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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 edited by Miguel A Moyers González and Phillip L Wilson. Editorial enquiries and items for submission to this journal should be submitted as plain text or LaTeX files with "NZMS newsletter" in the title of the email to phillip.wilson@canterbury.ac.nz. LaTeX templates are available upon request from the editors.

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EDITORIAL

Although this Newsletter is later than intended, we find ourselves still thinking about the recent Games of the XXXI Olympiad, Rio 2016, and the current fifteenth summer paralympic games. Searching through the web about Maths and Olympics we came across a website created four years ago for the London Olympics called sport.maths.org. Even though is not current, it is a nice site to get students interested in maths. One of the projects caught our attention: "What would be the ideal weather conditions for breaking the world record in the shot put?" It is a nice modelling question and could be a great problem for first year maths or engineering students wanting to do some mathematical modelling. They could even check their solutions with actual physical data! They just have to check the weather conditions at the exact moment when Michelle Carter made her last shot in order to strip away Valerie's gold medal.

Beyond projects for undergraduates, what can we do as a community of mathematicians to engage with the sporting community and help our team for 2020? If you would like to write us a letter on this theme or any other, please send it to phillip.wilson@canterbury.ac.nz. We would also welcome your comments and suggestions following this, our second issue as editors.

We would also welcome articles of relevance to the forthcoming US Election, especially bearing in mind its obvious international implications. What is the fairest voting system? How would international mathematical collaborations fare under each candidate?

We look forward to hearing from you.

Miguel Moyers and Phil Wilson

PRESIDENT'S COLUMN

Many thanks to Gaven Martin for his long service (18 years!) as Editor of the NZ Journal of Mathematics. The new Editor is Shaun Cooper, and I'm grateful to Shaun for taking on this role. Shaun has a lot of experience with the Journal. He has been an active member of its Editorial Board for several years. He has also served on the joint Committee of the NZMS and the Department of Mathematics of the University of Auckland which publishes the Journal. Winston Sweatman has replaced Shaun as one of the two NZMS representatives on the Committee (the other is Rod Goldblatt).

A new research prize has been established. The "Kalman Prize for Best Paper" is generously funded by the Margaret and John Kalman Charitable Trust. The Prize will be awarded for an outstanding and innovative piece of research published by a member of the NZMS. Included later in this Newsletter is a call for nominations for the Prize, as well as calls for nominations for Council and for Incoming Vice President, and for applications for student-travel grants.

The NZMS Council has decided to no longer charge for job or PhD-position listings on our website, provided the request comes from a source appropriately affiliated with our community. The listings will be on our site under "Opportunities", and will be linked to from the homepage.

There are several events to look forward to. The 2016 NZ Mathematics and Statistics Postgraduate Conference will be held in Queenstown from Sunday 20 November to Tuesday 22 November. The organisers are Paula Bran, Chuen Yen Hong, Johannes Mosig and Vee Liem Saw of the University of Otago.

The 2016 NZ Mathematics Colloquium will be held at the Victoria University of Wellington from Monday 5 December to Thursday 8 December. There will be a reception on the evening of Sunday 4 December. Thursday will be dedicated to Mathematics Education and may be registered for separately from the remainder of the Colloquium. Registration is open at nzmathsoc.org.nz/colloquium2016/. The NZMS Colloquium Lecturer is Hinke Osinga, the ANZIAM Lecturer is Roy Kerr, and the Butcher-Kalman Lecturer is Rachael Tappenden. The other plenary speakers are Alex Melnikov, Caroline Yoon, Geoff Whittle and Ben Burton.

Adam Day and Noam Greenberg from the Victoria University of Wellington are organising the 2017 NZMRI Summer School. It will take place in Napier, from Monday 9 January to Saturday 14 January. The topic is mathematical logic and computability. See sms.victoria.ac.nz/Events/NZMRI2017/WebHome.

Astrid an Huef

INVITED ARTICLES

The following invited article is by 2015 NZMS Research Award winner Hinke Osinga of the University of Auckland, whose citation read "for pioneering work on theory and computational methods in dynamical systems and its applications in biology and engineering."

NZMS award ceremony, 3 Dec. 2015, Christchurch; photograph by Chris Tuffley, Massey University.

Theory and computational methods in dynamical systems

Dynamical systems is a field of mathematics that naturally combines both theory and applications. Its geometrical and topological character has led to classical textbooks that are studied by mathematicians, physicists, and engineers alike [1, 6, 9, 10, 11]. While the textbooks often rely on sketches to illustrate ideas, numerical computations are more common when tackling realistic applications. Either way, visualisations are an important tool to convey ideas and communicate with other disciplines. It is not surprising that applications often pose new challenges that drive the development of numerical techniques. However, the field of applied dynamical systems can also offer new insights that go far beyond a confirmation of known theory.

My research has always focussed on visualisation: the creation of the perfect picture involves a deep understanding of the subject area. Just as the write-up of a paper often reveils subtleties of the theory that need a more thorough investigation, so can visualisation point to gaps in our understanding that were glossed over in the study so far. Visualisation is not only a reality check. It is often necessary to develop new numerical tools that push the boundaries of our knowledge, both in numerical analysis as well as dynamical systems theory. After all, one can only visualise what was computed and understood first. The final slide of my presentation at the International Congress of Mathematics in Seoul, 2014, stated: "Numerics boldly goes where no theory has gone before." This statement effectively summarises my research since I started my professorship at The University of Auckland in October 2011.

My expertise is the computation and visualisation of invariant manifolds. Stable and unstable manifolds of equilibria, periodic orbits, or other compact normally hyperbolic invariant manifolds of saddle type are an important part of the so-called *skeleton* of a dynamical system. While the attractors organise the eventual, asymptotic behaviour of the system, stable and unstable manifolds describe the global structure of the system, dictating which initial condition goes where, and in what manner. Consider a dynamical system described by a vector field

$$\dot{x} = \mathbf{f}(x), \tag{1}$$

where $x \in \mathbb{R}^n$ and $\mathbf{f} : \mathbb{R}^n \to \mathbb{R}^n$ is sufficiently smooth. An equilibrium p of (1) satisfies $\mathbf{f}(p) = 0$ and p is typically hyperbolic, meaning that the eigenvalues of the Jacobian matrix evaluated at p do not typically lie on

the imaginary axis. Suppose that k eigenvalues are stable and the other $n-k$ eigenvalues are unstable. Then p has a k-dimensional stable manifold $W^s(p)$ that consists of all trajectories of (1) that converge to p in forward time; similarly, p has an $(n-k)$-dimensional unstable manifold $W^u(p)$ that is its stable manifold for the time-reversed flow. The Stable Manifold Theorem [8] guarantees that $W^s(p)$ and $W^u(p)$ are as smooth as $\mathbf{f}$, and they are tangent to hyperplanes at p spanned by the k stable and $n-k$ unstable eigenvectors, respectively. In particular when $k = n-1$, the global stable manifold $W^s(p)$ acts as a critical boundary that separates two regions with substantially different behaviour.

The Lorenz system is an illustrative example. It is the vector field in $\mathbb{R}^3$ given by

$$\begin{cases} \dot{x} &= \sigma(y-x), \\ \dot{y} &= \rho x - y - xz, \\ \dot{z} &= xy - \beta z, \end{cases} \tag{2}$$

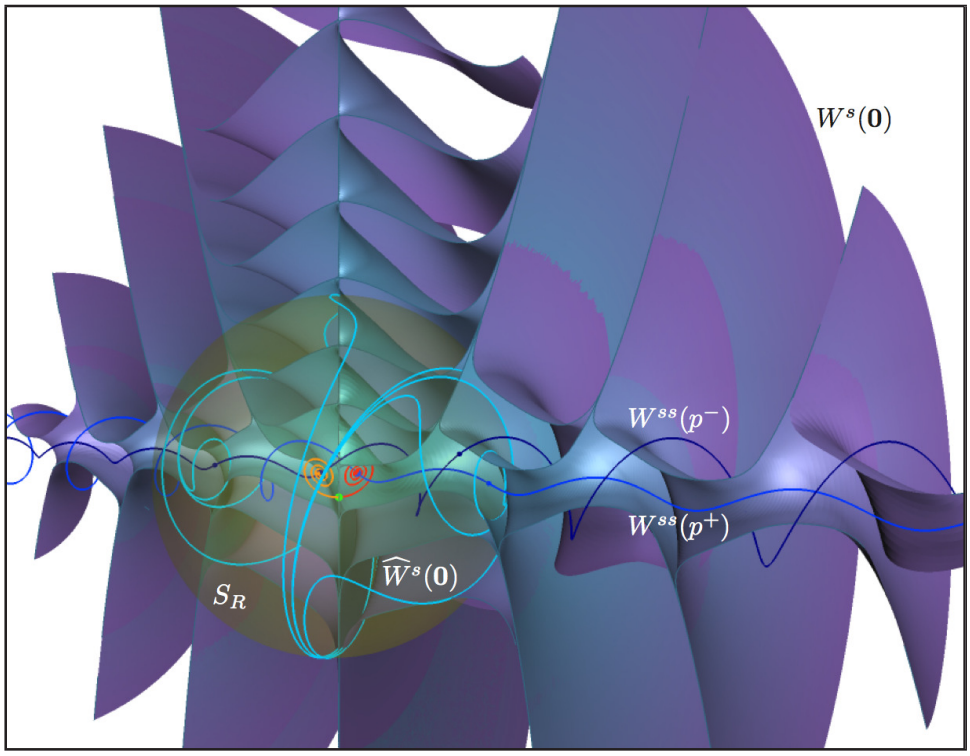

Figure 1: Invariant manifolds of the Lorenz system (2) with $\rho = \sigma = 10$ and $\beta = \frac{8}{3}$. Reproduced with permission from [4].

where $\rho, \sigma, \beta \in \mathbb{R}$ are parameters. There always exist three equilibria, namely, the origin $\mathbf{0}$ and two non-trivial equilibria $p^{\pm}$ that are symmetric with respect to rotation by π about the z-axis. Figure 1 shows the two-dimensional stable manifold $W^s(\mathbf{0})$ of the origin $\mathbf{0}$ for $\sigma = 10$ and $\beta = \frac{8}{3}$ at their classical values and $\rho = 10$ instead of its classical value 28. With Sebius Doedel and Bernd Krauskopf, we use $\rho = 10$ in [3, 4] to illustrate the simple case: for this smaller value of ρ, there is no strange attractor. Most trajectories converge to either p^+ or p^-, which are both stable when $\rho = 10$ and the only attractor of the system. The origin is a saddle with two stable and one unstable eigenvalues. The basins of attraction of $p^{\pm}$ are separated by the surface $W^s(\mathbf{0})$, and the one-dimensional unstable manifold $W^u(\mathbf{0})$ consists of two trajectories that spiral into $p^{\pm}$.

Topologically, $W^s(\mathbf{0})$ is growing disk, but Figure 1 shows that this surface in the (x,y,z)-space seems a lot more complicated. It is no surprise that $W^s(\mathbf{0})$ is often used to test numerical algorithms for the approximation of two-dimensional manifolds. The manifold has a strong spiralling character with two different rotation axes formed by the one-dimensional strong stable manifolds of $p^{\pm}$, which are tangent to the eigenvector associated with their only real and strongest contracting eigenvalue. Figure 1 also shows the intersection curve $\widehat{W}^s(\mathbf{0})$ of the manifold with a sphere S_R that encloses $p^{\pm}$, $\mathbf{0}$, and its unstable manifold $W^u(\mathbf{0})$. The numerical computation of $\widehat{W}^s(\mathbf{0})$ was

performed in one run producing a single closed curve. This confirms the geometric property of $W^s(\mathbf{0})$ and offers topological insight into what happens to the Lorenz system (2) as ρ is increased into the chaotic regime; see [3, 4] for more details.

Global invariant manifolds are key to our understanding of asymptotic behaviour of dynamical systems. More recent developments show that they can also be very useful for explaining short-term transient dynamics. As a particular example, consider the situation that system (1) has two different time scales, so that it can be written as

$$\dot{x} = \begin{pmatrix} \dot{x}_r \\ \dot{x}_s \end{pmatrix} = \begin{pmatrix} \mathbf{f}_r(x_r, x_s) \\ \varepsilon \mathbf{f}_s(x_r, x_s) \end{pmatrix}, \tag{3}$$

with $r+s=n$ and $(\mathbf{f}_r, \varepsilon \mathbf{f}_s)^T = \mathbf{f}$. Here, we assume $0 < \varepsilon \ll 1$, which means that x_s evolves on a much slower time scale than x_r. If we take the singular limit $\varepsilon \to 0$ then x_s becomes a vector of parameters and the equation for x_r, called the fast subsystem, exhibits dynamics that depends on the choice of x_s. For each x_s, the skeleton of the fast subsystem includes equilibria, periodic orbits, and global invariant manifolds. As x_s varies slowly, the system transforms continuously through the family of skeletons and its behaviour is dictated by the asymptotic properties of the fast subsystem.

