ICIAM 99
5 - 9
July
1999

Monday, 5 July, Morning Session
Overview

09.15 – 10.30 Opening Ceremony		
11.00 – 13.00 Mini-Symposia		
MSP-001	Rotary Flows	AT-1
MSP-002	Stochastic Models for Turbulent Diffusion and Environmental Pollution	DHT-S
MSP-011	Applications of Random Dynamical Systems (RDS) I	WRB-10
MSP-013	Nonlocal Elliptic-Parabolic Problems in Reaction-Diffusion Equations	WRB-4
MSP-019	New Developments in Partial Differential Equations, in the Calculus of Variations, in Simulation and Applications to Materials I	WRB-11
MSP-031	Fractals and Scaling in Industrial and Environmental Applications	AT-8
MSP-033	Analysis of Boundary Value Problems for PDEs I	MS-5
MSP-037	Integral Transforms, Spectral Representation, Boundary Value Problems and the D-Bar Problem	MS-4
MSP-040	A-Posteriori Error Estimation and Adaptive Procedures in Finite Elements I	AT-5
MSP-057	Kinetic and Gas Dynamic Models for the Simulation of Semiconductor Devices and their Manufacturing Processes I	WRB-9
MSP-071	New Numerical Methods for Geometrical Optics	DHT-4.18
MSP-079	Wave Field Decomposition Methods in Direct and Inverse Scattering I	AT-2B
MSP-087	The Dynamics of Granular Materials: Physical Modeling and Mathematical Analysis I	WRB-2
MSP-090	Differential Algebraic Equations and Descriptor Systems	DHT-4.01
MSP-100	Detailed Mathematical Modeling of Reactive Flows	AT-3
MSP-103	Optimal Targeted Network Approximations of PDE Solutions I	AT-4
MSP-108	History Dependent Material Behavior: Constitutive Models and Mathematical Analysis	DHT-C
MSP-123	Nonlinear and Dynamical Signal Processing	DHT-3.01
MSP-125	The ECMI Special Interest Group on "Mathematics of Polymers" I	MS-1
MSP-150	New Challenges in Modeling Active Sensors/Actuators in Structures and Materials	AFB-10
MSP-168	Nonlinear Gravity-Capillary Free Surface Flows I	AT-2
MSP-187	Reduced-Order Modeling of Large-Scale Systems and Applications in Industry	MS-3
MSP-255	Dynamic Problems in Fracture	AFB-19
MSP-257	Evaluating Integral Functionals from CFD Calculations - Superconvergence, Error Analysis, Adaptation	DHT-B
MSP-260	Computational Electromagnetics I	DHT-N
MSP-264	Schlumberger Minisymposia Reviews I	WRB-8
MSP-270	Statistical and Deterministic Approaches to Large Scale Problems	WRB-1

Monday, 5 July, Morning Session
Details

09.15 – 10.30 Opening Ceremony

Opening Ceremony — McEwan Hall

ICIAM 99 will be opened by H.R.H. The Prince Philip, Duke of Edinburgh, K.G., K.T, who is a Joint Patron of the Congress.
The Committee for International Conferences on Industrial and Applied Mathematics have established four prizes to recognise outstanding achievments in applied mathematics and these will awarded also at the Opening Ceremony. The Lagrange prize will be awarded to individual mathematicians who have made an exceptional contribution to applied mathematics throughout their career. The Lothar Collatz prize will be awarded to an individual scientist under 42 years of age for outstanding work in industrial and applied mathematics. The SIAM Pioneer Prize will be awarded for pioneering work introducing applied mathematical methods and scientific computing techniques to an industrial problem area or new scientific field of applications. The Maxwell Prize which is funded by the IMA and the James Clerk Maxwell Foundation is to provide international recognition to a mathematician who has demonstrated originality in applied mathematics.
For security reasons, participants are asked to be in McEwan Hall by 9.15am.

11.00 – 13.00 Mini-Symposia

MSP-001 — Appleton Tower, Lecture Theatre 1
Rotary Flows

Organisers: CONLISK, A Terrence (Ohio State University, USA)
SMITH, Frank T (University College London, UK)

Flows generated by rotation of bodies occur in a wide variety of situations. The applications include turbomachinery, helicopters, mixers, natural rotors, and geophysical flows. Often small length scale phenomena are important to resolve in these problems so that a purely computational approach is not feasible. In addition, time scales can be fairly short so that a purely experimental approach is not adequate either. In this mini-symposium, we discuss problems such as boundary layers on rotating blades, the origin of the tip vortex on a rotating blade and the influence of boundary layers in a rapidly rotating fluid from an analytical and computational perspective. Complex flow phenomena which have been observed on helicopter blades and which can impede efficient design of the blades are also presented.

SMITH, Frank T (University College London, UK) *Rotary blade-wake flows* (p. 14)
PAGE, Michael A (Monash University, Australia) *Boundary-layer analysis for rapidly rotating flows* (p. 14)
CONLISK, A Terrence (Ohio State University, USA) *The rotor-tip vortex: Structure and interactions* (p. 14)
KOMERATH, Narayanan M (School of Aerospace Engineering, Georgia Institute of Technology, Atlanta, USA) *Measurement of vortices generated by rotary wings* (p. 14)

MSP-002 David Hume Tower, Faculty Room South

Stochastic Models for Turbulent Diffusion and Environmental Pollution

Organisers: CHATWIN, Philip C (Applied Mathematics, University of Sheffield, UK)
SULLIVAN, Paul J (Applied Mathematics, University of Western Ontario, Canada)

Turbulent diffusion is the controlling process for much environmental pollution, including that associated with many industrial accidents. But, strictly, it is still an unsolved mathematical problem. Abundant and recent high quality datasets increasingly emphasize the need for models that represent physical reality to be stochastic. The same is true for industrial risk assessment. In this minisymposium, different but complementary mathematical approaches to stochastic modelling will be discussed. A strong common theme will be how basic physics, which controls the probabilities through the basic advection-diffusion equation is incorporated. Another theme will be the comparison with data, requiring novel data-analysis.

