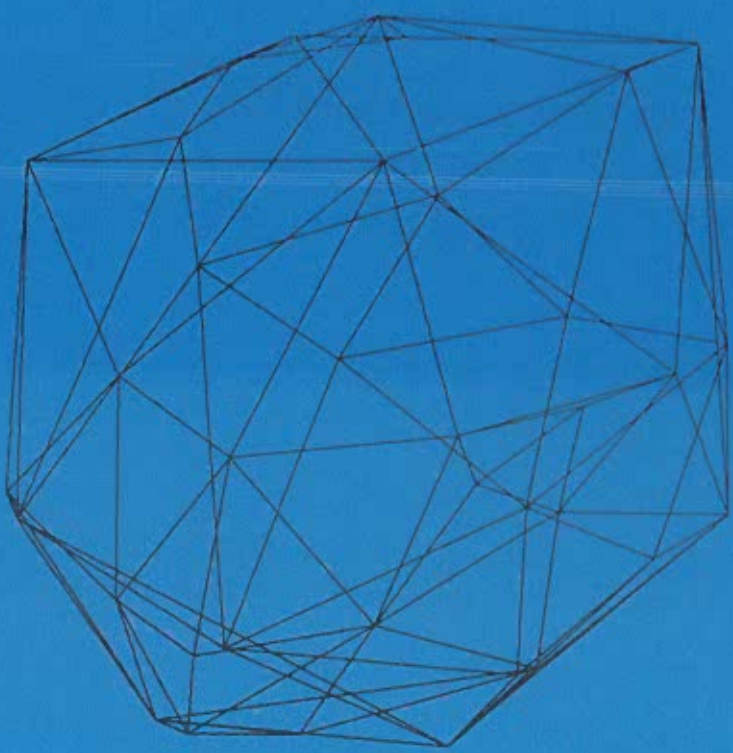


Heriot-Watt University

Department of Mathematics



ANNUAL REPORT 1990-91

HERIOT-WATT UNIVERSITY
DEPARTMENT OF MATHEMATICS
ANNUAL REPORT 1990-91

The numbers of both undergraduate and PhD students have risen to an all time high and the MSc "Mathematics of Nonlinear Models" run jointly with Edinburgh University has continued to flourish.

There has been considerable activity in the field of computer based learning in the department throughout the year. A new course on the use of the computer algebra system 'DERIVE' was successfully introduced for first year mathematics students. On the service teaching side the CALM (Computer Assisted Learning in Mathematics) Group fostered further national and international links. In April a book 'Software Tools for Computer Aided Learning in Mathematics' was published describing the work of the CALM team since the project began in 1985. Development work has continued on the production of courseware material to help bridge the school-university interface. The CALM team also became involved in a project with Marconi on the use of the Marconi language 'Mandarin' for educational purposes. Professor David James, Dearborn-Michigan, who is involved in a major NSF funded project to increase the use of computers in mathematics teaching, visited the department from August to December 1991.

The department, in a joint venture with Edinburgh University, has been involved in the setting up of the International Centre for Mathematical Sciences with support from Standard Life, the City of Edinburgh District Council, Lothian and Edinburgh Enterprise limited and several learned societies. An inaugural meeting on Geometry and Physics was held at Newbattle Abbey College and a major research programme on Mathematical Problems in Materials Science has been organized for academic year 1991/92.

The department has enjoyed a large number of visitors in the research area of differential equations and nonlinear analysis funded by a Grant from the SERC Nonlinear Systems Initiative. In addition Dr Yihong Du, Shandong University, and Dr Andrea Braides, Brescia, spent extended periods at Heriot-Watt. In November honorary degrees were conferred on two eminent mathematical scientists, Professor R E Kalman and Professor P D Lax.

Many members of the department participated in international conferences and Dr Alan Prince was on leave of absence for the year at the National University of Singapore and Dr Habib Rahman spent three months at the Middle East Technical University, Ankara, Turkey. In addition the Department hosted a one day international conference on Statistical Mechanics and Phase Transitions in August organized by Professor Oliver Penrose.

Dr Ken Brown, the Head of Department, was elected Fellow of the Royal Society of Edinburgh, becoming the seventh member of the department to be so honoured.