As an important example, consider the case with $r=2$ and $s=1$, and $\mathbf{f}$ such that the fast subsystem has an s-dependent Z-shaped curve of equilibria with a middle branch e_M that consists entirely of saddles. Since $r=2$, each saddle equilibrium on e_M has a one-dimensional stable and one-dimensional unstable manifold. Within the two-dimensional fast subsystem dynamics, this one-dimensional stable manifold acts as a separatrix, but the s-parametrised family of stable manifolds, which we denote $W^s(e_M)$, is not invariant for the full three-dimensional system (3). This situation is precisely as in [5, 7], where we predict spiking dynamics of an excited system of the form (3) with $r=2$ and $s=1$. The precise equations are given by

$$\begin{cases} \dot{x} &= -1.1x^3 + 2x^2 - y - bz + \text{Perturb}(t, T_{\text{ON}}, I_{\text{app}}), \\ \dot{y} &= x^2 - y, \\ \dot{z} &= \varepsilon[2(x-z) + 0.1], \end{cases} \tag{4}$$

where

$$\text{Perturb}(t, T_{\text{ON}}, I_{\text{app}}) = I_{\text{app}} \,\text{Heav}(t) \cdot \text{Heav}(T_{\text{ON}} - t) = \begin{cases} I_{\text{app}}, & 0 \le t \le T_{\text{ON}}, \\ 0, & \text{otherwise}, \end{cases}$$

represents a perturbation of duration $T_{\text{ON}} = 15$ and strength $I_{\text{app}} = 0.2$, that excites the system away from equilibrium. The time-scale separation is $\varepsilon = 0.001$ and the parameter b controls the number of spikes produced during the transient process of relaxation back to equilibrium as $t > T_{\text{ON}}$.

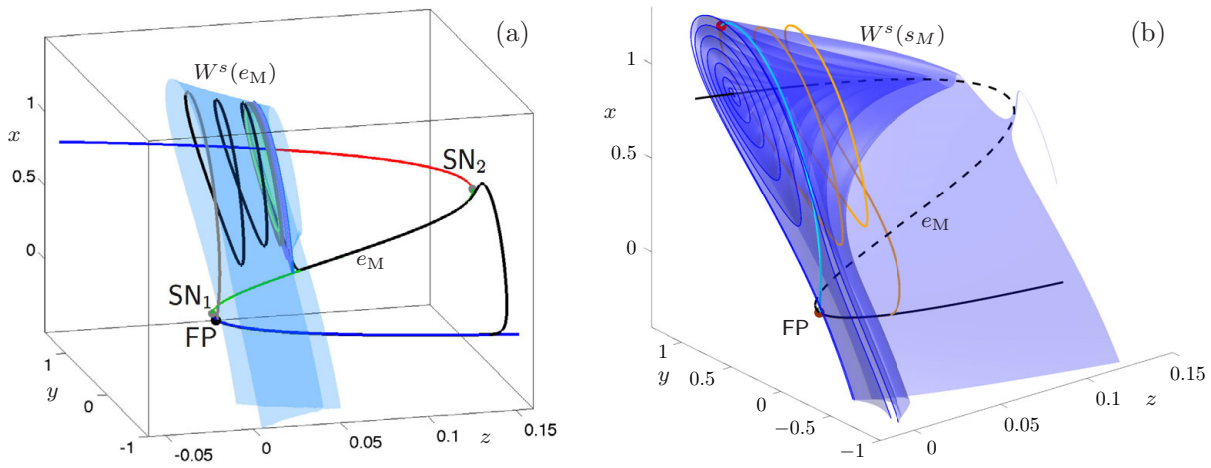

Figure 2: Separatrices organising the three-spike transient response of system (4) with $b = 0.778355$ in panel (a) and $b = 0.9$ in panel (b). Panel (a) reproduced from [7], with the permission of AIP Publishing. Panel (b) is yet unpublished joint work with Saeed Farjami and Vivien Kirk.

Figure 2 illustrates the Z-shaped curve of equilibria with the middle saddle branch e_M; panel (a) is for $b = 0.778355$ and panel (b) is for $b = 0.9$. In both cases, the response produces three spikes after perturbation from the equilibrium FP. The value for b is minimal in panel (a); for any smaller value of b, the response will produce four or more spikes. In [7], Krasimira Tsaneva-Atanasova and I argue that the spike onset is brought about by the family $W^s(e_M)$ of one-dimensional stable manifolds of the saddle branch e_M that is invariant for the fast subsystem. Indeed, immediately following the three spikes, the response lies (approximately) on $W^s(e_M)$, which causes it to accumulate on e_M and track this branch up to the fold point SN_2.

In follow-on work with Saeed Farjami and Vivien Kirk, we define a separatrix $W^s(s_M)$ in the full system that organises the entire three-spike response and not just the local behaviour near e_M. The theory of multiple-time-scale systems [2] predicts the existence of a so-called slow manifold s_M that lies $O(\varepsilon)$ close to e_M. This manifold has the same dimension as e_M and is also of saddle type. Moreover, s_M is invariant, in the sense that it is an orbit segment of (4) if $I_{\text{app}} = 0$. We designed an algorithm based on the pseudo-arclength continuation of a two-point boundary value problem that approximates the stable manifold $W^s(s_M)$ of the saddle saddle slow manifold s_M. Since $W^s(s_M)$ is again a family of orbit segments of (4) with $I_{\text{app}} = 0$, the response cannot cross $W^s(s_M)$ as soon as $t > T_{\text{ON}}$. The red dot in Figure 2(b) indicates when $t = T_{\text{ON}}$ and the yellow segment past this point must remain on the same side as $W^s(s_M)$; this explains why the response is forced to make exactly three rotations before relaxation back to FP.

Invariant manifolds are the crucial components of a dynamical system that offer information about the global behaviour. Their interactions with each other or with slow manifolds in multiple-time-scale systems are hot topics of current research. Computing invariant and slow manifolds accurately and efficiently is key in this context. Similarly important is their visualisation to convey meaning and insights, as well as the beauty and elegance of dynamical systems theory. Especially when working with colleagues in other fields, an image is worth more than a thousand words.

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MATHEMATICAL MINIATURE

MM40: Tekel — weighed and found wanting

Attempts we have made in the last few Miniatures to understand the coin-weighing problem have always started with 12 coins but 13 is also possible on condition that there are additional standard coins available. I believe the following is true.

Proposition: Given $(3^n-1)/2$ coins which are all the correct weight or one only is either too heavy or too light, together with a supply of additional coins with the correct weight, it is possible with n weighings with balance scales to determine whether all the coins are correct or which one is too heavy or which one is too light.

Can any reader offer me a proof of this and tell me what the answer would be if there were no additional standard coins available?

Many people have contributed to the discussion of

$$1-\tfrac{1}{4}+\tfrac{1}{7}-\tfrac{1}{10}+\cdots=\int_0^1(1+x^3)^{-1}\mathrm{d}x \qquad (*)$$

and I think this has now been worked through. But a suggestion by John Mahony has raised a further question and I am grateful to him for sharing the writing of this miniature with me.

The left-hand side of $(*)$ is a slowly convergent series but it can be evaluated accurately by acceleration techniques. Similarly, the right-hand side, when evaluated by the simple trapezoidal rule over n subintervals, has an error which behaves like n^{-2}. Just as the series can be accelerated, so can the quadrature approximations.

The remainder of this miniature is a synopsis of various suggestions made by John Mahony in an effort to approximate a target figure of 0.83564885 evaluated from the closed form of the integral. According to John, there are several methods available, ranging from simple ones that involve subintervals of equal length (Trapezoidal rule, Simpson's rule etc), to more sophisticated ones that use intervals of variable length (Gaussian quadrature etc). For the simple ones, it can be shown, using the Trapezoidal rule in conjunction with Richardson's extrapolation procedure, that it is possible to reach the target when the integrand is tabulated across 52 intervals. Similarly, using the more accurate Simpson's rule, again with extrapolation, it is possible reach it with tabulations across only 16 intervals.

For the sophisticated methods, Gaussian quadrature produces accurate results fairly rapidly. In these methods, the variable of integration has to be changed to accommodate the formulae. The integral is represented as a finite sum of weighted integrand terms evaluated at n specific abscissa points. These freely available abscissae, and their weights, form the required input data, which has to be stored in memory. In the case of a Gauss-Legendre procedure it is possible to converge on the target with tabulation at only 8 abscissa points ($n=8$).

The question as to which is the best method to use depends on the requirements and on the availability of resources. The simpler ones are easy to remember, are "stand-alone" (do not require the support of a library of coefficients) and are particularly well suited for use with extrapolation. If significant accuracy is not required they can be exploited using pencil, paper and a hand held calculator, otherwise a spreadsheet could be employed. On the other hand, if there is a call for significant accuracy then Gauss-Legendre quadrature is the method to adopt. It works well on a spreadsheet but its disadvantage is that it is not "stand-alone". It requires access to material in memory, and accuracy in results will be limited by the accuracy of this material. From a purist's perspective, the treatment of the sum via a numerical integration procedure avoids the need to use intrinsic transcendental functions and logarithms that were drawn upon to produce the above target figure.

n	$T(n)$	$T'(n)$	$T''(n)$
1	0.75000000		
2	0.81944444	0.84259259	
4	0.83170024	0.83578551	0.83533171
8	0.83466962	0.83565941	0.83565101
16	0.83540454	0.83564951	0.83564885

In conclusion a table is presented with $T(n)$, the trapezoidal rule result over n subintervals, together with its first extrapolation

$$T'(2n)=(4T(2n)-T(n))/3$$

and the second extrapolation

$$T''(2n)=(16T'(2n)-T'(n))/15.$$

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CYBERMATH

There has been a lot of discussion about scholarly publishing in the last several years. The crisis in libraries caused by escalating serials costs, the development of open access publishing options (some of which are very good, but others truly awful) have been the most talked about issues. Also, the peer review system has been seen to be struggling — errors in published work, suspicions about ethics of reviewers and editors, and outright fraud and plagiarism by authors are being reported more often than ever.

The debate has been strident at times, with the "silent majority" of researchers unheard. I therefore decided to try to gauge global mathematical community opinion on many issues related to mathematical research publication, via an online survey. A fuller description is intended to appear in Notices of the American Mathematical Society, and preliminary results have been described in a blog post I wrote with Cameron Neylon and David Roberts: blogs.lse.ac.uk/impactofsocialsciences/2016/06/22/. More about the rationale behind the survey can be found in this interview: blog.scholasticahq.com/post/mathematician-asks-peers-how-they-feel-about-scholarly-journal-publishing-interview-with-mark-c-wilson/.

So far there are almost 1000 responses. The first 842 were generated via a process of directly emailing personal contacts and email lists and asking people to propagate the survey. The remainder are responses to a semi-random sampling of published authors and mathematics department members. Just over 10% were from Oceania (we have no way of knowing how many of those are from NZ).

The preliminary results show that there is substantial and widespread appetite for change. Over 60% of respondents rated the need for improvements to mathematical journals as 3 or 4 on a 1–5 Likert scale. In addition to multiple choice survey questions, we allowed free-form answers about specific journals which we are still analysing. The number of journals mentioned is around 100.

Interestingly, about one third of respondents had acted as an editor of a journal in the last three years. Responses of editors and non-editors differed somewhat, but overall were remarkably similar. The biggest difference is that editors are less interested in open access than non-editors.

One reason I started this survey is to open a conversation in the mathematical community about ownership of journals. My own view is that the research community should have control over journals, because this is the only way to implement much-needed improvements in professionalism, ethics and efficiency. The current dysfunctional journal market does not provide sufficient incentives for such improvements to be undertaken by publishers. I included several questions aimed at gauging what researchers find important about journals. As I expected, such factors as peer review quality, and editorial board research reputation were hugely more important to respondents than the identity of the publisher or the historical reputation of the journal. I included several questions asking about not only the participant's attitudes to change but how they think the community feels about these issues. A key finding is that respondents are on average much more interested in change than they perceive the community as a whole to be. So the status quo may be relatively unchallenged because of the perception of peer pressure, not actual peer pressure.

It is not just publishers who need to improve. Editorial processes are very opaque: how editors are selected (not elected!) and how peer review process is handled are very important issues that should have much more transparency and community input. In the survey, around 30% supported compulsory term limits for editors, 40% direct election of editors, and 40% a ban on monetary payments to editors, while over 50% supported compensation for referees and nearly 50% supported moderated post-publication review.

There is much more to be said about the results. take a look at the above links, and fill in the survey yourself if you haven't already: docs.google.com/forms/d/1r4LBUJk1VF9e4Dl4aXgS4fW-O8HR9yz1cqmXdzz0CjM/.

Mark C. Wilson

PROFILE

Astrid an Huef

Astrid an Huef was born in Karlsruhe, Germany. When she turned 13, her family moved to New Zealand, and she spent two years as a student at Wellington High School. The biggest culture shocks were the requirement to wear a school uniform and the notion of single-sex schools. Fortunately Wellington High was co-ed, though the uniform was the antithesis of a fashion statement. She and her family enjoyed their two years in Wellington, and Astrid was delighted at the opportunity to return to New Zealand when she took up the Chair of Pure Mathematics at the University of Otago in December 2009.

