Number 96 April 2006

NEWSLETTER

OF THE

NEW ZEALAND MATHEMATICAL SOCIETY

Contents

PUBLISHER'S NOTICE

This newsletter is the official organ of the New Zealand Mathematical Society Inc. This issue was assembled by Rowan M^{c}Caffery and printed at Victoria University of Wellington. The official address of the Society is:

The New Zealand Mathematical Society,
c/- The Royal Society of New Zealand,
P.O. Box 598, Wellington, New Zealand.

However, correspondence should normally be sent to the Secretary:

Winston Sweatman
Institute of Information and Mathematical Sciences
Massey University
Private Bag 102 904
North Shore Mail Centre
Auckland
w.sweatman@massey.ac.nz

NZMS Council and Officers

Newsletter Correspondents

Web Sites

The homepage of the New Zealand Mathematical Society is:
http://www.math.waikato.ac.nz/NZMS/NZMS.html (Webmaster: stephenj@math.waikato.ac.nz)
The newsletter is available at: http://IFS.massey.ac.nz/mathnews/NZMSnews.shtml
Editorial enquiries and items for submission to this journal should be submitted as text or LaTeX files to mark.mcguinness@vuw.ac.nz.

ISSN 0110-0025

EDITORIAL

Hello, this is the first Newsletter under my Editorship, and any feedback is welcome!

Firstly my apologies for the lack of a Centrefold in this edition, please — Gentle Reader — put it down to my newness, and trust that there will be great Centrefolds to come.

I have just come back from a series of interviews of candidates for a position in Statistics here at Vic, and in Maths we are also presently short-listing for a Lectureship. The high quality of the candidates, and their youthful energy and enthusiasm, does give me renewed heart for the state of mathematics in the world. I have also just finished marking one hundred projects for second-year Calculus assessment, and here also is cause for celebration, at the number of students making great progress in vector calc concepts.

The ANZIAM conference in Mansfield in February, and the Maths in Industry Study Group (MISG) at Albany before it, also gave me confidence in the health of applied mathematics in this part of the world. So many young students attending and producing excellent talks at both events, Graeme Wake getting the ANZIAM Medal (see later), the Foundation for Research, Science and Technology providing funding for the MISG again, and the Honourable Steve Maharey addressing the MISG, were highlights that stand out in an excellent fortnight of mathematics. I'm looking forward to further and evolving NZ Study Group activities in the future.

Mark McGuinness
Victoria University of Wellington

PRESIDENT'S COLUMN

Well this is my first report as the new president of the NZMS. Thanks to Mick Roberts for doing such a great job over the last few years. Im not sure what this report is really supposed to be about perhaps an informed (?) opinion piece. Anyway, here is some opinion. I'd welcome suggestions (polite) and comments as to the issues facing members that we might discuss in future.

1. **PBRF**. At the time of writing one of the hot topics of discussion around our common room (and those I visit) is Performance Based Research Funding — not the assessment itself but the near universal problems academics are having dealing with the various systems each university has in place for entering data and the problems convincing librarians that research actually exists, together with the considerable amounts of time and energy academics are having to invest in it. I strongly support the ethos of PBRF if not the exact implementation — the grading of emerging researchers last time round was a travesty. Universities, with their commitment to research and research-based teaching, are considerably more expensive places than Polytechs (and similar institutions) to teach at and some mechanism should be built to address this difference. It may be a blunt instrument, but already it has made an impact on the way universities conduct their business and in particular the way they value their top researchers. The reported death of the RAE (the UK version of PBRF) was premature. It will continue in some guise or other for the foreseeable future, the first few rounds having sorted out universities and their staff to varying degrees, and forced them to clearly think about their commitment to research and their areas of strength and weakness. Presumably after a few of rounds of PBRF here some less onerous mechanism for identifying and promoting research excellence and commitment to research based teaching will be found (what are common sense metrics ?) and the process will settle down. Already the first round has had an impact on the level of recognition of the academic strength of some mathematics departments in the country — perhaps slightly offsetting the near universal decrease in enrollments around the country. Anyrate — time will tell.

2. **Marsden et al**. No doubt some of you will have received good or bad news from the Marsden fund round this year. As a member of the panel I can tell you that there were great proposals, promising interesting mathematics and fully worth funding, that didn't even make it into the second round. I know this is very disappointing for those who have invested considerable time, effort as well as emotional energy into their applications. Of course the simple fact is that there is not enough money invested by NZ in the research community. There are roughly 5 full proposals funded every year on a three yearly cycle, so about 15 grants in total. According to the last PBRF round there are more than 600 university based academics in the Mathematics and Information Sciences with a research component to their duties, nearly 200 were rated A or B (ignoring the many talented young researchers who got an R for their efforts because of the way the system was set up). This number does not include researchers in other disciplines with a significant mathematical content to their research and also apply to the MIS panel for funding nor those mathematical ly oriented scientists in CRIs and the like. The math is simple; I guess around 2% of researchers in MIS are funded. Further, less than 7% of A or B PBRF-rated staff are funded — and for the most part these are high quality active researchers.

It drives me crazy to think that as a nation we spend quite a bit less on R&D than the OECD average. Looking ahead, a number of countries (not NZ !) have set long-term targets for increasing R&D spending, with Austria aiming for 2.5% of GDP by 2006, Germany 3.0% by 2010, and the UK 2.5% by 2014. Canada has set a target of being among the top five investors in R&D among OECD countries. Total R&D spending in Sweden amounts to 4.3 percent of total output, more than any other country. Money spent on R&D is frequently taken as an indicator of efforts by countries to innovate and develop knowledge-based industries. Highest ranked after Sweden were Finland on 3.4 percent and Japan and Iceland on 3 percent, while the average among the OECD's 30 member nations was 2.3 percent. Apart from Japan, these high rankers are small somewhat isolated countries. Yet here we are in NZ, quite distant from major markets with all their problems and more, struggling to be average!

The council of the Royal Society of New Zealand is currently in the business of setting up a National Science Panel (NSP). It is hoped that this panel can provide some long term strategic planning in the science sector (something sorely lacking for decades) and at least get people talking about how we might move forward profitably. I dont think there's any Machiavellian subscript here but a genuine desire to see science and scientific research adequately funded, sustainable career pathways for new researchers and the outlining the wider benefits to NZ of science (in all its manifestations), as well as providing strategies for attaining these goals.

Despite the overall lack of funds and the low probability of success, it really is imperative that as many eligible people as possible apply for grants. There are current grant holders who didn't get through the first three of four times they tried — persistence and improving the application over time paid off. Be aware that the other sciences (including social sciences and humanities) know this only too well. Many of them have two or more applications in each round, which because of the funding mechanism increases the allocations to their discipline and the number of people funded. Further, even if you are not funded it is surely a valuable exercise to plan out some research project (it's almost half the battle sometimes). So lets flood the MIS panel with good applications next year !

The vitality of mathematics in New Zealand is measured in part by the quality of conferences and workshops that continue to be held here. The Conferences section of this Newsletter includes information on this year's Colloquium at the University of Waikato in December and next year's joint meeting between the NZMS and American Mathematical Society in Wellington. The organisers of the latter are inviting applications for Special Sessions and I encourage you to consider this opportunity to bring together a number of researchers in your field in New Zealand.

Finally some good news. Graeme Wake's win of the ANZIAM prize, awarded on the basis of research achievements, activities enhancing applied and industrial mathematics and Contributions to ANZIAM is well deserved. Graeme is the first NZ-based person to receive this award (first given in 1995). True international recognition is desperately difficult to obtain in NZ and this prize, together with Rod Downey's recent invitation to speak at the ICM in Spain in August are two such. So well done both of you!

Gaven Martin
Massey University, Auckland

LOCAL NEWS

THE UNIVERSITY OF AUCKLAND

Department of Computer Science

Rick Mugridge has resigned from the Department, to develop his software company. Rick will continue doing some teaching in our Department.
John Grundy and John Hosking (with others) applied to the TEC Growth and Innovation Pilot Initiative to fund programmes around the establishment of the Centre for Software Innovation. They have been awarded $854,000 of funding over 3 years, for activities around "building up a research culture in local industry".
Two of the recently instituted University of Auckland General Staff Excellence Awards for distinguished service have been awarded to members of the Science Faculty. The first award goes to our Computer Science team, led by Rob Burrowes. In the citation for the award, the committee stated, "The Computer service team under the leadership of Robert Burrowes has been awarded Excellence in Innovation for their outstanding track record in developing innovative solutions to complex service delivery problems that are then adopted University-wide as best-practice solutions. In addition, the team provides leadership in operational and strategic developments in IT across the University. Innovations introduced by the team are now used on a daily basis by almost all students and staff within the University".
University of Auckland Doctoral Scholarships from 2006 (now worth up to $25,000 pa for up to 36 months) have been offered to Yizhe Lin, Clemens Berndt, Santiago Franco Aixela, and Jonathan Teutenberg.

Seminars

Ewan Tempero , "Supporting software re-use by the individual programmer".

Nathan Holmberg , "A framework for interactive web-based visualization".

Hayden Melton , "Identifying refactoring opportunities by identifying dependency cycles".

Christof Lutteroth , "User interface layout with ordinal and linear constraints".

Anirban Majumdar , "Manufacturing opaque predicates in distributed systems for code obfuscation".

James Arvo & Kevin Novins , "Fluid sketching of directed graphs".

Kevin Moore , "LogTM: Log-Based Transactional Memory".

Robert M. Gray , "History of digital speech coding and its impact on the development of the Internet protocol", "Quantization, compression, and classification", and "Mentoring for engineering academia".

Clark Thomborson , "Trusted computing: open, closed, or both?".

Garry J. Tee

Department of Engineering Science

It is again twelve months since your tardy correspondent communicated. Not a great deal here has changed.

David Ryan is now into his second year as Deputy Dean of Engineering. Andy Philpott is back from leave during which Mike OSullivan was acting HOD in his place

Nic Smith will be resigning in June in order to take up a lectureship at the University of Oxford.

Your correspondent presented the GI Taylor Memorial Lecture at the Golden Jubilee Congress of the Indian Society of Theoretical and Applied Mechanics held at the Indian Institute of Technology Kharagpur just before Christmas. His title was "Modelling laminar flow in saturated porous media".

Edmund Crampin has been given an Early Career Research Excellence Award in support of his new research project on analysis of gene expression networks. The funding that comes with the award will support travel to visit his collaborators in the US (Indiana) and the UK (Oxford).

The School of Engineering now has an "Accelerated pathway" that allows students to proceed directly from school into the second year of a BE course. This year half a dozen students have entered our departments courses via this route.

Recent BE graduate Stuart Donovan's paper titled "Wind Farm Optimization" won the prize for the Best Applied Paper at the APORS conference in Manilla. Stu was selected by the ORSNZ to represent NZ in the APORS Young Scholars' Program at the conference. He presented the work he carried out last year as part of his final year undergraduate project. Stu is continuing to work on this problem for his ME.

Dr Grant Christie, a PhD graduate of the Department, has been made a Member of the New Zealand Order of Merit for services to Astronomy.

Don Nield

Department of Mathematics

Dr Tom ter Elst, formerly at Eindhoven University of Technology, is now a Lecturer in our Department. Paul Bonnington has been promoted to Associate Professor, and Sheena Parnell has been promoted over the Senior Tutor bar. Vivien Kirk will head the Applied Mathematics Unit for 2006 and 2007. Jiling Cao has been a PostDoctoral Fellow here, and now he has accepted an offer from Auckland University of Technology to become a research-path lecturer. That is a half-time teaching and half-time research position, an innovation for AUT.

Several conferences and workshops have been hosted by the Department over recent months:
On 2005 November 29 the Department held a day for mathematics teachers (organized by Hannah Bartholomew), which was attended by more than 50 secondary teachers from around Auckland.
The NZ Japan Knot Theory conference took place on 4-7 January in the Department, a Workshop on Geometric Methods in the Topology of 3-Dimensional Manifolds was held at Taipa on January 8-15, and a Workshop on Algebra and Set Theory in Geometry and Topology was held at Hahei on February 7-10. All three meetings were organized by David Gauld.
The Mathematics-In-Industry Study Group took place at Massey University, Albany, on January 30 - February 3, a part of which was organized by Steve Taylor.
A Workshop on Infinite Aspects of Topological Graph Theory took place in the Department on February 14-17, organized by Paul Bonnington and supported by CDMTCS.
The Third International Conference on Ethnomathematics was hosted by the Department, convened by Bill Barton on February 12-16, at Langham Hotel.
A Workshop on Non-Standard Techniques in Low-Dimensional Topology took place at Leigh on March 22-24 March, with invited speakers including Vaughan Jones, Patrick Dehornoy and Louis Kauffman.

Paul Bonnington is the lead bidder in a successful application to TEC to build digital science capability in New Zealand. This bid is led by the University of Auckland with two partner institutions, and Paul is working with Peter Hunter (Bioengineering Institute), John Hosking and Nevil Brownlee (Computer Science), Allen Rodrigo (Biological Sciences) and Tim Chaffe (ITSS). It is worth about $2 million in the first year. And Paul has been invited to be part of MFAT/REANNZ Delegation to Brussels, Washington, Chicago and Toronto, to meet EU and USA representatives for Advanced Networking. In the last ISAT round, research grants were awarded to: Bill Barton $5000, Vivien Kirk $3250, Arkadii Slinko $3000. Judy Paterson and Greg Oates were part of a successful bid for $75000 from the RSNZ to fund Jonathon Baxter, the Origami man, to work with mathematics teachers.

The Mathematics Colloquium 2005 was held at Massey University - Palmerston North, on December 5-7. Eamonn O'Brien was the NZMS Speaker, giving an address on "Algorithmic approaches to the study of linear groups", and Mike Thomas gave a Keynote Address to the Mathematics Education afternoon, on "Algebraic manipulations with the graphics calculator". Members of this Department gave the following Contributed Talks:
John Butcher, "Some examples of structure preservation",
Marston Conder, "Highly transitive imprimitivities",
David Gauld, "Games and metrisability of manifolds",
Allison Heard, "The approximate computational process for general linear methods",
Bart Oldeman, "Homoclinic and Hopf bifurcations in calcium and Fitzhugh-Nagumo models",
Boris Pavlov, "Analytic perturbation on the continuous spectrum",
Garry J. Tee, "Surface area and surface integrals over ellipsoid segments".
Elan Gin was awarded an Aitken Prize, for her lecture on "Calcium waves and buffers".

In October 2005 Marston Conder spent the last part of his Hood Fellowship visiting Vaughan Jones at Berkeley and the Institute for Advanced Studies at Princeton. Also (as reported in the last Newsletter) he took part in a meeting at BIRS (Banff) attended by representatives of various mathematical departments, institutes and societies, at which the Pacific Rim Mathematical Association (PRIMA) was established. Following his visit to the IAS, in joint work with Charles Leedham-Green and Eamonn O'Brien he discovered a family of 2-generator presentations for the alternating and symmetric groups with a bounded finite number of relations, thereby answering a long-standing question in combinatorial group theory. Since then he has hosted visits by Professors Roman Nedela (Slovak Academy of Sciences) and Ruth Kellerhals (University of Fribourg, Switzerland).

David Gauld attended the NZ Mathematics Col-

loquium at Palmerston North in December, and gave a talk on "Games and metrizability of manifolds". With Tsukasa Yashiro and Gaven Martin he organized the New Zealand-Japan Knot Theory Conference at UoA on 2006 January 3–7. With Vaughan Jones he organized the NZMRI summer workshop in Taipa on January 8-15. The theme of the workshop was "Geometric Methods in the Topology of 3-Dimensional Manifolds" and it was supported by funding as part of an NZIMA Programme of that title. From January 16–21 he attended "Manifolds at Melbourne", at the University of Melbourne.

In February Roger Fenn (visiting from Sussex), Stevie Budden (new PhD student), Richard Evans and David held a workshop on topological methods on low-dimensional manifolds at Hahei. From February 23 to March 10 he was in India, where he began his Marsden-funded research project with Professor Satya Deo, based in the Harish Chandra Research Institute at Allahabad, located right on the bank of the Ganga River. With Roger Fenn he organized a further workshop as part of the NZIMA Programme from March 22–24, at the UoA Marine Research Laboratory in Leigh.

In December 2005 Sina Greenwood visited Aisling McCluskey in Galway and Chris Good in Oxford, and she attended the 2nd Workshop on Coverings, Selections and Games in Topology, held at Lecce (Italy).