NIELSEN, Morten (Risoe National Laboratory, Denmark) *Prediction of concentration fluctuations by combination of a Plume-Meander model and an empirical stochastic model for in-plume fluctuations* (p. 15)
BORGAS, Michael (CSIRO Atmospheric Research, Australia) *Lagrangian stochastic modelling of dispersion - from theory to practice* (p. 14)
YEE, Eugene (DRE Suffield, DND, Canada) *Probability theory as logic for representation of uncertainty in turbulent diffusion problems* (p. 15)
CHATWIN, Philip C (Applied Mathematics, University of Sheffield, UK) *Simple concepts underlying the structure of probabilistic models for concentration and dosage* (p. 15)
SULLIVAN, Paul J (Applied Mathematics, University of Western Ontario, Canada) *The PDF of scalar concentration* (p. 15)

MSP-011 William Robertson Building, Seminar Room 10

Applications of Random Dynamical Systems (RDS) I

(see also Part II, MSP-242, p. 36)

Organisers: NAMACHCHIVAYA, N Sri (University of Illinois, Urbana-Champaign, USA)
SOWERS, Richard (University of Illinois, Urbana-Champaign, USA)

During the past ten years there has been a great interest and real progress in stability theory of stochastic systems, stochastic bifurcation theory and large deviation theory. These progress in the theory has led to the development of reliable methods for computing characteristic quantities in random dynamical systems. The emphasis of the proposed Mini-Symposium will be on probabilistic MODELING of Systems, emerging APPLICATIONS of RDS in engineering and economics and NUMERICAL analysis of RDS. Nonlinear behavior, uncertainties, spatial and temporal randomness along with development of methods to analyze the complex interactions between noise, stability, and nonlinearities will be the focus of this Mini-Symposium. The proposed Mini-Symposium will bring together mathematicians, physicists, engineers and economists and emphasize the study of the foregoing problems and interaction between these groups.

BAXENDALE, Peter H (University of Southern California, USA) *Bifurcation theory for stochastic differential equations* (p. 22)
IMKELLER, Peter (Humboldt-Universität zu Berlin, Institut für Mathematik, Berlin, Germany) *Explicit description and global properties of Lyapunov exponents and rotation numbers of systems generated by two-dimensional stochastic differential equations* (p. 22)
WIHSTUTZ, Volker (University of North Carolina, Charlotte, USA) *Stability maps for systems with noise induced stability* (p. 23)
NAMACHCHIVAYA, N Sri (University of Illinois, Urbana-Champaign, USA) *Stochastic stability and bifurcation* (p. 22)

MSP-013 William Robertson Building, Seminar Room 4

Nonlocal Elliptic-Parabolic Problems in Reaction-Diffusion Equations

Organisers: CARRILLO, José A (University of Texas at Austin, Texas, USA)
LACEY, Andrew A (Heriot-Watt University, Edinburgh, UK)

In recent years many interesting problems arising in mathematical physics have been modelled by equations with nonlocal terms of integral type. Examples include the stationary distribution of charged or mass particles in statistical mechanics, temperature variation in electrical conduction, and thermo-viscous flow. The minisymposium will demonstrate the use of analytical tools such as comparison functions, imbedding theorems and variational principles to determine properties of solution and qualitative behaviour. It is aimed at applied analysts with interest in physical problems and also scientists who might meet such models in their work.

LACEY, Andrew A (Heriot-Watt University, UK) *Thermal runaway in nonlocal models of Ohmic heating* (p. 25)
CHIPOT, Michel (Universität Zürich, Institut für Mathematik, Zürich, Switzerland) *On the asymptotic behaviour of some nonlocal problems* (p. 24)
SOUPLET, Philippe (Département de Mathématiques, Université de Picardie, France) *Blowup behaviour in nonlocal versus local reaction-diffusion equations* (p. 25)
CARRILLO, José A (Department of Mathematics, University of Texas at Austin, Texas, USA) *Some results about nonlocal problems with decreasing nonlinearity of exponential type* (p. 24)

MSP-019 William Robertson Building, Seminar Room 11

New Developments in Partial Differential Equations, in the Calculus of Variations, in Simulation and Applications to Materials I

(see also Part II, MSP-020, p. 29; Part III, MSP-021, p. 47; Part IV, MSP-022, p. 64; Part V, MSP-023, p. 82; Part VI, MSP-024, p. 102)

Organisers: FONSECA, Irene (Center for Nonlinear Analysis, Carnegie Mellon University, Pittsburgh, USA)
KINDERLEHRER, David (Center for Nonlinear Analysis, Carnegie Mellon University, Pittsburgh, USA)

This minisymposium brings together scientists working in neighbouring disciplines within the areas of Mechanics, Analysis, and Scientific Computation. Recent advances in the study of materials with underlying mathematical problems at the forefront of traditional theories have motivated new developments in applied mathematics. The goal of this minisymposium is to disseminate current progress in the development of mathematical techniques and physical theory as these contribute to a better understanding of multiple scale structures and multiple scale systems. Topics include microstructure, thin structures, phase transformations, magnetic materials, conservation laws, materials design, and related questions.

