Number 120 April 2014

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 Mark C. Wilson with paid proofreader assistance. Editorial enquiries and items for submission to this journal should be submitted as plain text or LaTeX files to mcw@cs.auckland.ac.nz with "NZMS newsletter" in the title of the email.

The official address of the Society is:

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

However, correspondence should normally be sent to the Secretary:

Emily Harvey
Institute of Natural and Mathematical Sciences
Massey University
Private Bag 102 904
North Shore City 0745
Auckland, New Zealand
e.p.harvey@massey.ac.nz

NZMS Council and officers

Other positions of responsibility

Correspondents

Web Sites

NZMS homepage: http://nzmathsoc.org.nz/ (Webmaster: bbaeumer@maths.otago.ac.nz)

The newsletter is available at: http://nzmathsoc.org.nz/?newsletter

ISSN 0110-0025

EDITORIAL

Welcome to 2014, which is rushing past at an alarming rate. In the first edition of the year, we continue the series of articles by recent NZMS prizewinners, with Ben Martin and Tom ter Elst contributing. We also have an interview with Ben Green, and plenty of good reading from other regular features.

The local news is still a valuable part of this newsletter. Currently there are several vacancies for local correspondents. I would also like to have some news from Australia, so would appreciate nominations for a West Island correspondent. Small changes reported in the local news over many years can lead to huge changes in departments. The number of new colleagues and retirements in the last few years has been substantial. Thus we intend to have special focus articles on the various departments in turn, in order to give a snapshot of current conditions. However this is a lot of work for the local correspondents. The hardest part of their job is trying to pry information from their colleagues. So, please support your local correspondent if you have one, and if not, please volunteer yourself! On a related note, there have been no letters to the editor.

To elaborate on the reason why this is important, the main point of this newsletter is community-building. As nicely pointed out by Ben Green, NZ is not quite at the centre of world activity in mathematics, nor in science overall, although there are of course some very good pockets. We suffer from lack of critical mass, among other things, one of the most severe being lack of effective political leadership in the area. Current plans by the Minister of Everything, Steven Joyce, to reduce the size of university councils and assert more government control are just the latest of many irritation, and distractions from the real issues that we ought to be concerned with. From what I can see of trends overseas, New Zealand is in serious danger of being out-competed economically, and science and technology (including mathematics) must be used more effectively. Analysis by this issue's centrefold, Shaun Hendy, and others indicates that we would be more competitive if we improve the density of connections between our researchers. In a small way, this newsletter attempts to help in that direction.

Correction: In Issue 119, December 2013, the President's Report stated that John Butcher had been appointed an "Officer of the Order of New Zealand". The correct term is: "Officer of the New Zealand Order of Merit" (ONZM).

Mark C. Wilson

PRESIDENT'S COLUMN

ANZMC 2014

The Eighth Australia New Zealand Mathematics Convention (ANZMC 2014) takes place in Melbourne during 8th–12th December. This joint meeting with the Australian Mathematical Society incorporates the 2014 NZMS Mathematics Colloquium. Astrid an Huef is the NZMS Council representative for the organisation and reports preparations going well. Preliminary ANZMC 2014 details are at http://www.austms2014.ms.unimelb.edu.au/. The previous ANZMC was held at University of Canterbury in 2008, directed by Rick Beatson. That was a most enjoyable meeting. The ANZMC 2014 promises to be a great meeting too and I encourage you to attend.

Students can apply for NZMS funding towards travel to attend ANZMC 2014. The deadline is 1st June. As with other NZMS travel grants, these will not cover the full costs but are rather intended to help begin the process of raising funds. Students making an application will be expected to make a spoken or poster presentation at ANZMC 2014, or even better: both! Further details are elsewhere in this newsletter. There are limited NZMS funds for such support. This year, Council plans to distribute the Gloria Olive Travel Award among several students attending ANZMC rather than make the award to a single student. We will also be setting aside any money in the Fellows Fund described below. Any other donations for this or towards the general student travel fund would be gratefully received.

Fellowships

The New Zealand Mathematical Society, like many other societies, has an accreditation scheme. In particular, members may be recognised with the award of Fellowship of the NZMS. I would encourage members to consider applying and to encourage and nominate their colleagues who meet the criteria. Some people are unsure what is involved. There is even an anecdote of a member wondering whether they had sufficient credentials when they had won the NZMS Research Award, been a former NZMS President and been elected FRSNZ. Any one of these would have been sufficient to meet the third criterion below.

Here are the complete criteria, all three are to be satisfied.

Criteria for Fellowship

1. Shall normally have been a Member of the NZMS for a period in excess of three years.
2. Shall have had the qualifications of an Accredited Member for a period in excess of three years [i.e. have completed a postgraduate degree in mathematics at a recognised university or other tertiary institution, or shall have equivalent qualifications, and shall have been employed for the preceding three years in a position requiring the development, application or teaching of mathematics.]
3. Shall have satisfied criteria 3.1 or 3.2, and 3.3 or 3.4 or 3.5:
   - 3.1 Have demonstrated a high level of attainment in mathematics;
   - 3.2 Have demonstrated a high level of responsibility in mathematics;
   - 3.3 Have made a substantial contribution to mathematics;
   - 3.4 Have made a substantial contribution to the profession of mathematician;
   - 3.5 have made a substantial contribution to the teaching or application of mathematics.

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

Full details and the application form are on the NZMS internet site http://nzmathsoc.org.nz/?accreditation. Proceeds from fellowship applications will be put into a Fellows Fund. Those received before 1 June will be available to help fund student travel to ANZMC 2014.

NZMS Awards and Forder Lecturer

Elsewhere in this newsletter is the call for nominations for the NZMS Research Award and NZMS Early Career Award. The deadline is 31st July.

The next Forder Lecturer will be Endre Süli of the University of Oxford. His tour will take place in March/April 2015, and will be something to which we can look forward. I am grateful to Tom ter Elst who has kindly offered to coordinate the visit.

The Butcher-Kalman Invited Speaker

The NZMS has gratefully received a donation from Mathematical Chronicle Funds. The money is to encourage younger members of the New Zealand mathematical community. The Mathematical Chronicle was founded by John Butcher and John Kalman in the 1960s to promote mathematical communication in New Zealand. It was later superceded by the New Zealand Journal of Mathematics, a joint venture between the NZMS and the Mathematics Department of the University of Auckland.

The donation will be used to fund a speaker at the NZMS Colloquium from 2015. The speaker will be named the Butcher-Kalman Invited Speaker and will be a New Zealand resident mathematician who is within ten years of completion of her/his doctoral degree. I thank the Mathematical Chronicle Committee (Ivan Reilly, Vivien Kirk, David Gauld) for suggesting this way of supporting early career mathematicians in New Zealand and for making these funds available.

Winston Sweatman

BOOK REVIEWS

Please send all material involving book reviews to the Book Review Editor, Bruce van Brunt. Offers to review are particularly welcome, as are suggestions for books to review. Contact: b.vanbrunt@massey.ac.nz.

Computability and Randomness

André O. Nies: *Computability and Randomness*
Oxford University Press — Oxford Logic Guides 51
January 2009 Hardback ISBN: 978-0-19-923076-1
456pp

The sequence

$$1011011100001001101011 1001$$

is clearly more random than the sequence

$$0101010101010101010101010101.$$

From the point of view of probability theory though they are equally as likely to be the result of a sequence of independent coin-flips. Probability is even less informative when we try to consider the randomness of an individual infinite binary string. The theory of *algorithmic randomness* uses tools from computability theory to give a robust definition of randomness for strings. Roughly, the following are equivalent for an infinite binary string X: (1) X does not belong to an effectively presented, effectively null set; (2) the initial segments of X cannot be compressed (say by algorithms such as gzip); (3) one cannot make money using a computable betting strategy if the outcome of coin tosses is X. The roots of the theory go back to Richard von Mises and was initially developed in the 1960's and 70's by (among others) Martin-Löf, Levin, Kolmogorov, Schnorr, Chaitin and Solovay. Since 2000 though the area has seen rapid development, much of it centred in New Zealand, originating in the 2000 NZMRI summer conference in Kaikoura. The two standard texts are now Downey and Hirschfeldt's "Algorithmic Randomness and Complexity" and Nies' "Computability and Randomness". The theory now gives a hierarchy of notions of randomness, investigates ways of measuring relative randomness and has applications in classical computability and proof theory.

Unlike the Downey-Hirschfeldt 900-page tome, André's book is not encyclopaedic. Rather, it represents his point of view of the subject and naturally emphasises his particular interests. Thus, topics such as lowness notions and K-triviality, randomness at the level of Π^1_1 sets and interactions with the Turing degrees of computably enumerable sets receive a detailed treatment. On the other hand effective Hausdorff dimension, monotone complexity and other topics are not covered. Nonetheless, André's choices have so far proved to be prescient; most of the pre-2009 results in the area that have been used in the five years since the book's publication are present. André's style of presentation manages to convey the way he thinks of the subject, and usually strikes a good balance between informal exposition of ideas and rigorous detail. The absence of an introduction, though, is notable.

It is a tricky task to write a book about a relatively young and quickly expanding area. André's book helped standardise notation and direct research efforts. It gives a coherent picture at the time of its writing. However, recent developments have taken some areas to a natural point of maturation, which are left in an unfinished state in the book. Completely new aspects such as the infusion of notions and techniques from real analysis and ergodic theory have only happened since publication, and would no doubt appear prominently in a text written today. Overall, this book has served the community well as both a reference and a study guide.

Noam Greenberg

INVITED ARTICLES

Algebraic groups and complete reducibility

Finite group theory arose from efforts to understand polynomials and their behaviour under permutations of their roots. Sophus Lie devised a continuous analogue of this theory to study the symmetries of differential equations. The resulting symmetry groups are now called Lie groups. Many, though not all, can be realised concretely as groups of $n \times n$ matrices with real or complex entries.

We can extend this idea by replacing $\mathbb{R}$ or $\mathbb{C}$ with an arbitrary field k. Let $\mathrm{GL}_n(k)$ denote the general linear group of invertible $n \times n$ matrices with entries from k. A (linear) algebraic group G is a subgroup of $\mathrm{GL}_n(k)$ for some n such that G is the set of zeroes of some polynomials in the matrix entries. For instance, the determinant of a matrix is a polynomial in its entries, so the special linear group $\mathrm{SL}_n(k)$ of $n \times n$ matrices over k with determinant 1 is algebraic. The theory of algebraic groups combines ideas from algebra and geometry; but rather than being a differentiable manifold, as in the Lie group case, an algebraic group is instead an algebraic variety over k.

Algebraic groups arise in algebraic geometry, number theory, physics and the theory of buildings. When $k = \mathbb{R}$ or $\mathbb{C}$, algebraic groups are closely related to Lie groups: for instance, a compact real Lie group is an algebraic group over $\mathbb{R}$, by the Peter–Weyl Theorem and work of Chevalley. On the other hand, when k is a field of positive characteristic $p > 0$, such as a finite field $\mathbb{F}_q$ of size $q = p^r$ or a function field $\mathbb{F}_q((t))$, algebraic group theory has its own distinctive flavour. If $G = \mathbb{F}_q$ for some prime power q then G is a so-called finite group of Lie type. These give rise to one of the main sources of finite simple groups.