In December and January Philip Sharp visited UCLA and JPL, where he continued collaboration with Prof. Bill Newman and Dr. Kevin Grazier on the hotly-debated topic of whether the Solar System is chaotic over its lifetime. He then travelled to the University of Ottawa where he continued his collaboration with Prof. Remi Vallaincourt, then on to the University of Toronto where he gave a seminar in the Department of Computer Science. That trip was funded by the Department of Mathematics and the University of Auckland Research Committee.

Prof. John Conway (Princeton University) was here for January on a MacLaurin Fellowship awarded by the NZIMA, to work with Eamonn O'Brien. He gave a public lecture on "Tangles, bangles and knots", which was sponsored by our Department and by NZIMA. We expect John to be back again in 2007 and in 2008.

Recent visitors include Prof. Len Bos (University of Calgary), Dr Louise Parsons Chini and Dr Greg Chini (University of New Hampshire), Prof-Emeritus Ubiratan D'Ambrosio (University of Campinas), Prof. Maria do Carmo Domite (University of Sao Paulo), Dr Michael Eastwood (University of Adelaid), Dr Roger Fenn (Sussex University), Dr Thierry Hild (University of Fribourg), Prof. Paul Fong (University of Illinois - Chicago), Prof. Ruth Kellerhals (University of Fribourg), Prof. Peter Kuchment (Texas A&M University), Prof. Jari Kaipio (University of Kuopio), Prof. Colette Laborde (Grenoble University), Dr Kate Lee (Queensland University of Technology), Dr Roman Nedela (Slovak Academy of Sciences), Dr Konstantin Pankrashkin (Humboldt University of Berlin), Dr Malte Peter (University of Bremen), Prof. Bruce Richter (University of Waterloo) Prof. David Tall (Warwick University) and Dr Lennaert van Veen (LaTrobe University).

David Welch, who is about to complete his doctorate, has been offered a 3-year research fellowship at Imperial College London, working with David Balding on Approximate Bayesian Computation, with funding from the EPSRC. Our former student Stuart Laurence has recently been awarded his PhD from CalTech, for his thesis on hypersonic aerodynamics.

Elan Gin, Yu Wang, and Matthew Auger have been offered University of Auckland Doctoral Scholarships, and Elan Gin won a Top Achiever Doctoral Scholarship.

Anne Guan, Dror Speiser, and Peter Nelson won University of Auckland Masters / Honours Scholarships for 2006. Of the 9 students to have been awarded NZEST Scholarships, 2 were from the Mathematics Olympiad programme run by Arkadii Slinko and Ivan Reilly (Heather MacBeth and Eric Kang), and 4 were from the Max Programme Maths 153 run by Wendy Stratton and Ivan Reilly (Bojan Blazevic, Caroline Jiang, Joseph Nelson and Daniel Sardelic). Heather and Joseph are currently enrolled in Maths 250, while Bojan intends to do as much mathematics in this department as his engineering degree allows. Another Maths 153 student from 2005, John (Gyeong-sik) Choi, has won a full scholarship to Princeton.

Seminars

Prof. John Conway (Princeton University), "Integral lexicographic codes".

Prof. Ernie Kalnins (University of Waikato), "Superintegrability and polynomial algebras (An Introduction)".

Dr Thierry Hild (University of Fribourg), "Small volume cusped hyperbolic orbifolds".

Dr Malte Peter (University of Bremen), "Modelling and homogenization of chemical degradation mechanisms in porous media with evolving microstructure".

Prof. Ruth Kellerhals (University of Fribourg), "Polylogarithms and non-Euclidean volume", and "Some aspects of higher-dimensional geometry".

Dr Michael Eastwood (University of Adelaide), "Higher symmetries of the Laplacian".

Prof. Bernd Krauskopf (University of Bristol), "Compound laser modes of mutually delay-coupled lasers".

Dr Hinke Osinga (University of Bristol), "Global manifolds: computations & crochet".

Dr Konstantin Pankrashkin (Humboldt-University of Berlin), "Spectral duality between quantum and combinatorial graphs".

Prof. R. Bruce Richter (University of Waterloo), "The Jordan curve theorem revisited".

Dr. Helmut Podhaisky (Martin Luther University Halle-Wittenberg), "Programming, puzzles and games".

Matthew Auger , "Coxeter groups and hyperbolic 4-manifolds".

Dr Roger Fenn (University of Sussex), "Long (but not too long) knots".

Dr Richard Evans , "Self-bumping and how to avoid it".

Dr. Murali Agastya (University of Sydney), "The core of an n-person game".

Dr Tsukasa Yashiro , "Cell-complexes for surface diagrams".

Prof. Derek Robinson (ANU), "Evolution equations and elliptic operators".

Dr Sean Cleary (CUNY), "Thompson's group F and its remarkable Cayley graph".

Prof. David Gauld , "Exploring the group of homeomorphisms of non-metrizable manifolds".

Garry J. Tee

Department of Statistics

Marti Anderson and Rich Ford (with Jenny Webster) were funded with $85,000 from the VC's University Development Fund for a project entitled "Investigating the impact of multiple stressors on benthic communities". James Curran has obtained a 3-year $176,000 contract with the Forensic Science Service of the UK.

Russell Millar gave two invited talks at the American Fisheries Society 135th Annual Meeting in Anchorage, Alaska, namely "Reference priors for Bayesian fisheries models" and "Automatic calculation of the sensitivity of Bayesian fisheries models to informative priors". Russell starred again on TV1 on the subject of Lotto, at the time of an unusually large draw.

Matt Regan took our 2004/5 Teachers' Day workshop on tour in February (Palmerston North, Wellington, Dunedin) delivering all of the presentations himself. It was well received, and so we intend to repeat.

Alastair Scott has given invited week-long workshops on sampling to the Washington Statistical Society in DC, and a shorter version to Statistics New Zealand. While in Washington he also gave an invited talk in the Joint Program in Survey Methodology Distinguished Lecture Series.

Dr Ilze Ziedins has received the Dean's Awards for Teaching Excellence. In selecting Ilze, the panel noted the following:
"Ilze has inspired many students to develop a deep appreciation and love for the field of applied probability. Drawing on her extensive consulting experience with telecommunications and network companies, undergraduate students have been introduced to real-life examples in operations research. Behind her teaching is a philosophy, which facilitates and promotes a two-way dialogue with her students and encourages students to think critically about what they are doing and what they are being taught.

Her colleagues report that the most able students in the Statistics Department gravitate towards her as their project supervisor. Apart from her rapport with students they suggest that Ilze has a particular talent for "designing projects that stretch students to their maximum potential and that students are challenged from the outset to debate and criticize both their own and her ideas." Comments from her many past and present students such as: "I owe a great deal to her high yet achievable expectations and her ability to put me as a postgraduate student in a position where I could work at the cutting edge of our field", and "it is not the correct answer but the innovative thinking that is rewarded", attest to her ability to develop students' research capabilities.

Ilze has played a major curriculum leadership role in developing operations research courses in the Statistics Department. As a mentor she cares deeply about students under her tutelage and has inspired no fewer than seven of her project students to progress to PhD research at top international universities. Her joint publication work with pre-PhD students is unparalleled in the department.

Ilze radiates enthusiasm, a passion for teaching and research, has an infectious sense of humour and in the words of one student "her vast energy created a positive, joyful learning environment which helped me realize and unlock my potential. "Ilze is, without a doubt, a most distinguished teacher".

Our Annual Teachers day drew over 90 participants, despite prominently advertizing that we were recycling many elements from the last 2 years.

Babies have arrived for Renate Meyer (December 18), and for Mik Black. Mik is to leave the Department, and we are advertising for a successor.

We are gearing up for the joint Australian Statistical Conference/NZSA Conference in Auckland in July - the first time the ASC has been in New Zealand. The Conference Chair is David Scott. There will also be several satellite workshops.

Seminars

Richard Penny , "Statistics New Zealand and the official statistics system - data collection and access".

Karen Baker , "The Mathematics and Statistics Learning Centre at the University of Melbourne: its evolution, work and life".

Dr Michael Lauren , "Agents of chaos".

Dr David Johnson , "Teaching statistics with Microsoft Excel".

Dr Colin Fox , "A conjugate direction sampler for Gaussian random fields - or - my mega-huge Gaussian sampler".

Jochen Mundinger , "Reputation system modeling".

Dr Peter Clifford , "On-line inference from data streams", and "Exact likelihood calculation for a class of Cox processes".

Garry J. Tee

UNIVERSITY OF CANTERBURY

Department of Mathematics and Statistics

Jennifer Brown, Alex James and David Wall have been awarded a grant for an NZIMA programme on "Modelling Invasive Species and Weed Impact". The aim of the 3-year programme is to bring mathematicians and statisticians together with biologists to stimulate applied research that will benefit weed control and management. The programme will begin with a 5-day workshop in Hanmer Springs in April 2007.
The workshop will consist of introductory sessions by New Zealand weed managers outlining the current issues and problems in weed management in New Zealand, followed by sessions from invited international experts on the latest developments in relevant mathematical and statistical tools. In the follow-up sessions, workshop attendees will identify gaps between the knowledge that can be gained from the current mathematical models and the needs of New Zealand weed managers. The NZIMA programme goal is to bridge that gap by stimulating relevant research amongst New Zealand mathematicians and statisticians. The grant includes funding for a two-year postdoctoral fellow and two PhD studentships to be based in the department. More information on the programme may be found at http://www.math.canterbury.ac.nz/bio/NZIMA.

February was a busy month in the Biomathematics Research Centre, with many visitors and students from overseas passing through. The focus was the annual phylogenetics conference, held this year in Kaikoura, and organised by Mike Steel and Charles Semple with support from the Marsden Fund and Allan Wilson Centre. The week-long meeting brought together 50 mathematicians and biologists from 8 countries and was held at the University's Edward Percival marine field station. These meetings have become very popular, and this one was full nearly 5 months before the meeting. It was the 10th meeting in a series (which is held in various locations in February each year since 1996) and more information (including photos) can be found at http://www.math.canterbury.ac.nz/bio/kaikoura06.
Next year's meeting will be in Tongariro National Park and organised by Associate Professor Peter Lockhart from Massey. Visitors taking part in this phylogenetics programme included Professor Daniel Huson from Tübingen, who is visiting for 6 months as an Erskine Fellow, and Dr Katherine St John (City University of New York) who is visiting for two months with her husband Sean Cleary (a group theorist). Visiting students who were also part of this programme included three diplom students and one PhD student, all from Germany, and a PhD student from Harvard, some of whom were supported by Allan Wilson Centre summer studentships. The Allan Wilson Centre is also supporting some new postdocs, including Oliver Will (USA) who started in February, and Erick Matsen (USA) who starts in August, and Canterbury-based PhD students Klaas Hartmann and Mareike Fischer. Following the Kaikoura meeting a more informal follow-up workshop was held during a later week in February at the University's biology field

station at Cass.

Ben Martin attended the AMSI Workshop on Lie Theory, Lattices and Dynamics at the University of Newcastle, Australia in November 2005. The conference was in honour of Professor S. G. Dani from the Tata Institute for Fundamental Research, who was visiting Australia. Ben gave a plenary talk entitled "Representation growth and the congruence subgroup property". Early this year, Ben spent six weeks visiting Gerhard Roehrle at the University of Southampton, working on a project involving reductive algebraic groups. He gave talks at Imperial College London, the University of Kent, Royal Holloway College and Southampton. Alex James is currently visiting Satish Iyengar at the University of Pittsburgh. David Wall is visiting as the Jubilee Professor in the Applied Mechanics Department at Chalmers University of Technology, Gothenburg, Sweden. Rick Beatson has been appointed as acting head of department for 6 months while David is on study leave. Ben Martin, Alex James and Arno Berger have all been promoted to Senior Lecturer as of January 2006.

Arno Berger, Alex James, David Wall and Neil Watson attended the NZ Mathematics Colloquium at Massey University (Palmerston North) from 5-7 December 2005. Mike Plank presented a paper at the 12th International Conference on Biomedical Engineering in Singapore, 7-10 December 2005. In February 2006, Mike was a moderator for the problem presented by Ensis Ltd. on modelling tree growth at the Mathematics-in-Industry Study Group (Massey University, Albany) and gave a talk at ANZIAM in Mansfield, Victoria.
On 29 March there was an informal one-day meeting on group theory at Canterbury, with talks given by visitors Laura Ciobanu (Auckland), Sean Cleary (City University of New York) and John Holt (Massey, Albany).

A special issue of the Journal of Universal Computer Science entitled Constructivity, Computability, and Logic was edited by Cris Calude (Auckland) and Hajime Ishihara (JAIST, Ishikawa) in honour of Douglas Bridges 60th birthday. Happy birthday Douglas!

Six students were awarded studentships to work on research projects over the summer, and all enjoyed the experience very much. The students involved, and their topics, were as follows.
Maarten Jordens (supervisor Douglas Bridges): "A constructive analysis of the Vitali covering theorem".
Jason Bentley (supervisors Jennifer Brown, Hazel Chapman and Marco Reale): "Causal models in Nigerian Montane forest phenology".
Thi Phoung Tra Dinh (supervisor Arno Berger): "The dynamics of β-transformations".
Ryoko Ito (supervisors Alex James and Roger Dungan): "Modelling Honeydew Beetles".
James Roscoe (supervisor Dominic Lee): "Developing a hidden Markov model for assessing the health of premature babies".
Alethea Rea (supervisors Marco Reale and Carl Scarrott): "Spillover effects between Japan and the US".

Professor Domenico Piccolo has recently arrived from the Department of Statistical Sciences, University of Naples, Italy, on a 3-month Erskine Fellowship. Domenico will be giving some 300-level lectures on likelihood-based statistical inference. His area of research includes time series analysis with a special emphasis on ARIMA and ARFIMA modelling, decomposition methods and forecasting, with applications to economics, hydrology, demography and financial data. Between 1980 and 1990, he coordinated several projects that implemented a unifying approach to the seasonal adjustment procedures for public institutions in Italy. Recently, his research interests have moved towards ordinal modelling where he has introduced a new class of models useful for marketing, evaluation, and ranking.
David Borchers is a recently arrived visitor from the University of St Andrews in Scotland. David is head of the Research Unit for Wildlife Population Assessment, which specializes in the development and application of innovative statistical methods for wildlife assessment problems. He is working with Jennifer Brown over the next 6 months on wildlife assessment problems relevant to New Zealand wildlife conservation. His visit to Canterbury is partly sponsored by an NZIMA grant.
John Newell, a Lecturer in Statistics in the Department of Mathematics, National University of Ireland, Galway is visiting the department until June. John's main area of research involves applied statistics including multivariate survival analysis problems, computational inference, functional data analysis, and applications in medicine and sports science. He is the Consultant Statistician for the Sports Performance Unit at Glasgow Celtic Football Club.
Other recent and current visitors to the department include Emily Lane (UCLA), Ramona Schmid (Tübingen University), Simone Linz (University of Dusseldorf, Germany), Gene Myers (University of California, Berkeley), James Oxley (Louisiana State University), Geoff Whittle (Victoria University, Wellington), Stefan Grunewald (Max Planck Institute, Shanghai), Balchandra Thatte (Massey University) and Vincent Berry (University of Montpellier, France).

Josef Berger, who visited the department last

year, has recently arrived from the Mathematisches Institut of the University of Munich, Germany. He is taking up a Marsden-funded postdoctoral fellowship for research with Douglas Bridges on reverse constructive mathematics.
In February, Alan McInnes retired from the department. Irene Hudson left the department to take up a position as Head of Statistics in the Mathematics Department at the University of South Australia, Adelaide.
Simona Vîta is also leaving Canterbury after 7 years as a PhD student and then a postdoctoral fellow. She is taking up a position at the New Zealand Institute of Economic Research in Wellington as a Senior Economist. Fortunately, she and Douglas Bridges finished their book on techniques of constructive analysis before she took up her new post.

Seminars

Peter Clifford (University of Oxford), "Particle filtering".

Jon Pitchford (University of York), "If you can't beat 'em, eat 'em: mathematical models of mixotrophy".

Matthew Jackson (University of Pittsburgh), "A framework for translating elements of measure theory into sheaf theory".

Martin Bridgeman (Boston College), "Positive definiteness of Hausdorff dimension under bending deformations".

Jochen Garcke (Australian National University), "The sparse grid method ".

Daniel Huson (Tübingen University), "Phylogenetic networks".

Laura Ciobanu (University of Auckland), "Solving equations in groups".

