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NEWSLETTER

OF THE

NEW ZEALAND MATHEMATICAL SOCIETY

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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.

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The newsletter is available at: http://nzmathsoc.org.nz/?newsletter
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PRESIDENT'S COLUMN

Reflecting recent weather conditions, the last few months have been good, on average, for NZs mathematical community.

Congratulations to John Butcher, Emeritus Professor of the University of Auckland's Department of Mathematics, for being appointed an Officer of the Order of New Zealand in the Queen's Birthday Honours, for his services to mathematics, on 4 June, 2013. As Eamonn OBrien writes, "This is an appropriate recognition of John's many contributions to mathematics and to the mathematical community in New Zealand and world-wide during a long and distinguished career."

Congratulations are also due to Rua Murray, from the Department of Mathematics and Statistics, University of Canterbury, for winning a Sustained Excellence in Tertiary Teaching award. The Tertiary Teaching Excellence Awards celebrate New Zealand's finest tertiary teachers - as recognised by their organisations, colleagues and learners alike.

The NZ maths community has been fortunate to have had Terry Tao, arguably the world's greatest living mathematical prodigy, tour the country in late August, as the inaugural AMS-based Maclaurin Fellow. Terry has given public talks and technical seminars around the country, some to overflowing houses. Inside this issue is a summary of an interview of Terry by Robert McLachlan. Terry Tao visited the six major university centres in NZ, in the sequence: Auckland, Hamilton, Dunedin, Christchurch, Palmerston North and Wellington. Terry holidayed with his family in the North Island in the first week of his visit, and has indicated that when his family are older, he may be interested in touring the South Island.

The NZMS Council has recently sent to the LMS a ranked list of possible speakers from the LMS, one of whom could tour NZ as the 2014 Forder lecturer.

The initiative to form a Maths Education committee is progressing, with a major aim being that the NZMS will provide the NZ community with independent and hopefully influential commentary on mathematical education issues, such as the school syllabus. The current committee comprises of the NZMS President, Angela Jones, Alex James, Pip Arnold, Sean Cooper, Winston Sweatman, Stephen McConnachie, Jen Hudson, Luke MacEwan, Dillon Mayhew and Mike Camden. This committee will participate in a closed session at NZAMT13 in October.

Recent data from Australia shows that Australian graduation rates in the mathematical sciences is only half that of the OECD average for men, and one-third for women. Perhaps contributing to this statistic is that more than 30% of secondary school mathematics classes in Australia are taught by staff not trained as mathematics teachers. The Australian mathematical community is suggesting that these statistics should be raised as a concern in the upcoming Australian election. If similar statistics hold in NZ, then this may become an issue of concern for the Maths Ed committee.

Another recent highlight has been the successful completion of the Maths Quest poster competition, on 29 August, in which 16 (of the 17) winners travelled to Wellington. This is described in more detail inside.

However, reflecting the instability of weather systems, the bad news comes from my own institute, Callaghan Innovation, which has decided to disband its applied mathematics team. This group has a linked history extending back to the 1940s, to the earlier DSIR times.

Graham Weir
NZMS President

EDITORIAL

Incoming editor's notes

I have taken over as Editor from Steven Archer, effective from this issue. I thank the NZMS Council, and particularly Graham Weir and Alex James, for their help so far. Reading the previous newsletters is an interesting experience, and I hope I can keep the newsletter above its historical average quality, and approach or exceed the maximum.

The general goals set in Issue 1 (available online and highly recommended) still stand: to inform mathematicians in New Zealand, often separated by substantial geographic and disciplinary distance, about activities in other centres, and to foster a sense of community and encourage discussion. In particular, I aim to help produce something of value to a wide variety of readers, including research mathematicians in universities, PhD students, former colleagues now overseas, members working in industry or pre-tertiary education.

This issue marks a change in the venerable NZMS Newsletter. Based on changes in costs and income, and supported by 52 of the 63 respondents to the online survey (which I initiated a few weeks ago, and about which all members were notified by email), we will no longer be producing a paper version as a default. I realize that some readers will not be happy with this decision. As consolation I can only offer the following:

- You can always print out and staple a paper copy of your own. The paper versions mailed to members had no added value beyond that (no special paper, for example, as the AMS Notices has).
- For at least a while, those requesting a paper copy (as per Graham Weir's email in August) can have it mailed as before, thanks to John Shanks. This service may not last forever.
- We will be able to use hyperlinks.

Importantly, the Newsletter will be produced on time and with higher quality proofreading. The current issue is slightly later than intended for future issues, because we wanted to cover some late news. In general, members should expect the issue by the end of the month of issue.

The overall format of the newsletter will not change greatly. Perceptive readers may soon notice a change in font, and minor improvements in presentation are in the works. I plan the general structure of the newsletter to be roughly as follows: opinion, ideas, people, events, notices. Under "people" the Local News will be refocused and trimmed somewhat. A new "Focus on" section will give a more detailed snapshot of a particular department or research group. I would like photos, especially of new colleagues and interesting events, for an expanded photo section. Under "opinion", I aim to facilitate more discussion via a Readers' Forum, and hereby call for you to send me a Letter to the Editor or an opinion piece. I plan some new regular features, to be gradually introduced as content providers allow their arms to be twisted. This will probably involve a small increase in overall mathematical content. The online survey showed broad agreement for these changes.

This newsletter couldn't be produced without the contributions of content from many people, whose efforts I gratefully acknowledge. Anyone is free to submit content suggestions to the editor and I encourage all readers to do so, in particular PhD students, whom we intend to be involved more in the Newsletter. A note to those who contributed to this issue: in order to produce it on time I was not able to get your approval for edited versions of your copy. If you have any concerns about this becoming the regular policy, please let me know.

Mark C. Wilson
Editor

READERS' FORUM

Please send your Letters to the Editor (as usual, the editor's decision is final and excessively long ones may be abridged), requests for collaboration, etc. Anything that genuinely helps create useful discussion and interaction between members on topics related to mathematics is desirable.

In order to fill space this time, we reprint a classic letter from a reader in the August 2005 edition, responding to the Mathematical Miniature in April 2005. That contribution by John Butcher dealt with the question of "how many mathematicians does it take to change a light bulb"? Several personalities from the NZ mathematical scene (broadly interpreted) are mentioned pseudonymously in the article. One of them replied:

> *Dear Sir,*
>
> *With regard to the article on changing light-bulbs: How like an applied mathematician to butcher such a problem. Assumptions such as integrality (presumably over some number field) and existence were not given rigorous justification, etc. etc. Also I would have thought the author would be more aware of such ill posed problems. My first thought on being asked how many mathematicians does it take to change a light bulb, was to insure well posedness by asking what into.*
>
> *Sincerely, Gav Merhtens*

Results of the online survey

Instructions for how to complete an online survey was emailed to all members on the email list in early August. The results are as follows: 63 responses (from over 250 members — I don't know whether this is good or bad).

- Q1: Would you be satisfied to receive the NZMS Newsletter in electronic (PDF) format by email, with no paper copy? Answers: Yes 52, No 11.
- Q2 asked respondents to rank in order of importance the following 5 sections of the newsletter: opinion and discussion, local news, serious mathematical content, official NZMS business, diversions.