TARTAR, Luc C (Carnegie Mellon University, Pittsburgh, USA) *The applications of H-measures and their variants to partial differential equations from continuum mechanics and physics* (p. 35)
MILTON, Graeme W (Department of Mathematics, University of Utah, USA) *Bounding the stress-strain relation of non-linear composites* (p. 34)
BOUCHITTE, Guy (University of Toulon, France) *Singular perturbations related to a potential degenerated at infinity: Applications to nucleation and free discontinuity problems* (p. 31)
LUCKHAUS, Stephan (Universitaet Leipzig, Germany) *Stefan problems as gradient flows for the entropy Stefan problems as gradient flows for the entropy* (p. 33)
PEDREGAL, Pablo (Universidad de Castilla-La Mancha, Spain) *Relaxation in magnetostriction* (p. 34)

MSP-031 Appleton Tower, Seminar Room 8

Fractals and Scaling in Industrial and Environmental Applications

Organisers: GOMATAM, Jagan (Glasgow Caledonian University, UK)
BORODICH, Feodor M (Glasgow Caledonian University, UK)

Many physical, industrial and environmental processes are naturally described as systems which obey the law of bounded dilation similarity. In recent years much attention has been paid to the development of new similarity methods which include fractal approaches, parametric-homogeneity, complex fractal exponents and other scaling and renormalization techniques. The minisymposium reflects the state of the art as well as provides an opportunity to discuss many new results in this field, in particular novel applications of the scaling and fractal methods to problems of fracture, failure predictions, development of probabilistic processes on fractal trees, and the calculation of the physical properties of heterogeneous composites.

GOMATAM, Jagan (Glasgow Caledonian University, UK) *Fractal morphology of deposits in heat exchangers and their physical properties* (p. 42)
LOUIS, Enrique (Universidad de Alicante, Spain) *Scaling laws in fracture* (p. 42)
BORODICH, Feodor M (Department of Mathematics, Glasgow Caledonian University, UK) *Self-similar models and size effect of multiple fracture* (p. 42)
ONISHCHENKO, Dmitry A (Institute for Problems in Mechanics, RAS, Moscow, Russia) *Strength of fractal trees and renormilization group method* (p. 43)
SORNETTE, Didier (IGPP, UCLA, USA and CNRS, LPMC, France) *Failure prediction in heterogeneous materials using complex fractal dimensions* (p. 43)

MSP-033 Management School, Lecture Theatre 5

Analysis of Boundary Value Problems for PDEs I

(see also Part II, MSP-034, p. 29; Part III, MSP-035, p. 47)

Organiser: KRUTITSKII, Pavel (Moscow State University, Russia)

Similar boundary value problems can be effectively used for mathematical modelling in different areas of natural sciences. The minisymposium gives a survey of a wide range of boundary value problems arising in applications and presents constructive methods for their analysis. These methods enable either to obtain a representation for a solution or to predict its properties and behaviour. The talks are concerned with nonclassical impulse evolutionary problems describing automatic systems in industry, elliptic problems in nonsmooth and cracked domains, aerodynamics problems, such as flow over wings, diffusion and diffraction problems. Constructive methods to be discussed at minisymposium include methods of functional analysis and qualitative theory for general problems, methods of local analysis, Neumann series, separation of variables in nonclassical problems, analysis of integral and pseudodifferential equations associated with boundary value problems in case of nonsmooth and complicated domains. Special emphasis will be given to the theory of singular integral equations and to construction of their approximate solutions.

TAIRA, Kazuaki (Institute of Mathematics, University of Tsukuba, Tsukuba, Japan) *Diffusions and boundary value problems* (p. 45)
MEDKOVA, Dagmar (Mathematical Institute, Academy of Sciences of the Czech Republic, Czech Republic) *Construction of the solution of the Dirichlet problem in nonsmooth domains* (p. 45)
HINDER, Rainer (Weierstrass-Institut fuer Angewandte Analysis und Stochastik im Forschungsverbund Berlin e.V., Germany) *Analysis and numerics of the conical diffraction problem* (p. 44)
TRENOGIN, Vladilen A (Moscow State Steel and Alloys Institute, Russia) *Generalized Lagrange formula and abstract boundary value problem* (p. 46)

MSP-037 Management School, Lecture Theatre 4

Integral Transforms, Spectral Representation, Boundary Value Problems and the D-Bar Problem

Organisers: FOKAS, Athanasios S (Department of Mathematics, Imperial College, UK)
PELLONI, Beatrice (Department of Mathematics, Imperial College, UK)

The "inverse scattering" or "inverse spectral method" is a nonlinear Fourier transform method, which can be used for the solution of initial value problems for integrable nonlinear PDE's. Recently, this method has been extended to the solution of boundary value problems in arbitrary domains. It is interesting that these results have motivated the discovery of a new transform method for solving linear PDE's in two variables. The new method can be used to solve problems with complicated boundary conditions and/or complicated domains. This development unifies and extends several branches of classical applied mathematics: the classical transform method for simple linear PDE's, the solution of linear PDE's by the Wiener-Hopf and other similar techniques, the treatment of integral nonlinear PDE's; furthermore it extends those results to arbitrary domains. Applications include fluid mechanics, acoustics and elasticity.