Erick Matsen (Harvard University), "Optimization over tree shape statistics".

Mike Plank

MASSEY UNIVERSITY

Institute of Fundamental Sciences (Palmerston North)

We welcomed Christine Burr to the position of Senior Tutor in Mathematics in February. Christine, who is a trained secondary mathematics teacher, has accepted the position after many years marking extramural papers and teaching foundation level maths courses at Massey on a part-time basis while her family was growing up. We look forward to her strengthening our teaching in the service papers to science, business and applied science students.

The above position became vacant when Rob Krausz returned to Canada for personal reasons. It was a pity to see him go. His teaching was excellent and he was awarded an "IFS Distinguished Teaching Award 2005". We wish Rob and his family all the best for their future back in Canada.

Jonathan Marshall has returned from Scotland and has been appointed as a contract lecturer for this year. We are still trying to fill the vacancy left behind by the retirements of John Hudson and Gillian Thornley.

Matt Perlmutter spent December and January as an academic visitor to the Ecole Polytechnique Federale de Lausanne collaborating with Professor Tudor Ratiu and Dr. Miguel Rodriguez Olmos. The research concerns the problem of Poisson and symplectic stratifications of reduced cotangent bundles, and has been ongoing since Matt Perlmutter was a Postdoc at the Instituto Superior Tecnico in Lisbon from 2002–2004. This visit was very productive resulting in acceptance of two more papers on this work, and continued development of the theory. They now have a conjecture and a significant part of its proof for the most general solution to this problem. We are also developing simultaneously a singular connection theory. Matt spoke in the brand new EPFL/University of Geneva joint Symplectic geometry seminar. Cultural highlights included multiple visits to the Lausanne Music Conservatory, midnight mass in the old cathedral, and a museum/music/cafe binge in Geneva. All in all, the EPFL could write THE book on how to look after its visitors.

Congratulations to Brett Ryland, Philip Zhang and Dion ONeale who have all won travel grants from Education New Zealand. Dion and Philip will spend six weeks at the Chinese Academy of Sciences, Beijing, and Brett will spend six weeks at the Centre for Mathematics and Computer Science, Amsterdam.

Our congratulations to Charles Little who has met the requirements for a DSc which have just been approved by the DRC at its March meeting. Charles is currently in Campo Grande, Brazil. Till now Barbara and Charles have not had much opportunity for sightseeing but they managed to visit the Iguassu Falls in January. After Easter they intend to hire a car and drive to the Bonito area, which is about 250 kilometres southwest of Campo Grande. In July, during the break between semesters at her school, they will take 5 days off to see the Pantanal, a vast wetland a little further

to the west, near the border with Bolivia. And in October they have booked flights for a week in Argentina.

Robert McLachlan arranged a brief escape from his family and headed for Germany, first to TU Munich to the group of Jurgen Scheurle, and then to Oberwolfach. TU is building a whole new campus north of Munich, the maths building is huge and impressive and features a 3 storey parabolic slide (should have been a brachistochrone). The new German government is getting cracking and is selecting 4 'elite' universities, the whole process taking just a few months. Then on to the first ever geometric integration meeting at Oberwolfach which was just fabulous, so many old friends and an impressive generation of young people forging ahead. The set up is both stimulating and relaxing, great facilities, great company and of course frequent short walks in the black forest.

Vaughan Jones visited Palmerston North in the last week of March as the 2006 Sir Neil Waters distinguished lecturer. Although he was here for only 47 hours following his visit to the Albany Campus, he managed to give a research seminar, lead an informal "conversation" with the Allan Wilson Centre on his attempts (which ended a decade ago) to collaborate with biologists, and dazzle a public audience at the Boys High. In his public lecture, he recalled his days working in a brewery in Gisborne, his precarious road to Geneva and the superior beer of Europe, and oh yeah, some mathematics as well. Starting gently with the natural numbers and counting sheep, appropriate for any Manawatu audience, he worked his way to an introduction to the field of noncommutative geometry, finally crashing back down to earth with an application of Penrose tilings toward the design of better packed toilet paper. Along the way, he even sneaked in a slide containing the generators of his famous tower of nested algebras which led to the Jones polynomial. At one point, he had the high school kids cheering along with him in the proof that ij = -ji for the (non-commutative) algebra of quaternions. All in all, it was a smashing success and a lesson to anyone in delivering a public talk in mathematics. It is not often that a Fields medallist comes to Palmerston North, and the entire math community here was very pleased and stimulated by his visit for which we are all grateful to the Massey University Foundation.

Seminars

Professor Michael Baake (University of Bielefeld, Germany), Unequal crossover.

Graduate Seminars Series

Dion ONeale "Geometric integration for classical spin systems".

Luke Fullard "Geometric integration of the Kepler 2 – body problem".

Philip Zhang "Dynamics of generalised Euler equations".

Michael Woodhams (Allan Wilson Centre, Massey University), "Deletarious Mutations and the Changing Rate of Evolution".

Marijcke Vlieg-Hulstman

Institute of Information and Mathematical Sciences (Albany)

In December 05, several of us participated in the NZ Mathematics Colloquium. The following talks were given by members of IIMS:
Alona Ben-Tal, Simplified models for the lungs and the control of respiration.
Amanda Elvin, The role of gap junctions in a neural field model.
Mini Ghosh, Modelling and analysis of bovine tuberculosis in possums.
Sharleen Harper, Transport of individual droplets sprayed from a line or point source.
Carlo Laing, Equation-free modelling: some neural examples.
Heung Yeung Lam, The number of solutions of $a^2 + 2b^2 + 2c^2 + 4d^2 = n$ in integers.
Leng Leng Lim, Volcanic ashfall deposits from different source shapes.
Joanne Mann, A discrete mapping model for measles.
Robert McKibbin, Fluid flow in a flashing cyclone separator.
Ratneesh Suri, Optimal harvesting strategies: fisheries in stochastic settings.
Winston Sweatman, Interplay orbits in the few-body problem.
Graeme Wake, Animal fouling of pasture: a discrete stochastic dynamical system (DSDS).

Amanda Elvin took out the Aitken Prize for best student talk at the Colloquium, while Sharleen Harper received a commendation.

We celebrated the beginning of the New Year with a few promotions. Mick Roberts was promoted to Professor (in Mathematical Biology). Winston Sweatman was promoted to Senior Lecturer during last year.
Gaven Martin has agreed to take over the role

of Discipline Leader for Mathematics and Graeme Wake has been appointed Director of the Centre for Mathematics in Industry for three years. These two roles have been previously undertaken by our Head of Institute, Robert McKibbin.

In January we hosted MISG 2006. It was again very successful with 111 attendees from academia and industry and 7 problems to discuss. Graeme Wake did a great job at organizing the workshop and now he has follow-ups to coordinate. Next year MISG will be held at Wollongong. Graeme notes: "Hosting MISG, ANZIAM-style, for the last 3 years was a great privilege for us here in NZ. It has given us a nice profile to launch a series of individual industry-specific workshops in cooperation with FRST's TIF-expert scheme, starting from April. These will involve experts from all round ANZ. I am honoured to be invited to participate in the world-wide forum on MI initiatives to be held in Madrid, Spain as part of the European Conference on Mathematics-in-Industry in July of this year."

Immediately following the MISG, ANZIAM 2006 took place at Mansfield Victoria. The following members of IIMS gave talks at ANZIAM:
Carlo Laing, "The importance of different timings of excitatory and inhibitory pathways in neural field models".
Robert McKibbin, "Dispersal of eruption ejecta by elevation-dependent atmospheric flows".
Mick Roberts, "The evolution and transmission of virus".
Graeme Wake, "The ANZIAM Mathematics-in-Industry Study Group experience in Eastern Australasia".
Graeme Wake, "Conservative Reaction-Diffusion Equation Systems do not oscillate indefinitely".
Amanda Elvin, "The role of gap junctions in a neural field model".
Sharleen Harper, "Individual droplets in sprays — their transport and deposition".
Joanne Mann, "Spot the difference: two models for measles epidemics".

Graeme Wake has received the 2006 ANZIAM medal. The citation for the ANZIAM medal says "His work in any one alone of the research areas to which he has contributed would constitute a solid achievement; taken together, it is particularly impressive". Congratulations Graeme!
Amanda Elvin was highly commended for the Cherry Prize at ANZIAM.
Robert McKibbin took a 2-week period of leave in Kanazawa, Japan during early March. He was an Invited Speaker at two conferences:
— The 4th International Symposium of the Kanazawa University 21st-Century CoE Program, Promoting Environmental Research in Pan-Japan Sea Area, talking about "Particle transport in a layered atmosphere";
— The Second B-J-K Symposium on Biomechanics, with a talk on "Modelling pollen distribution by wind through a forest canopy" [B-J-K = Beijing University of Technology - JAIST - Kanazawa University].

Robert also spent one week at Kanazawa University, to continue some collaborative work on dispersion with Shigeo Kimura, Professor of Thermal Systems (Shigeo was an Invited Speaker at the ANZIAM meeting in Masterton in 1996). This was Robert's fifth trip to Japan. He first visited Professor Kimura at the Tohoku Industrial Research Institute in Sendai in 1992. Subsequently, Robert attended the World Geothermal Congress (held in Beppu and Morioka, Japan) in 2000. In 2003 he was an Invited Speaker at the 1st International Symposium of the Kanazawa CoE, while in 2004 he visited Kanazawa University for a period of interaction with Professor Kimura's research group involved with dispersion processes in forests.

PhD student Sharleen Harper also participated in the CoE Symposium as an Invited Speaker; her talk was on "Transport of individual droplets in crop spraying".

Mick Roberts arrived home in time for the IIMS Christmas party after spending two weeks in September working at Utrecht University and a term at Oxford as Christensen Fellow at St Catherines College, developing a model for the evolution and transmission of HIV. His work at Oxford was in collaboration with Angela McLean. While away he presented seminars at Utrecht, Oxford, Bath, Liverpool and Nottingham Universities. In March, Mick attended a Workshop on "Modelling of Emerging Infectious Diseases" at The National Centre for Immunisation Research (NCIRS), The Children's Hospital at Westmead, Sydney. He presented two invited papers, "How to model a virus that doesnt (yet) exist" and "The pluses and minuses of R_0"
Carlo spent the second half of February visiting the group of Yannis Kevrekidis at the Chemical Engineering Department in Princeton, learning more about their "equation-free" approach to studying complex systems. Several collaborative projects were started.
Alona Ben-Tal took a break from her holiday in Israel to give a seminar entitled "Simplified Models for the Lungs and the Control of Respiration" at the Department of Biomedical Engineering in the Technion Israel Institute of Technology. She managed to give the talk in Hebrew!

In March Vaughan Jones gave two talks at

Albany campus. A research seminar entitled: "Maximal abelian subalgebras of von Neumann algebras" and The Sir Neil Waters Distinguished Lecture entitled "Romancing the commutator, being the tale, from prehistory to the twenty-first century, of the stormy relationship between PQ and QP".

Congratulations to Leng Leng Lim who has successfully defended her PhD thesis and has satisfied all of the requirements for her PhD in Mathematics.

Welcome back to Nicoleen Cloete who has joined IIMS as a temporary lecturer and will be working on a research project with Mick Roberts.

Thanks to Joanne Mann who is coordinating the post grad seminars and related activities for the Institute.

Well done to Marie Fitch and Graeme Wake (Statistics and Math Modelling respectively) who have run workshops at the Auckland Mathematical Association day for teachers on Saturday 1st April.

Visitors

Dr Heng Huat Chan, who has been at IIMS for most of 2005 working with Shaun Cooper, has now returned to Singapore.

Dr Mark Harmer, who has spent the last year with IIMS working with Gaven Martin as a Postdoctoral Fellow in Mathematics, has left in late January to take up a research position in Canberra.

We had three summer students who worked with Gaven Martin and Tatiana Evans.

Ronald Begg, a FRST Top Achiever final-year PhD Scholar from the University of Canterbury will be visiting us until 31 May, working with Graeme.

Seminars

Dr Kevin Byard (Parnell College), "The Theory and Physical Applications of Binary Sequences".

Sasa Radomirovic (Norwegian University of Science and Technology, NTNU), "Cusp Forms over Function Fields and Modular Symbols.

Rowan Killip (UCLA), "CMV matrices and applications."

Weiwei Luo (PhD student in IIMS, resident in Alabama), "Critical initial conditions for thermal ignition"

Gary Walsh (University of Ottawa), "Linear Recurrence Sequences and their connections to Cryptography and Diophantine Analysis.

Jeff Hunter "Some problems related to Markov chains".

Beatrix Jones "Design of parentage analysis experiments: a case study for understanding uncertainty in models with latent (unobserved) variables."

Mick Roberts "Modelling the Evolution and Transmission of a Virus.

Alastair Wood (Dublin City University), "The influence of G.G. Stokes on the modern asymptotic theory of differential equations".

Alona Ben-Tal

UNIVERSITY OF OTAGO

Department of Mathematics and Statistics

Several staffing changes took place at the end of 2005. We are happy to have appointed Dr Austina Clark (formerly a Senior Teaching Fellow) as a Lecturer in Statistics. Ms Claire Cameron's and Mr Warren Palmer's positions changed from Senior Teaching Fellows to Teaching Fellow (half time) while also studying full-time towards PhDs. Warren also continues as Organising Tutor for the Dept. Mrs Stephanie McConnon left her Senior Teaching Fellow position in December. Stephanie's excellent teaching skills over many years will be missed by the Department. Dr Richard Martin's Fixed Term Statistics Lecturer position has been extended for another year.

An international symposium on fractional calculus was held January 9-13 at the University of Otago. The organizers were Boris Baeumer and Mark Meerschaert. A distinguished list of international speakers in mathematics and statistics, physics, chemistry and geology spent a week sharing information and results on the theory and practical applications of fractional derivatives. The meeting included a walk up Mt. Cargill and visit with yellow-eyed penguins on the Otago peninsula.

Fractional derivatives have been known since the time of Leibnitz, but are only recently finding practical applications in science and engineering. Now they are used to model anomalous diffusion, where clouds of particles spread at a different rate than the classical diffusion model predicts. Other applications include the dispersal of biological species, price changes in finance, and diffusion across cell

membranes. Talks at the conference included the functional analysis of interpolation spaces, pseudo-differential operators and semigroups, numerical schemes for fractional differential equations, and related stochastic models of random walks, jump processes, and heavy tailed probability tails.

John Harraway and Fred Lam gave a four day intensive workshop on Generalized Linear Models 13-16 February this year to the Ecology Research Group at Otago. Twenty five PhD students and staff attended. The workshop had eight one and a half hour instruction sessions with each followed by a one and a half hour hands on session where various data sets were analysed. Claire Cameron and Austina Clark helped with the hands on sessions.

John and Austina Clark spent part of December and January at Nanjing University in China. John was working with algebraist Ding Nanqing and his doctoral students on some problems in module theory and also gave lectures on some of his earlier research. Austina gave some lectures on statistical applications in ecology and, as a consequence of these, is currently collaborating with an ecologist there on the design and analysis of field experiments. Both Austina and John found their China experience richly rewarding.

Jonni Bidwell, Vivien Challis, Peter Fenton, Mihaly Kovacs, Dennis McCaughan and Mark Meerschaert were the Otago team at the Colloquium in Palmerston North, 5-7 December. Mark was the ANZIAM Invited Speaker, on the topic of Vector Fractional Calculus. Jonni gave a talk on Automorphisms of Direct Products of Groups, Mishi on Hille-Phillips Functional Calculus and Numerical Methods, and Dennis on Monotone Sequence Games. The Colloquium was very enjoyable and well run by Dean Halford and his Committee. The main business was of course after lunch on the Tuesday: the Manawatu Gorge tramp (more of a slide really, they did say stout shoes, waterproof, etc) was followed by the Dinner at the Rugby Institute, which was an event to remember, so much so that most of us can't recall any detail. It was in two halves and Mathematics was the winner on the day.

In January and February we had a visit from a young Dane, Troels Erikson, who was travelling under a Danish scholarship. Troels had gained a Masters in Mathematics and Chemistry and had taught mathematics for one year in a Danish secondary school. From September 2005 to August 2006 he was visiting San Diego, Dunedin, Auckland and Tokyo. In that period he was looking at local maths education and, where possible, taking courses to further his mathematical career. While he was in Dunedin he was taken to the Cathedral Caves in the Catlins where he had an encounter with a young seal. He also watched the Highlanders beat the Blues at 'The House of Pain'.