In January 1985, Astrids family moved to Australia. By then she spoke English with a New Zealand accent, which resulted in some teasing and questions about "the underarm incident" (Astrid was mystified). They lived in Toronto, NSW (not to be confused with the small town on the shores of Lake Ontario) where she finished high school. The international moves caused some significant gaps in Astrids education. In particular, a mathematics teacher at Toronto High School advised her against taking the higher mathematics class. Astrid recalls that at the time she was incensed, and she did not even think about taking his advice. Instead, she successfully worked at filling her gaps with the help of her older sister.

After finishing high school, Astrid went to the University of Newcastle, majoring in Computer Science. She enjoyed the mathematics courses more than the computer science ones, and in her third year she switched to a combined degree with Mathematics. She then went on to do an Honours degree in Mathematics.

At the time, Newcastle had a lively research group working in operator algebra. Having had courses on Functional Analysis and Measure Theory in third year, Astrid was well-prepared to work with the group. Her Honours thesis contained several innovations and earned Astrid a University Medal. (In hindsight, her innovations have proved to be of lasting significance.) The operator-algebra group had many international collaborators, and encouraged them to spend time in Newcastle. It also made sure that Honours and PhD students got the chance to interact with these visitors. Thus Astrid met Dana Williams of Dartmouth College, who soon after became her PhD supervisor.

In 1994 Astrid moved to Hanover, New Hampshire (not to be confused with the small village on the River Leine) to start her PhD studies at Dartmouth College. Dartmouth College is primarily a small Liberal-Arts university which belongs to the Ivy League, and has a small but strong graduate program in mathematics. Hanover is a small picturesque college town several hours north-west of Boston. This was light years from Newcastle (and indeed Wellington)!

Of her time as a PhD student, Astrid is particularly appreciative of the support system provided by her fellow students and the faculty. As part of her graduate fellowship at Dartmouth, Astrid participated in a two-month long teaching seminar in the summer of her second year, after which she taught one undergraduate course per year. On the research side, Astrid obtained significant results in the representation theory of operator algebras associated to dynamical systems. She graduated in 1999.

Helped by her teaching experience at Dartmouth College, Astrid straightaway obtained a tenure-track position at the University of Denver. The University of Denver is again a small Liberal-Arts university, but this time in the beautiful Rocky Mountains region. She very much enjoyed the students and working with her colleagues there.

There was a desire to go home, and Astrid applied for a job at the University of New South Wales (UNSW) in Sydney. The day that UNSW offered her a job, she also got an email from the National Science Foundation congratulating her for her successful grant application. Unfortunately she couldn't take the grant to UNSW, where she spent the next eight years of her career.

UNSW is a large metropolitan university of 30,000 students specializing in engineering. The School of Mathematics and Statistics has a major role teaching the engineering students, and Astrid learned first-hand how much effort it takes to coordinate lecturers and tutors teaching thousands of students. UNSW also placed an emphasis on research that Astrid had not seen before. She was expected to organize research programs, find collaborators and students to help implement them, and apply for grants to make this all happen. In retrospect, she found this surprisingly easy: she found that, in following her own instincts, she had already built up a substantial support network. So her research programs flourished.

In 2008 the University of Otago advertised a Chair of Pure Mathematics. Astrid saw this as an opportunity she was ready for, and, the more she thought about it, the more she fancied returning to NZ. So she applied. It turns out she was on holidays in Wanaka when e-mailed to arrange and interview, and almost lost out because she was not checking e-mail. Anyway, she got the job.

Astrid realised that if she wanted to have an influence in NZ, she had to demonstrate that she wanted to help make things happen. She has enthusiastically engaged with the NZ mathematical community (she is currently President of the NZ Mathematical Society), and has become heavily involved in University affairs (for example, she has served on many promotion committees and sits on Senate). But she has continued to develop her research network, and her research is flourishing.

Astrid looks forward to many years doing what she likes to do, with people she likes, in a place she likes very much.

Miguel Moyers

LOCAL NEWS

AUCKLAND UNIVERSITY OF TECHNOLOGY

SCHOOL OF ENGINEERING, COMPUTER AND MATHEMATICAL SCIENCES

Dr Willem van Straten is a newly appointed senior lecturer in the Department of Mathematical Sciences at AUT. He is primarily interested in two major themes of radio pulsar astronomy: 1. using pulsar timing to test our understanding of gravity and search for low-frequency gravitational waves; and 2. applications of the latest developments in high performance computing, digital signal processing, artificial intelligence and autonomous systems to all aspects of the search for new pulsars and fast radio transients.

Willem van Straten

Dr Katharina Parry, who joined in the School of Computer and Mathematical Sciences in 2013, resigned her lectureship position at AUT in June and took a lectureship position at Massey University (Palmerston North).

Visitors

Prof Gerald Beer (California State University at Los Angeles) visited Prof Jiling Cao in February 2016 and presented a talk entitled "Uniform continuity of a product of real functions" in the Mathematical Sciences seminar series.

Prof Peter Nyikos (University of South Carolina) visited Prof Jiling Cao in March 2016 and presented a talk entitled "Discontinuities and smooth curves in n-space" in the Mathematical Sciences seminar series.

A/Prof James Allison (North-West University, South Africa) visited the Department of Mathematical Sciences in May 2016 and presented a talk entitled "Two new tests for symmetry based on the empirical characteristic function" in the Mathematical Sciences seminar series.

Prof Irene Hudson (University of Newcastle, Australia) visited the Department of Mathematical Sciences in May 2016 and presented a talk entitled "Analytics and informatics" in the Mathematical Sciences seminar series.

Dr Patrick Beissner (National University of Australia) visited the Department of Mathematical Sciences, between 27 June and 5 July. During his stay at AUT, Patrick worked with Prof Jiling Cao on a couple of topics in Mathematical Economics.

Prof Jeong-Hoon Kim (Yonsei University, Republic of Korea) visited the Department of Mathematical Sciences in July. Prof Kim worked with Prof Jiling Cao and Dr Wenjun Zhang on using mathematical models to price volatility derivatives.

Events

The Mathematical Sciences Research Group (MSRG), within the School of Engineering, Computer and Mathematical Sciences, is planning to host a Mathematical Sciences Symposium over the period 1st–2nd December 2016 at AUT.

Earlier this year, the Department of Mathematical Sciences signed a one-year partnership with Sovereign. This partnership will give the AUT Master of Analytics students insight into the key analytics challenges faced by Sovereign, through guest lectures, case studies and student projects. The partnership will also provide the starting point for future joint research projects between Sovereign and the Department of Mathematical Sciences at AUT.

The Department of Mathematical Sciences negotiated an agreement with SAS so that a SAS Joint Certificate in Advanced Analytics can be awarded to postgraduate students completing a selection of papers in which SAS is used as the primary software tool.

Dr Hyuck Chung, Dr Wenjun Zhang and several postgraduate students from AUT went to Victoria University of Wellington to participate in the Maths in Industry NZ Study Group (MINZ) to work on 6 challenges proposed by the industry.

Travel and Conference Participation

Dr Alna van der Merwe attended the 40th South African Symposium of Numerical and Applied Mathematics (SANUM) held in University of Stellenbosch

and presented a talk "Error estimates for the Galerkin nite element approximation for a linear second order hyperbolic equation with modal damping" in March 2016.

Dr Alla Shymanska was invited as a plenary speaker at the International Conference on Engineering Mathematics and Physics (ICEMP 2016) held at Dubai, UAE 7-9 April, 2016. Her plenary talk was "Spatial Resolution of Infrared Imaging Systems".

Dr Robin Hankin attended the useR2016 conference in Stanford University, California. He presented his recent work on computational combinatorics to a specialist audience, and chaired a session on reproducible research.

Prof Jeffrey Hunter was honoured at the 25th International Workshop on Matrices and Statistic (IWMS-2016), held at the University of Madeira, Funchal, Madeira over the period June 6-9, 2016, with a special session devoted to his 75th Birthday. The session was chaired by Professor Peter Taylor, University of Melbourne, Australia with additional contributions from Professor Stephen Kirkland, University of Manitoba, Canada, Professor Tugrul Dayar, University of Bilkent, Turkey and Professor Guy Latouche, Universite Libre de Bruxelles, Belgium. Jeff delivered a presentation "A fifty year journey with colleagues, generalized matrix inverses and applied probability". Jeff also contributed to a Memorial session celebrating the life of Ingram Olkin (1924-2016). Prof Hunter has been a member of the International Organizing Committee of IWMS for the past ten years having chaired the workshops held in Shanghai, China in 2010 and Haikou, China in 2015.

Dayar, Latouche, Hunter, Taylor, Kirkland at the University of Madeira.

A/Prof Sergiy Klymchuk presented a paper at the third international conference Mathematics Education and Contemporary Theory (MECT-3) held in Manchester, UK 18–21 July. After that he presented another paper at the Topic Study Group "Teaching and Learning of Calculus" at the 13th International Congress on Mathematics Education (ICME-13) held in Hamburg, Germany 24-31 July. He was also an invited speaker at the Discussion Group on Mathematics Teacher Noticing at the ICME-13 Congress. Between and after the conferences Sergiy visited five STEM Centres in the UK, Germany and Norway.

Wenjun Zhang

UNIVERSITY OF AUCKLAND

DEPARTMENT OF ENGINEERING SCIENCE

Prof. Rosalind Archer (HoD, EngSci) is the new IUTAM representative for NZ and also the inaugural recipient of the Deloitte Energy Excellent Award (www.des.auckland.ac.nz/en/about/newseventsandnotices/news/news-2016/archer-energyexcellence.html).

Prof. Andrew Fowler (Oxford/Limerick) gave a seminar on two-phase flow in volcanic conduits in August, while Dr Stuart Dalziel (DAMTP/Head of Bachelor Laboratory) gave a seminar titled "Water bombs and other fun things" in late July.

Prof. Roger Filliger is visiting from the Bern University of Applied Sciences in Switzerland where he is a Professor of Mathematics and Head of the Master of Science in Engineering Program. His research interests have a strong practical emphasis and range from supply chains, precision farming, wind turbines, and stochastic modelling through to condensed matter physics.

Prof. Karen Willcox (MIT, former EngSci graduate) has been based in the Department during her sabbatical over the past 12 months.

Taniwha, the human-powered submarine developed by staff and students in EngSci and ABI won the world title at the recent championships in the UK (www.auckland.ac.nz/en/about/news-events-and-notices/news/news-2016/07/taniwha-human-powered-sub-world-champion.html).

Richard Clarke

DEPARTMENT OF MATHEMATICS

Eamonn O'Brien has been awarded an outgoing Hood Fellowship which will support him to visit colleagues at leading UK universities to conduct joint research. He will use the opportunity afforded by the Fellowship to conduct research on a number of challenging problems in group theory, including some long–standing conjectures and open problems. During the Fellowship, he will visit and collaborate with researchers at Oxford, Cambridge, Warwick and Imperial College.

Several members of this Department attended ICME-13 (The 13th International Congress on Mathematics Education) in Hamburg. There were 3500 participants, from 106 countries. Bill Barton gave one of

the four plenary addresses with a talk on "Mathematics, Education & Culture: A contemporary moral imperative", and he also chaired a Discussion Group on the Capacity and Networking Project. Tanya Evans chaired a Topic Study Group. Phil Kane was a part of Topic Study Group 03 on Mathematics Education in and For Work, and he gave a presentation on workplace numeracy at one of the sessions on "What is the role and place of mathematics in education in and for work?". Igor' Kontorovich gave an invited paper on "Exploring students interactions in an online forum that accompanied a course in linear algebra". Barbara Miller-Reilly gave an invited talk in the Topic Study Group on "Adults Learning Mathematics". Mike Thomas gave an Invited Lecture on "Building up Mathematics: The Legacy of Zoltán Diénès ".

Jean-François Maheux arrived on June 15, as our new Senior Lecturer in Mathematics Education.

Greg Oates was honoured on June 10 by the LOGOS 18 Seminar on Technology & Pedagogical Knowledge, before his departure to the University of Tasmania.

Arkadii Slinko will be an invited speaker at the workshop "Secret Sharing for Dependability, Usability and Security of Network Storage and Its Mathematical Modeling" on September 5–7, organized by the Institute of Mathematics for Industry, Kyushu University, Fukuoka, Japan. And he has been appointed as Reviewer of The Catalyst Fund of The Royal Society of New Zealand.

Steve Taylor was a member of a team of 6 from New Zealand who were invited to participate in the Japanese Mathematics in Industry Study Group held at Kyushu University and the University of Tokyo, July 27 to August 2. This initiative, partly funded by the Royal Society of New Zealand, also involved a Japanese team participating in the New Zealand study group, MINZ 2016, Wellington, July 4 to 8. Both meetings involved an industry problem from the other country.

Mike Thomas (who is now Emeritus-Professor Michael Oliver John Thomas) gave a plenary talk to the Waikato Mathematics Association of Teachers as the Bevan Werry speaker, entitled "Aim High, Aim Wide".