STAFF

Head of Department	K J Brown¹
Professors	J M Ball J Carr J C Eilbeck R J Knops ² O Penrose
Professor Emeritus	J H Williamson
Readers	M van den Berg J Howie A A Lacey
Senior Lecturers	C E Beavers³ R N Hills ⁴ A R Prince
Lecturers	L E Nicholas C Noble H U Rahman B P Ryne W L Sweatman D G Wilkinson M A Youngson
Research Associates	V Nesi ¹³ V Sverák ¹⁴ B Toth ¹⁵
Programmer	C Godsalve ¹⁶
Computing Officers	D Smith¹⁷
Visiting Mathematicians	Dr Yihong Du ²⁰
Secretaries	Mrs P Hampton ²¹ Mrs L Hunter ²¹
Miss I Fraser	
Mrs M Gardiner	
1 Reader from 1.8.91	12 from 1.9.91-31.8.92
2 Vice-Principal 1988-93	13 until 31.10.90
3 Dep. Head of Department	14 17.12.90-16.10.92
4 on leave 1.7.90-30.6.92	15 until 14.9.91
5 from 1.9.90-31.8.92	16 until December 1990
6 from 1.9.91-31.8.92	17 18.3.91-30.9.92
7 Part-time	18 14.1.91-13.9.91
8 until 31.8.91	19 from 1.10.90-30.11.90
9 from 15.9.91 - 14.7.93	20 from 1.10.90-30.9.91
10 until September 1993	21 until 31.10.91
11 from 1.9.90-31.8.93	

Visitors to the Department

The following made long-term visits:

A Braides (Brescia) D James (Michigan)
S D Brodskii (Ivanovo, USSR) L E Payne (Cornell)

In addition short-term visits were made and seminars given by the following:

C Atkinson (Imperial)
C Baillie (Colorado)
J Bricomont (Louvain)
M Buhmann (Cambridge)
R Cannings (Leeds)
I Chavel (City University New York)
M Chipot (Metz)
Jung R Cho (Glasgow)
P A Clarkson (Exeter)
S D Cohen (Glasgow)
P Covey (Schlumberger Cambridge)
W Craig (Brown/Oxford)
N Cutland (Hull)
A M Davie (Edinburgh)
J W Dold (Bristol)
E Domany (Weizman Institute)
N Dorey (Edinburgh)
T C Dorlas (Swansea)
M P F du Sautoy (Oxford)
M Edjvet (Nottingham)
I Edmund (Sussex)
J N Flavin (Univ. College Galway)
G Friedlander (UCL)
C M Friend (Shrivenham)
J E Furtter (Warwick)
G Grimmett (Bristol)
J K Hale (Georgia Tech.)
W S Hall (Teesside Polytechnic)
R Harding (Cambridge)
J Harper (Victoria, N.Z./Oxford)
P Hess (Zürich)
N Hitchin (Warwick)
J Hunter (California)
M N Huxley (Cardiff)
A J M Jacobs (Utrecht)

M Keane (Delft)
P Latiolais (Portland, Oregon)
P D Lax (Courant Institute)
T H Lenagan (Edinburgh)
J T Lewis (Dublin)
J López-Gómez (Madrid)
D Mcullan (Warwick)
B Malomed (USSR)
S Manakov (Moscow)
J D P Meldrum (Edinburgh)
G Milton (Courant Institute)
S Müller (Bonn)
N Nadvashvili (Moscow/Bielefeld)
R W Ogden (Glasgow)
D F Parker (Edinburgh)
S Pokrovsky (Moscow/Edinburgh)
M J D Powell (Cambridge)
D Preiss (UCL)
A Reid (Aberdeen)
K R Rajagopal (Pittsburgh)
M Remoissenet (Bourgogne)
C Rogers (Loughborough)
R Russell (Simon Fraser, Canada)
P Schenzel (Halle and Sheffield)
R Shivaaji (Mississippi)
P D Smith (Dundee)
S P Smith (Seattle)
D M Sloan (Strathclyde)
A Soward (Newcastle)
C T Sparrow (Cambridge)
M Struwe (ETH Zürich)
D Szász (Budapest)
R M Thomas (Leicester)
B Turkington (Amherst/Oxford)
E I Zel'manov (Novosibirsk/Oxford)

