24TH ANNUAL MEETING OF THE IRISH MATHEMATICAL SOCIETY
29–30 AUGUST 2011

The 24th Annual Scientific Meeting of the Irish Mathematical Society was held at the University of Limerick. The meeting was organised by the Department of Mathematics and Statistics at the University of Limerick, in cooperation with the Mathematics Applications Consortium for Science and Industry (MACSI). The organisers gratefully acknowledge financial support from the National Centre for Excellence in Mathematics and Science Teaching and Learning (NCE-MSTL), and the Departments of CSIS and Physics & Energy at UL. The meeting brought together researchers from a wide range of mathematical disciplines and across Ireland and the United Kingdom. Below we give the meeting timetable and abstracts of the talks. We also refer the reader to the meeting website `http://www.maths.ul.ie/IMS_ul_2011/`.

TIMETABLE

Monday 29 August

10:30–11:00	Registration; Tea & Coffee
	Chair : Alan Hegarty
11:00–11:10	**Kieran Hodnett**, *Dean of the Faculty of Science and Engineering, University of Limerick* Opening address
11:10–12:00	**Anne Brosnan**, *Project Maths Development Team* Project Maths Development Team: Supporting Good Practice
12:00–12:50	**Duncan Lawson**, *Coventry University* Who'd be a mathematician?
12:50–14:00	Lunch

	Chair : Bernd Kreussler
14:00–14:30	**David Conlon**, *University of Cambridge* Combinatorial theorems in sparse random sets
14:30–15:00	**Francesca Shearer**, *Queen's University Belfast* Electron detachment from negative ions in a short laser pulse
15:00–15:40	**Kevin McGerty**, *University of Oxford* Langlands duality and quantum groups at a root of unity
15:40–16:00	Tea & Coffee
	Chair : Gordon Lessells
16:00–16:50	**Philip Maini**, *University of Oxford* Modelling aspects of tumour growth
16:50–17:20	**Kevin Hutchinson**, *University College Dublin* The dilogarithm and SL_2
17:20–17:25	Presentation of the Fergus Gaines Cup
19:30	Dinner at the Castletroy Park Hotel

Tuesday 30 August

	Chair : Natalia Kopteva
9:20–10:10	**Martin Stynes**, *University College Cork* Convection-diffusion problems and their numerical solution
10:10–10:40	**Michel Destrade**, *National University of Ireland Galway* Acoustics of soft solids
10:40–11:00	Tea & Coffee
	Chair : Stephen Buckley
11:00–11:30	**Ailish Hannigan**, *University of Limerick* Modelling survival time: an application to data from Irish cancer patients
11:30–12:00	**Jean Charpin**, *University of Limerick* The MACSI summer school

12:00–13:00	IMS meeting
13:00–14:10	Lunch
14:10–15:00	Chair : Stephen Wills **John Appleby**, *Dublin City University* Preserving long-run properties when discretising stochastic and deterministic differential equations
15:00–15:45	**Richard Timoney**, *Trinity College Dublin* A brief survey on hypercyclicity
15:45	Tea & Coffee; Close

Abstracts

John Appleby, *Dublin City University*

Preserving long-run properties when discretising stochastic and deterministic differential equations

In this talk, we consider some highly schematised stochastic dynamical models of simulated annealing, bubble formation in financial markets and the propagation of fractures in metal. In each case we are lead to open mathematical problems in the asymptotic analysis of dynamical systems. In order that more realistic models of these phenomena can be developed, it is necessary to prove that the numerical methods applied will reproduce both qualitatively and quantitatively the appropriate asymptotic properties, namely pathwise stability, unbounded fluctuations and finite-time blow up of solutions. In order to minimise the computational cost, it should also be shown that, in some sense, no simpler numerical method will perform better than the method chosen. Each problem presents different challenges, requiring different numerical techniques, with the role of the simplified stochastic system being that of a test equation for the method.

Anne Brosnan, *Project Maths Development Team*

Project Maths Development Team: Supporting Good Practice

This presentation seeks to provide an understanding of the timeframe for Project Maths in the initial 24 schools and subsequent

National roll out for all other post primary schools. The presentation also seeks to provide an understanding of the work carried out by the Project Maths Development Team (PMDT). The influences that have informed and continue to inform this work are then reviewed. Arising from the work carried out by PMDT some key questions concerning Project Maths in general and the Continuing Professional Development being offered to teachers are then reviewed. The presentation concludes with a brief sketch of the integral teaching and learning resources developed by PMDT for teachers and a consideration of future work.

Jean Charpin, *University of Limerick*
The MACSI summer school
To encourage the study of mathematics in Ireland, the Mathematics Applications Consortium for Science and Industry (MACSI) organises a summer school once a year. The different aspects of this summer school are presented. Students are selected depending on their motivation, academic abilities, gender and geographical origins. Instruction and supervision is provided by academics, postdoctoral fellows and postgraduate students. The teaching programme evolves every year and reflects the interests of the people involved. Feedback from participants has been almost uniformly positive. Students favour interactive sessions and enjoy the residential aspect of the summer school. Food and accommodation are however the most costly aspects of this summer school. In this respect the support of Science Foundation Ireland has been invaluable.