Dr Friedrich Martin Schneider (from TU Dresden) is a Post–Doctoral Fellow for 2016. His research interests are mainly in general topology, topological algebra and topological dynamics.

Recent visitors include Dr Turgay Bayraktar (Syracuse University), Dr Tommaso Buvoli (University of Washington), Prof. Andrew Fowler (Limerick and Oxford), Dr Julia Gog (Forder Lecturer, University of Cambridge), Prof. Wilfrid Kendall (University of Warwick), Dr Jonathan Kress (UNSW), A-Prof. Simon Marshall (University of Wisconsin — Madison), Prof. Gian-Luca Oppo (University of Strathclyde), Dr Artem Pulemotov (University of Queensland), A-Prof. Dominic Searles (USC), Nicoline van Loenen-den Breems (Lincoln University), Dr Carlos H. Vásquez (Pontificia Universidad Católica de Valparaíso), Prof. Andras Vasy (Stanford University), Prof. Andrew Waldron (UC Davis), Prof. Karen Willcox (MIT) and Prof. James Wilson (University of Colorado — Fort Collins).

Garry J. Tee

UNIVERSITY OF WAIKATO

DEPARTMENT OF MATHEMATICS AND STATISTICS

Ian Craig retires

Ian started at the University of Waikato in 1979 as a lecturer in mathematics and statistics. He had completed a PhD at University College of the University of London in 1974 and post docs at the Mullard Space Science Laboratory, Stanford University and the University of Glasgow, He attained the rank of professor, based in the main on his research achievements. His research areas included solar flares, in particular how vast amounts of energy are stored in these flares and how it is released, the "magnetic field line reconnection problem". He had a very successful research collaboration with Alfred Sneyd.

Tim Stokes

Tim was an invited speaker in June at USMac16 (Universal Structures in Mathematics and Computing 2016), a workshop at the city campus of La Trobe University. His well attended and received presentation was entitled "Constellations: Arrows Without Targets."

Vaipuna Raass

Vaipuna (Puna) successfully defended his PhD thesis in combinatorics entitled "Critical sets in full latin squares". He was supervised by Nick Cavenagh.

Emeritus professorship — text by Stephen Joe

At a recent ceremony, the title of Emeritus Professor was conferred on Kevin Broughan. Besides recognising his research and teaching contributions to Mathematics and the University generally, it also recognised his other substantial contributions to the University. This included the establishment of the School of Computing and Mathematical Sciences (now a Faculty) and the offering of engineering degrees. He was on the University Council for five years and served over 15 years on the Academic Board. He was one of the founders of the New Zealand Mathematical Society. Of particular note is that six of his former students have gone on to academic positions.

New Law building

The new Law building on Hillcrest Road was opened. The image shows the bow of a very sharp ship,

pointing in the direction of the Faculty of Computing and Mathematical Sciences. Mathematics has teaching collaboration with Law in that both subjects contribute to the Cyber Security masters programme.

Kevin Broughan

MASSEY UNIVERSITY

INSTITUTE OF NATURAL AND MATHEMATICAL SCIENCES

Gaven Martin has been elected as a Foreign Member of the Finnish Academy of Science and Letters. Congratulations!

In April, Gaven stood down from being the heads of both the Institute of Natural and Mathematical Sciences (INMS) and the New Zealand Institute for Advanced Studies (NZIAS). Gaven is a founding director of NZIAS and has been the head since its inception in 2007. He became the head of INMS when it was formed in 2012 and before that was head of the Institute of Natural Sciences at Albany. All of these institutes grew tremendously in size, stature and vibrancy under Gaven's energetic and visionary leadership.

Dianne Brunton has accepted appointment as interim head of INMS with Chris Scogings as deputy head, and Peter Schwerdtfeger has been appointed as interim head of NZIAS. We wish the new leaders all the best.

In April, Alona Ben-Tal travelled to the UK where she gave an invited seminar at Exeter University. She then attended the International Conference on Biological Oscillations and the 9th meeting of the European Study Group on Cardiovascular Oscillations in Lancaster, where she chaired a session entitled "Cardiorespiratory interactions" that she had organized and gave a talk.

Alona is an AI on a successful grant from the Health Research Council of New Zealand that aims at improving the outcomes of heart pacemakers by including inputs from breathing; see: www.scoop.co.nz/stories/SC1607/S00042/innovative-study-could-transform-pacemakers.htm. The study is in collaboration with Rohit Ramchandra (PI) and Ian LeGrice (University of Auckland), Nigel Lever (Auckland District Health Board), Julian Paton (University of Bristol), and Alain Nogaret (University of Bath).

Annalisa Conversano attended the International Conference in Model Theory at the Center for Mathematics at Notre Dame, South Bend (USA) in June as an invited speaker.

Shaun Cooper returned from 12 months of long leave at the University of Newcastle, Australia.

In July Mick Roberts attended the ICMS Workshop: Stochastic models of the spread of disease and information on networks at the International Centre for Mathematical Sciences, Edinburgh as well as the joint meeting of the European Society for Mathematical and Theoretical Biology and the Society for Mathematical Biology at Nottingham University, giving talks at both. From there he spent a week at Cambridge University, visiting Julia Gog, the recent Forder Lecturer.

Several staff and students from Albany were involved in the second annual Mathematics-in-Industry in NZ Study Group in Victoria University of Wellington during July 4–8. A report appears elsewhere in this newsletter.

Winston Sweatman and Barry McDonald travelled to Japan in late July to participate in the second half of the two-country arrangement in Mathematics in Industry under the grant received from the Japanese Society for the Promotion of Science and the Royal Society of NZ.

Congratulations to mathematics graduate students Lynette O'Brien (enrolled for MSc) and Graeme O'Brien (enrolled for PhD) on becoming grandparents for the fourth time. Daniel Kenneth Allfrey arrived on August 11 at 6:04 in the morning, weighing a whopping 9 lb 2 oz. Mum Sarah (daughter of Lynette and Graeme) and Daniel are both doing well.

Shaun Cooper

VICTORIA UNIVERSITY OF WELLINGTON

SCHOOL OF MATHEMATICS AND STATISTICS

We are very pleased to have been joined by two new academic staff members. *Georgios (George) Barmpalias* has returned as a Senior Lecturer after a couple of years at the Software Institute of the Chinese Academy of Sciences in Beijing, where he held a prestigious 1000 Young talents scholarship. George was at Victoria in two roles previously, first as a post-doctoral fellow working with *Rod Downey* between 2007–9 and then as a Teaching Fellow in 2014. George has worked on computability and randomness and more recently has completed some startling and visually appealing research on spatial modes in discrete dynamical systems, in particular Schelling segregation. Several colourful computer simulations exhibiting evolution of segregation patterns now adorn the School's corridors. *Nick Brettell* has taken up a post-doctoral fellowship, working with *Geoff Whittle* on algorithmic and complexity problems in matroid theory. Nick will be well known at Canterbury where he completed his PhD with *Charles Semple* before periods as a post-doc in Lyon and Budapest.

Colleagues and students alike were deeply saddened by the illness and death in May of *Ken Pledger*. Although Ken had officially retired in 2003 after 40 years on the academic staff, he continued to teach undergraduate courses, notably his renowned third-year Geometry paper right up until 2015 and had expected to do so again this year. Ken's interest in, profound knowledge and understanding of the history of the subject suffused the course. His inimitable teaching style earned him a reputation honoured by students at the Ken Pledger Fan Club Facebook site. A fuller obituary appears elsewhere in this edition. In just the last month we have also heard of the death of former colleague *Jock Hoe*, in Christchurch. Jock joined the department in Victoria in 1963 and was a gifted teacher of statistics and mathematics as well as a polyglot. He left Wellington to teach in Shanghai before finally returning to New Zealand. His enduring mathematical contribution is the translation initially into French, then English, of an early (1303CE) Chinese monograph on multivariate polynomials. Again, a more complete account of Jocks mathematical life appears elsewhere.

The biggest recent mathematical event at Victoria has been the second Mathematics in Industry New Zealand (MINZ) Study Group, co-organised by *Mark McGuinness* and *Graeme Wake*, and opened by Minister of Science and Innovation, Steven Joyce. (See also the report on the Study Group later in this issue.) In the style of such study groups, especially ones with these experienced leaders, the meeting was intellectually challenging, fruitful for all the participants — both researchers and industry partners — and, of course, great fun. The presence of a delegation from the sister organisation in Kyushu, Japan, added a valuable extra dimension to the proceedings. Keynote speakers included Adjunct Professor *Andrew Fowler* for whom MINZ is part of a two-month visit to Victoria where he is collaborating on research with Mark McGuinness. Andrew has also been the inaugural speaker in the School's re-launched colloquium series that aims to bring together and challenge researchers from across the mathematical sciences. The talk, "Predicting the unpredictable: drumlins, exploding rocks, worms, landslides" succeeded admirably in posing statistical problems that arise in the realm usually dominated by methods of applied mathematics.

Congratulations to *Michael Mcinnerney* and *Rachel Hunt* on successfully completing their PhDs. Michael's thesis, on Topics in Algorithmic Randomness and Complexity, was co-supervised by Rod Downey and *Noam Greenberg* while Rachel's is entitled Genetic Programming Hyper-Heuristics for Job Shop Scheduling and was co-supervised by Mark Johnston, now at the University of Worcester, and Mengjie Zhang in the computer science programme.

In early April, Mark McGuinness gave his well-attended and beautifully delivered inaugural professorial lecture titled "Problem Solved", in which he recounted some of the modelling problems he has tackled during his career and also gave an insight into the way mathematical modellers work. Quite shortly afterwards we enjoyed further exertion of that theme by this year's Forder Lecturer, Professor Julia Gog, whose talks on the mathematics of disease were models of engaging presentation as well as full of insight into the topics.

Several colleagues, *Ivy Liu*, *Laura Dumitrescu*, *Budhi Surya*, *David Balduzzi* and *Dimitrios Mitsotakis*, visited universities in Beijing and Indonesia in connection with potential research collaborations. The School also held a very successful careers evening for its students, with around 80 attending to hear advice from and talk with alumni in a range of careers, as well as employers. Members of the school, both academic and professional staff, are busy preparing for several upcoming meetingsthe Colloquium in December, the Computability and Complexity Symposium in January (in honour of Rod Downey's 60th birthday) and which precedes the NZMRI Summer School being organised by *Adam Day* and Noam Greenberg in Napier on the topics mathematical logic and computability.

Visitors

Irene David (University of Canterbury) gave a talk "Out of the Ashes", reflecting on lessons learned from the 2011 earthquake. Theodora's Katsaounis from the University of Crete visited Dimitrios Mitsotakis in May and gave a talk on "A posteriori error control and adaptivity for Schrodinger type of equations". Nicholas Witte paid a visit from Massey's Manawatū campus and talked about random matrix theory. Heather Macbeth, an Auckland graduate now at MIT, gave a talk on "K ahlerEinstein metrics on hypersurfaces". Professor Leda Minkova (University of Sofia) visited to continue her collaboration with *Stefanka Chukova* and gave a talk titled "Compound weighted Poisson distributions". Professor Miodrag Lovric gave a talk on statistical controversies and paradoxes. Professor Eric Ulm (Georgia State University) gave a talk on modelling death benefit options under various mortality laws while Renato Costa talked about "Option pricing under nonlinear and non-normal GARCH models". Local speakers recently have included Linda Westrick, Geoff Whittle and Dimitrios Mitsotakis.

Peter Donelan

UNIVERSITY OF CANTERBURY

SCHOOL OF MATHEMATICS AND STATISTICS

Congratulations to *Phillipa Gourdie* who received a 2016 UC Teaching Award in June. Phillipa's work as

a Senior Tutor involves supporting students in the transition to university as well as teaching first year mathematics. Her teaching is described by students as enthusiastic, effective, enjoyable, and exciting — even for mathematics! Phillipa's greatest desire is to see students succeed, and she is always learning so that she can better support this. Her belief is that a great teacher must have a deep love of learning themselves.

Phillipa Gourdie (centre) after receiving her 2016 UC Teaching Award with VC Rod Carr (right) and Charles Semple.

Congratulations to *Raazesh Sainudiin* who secured grants from Databricks Academic Partners Program and Amazon Web Services Educate which enable free and ongoing access for all UC faculty, staff and students to use their enormous cloud-computing infrastructure for academic teaching and research to solve big-data analysis problems. UC has already established a research cluster with thousands of computer nodes. This locally set-up resource taps into the infrastructure provided by these grants and is being used by UC students in a new course in Scalable Data Science.

In July the School welcomed *David Rodda* from St Andrew's College. David took up a continuing senior tutor position.

David Rodda

The same month *John Hannah* retired after nearly thirty years with us. Over all these years John had made many contributions to the University and our School, including being Associate Dean of Engineering for the last three years. He started out in ring theory and became more and more involved in mathematics education. He has tirelessly been a great advocate for mathematics teaching and learning both at a university level and through schools. He has a true commitment to positive student learning and his genuine care for students flows over to all of us in the School. The School's focus on teaching excellence stems from many of John's ideas and beliefs about student learning.

John Hannah.