Invited Papers and Seminars given by members of staff

Professor J M Ball Colloquium, University of Warwick, 12 October 1990, 'Crystal microstructure and the calculus of variations'.
 Edinburgh Mathematical Society (Presidential address) 19 October 1990, 'Layers within layers - the calculus of variations and crystal microstructure'.
 Seminar, University College London, 31 October 1990, 'Rank-one convexity and the direct method of the calculus of variations'.
 Invited lecture, Workshop on Microstructure and Phase Transition, University of Minnesota, 13 November 1990, 'Remarks on the two-well problem for elastic crystals'.
 Colloquium, University of Minnesota, 29 November 1990, 'Remarks on rank-one convexity, and the lower semicontinuity of multiple integrals'.
 Seminar, University of Minnesota, 3 December 1990, 'The Biting lemma, Young measures and the calculus of variations'.
 Invited lecture, Stanford-Berkeley Mechanics and Applied Mathematics Workshop, MSRI, Berkeley, 11 December 1990, 'Nonlinear elasticity and phases'.
 Colloquium, Stanford University, 14 December 1990, 'Crystal microstructure and the calculus of variations'.
 Seminar, University of California, Santa Barbara, 17 December 1990, 'Crystal microstructure and the calculus of variations'.
 Seminar, Collège de France, Paris, 1 February 1991, 'Equilibre d'un corps élastique soumis à un gradient de la température'.
 2 Invited lectures, SERC Spring School on Nonlinear Systems, Cambridge, 25-26 March 1991, 'Weak convergence methods for nonlinear PDE'.
 Seminar, Brown University, 29 March 1991, 'Elastic equilibrium in the presence of a temperature gradient'.
 Seminar, Pennsylvania State University, 1 April 1991, 'Elastic equilibrium in the presence of a temperature gradient'.
 The Barrett Memorial Lectures, University of Tennessee, 4-6 April 1991, 1. 'Nonattainment of the minimum in the calculus of variations', 2. 'Crystal microstructure via elasticity theory', 3. 'Dynamics and minimizing sequences'.
 Invited lecture at minisymposium on 'Materials Science', British Applied Mathematics Colloquium, Oxford, 10 April 1991, 'Remarks on crystal microstructure'.
 Colloquium, Imperial College, 1 May 1991, 'Dynamical models related to phase transformations in solids'.
 Invited lecture, Workshop on Calculus of Variations and Nonlinear Elasticity, Cortona, Italy, 31 May 1991, 'Nonlinear and linearized theories of elastic crystals'.
 Invited lecture, 1st European Conference on Elliptic and Parabolic Problems, Pont-a-Mousson, France, 17 June 1991, 'Elastic deformations induced by a temperature gradient'.

Professor J M Ball

Invited Presentation, 2nd International Conference on Industrial and Applied Mathematics, Washington DC, 10 July 1991, 'Dynamic energy minimization and phase transformations in solids'.
 Invited lecture, Equadiff 1991, Barcelona, 2 September 1991, 'Elastic deformations due to a temperature gradient'.

Dr C E Beavers

Seminar, University of Aberdeen, January 1991, 'Computer aided learning for engineering mathematics'.
 Contributed joint talk (with M G Foster, G R McGuire and J Renshaw, University of Southampton), CAL '91, Lancaster University, 8 - 14 April 1991, 'Some problems of mathematical CAL'.
 Talk, CALM Workshop, Brunel University, June 1991, 'The CALM project'.
 Invited talk, Mathematics Workshop, University of Birmingham, 16 September 1991, 'A CALM hereafter'.
 Talk, (with R Tanner, Department of Computer Science, Heriot-Watt University), London, September 1991, 'Computers and learning in chemical reactor engineering'.

Dr M van den Berg

Seminar, Dublin Institute for Advanced Studies, 20 December 1990, 'On the spectrum of the Dirichlet Laplacian for wild domains'.
 Seminar, King's College London, 7 February 1991, 'On the spectrum of the Dirichlet Laplacian'.
 Invited lecture, Conference on Diffusion Problems, Semi-classical Methods, the Heat Kernel and the Index Theorem, Université de Paris-Sud, Orsay, 22 April 1991, 'Mean curvature and the heat equation'.
 Invited lecture, Workshop on Probabilistic Methods in Differential Equations, Technon Halfa, Israel, 28 May 1991, 'Wiener sausage mean curvature and the heat equation'.
 Seminar, University of Amsterdam, 27 June 1991, 'Mean curvature and the heat equation'.
 Invited lecture, Journées de Probabilités, Luminy, Marseille, 30 September 1991, 'Heat flow, Minkowski measure and capacity density'.