PELLONI, Beatrice (Imperial College, Mathematics Dept., London UK) *Linear and integrable nonlinear PDEs in arbitrary domains* (p. 48)
SUNG, Li-Yeng (University of South Carolina, USA) *Initial-boundary value problems for linear evolution equations on the half-line* (p. 48)
FOKAS, Athanasios S (Department of Mathematics, Imperial College, UK) *An integral transform method for the Laplace equation in an arbitrary polygon* (p. 48)

MSP-040 Appleton Tower, Lecture Theatre 5

A-Posteriori Error Estimation and Adaptive Procedures in Finite Elements I

(see also Part II, MSP-041, p. 29)

Organisers: BABUSKA, Ivo M (The University of Texas at Austin, USA)
STROUBOULIS, Theofanis (Texas A&M University, USA)

The quality of the computed data of interest is essential in the numerical treatment of PDE'S in engineering and scientific computations. The goal of the a-posteriori error estimations is to obtain accurate and close upper and lower estimates of the error in the computed data of interest. In the recent years, progress has been made especially in solving elliptic equations with applications in solid mechanics. The aim of the adaptive procedures is to obtain desired results in the range of prescribed accuracy in the cheapest way. Most present approaches have a heuristic character or at best are asymptotic. The talks will present the state-of-the-art in theory, computations and engineering applications.

AINSWORTH, Mark (Strathclyde University, Glasgow, UK) *A posteriori error estimation for singularly perturbed problems* (p. 48)
BABUSKA, Ivo M (Texas Institute for Computational and Applied Mathematics, University of Texas at Austin, USA) *Guaranteed A-posteriori upper and lower bounds for the exact error in the FEM and their iterative enhancement* (p. 48)
WOHLMUTH, Barbara (University Augsburg, Germany) *Local A posteriori error estimators for nonconforming discretization techniques* (p. 49)
STEIN, Erwin (Institute for Structural and Numerical Mechanics, University of Hannover, Germany) *Hierarchical finite-element- and model-adaptivity for composites* (p. 49)

MSP-057 William Robertson Building, Seminar Room 9

Kinetic and Gas Dynamic Models for the Simulation of Semiconductor Devices and their Manufacturing Processes I

(see also Part II, MSP-253, p. 36)

Organiser: RINGHOFER, Christian (Arizona State University, USA)

Kinetic models for semiconductor device and process simulation model charged particle flow via the Boltzmann equation (BE). While the BE gives a relatively accurate physical description, the large computational cost limits its use as a simulation tool. Therefore the BE is frequently replaced by gas dynamic models, derived from the BE through asymptotics and moment closures. This is the case for the simulation of electron flows in a given device as well as for the diffusion and deposition processes used in the manufacture of devices. This mini-symposium gives an overview over recent work on fluid models and their relation to the underlying kinetics from an analytical and numerical perspective.

GOBBERT, Matthias K (University of Maryland, Baltimore County, USA) *A homogenization technique for a kinetic model for chemical vapor deposition* (p. 62)
JÜNGEL, Ansgar (Fachbereich Mathematik, Technische Universität Berlin, Germany) *Mixed finite-element discretizations of fluid dynamical models for semiconductors* (p. 62)
KING, John R (University of Nottingham, UK) *Mathematical modelling of diffusion in compound semiconductors* (p. 62)
ROMANO, Vittorio (Politecnico di Bari, sede di Taranto, Italy) *Hyperbolic hydrodynamical model for charge transport in semiconductors* (p. 63)

MSP-071 David Hume Tower, Room 4.18
New Numerical Methods for Geometrical Optics

Organiser: BENAMOU, Jean-David (INRIA, France)

The numerical limitations of the classical ray tracing method are either linked to the existence of low density zones where very few rays enter or, on the contrary, to the apparition of multivalued traveltimes when rays are crossing near caustics. The mini-symposium will present recently proposed alternate algorithms. They are either based on a new resolution technique of the associated "kinetic" Liouville equation or on the direct discretization and resolution of the Eikonal equation with ad-hoc treatment of multivalued travel-times.

BRENIER, Yann (IUF and University Paris 6, France) *Moment methods for the Eikonal equation* (p. 74)
RUNBORG, Olof (NADA KTH, Sweden) *New results in multiphase geometrical optics* (p. 74)
ENGQUIST, Bjorn (UCLA, USA and NADA KTH, Sweden) *Application of level set techniques in geometrical optics* (p. 74)
BENAMOU, Jean-David (INRIA-Rocquencourt, France) *Direct computation of phase-space multivalued solutions of the Eikonal equation* (p. 74)

MSP-079 Appleton Tower, Room 2B
Wave Field Decomposition Methods in Direct and Inverse Scattering I
(see also Part II, MSP-080, p. 29; Part III, MSP-081, p. 50)

Organisers: KARLSSON, Anders (Department of Electromagnetic Theory, Lund Institute of Technology, Sweden)
FISHMAN, Louis (Naval Research Laboratory, USA)

This minisymposium addresses both direct and inverse scattering problems of applied and industrial interest in acoustics, electromagnetics, and elastodynamics. Wave field decomposition, which correctly captures the kinematics of a scattering experiment, provides the unifying theme for the one- and multi-dimensional spatial formulations in both the time and frequency domains which are considered. In conjunction with key ideas from invariant imbedding (reflection and transmission operators), Green's functions, wave propagators, Dirichlet-to-Neumann operators, pseudodifferential and Fourier integral operators, and path integrals, theoretical results, exact solution cases, and extensive numerical calculations for a variety of direct and inverse algorithms are developed.