A standard procedure when we are given a class of mathematical objects is to study the simple objects. There is a natural notion of simplicity for algebraic groups, which is closely related to the usual notion for abstract groups. Until further notice we assume k to be algebraically closed. The simple algebraic groups over k are then essentially classified by the connected Dynkin diagrams. There are four infinite families A_n, B_n, C_n and D_n and five exceptional types G_2, F_4, E_6, E_7 and E_8. For instance, A_n corresponds to $\mathrm{SL}_{n+1}(k)$, and B_n corresponds to the special orthogonal group $\mathrm{SO}_{2n+1}(k)$. This is very similar in spirit to the classification of the simple complex Lie algebras. Indeed, any algebraic group has associated to it a Lie algebra, but the correspondence between group and Lie algebra is not as well-behaved as in the Lie group case (for example, the Lie algebra of a simple algebraic group need not be simple). For technical reasons it is convenient to study a larger class of groups, the reductive groups, which contains the simple groups and is closed under taking products and quotients. For example, $\mathrm{GL}_n(k)$ is reductive but not simple.

A central topic in the study of algebraic groups is representation theory. A representation of a group Γ is a homomorphism $f\colon \Gamma \to \mathrm{GL}_n(k)$ for some n. We say that f is completely reducible if whenever a subspace V of the vector space k^n is stabilised by $f(\Gamma)$, there is a complementary subspace W that is also stabilised by $f(\Gamma)$. This property depends only on the image of f, so it makes sense to define complete reducibility for subgroups of $\mathrm{GL}_n(k)$. Serre in the mid-1990s extended this notion to an arbitrary reductive group G: he defined what it means for a subgroup H of G to be completely reducible. The definition is formulated in terms of a special class of subgroups of G, the so-called parabolic subgroups. For example, when $G = \mathrm{GL}_n(k)$ then the stabiliser of any subspace of k^n is parabolic.

In 2005 Bate, Röhrle and I gave a geometric criterion for a subgroup of G to be completely reducible. This allowed us to apply powerful tools from geometric invariant theory. Using a generalisation of the Hilbert-Mumford Theorem due to Hesselink, Kempf and Rousseau, we proved the following result.

Theorem 1. *Let H be a subgroup of G such that H is* **not** *completely reducible. Then there is a canonical parabolic subgroup P of G such that P contains H.*

Roughly speaking, saying that P is "canonical" means that any automorphism of G that stabilises H also stabilises P. For instance, H is stable under conjugation by its normaliser $N_G(H)$ (by definition of a normaliser!), so P is also $N_G(H)$-stable. Since $N_G(Q) = Q$ for any parabolic subgroup Q of G, this implies that P contains not just H but the whole of $N_G(H)$.

Surprisingly, Theorem 1 has consequences for subgroups that **are** completely reducible. We proved that if N and H are subgroups of G, H is completely reducible and N is a normal subgroup of H then N is also completely reducible. When $G = \mathrm{GL}_n(k)$, this yields Clifford's Theorem, a well-known result from representation theory. Here is another result that also follows from Theorem 1.

Theorem 2. *Let H be a completely reducible subgroup of G. Then the centraliser $C_G(H)$ is completely reducible.*

Hence we have a useful dichotomy: we obtain information about a subgroup both when it is completely reducible and when it is not. Complete reducibility plays an important part in the analysis of the subgroup structure of simple algebraic groups.

One of the original motivations for Serre's definition was the theory of spherical buildings $\Delta(G)$. Given a reductive group G, one constructs a simplicial complex $\Delta(G)$ on which G acts by automorphisms. The simplices of $\Delta(G)$ correspond to the parabolic subgroups of G. One can translate certain geometric properties of $\Delta(G)$ into the language of complete reducibility. Using results on complete reducibility, we have proved some special cases of the Centre Conjecture, which asserts the existence of fixed points in $\Delta(G)$ under certain collections of automorphisms.

Our recent work with Herpel and Tange is on complete reducibility when we allow k to be non-algebraically closed. The basic definitions carry over to this more general setting but some key results are missing: we do not yet have an analogue of the Hilbert–Mumford–Hesselink–Kempf–Rousseau Theorem. Very little is known and there are many open problems.

[1] M. Bate, B. Martin and G. Röhrle, *A geometric approach to complete reducibility*, Invent. Math. **161** (2005), no. 1, 177–218.

[2] A. Borel, *Linear algebraic groups*, 2nd ed. Graduate Texts in Math. 126, Springer-Verlag, New York, 1991, xii+288 pp.

Ben Martin

The Laplacian

The Laplacian

$$\Delta = \sum_{k=1}^{d} \frac{\partial^2}{\partial x_k^2}$$

is a very interesting operator, because it appears at various places in physics and mathematics, and it has beautiful properties. Although it has been studied extensively, there are still many open problems. Because of the restricted space, I will not discuss how the Laplacian is connected to the angular momentum operator in quantum mechanics or the quantum harmonic oscillator, or used in tomography.

The *heat equation* in $\mathbb{R}^d$ is the partial differential equation

$$\frac{\partial}{\partial t} u(t,x) = \Delta u(t,x) \qquad t > 0,\ x \in \mathbb{R}^d. \tag{0.1}$$

It describes the heat diffusion in a homogeneous medium in $\mathbb{R}^d$. If the initial heat distribution u_0 is not blowing up too fast at infinity, then with Fourier theory it follows that the solution is given by

$$u(t,x) = \int_{\mathbb{R}^d} K_t(x,y)\, u_0(y)\, dy, \tag{0.2}$$

where

$$K_t(x,y) = \Big(\frac{1}{\sqrt{4\pi t}}\Big)^d e^{-\frac{|x-y|^2}{4t}}. \tag{0.3}$$

Since the integral kernel K_t is smooth and fast decaying one deduces from (0.2) and (0.3) that the heat distribution $x \mapsto u(t,x)$ at time t is smooth for all (including small) $t > 0$, even if u_0 is not smooth. Moreover, if $u_0 \geq 0$ and $\int u_0 \neq 0$ (for example if u_0 takes the value one on a tiny pea and vanishes elsewhere), then $u(t,x) \neq 0$ for all $t > 0$ and $x \in \mathbb{R}^d$.

Generalisations of the above are easy to formulate. Instead of a homogeneous medium in $\mathbb{R}^d$ one can consider heat diffusion in a medium where the conductivity varies. Then the Laplacian Δ in (0.1) has to be replaced by

$$\sum_{k,l=1}^{d} \frac{\partial}{\partial x_k} c_{kl} \frac{\partial}{\partial x_l},$$

where $(c_{kl}(x))_{k,l\in\{1,\ldots,d\}}$ is a positive definite matrix for every $x \in \mathbb{R}^d$. Moreover, one can replace the Euclidean space $\mathbb{R}^d$ by an open set $\Omega \subset \mathbb{R}^d$. Then boundary conditions are necessary to obtain a unique solution. Examples of such boundary conditions are the well-known Dirichlet boundary conditions, where the solution vanishes at the boundary; and Neumann boundary conditions, where the normal derivative vanishes at the boundary. One can also consider a mixture of these two or even completely different types, like the so-called Robin boundary conditions.

In these more general situations it is not clear whether the diffusion process still has a smoothing effect. In fact, it is in general no longer valid that $x \mapsto u(t,x)$ is a C^∞-function for all $t > 0$. It is a famous theorem, proved independently by Nash [Nas] and De Giorgi [DG], that the function $x \mapsto u(t,x)$ is nevertheless locally Hölder continuous if the conductivity is uniformly positive, i.e. if there exists a $\mu > 0$ such that

$$\Big(c_{kl}(x)\Big)_{k,l\in\{1,\ldots,d\}} \geq \mu I$$

for all $x \in \Omega$. But open problems remain: how does $u(t,x)$ behave if x approaches the boundary of Ω, and how does this depend on the boundary conditions on Ω, or the smoothness of the conductivity coefficients c_{kl}? Moreover, how does the situation change if the matrix $(c_{kl}(x))_{k,l\in\{1,\ldots,d\}}$ is singular for some points $x \in \Omega$?

The Laplacian also appears in the *wave equation*

$$\frac{\partial^2}{\partial t^2} u(t,x) = \Delta u(t,x).$$

One can consider the wave equation on a two dimensional connected set Ω with fixed boundary. Then u represents the displacement of a membrane, or a drum. Special solutions of the wave equation are of the form

$$u(t,x) = e^{i\omega t}\,\varphi(x)$$

where φ satisfies

$$\left[\begin{array}{l} -\Delta\varphi = \omega^2\,\varphi \\ \varphi|_{\partial\Omega} = 0 \end{array}\right. \tag{0.4}$$

and $2\pi|\omega|$ is a (pure) eigenfrequency of the membrane. Note that (0.4) states that φ is an eigenfunction of the Dirichlet Laplacian on Ω with eigenvalue $-\omega^2$. If the boundary of Ω is smooth, then the Dirichlet Laplacian has only countably many eigenvalues with finite multiplicity. Obviously, for two congruent sets Ω_1 and Ω_2 the corresponding sequences of eigenvalues of the Dirichlet Laplacians are equal. That is, two congruent drums have the same eigenfrequencies and sound the same. It is a famous question, formulated by Kac [Kac] in 1966, whether the converse is valid: ‘Can one hear the shape of a drum?’ Precisely, suppose that Ω_1 and Ω_2 are open nonempty connected bounded subsets of $\mathbb{R}^2$ with C^∞-boundary and such that the eigenvalues of the Dirichlet Laplacians, counted with multiplicity, are equal (that is, the domains are *isospectral*), does it follow that Ω_1 and Ω_2 are congruent? Up to now, the problem is still open.

Nevertheless, quite a number of results are known for related problems. Instead of subsets in $\mathbb{R}^2$ one can consider subsets in $\mathbb{R}^d$, or Riemannian manifolds. In 1964 Milnor [Mil] constructed two isospectral 16-dimensional compact Riemannian manifolds which are not isometric. Instead of a C^∞-boundary one can take a Lipschitz boundary. For this case, Gordon–Webb–Wolpert [GWW] constructed in 1992 two isospectral sets in $\mathbb{R}^2$ which are not congruent. These sets, however, are not convex, and in two dimensions no counterexample with convex sets is known. In four dimensions there is such a counterexample, found by Urakawa [Ura]. For sets with C^1-boundary no counterexample at all (even nonconvex) is known in any dimension.

Instead of Dirichlet boundary conditions one can also consider Neumann or Robin boundary conditions. The above counterexamples also work for the problem with Neumann boundary conditions. But for the Robin case the problem is wide open.

Finally, instead of drums which sound the same, one can consider drums on which the heat diffusion is the same. Here, surprisingly, the situation is different. Arendt [Are] proved that two open connected bounded subsets in $\mathbb{R}^d$ with Lipschitz boundary are congruent if their heat diffusion is the same. This is valid for Dirichlet, Neumann and Robin boundary conditions. If one considers heat diffusion on Riemannian manifolds with the Dirichlet version of the Laplace(–Beltrami) operator, then under a weak condition on the boundary it follows again that if the heat diffusion is the same, then the Riemannian manifolds are isometric [ABE]. In particular, heat diffusion determines a complete Riemannian manifold up to isometry. Whether diffusion determines the manifold in case of the Neumann version of the Laplace(–Beltrami) operator is still unclear.

Tom ter Elst

References

[Are] ARENDT, W., Does diffusion determine the body? *J. Reine Angew. Math.* **550** (2002), 97–123.