  According to the way these rankings were aggregated by the software, the order of importance to the community of respondents was as listed above (in descending order).
- The other two questions were free-form, involving suggestions for changes.

  In particular, proposed changes to the newsletter (37 respondents answered this part) were: less information on personal travel and similar promotional information, more pictures, more attempt to include PhD students, more on hot research topics internationally, more evidence of constructive efforts of the society to strengthen the profession and the mathematical literacy of society, fewer seminar listings, more international outlook, better quality control, punctual production.

After writing the above I looked back 25 years to the August 1988 edition, in which the results of a survey of members was reported (37/200 responded). It is amusing to note that many of the concerns then are the same as now: too much routine CV stuff, lists of visitors who have already left NZ, personal trivia; not enough professional debate and even "political" content. Interestingly, just over half the respondents felt professionally isolated in NZ. I wonder whether that proportion has changed in the past quarter-century. Also in the August 1988 edition, there appeared an opinion piece of more than 6 pages on the topic of final year secondary mathematics courses, by Peter Lorimer. Would any research mathematician in NZ have time to write such an article now?

INVITED ARTICLE

(by Mark Holmes, 2012 NZMS Early Career Award)

Probability theory is a core discipline in the mathematical sciences that is currently underrepresented in New Zealand. It is a subject that attempts to model and quantify uncertainty and as such has applications in all areas of science. It is a rich source of mathematical problems of the best kind: easy to state and, very often, hard to solve.

At this point the reader should demand an example satisfying the above, and in response, I give you Polya's urn, which is an elementary model for reinforcement processes in nature. Starting with one red ball and one black ball in an urn, repeat the following procedure ad infinitum: sample a ball from the urn at random, return it, and add another of the same colour. Rather than sampling without or with replacement, this is sampling with reinforcement - if you have thus far drawn more red balls than black from the urn, the next ball selected is likely to be red too. One of the questions that one immediately asks is "what happens to the proportion $X(n)$ of red balls as the number of iterations n goes to infinity?" Due to the symmetry (switch the colour labels) in this model, most people guess one of the following:

(1) $X(n)$ converges to $1/2$

(2) $X(n)$ converges to 1 or 0, with probability $1/2$ each

(3) $X(n)$ does not converge.

Each of these answers is wrong. In fact, $X(n)$ converges with probability 1, but for any $x \in [0,1]$, with probability 1, $X(n)$ does not converge to x. To be more precise, there exists a random variable X that is uniformly distributed on [0,1] such that $P(X(n) \to X) = 1$. This can be proved in a graduate course in probability theory using the following properties: (i) the *martingale* property - on average $X(n)$ stays where it is, i.e. $E[X(n+1)|X(n) = x] = x$, (ii) *exchangeability* - for fixed $k \in \{1, \ldots, n+1\}$ each possible sequence of ball selections resulting in $X(n) = k/(n+2)$ is equally likely e.g.

$$P(\bullet, \bullet, \bullet) = P(\bullet, \bullet, \bullet) = P(\bullet, \bullet, \bullet) = 1/12.$$

Property (i), together with the fact that the sequence $X(n)$ is bounded, is enough to prove that there is a limit X. One can use (ii) or simply induction on n to prove that $X(n)$ has a discrete uniform distribution $P(X(n) = k/(n+2)) = 1/(n+1)$ for each $k \in \{1, \ldots, n+1\}$. This translates into X having a (continuous) uniform distribution.

The above model can be extended or modified in a multitude of ways, see [2] and [1] for various generalisations. For example, we can add a red balls and b black balls when a red ball is selected, and c red and d black balls when a black ball is selected. We can have more than two colours, and change the ball selection probabilities.

Proceeding in this direction, suppose that there are $N_i(n)$ balls of colour $i \in \mathcal{A} = \{1, \ldots, J\}$ in the urn after n iterations, and that at the next iteration we choose a ball of colour i with probability

$$\frac{N_i(n)^\alpha}{\sum_{j=1}^{J} N_j(n)^\alpha}.$$

If $\alpha < 1$ then all colours are chosen equally often in the limit as $n \to \infty$. If $\alpha > 1$ then one colour wins, i.e. exactly one colour is chosen infinitely often. This generalisation shows just how "lucky" our basic model (where $\alpha = 1$) is.

Motivated by a desire to model reinforcement processes in the brain, my coauthors and I are investigating a further generalisation, where some "independent randomness" is included in the model. At each iteration of the process, first choose a random subset $A(n) \subset \mathcal{A}$ of the colours, independently of everything that has previously happened. Then choose a ball of colour $i \in A(n)$ from among those of colours $A(n)$ as above, i.e. with probability

$$\frac{N_i(n)^\alpha}{\sum_{j \in A(n)} N_j(n)^\alpha}.$$

Virtually all of these models lack the nice properties (i) and (ii) above, and as such we have found ourselves dipping our toes into the murky waters of stochastic dynamical systems.

An interesting class of examples arise when the ball colours are the (undirected) edges of a finite graph. At each iteration a signal arrives at a randomly chosen vertex $V(n)$ and is then sent along a single edge i incident to that vertex with probability

$$\frac{N_i(n)^\alpha}{\sum_{j \in V(n)} N_j(n)^\alpha}.$$

Considering the vertices of the graph as neurons and the edges as neural connections gives a toy model for reinforcement of neural connections in the brain.

For example, suppose that there are $J = 3$ colours and that each $A(n)$ is a subset of $\mathcal{A} = \{1, 2, 3\}$ of size two, chosen uniformly at random. Note that this corresponds to the complete graph on 3 vertices in the graph setting described above. Since no colour can be chosen more than $2/3$ of the time in the long run (any given colour will be absent from $A(n)$ one third of the time), at least two colours must each be chosen at least $1/6$ of the time. Thus no colour wins regardless of α. So are all colours chosen equally often in the limit as $n \to \infty$? It turns out that this does depend on α. For $\alpha \leq 1$ the answer is yes, that is, the limiting proportions of balls of each colour are $(1/3, 1/3, 1/3)$ with probability 1. For $1 < \alpha < 4/3$ this event occurs with probability strictly between 0 and 1. For $1 < \alpha < 3$, with positive probability the limiting proportions of the balls in the urn (listing from largest to smallest) are $(1/2, 1/2, 0)$. For $\alpha > 3$, there is some $v = v(\alpha) \in (1/3, 2/3)$ such that the limiting proportions are $(v, 1 - v, 0)$. Note that when $1 < \alpha < 4/3$ we have recovered a feature of the simple Polya urn - that of a random limit for the proportion of balls of each colour.

References

[1] Mahmoud, H.M. *Pólya Urn Models*, CRC Press, Boca Raton FL, 2009.

[2] Pemantle, Robin. A survey of random processes with reinforcement, *Probab. Surv.*4: 1–79, 2007.