KREIDER, Kevin L (University of Akron, USA) *Scattering problems for nonlinear viscoelastic rods via wave splitting* (p. 81)
JONSSON, B Lars G (Division of Electromagnetic Theory (TET), Royal Institute of Technology, Sweden) *Spectral decomposition of wave splitting in the presence of anisotropy* (p. 80)
STROM, Staffan E G (Department of Electromagnetic Theory, Royal Institute of Technology, Sweden) *Identification of current sources in a bounded domain for Maxwell's equations* (p. 82)
KARLSSON, Anders (Department of Electromagnetic Theory, Lund Institute of Technology, Sweden) *Wave splitting and wave propagators in spherical coordinates* (p. 80)

MSP-087 William Robertson Building, Seminar Room 2

The Dynamics of Granular Materials: Physical Modeling and Mathematical Analysis I

(see also Part II, MSP-088, p. 30)

Organisers: PITMAN, E Bruce (Dept of Mathematics, State University of New York, Buffalo, USA)
SHEARER, Michael (Dept of Mathematics, North Carolina State University, Raleigh, USA)

The physical properties of granular materials are understood only to a limited extent. Nonetheless, engineers have formulated constitutive models that purport to describe the behavior of such materials. Many models have been tested by experiment, and investigated both theoretically and with computer simulation. The field of granular materials is enjoying a period of intense activity among Physicists and Engineers, with increasing interest from Mathematicians. Recent developments to be addressed at the minisymposium include new theories of plasticity to model soils and rocks, discrete models to represent stress distributions in a granular material, numerical simulations of granular flow in hoppers, and two phase flow models for granular materials. This minisymposium brings together mathematicians, physicists and engineers, whose talks will address various aspects of the modeling, analysis, and computation of problems involving the deformation and flow of granular materials. These problems will typically be explored in the contexts of experimental results and industrial applications. The focus of the minisymposium is on the formulation of constitutive laws and models, and the mathematical properties of the resulting equations, including analysis and computation.

GREMAUD, Pierre (North Carolina State University, USA) *Numerical simulations of granular flows in hoppers* (p. 89)
SLEMROD, Marshall (Center for Mathematical Sciences, University of Wisconsin, Madison, USA) *Generalized rational approximation and Chapman Enskog expansion* (p. 90)
HAYES, Brian T (Stevens Institute of Technology, USA) *Response of a finite-depth saturated soil to a single-pulse disturbance* (p. 89)
SHEARER, Michael (North Carolina State University, USA) *Properties of granular materials* (p. 89)
OSINOV, V A (University of Karlsruhe, Germany) *Dynamic problems for granular media based on hypoplasticity* (p. 89)

MSP-090 David Hume Tower, Room 4.01

Differential Algebraic Equations and Descriptor Systems

Organisers: MEHRMANN, Volker (TU Chemnitz, Chemnitz, Germany)
KUNKEL, Peter (Univ. Oldenburg, Oldenburg, Germany)

Differential algebraic systems play currently an important role in the modelling, analysis, simulation and control in many applications such as mechanical multibody systems, electrical networks or chemical engineering. While there has been significant progress in this area in the last 25 years, there are still some widely open problems. These concern the analysis and numerical solution of heterogeneous systems like for example coupled systems of different types of partial differential equations, ordinary differential equations and algebraic constraints and also the treatment of over- and underdetermined systems as they arise in control. In this minisymposium some recent developments in the analysis and numerical solution of general differential algebraic systems are presented.

CAMPBELL, Stephen L (North Carolina State University, USA) *Numerical DAE integrators and control* (p. 91)
KUNKEL, Peter (Univ. Oldenburg, Oldenburg Germany) *Numerical solution of over and underdetermined differential algebraic equations* (p. 91)
STÖVER, Ronald (Zentrum für Technomathematik, Universität Bremen, Germany) *A new collocation method for solving linear differential-algebraic BVP* (p. 91)
SIMEON, Bernd (FB Mathematik, TU Darmstadt, Germany) *Weak descriptor forms for constrained motion in elastodynamics* (p. 91)

MSP-100 Appleton Tower, Lecture Theatre 3
Detailed Mathematical Modeling of Reactive Flows

Organisers: MASSOT, Marc (CNRS, Equipe d'Analyse Numérique, Université Lyon 1, France)
GIOVANGIGLI, Vincent (CMAP/CNRS, Ecole Polytechnique, France)

The purpose of this mini-symposium is to present recent developments on mathematical modeling of multicomponent reactive flows involving complex phenomena appearing in combustion processes. Typical of these flows are models describing detailed transport, complex chemistry, gas-surface interaction, developing instabilities. These fundamental studies have been made possible in the last few years by the increasing interaction of mathematics and physics of combustion, yielding results having an impact on both theory and applications.