In May Roy Kerr has been presented the prestigious Crafoord Prize in Astronomy in Sweden by HM King Carl XVI Gustaf of Sweden. The prize is shared equally with Roger Blandford, Stanford University, and is awarded "for fundamental work concerning rotating black holes and their astrophysical consequences". Roy retired as Professor of Mathematics at the University of Canterbury in 1993 after 22 years, including a decade as the head of UC's Mathematics department.

Roy Kerr (centre) with HM King Carl XVI Gustaf of Sweden (right) and Blandford

Black holes are the source of the universe's most powerful radiation, as well as of jets that can stretch many thousands of light years out into space. Roger Blandford's theoretical work deals with the violent processes behind these phenomena. Roy Kerr laid the foundation for this research in 1963, when he discovered a mathematical description of rotating black holes. This became one of the most important theoretical discoveries in modern cosmology.

During June/July, *Mike Steel* presented invited seminars at Oxford University (statistics), the Konrad

Lorenz Institute (Vienna), University of British Colombia (Canada), and was a plenary speaker at the FPSAC (Formal Power Series and Algebraic Combinatorics) conference in Vancouver. He is also co-organising (with Tanja Stadler, from ETH-Zurich) a week-long workshop at the Banff International Research Station on Random Graph Models in Phylogenetics, which is being held this August.

In July the School welcomed three Erskine/Cambridge Fellows in the School. Tim Robinson is from the Department of Statistics at University of Wyoming. During his seven weeks in the School Tim is hosted by *Jennifer Brown*, and he is teaching into STAT202. Tim's research interests are in design of experiments, response surface methodology, categorical data analysis and applications in engineering, medicine and the environment.

Thomas Forster is at Cambridge University, UK, and is hosted by *Maarten Mckubre-Jordens* While here for two and a half months he is teaching into MATH336. Thomas is interested in set theory, type theory, BQO theory, philosophy of mathematics and philosophy of mind. As Adjunct Fellow in UC's Department of Philosophy had visited the School a few times before.

Huaxiong Huang, hosted by *Phil Wilson*, is in the Department of Mathematics and Statistics at York University, Toronto, Canada. His field of special interest is in mathematical modeling and scientific computing, financial and industrial mathematics, biomathematics, and fluid mechanics. During his month long visit he is teaching into MATH363. Huaxiong has recently been appointed the Deputy Director of the Fields Institute for Research in Mathematical Sciences. He is a familiar face in the School having been here on an Erskine fellowship in 2012.

Günter Steinke

Giulio Dalla Riva, University of Canterbury

Supervisors: Mike Steel, Daniel Stouffer (Biological Sciences) and Charles Semple

Date: April 2016

Title: **The web and the tree: on the interplay between ecological processes and evolutionary histories.**

In this thesis, we introduce and explore a mathematical framework in which to study the evolution of and within ecological networks. Hence, we focus on a peculiar interpretation of the "biodiversity" concept, namely one that includes the complex pattern of interactions among species, along with the species abundancy and evolutionary distinctiveness.

Our objects of inquiry are species communities as complex wholes. Classically, communities have been approached from two distinct points of view: on one hand, we can consider the graph describing the energy flows among species in an ecosystem (i.e., an ecosystem's food web); on the other hand, we can consider the species' phylogeny, the tree graph describing the evolutionary relatedness of those species. The structure of an ecosystem (its biological diversity and the topology of its interactions) is the product of fast ecological processes within food webs and of the long-term evolutionary processes that give shape to the tree of life. In particular, early ecological literature recognized that the evolutionary history of a species (or its taxonomical classification, in the pre-Darwin era) helps to determine the species' role as part of an ecological network of interacting species. Conversely, the "ghost of past competition" and arms races are famous examples of the fact that a species' interactions with its resources and consumers helps to determine the evolutionary trajectory of that species.

As the empirical research presents strong evidence that the ecology-evolution (eco-evo) feedback loop is, indeed, significant, the ecological and evolutionary points of view are laboriously being connected more and more strongly. A theoretical framework has been developed for some important scenario (e.g., the co-evolution of hosts and parasites, butterfly and flowers, or plants and pollinators).

The case of complex food webs, where is not possible to distinguish two neatly separated trophic layers, has resisted such a treatment. We argue that this can be partially addressed by moving from a rigidly binary view of food webs to the representation of species interactions in a continuous metric space, where species evolution can be gradual. In Chapter 3 we show how this metric space representation of a food web can be estimated efficiently and gather insights about the evolutionary signature of food webs. Species' ecological interdependency, arising from their role as part of complex food webs, is something that the classic model of trait evolution has avoided. One reason is that it is hard to give a model determining the presence (and strength) of species interactions throughout their history. In Chapter 3 Appendix we show how the metric space representation of food webs may constitute a suitable environment in which to define such a model.

Assessing species' contribution to biodiversity is an important task that scientifically informs conservation efforts. In Chapter 4 we define a family of measures measures are defined directly on the food web's metric space representation we propose in the first chapter. We explore the relationship between evolutionary and ecological uniqueness.

In Chapter 5 we tackle the "mode" of food web evolution more directly exploiting, once again, the functional trait representation of food webs. In particular, we formulate two contrasting hypotheses on the evolu-

tion of frugivore birds' functional ecological niches and test it on a dataset of frugivore birds in the Andes.

Finally, in Chapter 6 we make a little detour from food webs and consider a different kind of ecological network: geographically grounded population networks composed of patches and corridors among patches. Population networks play a crucial role in evolution (e.g., determining the dynamics of genes' flows). The insight we gained throughout the previous work (especially in the second chapter) supports the notion that the relevance of a species in a network is not always perfectly captured by the species' local properties (such as its number of connections). In this spirit, we assess the importance of a patch in a geographic network by the global effect that removing that patch has on the whole network.

All the code and data used in this thesis will be available on a public Github repository (see gvdr.github.io).

Anuj Misra , University of Canterbury

Supervisors: Clemency Montelle and Kim Plofker (Union College NY)

Date: May 2016

Title: **The Golādhyāya of Nityānanda's Sarvasiddhāntarāja: an examination of 'The Chapter on Spheres' in a seventeenth century text on mathematical astronomy.**

In the study of the scientific exchanges in India, Nityānanda's works have been largely unknown and unexamined by modern scholars. As an astronomer at the Mughal court of Emperor Shāh Jahān through the early parts of the seventeenth century, Nityānanda was commissioned by his patron, Shāh Jahān's minister Āsaf Khān, to translate an Indo-Persian *zīj*, a set of astronomical, geographical and mathematical tables into Sanskrit. In the early 1630s, he presented the enormous translated compilation of these tables called *Siddhāntasindhu*; however, the use of Islamic parameters in the computation of these tables appears not to have been favourably received within the traditional Sanskrit scholarly community. In the years that followed, Nityānanda restructured Islamic concepts of astronomy into the more canonical format of a Sanskrit *siddhānta* 'treatise in astronomy' complete with separate chapters on computations, spheres, and instruments. He presented his work, The *Sarvasiddhāntarāja* 'King of all Siddhāntas', in 1639 CE . It is amongst the earliest known siddhāntic texts to explicitly include elements of Grco-Islamic astronomy within traditional *jyotia* astronomy.

This thesis includes a critical edition of the chapter on spheres' (*golādhyāya*) of Nityānanda's *Sarvasiddhāntarāja*, along with an English translation and commentary of the hundred and thirty-five verses that comprise the chapter. A technical and detailed analysis of these verses is attempted here in an effort to understand and comment on their contents. The introductory and concluding discussions of this thesis are included to provide the context to Nityānanda's work in the study of the history of Indian astronomy.

The study of the history of scientific exchanges between cultures is a dynamic enterprise due to the vibrancy and the mystery of the 'intellectual commerce' that occurred between them. The acceptance, accommodation, adaptation, innovation, or even rejection of ideas seen in the scholarly works of a period help us constantly reform our own understanding of the conceptual transactions within those cultures of scientific enquiry. In an attempt to address these themes in the context of Islamic and siddhāntic astronomy of seventeenth century India, I look at Nityānanda's *golādhyāya* containing the geometrical discussions on the different spheres conceptualised in the study of astronomy.

Shakira Suwan, University of Canterbury

Supervisors: Dominic Lee, Carey Priebe (Johns Hopkins University) and Carl Scarrott

Date: May 2016

Title: **Empirical Bayes estimation for random dot product graph representation of the stochastic blockmodel.**

Network models are increasingly used to model datasets that involve interacting units, particularly random graph models where the vertices represent individual entities and the edges represent the presence or absence of a specified interaction between these entities. Finding inherent communities in networks (i.e. partitioning vertices with a more similar interaction pattern into groups) is considered to be a fundamental task in network analysis, which aids in understanding the structural properties of real-world networks. Despite a large amount of research on this task since the emergence of graphical representation of relational data, this still remains a challenge. In particular, within the statistical community, the use of the stochastic blockmodel for this task is currently of immense interest.

Recent theoretical developments have shown that adjacency spectral embedding of graphs yields tractable distributional results. Specifically, a random dot product graph formulation of the stochastic blockmodel provides a mixture of multivariate Gaussians for the asymptotic distribution of the latent positions estimated by adjacency spectral embedding. The first part of this thesis seeks to employ this new theory to provide an empirical Bayes model for estimating block memberships of vertices in a stochastic blockmodel graph. Posterior inference is conducted using a Metropolis-within-Gibbs algorithm. Performance of the model is illustrated through Monte Carlo simulation studies and experimental results on a Wikipedia dataset. Results show

performance gains over other alternative models that are considered.

Instead of a complete classification of vertices via community detection, one may wish to discover whether vertices possess an attribute of interest. Given that this attribute is observed for a few vertices, the goal is to find other vertices that possess that same attribute. As an example, if a few employees in a company are known to have committed fraud, how can we identify others who may be complicit? This is a special case of community detection, known as *vertex nomination*, which has recently grown rapidly as a research topic. The second part of this thesis extends the empirical Bayes model for vertex nomination based on information contained in the graph structure. This yields promising simulation results as well as real-data results from an Enron email dataset.

Recent studies have shown that information pertinent to vertex nomination exists not only in the graph structure but also in the edge attributes (Coppersmith and Priebe, 2012; Suwan et al.,2015). This motivates the third part of this thesis by further extending the model to exploit both graph structure and edge attributes for vertex nomination. Simulation studies confirm the benefit of doing so. However, the same benefit is not observed when the model is applied to the Enron email dataset; further investigations suggest that this is due to the data violating one of the model assumptions

UNIVERSITY OF OTAGO

DEPARTMENT OF MATHEMATICS AND STATISTICS

Congratulations to *Florian Beyer* and his wife Kirsten on the arrival of their newest family member. The healthy baby boy is named James Henrik. All the best for the proud parents and little sister Rosalie. We wish you much joy and happiness — and much strength for the forthcoming sleepless nights!

Our colleague of many years, *Mihály "Misi" Kovács*, has left the department and taken on a position as Senior Lecturer at Göteborgs Universitet, Sweden. Misi first joined the University of Otago in 2005 as a Postdoc, and he left as Associate Professor this year. We wish you all the best and a fantastic career in Sweden. Enjoy your new life on the opposite side of the planet, Misi!

As part of the annual meeting of the International Society of Molecular Biology and Evolution (SMBE) this July, there was a symposium to honour the collaborative research of David Penny (Massey University) and Otago's *Mike Hendy*. Citation: *The collaboration of Penny and Hendy has provided a foundation for modern phylogenetics. First to test the theory of evolution from sequence data, and understand the properties of data that can mislead evolutionary tree building, they developed a theoretical framework to explain phylogenetic methods and evaluate their reliability. In this symposium, we celebrate the impact and influence of their work.*

The department was part of this year's SciFest Expo and presented the interactive exhibition "From Einstein to epidemics". Visitors from the general public could learn how to detect gravitational waves, how light waves travel in curved spacetime, how we predict the next wave of an infectious disease, and what earthquakes and epidemics have in common. The exhibition was received exceptionally well, and a lot of positive feedback commended the interactive nature of the exhibits, that there were things for their children to do, that they could talk with scientists and find out about their area of expertise, that they could experience things that they had never seen or even heard of before, and that they loved the genuine warmth and interest of the scientists at the expo. Many thanks to *Matt Parry* and his team for organising the exhibition.

PhD student Leon demonstrates the "relativistic bike" at this year's SciFest Expo, which simulates how the German town of Tübingen would look like from a bicycle when travelling near the speed of light.

Visitors

This year's NZMS Forder Lecturer Julia Gog (University of Cambridge) visited the Department in April. We could enjoy her interesting public lecture "Epidemics and viruses, the mathematics of disease", as well as her seminar "Spatial transmission of 2009 pandemic influenza in the US".

Jonathan Brown (University of Dayton, USA) visited *Astrid an Huef* and *Lisa Orloff Clark* for two weeks in May. They investigated purely infinite algebras.

Hyuck Chung (Auckland University of Technology) visited for one week in June. He worked with *Fabien Montiel* on the problem of acoustic wave scattering by an elastic Helmholtz resonator.