[ABE] ARENDT, W., BIEGERT, M. and ELST, A. F. M. TER, Diffusion determines the manifold. *J. Reine Angew. Math.* **667** (2012), 1–25.

[DG] DE GIORGI, E., Sulla differenziabilità e l'analiticità delle estremali degli integrali multipli regolari. *Mem. Accad. Sci. Torino cl. Sci. Fis. Mat. Nat.* **3** (1957), 25–43.

[GWW] GORDON, C., WEBB, D. L. and WOLPERT, S., One cannot hear the shape of a drum. *Bull. Amer. Math. Soc.* **27** (1992), 134–138.

[Kac] KAC, M., Can one hear the shape of a drum? *Amer. Math. Monthly* **73** (1966), 1–23.

[Mil] MILNOR, J., Eigenvalues of the Laplace operator on certain manifolds. *Proc. Nat. Acad. Sci. U.S.A.* **51** (1964), 542.

[Nas] NASH, J., Continuity of solutions of parabolic and elliptic equations. *Amer. J. Math.* **80** (1958), 931–954.

[Ura] URAKAWA, H., Bounded domains which are isospectral but not congruent. *Ann. Sci. École Norm. Sup. (4)* **15** (1982), 441–456.

MATHEMATICAL MINIATURE

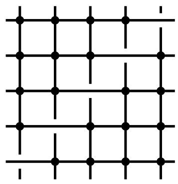
MM33: All ye need to know

Who said that mathematics should be beautiful? Keats wrote “Beauty is truth, truth beauty” and perhaps mathematics should be true and this should be beauty enough. When Hardy read the famous letter from Ramanujan he found even some of the untrue statements to be beautiful. Hence truth might not even be necessary.

In other fields of endeavour, such as music, opinions are expressed about which piece is the most beautiful. I do not think we should, even subjectively, suppose that a “most beautiful” can exist, but I have definite opinions of a “none more beautiful than this” nature. For example, a certain piece of music codenamed BWV 988 cannot be bettered, in my untutored opinion, but it is not the only work that I think of in this way. The “more beautiful than” ordering does not have, for me at least, a sup (or for that matter an inf) operation.

In the single year when I lived at O’Rorke Hall—not the present O’Rorke but the draughty collection of old buildings on a nearby site which were eventually demolished and replaced—the residents’ association got a bright idea. This was to ask notable members of the academic staff to drop by on an evening and add some culture to the lives of the students. I remember the visit by two well known poets and academics, A. R. D. (Rex) Fairburn and T. A. M. (Allen) Curnow. I can not remember anything they spoke about except that I soon realised that culture was given a meaning which excluded everything scientific.

Then H. G. Forder, Professor of Mathematics, had his turn. In explaining why he did mathematics, the word “beautiful” slipped out. His hosts couldn’t get the hang of that one. Did he mean beautiful mathematical pictures? Perhaps some of these are beautiful, like the one shown below, but Forder had been thinking of beautiful formulae, beautiful theorems and beautiful proofs. The picture, which Forder loved, represents a beautiful theorem in the beautiful subject of three dimensional projective geometry. I think the result is that if the various lines intersect at 19 of the points shown, then there is also an intersection at the remaining point. But after all these years I would appreciate a reminder.



Recently my attention was drawn to the website: http://www.bbc.com/news/science-environment-26151062. Amongst other things, this article put forward the view that Euler’s famous formula

$$e^{i\pi} + 1 = 0$$

is the most beautiful of all formulae. I certainly would agree that it is hard to find a more beautiful formula, but this is not the only formula about which this can be said. Above all it is a nice definition of π as the least positive solution of this equation. I will try to get bounds on π using the diagonal Padé approximations to exp, which we will denote here by $P_1(z) = (1+\frac{1}{2}z)/(1-\frac{1}{2}z)$, $P_2(z) = (1+\frac{1}{2}z+\frac{1}{12}z^2)/(1-\frac{1}{2}z+\frac{1}{12}z^2)$, … If we try to approximate $\exp(i\theta)$ by $P_k(i\theta) =: \exp(i\varphi_k(\theta))$ for small enough θ, then $\varphi_k(\theta) - \theta$ alternates in sign and becomes increasingly small in magnitude. Thus we can obtain bounds on π using, for example $P_3(ix/n)^n$ and $P_4(ix/n)^n$ and looking to see where the imaginary part changes sign. Using $n = 10$ and guesses for x, we find $3.1415926 < \pi < 3.1415927$.

Is there an ugliest formula? Perhaps not, but I think it would be hard to find an uglier formula than

$$\frac{a+b^n}{n} = x.$$

It does not even look very nice but its true ugliness rests on the use to which it was said to have been put. It would have been very ugly of Euler to have used this as a proof of the existence of God to humiliate the philosopher Diderot and to ingratiate himself with the Empress Catherine the Great. But this anecdote is evidently a myth and the nature of the ugliness has to move to the fact that the story was invented (by other people).

Consider the series

$$\varphi(x) = 1 + x + x^2 + 0x^3 + x^4 + \cdots,$$

where every power of x has coefficient 1 except terms of the form $x^{2mn+m+n-1}$, where m and n are positive integers, possibly equal. In this case the coefficient is zero. I have the strong belief that the series expansion for $\varphi(x)^2$ has only positive coefficients. I have checked this as far as I can but I have no proof. Can any reader give me hints or references?

J. C. Butcher

INTERVIEW

Ben Green talks to Steven Galbraith

Thursday March 6, 2014. Sunny afternoon in Albert Park on the grass. Cicadas buzzing in the background.

Brief bio: Ben is a renowned British Number Theorist. His PhD was supervised by Tim Gowers in Cambridge, and was completed in 2003. He was made an FRS in 2010 at age of 33. He has worked in Bristol, Cambridge, and is now Waynflete Professor of Pure Mathematics at the University of Oxford.

Ben has spent about 7 months in Auckland while his partner has been working here as a Psychiatrist.

SDG: Thanks for agreeing to the interview. You seem to be quite willing to communicate. You are very happy to give talks and courses and so on. Is this something you feel is important to you as a Mathematician?

BG: I think all mathematicians have some sort of duty to communicate what they do. I believe that very strongly. I mean, I don't think everyone thinks that way. But we are ultimately paid for by somebody or other, usually the taxpayer. So I think it is right to spend some time explaining, if you can, what it is you do and what other people in the area do.

SDG: That would apply to a general audience, but also within mathematics you are pretty generous with talks and writing. There are probably people who say "no" more than you do.

BG: Maybe I just like the sound of my own voice!

SDG: Like the number theory day we had in Auckland in February. You gave a couple of lectures about bounded prime gaps and you have given lectures on that topic in other places as well.

BG: This bounded gaps between primes thing is such a sensational breakthrough that, when it happened, I dropped everything to read it. Sometimes being forced to lecture on something is a good way of making sure that you've read it properly and understood it properly.

I wouldn't say I've done this sort of thing too many times, but I have in the past had the idea that one should invite people to speak with the rule that they are not allowed to mention any of their own work and not mention their own name once. I rather suspect you'd end up with a much higher quality of talks if you did that.

SDG: Maybe we'll try that at the next NZMRI Summer Workshop in Nelson!

SDG: I've noticed that you type up notes about all sorts of things (like you typed up some notes on the Goldreich-Levin theorem during our reading group here in Auckland). On arXiv there are notes you have written-up and it is not clear if you intend to publish them or not.

BG: I think it has become clear that I don't intend to publish them. I've actually been thinking more and more about having a blog, which is something I've resisted for a while. Not in the sense of putting every second thought on the web, but a mathematical blog where I put up notes that I've written on things, that other people may or may not find interesting. It would be useful for me and hopefully for other people.

I'm also thinking of having, as part of the same thing, a teaching blog. Instead of making lecture notes the traditional way, just blogging them so that students can comment and correct them. I think that would make things easier.

It is very hard to publish expositions of other people's work, generally...

SDG: ...unless you write a book.

BG: This particular thing, on bounded gaps between primes, because I spent a lot of time on it, I've submitted it on request to the Cambridge student's journal called Eureka. It has a long tradition of various articles like that.

SDG: Getting back to the blogs, Terry Tao and Tim Gowers, who are people you are very close to, are notable examples of people who have put a lot of information on their blogs.

BG: I love both of those blogs. I read them most days. Their existence is one of the reasons I have resisted having a blog: I'm not going to try to compete with Terry Tao in any sense. However, there are things that I think about and things that I write that I think would have an audience that is not the same as the traditional journal publishing audience. I'll see how it goes. I plan to resist any temptation to put opinions or political pieces up there. It will be purely mathematical.

SDG: I though it would be nice to have some mathematics in our conversation, so I went back to a couple of your early major papers. You have a 2002 paper about arithmetic progressions in sumsets. Arithmetic progressions have become one of the main themes of your research. Was this the topic of your thesis?

BG: My thesis was a collection of papers, about 8 or so. It was one of the chapters of my thesis. That particular paper remains one of the papers I am most pleased with in my career actually. Certainly at the time I did it, it was much better than anything I'd done before, and I'm quite fond of it.

Although I don't think the problem is ultimately hugely important. It is quite different to questions about progressions in more arbitrary sets or sets such as the primes.

SDG: Did you have those other problems in sight when you were working on it? How did you get into this in the first place? Did Tim suggest these as interesting questions to look at?

BG: No. I can't honestly remember how I got interested in that question. I had probably been reading Bourgain's paper, which got a weaker bound on the same thing. At that stage in my career I was basically reading anything by Bourgain. It was a very good way to learn stuff.

SDG: In 2003 you have a major paper about Roth's theorem in the primes. Do you want to talk about that one a little.

BG: Yes, that's much more closely linked to the later work I did with Terry on long progressions in the primes.

That was something I did while on a post-doc in Budapest. I guess one or two of the ideas in there went on to be very useful to proving there are arbitrarily long progressions in the primes. There's something called the W-trick. It's basically a way of ironing out some of the worst irregularities in the primes. I can explain the idea.

All of the primes except 2 are odd. That is a bias. They are not equidistributed mod 2. However, if you look at the set of integers x for which $2x+1$ is prime. It's a rescaling of the primes. If you have an AP in that set then you have an AP in the primes. And that set is nicely distributed mod 2: x is even iff the prime is $1 \mod 4$, and x is odd iff the prime is $3 \mod 4$.

SDG: But it is biased mod 3.

BG: It is biased mod 3. You can play a similar game with $6x+1$ to make the primes equidistributed mod 3. So that idea was quite important in our work. That was something I came up with there.

SDG: Why is it called the W-trick?

BG: I don't know. Terry and I have got some funny names in that paper. We called W the product of the first few primes. I don't think we are the only people to write W for the product of primes up to something or other. We had to call it something.

SDG: How did the collaboration with Terry come about?

BG: A story I've told a few times. A true story. I was applying for a lectureship in Cambridge and I asked Terry for a letter of recommendation. I had met him previously. Somehow in the course of that process we realised that we each had two pieces that could be put together to solve a different problem, about 4-term progressions in arbitrary sets. Curiously enough, although this was 10 years ago, only now are we finishing up writing up the paper on that. It turned out to be so much more painful than we expected.

SDG: You mentioned that you spent a lot of time as a student reading the papers of Bourgain. What advice do you have for young researchers?

BG: I currently have 5 PhD students and I will have 7 next year, most likely. And one point I emphasise to all of them is not to get too hung-up on reading stuff right at the start of their PhD. I like to encourage them to get stuck straight in to thinking about some questions. I have a big list of questions that I give them to choose from.