GIOVANGIGLI, Vincent (CMAP/CNRS Ecole Polytechnique, France) *Plane laminar flames with detailed transport and complex chemistry* (p. 100)
VOLPERT, Vitaly (University Lyon 1, France) *Influence of natural convection on stability of reaction fronts* (p. 100)
MASSOT, Marc (CNRS, Equipe d'Analyse Numérique, Université Lyon 1, France) *Asymptotic stability of equilibrium states for multicomponent reactive flows with detailed transport and complex chemistry* (p. 100)
ERN, Alexandre (CERMICS, ENPC, France) *Detailed modelling of chemical vapor deposition* (p. 100)

MSP-103 Appleton Tower, Lecture Theatre 4
Optimal Targeted Network Approximations of PDE Solutions I
(see also Part II, MSP-104, p. 32)

Organisers: INGERMAN, David (Courant Institute of Mathematical Sciences, USA)
DRUSKIN, Vladimir (Schlumberger-Doll Research, USA)

Historically difference scheme approximation methods focused on global error minimization of solutions of PDEs. For many practical problems, though, the approximation is needed only at specified regions where the measurements are made. Important examples of such problems are approximations of Dirichlet-to-Neumann maps for inverse problems solving and modelling with application to non-destructive testing in geophysics and medical tomography. The focus on targeted error minimization rather then on global one greatly improves the approximations and leads to many intriguing problems in mathematics from combinatorics to linear algebra and homogenization.

DRUSKIN, Vladimir (Schlumberger-Doll Research, USA) *Gaussian spectral rules for three-point second differences and their application to numerical solution of PDEs* (p. 103)
MORROW, Jim (University of Washington, Seattle, USA) *Continuous and discrete Dirichlet-to-Neumann maps for a plane region* (p. 103)
VOGELIUS, Michael (Rutgers University, USA) *A homogenization result linking discrete networks to continuous conductors*
BORCEA, Liliana (Rice University, USA) *Matching pursuit for imaging high contrast conductive media* (p. 102)
ISAACSON, David (Math Dept. RPI, Troy, USA) *Problems in electrical impedance imaging* (p. 103)

MSP-108 David Hume Tower, Lecture Theatre C
History Dependent Material Behavior: Constitutive Models and Mathematical Analysis

Organiser: ALBER, Hans D (Darmstadt University of Technology, Germany)

To utilize the capacity of fast computers and of the finite element analysis in computing the deformation and stress distribution in metallic structures, constitutive equations are needed which model the properties of metals with sufficient accuracy. In mechanics and the engineering sciences, therefore, often rather complex constitutive equations have been developed in the past twenty years. The aims of this mini-symposium are to discuss the mathematical analysis of initial-boundary value problems containing such constitutive equations, and, from the engineering point of view, to discuss the identification of parameters in these constitutive equations.

RASCLE, Michel (Université de Nice, France) *Global L^2 solutions to dynamical elasto-plasticity* (p. 107)
SOFONEA, Mircea (Université de Perpignan, France) *Variational analysis of some contact problems for elastic-visco-plastic materials* (p. 107)
CHEŁMINSKI, Krzysztof (Darmstadt University of Technology, Germany) *On initial-boundary value problems in the theory of inelastic deformation of metals* (p. 106)
SEDLAN, Konstantin (Universitaet Gesamthochschule Kassel, Germany) *Nonlinear viscoelasticity of elastomers: Constitutive modelling and experimental identification* (p. 107)

MSP-123 David Hume Tower, Room 3.01
Nonlinear and Dynamical Signal Processing

Organisers: KADTKE, James B (Scripps Institute of Oceanography, San Diego, USA)
MCLAUGHLIN, Stephen (Dept of Electronics and Electrical Engin, University of Edinburgh, UK)

Because of several theoretical advances in the last two decades, and the accessibility now of great computational power, a variety of new methods have surfaced which attempt to recover and utilize nonlinear and/or dynamical information from data. In particular, a need generally now exists to develop these techniques in a more rigorous manner, which allows direct application to real-world problems, and includes approaches for optimal design, calculation of asymptotic performance measures, feature extraction, and the like. In this session, the speakers will present several such ideas in the areas of modeling, detection/classification, and inverse problems, and discuss various issues related to their application to real data.

MCLAUGHLIN, Stephen (Dept of Electronics and Electrical Eng, University of Edinburgh, UK) *Nonlinear dynamics in speech synthesis and characterisation* (p. 119)
ROBINSON, John W C (Natl. Defence Research Est., Sweden) *Information theoretic distance measures in stochastic resonance* (p. 120)
STARK, Jaroslav (University College London, UK) *A Takens Embedding Theorem for stochastic systems* (p. 120)
BROOMHEAD, David S (University of Manchester Institute of Science and Technology, UK) *Embedding, oversampling and the estimation of nonlinear channels* (p. 119)
PENTEK, Aron (Marine Physical Laboratory of the Scripps Institution of Oceanography University of California, USA) *Nonlinear classification of time series using dynamical models* (p. 120)

MSP-125 Management School, Lecture Theatre 1
The ECMI Special Interest Group on "Mathematics of Polymers" I
(see also Part II, MSP-126, p. 34)

Organiser: CAPASSO, Vincenzo (Dept of Mathematics, University of Milan, Italy)

Polymer industry raises a large amount of relevant mathematical problems with respect to the quality of manufactured polymer parts. These include in particular questions about: (i) production of the polymeric material from a monomer (based on the Ziegler-Natta catalytic process), (ii) crystallization kinetics of the polymer melt, (iii) the coupling of the crystallization process with the fluid dynamics of the manufacturing process like extrusion, injection moulding or film blowing, etc. In crystallization processes, the final morphology of the crystallized material is a fundamental factor in the physical properties of a solidified part. Also the long term behaviour of such properties (dimensional stability, physical ageing, ...) is strongly influenced by the microstructure of the crystallized material. This mini-symposium is aimed at a unified presentation of some mathematical problems which arise in connection with the above mentioned processes. The group of speakers participate in the ECMI initiative of establishing an interdisciplinary and transnational Special Interest Group on the subject. All centers linked to this SIG operate in close relationship with European Industries involved in the production and manufacturing of polymeric materials. We may like to stress that polymer industry has indeed a centre of excellence in Europe, so that we may and in fact we do really participate in supporting its high competitivity.