Dr A Braldes

Seminar, Heriot-Watt University, 19 February 1991, 'Homogenization of almost periodic monotone operators'.
 Seminar, Heriot-Watt University, 4 June 1991, 'Free discontinuity problems in the calculus of variations'.

Mr J Bree

Invited lecture, Pressure Vessel and Piping Conference, San Diego, California, USA, 23-27 June 1991, 'Elastic-plastic behaviour of a pressure vessel subjected to cyclic thermal stresses'.

Professor J Carr

Seminar, Imperial College, 21 November 1990, 'Metastability'.
 Seminar, University of Wisconsin, 14 July 1990, 'Self-similarity in a coarsening model'.
 Invited lecture, SERC Conference on the Mathematics of Nonlinear Systems, Bath, 1-5 July 1991, 'Dynamics of coarsening'.

Dr D E R Clark

Contributed lecture, Symposium on Solid Modeling and CAD/CAM Applications, Austin, Texas, June 1991.
'A feature recognition algorithm for multiply connected depressions and protrusions in Z_2^1 D objects'.

Dr A J Duncan

Seminar, University of Nottingham, 1 February 1990.
'Spelling theorems and Cohen-Lyndon theorems in one-relator products of groups'.
Contributed lecture, 43rd BMC, University of Bath, 25-27 March 1990, 'Unique subwords and a theorem of Weinbaum's'.

Dr D B Duncan

Seminar, Dundee University, 6 November 1990, 'Jacobi iteration in implicit difference schemes for the wave equation'.
Contributed lecture, British Applied Mathematics Colloquium, Oxford, April 1991, 'On the motion of a mass on a non-linear elastic string'.
Contributed lecture, Parallel Numerical Analysis Workshop, Edinburgh University, June 1991, 'Optimal parallel finite difference algorithms'.
Contributed lecture, Dundee Numerical Analysis Conference, Dundee, June 1991, 'Optimal parallel finite difference algorithms'.
Poster, Workshop on Nonlinear and Coherent Structures in Physics and Biology, Dijon, France, June 1991, 'Symplectic solvers for lattice equations'.

Professor J C Eilbeck

Invited talk, LMS Meeting on Integrable Nonlinear Systems, London, 19 October 1990, 'Solitons in nonintegrable systems'.
Seminar, Newcastle University, 16 November 1990, 'Reaction-diffusion equations'.
Seminar, University of Leeds, 30 November 1990, 'Reaction-diffusion equations'.
Invited talk, NATO Advanced Research Workshop on Coherent and Emergent Phenomena in Biomolecular Systems, Tucson, Arizona, 16 January 1991, 'Energy storage and transport on model protein chains'.
Invited talk, Meeting on Nonlinear Systems, University of Glasgow, 13 March 1991, 'Numerical studies of solitons on lattices'.
Seminar, Universidad Complutense de Madrid, 16 April 1991, 'Numerical and analytic studies of reaction-diffusion equations'.
Invited talk, 7th Interdisciplinary Workshop on Nonlinear Coherent Structures in Physics and Biology, Dijon, France, 6 June 1991, 'Numerical studies of solitons on lattices'.
Contributed talk, Physiological Society Meeting, Cambridge, 19 July 1991, 'Effects of 4-aminopyridine on the responses to small decreases in light intensity in photoreceptors in the isolated retina of the drone honeybee', (with A M Vallet and J A Coles).
Contributed talk, Meeting of the Societe des Neurosciences: Neural nets and rhythms, Arcachon, France, 26-28 September 1991, 'Voltage-dependent channels in a non-spiking neuron', (with B Cardinaud, A M Vallet and J A Coles).

Dr H Feddersen

Contributed lecture, NATO Advanced Research Workshop on Coherent and Emergent Phenomena in Biomolecular Systems, University of Arizona, Tucson, 15-19 January 1991, 'Localization of vibrational energy in globular protein'.

Mrs M G Foster

Contributed lecture, 7th Interdisciplinary Workshop on Nonlinear Coherent Structures in Physics and Biology, Université de Bourgogne, Dijon, France, 4-6 June 1991, 'Solitary wave solutions to the discrete nonlinear Schrödinger equation'.