And then, as and when they find themselves needing to read up on stuff, then is the time to do it. One thing I've seen with my students is that they find that step from undergraduate learning, where everything is written down, often in a textbook, to having to think about stuff when you don't know how hard it is. This is clearly the biggest step to becoming a research mathematician. So the sooner you get started on that the better.

No student of mine is ever going to be told to go and read Hartshorne for a year, or EGA for 4 years.

SDG: Your area enables that. Because you can give them interesting questions that they can understand. If you were in algebraic geometry that would be harder.

BG: Yes, that is very fortunate.

SDG: The flip side is that, as a student, you might be using big theorems and the question is whether you ever have the time to read the proofs. And do you suffer for that?

BG: There used to be a point in my career when I understood all of the background of everything I had written. But that is no longer the case. And I don't think it needs to be the case. I've written a lot of papers that use at least small amounts of algebraic geometry, very simple stuff, like controlling the number of components of a subvariety given the degree of the polynomial. That kind of thing. I don't really know how those things are proven but I don't feel that I need to know. Somebody has proved them. It is completely reasonable that they should be true.

SDG: Also, they are not controversial new results. They are fully understood by their community. There is no danger you are being fooled.

BG: Zhang's paper presented a particular challenge in this regard. His original paper on bounded gaps between primes used very deep estimates on exponential sums: the estimates for Kloosterman sums and also much deeper things. As I mentioned in my talks, I think there was probably a point when the paper first came out that there was nobody in the world who understood the complete proof from first principles that there were bounded gaps between primes. I'm pretty sure that's true.

I don't really have a problem with it. As mathematics progresses we are increasingly going to have to learn black boxes. A favourite gripe of mine is that we don't seem particularly keen to do this with students. For example, I'm sceptical about the value of teaching all the innards of measure theory, the construction of Lebesgue measure and so on, before you start really using it. Measure theory is something mathematicians use all the time and you need to know roughly how it works, but you rarely need to know how it is constructed.

As long as you insist on this sort of ground-up building of the whole subject that's a huge hurdle you have to jump over before you can get to more interesting terrain beyond. It's like, you're going on a walk and there is some amazing view and you can either go up and over the mountain or around the side, you still get the same view.

SDG: At the elementary level this is exactly how we do it. We teach calculus before we teach the foundations of analysis.

BG: I'm not necessarily suggesting that one should just teach the statements of measure theory. If you just remember the statements then you don't really understand the whole thing. But many of the finer details of the construction are the kind of thing where I would be temped to say "Well, this is roughly how it goes. It would be 5 or 6 hours of lectures to really go over all the details and I'm not going to do that. Here are some references."

There are probably many other things like that. I'm sure of it. I remember going to an algebraic topology course as an undergraduate where it was rigorously proven that simplicial homology was a homotopy invariant. Well, I'm pretty sure that is something I only ever really need to vaguely know is true. I probably don't need to see proofs of that.

SDG: What about the whole process of refereeing, as mathematics gets so big and deep, and some of these papers are very long and use techniques from many different areas. I know you have some interesting thoughts on what to do about this.

BG: I am a managing editor of a journal (Math. Proc. Cambridge Phil. Soc.) and I know that there are some referees who are incredibly conscientious and really referee the paper in the old-fashioned way. For which I am very grateful, I should say. But for the most part, refereeing these days is an assessment of how important the paper is: Should it go in this journal?

You try to get a sense of whether the result is true. Often you get a sense that a paper is a bit dodgy. But I would admit freely that, unless it is a really important breakthrough paper for something like Annals, I do not very carefully referee papers line-by-line. There is just too much getting written and time is too short. So I take a look, get an assessment of the importance of it and the plausibility of it, and then I figure that really it is the authors responsibility to make sure it is correct. And if it is both important and incorrect then this will be outed sooner or later. It is very very rare for errors in important work to persist. I'm sure there are errors in completely unimportant and forgotten work that will never come to light.

So maybe this is a reasonable model for refereeing. The old model for refereeing dates from a time where people published a lot less, so there was less to referee and there was more time for refereeing because there was less pressure to publish publish publish.

SDG: The flip side is that authors will use peer-review as an arbiter of correctness. This is particularly true in science where medications are advertised as being supported by peer-reviewed publications in science journals. But it is not really clear how meaningful that is in some cases.

BG: It means something. You know, as a number theorist, that you get an awful lot of completely cranky rubbish stuff sent to you. If something appears in a sensible peer reviewed journal (and there are some peer-reviewed journals that are not that) then you know that it's not going to be some complete rubbish paper, generally.

At the level below the very top journals and the absolute breakthrough papers, it is much more a question of judging the importance. Because where people publish helps to decide whether they get a post-doc and go on to a career, and at some later point go on to write the absolute top breakthrough paper. This is the function of the great majority of journals.

SDG: Do you personally feel pressure to "publish publish publish"?

BG: There are quite a few things to say about this. First of all there is a definite sense in which I do have to publish at least some number of papers, due to something called the Research Excellence Framework in the UK. My University gets apportioned funding in some kind of proportion to the quality of papers its researchers submit, and to have a chance of being counted fully you need 4 papers. This is in a 7-year period, though, and I think most self-respecting professional mathematicians would want to be publishing at well over that rate anyway. Second, it's perhaps worth repeating what I was told some time ago by a very distinguished mathematician a little senior to me: there comes an age (probably about my age right now) where one transitions from trying to impress more senior mathematicians to trying to convince young mathematicians that one has "still got it". At least one way to try and convince them is to write a few decent papers. The third thing I would say is in the other direction – I don't feel any pressure to write papers just for the sake of writing, because I have a tenured job. I try to make sure that there's at least one serious idea in every paper I write.

SDG: What do you think about open access, for example the new Cambridge journals Forum of Mathematics (Pi and Sigma)?

BG: It's completely clear that the current model for journals is totally anachronistic. It's based on a time when people submitted journals handwritten on paper and they had no means of distributing them around the world.

I'm not entirely sure what the eventual model will be. But it will be something like an epi-journal, where you put your papers on the arXiv and then overlayed on that is some sort of stamp of approval. Call it a referee report or something like that.

The cost of the whole endeavour needs to be cut down massively. It's not free because web hosting and administration is a significant expense. But university libraries pay, I don't know what they currently pay for maths books and journals, but it would probably only cost a tiny fraction of that to subsidise an online archive system with secretarial support. Which is all that you'd need. Over time I am sure that things will change.

SDG: You participated in the Maths Olympiad. What are your thoughts on it?

BG: My own personal experience of Olympiads was more than half my lifetime ago. Though I was subsequently involved in training. I think it is broadly speaking a good thing. It was certainly good for me. It was the first time I realised that I had an aptitude for maths.

I don't think it should be taken too far. I used the word "training" just then. Somehow back then we didn't really used to train. We'd get together and a few problems would be solved. There was no syllabus or drills. Nowadays it is taken a little bit too seriously and that can result in burnout. People can lose interest in the problems.

I've completely lost interest in Olympiad problems. Nowadays I don't even look at the IMO problems.

SDG: I never look at them because I can never solve them.

BG: That's another thing. I would probably struggle a bit.

Because they have to be posed in such a way that they are suitable for everybody of school age from every country, they are necessarily of a slightly artificial type. So you get a lot of Euclidean geometry, which most mathematicians hardly ever do really in their research career. And you get these weird functional equation type things: "Find all functions such that $f(f(x)+y) = f(y) \times f(x)$ or some such. And then inequalities.

They do serve a useful purpose, which is that they are more interesting than a typical high-school syllabus. And they bring young mathematicians into contact with people of their own age who are also talented mathematicians, and also older people, usually at universities, who can point them in the direction of interesting things to read. So in that respect they're a good thing.

SDG: What have been the highlights of your visit to NZ? (Not necessarily mathematical)

BG: While it has been a pleasure hanging around in the Auckland maths department, talking to people here and attending the odd seminar or colloquium, I would have to add myself to the set of people for whom the highlight of their visit to NZ was not mathematical. For all I know, this set is identical to the set of visitors to NZ. Anyway, there's a great deal to enjoy in the immediate Auckland area (the volcanoes of the city, the West Coast beaches, the great food and coffee). I've done a good deal of hiking, running and orienteering in the area and got a bit fitter over the course of the year. Standout trips were a weekend in the Coromandel and a trip up north, and we are soon leaving for a 9-day trip to the South Island. It's a stunning country and it's a shame it's such a long way from anywhere, though no doubt Kiwis wouldn't want it any other way!

SDG: Thanks very much for your time Ben.

CENTREFOLD

Shaun Cameron Hendy

Shaun Hendy was educated at Massey University, Palmerston North, where he graduated with a BSc in Mathematics in 1992, and a BSc (Hons) First Class in Mathematical Physics in 1993. He completed his PhD in Physics (Cosmic Strings in Black Hole Spacetimes) at the University of Alberta in 1998. He returned to the Applied Maths team at IRL in 1998 as a FRST NZ Science and Technology Post-Doctoral Fellow, and became a permanent IRL employee in 2000. In 2002 he became a Principal Investigator at the MacDiarmid Institute for Advanced Materials and Nanotechnology, a Centre of Research Excellence headed by the late Sir Paul Callaghan. Shaun's most significant scientific discoveries have occurred in the last decade, when he pioneered, established, and continued the development of theoretical and computational nanotechnology in New Zealand. During these studies, he identified a new type of phase transition at the nanoscale, and found a regime where the coexistence of liquid and solid phases is metastable at the nanoscale, in contrast to the macroscale. He has shown how a transition occurs in moving from the nano- to the macro-scale when the two phases change from not coexisting, to coexisting. This is particularly important because unconstrained nanoparticle impacts are typically violent enough to produce partial melting, so that phase behaviour is important in many nanoscale experiments. Some of Shaun's mathematical discoveries have relied on new numerical methods, called hybrid kinetic Monte Carlo methods, developed in conjunction with Tim Schulze (U. Tennessee), which allow both a fine computational grid where significant atomic redistribution is occurring, and a coarse grid where atomic distributions are largely static.

Shaun has also made significant discoveries on the behaviour of fluids at the nanoscale, especially near solid interfaces. This work is important because of its potentially wide applicability to medical applications. Shaun completed fundamental research on the slip boundary conditions between liquids and solids at the nanoscale, and has derived the effective slip for a wide range of surfaces. Shaun's work has contributed to overturning the conclusion in the 20th century that fluid slip does not occur at solid boundaries. He has made fundamental advances in how to manipulate small fluid bodies using nano-tubes through the use of their corresponding capillary pressures. Shaun has also shown how non-wetting fluids can enter capillary tubes, a phenomenon previously thought by many to be impossible. Shaun's discovery was made serendipitously through numerical simulation, and subsequently confirmed by mathematical analysis, and then by experiment.

More recently, Shaun has used the international patent databases and Google Earth to show how patent innovation develops in space and time. He has shown that invention is a collaborative process, which generates scale-free networks that are similar those produced by a Yule process. He has developed methods which allow regional rates of innovation to be benchmarked internationally on measures of novelty, diversity and the chances of success. In 2011, IRL appointed Shaun their inaugural Industrial and Outreach Fellow, and provided additional resources for his research into innovation.