BOOK REVIEWS

We aim to relaunch the book review section with a few differences. Any member wishing to contribute a review of a book relevant to the NZMS membership is welcome to submit it. In addition, we will try to solicit reviews of books published by locals, preferably in the last 5 years (self-nomination of books by authors is encouraged). A (no doubt very incomplete) list of these includes:

- Andre Nies, Computability and Randomness, Oxford 2009
- Rod Downey and Denis Hirschfeldt, Algorithmic Randomness and Complexity, Springer 2010
- Robin Pemantle and Mark C. Wilson, Analytic Combinatorics in Several Variables, Cambridge 2013
- Sergiy Klymchuk, Counterexamples in Calculus, MAA 2010
- Estate Khmaladze, Statistical Methods with Applications to Demography and Life Insurance, CRC 2013

We rely on readers to fill in the gaps in this list, and to offer to review (or accept when asked). Please send all material involving book reviews to the Book Review Editor, Bruce van Brunt, (b.vanbrunt@massey.ac.nz).

CYBERMATH

(**by Mark C. Wilson**)

The internet has had a great influence on how mathematicians work. This column will attempt to present interesting new developments in mathematical research, publication, peer review, etc, with strong emphasis on those topics that are popular in internet forums or are made possible by the internet itself. I signed up to write this column before knowing I was to become editor, in order to develop and update ideas in my contributed editorial of April 2012. Obviously, it will reflect my personal biases. I hope that more content from readers will be forthcoming, in order to balance that.

New trends in peer review

These are turbulent times for traditional academic publication. In addition to the issue of cost and barriers to access to published work, thrust into the limelight by the Elsevier boycott, perhaps even more important issues are being debated. These centre around the reliability and quality of published research results, and the evaluation of researcher quality and impact.

There was no golden age of peer review where everything was done properly. Anecdotes abound about heavy-handed behaviour by journal editors. For example, I read on Igor Pak's blog this year: "A combinatorialist I know (who shall remain anonymous) had the following story with Duke J. Math. A year and a half after submission, the paper was rejected with three (!) reports mostly describing typos. The authors were dismayed and consulted a CS colleague. That colleague noticed that the three reports were in .pdf but made by cropping from longer files. Turns out, if the cropping is made straightforwardly, the cropped portions are still hidden in the files. Using some hacking software the top portions of the reports were uncovered. The authors discovered that they are extremely positive, giving great praise of the paper. Now the authors believe that the editor despised combinatorics (or their branch of combinatorics) and was fishing for a bad report. After three tries, he gave up and sent them cropped reports lest they think somebody else considers their paper worthy of publishing in the grand old Duke."

The topic of editorial standards and transparency will probably be covered in a future column, as will author behaviour. For now, I want to focus on improving peer review assuming that everyone is trying to do a good professional job.

One very annoying feature of the current journal system is the enormous waste of effort involved in submitting to several journals, but starting the refereeing process from scratch each time. Another is that the incentive to referee is minimal, since a good job is not noticed by anyone except the editor, and is time-consuming. Now several interesting ventures aim to provide portable pre-publication peer review decoupled from journals, and to promote post-publication review, in order to address some of these problems.

Much of the action in the publishing arena is occurring in the biomedical sciences. Mathematics has quite different research methodology and advances occur more slowly but more definitively. Not everything that works in other fields (such as open access journals with large publication fees) will work in mathematics. However there are two ventures that seem useful for mathematicians, which I strongly suggest readers try out for themselves. One is SelectedPapers.net by Christopher Lee, essentially a front end to arXiv.org that allows for public comments and is integrated with Google+. Another has a NZ connection: Publons is a promising startup company from VUW that facilitates pre-publication and post-publication review.

Amusingly, a NZ Herald article on Publons August claimed that pre-publication peer review can take as long as several weeks (!) My record wait as an author for an uninformative rejection is 22 months (Random Structures and Algorithms) — can any reader beat that?

New results online

A cluster of high-profile mathematical results received much discussion online in the past few months. Two of them are very easily understood (the statements, presumably not the proofs).

- Harald Helfgott: weak Goldbach conjecture (every odd number greater than 5 is the sum of 3 primes; this was previously known with 5 replaced by e^{3100}.)
- Yitang Zhang: there exist infinitely many pairs of primes separated by at most 70 000 000 (weak form of the twin prime conjecture; the upper bound has subsequently been reduced to about 5000 by others via a Polymath project). Zhang's life story is particularly interesting, and perhaps inspiring for many: not many people give invited lectures at Harvard after seemingly falling out of academia.

Heavily-read mathematicians online include Terry Tao and Tim Gowers, but there is also much interesting material written by many others. In general, this Newsletter will only report on such matters if there is a direct connection to the NZ mathematical community, such as in the report below. It seems that not many NZMS members are active on the internet, in terms of discussing mathematics at least. Please submit links to blogs, etc, of locals, for this column to explore.

Our own *Steven Galbraith* is one who is blogospherically active, and his report on another recent breakthrough led to interest from publications such as Wired magazine. He reports on a quasi-polynomial-time algorithm for discrete logarithms in finite fields.

> *A recent big result in algorithmic number theory is the work of Antoine Joux and others on index calculus algorithms for the discrete logarithm problem in finite fields of the form F_{p^n} where $n > 1$ and p is not too large. The discrete logarithm problem in finite fields has long been considered a hard problem, and has been used as a building block for cryptosystems. Recall that the discrete logarithm problem in a group G is, given $g, h \in G$, to find $a \in \mathbb{Z}$ such that $h = g^a$. In the case of finite fields we take $G = \mathbb{F}_{p^n}^*$ to be the multiplicative group.*
>
> *The most conservative case, and therefore the one most commonly used for real security applications, is finite fields $\mathbb{F}_p$ where p is a large prime. The new results are not applicable to these fields.*
>
> *The previous best algorithms for this problem were known as the number field sieve and function field sieve, and their complexity was roughly the same as the best algorithm for integer factorisation. For several years, Antoine Joux has been working on the "medium prime" case of finite fields, namely when $p \approx n$ in the field $\mathbb{F}_{p^n}$, and his progress has been astounding. The previous record computations were for fields of around 600 bits (i.e., $n \log_2(p) \approx 600$). However earlier this year Joux (and also a group based in Dublin) reported successful discrete logarithm computations in 6000 bit fields.*
>
> *Fortunately, it seems that no current security system is using fields $\mathbb{F}_{p^n}$ with $p \approx n$, and so the result has not caused any serious threat. However, it shows that unexpected algorithmic improvements can happen. Hence, systems that provide information security should always support a number of different technologies and have the flexibility to switch to new ones if an unexpected weakness is found.*
>
> *I attended the "Workshop on Number-Theoretic Algorithms for Asymmetric Cryptology" at Ecole Polytechnique in Paris on June 20, 2013 where the new "quasi-polynomial-time" algorithm was announced by Razvan Barbulescu, Pierrick Gaudry, Antoine Joux and Emmanuel Thom. I was quickly able to report on these developments in my blog. This seems to have provided a valuable service: in the following 2 weeks there were 1290 visits to the blog. Tim Gowers also mentioned the result on his Google+ feed on June 22. A more detailed discussion of the result, links to the papers and announcements of computational records, and my photo of Razvan Barbulescu, Emmanuel Thom and Antoine Joux, can be found on my blog.*

Just before the deadline for production of this issue, we received news of Geoff Whittle's claim to have essentially proved (with coauthors Gerards and Geelen) Rota's conjecture on the structure of matroids. We hope to have more to say about this in the next issue.