Dr N D Gilbert

Contributed joint lecture (with C E Beevers, G R McGuire and J H Renshaw, University of Southampton), CAL '91, Lancaster University, 8-14 April 1991, 'Some problems of mathematical CAL'.
Seminar, Heriot-Watt/Edinburgh Algebra Seminar, 9 November 1990, 'Universal central extensions in algebraic K-theory'.
Seminar, University of Sheffield, 28 November 1990, 'Algebraic models of 3-types from automorphism structures'.
Seminar, University of Glasgow, 23 January 1991, 'Dependence among the relations in a group presentation'.

Dr D A Johnston

Seminar, University of Newcastle, 24 October 1990, 'Crumpling random surfaces'.
Seminar, University of Glasgow, 8 March 1991, 'Random surface simulations'.
Seminar, University of Durham, 10 May 1991, 'Discrete and continuum string theory'.
Seminar, University of Colorado, Boulder, 10 September 1991, 'Random surfaces'.
Seminar, Fermi National Accelerator Laboratory, Batavia, Illinois, USA, 17 September 1991, 'Computer simulations of 2d gravity + matter'.
Seminar, University of Wisconsin, Madison, USA, 18 September 1991, 'Computer simulations of 2d gravity + matter'.

Dr J Howie

Invited lecture, Conference on Group Theory and Topology, State University of New York at Albany, 5-7 October 1990, 'The Kervaire problem: an algorithmic approach'.
Seminar, Yonsei University, Seoul, 15 October 1990, 'Fibonacci manifolds'.
Seminar, Seoul National University, 16 October 1990, 'Fibonacci manifolds'.
Seminar, Korea Institute of Technology, Daejeon, 17 October 1990, 'Fibonacci manifolds'.
Seminar, Pongyang Institute of Technology, 19 October 1990, 'Fibonacci manifolds'.
Seminar, Pusal National University, 20 October 1990, 'Pictures in group theory'.
Seminar, Cambridge University, 19 November 1990, 'One-relator products of groups'.
Contributed talk, British Mathematical Colloquium, University of Bath, 26-28 March 1991, 'Spelling theorems - and Cohen-Lyndon theorems for one-relator products'.

Dr J Howle
Invited lecture, Geometric Group Theory Symposium, University of Sussex, 14-19 July 1991, 'One-relator products'.

Professor R J Knops
Seminar, Heriot-Watt University, 5 February 1991, 'Behaviour of solutions of semi-linear elliptic equations on a half-strip'.
Invited lecture, 1st European Solid Mechanics Conference, Munich, 9-13 September 1991, 'Saint-Venant's principle for the elastic cylinder under nonlinear load'.

Dr A A Lacey
Seminar, Universidad Complutense de Madrid, 18 December 1990, 'Blow-up due to Ohmic heating'.
Seminar, Bristol University, 9 May 1991, 'Blow-up with oscillatory boundary conditions'.
Seminar, Exeter University, 10 May 1991, 'Blow-up with oscillatory boundary conditions'.

Dr G R McGuire
Contributed joint talk (with C E Beevers, M G Foster, and J Renshaw, University of Southampton), CAL '91, Lancaster University, 8-14 April 1991, 'Some problems of mathematical CAL'.
Invited talk at Conference on Computer Aided Learning in Mathematics, Brunel University, 26 June 1991, 'Marking in mathematical CAL'.

Professor O Penrose
Invited lecture, Ludwig-Boltzmann-Seminar on Time Evolution in Statistical Mechanics, Hohe Wand, Austria, 11-15 February 1991, 'Is there a "canonical" non-equilibrium ensemble?'.
Seminar, Heriot-Watt University, 27 February 1991, 'Poisson distribution in problems of quantum chaos (Signal 1990)'.
Contributed lecture, 6th One-day Conference on Statistical Mechanics and Phase Transitions, King's College, London, 23 May 1991, 'Quantum-mechanical sticky spheres'.
Invited lecture, SERC Conference on the Mathematics of Nonlinear Systems, Bath, 1-5 July 1991, 'Differential equation models for the kinetics of phase transitions'.

Dr H U Rahman
Seminar, Middle East Technical University, Ankara, 13 March 1991, 'Analytical formulae for n-dimensional Gaussian integrals'.