Abstracts of PhD theses

Leon Escobar, University of Otago

Supervisors: Jörg Frauendiener and Florian Beyer

Date: 2016

Title: **Studies of spacetimes with spatial topologies $\mathbb{S}^3$ and $\mathbb{S}^1 \times \mathbb{S}^2$**

The purpose of this work is to introduce a new analytical and numerical approach to the treatment of the initial value problem for the vacuum Einstein field equations on spacetimes with spatial topologies $\mathbb{S}^3$ or $\mathbb{S}^1 \times \mathbb{S}^2$ and symmetry groups $U(1)$ or $U(1) \times U(1)$. The general idea consists of taking advantage of the action of the symmetry group U(1) to rewrite those spacetimes as a principal fiber bundle, which is trivial for $\mathbb{S}^1 \times S^2$ but not for $\mathbb{S}^3$. Thus, the initial value problem in four dimensions can be reduced to a three-dimensional initial value problem for a certain manifold with spatial topology $\mathbb{S}^2$. Furthermore, we avoid coordinate representations that suffer from coordinate singularities for $\mathbb{S}^2$ by expressing all the fields in terms of the spin-weighted spherical harmonics.

We use the generalized wave map formalism to reduce the vacuum Einstein field equations on a manifold with three spatial dimensions to a system of quasi-linear wave equations in terms of generalized gauge source functions with well-defined spin-weights. As a result, thanks to the fully tensorial character of these equations, the system of evolution equations can be solved numerically using a $2+1$-pseudo-spectral approach based on a spin-weighted spherical harmonic transform. In this work, however, we apply our infrastructure to the study of Gowdy symmetric spacetimes, where thanks to the symmetry group $U(1) \times U(1)$, the system of hyperbolic equations obtained from the vacuum Einstein field equations can be reduced to a $1+1$-system of partial differential equations. Therefore, we introduce an axial symmetric spin-weighted transform that provides an efficient treatment of axially symmetric functions in $\mathbb{S}^2$ by reducing the complexity of the general transform.

To analyse the consistency, accuracy, and feasibility of our numerical infrastructure, we reproduce an inhomogeneous cosmological solution of the vacuum Einstein field equations with spatial topology $\mathbb{S}^3$. In addition, we consider two applications of our infrastructure. In the first one, we numerically explore the behaviour of Gowdy $\mathbb{S}^1 \times S^2$ spacetimes using our infrastructure. In particular, we study the behaviour of some geometrical quantities to investigate the behaviour of those spacetimes when approach a future singularity. As a second application, we conduct a systematic investigation on the non-linear instability of the Nariai spacetime and the asymptotic behaviour of its perturbations.

Jörg Hennig

OBITUARIES

Jock Hoe, 6 July 1929 – 29 July 2016

Jock Hoe was born in Te Kuiti, to immigrant Cantonese parents. His father had a fruit and vegetable shop. The family moved to Newtown, Wellington, where Jock went to kindergarten, and then to Wanganui, again with a greengrocer shop (Hoe Brothers). Jock went to primary and intermediate school in Wanganui, and won a fee-paying scholarship to Wanganui Collegiate. During his childhood he helped in the shop (washing dirt off potatoes, displaying fruit outside the door, sweeping the footpath, etc.). His father had bought a piano for ten pounds and Jock taught himself to play it, later having piano lessons because he showed such interest and promise. At Collegiate Jock obtained a National Scholarship at a time when only 20 were awarded in NZ each year; this paid a living allowance and fees to attend University. His Scholarship subjects were French, Latin, Mathematics, Applied Mathematics and Physics. After pleading with the Headmaster he was allowed to skip doing English.

Jock did a B.A. in mathematics at the University of Otago, then moved to Victoria University of Wellington to do Masters, which he obtained with first class honours. Professor J. T. Campbell was very helpful and encouraging to him. During that time in Wellington Jock obtained his A.T.C.L. in piano performance. After attending Teachers' College in Epsom, he obtained a teaching post at Wanganui Collegiate with his old headmaster, Mr Gilligan. Jock then decided he'd like to go to Cambridge, so sent off an inquiry. In Jock's words when interviewed by Ruth Barton in 2011:

I didn't get a reply but Mr Gilligan got a reply to say: We have had an application from Mr Jock Hoe for entry to Cambridge to do mathematics. Why does he want to do mathematics and why does he want to come to Cambridge? Yours sincerely, Senior Tutor, Corpus Christi College. *Mr Gilligan called me in and told me he'd had this letter, showed the letter and said - This is my reply:* "Dear Senior Tutor, I do not understand why Mr Hoe wants to come to Cambridge, but I did understand that Cambridge was able to give an education of some kind, Yours sincerely F.W. Gilligan, MA (Oxford)." *I got a reply by return post offering me a place at Corpus Christi College.*

Jock did the Mathematics Tripos with mathematical statistics, emerging with a Cambridge M.A. and Dip. Math. Stat. He next obtained a job in Paris, teaching (in French) statistics to engineers. This was followed by a lectureship in statistics at the (then) University of Malaya in Kuala Lumpur, during which time he added Malay to his portfolio of languages (English, French, Latin, German, Cantonese, Mandarin, plus some Russian and Greek). In 1963 he took up a Lectureship in Mathematics at Victoria University of Wellington, where Professor Campbell was still Head of Department. Jock was appointed to teach the newly-offered courses in Statistics, but it is a

measure of his breadth of scholarship that in 1963 when he was also required to teach rigid body dynamics in third-year applied mathematics, he did it so well that his students (well, this writer at least) thought he must be a specialist applied mathematician. He taught (mainly) statistics at Victoria until about 1982.

Around 1968–72 Jock spent sabbatical leaves and the summer breaks in Paris, working at the Sorbonne on his doctorate in the history of Chinese mathematics. His subject was a French translation of, and commentary on, a 1303 mathematics textbook, "The Jade Mirror of the Four Unknowns", by Zhū Shìjié. The commentary included substantial background material on earlier Chinese mathematics. The original text used rhetorical characters, in which substantial algebraic relationships were conveyed with very few characters. For the translation part of the thesis, Jock used ordinary French and ordinary algebraic symbols, but he also devised a semi-symbolic style of translation which conveyed the spirit of the original text accurately and concisely without using our modern algebraic notation. Jock suggested that the efficiency of rhetorical algebra in the Chinese language may help to explain why no genuine symbolic algebra developed in China. The textbook has 288 problems, which the students had to essentially reduce to polynomial equations (possibly with negative powers) and then solve by synthetic division. Jock emphasised that a good deal of logical reasoning must have been involved; the problems could not be handled merely by memorised rules obtained by trial and error. Jock tried to publish his doctoral thesis, "Les Systèmes d'Équations Polynômes dans le Siyuan Yujian (1303)", as recommended by his supervisor, Professor Jacques Gernet. The University published the commentary, but ran out of money so the translation part was unpublished. Jock tried other avenues for publication, but was refused because it was perceived as publication of a translation only, without the commentary.

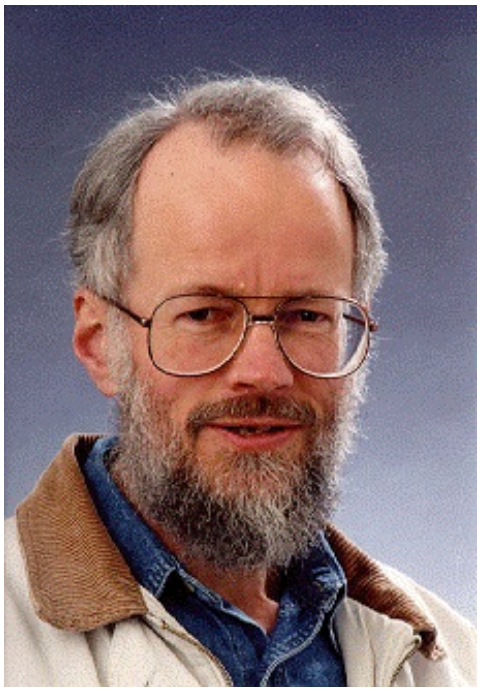
During the 1970s, Professor David Vere-Jones was Head of School in Mathematics. He was very helpful to Jock, getting him an unasked-for promotion to Reader (which Jock found out about on his return from Paris), and providing him with a sanctuary in the mathematics department while knowing that Jock's main interests by now were in languages and cultures; teaching English speakers about Chinese thought and culture and teaching Chinese speakers about English and Western culture. In the late 1970s Jock reduced his mathematics lecturing load to two-thirds, freeing up time to teach Mandarin in the Chinese Department at Victoria University. During that time he was a leading member of the New Zealand China Society, promoting a better understanding of China. In 1978 he led a trip of New Zealand observers (including Mary Vere-Jones) to China.

About 1982 Jock resigned from Victoria University and moved to Shanghai, where he taught English to students and lecturers at an English language institute. After a few years there, he returned to New Zealand, ultimately settling to teach Chinese at Christchurch Polytechnic, a position he held until his retirement. In recent years, Clemency Montelle has taken small groups of her University of Canterbury students to visit Jock and discuss the history of Chinese science. Jock also spent a lot of time in his "retirement" years rewriting his thesis in English, but again he had difficulty finding a publisher. He had epic fights with Microsoft Word, which kept changing his text and layout, especially when he was incorporating Chinese characters. Eventually he published it privately (2008, Mingming Bookroom, Christchurch).

The summary above does not convey Jock's personal qualities. He was a quiet, modest, scholarly man, highly intelligent and willing to share his knowledge and ideas with anyone who was interested. He had a dry sense of humour. As a teacher he was positive and encouraging, always patient, concerned that his students should do well and understand things fully. He entertained New Zealand friends at his home, and at his Paris apartment, and always knew where good Chinese restaurants were to be found. He loved classical music, both instrumental and operatic, and played both the piano and the recorder. Although Jock never married or had children, he came from a large family and always kept in contact with his extended family. His student Qi LuBao followed him from China to teach at Christchurch Polytechnic, and Qi's family were very close to him, both geographically and socially, over the last 20 years. Qi's sons called Jock Grandpa.

Shirley Pledger, Ruth Barton, with input from David Vere-Jones, Clemency Montelle and from Ken Pledger's 1978 review in Historia Mathematica, **5(2)***, 239–241.*

Ken Pledger, 24 July 1938 – 3 May 2016



Ken Pledger died on 3 May after a short period of serious illness following 52 years as a lecturer. Ken joined the academic staff of the Mathematics Department at Victoria University of Wellington in 1964. The university's registrar had cabled Ken in August of the previous year to offer him the position. He telegrammed back, "Accept appointment lecturer — conditions agreeable. Thank you. Pledger". At the time, Ken was enrolled for a PhD under the great English group theorist Philip Hall at King's College, Cambridge though he returned without having completed his thesis. He had a passion for teaching, honed at an early age in trying to teach mathematics to his younger twin brothers, and the opportunity to take up a teaching position was too appealing to defer.

In fact, Ken's association with the university had started even earlier — he was an alumnus, entering as a student in 1956, having been Dux of Wellington College where he had been awarded prizes in French, German, Chemistry, Physics and, of course, Mathematics. Ken's mathematical interests were equally catholic: he was deeply interested in geometry and on his return to Victoria became a regular participant in Victoria's weekly logic seminar. Victoria has a proud history of interaction between philosophers and mathematicians and according to Emeritus Professor of Philosophy, Max Cresswell, Ken was the smartest one in the seminar.

Ken's broad mathematical interests and a period of what was then termed 'refresher leave' — in modern parlance research and study leave — led, in 1981, to the award of his PhD from the University of Warsaw for his thesis 'Some Interrelations between Geometry and Modal Logic', formally under the supervision of Leslaw Szczerba. Anyone who had the good fortune to attend a graduation ceremony at which Ken was on stage will know that his black woollen gown, biretta and gloves stood out with austere crispness. For Ken, it was often an unpleasantly warm experience!

Ken was the quintessential mathematical scholar. Not a widely published researcher, nevertheless he was deeply knowledgeable, widely read and an active researcher. His article "Internal direct products in groupoids", which appeared in the Journal of Algebra, is beautifully crafted and written with a concision that emulated all that Ken admired in great mathematics.

In 1980 Ken sought to reduce from a full time to a half-time position as his wife, Shirley, was herself working in the department in a half-time position and they felt that one full-time job per family was sufficient. Ken acknowledged with gratitude that the university was happy to comply with this request. The residual half-position was duly advertised and I was appointee.

Ken is most remembered for his dedicated, passionate and sensitive teaching. His patient, subtle guidance, warm encouragement and, if necessary, cajoling of students towards mathematical enlightenment was never accompanied by an acknowledgement that mathematics, at whatever level, is hard and can tax the best minds. As a

tutor, Ken always took the trouble to learn his students' names and his tutorials were legendary for the energy he brought to encouraging students to work together and learn from each other as well as from him.

In 2004, Ken retired as a permanent senior lecturer but, fittingly, that year the postgraduate students' association, which each year hands out the awards to highly regarded lecturers and tutors, honoured him with a commendation for Best Lecturer and the award for 'Most Stimulating and Challenging Course' in mathematics. He continued to contribute to the mathematics programme until 2015 (and would have done so this year again had his health permitted). His first-year lectures on geometry and algebra wove those topics together in an inimitable style and it was a course he loved to teach. His third-year geometry course was a fine creation and always attracted numerous students. Ken brought to bear his broad knowledge of the history of the subject and his deep appreciation of the genius of the ancients to provide students with an ideal culmination to their undergraduate studies.