Links

- Selected Papers Network: http://selectedpapers.net
- Publons: http://publons.com
- Terry Tao blog: http://terrytao.wordpress.com
- Tim Gowers on Google+: https://plus.google.com/103703080789076472131
- Steven Galbraith blog: http://ellipticnews.wordpress.com
- Yitang Zhang: http://www.wired.com/wiredscience/2013/05/twin-primes/all/
- Harald Helfgott: http://blogs.scientificamerican.com/roots-of-unity/2013/05/15/goldbach-variations/
- Geoff Whittle: http://www.radionz.co.nz/national/programmes/saturday/audio/2566052/geoff-whittle-rota%27s-conjecture

MATHEMATICAL MINIATURE

31: Companion Matrices and more

Given a polynomial $P(x) = x^n + c_1 x^{n-1} + \cdots + c_n$, a matrix like one of the following is called the "companion matrix" of P:

$$M = \begin{bmatrix} -c_1 & -c_2 & -c_3 & \cdots & -c_{n-1} & -c_n \\ 1 & 0 & 0 & \cdots & 0 & 0 \\ 0 & 1 & 0 & \cdots & 0 & 0 \\ \vdots & \vdots & \vdots & & \vdots & \vdots \\ 0 & 0 & 0 & \cdots & 1 & 0 \end{bmatrix}, \qquad N = \begin{bmatrix} 0 & 0 & 0 & \cdots & 0 & -c_n \\ 1 & 0 & 0 & \cdots & 0 & -c_{n-1} \\ 0 & 1 & 0 & \cdots & 0 & -c_{n-2} \\ \vdots & \vdots & \vdots & & \vdots & \vdots \\ 0 & 0 & 0 & \cdots & 1 & -c_1 \end{bmatrix}.$$

The characteristic polynomials are $\det(\lambda I - M) = \det(\lambda I - N) = P(\lambda)$. We will use the "reverse characteristic polynomial" whose zeros are the reciprocals of the eigenvalues:

$$\det(I - zM) = \det(I - zN) = 1 + c_1 z + c_2 z^2 + \cdots + c_n z^n.$$

What happens if we combine the two types of companion matrix to obtain a "doubly companion matrix"?

$$\begin{bmatrix} -a_1 & -a_2 & -a_3 & \cdots & -a_{n-1} & -a_n - b_n \\ 1 & 0 & 0 & \cdots & 0 & -b_{n-1} \\ 0 & 1 & 0 & \cdots & 0 & -b_{n-2} \\ \vdots & \vdots & \vdots & & \vdots & \vdots \\ 0 & 0 & 0 & \cdots & 1 & -b_1 \end{bmatrix}.$$

The reverse characteristic polynomial is now

$$(1 + a_1 z + a_2 z^2 + \cdots + a_n z^n)(1 + b_1 z + b_2 z^2 + \cdots + b_n z^n) + O(z^{n+1}), \tag{1}$$

and since the polynomial we want has degree n, it is defined exactly by this formula.

It will be convenient to write T_m as a mapping on polynomials which throws away terms of degree higher than m. It is then possible to express (1) as $T_n(ab)(z)$, where $a(z) = 1 + a_1 z + \ldots$ and $b(z) = 1 + b_1 z + \ldots$. Corresponding to an inverse eigenvalue μ, the corresponding eigenvector is

$$\left[(T_{n-1}b)(\mu), \mu(T_{n-2}b)(\mu), \ldots, \mu^{n-2}(T_1 b)(\mu), \mu^{n-1}(T_0 b)(\mu)\right]^{\mathsf{T}}.$$

A tedious person once asked me "But does this have any applications?" I had an answer ready. "Yes, here is an application, and if you don't like it, I have others."

If $c \in \mathbb{R}^s$ then $\exp(cz)$ is defined by $\exp(cz)_j = \exp(c_j z)$, $j = 1, 2, \ldots, s$. The stages of an s stage Runge–Kutta method with full stage-order s are interrelated by a matrix A with the property

$$(I - zA)\exp(cz) = \mathbf{1} + O(z^{s+1}), \tag{2}$$

where $\mathbf{1}_j = 1$, $j = 1, 2, \ldots, s$, and the components of c are the stage abscissae. It follows, after some manipulations, that if A is to have only a single repeated eigenvalue, which is a desirable property for constructing efficient numerical schemes, the c_j are proportional to the zeros of L_s, the Laguerre polynomial with degree s. An analysis of the stability of the numerical methods based on this discussion reveals that for acceptable high order numerical methods this restriction on the values of c_j leads to methods with unexpected and undesirable properties. The best way to get around this is to use a generalized definition of the order of the numerical method. In this generalization known as "effective order", (2) is replaced by

$$(I - zA)\exp(cz) = (1 + \gamma_1 z + \gamma_2 z^2 + \cdots + \gamma_s z^s)\mathbf{1} + O(z^{s+1}),$$

and the γ_j can be chosen to move the c_j to wherever you wish. The theory for all this is based on doubly-companion matrices.

While I am too lazy to insert citations, I am not too lazy to respond to anyone who should be curious enough to ask for more information.

J. C. Butcher
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INTERVIEW

Terence Tao talks to Robert McLachlan - Part I

Terence Tao has just toured New Zealand as the inaugural Maclaurin Lecturer on behalf of the American Mathematical Society. He was interviewed by Robert McLachlan in Palmerston North, 28 August 2013. The first part of this interview follows.

RM: Thanks for doing this speaking tour of New Zealand as the first Maclaurin Lecturer.

TT: It was good timing as I was actually planning to go on vacation to New Zealand when I was contacted.

RM: Apart from your Fields Medal and some of your famous work I didn't know a whole lot about you, so I read about your childhood in Adelaide as a so-called child prodigy. It seems to me it's quite unusual for a child prodigy to grow into a top scientist. Is that a fair statement?

TT: Some do some don't. I mean I know lots of mathematicians, some of them had accelerated early education and so forth and many didn't - many good mathematicians only started getting into maths as undergraduates, or even as graduates. There are all sorts.

RM: So would you say there was something special in your early childhood environment, not that made you a prodigy maybe, but that let you continue developing?

TT: It's hard to say because I only really have my own experiences, though one thing I can say is when I went to Princeton as an postgraduate - I graduated from Flinders and I was used to very small universities, I was in the honours class which was very small, as small as three people, and it was sort of easy. I got in the habit of waiting until the last week of classes before actually studying, I'd take very sketchy notes for the whole class and not really pay attention and then cram at the last minute and pass, pass with not that great grades sometimes. When I went to Princeton I thought I could pull off the same thing. But somehow the level of difficulty was so much higher - the qualifying exams in particular for my postgraduate studies.

RM: They're famous, aren't they.

TT: Yes, they are oral, they are two hours and they are terrifying, but I thought okay I'll just study for a week before, and I did appalling badly on my orals, very soon they poked huge gaps in my knowledge. I was only saved actually because you pick three areas of mathematics for your orals and I picked analytic number theory as one of my subjects. The person who was going to quiz me on that thought mistakenly that I had said algebraic number theory, which is a very different subject and so he didn't have any proper questions prepared so he could only ask very easy questions for that subject, so I answered those questions very well, but my core field subject, harmonic analysis, which was my specialty, I actually did prepare, well I thought I did and I really did embarrassingly badly on that, and my advisor came up to me afterwards and said it was rather disappointing that I had such good recommendations. [laughter]. What this did for me is that it really changed my life, because from then on, I was so ashamed into actually studying and working hard and I think for many people who are talented at an early age sometimes things are a bit too easy for them and they don't pick up good study habits and for the long haul if you actually want to do research, it's actually not so much your initial talents it's really more your perseverance and maturity and your ability to stick at something for years which in the long run makes a difference. So there is a transition, and some people can make it and some don't.