Dr V Šverák
Seminar, School of Mathematics, University of Minnesota, 5 December 1990, 'Regularity in nonlinear elasticity'.
Seminar, Carnegie-Mellon University, Pittsburgh, 27 November 1990, 'Regularity of deformations with finite energy'.
Seminar, Heriot-Watt University, 15 January 1991, 'The problem of three wells and the Monge-Ampère equation'.
Invited lecture, Conference on Calculus of Variations, Cortona, 30 May 1991, 'Quasiconvexity and the regularity for the Monge-Ampère equation'.
Seminar, University of Bonn, 6 June 1991, 'On regularity of the Monge-Ampère equation without convexity assumptions'.

Dr V Šverák
Invited lecture, Conference on Microstructure and Phase Transition, IMA, University of Minnesota, 15 November 1991, 'Microstructures and quasiconvex functions'.

Dr B Toth
Seminar, Heriot-Watt University, October-November 1990, 'Four seminars on "Gaussian domination, infrared bounds and reflection positivity"'.
Seminar, University of Nottingham, 20 February 1991, 'Bose-Einstein condensation: an application of large deviation theory'.
Seminar, Mathematical Institute of the Hungarian Academy of Sciences, Budapest, March 1991, 'Failure of Nagaoaka's theorem for more than one hole'.
Contributed lecture, 6th One-day Conference on Statistical Mechanics and Phase Transitions, King's College, London, 23 May 1991, 'On Nagaoaka's theorem about the Hubbard model'.
Seminar, Institute of Advanced Studies, Dublin, 16 August 1991, 'Failure of saturated ferromagnetism in the Hubbard model'.

Research and other grants reported during the year ended 30 September 1991

£15,000 from Science and Engineering Research Council, for the period 1 January 1992 - 21 December 1992, to support a Visiting Fellowship for Professor R D James, awarded to Professor J M Ball.

£11,250 from Science and Engineering Research Council, for the period 1 January 1992 - 31 December 1992, for investigation into mathematical problems in materials science, under the direction of Professor J M Ball.

£7,000 from CNR (Italy) for the period 14 January 1991 to 13 September 1991, for investigation in nonlinear elasticity, under the direction of Professor J M Ball, to support a Visiting Fellowship for Dr A Braides.

£2,000 from British Council for the period 31 March 1991 - 1 April 1992, for collaborative work with Dr Jan Ambjørn, Niels Bohr Institute, Copenhagen on random surfaces, under the direction of Dr D Johnston.

£1,920 from North Atlantic Treaty Organisation for the period 31 March 1991 - 1 April 1993, for collaborative work with Dr Clive Baillie, University of Colorado, on random surfaces, under the direction of Dr D Johnston.

£1,000 from Ferranti, for the period 1 October 1990 - 30 September 1991 for the CALM project, under the direction of Dr C E Beevers.

£1,000 from British Council, for the period March - August 1991, travel grant for visiting position in the Middle East Technical University, Ankara, awarded to Dr H U Rahman.

£800 from Royal Society to visit Dr Clive Baillie in September 1991 for collaborative work at University of Colorado, Boulder, on random surfaces awarded to Dr D Johnston.

£620 from London Mathematical Society, for Scottish Algebra Day, awarded to Professor K A Brown, Dr J Howie and Dr I H Leneghan.

£550 from Royal Society, to attend the Pressure Vessel and Piping Conference held in San Diego, California, USA, June 23 - 27, 1991, awarded to Mr J Bree.

£450 from Royal Society, for travel to ICIAM 91 conference in Washington DC, July 1991, awarded to Professor J M Ball.

£300 from British Council, towards expenses of attending the Ludwig Boltzmann Workshop in Austria (11-15 February 1991), awarded to Professor O Penrose.

\$500 from Fermilab (Fermi National Accelerator Lab, Batavia, Illinois, USA), to support two-week visit 9 - 21 September 1991, awarded to Dr D Johnston.

£250 from Edinburgh Mathematical Society, for visit of Professor P Lathiols, awarded to Dr J Howie.

£235 from Carnegie Trust, for the period April - June 1991, for collaborative research in Turkey on photoionization in semiconductors, awarded to Dr H U Rahman.

PUBLICATIONS - OCTOBER 1990 - SEPTEMBER 1991

J Ambjørn, A Bellini and D JOHNSTON
'Spiky higher genus strings.' *Modern Phys. Letters A*, 1991, 6, 2467-2474.