Michel Destrade, *National University of Ireland Galway*
Acoustics of soft solids
Rubbers and biological soft tissues undergo large isochoric motions in service, and can thus be modelled as nonlinear, incompressible elastic solids. It is easy to enforce incompressibility in the finite (exact) theory of nonlinear elasticity, but not so simple in the weakly nonlinear formulation, where the stress is expanded in successive powers of the strain. In linear and second-order elasticity, incompressibility means that Poissons ratio is $1/2$. Here we show how third- and fourth-order elastic constants behave in the incompressible limit. For applications, we turn to the propagation of elastic waves in soft incompressible solids, a topic of crucial importance

in medical imaging (joint work with Ray Ogden, University of Aberdeen).

Ailish Hannigan, *University of Limerick*
Modelling survival time: an application to data from Irish cancer patients
Survival analysis describes the analysis of data that correspond to the time from a well-defined time origin until the occurrence of some particular event or endpoint. In medical research the time origin will often correspond to diagnosis with a particular disease and the endpoint is the death of the patient from that disease. Modelling survival data explores the relationship between the survival experience of the patient and explanatory variables such as age, sex, smoking history and treatment. This talk explores the issues involved in modelling survival data from cancer registry databases in particular the difficulty with inaccurate or missing death certificates. Relative survival models are introduced and applied to all women diagnosed with breast cancer in Ireland from 1994 to 2004 and followed up until the end of 2005.

Duncan Lawson, *Coventry University*
Who'd be a mathematician?
In England, mathematicians have something of an image problem. The general public does not have much understanding of what a mathematician is. The media tends to portray mathematicians as, at best, eccentric geniuses but often as anti-social loners. Research amongst school students has shown that their opinion of mathematicians is not very flattering either. Even amongst those who might be thought to have some commitment to mathematics, undergraduate students studying for degrees in the mathematical sciences, there are some quite negative opinions. The National Student Survey shows some quite disturbing results from mathematical sciences students, particularly in terms of their course giving them confidence and equipping them with broader skills. Furthermore, work amongst second year mathematics undergraduates at a range of universities has identified a range of perceptions of these students that may not be appreciated by academic staff including the worrying finding that over 20

Philip K. Maini, *University of Oxford*

Modelling aspects of tumour growth

The complex interaction of the multitude of physical and chemical processes that lead to tumour invasion is too difficult to understand by verbal reasoning along. As a result, the field of mathematical oncology is growing very fast. In this talk, mathematical models for tumour invasion, somatic evolution and tumour vasculature dynamics will be presented. They will consist of systems of partial differential equations, cellular automata and hybrid models. The results will be compared with experiment and therapeutic consequences will be explored.

Francesca Shearer, *Queen's University Belfast*

Electron detachment from negative ions in a short laser pulse

(joint work with M. C. Smyth and G. F. Gribakin)

We present an efficient and accurate method to study electron detachment from negative ions by a few-cycle linearly polarized laser pulse. The adiabatic saddle-point method of Gribakin and Kuchiev [Phys Rev A **55**, 3760 (1997)] is adapted to calculate the transition amplitude for a short laser pulse. Its application to a pulse with N optical cycles produces $2(N+1)$ saddle points in complex time, which form a characteristic "smile". Numerical calculations are performed for H^- in a 5-cycle pulse with frequency 0.0043 a.u. and intensities of 10^{10}, 5×10^{10}, and 10^{11} W/cm^2, and for various carrier-envelope phases. We determine the spectrum of the photoelectrons as a function of both energy and emission angle, as well as the angle-integrated energy spectra and total detachment probabilities. Our calculations show that the dominant contribution to the transition amplitude is given by 5-6 central saddle points which correspond to the strongest part of the pulse. We examine the dependence of the photoelectron angular distributions on the carrier-envelope phase, and show that measuring such distributions can provide a way of determining this phase.

Martin Stynes, *University College Cork*

Convection-diffusion problems and their numerical solution

Convection-diffusion problems arise in the modelling of many physical processes. Their typical solutions exhibit boundary and/or interior layers. As the associated differential operators are linear, one might not expect much difficulty is solving these problems numerically, yet they pose questions to the numerical analyst that are still unanswered after more than 30 years of research in this area. This talk will discuss the nature of solutions to convection-diffusion problems in one and two dimensions, the inadequacy of classical numerical methods in this context, and some leading numerical techniques (including SDFEM/SUPG and Shishkin meshes) in current use for these problems.

Richard M. Timoney, *Trinity College Dublin*

A brief survey on hypercyclicity

While the phenomenon of hypercyclicity (of linear operators on a topological vector space) was originally observed in the context of complex analysis by G. D. Birkhoff in 1929 and much later for operators on Hilbert spaces by S. Rolewicz (in 1969), it was generally regarded as a bizarre occurrence until later. Now there is a huge literature on related topics, too extensive to explain in a talk. Starting with the basic definitions and the early history, we will describe some of the ideas involved and concentrate on surveying some results which reveal that the hypercyclicity is a very common occurrence.