RM: What was your PhD study like, were you basically left alone to work on your research project?

TT: Yeah, Princeton was famous for being very sink or swim, at least when I was a student there. Their attitude was we only admit the best and so we don't need to train you that much further, you already know what to do. So you come in, here's your office and here's your computer, here's your keys to the library, you've got an oral exam in two years and you've got to do a thesis in four, see you then. There were classes but they were basically were not mandatory and so the students basically taught themselves, we would organize little informal seminars ourselves, there'd be classes but we didn't go to them. For some people this didn't work out very well so many people dropped out of the programme. It was actually a really good environment because it was so free form, so it worked out well for me. I think one thing that helped is that Princeton being a very small town there's actually not much else to do other than go to university and study and so forth. So you're obliged to go to the department and you go to the library because there's nothing else to do. The first two years I was there, I was there from 1992 to 1996, I discovered the internet and that took away a year of my time. (Laughter).

RM I went to Caltech in the 80s and it does sound a little bit similar.

TT: Different universities are different, UCLA is much more structured. We have lots of course requirements and people are likely to check up on you.

RM: That must be a very large programme?

TT: About 50 full time staff and a hundred odd postgrad students.

RM: So how did you settle on harmonic analysis?

TT: At Flinders when I was an undergraduate I did a masters with Garth Gaudry when he was there, he was a harmonic analyst. I always liked analysis, sort of estimating things. I liked epsilons and deltas actually, more than other aspects of mathematics. I also liked number theory, but ... it was intuitive to me, big and small and convergence, these things kind of made sense to me whereas geometry, topology and algebra, I have to think a lot harder to get my head around them. When I went to Princeton I was choosing between number theory and harmonic analysis and I went to lectures by the harmonic analyst Elias Stein and he's an extremely clear lecturer, he prepares very well and like every lecture he proves one theorem and its all set out perfectly and I could understand everything and it was all so self contained. I went to number theory classes with Peter Sarnak and Nicholas Katz and they were great and we were learning really cool stuff, but the amount of knowledge that they presumed, I remember in one of the first classes I went to there, they said so you are all familiar with the representation theory of $SL(2,\mathbb{Z})$, right? No! (Laughter) So I got intimidated out of number theory, it was too much work for me and at that point I didn't have the study habits to actually catch up, so ...

RM: So in a sense you got your own back?

TT: Yes, afterwards, most of the math I know now actually I learnt after my formal education. Actually most of my coauthors and collaborators — I learnt PDE by working with PDE people, I learnt number theory from working with people like Ben Green and so forth, somehow my whole education has been in a jumbled order, I skipped all these grades ...

RM: The story that Rodney Baxter tells is that of the two things he's most famous for in his whole career, one he did when he was unemployed on the way out to Australia and the other one he did when he was unemployed because he had retired. (Laughter) So looking at your vast list of papers in so many diverse areas, basically they are all analysis, would that be a fair statement? Youve taken hard analysis into sorts of areas where it maybe hasn't gone before?

TT: Right, yes, although more recently I'm getting to appreciate that the other areas of mathematics and science are very important I guess from algebra and logic and so forth, but I always, you know, analysis has always been my home base, but when I try to learn another subject I try to translate it into epsilons and deltas, because that's just my language. So if I had to pick a field I would say analysis, that is what I do.

RM: So the move to UCLA was then extremely influential, that was maybe the right place to go.

TT: Yes, it was fortuitous. When I finished from Princeton I applied for jobs and I got three job offers, one from UCLA, MIT, and one from New South Wales, and my advisors convinced me to stay in the States, just because it's a larger math community, and I chose UCLA for two reasons, one because its slightly closer to home. Flying from Princeton is not very easy. Also it was sunny. Four years in Princeton got me sick of snow, but also at the time there were three harmonic analysts in the faculty and that was the field I had done as a PhD, although when I arrived actually two had left, not because of me, for different reasons, but actually that worked out well because then I started talking to a postdoc instead who was working in PDEs which was an area which I had sort of vaguely had had some exposure to but not ... I got interested in applying methods from harmonic analysis to PDEs which was sort of a fashionable topic at the time. So from him I started brushing up on PDEs. So when I left graduate school I was very narrow, I basically knew harmonic analysis, and just a small amount of other mathematics but I found actually that collaborating with people in other fields was actually for me a lot more fun and I learnt a lot more and I just kept doing that. I think I collaborated with people from representation theory, number theory, combinatorics and so forth. I find that these sort of help, some how better suited to my mathematical taste or style than staying in one field and becoming an expert in one field. Knowing everything about one subject, it's not something I have the patience for, I'd much rather collaborate with someone who knows everything about one subject.

RM: Theres also a bit of grand theory building though, like these recent papers on random matrices and universality. Of course that's all analysis theorems but at least you were kind of hoping or dreaming that was going to be a new greater theory of universality.

TT: Yes, that's the dream. There is whole phenomenon, you can see numerically that all these different matrix models, which have no a priori reason to behave in any similar fashion, but if you look at their eigenvalues or whatever they have almost exactly the same distribution. Much like the central limit theorem in probability, you average together a whole bunch of random variables, it doesn't matter that they are discrete or continuous random variables pretty much you are always going to get a Gaussian when you do so. It's this universal limit. We are seeing these universal limits in matrix theory and in random Schrodinger operators and number theory and random permutations and so forth and it's not completely answered why we have these universal limits. We can compute them and we have some where we can prove that two cases give you the same limit, but ...

RM: So there should be an underlying phenomenon that they are all exhibiting.

TT: Right, like for the central limit theorem there's lots of explanations, the Gaussian is the thing that minimizes entropy, or maximizes, I always forget which way it goes, it extremizes the entropy for a given variance — it's very stable in various ways, so it can be viewed as an attractor of various processes and so we have very good intuition as to why the Gaussian is the output of the central limit theorem, but we don't yet have the same sort of explanation. So this is one thing I'm very interested in, in seeing if I can help figure out the answers.

RM: And there's this tantalizing connection with the Riemann hypothesis. Is it a sensible question to ask if it could be proved along these lines?

TT: Right. The zeros of the zeta function seem to have the same statistics as the zeros of random matrices. I think the reason why, well, we don't know why exactly, I think it's not so much because there's actually a random matrix behind the zeta function, it's just that these limiting distributions are so universal, they should actually be your default guess as to what these distributions should be. We know that Gaussians appear everywhere in mathematics if you create any sort of distribution, even if it's not coming from probability if you just had to blindly guess what kind of distribution you would get, people would expect a Gaussian, they're not surprised any more.

RM: So that suggests there might not be a direct connection to the Riemann hypothesis.