EDER, Gerhard (Institute of Chemistry, Linz University, Austria) *Morphological characteristics in the modelling of crystallization kinetics* (p. 122)
BURGER, Martin (Industrial Mathematics Institute, University of Linz, Austria) *Modelling multi-dimensional crystallization of polymers in interaction with heat transfer* (p. 121)
GRAMBERG, Heike J J (Eindhoven University of Technology, The Netherlands) *Instablities in industrial processes for polymer products.* (p. 122)
MANCINI, Alberto (Dip. di Matematica "F.Enriques", Milano, Italy) *Isobaric solidification processes of molten polymers* (p. 122)

MSP-150 Adam Ferguson Building, Room 10

New Challenges in Modeling Active Sensors/Actuators in Structures and Materials

Organisers: DELFOUR, Michel C (Centre de Recherches Matheématiques, Canada)
CAGNOL, John (Ecoles des Mines de Paris, France)

Devices such as piezoelectric patches or orientation of fibers inside a material are used to achieve sensing/control. They are found in various industrial applications ranging from pure actuators, to damping mechanisms or to shape the material as in the theory of formability.

BERNADOU, Michel (Pôle universitaire Léonard de Vinci and INRIA, France) *Some results on modelization and approximation of piezoelectric thin shells* (p. 141)
HANSEN, Scott (Iowa State University, USA) *Modeling and control of plates with localized piezoelectric patches* (p. 141)
HENROT, Antoine (Ecole des Mines and Institut Elie Cartan Nancy, France) *Optimization of the shape of the actuators in an internal control problem* (p. 141)
RAOULT, Annie (IMAG, France) *Relaxation results and applications to nonlinear shell models with directors* (p. 141)
RUSSELL, David (Virginia Tech, USA) *Issues in the formation of plates and shells by means of attached and embedded actuators* (p. 142)

MSP-168 Appleton Tower, Lecture Theatre 2

Nonlinear Gravity-Capillary Free Surface Flows I

(see also Part II, MSP-226, p. 35)

Organiser: VANDEN-BROECK, Jean-Marc (University of East Anglia, UK)

Time dependent and steady gravity-capillary nonlinear free surface flows have many intriguing properties. One of them is the importance played by exponentially small terms. We will describe recent advances in which effects such as non-newtonian properties of the fluids, highly nonlinear jets and ripples in the far field are included. Applications to the impact of sea waves against coastal structures, moving contact lines, the Saffman-Taylor problem, and the selection of physically relevant solutions will be discussed.

BEN AMAR, Martine (Laboratoire de Physique Statistique, Ecole Normale Superieure, France) *Finger-fracture behaviour of a shear-thinning fluid in a Hele-Shaw cell* (p. 156)
CHAPMAN, S Jonathan (Mathematical Institute, Oxford University, England) *Capillary waves in zero gravity ploughing flows* (p. 156)
COOKER, Mark J (University of East Anglia, UK) *Some theoretical and computational work on violent jet flows* (p. 156)
TUCK, Ernest O (The University of Adelaide, Australia) *A generalisation of the Benjamin-Ono equation* (p. 157)

MSP-187 Management School, Lecture Theatre 3

Reduced-Order Modeling of Large-Scale Systems and Applications in Industry

Organiser: FREUND, Roland W (Bell Laboratories, Lucent Technologies, Murray Hill, USA)

Many physical systems can be modeled as linear dynamical systems. Often, the state-space dimension of the system is so large that it becomes prohibitive to tackle the original dynamical system, and instead, in numerical simulations, suitable reduced-order models with significantly smaller state-space dimensions are used. The speakers in this mini-symposium will present recent advances in the area of reduced-order modeling for large-scale linear dynamical systems and discuss the use of reduced-order models in industrial applications, such as the simulation of VLSI circuits and communication systems. Special emphasis will be on reduced-order modeling techniques based on Krylov-subspace methods.

RUHE, Axel (Chalmers University of Technology, Göteborg, Sweden) *Rational Krylov algorithms for eigenvalue problems and model reduction* (p. 172)
FREUND, Roland W (Bell Laboratories, Lucent Technologies, Murray Hill, USA) *Passive reduced-order modeling for VLSI interconnect analysis* (p. 171)
PHILLIPS, Joel R (Cadence, San Jose, USA) *Model-extraction technology for RF communications systems analysis* (p. 171)
NUNNARI, Giuseppe (Universitá di Catania, Catania, Italy) *Reduced-order modeling by non-integer order equations* (p. 171)
BAI, Zhaojun (University of Kentucky, Lexington, USA) *Adaptive error estimation of reduced-order modeling of linear dynamical systems via Krylov-subspace techniques* (p. 171)

MSP-255 Adam Ferguson Building, Room 19
Dynamic Problems in Fracture

Organisers: MOVCHAN, Alexander B (Department of Mathematics, University of Liverpool, UK)
WILLIS, John R (DAMTP, University of Cambridge, UK)

The results presented will cover problems for cracks propagating in a three-dimensional elastic medium and diffraction problems. Presentations relating to propagating cracks will include discussion of the stability of a propagating crack, "crack front waves" and the development of crack front disorder. The diffraction problems presented at the mini-symposium will include analysis of waves propagating across an elastic diffraction grating composed of periodic cracks. The lectures will be of interest to both applied mathematicians and engineers.