C Baillie and D JOHNSTON
'Crumpling dynamically triangulated random surfaces in two dimensions.' *Phys. Lett. B*, 1991, 258, 346-352.

J M BALL and J CARR
'The discrete coagulation-fragmentation equations: existence, uniqueness and density conservation.' *J. Statist. Phys.*, 1990, 61, 203-234.

J M BALL, P J Holmes, R D James, R L Pego and P J Swart
'On the dynamics of fine structure.' *J. Nonlinear Sci.*, 1991, 1, 17-90.

J M BALL and R D James
'A characterization of plane strain.' *Proc. Roy. Soc. London Ser. A*, 1991, 432, 93-99.

J Bebernes and A A LACEY
'Finite-time blowup for a particular parabolic system.' *SIAM J. Math. Anal.*, 1990, 21, 1415-1425.

C E BEEVERS, B S C Cherry, M G M FOSTER and G R MCGUIRE
'Software Tools for Computer Aided Learning in Mathematics.' Avebury Technical, Aldershot, Brookfield USA, Hong Kong, Singapore, Sydney, April 1991, 206pp.

J Bell, A Friedman and A A LACEY
'On solutions to a quasi-linear diffusion problem from the study of soft tissue.' *SIAM J. Appl. Math.*, 1991, 51, 484-493.

M van den BERG
'Heat equation on a hemisphere.' *Proc. Roy. Soc. Edinburgh Sect. A*, 1991, 118, 5-12.

M van den BERG and B TOTH
'Exponential estimates for the Wiener sausage.' *Probab. Th. Rel. Fields*, 1991, 88, 249-259.

A BRAIDES
'Correctors for the homogenization of almost periodic operators', *Asymptotic Anal.*, 1991.

A BRAIDES and P D'Ancona
'Perimeter on fractal sets', *Manuscripta Math.*, 1991.

K J BROWN and P Hess
'Positive periodic solutions of predator-prey reaction-diffusion systems.' *Nonlinear Anal.*, 1991, 16, 1147-1158.

K J BROWN and R Shivaaji
'Instability of nonnegative solutions for a class of semipositve problems.' *Proc. Amer. Math. Soc.*, 1991, 112, 121-124.

K J BROWN and A Tertikas
'On the bifurcation of radially symmetric steady-state solutions arising in population genetics.' *SIAM J. Math. Anal.*, 1991, 22, 400-413.