TT: No, not between the Riemann hypothesis and random matrix theory, but if we had an explanation for universality, if we had a set of conditions or general principles that whenever you have a set of points on a line, whenever these points do such-and-such, they should naturally be distributed according to whats called the GUE distribution, the distribution coming from random matrix theory then you could try to apply this general principle to the zeta function. It's probably coming from some assertion about the primes, that the primes are distributed in a very random fashion, the most random way to distribute the primes, the one that maximizes entropy or something, and this should naturally give you these GUE distributions. There should be some explanation which we don't have yet. I think it is conceivable, not that we can prove the Riemann hypothesis yet, but this GUE hypothesis, the random matrix distribution for the zeta function zeros, we should be able to explain this in terms of other conjectures about the primes, which we also don't know how to prove, but I think we can at least make all our conjectures consistent with each other.

RM: A lot of the recent progress, like with arithmetic progressions in the primes, and with the prime gaps theorem, are more from using traditional techniques in a very complicated way from working harder.

TT: Right. Somehow the primes are so hard to understand directly, that the way we make any progress at all on the primes is by taking the primes out of the problem as much as possible and working on other aspects. For example, my collaborator Ben Green likes to say that in our main result about arithmetic progressions in the primes, the key insight is not to try to understand the primes better, but to understand arithmetic progressions better, and to understand what kind of sets contain arithmetic progressions, and what kind of sets don't. Not to try to figure out the primes as much as possible, but to find some abstract criteria on a set which would guarantee the existence of arithmetic progressions, and make those criteria as simple as possible, and only then do you think about do the primes obey these criteria? You try to keep the primes out of it because they're just so difficult. Our approach is coming from analysis and combinatorics and so forth and not so much from number theory.

RM: Part of your work that I have the least feel for is PDEs — every PDE is different and there is this forest of different exponents and different cases — for an outsider it's hard to see where it's going. It's too much like chemistry.

TT: Right. I know a top PDE person who refers to the theory of PDEs as the Balkans. There's an infinite number of PDEs and most of them are uninteresting. You restrict to the PDEs that are physically or geometrically interesting. Theres so many types of terms you can put in a PDE physically, they all correspond to some phenomenon, dispersion, dissipation, transport, energy minimization. Depending on the exponents and signs of these terms, some are dominant. The type of PDEs I used to work on a lot are nonlinear dispersive equations, with a linear dispersive part if you take a wave it will spread out, like water waves, or sound waves, or Schrodinger waves the energy is conserved, the wave doesn't die down to zero, it doesn't dissipate but it spreads out, it disperses and decays. But then there'll be this nonlinear part where the wave can interact with itself and reinforce itself and maybe get stronger and stronger. There would be this race, if you watch the wave evolve, the nonlinearity might be trying to focus the wave and make it stronger, and the linear part's trying to spread it out. The whole subject is focused on trying to see which side of the equation is stronger, which one wins. Sometimes, if your amplitude is small enough, or if your exponents are small enough, then dispersion wins, other times the nonlinearity wins and your solution focuses and can blow up.

RM: You're trying to do this without dynamics, just by interrogating the equation at a point, rather than how you get from one point to the next.

TT: Right, we've been trying to use dynamics techniques — it's infinite dimensional dynamics, so already it becomes very difficult. Even in ODEs you can have chaos, its hard to say what the long-time behaviour is, so its always been difficult to use dynamic system methods. This is presumably where the future of the subject should be. We rely much more on things like conservation laws.

RM: The symmetries, the conservation laws, the equation, and very little else.

TT: You can squeeze a lot out of that! For many decades we've been squeezing everything we can out of things like that. Conservation laws are great because they hold for all time, they're one of the few things that you can say for certain about your solution way into the future. There's a couple of other things, there's monotonicity formulas, and you can squeeze a lot of information out of these laws, but not everything, because there's an infinite number of degrees of freedom and a conservation law just constrains one of them. There's a lot we don't understand, particularly in so-called supercritical equations where the nonlinearity is stronger. This means the nonlinearity if it so chose could make the equation blow up and develop singularities, but maybe it chooses not to. With Navier-Stokes for example, the equation is nonlinear enough that if everything went exactly the wrong way, it is conceivable that a singularity could form, but in practice it never happens, but we can't stop that from happening. It's like the digits of π, conceivably you could get a whole string of 7s, you could get really odd patterns in the digits which are not consistent with uniform distribution.

RM: The blowup could be for highly exceptional initial conditions.

TT: Right, that's another thing about PDEs: most of our techniques are deterministic, which means they work for every single solution. Those are the types of tools that we use. As a consequence, whenever we prove existence or whatever, we either prove it for all data in a certain class or for none. Whereas what we should be proving is things like, "for almost all data in a certain class, something happens". It is quite conceivable for Navier-Stokes that for almost all data things are good, that's what we see in real life, but there could be some exceptional bad set where things go wrong. But we don't have the tools. There are some tools in dynamical systems, like invariant measures, that should in principle help us, and there has been a little bit of movement in that direction. That's another future direction for PDEs.

End of Part I.

WHERE ARE THEY NOW?

Mathematicians often like to think that they can do anything, and it is only love of mathematics that keeps them from conquering the world in other fields. Of course, there is plenty of evidence to the contrary, since some are apparently quite useless at many activities, and this goes back at least to Archimedes. No doubt the second view is held more often by non-mathematicians. It is therefore nice to receive the following contributed article from Garry Tee about Nicholas F. Dudley Ward, who has certainly had an active life so far.

This is the first in an occasional series about former colleagues that we may have lost track of, and readers are encouraged to submit similar articles.

Nick Dudley Ward

Nick Dudley Ward was born in 1966, at Hayling Island (in UK). As a teenager he read Bertrand Russell's books on mathematics, and those stimulated his early interest in the foundations of mathematics. Nick graduated in 1987 from Hull University (B.Sc. Honours in Mathematics). He then studied at the University of York, where he benefitted greatly from the very personal and classical graduate education in mathematics which he received from Prof. Walter Hayman (F.R.S., Emeritus Professor of Imperial College), Prof. Frank Bonsall F.R.S. and Prof. Jim Clunie (then in active semi-retirement). He gained his DPhil in 1991 (on Atomic decompositions of integrable or continuous functions) while studying under Prof. Hayman, who never bowed to fashion in mathematics. In retrospect he considers that this training has served him well.

Nick became a temporary Lecturer at the University of Auckland in 1991-1992, then he worked at the University of Otago with Peter Fenton for half a year. He also worked with Douglas Bridges at the University of Canterbury. However, his passion at that time was flying, which stimulated an interest in Control Theory. After that he returned to the UK for a 3-year SERC Post-Doctoral Fellowship at the University of Leeds, working in H^∞ Control Theory with Jonathan Partington, and then spent 2 years at INRIA Sophia Antipolis on a Marie Curie Fellowship. Somewhat out of the blue he was offered a job to work in the City of London, where his salary quadrupled overnight and he got a company car (he chose a Landrover, which suited his lifestyle). But his financial work in the City of London was dull, and so he made his life more interesting by several mountaineering and trekking expeditions in Europe and Nepal, and by his very active participation in the UK Territorial Army. His final TA unit was 266 Parachute Battery RA(V), based in East Ham, where he reckons he spent more time than in the City. He does not feel very satisfied with that phase of his life.