Seminars

Johan Grasman (Wageningen University), "Breakdown time of a chemostat exposed to stochastic noise"

Peter Clifford (University of Oxford), "Exact likelihood calculation for a class of Cox processes"

Peter Clifford (University of Oxford), "On-line inference from data streams"

Jon Pitchford (University of York), "Simple Stochastic Models for Fish & Fisheries"

Timothy Williams "The scattering of ice-coupled waves by a sea ice/ice shelf transition"

Janine Wright and Richard Barker "Incorporating genotype uncertainty into mark-recapture-type models "

Gareth Vaughan "The scattering of ice-coupled waves by an arbitrary ice sheet"

Matthew Schofield "A Unified Capture-Recapture Model"

Mihaly Kovacs "Fractional reaction-diffusion equation for species growth and dispersal"

David Gerrard (Dunedin School of Medicine), "Drugs in Sport Cheating and the Cheats"

Linda Hutchison (University of Wyoming), "Improving Middle-Level Mathematics Teaching and Learning: A Wyoming Statewide Initiative"

Melanie Bell (Department of Preventive and Social Medicine), "An Introduction and Overview of Mixed Models "

Peter Fenton "Estimating the size of a set"

Len Cook (Former National Statistician and Registrar General for England and Wales), "From scarfie to Her Majesty's Chief Statistician"

Lenette Grant

VICTORIA UNIVERSITY OF WELLINGTON

School of Mathematics, Statistics and Computing Sciences, *Te Kura Tatau*

The first team from Victoria University of Wellington to enter the Mathematical Contest in Modelling (MCM) is delighted to have achieved a grade that ranks them alongside teams from MIT and Harvard. The MCM is a unique annual international contest, in which University undergraduates try to solve real-world problems posted on the internet, in an intensive four-day team brainstorming session.
David Williamson, Martijn Jasperse, and Jonathan Stephenson, of the School of Mathematics, Statistics and Computer Science, were awarded a Meritorious grade for their efforts at designing an irrigation system, putting them in the top 20% of competing teams. They were mentored by Dr. Mark McGuinness and Prof. Matt Visser.
The contest was held from 3–7 February 2006, and the results have been published on the MCM website - http://www.comap.com/undergraduate/contests/mcm/. A total of 970 teams submitted reports, from USA, China, UK, South Korea, South Africa, Ireland, Finland, Canada, Hong Kong, Australia, Indonesia and New Zealand. The team from Victoria University (the only team from New Zealand) worked day and night considering how to configure and move a system of pipes to most evenly distribute water over a farmers field, without flooding it. In four days and nights, they combined their skills in mathematics, physics, computing, communicating and writing, culminating in the submission of a highly-ranked report.

Professor Matt Visser, together with other leading scientists and historians from around New Zealand, has published the new book *The Elegant Universe of Albert Einstein*. The book is based on the Radio New Zealand Year of Physics Lecture series of 2005 (sponsored by the Royal Society of New Zealand), and discusses the events leading up to — and following on from — the greatest revolution in modern science.
The book includes chapters by Tom Barnes, Paul Callaghan, Hamish Campbell, Lesley Hall, Richard Hall, Robert Hannah, John Stenhouse, and Matt Visser, with an introduction by Rebecca Priestley. Prof Visser's chapter, "A short history of the Universe", is based on his lecture entitled "Star birth and star death — the crucible of life". It is survey of the evolution and eventual death of our Universe.
See the book's website for details: http://www.awapress.com/products/published/books/sciencenature/ntuniverseofalberteinstein

A prestigious Vice Chancellor's Strategic Research Scholarship has been made available for an interdisciplinary project proposed by Matt Visser and Dennis Sullivan (Physics) for a student to pursue a PhD searching for extra-solar planets using gravitational microlensing.

Rob Goldblatt and Ed Mares (Philosophy) have started a new research project "Semantic analysis of substructural logics", supported by a grant of $465,000 from the Humanities panel of the Marsden Fund.

Mathematics PhD student Silke Weinfurtner has been awarded a "New Zealand Postgraduate Study Abroad Award" by Education New Zealand. The award of NZ$4200 will enable her to attend the Fourth International Summer School in Field Theory and Gravitation, to be held in Brazil later this year.
Silke is studying under the supervision of Matt Visser, on analogue models for gravity.
For more information about the Scholarship, visit: http://www.newzealandeducated.com/scholarships/page3.html
And for details of the Summer School, see: http://www.ufrrj.br/rioschool2006/paginas_ing/index.htm

The Statistics and Operations Research (STOR) Group have had some exciting developments on the staff front, with two new arrivals in the second half of 2005. Colleen Kelly started in August, and is our official "Consulting Statistician", giving statistical advice to graduate students and staff in other disciplines around the University. The rest of the University view Colleens arrival as something akin to a miracle, since there is now someone who (nearly always!) has time to see them and to sit and listen to their statistical problems. Mark Johnston started in late June, as a new lecturer in Operations Research. Mark came to VUW after 4 years at U. Essex teaching mathematics and computer science; he has a PhD in Operations Research from Massey University, on combinatorial optimization.

Dong Wang and Stefanka Chukova were promoted to the rank of Reader/Associate Professor at the start of 2006, while in May 2005, on her return from sabbatical, Megan Clark added the Deputy Head of School position to her already formidable list of administrative responsibilities; how's that for a homecoming present?! Stefanka Chukova took over from Shirley Pledger as STOR Programme Director on 1 July 2005, yet is still seen smiling on a regular basis despite the additional administrative tasks now required of her. Perhaps not surprisingly, Shirley is smiling quite a lot about the change too! As a consequence of the recommendations of the 2005 review, we have recently advertised a new per-

manent position with a focus on Applied Statistics, the latter interpreted in a quite broad sense.

2006 has started with an increase in numbers in just about all STOR courses and graduate students. Of STOR graduates nearing completion, Nuovella Williams went part time on her PhD from March 2004, and is about to submit. Nuovella was employed on a temporary contract as a Systems Analyst by the Caribbean Government Accounting Reform Project in Montserrat from March 2004 to Sept 2004, and has been employed full time as a Research Officer at the UK Office for National Statistics from Jan 2005 to the present. Steve Johnston is also making good progress with his PhD. In January Steve went to the 4th International Workshop on Statistical Seismology, held at Shonan Village, south of Tokyo, Japan. Steve presented a poster entitled "An accelerating moment release version of the stress release model". Others from MSCS who went to the same conference included David Vere-Jones, Ray Brownrigg and Junko Murakami. Junko is one of DVJs postdocs on the Hidden Markov Models program, which is coordinated by DVJ and supported by NZIMA. Johanna Prebble is very close to completing her MSc on the New Zealand Health Survey, and has recently started work at Statistics New Zealand. Johanna is the second of two successful Masters students (following Kylie Mason a year earlier) supervised by Richard Arnold, supported by awards from Public Health Intelligence in the Ministry of Health.

Various STOR staff have been travelling, including Stefanka Chukova and Dong Wang on separate overseas trips for a couple of months during the 2005/6 summer. Richard Arnold attended the 25th Workshop on Bayesian Inference and Maximum Entropy Methods in Science and Engineering in San Jose, in August. Richard presented a paper on the application of Bayesian statistics to seismology ("Earthquakes as signatures of the stress in the earths crust"). Estate Khmaladze also travelled extensively over the summer. In December Estate was a keynote lecturer at the EURANDOM Workshop "Economics and finance of extremes", and an invited speaker at the European Science Foundation Workshop on Model Specification in Santander, Spain. While in Europe, Estate also worked with Miguel Delgado (Madrid) and John Einmahl (Tilburg), before returning to EURANDOM to give a series of lectures on the differentiability of set-valued functions and their use in statistics. On the way back to New Zealand, Estate fitted in working visits to see Hira Koul (Michigan State) and Roger Koenker & Stephen Portnoy (Illinois).

In other news, Stefanka Chukova and Mark Johnston helped to organise the Operational Research Society of New Zealands 40th conference in December 2005 at VUW. One highlight was that Stefanka organised two Stochastic OR sessions, the first of which was chaired by John Haywood. As I told the slightly bemused audience, they were making history just by being there, since there had never been any sessions devoted just to stochastic OR in the previous 39 years! Tony Vignaux fittingly gave the leading talk in that first Stochastic OR session; fitting since Tony has done so much to champion OR in NZ, and Stochastic OR in particular - a fact acknowledged with thanks by many at the conference. Other members of MSCS who presented papers at the conference included Richard Arnold, Stefanka Chukova, John Haywood, Ivy Liu, and Dong Wang. After helping to organise the conference, Mark Johnston couldnt actually get to it since he was in England at the time, at a PlanSIG planning and scheduling workshop held at City University, London.

Seminars (From January 2006)

Willemijn Vermaat (U. Utrecht), "The Logic of Variation: A cross-linguistic account of wh-question formation"

Prof. Johannes Ruhland (Friedrich Schiller University), "Data Mining in Analytic Customer Relationship Management"

Prof Harry Perros (North Carolina State University), "The Optical Burst Switching Architecture"

Dr Pat Langhorne, "Under Ice, Over Winter"

Dr. J. Haywood (School of MSCS, VUW), "Goodness of fit testing problem for the exponential distribution"

Hu Jun, "Crystal bases and simple modules for the cyclotomic Hecke algebra of type G(r,p,n)"

Dr R. Brownrigg (MSCS, Victoria University), "On exponentiality of the reign lengths: Roman emperors, Chinese emperors and some European monarchies"

Prof. Harry Perros (Dept. Computer Science, North Carolina State University), "Service Sciences Management and Engineering (SSME)"

Prof Raimo Hamalainen (Helsinki University of Technology, Finland), "Decision Support Tools"

John Haywood

RESEARCH MEDAL FOR AUSTRALASIA AWARDED TO MASSEY PROFESSOR

At the annual ANZIAM (Australian and New Zealand Industrial and Applied Mathematics) conference held 5-9 February in Mansfield (Victoria, Australia), Graeme Wake, Professor of Industrial Mathematics at Massey University, was awarded the ANZIAM Medal for 2006.

The ANZIAM medal is awarded on the basis of research achievements, activities enhancing applied or industrial mathematics, or both, and contributions to ANZIAM.

This is the premier award that ANZIAM bestows and is usually awarded every two years. Professor Wake is the first NZ-based person to receive this award, which was initiated in 1995.

Figure 1: Professor Peter Taylor, President of ANZIAM (left) congratulates Professor Graeme Wake on being awarded the ANZIAM Medal for 2006. *Photographer: Mark McGuinness*

Citation

The 2006 ANZIAM Medal

The Selection Panel for the 2006 ANZIAM Medal proposes that the Medal be awarded to Professor Graeme Wake. We cite the following outstanding contributions by Professor Wake in terms of the selection criteria for the medal.

Graeme Wake's research career is very broad-ranging, both in areas of application and in its mathematical basis. He has published more than 175 papers, most in refereed international journals. His first paper in 1964 was entitled "Calorimetry of oxidation reactions" and his third in 1969 was entitled "Uniqueness theorem for a system of parabolic differential equations". This movement between applications and mathematical methods has been a constant theme of his research ever since. Thermal problems, especially involving chemical reactions and combustion, have continued as his major application of interest, and parabolic differential equations as a major mathematical method. However, there have been many other interests, especially lately in biological areas and dynamical systems.

Professor Wake's academic and professional merit has been recognised by awards, appointments, and elections to significant bodies. He was elected a Fellow of the Royal Society of New Zealand in 2004, and has been a Fellow of the NZ Mathematical Society since 1999 (and President of that Society twice, first in 1979-80) and of the IMA in the UK since 1977. He has supervised more than 22 completed PhD theses, and is Associate Editor of five international journals. His academic career has included Chairs at Massey University, University of Canterbury and University of Auckland, as well as visiting appointments in the UK and USA. He is a strong and competent academic leader, carrying the flag for Applied Mathematics with great vigour in NZ and internationally.

Professor Wake has made very substantial contributions to ANZIAM. He was elected to the Chair of the Division in 1995, serving two years as Chair, and two years as Deputy Chair. In fact Wake was the very first New Zealander to be so elected. He was universally recognised as having done an excellent job in his two years in the Chair, and in particular was able to manage the fact that most of the business of ANZIAM relates to Australia, while maintaining a uniquely NZ contribution. Even prior to his period as Chair, and indeed prior to its transformation (to which he contributed substantially) from a Division of the Australian Mathematical Society, he was an active supporter of ANZIAM, a regular attendee at its conferences, and an Associate Editor of its Journal. More recently, he has been Director of its Mathematics-in-Industry program, and again was been responsible for the first migration of the annual MISG meeting across the Tasman in 2004.

Graeme Wake has shown by his energy and achievement over a long career that he meets the criteria for this award. The Selection Panel recommends that Professor Graeme Wake be awarded the ANZIAM Medal for 2006.

30 January 2006

FEATURES

Amanda Elvin and Elan Gin, both from Massey University at Albany, were jointly awarded the Aitken Prize, for the best student talk at the NZ Mathematics Colloquium, held in December 2005. Here are extended abstracts of their talks.

The role of gap junctions in a neural field model — *Amanda Elvin*

Introduction

The brain consists of around 100 billion neurons, or brain cells, connected by an incredibly complex network. In certain situations, such as when we are remembering something, making a decision, or having an epileptic seizure, large groups of these neurons fire at the same time and form spatial patterns within the brain.

Communication between neurons is either through chemical synapses or directly through gap junctions, which allow electrical connections between cells. In areas of the brain where epileptic events are common, researchers have recently discovered there is a high incidence of gap junctions ([3]) and it is possible that these gap junctions are responsible for the abnormal waves that occur during an epileptic seizure.

Modelling gap junctions

Gap junctions cause a diffusive-type effect on neuronal voltage between surrounding cells since the electrical charge spreads and has the effect of causing the voltage of these cells to become similar. We mimic the effect of a high density of gap junctions by adding a term of the form $\partial^2 u/\partial x^2$ to a neural field model introduced by [1] and extended by [2]. Our model is

$$\frac{\partial u(x,t)}{\partial t} = \kappa^2 \frac{\partial^2 u}{\partial x^2} - u(x,t) + \int_{-\infty}^{+\infty} w(x-y) f(u(y,t))\, dy \tag{1}$$

where κ^2 determines the strength of the term modelling gap junctions. The partial integro-differential equation in (1) models a single line of neurons where $u(x,t)$ is the synaptic drive to a neural element in position $x \in (-\infty, \infty)$ at time $t \geq 0$.

Connections between neurons via chemical synapses are modelled using an oscillatory coupling function of

$$w(x) = e^{-b|x|}(b\sin(|x|) + \cos(x)) \tag{2}$$

where parameter b controls the rate at which the oscillations decay with distance ($b > 0$).

Neurons fire when their synaptic drive is greater than the threshold θ and at a rate defined by a smooth firing rate function with steepness parameter r

$$f(u) = 2e^{-r/(u-\theta)^2} H(u-\theta) \tag{3}$$

where $H(u)$ is the Heaviside function.

We define the region of excitation (or "bump") for a given distribution $u(x)$ as

$$R(u) = \{x | u(x) > \theta\}$$

and study the existence of N–bump stable steady states for which the region of excitation consists of N disjoint, finite, connected intervals. Steady states of (1) satisfy

$$u(x) = \kappa^2 \frac{\partial^2 u}{\partial x^2} + \int_{-\infty}^{+\infty} w(x-y) f(u(y))\, dy. \tag{4}$$

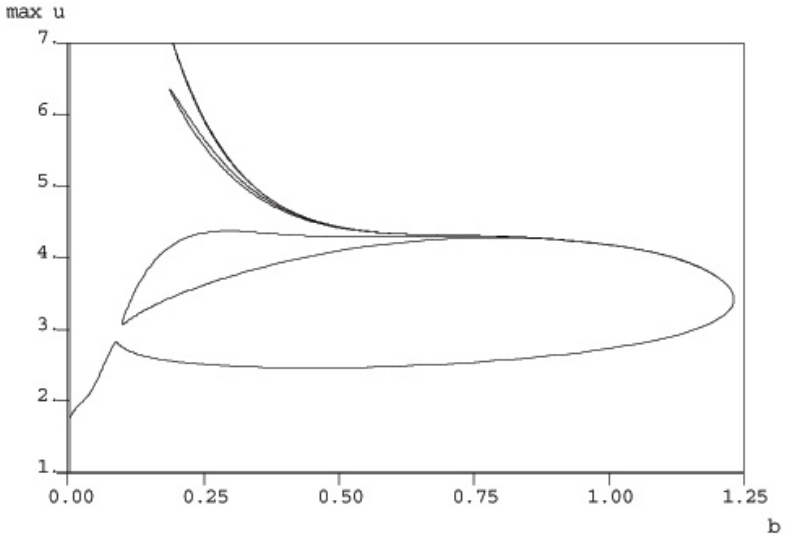


Figure 2: Bifurcation curve for spatially localised solutions of (1) with $\kappa^2 = 0$, $\theta = 1.5$ and $r = 0.095$.