- J CARR and R L Pego
'Invariant manifolds for metastable patterns in $u_t = \epsilon^2 u_{xx} - f(u)$.'
Proc. Roy. Soc. Edinburgh Sect. A, 1990, 116, 133-160.
- 'Self-similarity in a coarsening model in one dimension.' *IMA Preprint Series*, 1991, #79, 1-16.
- D E R CLARK and J Corney
'A feature recognition algorithm for multiply connected depressions and protrusions in $2\frac{1}{2}$ D objects.' *Proceedings of Symposium on Solid Modeling Foundations and CAD/CAM applications*, Austin, Texas, June 1991, 171-183.
- J A Coles, J C EILBECK, A C Scott and C Zeumer
'Graded amplification of small signals in honeybee drone photoreceptors—described by the Hodgkin-Huxley equations.' *J. Physiol.*, 1991, 435, 104P.
- G Dell'Antonio and V NESI
'A scalar inequality which bounds the effective conductivity of composites.' *Proc. Roy. Soc. London Ser. A*, 1990, 431, 519-530.
- A J DUNCAN and J HOWIE
'The nonorientable genus problem for one-relator products.' *Commun. Alg.*, 1991, 19, 2547-2556.
- D B DUNCAN
'A simple and effective self-adaptive moving mesh for enthalpy formulations of phase change problems.' *IMA J. Num. Anal.*, 1991, 11, 55-78.
- D B DUNCAN, J C EILBECK, C H WALSHAW and V E Zakharov
'Solitary waves on a strongly anisotropic KP lattice.' *Phys. Lett. A*, 1991, 158, 107-111.
- K DUNCAN
'The pseudo-spectral method applied to a problem in counter-current, gas-solid reactors.' *J. Appl. Math. Modelling*, 1991, 15, 209-215.
- M Edjvet and J HOWIE
'The solution of length four equations over groups.' *Trans. Amer. Math. Soc.*, 1991, 326, 345-369.
- J C EILBECK
'Introduction to the discrete self-trapping equation.' pp.473-483 In 'Davydov's Soliton Revisited', Eds. P L Christiansen and A C Scott, Plenum, New York, London, 1990, 531pp.
'Proof of a conjecture by Scott concerning energy levels in the quantum DST equation.' *Phys. Lett. A*, 1991, 155, 407-409.
- H FEDDERSEN
'Localization of vibrational energy in globular protein.' *Phys. Lett. A*, 1991, 154, 391-395.
- H FEDDERSEN, P L Christiansen and M Salerno
'Quantum chology in the discrete self-trapping equation in the presence of Arnold diffusion.' *Phys. Scripta*, 1991, 43, 353-355.
- H FEDDERSEN, L Cruzeiro-Hansson, R Fiesch, P L Christiansen, M Salerno and A C Scott
'Quantum and classical descriptions of chaos in the DST equation.' pp.505-510, In 'Davydov's Soliton Revisited', Eds. P L Christiansen and A C Scott, Plenum, New York, London, 1990, 531pp.
- R FLESCH M G Forest and A Sinha
'Numerical inverse spectral transform for the periodic Sine-Gordon equation: theta function solutions and their linearized stability.' *Phys. D*, 1991, 48, 169-231.
- P Fratzi, J L Lebowitz, O PENROSE and J Amar
'Scaling functions, self-similarity, and the morphology of phase-separating systems.' *Phys. Rev. B*, 1991, 44, 4794-4811.
- N D GILBERT
'Derivations, automorphisms and crossed modules.' *Comm. Algebra*, 1990, 18, 2703-2734.
- D C HEGGIE and W L SWEATMAN
'Three body scattering near triple collision or expansion.' *Mon. Not. R. Astr. Soc.*, 1991, 250, 555-575.
- R N HILLS and P H Roberts (with an appendix by A M Soward)
'On the life cycle of a mush.' *SAACH*, 1991, 1, 1-26.
- J HOWIE
'The quotient of a free product of groups by a single high-powered relator. III. The work problem.' *Proc. London Math. Soc.* (3), 1991, 62, 590-606.
'Nonsingular systems of two length three equations over a group.' *Math. Proc. Cambridge Philos. Soc.*, 1991, 110, 11-24.
- D JOHNSTON
'Spiky projective planes.' *Phys. Lett. B*, 1991, 257, 51-54.
- J R King, A A LACEY, C P Please and P Hilmolt
'Formation of oscillation marks on continuously cast steel'. pp.267-270, In *Proceedings of the Fifth European Conference on Mathematics in Industry*. Ed. M Hellio, Kluwer, Dordrecht, 1991, 400pp.
- R J KNOPS
'A Phragmén-Lindelöf theorem for the free elastic cylinder.' *Rend. Mat.* (7), 1990, 10, 601-622.
'Spatial decay estimates in the vibrating elastic beam.' *Proceedings of V International Meeting 'Waves and Stability in Continuous Media'*. Sorrento, October 1989, 192-203.
'On isolated point singularities in classical elasticity.' pp.286-295 In 'Advances in Continuum Mechanics'. Anniversary volume in honour of Professor Horst Lippmann's 60th birthday. Eds. O Brüller, V Manni and J Najjar, Springer-Verlag, Heidelberg, 1991, 497pp.
- R J KNOPS, S Rionero and R Russo
'Stability and related results in linear elastodynamics on unbounded regions.' *Arch. Rational Mech. Anal.*, 1991, 115, 179-200.
- J Milota, J Nečas, V ŠVERÁK
'On weak solutions to a viscoelasticity model.' *Comment. Math. Univ. Carolin.*, 1990, 31 (3), 557-565.
- A Moroz, V ŠVERÁK
'Angular momenta in a planar field theory.' *Modern Phys. Lett. A*, 1991, 6(2), 137-143.
- V NESI
'Multiphase interchange inequalities.' *J. Math. Phys.*, 1991, 32(8), 2263-2275.

- L E NICHOLAS
 'The solution of elementary ordinary differential equations by a first-order method.' *Teaching Mathematics and its Applications*, 1991, 10, 29-31.
- L E NICHOLAS et al
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