He returned to the University of Auckland in 2002, but then went to the Wharton School, University of Pennsylvania, in 2003, nominally to build a research profile in Mathematical Finance . He soon gave that up and, supported by teaching duties at Penn, he worked with civil engineers at Drexel University and combined teaching, research and study, walking away in 2006 with a broad spectrum of papers and an MS in Civil Engineering.

He finally returned to NZ in 2007 and worked for an engineering consultancy in Christchurch, before founding the Otago Computational Modelling Group Ltd (OCMO) in 2010. Following a startup grant from FRST,

OCMO is currently funded by MBIE on two long-term research projects on groundwater and liquefaction, in collaboration with GNS Science. One project characterises NZ groundwater systems, and the other works on better quantifying the processes that led to the extensive liquefaction and lateral movement which have been experienced in Christchurch. The Canterbury earthquakes have resulted in several realisations, one of which is that passive seismic activity may be used to characterise NZ's aquifers (about which our knowledge is surprisingly incomplete). Both projects are in collaboration with GNS Science. He works extensively with Colin Fox and Jari Kaipio in New Zealand, as well as with a former student Tiangang Cui, currently a post-doc at MIT, and with Timo Lähivaara in Kuopio. He will spend 2014 in Kuopio, working with Timo on using seismic waves to characterise groundwater.

Nick sits somewhat uncomfortably on the border between engineering and mathematics, not always knowing which way to look. To increase his acceptance as an engineer he went through assessment to become a registered engineer with IPENZ, and now he is a practice area assessor. In view of some of his ideas, that registration still surprises him: however, it says something about the openness of the engineering profession. To counter any potential accusation of bias he also became a fellow of the IMA! Both IPENZ and the IMA have been extremely successful in their roles as representatives of their respective professions, lessons that are worth taking on board.

Currently OCMO operates rather informally as a consortium. They are waiting to see whether they can obtain funding for a large-scale MBIE-funded project, which would really get OCMO off the ground. Nick has remarked that "It was always the desire to do something of more practical value that drove me on. In some ways I have got there now."

Here is a selection of Nick's publications which shows remarkable diversity:

- (with Simon Cox, Anton Gulley and Jari Kaipio) Groundwater responses to the recent Christchurch earthquakes: a comparison. *Journal of Hydrology*, 2013, to appear
- (with Jari Kaipio) Uncertainty, decision and control: an introduction. *NZ Journal of Hydrology*, 2013, to appear
- (with J. Richard Weggel) A model for filter cake formation on geotextiles. *Geotextiles and Geomembranes*, 2012
- (with Tao Hong and Patrick Gurian) Setting risk-informed environmental standards for Bacillus Anthracis spores. *Risk Analysis*, 2010
- (with Patrick Gurian et al.) Observed and perceived inconsistencies in U.S. border inspections. *Journal of Homeland Security and Emergency Management*, 2008
- Asymptotic balayage in Hardy and Bergman Spaces. *New Zealand Journal of Mathematics* **33**, 2004
- (with D.S. Bridges) Kernels of seminorms in Constructive Analysis. *Theoretical Computer Science* **284:2**, 2002

CENTREFOLD

Robert McLachlan

It is perhaps an understatement to say that Robert McLachlan is a well known member of the New Zealand mathematics community. In his nineteen years as an academic in New Zealand he has left a large footprint here and abroad not only through his research in numerical analysis, but also through his extensive involvement with the NZMS and the Royal Society among other organizations. If, for example, we look at his contributions to the NZMS we find that he served six years on the council, he edited the newsletter for six years (matching Mike Hendy's term), he was the president of the society in 2008 and 2009, becoming vice president in 2010. He is still an editor for the New Zealand Journal of Mathematics. Given his extensive research record, it is hard to see where he found the time to serve on so many committees and panels.

Robert is known worldwide for his contributions to geometric integration and, in particular, the application of symplectic techniques to the numerical solution of differential equations. The field is not narrow: to tackle questions one must have a taste for differential geometry, groups, dynamical systems, classical mechanics, analysis, and of course numerical analysis. Keeping in touch with all these fields, he never lost sight of solving concrete problems in dynamics and in industry. The central idea is to develop numerical techniques that mimic the symmetry/structure of the equations. If, for instance, energy is conserved, an algorithm should reflect this property. The field was emerging in the early 1990's and Robert soon made his contributions. His research went from strength to strength as he and his collaborators investigated Hamiltonian systems and differential equations with symmetries. He developed novel numerical techniques that exploited the underlying structure of the equations and led to more efficient and stable computation. In 2007, he was awarded the prestigious Dahlquist Prize for his work on the numerical solutions of differential equations.

Robert is a native of Christchurch. He was schooled there and went to the University of Canterbury, where in 1984 he earned his BSc honours in mathematics. Asked about "defining moments" in his education that sparked interest in what would later be his passion (numerical analysis) he is quick to cite two instances. In his last year of high school, the institution, like many others, had acquired a computer. This was in the very early 1980's before micro computers were available and still in the last days of computer cards. Although the school had the machine (a PDP-11/10), it did not appear to have a structured learning programme for its use. Robert had freedom to experiment and play with the computer and thus develop his computing and programming skills (remember Assembly Language). His second formative experience was at the University of Canterbury. Here, Bob Broughton introduced project based computing papers that provided students with the freedom to learn, develop and apply algorithms among other things. Other highlights were Gordon Petersen's famous Analysis I [1] and a Moore method course on topology with Bill Baritompa. Robert flourished in this environment and went on to do graduate work in numerical analysis.

He embarked on his Ph.D. studies in the United States at the California Institute of Technology in 1986 under the supervision of Herb Keller. His work here was in computational fluid dynamics. He finished his Ph.D in 1990

[1] The first words he heard at university were not "Good morning" or "Welcome" but "We'll start with metric spaces"

having submitted the thesis "Separated Viscous Flows via Multigrid". Robert went on to a postdoctoral position at the University of Colorado, Boulder, and soon his interest turned from computational fluid dynamics to the emerging field of symplectic geometry and the use of it in numerical analysis. Jürgen Moser was visiting Boulder at the time and met with Robert frequently to discuss the new field. Robert found these meetings formative and he went on to take a postdoctoral position at ETH Zurich for six months. Yet another formative person in his early career was Jerry Marsden, who invited Robert to one of the first conferences on geometric integration.

Robert came to Massey University in 1994 and expanded his worldwide network of collaborations. Of particular note is the long and fruitful collaboration with Reinout Quispel at La Trobe that led to some 26 publications on geometric integration including a weighty tome on splitting methods published in *Acta Numerica* (2002). More recently, Robert has turned his attention to B-series, which were pioneered in the 1960s and 1970s by John Butcher. Robert and his collaborators found new structure and generalizations of these series, particularly when the underlying vector field is Hamiltonian. In this case, there is a detailed structure with respect to the vector field's Hamiltonian and its symplectic structure. A generalization to affine-equivariant series has structure with respect to Euclidean volume.

Aside from a prolific research output, Robert was also busy facilitating research in NZ and abroad through organizing conferences. He was a founder and organizer of the Manawatu-Wellington Applied Mathematics Conference, which began in 1998 and is now an annual event. Over the last decade, he organized conferences on dynamical systems and geometric integration along with more general events such as the NZ Mathematics Colloquium.