As a CRI scientist, Shaun has had to compete for research funding, and to date has won over $20M in research grants, including two Marsden grants. He has supervised over 20 postgraduate students, organised over 6 conferences, given many invited talks, and continues ongoing collaborations with Stanford, Tennessee, MIT, Flinders, Sydney, Dresden, Lyon, Adelaide and Imperial College.

Shaun's scientific achievements have been recognised by his Chair in Computational Physics at VUW in 2010, and his Chair in Physics at the University of Auckland in 2013. He was awarded the Massey University Distinguished Young Alumni Award in 2010, the New Zealand Association of Scientists Research Medal in 2010, the Prime Minister's Science Media Communication Prize in 2012, The Royal Society of NZ's Callaghan Medal in 2012, a Fellowship of the Royal Society of New Zealand in 2012, and the ANZIAM's EO Tuck Medal in 2013. He has been President of the NZ Branch of ANZIAM, President of the NZ Association of Scientists, and Secretary of the NZ Mathematical Society.

Shaun is perhaps best known in NZ as a science communicator. He communicates through radio, public talks, print media and blogging. His blog at Sciblogs.co.nz, "A Measure of Science", was launched in 2009. It is widely read by policy makers in the innovation sector in New Zealand, and has become a leading forum for discussion of the links between science, innovation and economic growth, attracting a monthly audience of more than 1,000 readers. He has written over 80 posts, attracting more than 50,000 page views. Some of his posts attract much wider audiences, e.g. his post on the Fukushima nuclear disaster was syndicated by the NZ Herald ("How to shut down a nuclear reactor", 17/3/11) and attracted a large international audience. Shaun has also had a regular slot as physics correspondent on Radio New Zealand's Nights with Bryan Crump. Shaun is a regular media commentator on issues to do with science and innovation, and the importance of both for economic growth. He is frequently interviewed by Radio NZ National, Radio Live, Newstalk ZB, the NZ Herald, the Dominion Post and both major TV channels. He is one of the few researchers to analyse the impact of the formation of the CRIs, the introduction of the PBRF system, and the formation of the COREs, within NZ's innovation system. Shaun has recently completed a joint book ("Get off the grass") with the late Sir Paul Callaghan, in which he has attempted to bridge the gap between academia and the general public. Shaun enjoys the outdoors, especially tramping in the Canadian Rockies. We wish him a long and successful research and outreach career.

Graham Weir

CYBERMATH

Last issue's column elicited a total of $e^{i\pi}+1$ official responses, despite possibly overstepping the bounds of good taste as apparently defined by the dominant NZ culture. In an attempt to get at least one response this time, let's try another tack. The following uses the terms "metric" and "measure", but not in the usual mathematical sense.

I have recently seen much discussion online of alternative methods for measurement of research performance. While no doubt most readers, like me, are skeptical of performance metrics for researchers (most troubling to me is Goodhart's Law http://en.wikipedia.org/wiki/Goodhart's_law), I am convinced that they are here to stay, and in fact will be used increasingly to evaluate researchers and allocate funding. Their advantages to administrators are many: objective, simple to compute without asking the researcher, quantitative. We can only try to refine them and to explain their limitations to administrators. Using many different measures will give a more accurate picture of a researcher's productivity.

Traditional citations in peer-reviewed journals still form the basis for most of the performance metrics. There are many obvious issues, such as negative citations, self-citations, vastly differing citation practices and rates in various fields. The IMU report www.mathunion.org/fileadmin/IMU/Report/CitationStatistics.pdf explains these well. However for the purposes of this column, we will assume that more citations is a good thing (alternatively, we are measuring "impact", not necessarily "quality").

The most commonly used citation metrics are the total number of papers (P), the total number of citations so far (N), and the h-index introduced by Jorge Hirsch in 2006 (the largest h such that the researcher has h papers all with at least h citations). There are many variations, but those proposed so far are mostly tweaks of the above. They all increase over time, and are thus biased toward older researchers. Here I want to propose something else that takes time into account. The measure is very simple. Let t be the number of years since the first publication by researcher x. Define $C_t(x) = N_t(x)/t^2$. The basic model is of a researcher publishing work that garners c citations per year, every year. One must be careful: C_t usually declines after the (effective) end of a career, unlike the other measures above.

A recent summer scholarship student computed $C_t(x)$ for several well-known values of x, and for a range of nonnegative integer t. The data is not as easy to extract from proprietary databases (none of which is as complete as one would like, and often has systematic bias against certain fields). We ended up using Thomson Reuters' Web of Science (probably MathSciNet would be better, but it is even harder to extract the data). However, once the data was finally obtained, a few conclusions could be drawn about the sample. One is that C_t is close to constant as a function of t (which was my initial hypothesis), and so might actually be measuring something important about that researcher. In particular it might be useful for prediction of future citation rates. I predict that with a bit more work, C_t will soon be ready for widespread use. Perhaps in a few years people will be asking each other, "what's your W-index?". I would be very happy to hear from statistically-minded members interested in helping me apply best practice to analysing C_t. Of course, one can think of other ideas, such as metrics based on the PageRank principle.

It is well known that citation rates differ greatly between research fields. For example, roughly speaking, for every citation in mathematics, there are 19 in physics and 78 in biomedical sciences (http://www.ams.org/notices/201105/rtx110500653p.pdf). This means that applied mathematicians have citation rates influenced to some extent by the application field. With this and all other caveats in mind (including the excessive precision in the table below), and with no attempt yet to draw any conclusions, we present here preliminary recently calculated values of C_t for some Fields' medallists, some NZMS prizewinners, and a few other data points.

T. Tao	18.15	P-L Lions	14.81	C. Villani	5.11	J. Bourgain	5.05
A. Connes	3.93	A. Okounkov	3.13	S. Smale	2.27	V. Jones	2.09
T. Gowers	1.20	J-P Serre	1.02	M.Kontsevich	0.74	E. Zelmanov	0.46
J. Kaipio	7.53	M. Saunders	4.04	S. Galbraith	3.60	R. Killip	2.63
I. Klep	1.51	R. Downey	1.51	R. McLachlan	1.48	A. Nies	1.44
J. Sneyd	0.73	M. Conder	0.72	S. Cooper	0.72	G. Martin	0.71
G. Whittle	0.51	W. Moors	0.48	J.Butcher	0.47	E. O'Brien	0.46
E. Kalnins	0.31	R. Aldred	0.24	B. Martin	0.23	J.An	0.22

Mark C. Wilson

LOCAL NEWS

AUCKLAND UNIVERSITY OF TECHNOLOGY

SCHOOL OF COMPUTING AND MATHEMATICAL SCIENCES

Sarah Marshall joined the School of Computer and Mathematical Sciences as a Lecturer in February 2014. Sarah completed a Bachelor of Commerce and Administration in Economics and a Bachelor of Science in Psychology and Operations Research at Victoria University of Wellington. After graduating, she worked in the Australian stockbroking industry before returning to New Zealand to complete a Master of Science in Statistics and Operations Research at Victoria University of Wellington. Sarah completed her PhD in Management Science on the application of deterministic and stochastic models to product recovery systems at the University of Edinburgh in 2012. Sarah taught in the Department of Management Science at the University of Strathclyde in Glasgow for three years before moving back to New Zealand to accept a position at AUT. Her current research interests include stochastic modelling, particularly Markov decision processes, with applications to inventory management, reliability, product recovery and recycling.

On 20 February, the School organised a one-day research retreat in two groups. The Computer Sciences Group held its retreat at the AUT North Shore Campus, and the Mathematical Sciences Group had its research retreat at the City Campus. Each academic staff member from the School presented a ten-minute talk on their recent research work in one of two groups. The main purpose of this event was to let staff know each other's research so that they can undertake research collaboration in the future. The retreat of the Mathematical Sciences Group ended with a BBQ dinner at Jeffrey Hunter's home.

On 27 February, a one-day workshop on AI and Logic was held at the School of Computer and Mathematical Sciences at AUT, featuring a number of talks presented by logicians and computer scientists from AUT, the University of Auckland, and the Technische Universität Ilmenau, including Bakhadyr Khoussainov (UoA), Patrick Girard (UoA), Jiamou Liu (AUT), Keeneth Johnson (AUT), Martin Huschenbett (Ilmenau) and Roopak Sinka (AUT). The workshop was organized by Jiamou Liu and Ji Ruan.

In February and March, Martin Huschenbett and Dietrich Kuske from the Technische Universität Ilmenau visited Jiamou Liu. The three continued their research collaboration on various topics in theoretical computer science.

Jiling Cao

UNIVERSITY OF AUCKLAND

DEPARTMENT OF ENGINEERING SCIENCE

The Department is very proud to announce the University appointment of Rosalind Archer to the Mighty River Power Professorial Chair in Geothermal Reservoir Engineering and as Director of the University of Aucklands Geothermal Institute. In addition, Mighty River Energy has guaranteed $1 million to support the establishment of a Chair in geothermal reservoir engineering over the next 5 years. Rosalind joined the University of Aucklands Engineering Science department in 2002 as a lecturer. Previous to this she was an acting assistant professor at Stanford University and an assistant professor at Texas A&M University. Recently, Rosalind led the University of Aucklands arm in a successful MBIE $4.4 million bid in Geothermal Supermodels together with GNS Science. Her research interests are in reservoir engineering of geothermal and petroleum reservoirs. We would also like to congratulate Rosalind in making history, being the first woman to be appointed to a Chair in Engineering in New Zealand.

The Department would like to congratulate two members of staff Dr. Andrew Mason and Dr. Thor Besier and for their recent promotions to Associate Professor. Andrew has a PhD from Cambridge University, UK, and a Bachelor of Engineering (in Engineering Science) from The University of Auckland. Andrew is the President of the Operations Research Society of NZ (until Nov 2013, then replaced by Golbon Zakeri — *Ed.*) , and a founder of The Optima Corporation, a University spin-off company specialising in Emergency Services Logistics. Andrew developed the first versions of the Optima ambulance simulation software, and is actively involved in research in ambulance logistics. He has created and maintains 'OpenSolver', an open-source Excel add-in for solving large spreadsheet optimisation models. He has for many years been developing solutions for staff scheduling problems that use advanced column generation approaches. This year's ORSNZ annual conference, run by Andrew Mason, was jointly held with the NZ Statistical Association and titled "Analytics for a Changing World: From Data to Decisions". This new collaboration proved to be very successful with 175 attendees and provided over 130 talks. Thor received a BPhEd Hons from the University of Otago, New Zealand, in 1995 and a PhD in Biomechanics from the University of Western Australia in 2000. He joined the Bioengineering Department at Stanford University in 2003 as a post-doctoral research fellow and became a faculty member in the Department of Orthopaedics at Stanford in 2006. For four years he established Stanford's Human Performance Laboratory as the Director of Research. In February 2011, Thor returned to New Zealand where he joined the Auckland Bioengineering Institute as a Senior Research Fellow and Principal Investigator. Thor holds a joint appointment with the Department of Engineering Science. His research combines medical imaging with computational biomechanical simulation to understand mechanisms of musculoskeletal injury and disease.