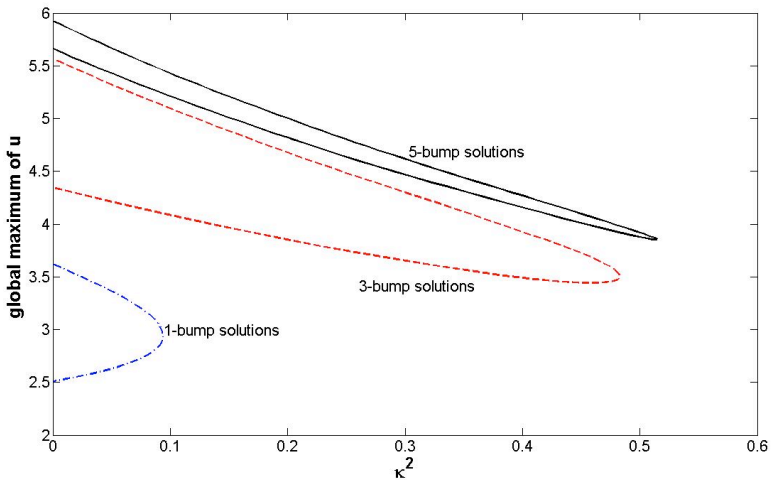


Figure 3: Bifurcation curves of gap junction model (5) for $b = 0.25$, $\theta = 1.5$ and $r = 0.095$ where κ^2 is the continuation parameter.

Laing *et al* [2] used Fourier transforms to convert (4) (without the term modelling gap junctions) to an ODE. We apply the same technique to (4) to derive a sixth-order ODE

$$-\kappa^2 u^{(vi)} + (1 + 2\kappa^2(b^2 - 1))u^{(iv)} - (2(b^2 - 1) + \kappa^2(b^2 + 1)^2)u'' + (b^2 + 1)^2 u = 4b(b^2 + 1)f(u) \tag{5}$$

where

$$\lim_{x \to \pm\infty} (u, u', u'', u''', u^{(iv)}, u^{(v)}) = (0, 0, 0, 0, 0, 0).$$

This limit is consistent with spatially localised patterns.

Setting $\kappa^2 = 0$, $\theta = 1.5$, $r = 0.095$, and continuing in b, the bifurcation curve of spatially localised solutions of (5) from [2] is obtained (Fig. 2) where it can be seen there are multiple solutions for smaller values of b.

By setting $b = 0.25$ and using κ^2 as the continuation parameter, the bifurcation curves in Fig. 3 are found. Numerically, saddle node bifurcations seem to destroy families of solutions as κ^2 increases.

Analytic solutions using a piecewise differential framework

To analytically find single bump steady state solutions of the model without gap junctions, we set $r = 0$ in (3) to obtain a step firing rate function of

$$f(u) = 2\,H(u-\theta) \tag{6}$$

and let $\kappa^2 = 0$ in (5) to obtain

$$u^{(iv)} - 2(b^2-1)u^{''} + (b^2+1)^2 u = 4b(b^2+1)f(u). \tag{7}$$

We decompose u into two functions, g and h, such that $g(x) > \theta$ and $h(x) < \theta$, and define x^* such that $g(x^*) = h(x^*) = \theta$. We therefore solve the nonhomogeneous equation

$$g^{(iv)} - 2(b^2-1)g^{''} + (b^2+1)^2 g = 8b(b^2+1)$$

on the interval $0 < x < x^*$ and the homogeneous equation

$$h^{(iv)} - 2(b^2-1)h^{''} + (b^2+1)^2 h = 0 \tag{8}$$

on the interval $x^* < x < \infty$.

The function g is of the form

$$g(x) = c_1 e^{bx}\cos(x) + c_2 e^{bx}\sin(x) + c_3 e^{-bx}\cos(x) + c_4 e^{-bx}\sin(x) + \frac{8b}{b^2+1} \tag{9}$$

and satisfies the following initial conditions

$$\begin{aligned} g(0) &= u(0) \\ g^{'}(0) &= 0 \\ g^{''}(0) &= u^{''}(0) \\ g^{'''}(0) &= 0. \end{aligned} \tag{10}$$

We can write c_1–c_4 in terms of $u(0)$ and $u^{''}(0)$. Given the boundary conditions of $h(x) \to 0$ as $x \to \pm\infty$ on (8), h must have the form

$$h(x) = a_1 e^{-bx}\cos(x) + a_2 e^{-bx}\sin(x)$$

and the matching conditions are

$$\begin{aligned} g(x^*) &= h(x^*) \\ g^{'}(x^*) &= h^{'}(x^*) \\ g^{''}(x^*) &= h^{''}(x^*) \\ g^{'''}(x^*) &= h^{'''}(x^*) \\ g(x^*) &= \theta. \end{aligned} \tag{11}$$

These five equations (11) implicitly define $u(0)$, $u^{''}(0)$, a_1, a_2 and x^* and can be solved numerically for given values of b and θ.

Using continuation in b, we find the bifurcation curve in Fig. 4. Numerically, we see that stable single bump solutions are found on the upper branch and unstable solutions on the lower branch. The upper branch does not extend beyond $b = 0.5$, however, which is unexpected and shows that using different firing rate functions gives very different results.

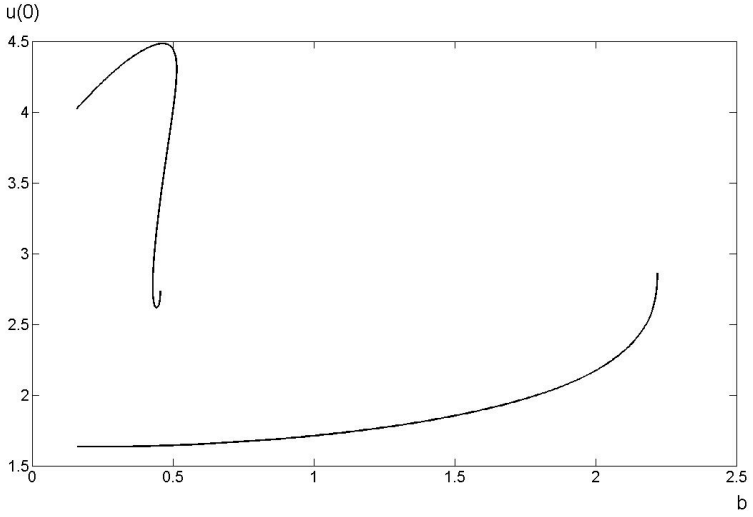


Figure 4: Bifurcation curve for piecewise analytic single bump solutions of (7) with a step firing rate function and $\theta = 1.5$.

Conclusion

A first approximation to modelling gap junctions in a neural field model is made using a partial-integro differential equation model first introduced by [1] and subsequently extended by [2] to include an oscillatory coupling function and smooth step exponential firing rate function. Using the Fourier transform method of [2], the time-independent PDE representing N–bump steady states is tranformed into an ODE and bifurcation analysis undertaken. It is found that families of solutions seem to be destroyed through saddle-node bifurcations as the strength of the term modelling gap junctions is increased.

Piecewise analytic single bump steady state solutions without the gap junction modelling term are found by assuming a step firing rate function and solving the resulting system of nonlinear equations. We find that the use of different firing rate functions gives very different results. It would be interesting to see how inclusion of the gap junction term would affect these results.

Amanda Elvin
Massey University

References

[1] Amari, S. (1977). Dynamics of pattern formation in lateral-inhibition type neural fields. Biol. Cybernetics, 27:7787.

[2] Laing, C. R., Troy, W. C., Gutkin, B., and Ermentrout, G. B. (2002). Multiple bumps in a neuronal model of working memory. SIAM J. Appl. Math, 63(1):6297.

[3] Walsh, R. (2003). Epilepsy focus has wider implications. The New Zealand Herald (25 May).

A bifurcation analysis of calcium buffering — *Elan Gin*

Introduction

Calcium is important for many cellular functions, regulating many aspects of cell physiology. It is believed that the signal encoded in the frequency of oscillations in the calcium concentration level control a diverse array of cellular functions, including gene expression, secretion, cell movement, muscular contraction and differentiation. Though Ca^{2+} is important, prolonged high concentrations of Ca^{2+} can be toxic. In particular, high Ca^{2+} concentrations can trigger apoptotic cell death. The use of oscillations in Ca^{2+} concentration as a signal avoids the effects of prolonged high concentration.

One method by which cells maintain a low resting Ca^{2+} concentration is through buffers. At least 99% of calcium entering the cytoplasm is rapidly bound to large endogenous proteins which can be immobile or mobile. Fluorescent calcium dyes also act as exogenous calcium buffers. Calcium buffering also occurs in the internal stores. Many mathematical models include buffering by assuming that buffering acts on a fast time scale, resulting in the *rapid buffering approximation*.

The goal is to determine whether using the rapid buffering approximation for slow buffers gives the same dynamics as would be observed had buffering been modelled explicitly. To do this, a bifurcation analysis is performed on the differential equation system modelling calcium oscillations. We focus on whether oscillatory behaviour appears or disappears when switching between the rapid buffering approximation and the explicit buffering regime. The rapid buffering approximation reduces the number of equations as well as the number of parameters in the model. Differences in the time scales are also eliminated, meaning larger times steps can be used to obtain numerical solutions. Therefore the ability to use the rapid buffering approximation for parameter values for which the approximation may not be valid is of practical interest. Bifurcation diagrams were computed using the bifurcation and continuation package AUTO [1].

Calcium buffering

Calcium buffering can be represented by the reaction

$$Ca^{2+} + B \underset{k_-}{\overset{k_+}{\rightleftarrows}} CaB,$$

where B denotes the buffer, CaB the buffer-bound Ca^{2+} and k_- and k_+ are the dissociation and association rates respectively. Mathematically this can be written according to the mass-action law to derive an equation for the rate of change of the cytoplasmic Ca^{2+} concentration, c and the rate of change of the buffer-bound Ca^{2+} concentration, b. If the buffer is free to diffuse, the buffered reaction-diffusion system in one-dimension is obtained:

$$\frac{\partial c}{\partial t} = D_c \frac{\partial^2 c}{\partial x^2} + f(c, c_e) + k_- b - k_+ c(b_t - b), \tag{12}$$

$$\frac{\partial b}{\partial t} = D_b \frac{\partial^2 c}{\partial x^2} - k_- b + k_+ c(b_t - b), \tag{13}$$

where c_e the Ca^{2+} concentration in the ER. The parameter b_t represents the total concentration of buffer while k_- and k_+ denote the dissociation and association rates respectively. The function $f(c, c_e)$ includes all other calcium fluxes. The diffusion coefficients are given by D_c and D_b.

The rapid buffering approximation assumes that separate time scales exist: the reactions with buffering occur on a faster time scale than all other calcium fluxes. In this way, b may be taken to be in quasi-steady state (the buffers and Ca^{2+} are in chemical equilibrium):

$$k_- b - k_+ c(b_t - b) = 0,$$

and so

$$b = \frac{b_t c}{K + c},$$

where $K = k_-/k_+$ is called the dissociation constant. Hence, the variation in the total concentration of Ca^{2+}, c_t ($c_t = c + b$), is governed by the equation:

$$\frac{\partial c_t}{\partial t} = \frac{\partial c}{\partial t} + \frac{\partial b}{\partial t} = \frac{\partial c}{\partial t} + \frac{db}{dc}\frac{\partial c}{\partial t} = \frac{\partial c}{\partial t}\left(1 + \frac{b_t K}{(K+c)^2}\right). \tag{14}$$

Letting $\psi = K/(K+c)^2$, $\tilde{K} = 1 + b_t K/(K+c)^2$ and combining Eqs. (12) and (13) with Eq. (14), we get

$$\begin{aligned} \frac{\partial c}{\partial t} &= \left(\frac{D_c}{\tilde{K}}\right)\frac{\partial^2 c}{\partial x^2} + \left(\frac{D_b b_t}{\tilde{K}}\right)\frac{\partial^2}{\partial x^2}\left(\frac{c}{K+c}\right) + \frac{f(c,c_e)}{\tilde{K}} \\ &= \left(\frac{D_c + D_b b_t \psi}{\tilde{K}}\right)\frac{\partial^2 c}{\partial x^2} - \frac{2D_b b_t \psi}{(K+c)(\tilde{K})}\left(\frac{\partial c}{\partial x}\right)^2 + \frac{f(c,c_e)}{\tilde{K}}. \end{aligned} \tag{15}$$

Thus, the rapid buffering approximation results in a scaling of the calcium fluxes $f(c, c_e)$ with dependence on c, and a single equation now governs the change in Ca^{2+} concentration. The rapid buffering approximation was first derived in [4].

Model Equations

We use a model based on one derived in [3] of calcium waves in the basal region of pancreatic acinar cells. The equations are:

$$\frac{\partial c}{\partial t} = D_c\frac{\partial^2 c}{\partial x^2} + (k_f P_{IPR} + J_{er})(c_e - c) - J_{serca} + \delta(J_{in} - J_{pm}) + \lambda k_- b - \lambda k_+ c(b_t - b), \tag{16}$$

$$\frac{dc_e}{dt} = (-\gamma\left[(k_f P_{IPR} + J_{er})(c_e - c) - J_{serca}\right])/\tilde{L}, \tag{17}$$

$$\frac{\partial b}{\partial t} = D_b\frac{\partial^2 b}{\partial x^2} - \lambda k_- b + \lambda k_+ c(b_t - b), \tag{18}$$

$$\frac{dO}{dt} = \phi_2 pR - \theta_1 O + (k_{-1} + l_{-2})I_2 - \theta_2 O, \tag{19}$$

$$\frac{dR}{dt} = \theta_1 O - \phi_2 pR, \tag{20}$$

with

$$\tilde{L} = 1 + \frac{b_{t_e} L}{(L + c_e)^2},$$

and $L = l_-/l_+$ where l_- is the dissociation rate and l_+ is the association rate of the ER buffer. The total buffer concentration in the ER is denoted by b_{t_e}. We assume that the buffer is mobile in one spatial dimension in the cytoplasm. A parameter λ is introduced to control the buffer speeds λk_- and λk_+, in Eqs. (16) and (18). This parameter is varied between zero and one, with zero corresponding to no buffering and one corresponding to fast buffers. Thus we are able to control the buffer speed by varying one parameter. Calcium buffering has been included explicitly in the cytoplasm and the rapid buffering approximation is used only for an immobile buffer in the ER. We only test whether the rapid buffering assumption is appropriate for use with slower buffers in the cytoplasm.

For the original dissociation and association rates with $\lambda = 1$ for the cytoplasmic buffers, the rapid buffering approximation is valid and it therefore comes as no surprise that analysis of the rapid buffering equations produces essentially identical results to analysis of the explicit equations with $\lambda = 1$. In fact, as $K = \tilde{k}_-/\tilde{k}_+ = \lambda k_-/\lambda k_+ = 2$ μM for all λ, the rapid buffering equations will be the same regardless of the value of λ. Therefore the bifurcation analyses for $\lambda < 1$ will be compared with the analysis for $\lambda = 1$.

Details of all calcium flux terms and parameter values can be found in [2], along with details of Eqs. (19) and (20). For the rest of this paper, let $\tilde{k}_- = \lambda k_-$ and $\tilde{k}_+ = \lambda k_+$.

The model in the absence of diffusion

A bifurcation analysis was performed in the case that $D_c = D_b = 0$ for $\lambda = 1$ and $\lambda = 10^{-3}$. A study of the equations in which diffusion is included has been studied and can be found in [2]. The bifurcation parameter used was p, which represents the IP_3 concentration. The bifurcation diagrams are given in Figure 5.