In 2010, a group of students established the Ken Pledger Fan Club Facebook page. Their initial intention was to establish a record of the wit of Ken Pledger, recording his wry observations and aphorisms. The page also recorded the impression Ken left on his students: 'Found out today that Ken lectured my Mum when she was at uni. That means he's spent more time being awesome than I have being alive!' and, 'He taught with a passion, that spread to the students. He is truly a legend among the common-folk'.

Ken was a highly valued colleague. He was a source of mathematical wisdom and knowledge and owned a splendid collection of books — a significant part of which has been inherited by Clemency Montelle in Canterbury. It is a great pleasure to know that the books are in such good hands. Our colleague, Byoung Du (BD) Kim, recalls Ken visiting his office and offering a selection of books he thought BD would be interested in. It included classics such as Lefschetz's Algebraic Geometry, Weil's Foundation of Algebraic Geometry, Herstein's classical textbook on Algebra, and more. BD gladly took the books offered, but for one: an English translation of Felix Klein's treatise on the modular elliptic function solution of quintic equations. He had only ever seen a German copy and heard merely a rumour that there was an English translation. BD says, "In the end, I turned it down because it is such an intellectual treasure, and I felt that Ken should keep it. Offering me this book was an ultimate act of kindness that only a fellow mathematician can truly appreciate".

Ken will be remembered by his colleagues, family and friends for his great personal characteristics. His gentle warmth and friendship, unobtrusive kindness, a simple quiet chat in the tea roomall will be missed. Ken's careful curatorship of the School's collection of geometric models, constructed by Professor D. M. Y. Sommerville and David Patterson, adorn the school and are among the university's precious collections. Just recently, some beautifully hand-written and drawn descriptions that Sommerville produced, along with his polyhedral models, and which Ken saved from accidental disposal, have been preserved, framed and mounted in the School. All serve as a reminder of and tribute to Ken as a matchless colleague, scholar and teacher.

Peter Donelan

Jonathan Borwein, 20 May 1951 – 2 August 2016

It is my sad duty to report that our colleague Jonathan Borwein, Laureate Professor of Mathematics at the University of Newcastle, Australia, has passed away at the age of 65. He is survived by his wife Judith and three daughters.

What can one say about Jon's professional accomplishments? Adjectives such as "profound", "vast" and "far-ranging" don't really do justice to his work, the sheer volume of which is astounding: 388 published journal articles, plus another 103 articles in refereed or invited conference proceedings (according to his CV, dated one day before his death). The ISI Web of Knowledge lists 6,593 citations from 351 items; one paper has been cited 666 times. The Google Citation Tracker finds over 22,048 citations.

But volume is not the only remarkable feature of Jon's work. Another is the amazing span of his work. In an era when academic researchers in general, and mathematicians in particular, focus ever more tightly on a single specialty, Jon ranged far and wide, with significant work in pure mathematics, applied mathematics, optimization theory, computer science, mathematical finance, and, of course, experimental mathematics, in which he has been arguably the worlds premier authority.

Unlike many in the field, Jon tried at every turn to do research that is accessible, and to highlight aspects of his and others' work that a broad audience (including both researchers and the lay public) could appreciate. This was, in part, behind his long-running interest in Pi, and in the computation and analysis of Pi — this topic, like numerous others he has studied, is one whose wonder and delight can be shared with millions.

This desire to share mathematics and science with the outside world led to his writing numerous articles on mathematics, science and society for the Math Drudge blog, the Conversation and the Huffington Post. He was not required to do this, nor, frankly, is such writing counted for professional prestige; instead he did it to share the facts, discoveries and wonder of modern science with the rest of the world.

Jon was a mentor par excellence, having guided 30 graduate students and 42 post-doctoral scholars. Working with Jon is not easy — he is a demanding colleague (as the present author will attest), but for those willing to apply themselves, the rewards have been great, as they become first-hand partners in ground-breaking work.

There is much, much more that could be mentioned, including his tireless and often thankless service on numerous committees and organizational boards, including Governor at large of the Mathematical Association of America (2004–07), President of the Canadian Mathematical Society (2000–02), Chair of the Canadian National Science Library Advisory Board (2000–2003) and Chair of the Scientific Advisory Committee of the Australian Mathematical Sciences Institute (AMSI).

But Jon was more than a scholar. He was a devoted husband and father. He and Judi have been married for nearly 40 years, and they have three lovely and accomplished daughters. They have endured some incredible hardships, but Jon has made some equally incredible sacrifices on their behalf. Jon has also been devoted to his own father and mother, often collaborating on research work with his father David Borwein (also a well-known mathematician), and following the work of his mother, a scholar in her own right.

I myself am at a loss of what to say at Jon's passing. What can I say? I have collaborated with Jon for over 31 years, with over 80 papers and five books with Jon as a co-author. Thus my personal debt to Jon is truly enormous. My work will forever be connected with (and certainly subservient to) that of Jon's. I am humbled beyond measure and grieve deeply at his passing.

Jon's passing is an incalculable loss to the field of mathematics in general, and to experimental mathematics in particular. Jon is arguably the world's leading researcher in the field of experimental mathematics, and his loss will be very deeply felt. We will be reading his papers and following his example for decades to come.

David H. Bailey, Lawrence Berkeley National Laboratory and UC Davies.

REPORTS ON EVENTS

Mathematics-in-Industry NZ Study Group 2016

The combined power of New Zealands best and brightest mathematical scientists was engaged in solving significant business challenges at New Zealand's second annual Mathematics-in-Industry NZ event, 4th–8th of July at Victoria University, Wellington.

Successfully implemented in about 20 countries worldwide, these intensive week-long workshops offer a collaborative environment to solve problems arising in industry. Scientists participate from a range of mathematical disciplines such as dynamical systems, statistics, and operational research.

This unconventional model sees companies paying $6000 each up-front for the rare opportunity to have their meatiest challenges tackled by mathematicians from across the country.

New Zealand businesses that participated in 2016, include:

- NZ Steel — Improving how the steel finishing rolling through modelling;
- Compac Sorting Equipment — Estimating the weight of a moving article across multiple weigh points;
- Transpower — Understanding how home solar electrical generation affects the national grid;
- Fonterra — Predicting the length of time milk powders can be stored in elevated temperatures and humidity;
- Zespri — Predicting fruit quality in the supply chain from harvest to market.

This year a new dimension was been added with representatives from Japan's Institute of Mathematics in Industry in Kyushu attending MINZ, and NZ mathematicians joining Japan's Study Group week later in July. This has come about with funding from the NZ Royal Society and the Japan Society for the Promotion of Science. We also had a challenge from the Japan Agency for Marine-Earth Science and Technology entitled

- Jamstec — Smoother probabilistic distributions in climate prediction models.

The New Zealand event is championed by Professor Emeritus Graeme Wake of Mathematics-in-Industry New Zealand (MINZ), who co-Directed the workshop with Professor Mark McGuinness from Wellington. Professor Wake has been involved in the concept since his time as a Postdoctoral Fellow in Oxford where it was first launched. Professor Wake is passionate about the impact of applied mathematics noting, "These events are often the launch pad for long term partnerships between mathematicians and businesses, powering up innovation within industry."

Left, left to right: Pro-VC Science VUW Mike Wilson, Professor Emeritus Graeme Wake, Hon. Steve Joyce. Right: Japanese Ambassador to NZ, His Excellency Toshihisa Takata.

The event was opened by government Minister Hon. Steve Joyce and Pro-VC Science VUW Mike Wilson (seated above, with co-Director, Professor Emeritus Graeme Wake), and had invited speakers Professor Andrew Fowler from Limerick/Oxford Universities, Dr Mary Quinn CEO of Callaghan Innovation, and Japanese Ambassador to NZ, His Excellency Toshihisa Takata (pictured above right).

Compac is a keen supporter of the concept, having seen the power of Mathematics in Industry in action. Compac's R&D Manager, Nigel Beach comments, "The support of the math group helped us transform how we sort products into fixed weight packaging. This avenue was fast, effective and productive for our team."

Global dairy giant, Fonterra, has been involved in several Mathematics-in-Industry events in Australia. Fonterra's Calibration Technologist, Jo Simpson comments, "The support of the math group increased our confidence that the procedures we have in place met or exceeded international best practice. This event is an efficient process to have a large group of experts looking at a specific industry issue."

New Zealand mathematicians and businesses have previously taken part in joint events run by the Australia and New Zealand Industrial Applied Mathematics (ANZIAM). Professor Wake comments, "Kiwi businesses have previously had to travel across the Tasman to participate in these events, but now we are running this event right in our back yard."

This year's MINZ initiative was supported by the Centre for Mathematics-in-Industry in Massey University, ANZIAM (A/NZ Industrial and Applied Mathematics Group), KiwiNet (NZ's national network of Universities and Crown Research Institutes and Entities), New Zealand Mathematical Society and Victoria University where the event is being held.

Dr Bram Smith, General Manager of the Kiwi Innovation Network (KiwiNet).

Dr Bram Smith (pictured above), General Manager of the Kiwi Innovation Network (KiwiNet) believes the model is highly compelling. Smith comments, "There is a wealth of world leading mathematics and statistical capability in Universities and Crown Research Entities across New Zealand that are hungry to solve industry problems. It's great to see mathematicians working together to provide this creative new approach to drive business innovation."

More than 100 mathematicians, a number of whom were postgraduate students participated. A summary and technical report will be prepared with aim of future publication in the ANZIAM Journal Series E.

"Mathematics-in-Industry is an extremely powerful and effective initiative to solve industry challenges. It enables businesses to focus on operations and lets mathematicians focus on what they do best — solve industry problems" notes Professor Graeme Wake. "NZ will benefit immensely from the greater use of clever mathematics in these organisations."

To see more information, visit minz.org.nz.

Graeme Wake (Institute of Natural and Mathematical Sciences, Massey University at Auckland)

Roy Kerr awarded the 2016 Crafoord Prize

David Wiltshire, Roy Kerr, Graham Weir.

Roy Kerr received the Crafoord Prize in Astronomy from the King of Sweden, on 26 May 2016, in the Beijer Hall, The Royal Swedish Academy of Sciences, Stockholm, for his foundational research leading to his discovery of a mathematical description of a rotating black hole, now termed a Kerr Black Hole. This became one of the most important theoretical discoveries in modern cosmology. The prize sum of 6 million SEK was shared with Roger Blandford, who modelled the accretionary disc about a Kerr Black Hole. Frictional effects within the accretionary disk, and extraction of angular momentum from the Kerr Black Hole, contribute to energy outputs which can exceed that from several hundred ordinary galaxies, and produce jets that can stretch many thousands of light years out into space.

The Crafoord Prize is awarded annually by the Royal Swedish Academy of Sciences, and is one of the world's largest and most prestigious scientific prizes, covering fields not covered by the Nobel Prize. The Crafoord Prize is funded from the Crafoord Fund established in 1980, and supplemented by revenues from the Gambro AB company in Lund, which specializes in medical devices, especially a novel kidney dialyser. The Crafoord Prize is intended to promote international basic research in the disciplines of mathematics and astronomy; geosciences; biosciences; and potentially polyarthritis, with each different discipline being funded every three years.

The mathematical brilliance of Roy Kerr in obtaining his exact solution to the Einstein equations of General Relativity, is widely acknowledged. His derivation is considered by many as "the most important exact solution to any equation in physics", and Roy Kerr's discovery "ushered in a decade which might be called the Golden Age of Black Hole Physics, when General Relativity saw a Renaissance." Roy is the second most cited person in General Relativity, only behind Einstein. Stephen Hawking writes in A Brief History of Time, Roy Kerr "is a name in science which will be ever remembered."

According to presentations from leading researchers in Stockholm on 25 May, the Kerr metric continues to be central to understanding and analysing many important astrophysical experiments, including the Event Horizon Telescope which aims to image the event horizon of Kerr Black Holes; LIGO recordings of Kerr Black Hole mergers and gravitational radiation; and X-ray observations from rotating black holes.

The masses of the Kerr black holes discovered by LIGO's gravitational wave breakthrough are larger than previously anticipated, suggesting that black holes may play an important role in galaxy formation, and that perhaps

the missing dark matter could also be largely made of primordial black holes that formed in the early Universe. If true, this would move the Kerr solution from astrophysics into cosmology, and its scientific importance would increase accordingly.

Roy was accompanied by his wife Margaret and his son-in-law, Dr Hannes Diener (University of Canterbury, Mathematics & Statistics) in Sweden. David Wiltshire (University of Canterbury, Physics), Anneke a Campo, Graham (ex PhD student of Roy) and Helen Weir also travelled to Stockholm to celebrate with Roy. Glenda Lewis and her daughter Laura Pishief, on their own initiative, travelled to Stockholm to record the Crafoord Prize ceremony for the NZ science community and general public, and to arrange news coverage back in NZ.

