacial floods. *Proc. R. Soc. A*465, 1809-1828. doi:10.1098/rspa.2008.0488.

Hewitt, I.J. and A.C. Fowler 2009 Melt channelization in ascending mantle. *J. Geophys. Res.* 114, B06210, doi:10.1029/2008JB006185.

Fowler, A.C. 2009 Instability modelling of drumlin formation incorporating lee-side cavity growth. *Proc. R. Soc. A*.465, 2681-2702, doi:10.1098/rspa.2008.0490.

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Dyson RJ, Brander J, Breward CJW and Howell P.D., (2009) Long-wavelength stability of an unsupported multilayer liquid film falling under gravity. *Journal of Engineering Mathematics*, 64 (3), 237--250. DOI 10.1007/s10665-009-9278-y.

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Grants obtained 2008-2009

Intel Studentship (McSharry)	£86,766
Nuffield Wave propagation in one-dimensional granular crystals (Porter)	£1,440
EPSRC PhD Plus (Norbury)	£15,171
KAUST GRP (top-up to original funding) Oxford Centre for Collaborative Applied Mathematics (Ockendon J/ Breward/ Chapman/Howison)	£2,416,094
EPSRC-Smith Network analysis of foreign exchange markets (Howison/Porter)	£105,789

OCIAM WORKSHOPS 2008-2009

Michaelmas Term 2008

- 17th October 2008 Extending filament-based rheometry
Dr Alex Lubansky (Engineering Science, Oxford)
- 24th October 2008 Subglacial drainage and ice stream flow
Narelle Baker (Scott Polar Research Institute)
- 31st October 2008 Dislocations
- 7th November 2008 Magma fragmentation
Betty Scheu (Munich)
- 14th November 2008 Isentropic Compression of material to determine the
Equation of State (msc project)
Chris Robinson (AWE)
- 21st November 2008 MSc Industrial Sponsor Presentations
Various speakers
- 28th November 2008 (EXTRA SEMINAR) : Scale invariance, dimensional
analysis and tokamak scaling laws
Jack Connor (Culham)
- 28 November 2008 Multiporoelasticity: modelling brain parenchyma -
cerebrospinal fluid - blood compartments in a
poroelastic framework
Ian Sobey (Oxford Comlab)
- 5th December 2008 Challenges in understanding Biological Complexity and
Function
Nick Jones (Physics)
- 5th December 2008 Tear dynamics – inputs influencing dry eye disease
Anthony Bron (Ophthalmology)

Hilary Term 2009

- 23 January 2009 OCIAM Meeting
- 30 January 2009 Reconstruction atom-probe tomography data
Emmanuelle Marquis (Oxford / Dept. of Materials)
- 6 February 2009 Reconstruction and statistical modelling of geometric
measurements from the LiCAS project

Patrick Brockill (Oxford / Dept. of Physics)

13 February 2009

Sand Dunes Workshop
Matt Telfer (Oxford)

20 February 2009

Internal transport barriers in magnetically confined plasmas
Jack Connor (UK AEA)

20 February 2009

Multi-scale modelling of Root Systems
Andrea Schnepf ((University of Natural Resources and Applied Life Sciences (Vienna))

27 February 2009

Curing Cancer with accelerators
Ken Peach (John Adams Institute for Accelerator Science)

6 March 2009

Preview of Indian Study Group

13 March 2009

Thermal Effects in Porous Medium Flow
Mark Wakefield (Schlumberger)

20 March 2009

Signal detection, identification, extraction and classification
Edward Stansfield (Thales)

27 March 2009

Southampton study group review

Trinity Term 2009

1 May 2009

OCIAM Meeting

8 May 2009

Inverse problems in residual stress analysis and diffraction
Alexander Korsunsky (Department of Engineering Science, University of Oxford)

22 May 2009

Failure processes in engineering materials (cavitation and crack growth) particularly at elevated temperatures
Alan Cocks and Steve Roberts (Engineering Science, Oxford and Materials, Oxford (respectively))

29 May 2009

Bayesian and non-bayesian approaches to climate modelling
Myles Allen, David Frame and Chris Farmer ((Physics, Smith School and Maths, Oxford (respectively))

5 June 2009

Radar Multipath
Andy Stove and Mike Newman (Thales UK)

12 June 2009

Mathematical challenges in Optometry
Graeme Mackenzie and David Crosby (Oxford)

19 June 2009

First Year Student Transfer Presentations

26 June 2009

Limerick Study Group Review

OCIAM DIFFERENTIAL EQUATIONS SEMINARS 2008-2009

Michaelmas Term 2008

- 16th October 2008 On the choice of coarse variables for dynamics
Amit Acharya (Pittsburgh)
- 23rd October 2008 The spreading dynamics of a surfactant-laden droplet
Shailesh Naire (Keele)
- 30th October 2008 Solar Concentrators
Chris Bell (Oxford)
- 6th November 2008 Multistability in confined liquid crystals
Nigel Mottram (Strathclyde)
- 13th November 2008 Bifurcations in piecewise-smooth dynamical systems
C J Budd (Bath)
- 20th November 2008 Trapped modes in elastic waveguides
Julius Kaplunov (Brunel)
- 27th November 2008 Stability theory of linear systems with saturation inputs
Shuli Guo (Beijing)
- 4th December 2008 Mathematical models of protein trafficking in neurons
Paul Bressloff (Utah)

Hilary Term 2009

- 22nd January 2009 On the drag-out problem in liquid film theory
Eugene Benilov (Limerick)
- 29th January 2009 The fluid dynamics of sperm motility
Dave Smith (Birmingham)
- 5th February 2009 Seminar Cancelled
- 12th February 2009 Why is brake squeal so twitchy. Modelling and
sensitivity studies of friction-driven vibration
Jim Woodhouse (Cambridge)
- 19th February 2009 Formation of defects in the harmonic map heat flow
Jan Bouwe van den Berg (Amsterdam)
- 26th February 2009 Instabilities of flows through deformable tubes and
channels

Oliver Jensen (Nottingham)

5th March 2009

Free surface flows in the presence of electric fields
Jean-Marc Vanden-Broeck (UCL)

12th March 2009

On the Moffatt-Pukhnachov problem
Mark Kelmanson (University of Leeds)

Trinity Term 2009

30th April 2009

Cascades on Complex Networks
James Gleeson (University of Limerick)

7th May 2009

Diffusion in colloidal suspensions: Application to frost
heave, tissue scaffolds and water purification
Stephen Peppin (OCCAM (Oxford))

14th May 2009

Applications of Sparse Signal Recovery for High-
Dimensional Data
Nicolai Meinshausen (Department of Statistics, Oxford)

21st May 2009

Localized structures in elastic sheets: From a ruck in a
rug to flexible electronics
Dominic Vella (Cambridge)

28th May 2009

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