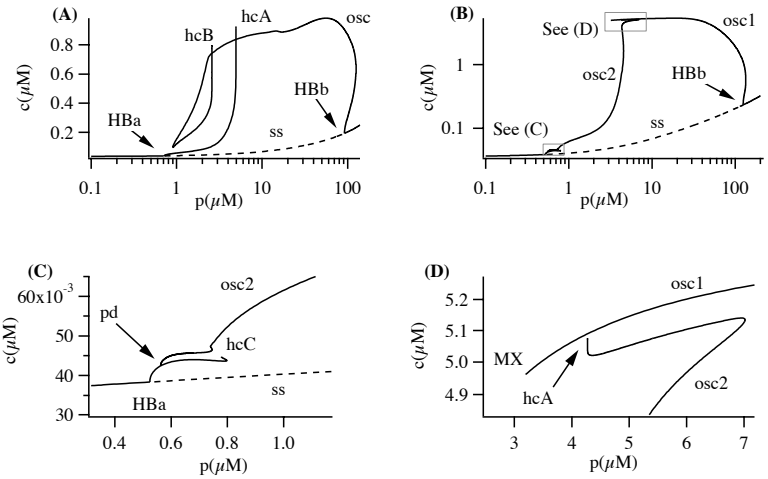


Figure 5: Partial bifurcation diagrams for: (A): $\lambda = 1$ and (B): $\lambda = 10^{-3}$. Panels (C) and (D) are magnifications of parts of panel (B). Hopf bifurcations are labelled HB, homoclinic bifurcations are labelled hc. Curves of steady state solutions are labelled ss, while osc is the maximum value of c over an oscillation. Period-doubling bifurcations are labelled pd. The point labelled MX is explained in the text.

General observations on the bifurcation diagrams can be made. One steady state solution exists for all values of p. The solution is labelled ss in Figure 5, with a solid line indicating a stable solution. As p increases, this steady state loses stability via a Hopf bifurcation from which a branch of stable periodic orbits appears. These periodic orbits disappear at high p, so that oscillations occur for an intermediate range of p.

For $\lambda = 10^{-3}$, the first Hopf bifurcation occurs at a lower value of p than for $\lambda = 1$, i.e., at $p \approx 0.4$ while the second Hopf bifurcation occurs at a higher value of p than was the case for $\lambda = 1$. The branch of periodic orbits created in the lower Hopf bifurcation terminates at a homoclinic bifurcation, but at this point, the maximum value of c over the oscillations is lower than for $\lambda = 1$ (Figure 5(C); the homoclinic bifurcation is labelled hcC). A branch of period-doubled orbits bifurcating from the point labelled pd in Figure 5(C) was followed, giving the curve osc2. The mechanism for the destruction of this branch is a homoclinic bifurcation of the equilibrium, labelled hcA in Figure 5(D). Following the branch of periodic orbits created by the upper Hopf bifurcation, HBb, gave the curve labelled osc1 and we find that the maximum value of c over an oscillation is higher than for $\lambda = 1$, with the maximum Ca^{2+} concentration reaching approximately 5 μM in Figure 5(B). The mechanism for the termination of this branch of periodic orbits is unknown, with AUTO unable to follow the branch of periodic orbits further than the point marked MX in Figure 5(D).

In order to establish what happens for intermediate values of λ, the loci of the bifurcations found in two parameters, p and λ, were followed to construct the bifurcation set shown in Figure 6. The bifurcation diagram in Figure 5(A) corresponds to taking a cross section at fixed $\lambda = 1$ in Figure 6, as marked by the horizontal dashed line, a. It is clear from Figure 6 that qualitatively similar behaviour occurs for all λ greater than about 3×10^{-3} and the rapid buffering approximation can be used without a problem so long as we are interested only in qualitative features of the dynamics.

Taking a cross section through Figure 6 at $\lambda = 10^{-3}$, dashed line b, yields the bifurcation diagram in Figure 5(B). We see that the branch of periodic orbits created at HBa terminates at a homoclinic bifurcation on hcC rather than hcA as was the case for $\lambda = 1$. The period-doubling bifurcation in Figure 5(C) was followed in two parameters to give the dashed curve labelled pd in Figure 6. It is the branch of period-doubled orbits created at this bifurcation which terminates at a homoclinic bifurcation on hcA.

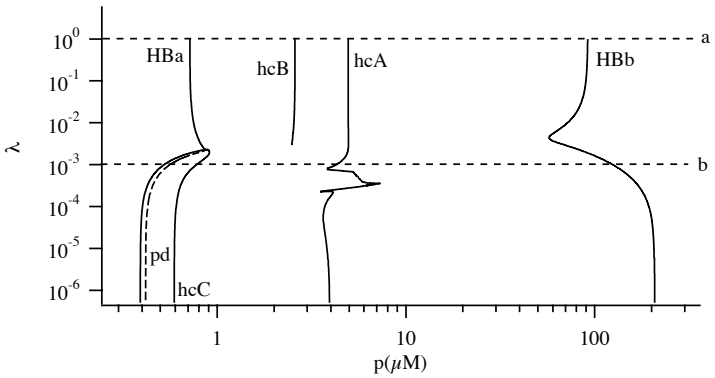


Figure 6: A partial bifurcation set. The Hopf bifurcation curves are labelled HBa and HBb. Homoclinic bifurcation curves are labelled hcA, hcB and hcC. The two horizontal lines are described in the text.

Two-parameter continuation of the bifurcation curve hcB did not help resolve the mechanism for the termination of the branch of periodic orbits created on HBb; in the numerical simulations the curve hcB terminates abnormally. As shown in Figure 6, there is no qualitative change in dynamics as λ is reduced from 10^{-3} to 10^{-6}. At $\lambda = 10^{-6}$, buffering is so slow that it is irrelevant and we conclude that we can ignore buffering terms altogether for $\lambda < 10^{-3}$ and in particular do not need to consider the use of the rapid buffering approximation in this regime.

The middle region of Figure 6 provides a transition between the behaviour exhibited by Figures 5(A) and 5(B). Further details can be found in [2]. Oscillations still occur in this region though.

Discussion

We investigated the range of applicability of the rapid buffering approximation, focussing on whether the approximation could be used even when the buffers are not fast. To summarise, we find that the qualitative behaviour for different buffer speeds can be divided into three regions. For a wide range of buffer parameters the rapid buffering approximation can be used. A small transition region exists in which care needs to be taken in how buffering is included for buffers in this parameter range, but even in this transition region, the dynamics is still essentially the same as for fast buffering: oscillations still exist. For buffers which are very slow, buffering can be ignored altogether.

Acknowledgements

Elan Gin thanks the New Zealand Institute of Mathematics and its Applications for financial support.

Elan Gin
Massey University

References

[1] E.J. Doedel, A.R. Champneys, T.F. Fairgrieve, Y.A. Kuznetsov, B. Sandstede and X. Wang. AUTO 97: Continuation and bifurcation software for ordinary differential equations. http://indy.cs.concordia.ca/auto/main.html

[2] E. Gin, V. Kirk and J. Sneyd. A bifurcation analysis of calcium buffering, J. Th. Biol., accepted 26 January 2006.

[3] J. Sneyd, K. Tsaneva-Atanasova, J.I.E. Bruce, S.V. Straub, D.R. Giovannucci and D.I. Yule. A model of calcium waves in pancreatic and parotid acinar cells, Biophys. J. 85 (2003) 1392-1405.

[4] J. Wagner and J. Keizer. Effects of rapid buffers on Ca^{2+} diffusion and Ca^{2+} oscillations, Biophys. J. 67 (1994) 447-456.

BOOK REVIEWS

Please indicate your willingness to review new books, to the Review Sub-Editor Bruce van Brunt, at B.vanBrunt@massey.ac.nz. Bruce will then organise for you to receive a complimentary copy for reviewing.

Computational Ergodic Theory
by Geon Ho Choe, Springer
Algorithms and Computation in Mathematics **13** (2005) xix, 453p [ISBN 3-540-23121-8]

What can a computer tell us about ergodic theory? Well, the answer is *quite a lot*, as this recent volume testifies. Before opening my review copy I had anticipated (hoped for?) a comprehensive survey of algorithms for computing objects of interest in ergodic theory — perhaps a careful and consistent mathematical treatise to complement the edited collection [2]. Instead, this book is really a unique dynamical systems text, in which the key ideas of measurable dynamics are presented in a way that renders them intelligible to the uninitiated reader. For the most part, this is done without compromising rigour. The pedagogy employed is to interleave the theorems and definitions with numerous examples and accompanying figures which illustrate the main points. The figures (250 in all) are produced using Maple, and each chapter concludes with a section containing all the Maple source code. In fact, these programmes replace the more traditional problem sets, and (together with the commentaries, figures and incitements to experiment) comprise about 40% of the book. This approach is succinctly summarized by the author's new terminology — the *mathematical pointillism*, wherein geometric objects are visualized by looking at a suitably large number of points on the object. The computer aided visualizations really do aid understanding of the subject (the programmes are also available from the author's webpage http://shannon.kaist.ac.kr/choe/book/). As well as these illustrations, ample references are given to other excellent and well-known ergodic theory texts, especially [5] and [6]. The book also contains up-to-date references to the literature in some areas (for example, on recurrence times, central limit theorems, decay of correlations, normality mod 2).

The book is organized into 14 chapters and is evenly paced (with the exception of Chapter 1). Chapter 1 summarizes the mathematical pre-requisites for the book, including: point-set topology, measure and Lebesgue integration, the Perron-Frobenius theorem for non-negative matrices, compact Abelian groups and characters, statistics and probability. All this (and more) is done in 28 pages, although the treatment is probably too brisk for a student who lacked familiarity with these concepts. This is a pity, since the rest of the book is much more approachable. Indeed, the cover description begins: *Ergodic theory is hard to study because it is based on measure theory, which is a technically difficult subject to master for ordinary students, especially for physics majors.* The style adopted in the rest of the book (plenty of numerical computations to illustrate the main points) could really assist the "ordinary student" through Chapter 1, and would be an excellent complement to the provided references to analysis texts. The main body of the book includes the presentation of several key concepts from ergodic theory (ergodicity, entropy, recurrence) as well as topics that are often presented without reference to ergodic theory (circle maps, Lyapunov exponents and stable and unstable manifolds).

Invariant measures and ergodicity for iterations of a map are discussed in Chapters 2, 3 and 5. The presentation is easily digestible, and lots of standard examples are presented (continued fraction, logistic, Henon, beta, baker, solenoid, standard and shift maps). The pointwise and mean ergodic theorems are proved (averages along orbits converge pointwise and in L^2 respectively), as is Kac's lemma (the average time to return to a set E is 1/measure(E)). Chapter 4 covers mixing, the central limit theorem and decay of correlations. Again, the presentation is clear and informative. Chapter 7 *Mod 2 normal numbers* offers a tantalizing glimpse at the surprising ergodic behaviour of apparently simple transformations. Entropy is introduced in Chapter 8, and the Shannon-McMillan-Breiman theorem is presented, along with the connections between measure theoretic entropy and data compression. Chapters 12 and 13 cover several important relations between recurrence (first return times), entropy and dimension; again, the carefully constructed computer experiments illustrate the delicacy of some of the results (for example, the computations in Chapter 12, using the Ornstein–Weiss formula to estimate the entropy of a Bernoulli shift using recurrence times).

The remainder of the book treats topics which have their roots in measurable dynamics, but are of fundamental interest beyond ergodic theory. Chapter 6 is about circle homeomorphisms (including

rotation numbers, Denjoy's theorem, Arnold tongues); as always, numerical algorithms are provided for sketching the various constructions. Chapters 9 and 10 cover Lyapunov exponents from a rigorous point of view, including Oseledec's multiplicative ergodic theorem, loss of significant digits in computations, speed of approximation by continued fraction convergents, shuffling of cards and Pesin's formula. Chapter 11 describes stable and unstable manifolds, and gives an idea of how these might by sketched on a computer; this chapter is the least rigorous in the book, with no proofs, and no references to the literature. Chapter 14 concerns data compression, and does not seem out of place.

Throughout the text, the numerical calculations are done carefully. However, care should be taken in interpreting the pictures. The author notes that round-off effects are eliminated by using Maple at essentially arbitrary precision (eg Digits:=10000). In this sense, the numerical experiments are rigorous (one can be sure that the pictures depict what they are supposed to). However, even in the absence of numerical error, the computations may not converge to the desired object. Two examples (reflecting my personal biases) are: (1) The visualizations of invariant measures rely on the Birkhoff Ergodic Theorem to draw approximately invariant histograms. There is no general guarantee that such a histogram will be close to an invariant measure (the orbit segment may not be long enough, or the initial condition may not be typical). (2) The invariant subspaces from Oseledec's theorem are notoriously difficult to resolve in all but the simplest cases, so the pictures presented in Chapter 10 do not necessarily have a rigorous interpretation.

Despite my gripes above, *Computational ergodic theory* is a very good book for the right audience: those who want to learn about ergodic aspects of dynamics, but lack a strong background in analysis. Such readers would do well to follow this book, using [5] and [6] for further details when required. (Better prepared readers may prefer the more traditional texts—[5,6]—and find the pictures and algorithms in the volume under review beneficial.) One final comment: the style of the book may not excite the "ordinary student" to study ergodic theory; for extra motivation, I recommend [1], [3] and [4].

References

[1] Berger. Chaos and Chance. Walter de Gruyter (2001).

[2] Feidler (ed). Ergodic theory, analysis, and efficient simulation of dynamical systems. Springer (2001).

[3] Hasselblatt and Katok. A first course in dynamics with a panorama of recent developments. Cambridge (2003).

[4] Lasota and Mackey. Chaos, fractals and Noise. Springer (2nd ed) (1994).

[5] Petersen. Ergodic Theory. Cambridge (1983).

[6] Walters. An introduction to ergodic theory. Springer (1982).

Rua Murray
University of Waikato

CONFERENCES

NZ Mathematics Colloquium 2005 — Report

Overview

NZMC 2005 was held at Massey University, Palmerston North, 5 7 December 2005. Participants totalled 123, comprising 52 standard, 16 student, 9 one-day, and 46 Education Afternoon registrations. A total of 59 talks were timetabled into four parallel sessions, including a Dynamical Systems Day and an afternoon devoted to Mathematics Education. An HoD meeting and the Colloquium Business Meeting were held. Incorporated into the Colloquium were the Annual General Meetings of the New Zealand Mathematical Society and the NZ Branch of ANZIAM. A Reception was held in the Wharerata Function Centre on campus. Two excursions were programmed, one to Cross Hills Gardens and the other a hike through the Manawatu Gorge. The Colloquium Dinner, held in the Massey University Institute of Rugby, attracted 72 people at which the Aitken Prize for the best student talk was presented by the NZMS Treasurer, Tammy Smith, on behalf of the Council.

Invited Speakers

- Professor Peter Kuchment (Texas A & M University) Circular Radon transform, nodal lines, thermal acoustic tomography, and all that.
- Tatiana Mrquez Lago (University of New Mexico), Butcher Prizewinner Stochastic variation estimates of progesterone transcriptional activity in the EGFR pathway.
- Professor Mark Meerschaert (University of Otago), ANZIAM Speaker Vector fractional calculus.
- Associate Professor Eamonn OBrien (University of Auckland), NZMS Speaker Algorithmic approaches to the study of linear groups.
- Associate Professor Bruce van Brunt (Massey University) Complex functional differential equations.

Aitken Prize

Two students shared the Prize for best student talk at the Colloquium: Amanda Elvin (Massey University, Albany Campus) and Elan Gin (University of Auckland). Abstracts of their talks appear earlier in this newsletter. Highly commended talks were given by Dion ONeale (Massey University, Palmerston North) and Sharleen Harper (Massey University, Albany Campus).

Colloquium Organising Committee

Igor Boglaev, Jonathon Godfrey, Dean Halford (Convenor), Sven Hartmann, Barbara Holland, Charles Little, Robert McKibbin, Robert McLachlan, Aroon Parshotam (Treasurer), Bruce van Brunt, Marijcke Vlieg-Hulstman, Margaret Walshaw, Graham Weir, Toni Wilson (Secretary).

Dean Halford, Convenor

ANZIAM 2006 Mansfield — Report

This is lifted by your intrepid reporter from the preliminary report made to the ANZIAM AGM. Great to see applied mathematics thriving at this conference, especially with so many thesis students giving excellent talks.

There were 139 registrants, 35 student talks, 8 invited speakers and 77 contributed talks, at this 42nd Applied Maths Conference. It was a very social event as usual, opening with a barbie on Sunday 5 February at the Alzburg Inn at Mansfield, Victoria. The walk up Mount Buller on Tuesday afternoon was spectacular, only slightly marred by those terribly persistent bush flies that are so difficult to brush off one's face. A number of walkers actually swallowed a number of flies, your reporter saw it happen! A cold Australian beer helped wash them down, halfway along the walk where there was a very conveniently located pub.