Graham Weir (Institute of Fundamental Sciences, Massey University)

Maths Craft Festival

On the weekend of 3–4th September New Zealand saw nearly 2000 people attend its first ever dedicated maths festival. And it was a maths festival with a very special flavour: getting the public engaged with the subject through the medium of crafts.

Taking place in the Auckland Museum, the festival gave people a chance to crochet their own piece of hyperbolic geometry, design their own Escher tessellations, build a giant fractal Menger sponge from business cards, fold origami dodecahedra and even more. With eight craft creation stations and seven public lectures happening over the weekend, there was something to delight everyone no matter what their age or background.

One of the speakers was University of Auckland Professor Hinke Osinga, who was the first person in the world to design and crochet a Lorenz manifold. In her talk she noted that no such manifold had yet been crocheted in New Zealand, and offered a bottle of champagne to the first person who would do so.

The idea to have the festival was the brainchild of mathematicians Jeanette McLeod (University of Canterbury) and Julia Collins (University of Edinburgh), who have both had the experience of mathematical knitting and crochet being a great way to start mathematical conversations with people. Phil Wilson of the University of Canterbury is also an organiser. Crocheting a hyperbolic plane or building an origami dodecahedron can be very instructive about the underlying mathematics, and the idea behind Maths Craft NZ was to create an event to get the public making and learning about these beautiful things.

The festival has been a resounding success, with comments from visitors such as “I took my 7 year-old who claimed to hate maths but now she wants to show her class how to make an origami cube”, and “Our whole family has enjoyed it, from age 7 to 47!”, and “A great initiative — please do it more often.” The festival has clearly achieved its goals of introducing a new audience to mathematics, and showing people a whole new way to approach mathematics. Moreover, the festival even made it on to the evening news – has the phrase “hyperbolic geometry” ever before been heard on One News?

The weekend-long festival was made possible by support and funding from Te Pūnaha Matatini, along with funding from NZMS, the University of Canterbury, the University of Auckland, the Dodds-Walls Centre, Ashford, and material support from Auckland Museum and The Royal Society of New Zealand.

A full speaker list, blog posts, and craft and maths instructions are available on mathscraftnz.org.

Julia Collins

University of Edinburgh

General relativity and gravitation: A centennial perspective

The year 2015 is the one hundredth year anniversary of Einstein’s paper of General Relativity. To mark this momentous occasion, the conference General relativity and gravitation: A centennial perspective was held in Pennsylvania State University from June 7th to June 12th. As this is a long way from New Zealand, the funds gifted to me and my colleague Leon Escobar were invaluable.

We first flew to New York and spent a few days roaming around Manhattan before making a bus trip to College park, PA. At the Pennsylvania State University, world leaders in the field of relativity were gathering for this special event. I was lucky enough to be able to present a talk titled “Numerical Evolution of Colliding Plane Waves in the Friedrich Nagy Gauge” in front of many famous relativists.

This was an amazing and rewarding experience. Listening to the broad expertise that was available gave me insights into specialist fields I had not pursued before, and was fascinating. It was my first conference outside of New Zealand or Australia, and I am indebted to the New Zealand Mathematical Society for their contribution to making this happen. Thank you.

Chris Stevens (University of Otago)

Young Mathematicians in C^*-Algebras, 2015

The Young Mathematicians in C^*-Algebras or YMC*A was organised by the University of Copenhagen and ran 17–21 August 2015. It consisted of talks given by young mathematicians (PhD students and Postdoctoral researchers) and two mini-courses presented by Prof. Stuart White from the University of Glasgow and Prof. Stefaan Vaes from the K.U. Leuven, Belgium.

The mini-courses were run in the morning sessions. They covered very interesting and important topics in the area of operator algebras (the classification of the C^*-algebra, and the interactions between von Neumann algebras and C^*-algebra). We all had the chance to learn these topics from the experts. In particular there were well-known mathematician in the conference which made these mini-course even more productive. They discussed the topics with different points of views and they asked for some open problems from the audiences to think about.

As one of the speakers, I presented part of my PhD thesis (at the University of Otago) with the title of "KMS States of the C^*-Algebras associated to local homeomorphisms". This was a joint work with Prof. Astrid an Huef and Prof. Iain Raeburn. I received much interesting feedback from the audience which were very beneficial in defining future projects.

In addition, a conference for young researcher was an opportunity for all of us to know everyone's expertise deeper. We were looking at each other as future colleagues. The feeling of connecting with people from all over the world was exceptional. I started to collaborate with a group of people from the University of Oslo. Now as a postdoc at the University of Wollongong, I spent a certain amount of my research time on the defined project.

In conclusion, I think I reached all the goals and expectations that I wanted from this conference. It was a great exposure for my PhD work. It also provided me a great potential to mediate fruitful collaborations. I would like to thank the NZMS foundation committee for funding expected part of my travel expenses. I highly recommend future support for other students at New Zealand to attend this annually conference.

Zahra Afsar (University of Wollongong)

GENERAL NOTICES

New Zealand Mathematical Research Institute Summer School

Registration is now open for the 2017 New Zealand Mathematical Research Institute Summer School. Next year's summer school will be held in Napier from 9–14 January. The summer school will focus on mathematical logic. We have arranged speakers from a variety of different areas in mathematical logic: computability, complexity, model theory and set theory.

We will aim to ensure that the lectures are accessible to a wide mathematical community and graduate students. We are also planning to give preparatory lectures and follow-up lectures to non-logicians.

We will cover the accommodation costs for New Zealand based participants on the basis of a shared room.

Thursday 12 January will be a free day, and weather permitting David Gauld will lead a tramp to the highest point of the Kaweka range, North-West of Napier.

We encourage you to register. Please circulate this message to your department, graduate students and anyone you think will be interested. The conference website with instructions as to how to register can be found at sms.victoria.ac.nz/Events/NZMRI2017

Please register soon. Registration will close at the end of October.

Adam Day and Noam Greenberg
2017 NZMRI Summer School organisers

The Australasian Conference on Combinatorial Mathematics & Combinatorial Computing (ACCMCC)

Date: 12-16 December 2016

Venue: The University of Newcastle, Newcastle, Australia

Website: 40accmcc.newcastle.edu.au/

ACCMCC, the Australasian Conference on Combinatorial Mathematics and Combinatorial Computing, is the annual conference of the Combinatorial Mathematics Society of Australasia. This year it will be held at the University of Newcastle, Australia. The conference covers all areas of combinatorics in mathematics and computer science.

Just after the conference, on the 16th and 17th of December, there will be a workshop on Applied Probability, Combinatorics and Optimisation at the same venue.

Registration for the conference and the workshop is open now. The following people will be giving invited talks.

- Nathan Clisby, University of Melbourne
- Amy Glen, Murdoch University
- Bojan Mohar, Simon Fraser University
- Florian Pfender, University of Colorado Denver
- Dana Randall, Georgia Institute of Technology
- Bruce Reed, McGill University
- Benny Sudakov, ETH Zurich
- Geoff Whittle, University of Wellingtton

Attendees (especially students) are invited to give contributed talks. Contributed talks are 20 minutes in length with an additional 5 minutes for questions. The CMSA Student Prize will be awarded to the best student talk at the conference.

Thomas Kalinowski
School of Mathematical & Physical Sciences, University of Newcastle Callaghan

The 13th Engineering Mathematics and Applications Conference

The 13th EMAC will be held in Auckland from 29th November – 1st December 2017 (the week before NZMS, also in Auckland in 2017). This is the first time that EMAC will have been held in NZ, and we hope that many from the local community will be able to come along.

EMAC is the biennial meeting of the Engineering Mathematics Group (EMG), a special interest group of the Australian and New Zealand Industrial and Applied Mathematics (ANZIAM) division. This meeting provides a forum for researchers interested in the development and use of mathematical methods in engineering and applied mathematics. It aims to foster interactions between mathematicians and engineers, from both academia and industry. Proceedings are usually published after the conference in the electronic supplement of the ANZIAM Journal (following usual peer review by the journal).

Updates will be made available on emac2017.com, and if you have any questions, please dont hesitate to contact either Richard Clarke (rj.clarke@auckland.ac.nz) or Alys Clark (alys.clark@auckland.ac.nz).

Richard Clarke

Department of Engineering Science, University of Auckland

NZMS NOTICES

Notice of 2016 Annual General Meeting

The Annual General Meeting of the New Zealand Mathematical Society will be held on Monday 5th of December at 5:30pm, during the New Zealand Mathematics Colloquium, at Victoria University of Wellington. Items for the Agenda should be forwarded by Friday the 25th of November to the NZMS Secretary.

NZMS Colloquium 2016 childcare related costs

The NZMS recognises that childcare responsibilities can be a barrier to attendance at conferences. To help address the possible financial barriers for parents or carers to attend the Colloquium, the NZMS has set aside a modest amount to help with additional costs related to childcare responsibilities. Due to the diversity of situations and individual requirements, the spending of the funds will be discretionary, especially in this trial year. Interested persons should discuss their needs with the local organising contact person at VUW: Hung Le Pham: hung.le.pham@msor.vuw.ac.nz.

For full consideration please get in touch with Hung Le Pham before the 4th of November, but the sooner the better.

NZMS Student Travel Grants

One of the main activities of the NZMS is providing financial support to postgraduate students in mathematics in New Zealand. Towards this aim, the Society invites applications for Student Travel Grants from students to support them presenting their research at conferences, attending workshops, and developing new collaborations.

Students wishing to apply for a grant towards travel that will occur in the first half of 2017 must apply by 1 December 2016 for full consideration. Retrospective applications are not considered. Further information about the Student Travel Grants is available on our website nzmathsoc.org.nz/?assistance.

The current version of the application form is available at nzmathsoc.org.nz/downloads/applications/NZMS_FundingApplication_2016.pdf.

Call for nominations for the new Kalman Prize for Best Paper

The 'Kalman Prize for Best Paper' was instituted in 2016 to recognise excellence in research carried out by New Zealand mathematicians. The Prize will normally be awarded annually for an outstanding and innovative piece of research in the mathematical sciences published by a member or members of the New Zealand Mathematical Society. The Prize is for a single publication of original research, which may be an article, monograph or book, having appeared within the last five calendar years: 2011–2015.

The value of the Prize is $5000. The Prize is generously funded by the Margaret and John Kalman Charitable Trust, and recognises the significant contributions to mathematics in New Zealand made by Professor John Kalman www.math.auckland.ac.nz/wiki/Emeritus_Professor_John_Kalman.

The full details including eligibility and how to nominate a publication can be found here: nzmathsoc.org.nz/?awards. All nominations should be sent by 30 September 2016 to the NZMS President Astrid an Huef. Submissions should be made by email to astrid@maths.otago.ac.nz, stating clearly that they are for the Kalman Prize for Best Paper.

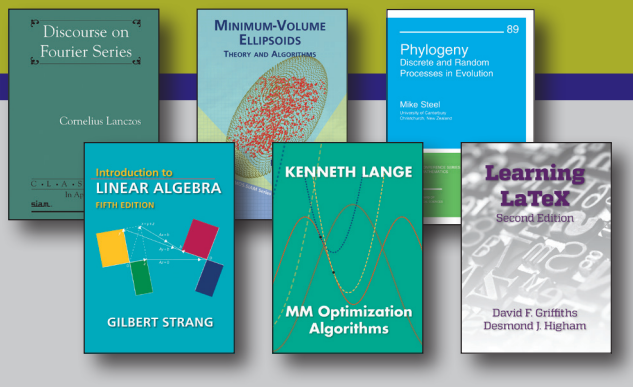
Call for nominations for NZMS Council positions

Nominations are called for three Councillor positions on the New Zealand Mathematical Society Council. The term of office of a Council member is three years. Council members may hold office for two (but no more than two) consecutive terms. I would invite members to consider the current makeup of the Council and to nominate candidates who would increase the diversity of the Council (e.g. career stages, areas of mathematics, geographic locations, genders, types of institutes) in order for us to best represent the NZ mathematics community. Existing Council members, and their terms, can be found on the website: nzmathsoc.org.nz/?membership.

Nominations are also called for the position of Incoming Vice-President. The term of this position is one year, with the Incoming Vice-President then becoming President for a term of two years. Ordinary members (including existing Councillors) may be nominated for the position of Incoming Vice-President. If an existing Councillor is elected their vacant Council position will be filled by nominations for the vacant Council positions.

Nominations should be put forward by two proposers. The nominee and the two proposers should be current Ordinary members (including Student members) or Honorary members of the New Zealand Mathematical Society. The nominations, including the nominees consent, should be forwarded by 4 November 2016 to the NZMS Secretary, preferably by email. If nominations are sent by email, the two proposers and the nominee should each send separate email messages to the NZMS Secretary.

New & Notable Titles from SIAM



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This book addresses the problem of finding an ellipsoid to represent a large set of points in high-dimensional space (which has applications in computational geometry, data representations, and optimal design in statistics). The optimization problems in the book have the entries of a symmetric matrix as their variables, so the author's treatment also gives an introduction to recent work in matrix optimization.

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