The Department would like to congratulate Peter Bier on his AUEA Teaching Excellence Award. Peter received a grant from the AUEA award and will use part of the grant to attend international education conferences and workshops to help to improve teaching practices across the faculty. The grant will also fund the purchase of tablet hardware and software to help with his current investigation into how new mobile and tablet devices can be used to improve students learning. In addition, Peter was also promoted this year to the Highest grade of the Professional Teaching Fellow scale for his contributions to teaching in Engineering. Peter also directs New Zealands Next Top Engineering Scientist Competition of which the 2013 results were announced recently and are as follows: The Pullan Memorial Prize winner for first place of $6000 went to Team 1152 from Westlake Boys High School (Year 13); Runners up, in second place of $2000 each went to Team 1045 from Botany Downs Secondary College (Year 13) and Team 1141 from Matamata College (Mixed). In addition, there were 8 teams which were highly commended, and came from Rangitoto College (Mixed), Macleans College (Mixed) St Peters School (Year 13), Otumoetai College (Year 13) ACG Strathallan College (Mixed), Kristin School (Year 13), Burnside High School (Year 13) and Bayfield High School (Year 13).

Charles Unsworth

DEPARTMENT OF MATHEMATICS

John Butcher has been honoured by Volume **65**, Issue 3 of *Numerical Algorithms* (March 2014), which is dedicated to John in celebration of his 80th birthday. That issue contains 18 papers arising from presentations at the ANODE2013 conference, held in Auckland in January 2013. It is available at http://link.springer.com/journal/11075/65/3/page/1.

Steven Galbraith received the NZMS Research Award at the 2013 New Zealand Mathematics Colloquium.

Sina Greenwood has been promoted in the Senior Lecturer scale, from SL5 to SL6.

Vaughan Jones gave a course of lectures on Knots and Braid Groups and their Representations, from February 10 to February 13. A series of posters about the history of the University of Auckland has been installed in the Symonds Street pedestrian arcade, with a poster for 1990 featuring a larger-than-life photograph of Vaughan Jones, Paul Hafner and Mike Lennon. Paul Hafner's photograph of that poster is reproduced here.

On March 7 the Inaugural Sir Vaughan F.R. Jones PhD Scholarship was announced. This prestigious scholarship will fund the research in any area of mathematics of a PhD student supervised by a member of our Department of Mathematics. Selection is based purely on the record and research promise of the candidate. The Jones Scholarship offers an annual stipend of NZ$25,000 (tax-free), plus fees, for 3 years of PhD study. Interested candidates are encouraged to contact members of our Department informally concerning possible research projects. Full applications, via the University of Auckland online application system, must be received by August 30, 2014.

Igor Klep has been promoted in the Senior Lecturer scale, from SL4 to SL6.

Julia Novak and *Judy Paterson* each received the Dean's Award for Teaching Excellence.

James Sneyd has been awarded a new 5-year National Institutes of Health (NIH) grant, held jointly with David Yule (University of Rochester). The project is a continuation of the past 5 years of NIH funding, and it involves the construction of a multiscale model of saliva secretion.

Tom ter Elst has been appointed as Simons Visiting Professor at Oberwolfach. That award supports "distinguished scientists from outside Europe".

The Centre for Mathematics in Social Science (CMSS) held its 5th Summer Workshop on December 10 & 11, 2013. The two main topics were economic mechanism design, and game theory and electricity markets. The list of invited speakers is very impressive, including Ludovic Renou (University of Essex), Tim Roughgarden (Stanford), Frank Wolak (Stanford), Shmuel Oren (UC Berkeley) and Jim Bushell (UC Davis), plus many distinguished visitors from Australasia and Singapore.

The Algebra and Combinatorics Group had many international visitors in February, and a workshop was held on Friday February 14. The programme was: Prof. Jozef Širáň (Open University & Slovak Technical University), "Chiral regular maps of a given type"; Prof. Asia Weiss (York University), "Graphs and symmetric 4-polytopes"; Dr Maria Elisa Fernandes (University of Aveiro), "Regular polytopes for symmetric and alternating groups"; Dr Heiko Dietrich (Monash University), "Radical groups"; Prof. Gerhard Hiss (RWTH Aachen), "On the Steinberg representation in finite classical groups"; and Prof. George Havas (University of Queensland), "How hard is computing with matrices?"

At the 2013 New Zealand Mathematics Colloquium, our PhD students *Katie Sharp* and *Jennifer Creaser* won the first and second prizes respectively in the Poster Competition.

Recent visitors include Dr Pablo Aguirre (Universidad Técnica Federico Santa Mara, Chile), Prof. Marcus Appleby (University of Sydney), Dr Irene Biza (University of East Anglia), Prof. Len Bos (Universita di Veronà), Prof. Andreas Cap (Universität Wien), Prof. Harry Dankowicz (University of Illinois at Urbana-Champaign), Dr Steve Flammia (University of Sydney), Prof. Paul Gartside (University of Pittsburgh), Dr Markus Haase (Delft University of Technology), Dr Andy Hammerlindl (UNSW & University of Sydney), Dr John Hannah (University of Canterbury), Prof. Heikki Kälviäinen (Lappeenranta University of Technology, Finland), Prof. Peter A. Loeb (University of Illinois), A-Prof. Kevin McLeod (University of Wisconsin-Milwaukee), A-Prof. Ravi Montenegro (University of Massachusetts-Lowell), Prof. Elena Nardi (University of East Anglia), Dr Jan Rozendaal (Delft University of Technology), Dr Jan Sieber (University of Exeter), Prof. Piotr Skowron (University of Warsaw), Dr Mike Smith (Aix-Marseille Université) and Prof. Lutz Weis (Karlsruhe Institute of Technology).

Garry J. Tee

UNIVERSITY OF WAIKATO

DEPARTMENT OF MATHEMATICS

Ernie Kalnin's paper "Extended Kepler-Coulomb quantum superintegrable systems in three dimensions" has been selected for inclusion in the Journal of Physics: A Highlights of 2013 collection. This paper was co-authored with Ernie's former post-doctoral fellow Jonathan Kress (now at the University of New South Wales) and Willard Miller Jr (University of Minnesota).

The Department will shortly be advertising for a post-doctoral fellow in Pure Mathematics. This position is for two years.

The University has launched a new 1.5 year Master of Cyber Security degree this year. Though this degree is mainly a Department of Computer Science initiative, Mathematics will contribute a new cryptography course to the degree.

Stephen Joe

MASSEY UNIVERSITY

INSTITUTE OF FUNDAMENTAL SCIENCES

In September we were joined by *Richard Brown* as a Lecturer in Mathematics. Richard completed his PhD at the University of Canterbury, and subsequently held fixed-term appointments there in both the Mathematics and Statistics Department and the BlueFern High Performance Computing Centre.

Richard's research interests are in the modelling of biological and ecological systems, and also in numerical methods for scientific computing. His wife Emily is also working part-time at Massey tutoring mathematics. They have five children, of which two (Isabelle and Toby) are pre-schoolers, and the remaining three (Sam, Tom and Eliana) are at primary school.

A few of *Robert McLachlan*'s students and colleagues gathered at "Foxton Fizz", a kind of micro-summer workshop at Foxton Beach to mark his 50th birthday. There were talks by Yousuf Tufail (Massey), "Image Registration"; Stephen Marsland (Massey), "A twist in the talk: Shape correspondence and the role of the connection"; Raziye Zare (Massey), "Multiregistration"; Reinout Quispel & Dave McLaren (La Trobe), "Recent developments on the Kahan method"; Philip Zhang (Callaghan Innovation), "Thermal cloaking: visible or invisible?"; Robert McLachlan (Massey), "Symplectic integrators for spin systems"; and Klas Modin (Chalmers), "Optimal information transport and diffeomorphic density matching".

Richard Brown

UNIVERSITY OF CANTERBURY

SCHOOL OF MATHEMATICS AND STATISTICS

Yes, that's right, we have become a school in February. The name change from department to school was driven by the College of Engineering, which we belong to, in an initiative to divide the college into schools for marketing purposes. It entails no academic or administrative changes.

Jennifer Brown was re-appointed as Head of School for a further term of five years after her first term expires mid-year 2014.

Congratulations to *Alex James* who has been promoted to Associate Professor, and to *Carl Scarrott*, *Clemency Montelle*, *Elena Moltchanova* and *Rua Murray* who have been promoted to the rank of Senior Lecturer Above the Bar.

Remediation work in the Erskine building in making slow but steady progress. Scaffolding surrounds the building and also fills the atrium, and the building is hidden behind fabric (not quite a Christo wrapping though). Just in time for the start of Semester 1 we got our basement computer labs back, but all our undergraduate lecture and tutorial classes are spread all over campus. We are able to occupy our offices in the Erskine building, and you get the occasional worker outside your office window looking back at you.

At the end of 2013 we farewelled two US-bound academics. After five years at UC *James Degnan* has taken his young family back to their home town of Albuquerque, New Mexico, where the grandparents will no doubt be eagerly waiting. He takes up a position in the Department of Mathematics & Statistics at the University of New Mexico in Albuquerque. *Blair Robertson* has taken up a tenure-track professorship in the department of statistics at the University of Wyoming in Laramie—a town on a high plain between 2 mountain ranges with a lowest recorded temperature of minus 46 degrees. Blair is a graduate of UC receiving his PhD in 2011. Since then he has worked as a lecturer for us. We wish James and Blair well in their new positions.

In February the school welcomed two new staff members on fixed-term lecturing contracts. *Brendan Creutz* originally is from San Diego, California. He completed a BSc in Mathematics at California Polytechnic State University SLO in 2004, and an MSc at Jacobs University Bremen, Germany, in 2008. While working as a Research Assistant at the University of Bayreuth in Germany Brendan received his PhD from Jacobs University in 2010. He spent the balance of the past 3 years as a postdoc at the University of Sydney, where he enjoyed snorkelling, cycling and sunshine, but missed the mountains. Brendan's research focuses on number theory, algebraic geometry and computer algebra.

Richard Vale joined us as a part-time lecturer and will be working part-time as a Senior Intelligence Analyst at the IRD in Christchurch. He has a PhD from the University of Glasgow (2007) and worked as a lecturer for 4 years in the USA at Cornell University and Oberlin College. In his free time, he likes to study German and go dancing. While in Christchurch, he would like to learn the piano and go hiking at weekends. His research interests originally were in algebra, but he is now focussing on statistics with recent work in mathematical ecology, copulas, and data visualisation.

Rua Murray and *Jeanette McLeod* are on sabbatical for the first six months of the year.

In February we also welcomed Michelle Dalrymple who is visiting us until July under the auspices of a Royal Society Endeavour Teaching Fellowship. These fellowships for teachers have three purposes: to gain new and up-to-date knowledge which will enhance teaching and learning; to develop leadership capacity in early and mid-career teachers; and to give teachers the opportunity to experience how science, mathematics and technology are used outside teaching. Michelle completed her PhD in Statistics here and is now Head of the Mathematics and Statistics faculty at Cashmere High School.

The same month further saw the arrival of Erskine visitor Warwick Tucker from Uppsala University, Sweden, who is with us for 5 weeks. After receiving his doctoral degree in Mathematics at Uppsala University in 1998, proving that the Lorenz attractor exists (solving Smale's 14th Problem), Warwick spent 2 years at IMPA (Rio de Janeiro, Brazil) and 2 more at Cornell University (Ithaca, USA). During this period, he was awarded the Swedish Mathematical Society's Wallenberg Prize, and the R. E. Moore Prize for Applications of Interval Analysis. In 2004, he was awarded the European Mathematical Society's Prize for Distinguished Contributions in Mathematics. Warwick heads the Computer-aided Proofs in Analysis (CAPA) research group in Uppsala University. He is hosted by *Raaz Sainudiin*, and as part of the Erskine fellowship teaches engineering students in EMTH210.