ANZIAM Invited Speakers Lauded *photo: Mark McGuinness*

Talks were hugely varied and fascinating, and included tsunami buoy locations, solitons, brains, dynamos, body piercing, knapsack problems, Martian avalanches, minefields, viruses, termites, NZ frogs (I found it difficult to keep from wincing when this Australian student kept gleefully referring to how primitive the New Zealand frogs are, egged on by other Australians in the audience), measles, cell migration, wool scouring, airbags, MRI, sand, heart bypass operations, cracks and vortex blobs.

The conference was very well-organised, by a combined group from Monash, UniMelb, Deakin, and LaTrobe, ably led by Simon Clarke.

Christopher Fricke (University of Melbourne) is congratulated by Tim Marchant for winning the TM Cherry Prize for the best student talk; and James Sneyd (Auckland) and Vicky Mak (Deakin) were judged by students to be the best non-student speakers, and awarded the coveted (and very tasty) *Cherry Ripe Prize*!

Mark McGuinness
Victoria University of Wellington

Conferences Coming Up

5–8 June 2006, University of Brunei Darussalam, Brunei (Borneo): **International Conference on Mathematical Modelling and Computation**.
email: Seminar Secretariat, Dr Malcolm Anderson
mmc06@fos.ubd.edu.bn
website: http://www.ubd.edu.bn/news/conferences/fosmmc06/

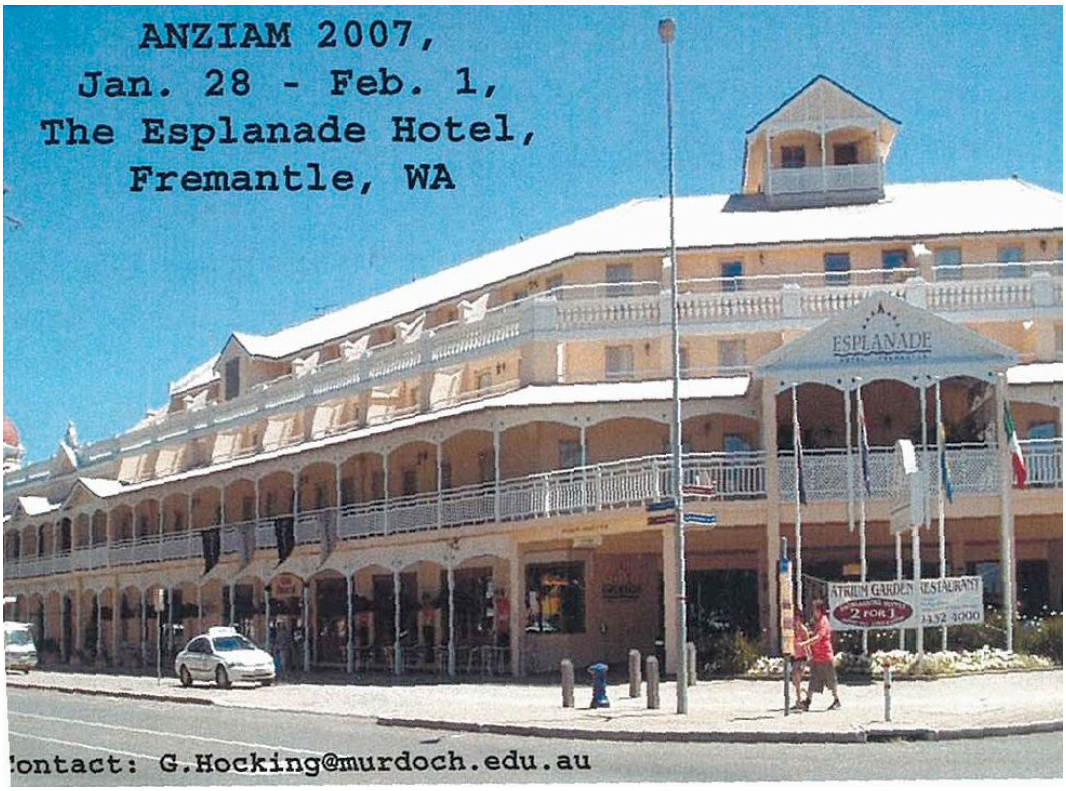
3–7 July 2006, at Sky City, Auckland: **ASC/NZSA 2006—Australian Statistical Conference/New Zealand Statistical Association Conference**.
website: http://www.statsnz2006.com

8-12 July 2006, Alice Springs, Australia: **31st Australasian Conference on Combinatorial Mathematics & Combinatorial Computing**.
website: http://www.cdu.edu.au/engineering/31ACCMCC.html

July 10 - 14 2006, Lake Plaza Rotorua Hotel, Rotorua, New Zealand **International Conference on Analytic Topology and Applications**
website: http://www.math.auckland.ac.nz/~cao/conference06.html

July 13-19, 2006, Yulara and King's Canyon, Australia: **17th Australasian Workshop on Combinatorial Algorithms**.
website: http://www.ballarat.edu.au/conferences/awoca2006/

July 13-19, 2006, Yulara and King's Canyon, Australia: **Dry and Discrete**.
website: http://www.cdu.edu.au/engineering/DandD.html



NEW ZEALAND MATHEMATICS COLLOQUIUM

4–6 December 2006

The University of Waikato, Hamilton, New Zealand

The annual New Zealand Mathematics Colloquium for 2006 will be hosted by the Department of Mathematics at the University of Waikato in Hamilton during the period 4–6 December.

The provisional invited speakers are:

- Associate Professor Brian Davey (La Trobe University)
- Professor Larry Forbes (University of Tasmania)
- Dr Georg Gottwald (University of Sydney)
- Professor Robert McLachlan (Massey University, Palmerston North)
- Professor Mick Roberts (Massey University, Albany)

Social events will include a Welcoming Reception on the evening of Sunday, 3 December and the Colloquium Dinner on the evening of Tuesday, 5 December. The award of the Aitken prize for the best student talk will be announced at the Colloquium Dinner. At least one optional excursion on the afternoon of the Tuesday is planned.

The programme on Monday will include a theme day on **Mathematics Education** and a theme day on **Dynamical Systems and Numerical Analysis**. The latter is part of the thematic programme of the same name sponsored by NZIMA (New Zealand Institute of Mathematics and its Applications).

The Annual General Meetings of the New Zealand Mathematical Society and the New Zealand Branch of ANZIAM (Australia and New Zealand Industrial and Applied Mathematics) will be held during the Colloquium.

Bed and breakfast accommodation at a rate of about $55 per night will be available at the Halls of Residence on campus.

Online submission of abstracts and online registration are expected to be available around June or July. This will be made available from the Colloquium website:

http://www.math.waikato.ac.nz/Coll2006/

This website is up and running and will be updated as information comes to hand. Enquiries may be made to the Colloquium Secretary, Stephen Joe, by email to stephenj@math.waikato.ac.nz.

We look forward to you participating in the Colloquium at our attractive campus in Hamilton.

Stephen Joe
Convener, NZMC2006 Organising Committee

Mathematics in Industry Study Group 2007

DATES: Monday 5 February – Friday 9th February 2007

VENUE: University of Wollongong, Australia

Immediately follows the annual Applied Mathematics Conference (ANZIAM 2007) in Western Australia.

MISG2007 is being organised by the School of Mathematics & Applied Statistics, University of Wollongong, Australia

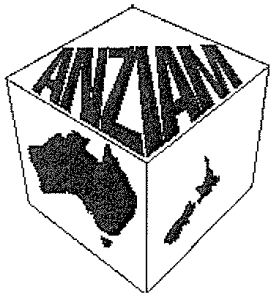
DIRECTOR – Associate Professor Tim Marchant
tim@uow.edu.au

ASSOCIATE DIRECTOR – Dr Maureen Edwards
maureen@uow.edu.au

ADMINISTRATOR – Ms Sue Denny
sdenny@uow.edu.au

www.misg.math.uow.edu.au
(currently under construction)

University of Wollongong



1ST JOINT AMS–NZMS MEETING
incorporating NEW ZEALAND MATHEMATICS COLLOQUIUM

12–15 December 2007

Victoria University of Wellington, Wellington, New Zealand

A joint meeting of the New Zealand and American Mathematical Societies will be held at Victoria University, Wellington, 12–15 December 2007. This meeting will incorporate the 2007 NZ Mathematics Colloquium.

The organising committee consists of Professors Jeff Cheeger (NYU/Courant), Peter Jones (Yale) and Matt Miller (USC Columbia) for AMS, Professors Rod Downey (VUW), Gaven Martin (Massey, Albany) and Dr Peter Donelan (VUW) for NZMS, together with Professor Vaughan Jones (UC Berkeley) for AMS/NZMS and Diane Saxe (AMS) and Ginny Nikorima (VUW) as secretariat.

The meeting will run from Wednesday to Saturday inclusive, with 3–4 plenary speakers from each society, together with a number of Special Sessions and general contributed talks. Special Sessions may consist of 1–4 blocks of 4–5 speakers, each of 20–25 minutes duration, with the option for a keynote address of longer duration.

Applications are invited from anyone interested in organising a Special Session. Applications should include a subject area (in any branch of the mathematical sciences), names of one or two organisers preferably, but not essentially, based in NZ and/or the US, and some indication of potential participants. However applicants should not issue firm invitations to speakers until approval to run a Special Session has been granted by the Organising Committee. Applications may be submitted up to 31 March 2007 but approvals will be notified as soon as possible after applications are received. Please send applications by e-mail to peter.donelan@mcs.vuw.ac.nz or miller@math.sc.edu. At this stage there are no dedicated funds available for Special Session speakers, but that will be subject to review.

Peter Donelan, Matt Miller
Co-conveners, AMS–NZMS 2007 Organising Committee

NOTICES

Unfolding The Secret Life Of Origami

After 25 years working to have paper folding regarded as a legitimate occupation for grownups, all those paper cuts have started to pay off for Jonathan Baxter! Recognised internationally for his work in this extraordinary art form, this kiwi origami master is now at the sharp end of introducing a new application of origami to New Zealanders — **origami math**.

This is math as you have never seen it before! Modern origami is a unique sculptural art that in recent years has inspired meaningful applications in engineering, math and various 21st century technologies. Across the globe, mathematicians and engineers with a fondness for origami have applied the rigour of scientific discipline to their hobby and yielded some fascinating results.

Origami artists are now able to fold, from a single, uncut square of paper, things which no one ever would have thought possible, and are able to portray levels of realism and expression never seen in the art forms lengthy history. Origami applications range from the design of medical aids, through to vehicle airbags and the unfolding of giant telescope lenses in space.

Thanks to support from the Royal Society of New Zealand, this kiwi paperfolder extraordinaire is forging partnerships with experts around the world to create the Great Origami Maths and Science Show. Touring the country in August 2006, Jonathan and his collaborator, math educator Hugh Gribben, will present an engaging live show exposing the math secrets hidden away in the intricate creases of origami models. Clearly there is more to origami than just paper folding!

With a passion for inspiring others and passing on his craft, Jonathan is renowned as an engaging speaker, teacher and performer. In 2001 he was awarded the prestigious "Michael Shall award" by the US National Origami organization for his work in promoting the art form. "With a sheet of paper, your hands and some perfect creases, you can make almost anything" he says, "its one of the most cost-effective teaching tools around!".

He is in demand as a speaker and presenter at conferences and festivals, and has been instrumental in bringing to New Zealand audiences a number of innovative exhibitions and programmes. Examples include the recent touring exhibition: Cellami, which featured complex cell-like origami models, inspired by confocal microscope imagery taken by De Jacqui Bond at the Forestry Research Institute.

Whether hes folding, teaching, entertaining or exhibiting, Jonathans paper genius produces striking reminders that the ancient arts of origami and mathematics are closely related.

The Great Origami Maths and Science Show:

Touring through Auckland, Rotorua, Hamilton, Palmerston North, Wellington, Christchurch and Dunedin from 7 August through to 3 September 2006. For more details contact the Tour Organiser.

Sponsored By: The Royal Society of New Zealand through its Science and Technology Promotion Fund.

Interview/Photo Opportunity: Origami Master - Jonathon Baxter. Contact on 021 041 7731 or jbax@mindspring.com. Collaborator: Math Educator - Hugh Gribben. Contact on 09 525 1126 or hgrib@mac.com.

Tour Organiser and Promoter: Bettina Anderson, Pukekoblue Science Communication. Contact on 027 668 9449 or bettina@pukekoblue.co.nz

Imagery: Further high quality photos of the presenters and various origami models are available upon request from the Tour Organiser.

NEW ZEALAND INSTITUTE OF MATHEMATICS AND ITS APPLICATIONS (NZIMA)

Newsletter 10 — extracts

February 2006

This is extracted from the tenth quarterly newsletter of the New Zealand Institute of Mathematics and its Applications (NZIMA), one of New Zealand's seven Centres of Research Excellence.

With thanks to the authors:

Marston Conder and Vaughan Jones, Co-Directors of the NZIMA

A special issue of the journal *Annals of Pure and Applied Logic* is being published by Elsevier, as part of the NZIMA's programme in Logic and Computation. This will appear as Volume **38** of the journal in March 2006, with guest editors Rod Downey and Rob Goldblatt (Victoria University of Wellington).

RECENT EVENTS SPONSORED BY THE NZIMA

The **14th International Workshop in Matrices and Statistics** was held at Massey University's Albany Campus from 29th March to 1st April 2005. The workshop was honoured by a Plenary talk by Prof. Calyampudi R Rao, and other plenary talks were given by Professors Shayle Searle (Cornell), Eugene Seneta (Sydney) and George Seber (Auckland). The workshop included 19 invited lectures, 13 contributed papers and 48 participants from 14 different countries (NZ, Australia, Canada, China, Estonia, Finland, Germany, Israel, Japan, South Africa, Spain, Ukraine, United Kingdom and the USA).

A conference on **Sampling and Missing Data** was held in Auckland in April 2005 to celebrate the career of one of New Zealand's foremost mathematical scientists, Professor Alastair Scott, and to advance research in areas where he has made his greatest contribution. The conference addressed problems which are important in many areas of scientific inquiry, and brought together in New Zealand the largest concentration of first-rank international statisticians in one place at one time for a considerable period.

A one-day workshop on **Dynamical Systems** was held in December 2005 as a special session of the 2005 New Zealand Mathematics Colloquium, at Massey University's Palmerston North campus. In fact 22 of the Colloquium's 55 speakers requested to join the latter special session. Also the Aitken Prize for the best student talk at the Colloquium was awarded jointly to two of the session's student speakers — see the abstracts published earlier in this NZMS newsletter.

Two workshops were held in 2005 as part of the NZIMA's programme on **Hidden Markov Models**, one in Wanaka (at the end of June and early July), and another in Wellington (in December 2005). Also a seminar series was organised through the Victoria University of Wellington's School of Mathematics, Statistics and Computer Science, during the 3-month period August to October 2005.

Professor Peter Kuchment (Texas A&M University) visited NZ in December 2005. Professor Kuchment is an expert on quantum graphs, a rapidly growing subject on the border between the theory of differential operators, combinatorics and mathematical physics. He gave an invited lecture at the 2005 NZ Mathematics Colloquium, and another lecture at the University of Auckland, where he interacted with Professor Boris Pavlov and colleagues.

Another highly successful **summer meeting** was held in January 2006, this one as part of the NZIMA's latest programme "Geometric Methods in the Topology of 3-Manifolds", at Taipa (Doubtless Bay, Northland). Some excellent short courses of lectures were given by world experts in the field, including Ian Agol (Illinois at Chicago), Jeff Cheeger (Courant Institute, NY), John Conway (Princeton), Michael Freedman (Microsoft), Cameron Gordon (Austin, Texas), Dale Rolfsen (UBC), Hyam Rubenstein (Melbourne) and Kevin Walker (Microsoft). The workshop was attended by over 70 people, including 19 students. A highlight for participants was hearing the very latest developments on the proof of the Poincare conjecture.

The NZIMA sponsored a public lecture by its Visiting Maclaurin Fellow, **John Conway FRS** (who is John von Neumann Distinguished Professor of Mathematics at Princeton University, and one of the world's most illustrious mathematicians). John entertained a large audience with his lecture on "Tangles, bangles and knots". He will visit New Zealand again in January 2007 and January 2008.