ABRAHAMS, I David (University of Manchester, UK) *Scattering by a periodic array of cracks* (p. 217)
ORTIZ, Michael (California Institute of Technology, USA) *Application of cohesive theories to dynamic fracture and fragmentation* (p. 218)
CRASTER, Richard (Imperial College, London, UK) *Pulse scattering by subsurface cracks* (p. 217)
WILLIS, John R (Department of Applied Mathematics & Theoretical Physics, Cambridge University, UK) *Dynamic weight functions for a crack propagating in a viscoelastic medium* (p. 218)
MOVCHAN, Alexander B (University of Liverpool, UK) *Asymptotic models of dynamic cracks propagating on an interface* (p. 217)

MSP-257 David Hume Tower, Lecture Theatre B
Evaluating Integral Functionals from CFD Calculations - Superconvergence, Error Analysis, Adaptation

Organisers: GILES, Michael B (Oxford University Computing Laboratory, UK)
SÜLI, Endre (Oxford University Computing Laboratory, UK)

In many engineering and scientific applications involving the numerical solution of PDEs, there is particular interest in the accurate computation of integral functionals of the computed solution. Lift and drag in CFD applications are prime examples. The talks in this minisymposium address the issue of error analysis for such functionals, and how the accuracy can be improved through grid adaptation or other means.

MACHIELS, Luc (MIT, USA) *A posteriori finite element bounds for output functionals of the incompressible Navier-Stokes equations* (p. 219)
BRAACK, Malte (INRIA, France) *Application of weighted residual error estimates to adaptive mesh refinement* (p. 219)
SÜLI, Endre (Oxford University, UK) *A posteriori error estimation for stabilised finite element approximations of hyperbolic problems* (p. 219)
GILES, Michael B (Oxford University, UK) *Improved lift and drag estimates using adjoint Euler equations* (p. 219)

MSP-260 David Hume Tower, Faculty Room North
Computational Electromagnetics I
(see also Part II, MSP-261, p. 37)

Organisers: MORGAN, Kenneth (University of Wales, Swansea, UK)
MCCOWEN, Andy (University of Wales, Swansea, UK)

The objective is to consider the application of numerical methods to electromagnetic problems of interest to the aerospace industry. In this area, the analyst is frequently faced with problems which can be computationally very large and, for this reason, the feasibility of undertaking a simulation may be determined by the choice of the numerical method to be employed.

JONES, Christopher C R (British Aerospace, Military Aircraft and Aerostructures, UK) *To be announced*
PERIAUX, Jacques (Dassault Aviation, Paris, France) *Multicriteria RCS minimization of active reflectors using genetic algorithms and game theory*
MURPHY, John A (British Aerospace, Sowerby Research Centre, UK) *A review of computational electromagnetics in the aerospace sector* (p. 222)
PARROTT, Kevin (University of Greenwich, UK) *Applications of the adjoint method to high frequency electromagnetic computations* (p. 222)

MSP-264 William Robertson Building, Lecture Theatre 8
Schlumberger Minisymposia Reviews I
(see also Part II, MSP-265, p. 37)

Organisers: BURRIDGE, Robert (Schlumberger-Doll Research, USA)
COVENEY, Peter V (Department of Chemistry, Queen Mary & Westfield College, University of London, UK)

Those two Minisymposia on Finance and Biology are sponsored by Schlumberger Oilfield Services to further enrich our exposure to modern applications of mathematics.

HODGES, Stewart (Warwick Business School, University of Warwick, UK) *What's going on in financial derivatives?* (p. 224)
AUSTIN, Daren (Oxford University, UK) *Mathematical models of infectious disease: From populations to individuals* (p. 224)
COWAN, Jack D (Mathematics Department, University of Chicago, USA) *Neural networks* (p. 224)

MSP-270 William Robertson Building, Seminar Room 1
Statistical and Deterministic Approaches to Large Scale Problems

Organiser: BARTON, Noel G (CMIS, North Ryde)

Applied mathematicians usually approach industrial or scientific problems from a deterministic standpoint. This involves development of equations which model the system, solving the equations by appropriate methods, comparison of model with experiment, and finally use of the model for predictive purposes. On the other hand, model equations are only a representation of reality, and variability is a key feature in some systems. Variability can occur because of random events such as sampling, infection or mutation, or because parameters involved in deterministic systems are known imprecisely. The discussion session explores these complementary approaches to large-scale systems.

JOLIFFE, Ian T (University of Aberdeen, UK) *Statistical modelling in atmospheric and other environmental sciences* (p. 226)
SANDLAND, Ron (Chief, CSIRO Mathematical and Information Sciences) *Deterministic or stochastic? Choosing a modelling approach that works* (p. 227)
CLEARY, Paul W (CSIRO Mathematical and Information Sciences, Australia) *Deterministic and statistical models for industrial granular flows* (p. 226)
GLASBEY, Chris A (Biomathematics and Statistics Scotland, UK) *Deterministic and statistical approaches to image analysis* (p. 226)