The work of *Raaz Sainudiin* and his collaborators from Australia, Brazil and France on the endangered Chatham Island Black Robin featured in National Geographic.

The project aims to develop novel mathematical models of population pedigree processes that can provide a unifying framework for behavioural ecology and evolutionary genetics. Field data on behaviour and multigenerational pedigrees from Melanie Massaro (Charles Sturt University, Australia) on the Chatham Island Black Robins is guiding the theory developed by Raaz and Amandine Veber (Centre de Mathématiques Appliquées, École Polytechnique, France).

See http://phenomena.nationalgeographic.com/2014/01/02/in-saving-a-species-you-might-accidentally-doom-it/.

Günter Steinke

UNIVERSITY OF OTAGO

DEPARTMENT OF MATHEMATICS AND STATISTICS

Florian Beyer and *Jörg Frauendiener* took up the invitation to join the Mathematical Sciences Research Institute, Berkeley, in their 2013 Fall Semester as research members in the programme "Mathematical General Relativity". Jörg stayed for four weeks and Florian was able to enjoy the Californian sun for six weeks.

Ting Wang has received a grant of $56,000 for two years from the Earthquake Commission. Ting's project is concerned with objectively characterising the statistical features of different seismicity patterns (foreshock, mainshock, aftershock and background) in varying tectonic environments.

Boris Baeumer has been appointed as the chair of the New Zealand branch of the Australia and New Zealand Industrial and Applied Mathematics Society (ANZIAM).

Matthew Schofield started his position as a Statistics lecturer in January, joining us from the Department of Statistics, University of Kentucky. He has research interests in Bayesian statistics with applications in ecology and environmental sciences. Recent work includes the use of approximate Markov chain Monte Carlo algorithms in capture-recapture modeling, modeling of capture-recapture data obtained from DNA samples, and exploring the statistical properties of tree-ring based climate reconstruction. A current research focus is the specification of Markov chain Monte Carlo algorithms for capture-recapture data with possible misidentification. Welcome, Matt!

During the past few months, the department was visited by four operator algebraists, hosted by *Astrid an Huef, Lisa Orloff Clark and Iain Raeburn*. Aidan Sims from the University of Wollongong is visiting for 3 months, and Ruy Exel (Universidade Federal de Santa Catarina), Michael Whittaker (University of Wollongong), and Efren Ruiz (University of Hawai'i at Hilo) came for 1–2 weeks.

Jörg Hennig

Colleagues mentioned in Local News reports: left to right, top to bottom: Sarah Marshall, Brendan Creutz, Richard Vale, Matt Schofield, Rosalind Archer, Andrew Mason, Thor Besier, Richard Brown.








REPORTS ON EVENTS

NZMASP Conference

Massive mountains, lush landscapes, a secluded settlement—Cass, home to the eponymous University of Canterbury field station, turned out to be an ideal venue to facilitate the fruitful exchange of mathematical ideas among postgraduate students from throughout New Zealand. A group of thirty PhD and Masters students attended this year's instalment of the annual NZ Mathematics and Statistics Postgraduate (NZMASP) conference, from the 11th to 14th of November. NZMASP2013 was held thanks to generous funding from the NZMS, Mathworks, NZ Statistical Association, Royal Society of NZ, SAS, Statistics NZ, and the Mathematics and Statistics departments of NZ Universities.

The diversity of the NZ mathematical community was reflected by the wide variety of topics covered by student talks, which everyone agreed to be of an excellent standard. Graph theory, spatial statistics, bifurcation analysis, fluid mechanics and constructive mathematics were just a few of a vast range of fields discussed over the course of the conference. The agenda also featured invited speakers Emmanuel Jo (SAS Institute Inc.), Alex James (Applied Mathematics), Jeanette McLeod (Pure Mathematics) and Elena Moltchanova (Statistics). Students benefited from the opportunity to network with young and established researchers, to chair sessions, and to present their research in front of a supportive audience. The invited speakers even provided detailed written feedback on the contributed talks for the speakers to put into practice at future presentations.

One highlight, which isolated Cass had to offer, was the view of the stars on a clear night. Imagine a bunch of excited mathematicians spotting satellites, observing shooting stars and identifying brightly shining planets made easy with augmented reality star maps on smartphones!

Congratulations to this year's winners of the four prizes for the best talks: Jennifer Creaser, James Dent, Katie Sharp and Timm Treskatis. The conference organisers, Peter Jaksons, Nick Brettell, James Dent and Rachelle Binny (postgraduate students from the University of Canterbury), did a great job running a conference that never went behind schedule. Next year's NZMASP conference, to be hosted by students from the University of Auckland, will be awaited with much anticipation.

Timm Treskatis

Report from the 2013 SMB meeting, 10–13 June, Tempe, AZ

The 2013 Annual Meeting of The Society for Mathematical Biology (SMB) was held in Tempe, Arizona from June 10–13, 2013. This year's theme was *physiology, disease, ecology and sustainability*. The conference was hosted by the School of Mathematical and Statistical Sciences at Arizona State University, at the Tempe Mission Palms Hotel and Conference Centre.

I left Dunedin on a cold and windy day and arrived in Phoenix where the temperature was around 42 degrees. Like most other students, I was allocated a single room in the Palo Verde West dormitories on the ASU campus located within 10 minutes walking distance from the conference venue.

The registration and welcome reception took place in the hotel lobby on Sunday 9 June from 3pm onwards. Hal Smith and Fabio Milner from the organising committee were around introducing themselves to the registrants and making sure that everything went smoothly. The reception continued until 9pm with plenty of food and drinks provided. According to the organisers, about 300 people were expected to attend SMB 2013. After the reception most participants made their ways to the Mill Ave District, which serves as the heart of Tempe, with shops and a variety of food places.

The conference officially began on Monday 10 June at 8:30am with a plenary speech. There were two plenary speakers every day and the rest of the day was divided into three 100 minute bulk sessions with breaks in between. Each of these 100 minute sessions consisted of six parallel sessions. Oral presentations were 20 minutes long plus 5 minutes for questions and transition; hence there were 4 speakers in each parallel session. The majority of the speakers were affiliated with American universities and institutions, followed by those from the UK and Canada. There were four speakers from Australia and I was the only one representing New Zealand.

The variety of topics and subjects was remarkable; from epidemics, population models, honey bees to cancer, tissue development, systems biology, PKPD, and more. I gave a talk at the immunology session and spoke about the effect of chemokine's anomalous diffusion on the speed of resolution in the event of a tissue inflammatory response. Overall, my talk was well-received with plenty of positive feedback. I also had further constructive discussions with people interested in modelling immune system and some of these may lead to more comprehensive collaborations in the future. Moreover, I believe that I have succeeded in extending my academic network.

I would like to thank the University of Otago Division of Sciences for their generous travel grant as well as Department of Preventive and Social Medicine and Department of Mathematics and Statistics for their financial support. I am also grateful to the NZMS for their financial contribution. Attending SMB 2013 was a great experience for me which would not have been possible without the financial aids mentioned above.

Aidin Jalilzadeh (MSc)

NZMS NOTICES

Student support to attend the 8th Australia – New Zealand Mathematics Convention (ANZMC) 2014, Melbourne

The New Zealand Mathematical Society invites applications for financial assistance for students who are planning to attend the ANZMC in Melbourne, 8–12 December 2014. To be eligible students must be based at an institution in New Zealand and be active within the New Zealand mathematical community. Preference will be given to students who are presenting their work either as a talk or as a poster.

To apply for funding students should complete the NZMS student travel grant application form available at `http://nzmathsoc.org.nz/?assistance`.

Completed application forms and required additional information (see details on application form) should be sent as a single pdf via email to the NZMS Secretary:

Dr. Emily Harvey: `e.p.harvey@massey.ac.nz`

entitling the email:

"Student Travel Grant Application: Travel to ANZMC2014".

For full consideration, the form must be received before the deadline of Monday 2 June 2014. The amount of money available for individual students will be decided shortly after that date.

Call for nominations for the 2014 NZMS Research Award

The annual NZMS Research Award was instituted in 1990 to foster mathematical research in New Zealand and to recognise excellence in research carried out by New Zealand mathematicians. **This award is based on mathematical research published in books or recognised journals in the last five calendar years: 2009–2013.** Candidates must have been residents of New Zealand for the last three years.

Nominations and applications should include the following:

- Name and affiliation of candidate.
- Statement of general area of research.
- A list of books and/or research articles published within the last five calendar years: 2009–2013.
- An electronic copy (pdf) of the each of the five most significant publications selected from the list above.
- A clear statement of how much of any joint work is due to the candidate.
- A Citation, of at most 40 words, summarising the mathematical research underlying the application.
- Names of two persons willing to act as referees.

A judging panel shall be appointed by the NZMS Council. No person shall receive the award more than once. The award consists of a certificate including an appropriate citation of the awardee's work, and will be announced and presented (if possible) at the New Zealand Mathematics Colloquium Dinner in 2014 which this year will be at the joint meeting of NZMS and AustMS in Melbourne in December.

All nominations and applications should be sent by 31 July 2014 to the NZMS President Winston Sweatman. Submissions should be made by email to `w.sweatman@massey.ac.nz`, stating clearly that they are for the NZMS Research Award.

Call for nominations for the 2014 NZMS Early Career Award

This award was instituted in 2006 for early career New Zealand mathematicians. Criteria for eligibility are the same as for the Marsden fast start grants. Essentially, this means that applicants must be within seven years of confirmation of PhD with an allowance made for extenuating circumstances. **The candidate will be judged on their three best papers and a two-page CV.** The papers should be published or in press. In cases of joint authorship, a clear statement of the mathematical contribution of the candidate should be made. The candidate will have completed a significant part of their research within NZ. They would also normally be expected to be a member of the NZMS. Candidates will also provide a Citation, of at most 40 words, summarising the mathematical research underlying the application. It is recommended that self-applicants approach a colleague to write this Citation.

A judging panel shall be appointed by the NZMS Council. No person shall receive the award more than once. The award consists of a certificate including an appropriate citation of the awardee's work, and will be announced and presented (if possible) at the New Zealand Mathematics Colloquium Dinner in 2014 which this year will be at the joint meeting of NZMS and AustMS in Melbourne in December.

All nominations and applications should be sent by 31 July 2014 to the NZMS President Winston Sweatman. Submissions should be made by email to `w.sweatman@massey.ac.nz`, stating clearly that they are for the NZMS Early Career Award.

Minutes of 2013 AGM

39th Annual General Meeting of the NZMS, Tauranga, 5pm Tuesday 4th December 2013 Present: Winston Sweatman, Steve Taylor, Graeme Wake, Carlo Laing, Amjad Ali, Andrea Babylon, Karen McCulloch, Emily Harvey, Igor Boglaev, Vivien Kirk, David Gauld, Bruce van Brunt, Joerg Hennig, Tim Stokes, Annalise Converano, David Simpson, Tammy Lynch, Graeme O'Brien, Astrid an Huef (minutes), Graham Weir (chair), Bernd Krauskopf, Hinke Osinga, Robert McKibbin, Rua Murray, Phil Wilson, Marten McKubre-Jordens, Steven Galbraith, Dion O'Neale, Alona Ben Tal, Mark Wilson, Tom ter Elst, Joerg Frauendiener, Ernie Kalnins, Mohd Hafiz Mohd, Iain Raeburn, Igor Klep, Ian Hawthorne, Mark McGuinness.