PACIFIC RIM MATHEMATICAL ASSOCIATION

The NZIMA is one of the founding members of the (new) Pacific Rim Mathematical Association (otherwise known as 'PRIMA'), set up at the end of 2005 with the aim of promoting and facilitating the development of the mathematical sciences throughout the Pacific Rim region.

More information about PRIMA and its intended activities can be found on its website http://www.primath.org/ .

OTHER NEWS

Rob Goldblatt (Director of the NZIMA's Programme in Logic and Computation) has been appointed Coordinating Editor of the Journal of Symbolic Logic.

Gaven Martin (a member of the NZIMA's Governing Board and Co-Director of the NZIMA's Geometry programme) has been appointed Managing Editor of the American Mathematical Society's journal "Conformal Geometry and Dynamics", and elected President of the NZ Mathematical Society for a 2-year term.

Robert McLachlan (Maclaurin Fellow and Director of the NZIMA's programme on Dynamical Systems) won the Massey University Research Medal for 2005.

Call For Nominations For 2006 NZMS Research Award

This annual award was instituted in 1990 to foster mathematical research in New Zealand and to recognise excellence in research carried out by New Zealand mathematicians. Recipients to date have been John Butcher and Rob Goldblatt (1991), Rod Downey and Vernon Squire (1992), Marston Conder (1993), Gaven Martin (1994), Vladimir Pestov and Neil Watson (1995), Mavina Vamanamurthy and Geoff Whittle (1996), Peter Lorimer (1997), Jianbei An (1998), Mike Steel (1999), Graham Weir (2000), Warren Moors (2001), Bakhadyr Khoussainov (2002), Rod Gover (2003), Eamonn O'Brien (2004) and James Sneyd and Robert McLachlan (2005).

Call for nominations 2006

Applications and nominations are invited for the NZMS Research Award for 2006. This award will be based on mathematical research published in books or recognised journals within the last five calendar years: 2001– 2005. Candidates must have been residents of New Zealand for the last three years.

Nominations and applications should include the following:

- Name and affiliation of candidate.
- Statement of general area of research.
- Names of two persons willing to act as referees.
- A list of books and/or research articles published within the last five calendar years: 2001– 2005.
- Two copies of each of the five most significant publications selected from the list above.
- A clear statement of how much of any joint work is due to the candidate.

A judging panel of three persons shall be appointed by the NZMS Council. The judges may call for reports from the nominated referees and/or obtain whatever additional referee reports they feel necessary. The judges may recommend one or more persons for the award, or that no award be made. No person shall receive the award more than once. The award consists of a certificate including an appropriate citation of the awardee's work, and will be presented (if at all possible) at the RSNZ Awards Dinner in 2006.

All nominations (which no longer need to include the written consent of the candidate) and applications should be sent by 30 July 2006 to the NZMS President, Professor Gaven Martin, Institute of Information and Mathematical Sciences, Massey University, Albany Campus, Private Bag 102 904, North Shore Mail Centre, Auckland, New Zealand.

Please consider nominating any of your colleagues whose recent research contributions you feel deserve recognition!

NZMS Accreditation

Applications are invited for NZMS Accreditation. The deadline for applications is Sunday 30 April 2006. If you would like to be considered or would like to nominate someone could you send for application forms to:

The Accreditation Secretary
C/- Department of Mathematics and Statistics
University of Otago University P O Box 56
DUNEDIN

or email lgrant@maths.otago.ac.nz

To help you understand better what each of the categories of membership are, I have added a copy of Article IV of the Constitution.

ARTICLE IV: OPTIONAL ACCREDITATION

An Ordinary Member (or Reciprocity Member) may apply to the Council to become a Graduate Member, Accredited Member, or Fellow. The Council shall make and issue, and may revise from time to time, Rules which shall give effect to the following requirements.

(1) A Graduate Member shall have completed a degree or diploma at a recognised university or other tertiary institution, the studies for which shall include mathematics as a major component, and shall be currently employed or occupied in the development, application or teaching of mathematics.

(2) An Accredited Member shall have completed a postgraduate degree in mathematics at a recognised university or other tertiary institution, or shall have equivalent qualifications, and shall have been employed for the preceding three years in a position requiring the development, application or teaching of mathematics.

(3) A Fellow shall be a person who currently has or previously has had the qualifications of an Accredited Member and who, in addition, is deemed by the Accreditation Committee (see paragraph below) to have demonstrated a high level of attainment or responsibility in mathematics and to have made a substantial contribution to mathematics or to the profession of mathematician or to the teaching or application of mathematics.

An Honorary Member shall have the right to become a Fellow immediately upon application to the Council and without payment of a fee.

The Council shall establish an Accreditation Committee to consider applications for designation as a Graduate Member, Accredited Member or Fellow, and to administer the Rules described in the first paragraph of this Article. In its determinations, the Accreditation Committee shall discount interruptions to employment such as temporary unemployment and parental leave.

A Graduate Member may use the abbreviation GNZMS, an Accredited Member may use the abbreviation MNZMS, and a Fellow may use the abbreviation FNZMS. These designations and the corresponding abbreviations are the rights of that class of Member only while the member remains a financial member of the Society and while the occupational requirements outlined in the first paragraph of this Article continue to be satisfied. The occupational requirements shall be deemed to be satisfied by Honorary Members and in the case of interruptions to employment such as temporary unemployment and parental leave, and they shall not be applied in the case of retirement or promotion to an administrative or other position.

A fee shall accompany each application to the Accreditation Committee. The fee shall be additional to the annual subscription charged by the Society and shall be the only charge for accreditation.

****

If you have any queries could you please direct them to me at the above address or by email (dholton@maths.otago.ac.nz).

Derek Holton
Chair, Accreditation Committee

Application for membership of the NZMS

The New Zealand Mathematical Society (Inc.) is the representative body of professional mathematicians in New Zealand, and was founded in 1974. Its aims include promotion of research in the mathematical sciences, the development, application and dissemination of mathematical knowledge within New Zealand, and effective cooperation and collaboration between mathematicians and their colleagues in New Zealand and in other countries.

Membership categories:

(Full details at www.math.waikato.ac.nz/NZMS/NZMS.html)

Ordinary*	$36 p.a.	
Reciprocal	$18 p.a.	
	For overseas residents who are fully paid-up members of societies with which the NZMS maintains a reciprocity agreement (including the American Mathematical Society, the Australian Mathematical Society, the Canadian Mathematical Society, the London Mathematical Society, and the Mathematical Society of Japan).	
Student*	$7.60 p.a.	For currently enrolled students in NZ
Overseas student	$18 p.a.	For currently enrolled students in overseas

(GST is added to rates for NZ residents.)

Members can subscribe to the New Zealand Journal of Mathematics (http://www.math.auckland.ac.nz/NZJM/index.html) at a reduced rate.

Members can also elect to make a donation, when paying their subs, to the NZMS Endowment for Student Support.

* The Society offers NZ students and new staff a special free one-year membership.

Please complete below and mail to:

John Shanks, NZMS Membership Secretary,
Department of Mathematics and Statistics,
University of Otago, P.O. Box 56, Dunedin, NZ

or Fax: +64 (3) 479 8427

E-mail: jshanks@maths.otago.ac.nz

NZMS Application Form

Name: _____ Title: _____

Address: _____

_____

_____

_____

An institutional address is preferred

E-mail: _____

Membership category: ☐ Ordinary ☐ Reciprocal ☐ Student ☐ Overseas student

If Reciprocal then complete this:

I am a fully-paid up member of _____

☐ I wish to receive the NZ Journal of Mathematics at special rate

Signed: _____ Date: _____

Please send no money now. You will be invoiced once your application is accepted.

THE CRAWLER

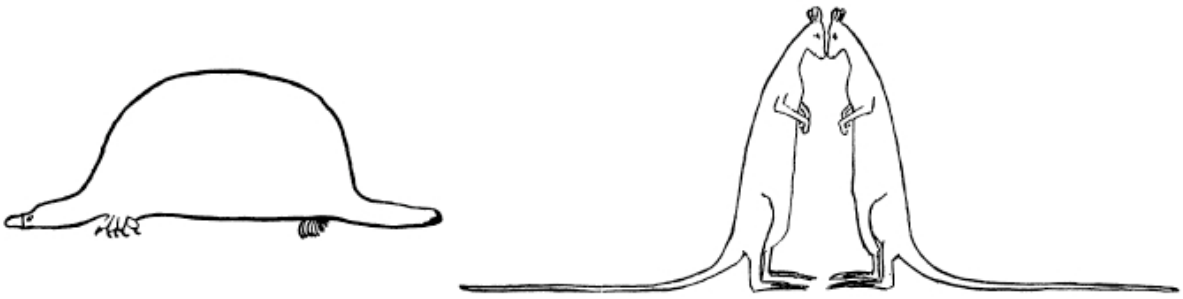
Sorry to harp on about this, but the recent visit of Vaughan Jones to Massey prompted me to read up on the Fields Medal on wikipedia. Incredibly, only 44 medals have been awarded since 1936. Being Commonwealth Games time, here are the current country standings: USA 11, France 8, UK 7, Russia/USSR 6, Japan 3, Belgium 2, NZ, China, Germany, Italy, Norway, Sweden, Finland 1 each. (But the rumour is that Australia's Terry Tao is definitely going to get one this year.) All but Ahlfors and Douglas (1936), Schwartz (1950), and Kodaira (1954) are still living. In the same period there have been 148 Nobel Prizes in physics.

The Abel Prize (`www.abelprisen.no/en/`) was announced last week. At a conference we ran a little sweepstake on the winner, but no one picked Lennart Carleson of Sweden. One of hist most famous results is the almost-everywhere pointwise convergence of Fourier series (Acta Mathematica, 1966), which he apparently tried for years to find a counterexample to, and spoke about at his Raglan NZMRI lectures. There is a good popular exposition of his work by Marcus du Sautoy.

Garry Tee has come up with another NZ *Annals* paper: Charles Earnest Weatherburn, "On Lamé families of surfaces", Annals of Mathematics (2) 28, 1926/27, 301–308 (MR1502782).

Jeff Miller's web site http://members.aol.com/jeff570/mathword.html gives the earliest known uses of some mathematical words and symbols, such as: abundant number (Theon of Smyrna, AD 130), associative (William Hamilton 1843), axis (Thomas Digges 1571), bootstrap (Bradley Efron, 1979). Fascinating short essays and references, and I'm impressed that so much is known. In my own field, I have been credited with the term *Geometric Integration*, because I used it in a seminar in 1993, but I'm pretty sure it wasn't due to me. I thought it was Ari Iserles's, but he denies it too. And that was only a dozen years ago! I found Jeff Miller's web site while searching for the term *tail* (of a probability distribution). This is apparently due to William Gosset (alias Student), who in 1927 drew the following picture:

* In case any of my readers may be unfamiliar with the term "kurtosis" we may define mesokurtic as "having β_2 equal to 3," while platykurtic curves have $\beta_2 < 3$ and leptokurtic > 3. The important property which follows from this is that platykurtic curves have shorter "tails" than the

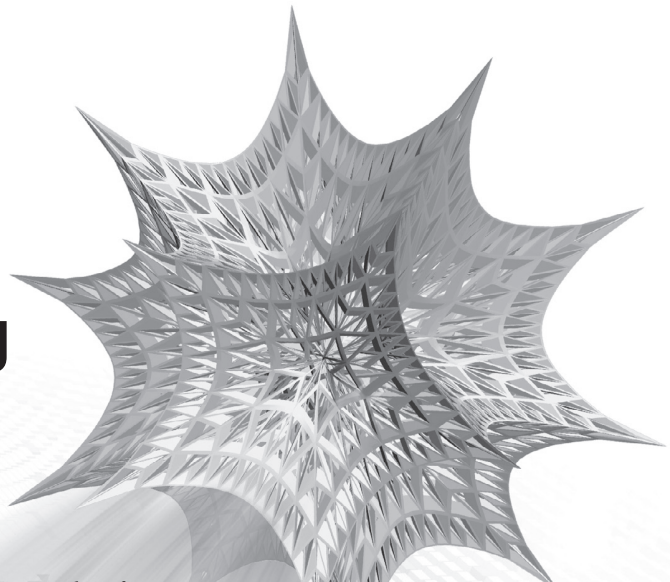


normal curve of error and leptokurtic longer "tails." I myself bear in mind the meaning of the words by the above *memoria technica*, where the first figure represents platypus, and the second kangaroos, noted for "lepping," though, perhaps, with equal reason they should be hares!

Geoff Jones

Introducing
64-bit & multicore
technical computing

MATHEMATICA® 5.2



New in *Mathematica* 5.2—

- All-platform support for 64-bit addressing
- Multicore support on major platforms
- Multithreaded numerical linear algebra
- 64-bit-enhanced arbitrary-precision numerics
- Vector-based performance enhancements
- Bundled notebook indexing for desktop search
- SSH support for secure remote kernels

New in *Mathematica* 5.1 and 5.0—

- Optimized numerical linear algebra
- Industrial-strength string manipulation
- Event handling in differential equations
- Fully integrated piecewise functions
- Integrated support for assumptions
- Support for quantifiers and quantifier elimination
- Large-scale linear programming
- Advanced methods for solving differential equations
- Solvers for differential algebraic equations
- Built-in universal database connectivity
- Integrated web services support
- Graphical user interface development tool
- Support for more than 60 import/export formats
- Highly optimized binary data I/O

A Selection of *Mathematica* Features—

Numeric computation: full support for arbitrary and machine precision ▪ hundreds of mathematical functions fully implemented for all parameters ▪ fast sparse and dense matrix operations ▪ solvers for equations and differential equations ▪ finite and infinite sums and products ▪ integral transforms ▪ global optimization ▪ linear programming ▪ automatic or manual algorithm selection ▪ precision control

Symbolic computation: expanding ▪ simplification ▪ factoring ▪ solvers for equations, differential equations, difference equations, and inequalities ▪ sums ▪ products ▪ differentiation ▪ integration ▪ limits ▪ power series ▪ integral transforms ▪ algebraic and semi-algebraic domains

Statistics and data analysis: descriptive statistics of uni- and multivariate data ▪ generalized linear and nonlinear fitting ▪ multidimensional interpolation ▪ convolution ▪ correlation ▪ regression ▪ ANOVA ▪ confidence intervals ▪ distributions ▪ hypothesis testing ▪ statistical plots

Programming: multiparadigm symbolic programming language ▪ support for procedural, functional, list-based, rule-based, and object-oriented programming ▪ advanced pattern matching ▪ just-in-time compilation ▪ platform-independent implementation

Discrete mathematics: combinatorics ▪ graph theory ▪ computational geometry ▪ number theory ▪ Diophantine equations

Graphics: over 50 2D and 3D plot types ▪ graphics language ▪ animations ▪ sound generation

Connectivity: .NET, Java, and C/C++ APIs ▪ import and export filters for over 40 data and image formats ▪ XML support ▪ symbolic language XML

Publishing: full technical document system for presentation, print, and the web ▪ interactive typesetting and graphics ▪ sound ▪ outlining ▪ one-step export to TeX, LaTeX, XML, MathML, HTML, and XHTML

Platforms: Windows, Macintosh, Linux, other Unix platforms ▪ web and grid versions available

User interface: WYSIWYG notebook interface ▪ programmable buttons and palettes ▪ presentation environment with slide show ▪ fully interactive help

WOLFRAMRESEARCH

Contact us today to get your FREE Info Pack!

Five Ways of obtaining your FREE *Mathematica* Info Pack:

1. Call 0800 477 776 or 07 839 9102 **2. Email** 1731@hrs.co.nz
3. Fax the form below to 07 839 9103 **4. Mail** a copy of this form completed to HRS, PO Box 4153, Hamilton East.
5. Visit www.hrs.co.nz/1731.aspx to request your info pack or download a trial version.
Note: Please ask for the *Mathematica* 5.2 information pack and quote lead reference **1731** when contacting us.

Contact Details

Name:_____
Position:_____
Department:_____
Organisation:_____
Address 1:_____
Address 2:_____
City:_____
Phone:_____ Fax:_____
E-mail:_____
Your industry:_____
Your particular interest:_____

Please tick the appropriate boxes below:

☐ I already use *Mathematica* but I want to upgrade to 5.2 from version_____

☐ Please send me my *Mathematica* 5.2 info pack.

☐ Please include the HRS Software Guide in the pack.

WOLFRAMRESEARCH

HRS
Hoare Research Software Ltd

1731

New Zealand's Technical Software Source