1. Minutes of the 38th Annual General Meeting were accepted (Graeme Wake/Robert McKibbon, passed).

2. Matters Arising. None.

3. President's report. Graham Weir read his report (as tabled). Graham moved that his report be accepted and this was passed unanimously.

4. Treasurer's report. Mark McGuinness spoke about his report (as tabled). There was discussion about expenses and recognition of visiting lecturers, which Council will consider further. The Treasurer's report was accepted (Graham Weir/Winston Sweatman, passed).

5. Appointment of auditors. The current auditor, Nirmala Nath from the School of Accountancy, Massey University, is to be re-appointed as Auditor (Mark McGuinness/Tammy Lynch, passed).

6. Membership Secretary's report. Not available at the meeting, but membership was addressed in the President's report.

7. Election of councillors. Robert McKibbin and Peter Donolan are retiring; the Society thanked them for their service. There were three nominations for Council: Miguel Moyers-Gonzalez (Alex James/Mike Plank), Shaun Cooper (Robert McKibbin/Carlo Laing) and Emily Harvey (Vivien Kirk/Hinke Osinga). Rua Murray and Robert McKibbin acted as Returning Officers in the election. Shaun Cooper and Emily Harvey were elected.

8. Report of 2012 Colloquium. Bruce van Brunt reported that the 2012 Colloquium was a success and that they have returned their surplus to the Society.

9. Report of 2013 Colloquium. Ian Hawthorne reported that the 2013 Colloquium was going well and that they expect a small surplus to be returned to the Society.

10. Forthcoming colloquia. The 2014 Colloquium is a joint meeting with the Australian Mathematical Society and will be held in Melbourne 8–12 December 2014. There was a request for more funding of student grants to allow for the greater travel cost to Melbourne. Possible venues for the 2015 and 2016 meetings are Canterbury and Victoria, respectively.

11. Report on New Zealand Journal of Mathematics. David Gauld reported that the Journal is going well. They now have a good process for online posting. It would be good to have more articles from NZ mathematicians.

12. Update on Forder and AMS lecturers. As in the President's report.

13. Research Awards and Medals. As in the President's report.

14. Student representative on council. Members, including students, can be nominated and elected. We welcome student nominations.

15. General Business. The members expressed their heartfelt thanks to Graham for his service as President of the Society.

The meeting closed at 5:55 pm.

GENERAL NOTICES

Inaugural Sir Vaughan Jones PhD scholarships and other scholarships available at the University of Auckland

We are pleased to announce the availability of a number of PhD scholarships in Mathematics at the University of Auckland. They include the inaugural Sir Vaughan Jones PhD scholarship and a number of other funded PhD scholarships covering a number of research areas funded by other research grants.

Additional information on the scholarships is available at https://www.math.auckland.ac.nz/en/for/future-postgraduates/phd-scholarships.html.

Eamonn O'Brien

38th Australasian Conference on Combinatorial Mathematics and Combinatorial Computing

The 38th ACCMCC will be held at Victoria University of Wellington, in Wellington, New Zealand, from Monday 1 December to Friday 5 December in 2014. Contributed talks will be sought from all areas of discrete and combinatorial mathematics and related areas of computer science. The invited speakers are:

Mike Atkinson (University of Otago), Simeon Ball (Universitat Politcnica de Catalunya), Alice Devillers (University of Western Australia), Jaroslav Nesetril (Charles University), Sergey Norin (McGill University), James Oxley (Louisiana State University), Andrew Thomason (University of Cambridge), Mark Wilson (University of Auckland), Stefan van Zwam (Princeton University).

The conference website can be found at http://msor.victoria.ac.nz/Events/38ACCMCC.

At this stage, the website contains only basic information. Information will be added as we get closer to the start date—so bookmark the page now. A further announcement will be made when registration opens. Queries should be sent to the head of the organising committee, Dillon Mayhew (dillon.mayhew@msor.vuw.ac.nz).

Dillon Mayhew

THE NEW ZEALAND MATHEMATICAL SOCIETY (INC.)

APPLICATION FOR FINANCIAL ASSISTANCE

Please fill in where appropriate

Name of Applicant: . . . .

Address: . . . .

. . . .

. . . .

email: . . . .

Academic Affiliation / Official Status / Present Position:

. . . .

NZMS Status: Ordinary member . . . . . Student member . . . . .

Other (give details) . . . .

Signature: . . . . Date: . . . .

Type of assistance sought	Amount
(a) Student Travel Grant	. . . .
(b) Research Grant: conference/travel/other	. . . .
(c) Grant from South Pacific Fund	. . . .
(d) Conference/Workshop Organisation	. . . .
(e) Other (please specify below)	. . . .

. . . .

. . . .

Estimated total expenditure: . . . .

Date of expenditure: . . . .

Other sources of assistance sought/approved (please specify below):

. . . .

. . . .

- Estimated total expenditure (please include a breakdown of this expenditure, e.g. conference fees, travel, accommodation, etc.)

  . . . .
  . . . .
  . . . .
  . . . .

- List all previous support of this kind you have received from the NZMS in the past five years. (Please note that the society has a total funding cap of $ 1000 per student over the course of their studies)

  . . . .
  . . . .
  . . . .
  . . . .

- Please give your reasons for making this applications and the plans you have for spending the grant if your application is successful:

  . . . .
  . . . .
  . . . .
  . . . .

- Please list any supporting documents or other evidence (attached to your application):

  . . . .
  . . . .
  . . . .
  . . . .

- Supporting statement from Supervisor, Head of Department or person of responsibility.

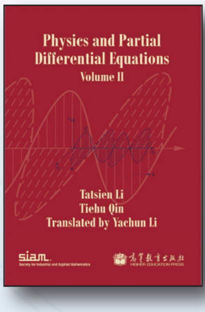
  . . . .
  . . . .
  . . . .
  . . . .

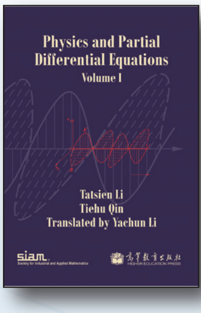
Please send this application (and any supporting documents or other evidence) to:

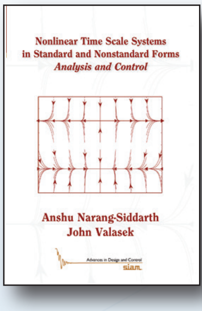
Dr Emily Harvey, Secretary, NZ Mathematical Society,
Institute of Information and Mathematical Sciences,
Massey University at Albany,
Private Bag 102 904,
North Shore 0745.

The NZMS Council normally considers these applications at its meetings in July and November each year, but applications may be considered at other times in exceptional circumstances.

New & Notable Titles from SIAM







Physics and Partial Differential Equations, *Volume II*

Tatsien Li and Tiehu Qin / Translated by Yachun Li

Physics and Partial Differential Equations, Volume II proceeds directly from Volume I (SIAM, 2012) with five additional chapters that bridge physics and applied mathematics in a manner that is easily accessible to readers with an undergraduate-level background in these disciplines. Readers who are more familiar with mathematics than physics will discover the connection between various physical and mechanical disciplines and their related mathematical models, which are described by partial differential equations (PDEs). Readers who are more familiar with physics than mathematics will benefit from in-depth explanations of how PDEs work as effective mathematical tools to more clearly express and present the basic concepts of physics.

2014 • x + 271 pages • Softcover • 978-1-611973-31-0
List Price $89.00 • SIAM Member Price $62.30 • Order Code OT137

And be sure to also order:

Physics and Partial Differential Equations, *Volume I*

Tatsien Li and Tiehu Qin / Translated by Yachun Li

2012 • x + 264 pages • Softcover • ISBN 978-1-611972-26-9
See Web for pricing • Order Code OT126

Practical Augmented Lagrangian Methods for Constrained Optimization

Ernesto G. Birgin and José Mario Martínez

Fundamentals of Algorithms 10

This book focuses on Augmented Lagrangian techniques for solving practical constrained optimization problems. The authors rigorously delineate mathematical convergence theory based on sequential optimality conditions and novel constraint qualifications. They also orient the book to practitioners by giving priority to results that provide insight on the practical behavior of algorithms and by providing geometrical and algorithmic interpretations of every mathematical result, and they fully describe a freely available computational package for constrained optimization and illustrate its usefulness with applications.

May 2014 • Approx. xiv + 220 pages • Softcover • ISBN 978-1-611973-35-8
List Price $65.00 • SIAM Member Price $45.50 • Order Code FA10

www.siam.org/catalog

Nonlinear Time Scale Systems in Standard and Nonstandard Forms: *Analysis and Control*

Anshu Narang-Siddarth and John Valasek

Advances in Design and Control 26

This book introduces key concepts for systematically controlling engineering systems that possess interacting phenomena occurring at widely different speeds. The aim is to present the reader with control techniques that extend the benefits of model reduction of singular perturbation theory to a larger class of nonlinear dynamical systems. New results and relevant background are presented through insightful examples that cover a wide range of applications.

May 2014 • Approx. xvi + 219 pages • Hardcover • ISBN 978-1-611973-33-4
List Price $94.00 • SIAM Member Price $65.80 • Order Code DC26

Analytic Perturbation Theory and Its Applications

Konstantin E. Avrachenkov, Jerzy A. Filar, and Phil G. Howlett

This new text includes a comprehensive treatment of analytic perturbations of matrices, linear operators, and polynomial systems, particularly the singular perturbation of inverses and generalized inverses; original applications in Markov chains, Markov decision processes, optimization, and applications to Google PageRank™ and the Hamiltonian cycle problem; and a problem section in every chapter to aid in course preparation.

2013 • xii + 372 pages • Hardcover • 978-1-611973-13-6
List Price $89.00 • SIAM Member Price $62.30 • Order Code OT135

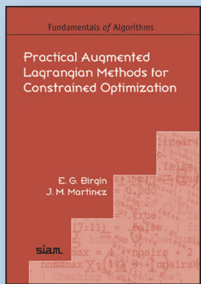
Uncertainty Quantification: *Theory, Implementation, and Applications*

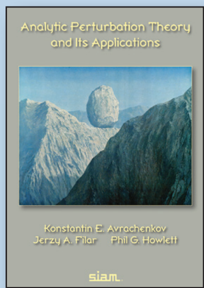
Ralph C. Smith

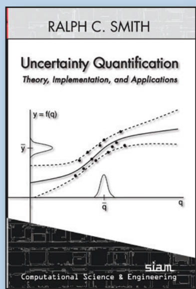
Computational Science and Engineering 12

The field of uncertainty quantification is evolving rapidly and this new text provides readers with the basic concepts, theory, and algorithms necessary to quantify input and response uncertainties for simulation models arising in a broad range of disciplines.

2014 • xviii + 383 pages • Hardcover • 978-1-611973-21-1
List Price $74.00 • SIAM Member Price $51.80 • Order Code CS12







TO ORDER: Shop online at *www.siam.org/catalog*

All prices are in US dollars.

Use your credit card (AMEX, MasterCard, and VISA) by phone: +1-215-382-9800 worldwide or fax: +1-215-386-7999.
Or send check or money order in US dollars to: SIAM, Dept. BKNZ14, 3600 Market Street, 6th Floor, Philadelphia, PA 19104-2688 USA.
Members and customers outside North America can also order through SIAM's distributor, Cambridge University Press, at *www.cambridge.org/siam*.

SIAM. Society for Industrial and Applied Mathematics