In 2002, Robert was appointed to a chair in applied mathematics at Massey University and was made a fellow of the Royal Society of New Zealand. Other highlights include an NZIMA Maclaurin Fellowship and an NZMS Research Award in 2005, and a James Cook Fellowship in 2013. Aside from his research output, Robert found time to accept numerous plenary speaker invitations and supervise twelve graduate students. It does not look like things are going to slow down. Currently Robert is supervising four Ph.D. students, he just finished organizing the international conference "Manifolds and Geometric Integration", and he is running the joint EU-NZ project "Collaborative Research in Structure Preservation" that brings some twenty international visitors to NZ. In September, he is off to the UK to deliver the LMS Aitken Lectures at six universities.

Bruce van Brunt

LOCAL NEWS

AUCKLAND UNIVERSITY OF TECHNOLOGY

SCHOOL OF COMPUTING AND MATHEMATICAL SCIENCES

Recently, a centre for statistical research and consultancy has been founded at the School of Computing and Mathematical Sciences. The centre is led by *Robin Hankin*. In Semester Two, *Alexander Gavruskin* was appointed as a temporary lecturer in Mathematical Sciences at the SCMS. Before joining AUT, Alexander was a research fellow at the Computer Science Department of the University of Auckland. Prior to that, Alexander received his PhD in Mathematics in 2009 from Sobolev Institute of Mathematics, Novosibirsk.

On 24 April, *Murray Black* graduated from Deakin University located in Geelong, Victoria with a PhD in statistical education in the Faculty of Arts and Education. His thesis focused on the use of inquiry-based learning both in the teaching and assessment of statistics in order to develop and improve a learner's statistical reasoning skills. Dr Black was supervised by Associate Professor Peter Smith in the first half of his candidature then by Dr Steven Hodge and Dr Esther Leong. When Dr Hodge left Deakin, Professor Terry Evans completed Dr Black's supervision.

In June-July *Sergiy Klymchuk* published two books - *Paradoxes and Sophisms in Calculus* by the Mathematical Association of America, USA and *Mathematical Analysis for First-year Students* by the Moscow Centre for Continuing Education in Mathematics, Russia.

Jiling Cao

UNIVERSITY OF AUCKLAND

DEPARTMENT OF ENGINEERING SCIENCE

New colleagues

Thor Besier, Senior Lecturer, 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 where he is now a Senior Lecturer. Thors research combines medical imaging with computational biomechanical simulation to understand mechanisms of musculoskeletal injury and disease. In particular, he is interested in the mechanical aetiology of patellofemoral pain, knee ligament injury, and knee osteoarthritis.

Justin Fernandez, Senior Lecturer, graduated with a BE in Engineering Science and a PhD in Bioengineering. His PhD work was in musculoskeletal modelling and was funded by an enterprise scholarship from the Foundation for Research Science and Technology. He graduated with a Vice Chancellor's prize for best doctoral thesis. Justin has been a postdoctoral researcher at Melbourne University and a research scientist at the CSIRO in Australia. He is currently a Senior Research Fellow in the ABI Musculoskeletal Modelling Group, and holds a joint appointment with the Department of Engineering Science where he is now a Senior Lecturer. Justin's research interests are in computational biomechanics (soft tissue and bone), orthopaedics, finite element modelling and more recently particulate methods. His aim is to develop diagnostic tools that can better inform the medical field.

Bryan Ruddy, Lecturer, graduated from the Massachusetts Institute of Technology with SB (2004), SM (2006), and PhD (2012) degrees in Mechanical Engineering. His doctoral research, supervised by Professor Ian W. Hunter in the MIT BioInstrumentation Laboratory, focused on the design and modelling of compact, high-force linear electric motors for use in robotics and in medical devices. Bryan joined the Auckland Bioengineering Institute as a Research Scientist upon the completion of his PhD, in July 2012, to continue his work on actuator design and control with particular application to biological instrumentation. Bryan is now a Research Fellow at the ABI. He also holds a joint appointment with the Department of Engineering Science where he is a Lecturer. In particular, his work focuses on the development of miniaturized actuation and control systems for use in muscle work-loop calorimetry (the Cardiac Myometer), as well as on the design of improved Lorentz-force motors for needle-free jet injection.

Events

David Ryan has been bestowed the title Emeritus Professor by the University of Auckland. David is a world authority on operations research. Professor Ryan joined the Faculty of Engineering in 1975 with an MSc from Otago and a PhD from the Australian National University. David served as Deputy Dean in Engineering from 2004 to 2011 and was elected as a Fellow of the Royal Society of New Zealand (RSNZ), a Fellow of the Institute of Professional Engineers New Zealand (IPENZ) Institute for Operations Research, and a fellow of Management Sciences (INFORMS). In November 2011, he was awarded the Royal Society's Pickering Medal that recognises excellence and innovation in the practical application of technology. David is well known for developing the innovative "Ryan-Foster constraint branching" which is now a fundamental component of optimisation software used worldwide for solving complex logistics problems. In New Zealand, his methods

have allowed a new range of practical real-world problems to be solved. For example, he has collaborated with Air New Zealand for more than 20 years to commercially exploit his technology. He developed pioneering optimisation software that is now used by the airline to optimally schedule flight crews. The savings from these optimisers were estimated in 2000 as being more than NZ$15 million per year. He has recently worked with Air New Zealand to develop robust solutions that can reduce the impact of disruptions, work which is regarded as ground-breaking and possibly the first airline implementation of this new technology. David had a health scare in February which resulted in him spending a period of time in hospital. The source of his illness remains undiagnosed, however his recovery is progressing well, and he is feeling much better. Due to his illness, David recently decided to officially retire from his position with the University, but hopes to return part time when he has fully recovered. The Department would like to wish David all the very best for a continuing health recovery and relaxing retirement.

Aorere College has dedicated its new science centre to the memory of former dux, Professor Andrew Pullan. Professor Pullan was both a student and later, a staff member of the Department of Engineering Science at the Faculty of Engineering. He was also a member of the Auckland Bioengineering Institute. At the official opening last week, his wife Patti unveiled a plaque for the new Professor Andrew Pullan Science Centre. Andrew was Head of Department from 2008 to 2010 and sadly died of cancer in March last year. "He was a well-loved and respected son of Aorere College", said Principal, Pat Drumm. "He was one of a few students to get the trifecta of dux, university scholarship and onto the college honours board when he gained his PhD." "It was his special combination of qualities that set him apart; he was a dedicated scientist, a great human being and he was very much a member of the Aorere community", said Associate Professor Donna Rose Addis (Psychology), who is also a former student. "Andrew was a wonderful mentor to many up-and-coming scientists, and made a huge contribution in his field, as a member of both national and international scientific communities. This new science centre will inspire the next generation of scientists and there is no better person to name it after, than Andrew", she said. Professor Ron Paterson, a close friend, spoke on behalf of the Pullan family, especially Patti and their two children Zeke and Xanthe who were all at the ceremony. "Andrew would have thought it was fantastic to have this centre named after him," said Professor Paterson. "Everything he did, he did with a zest for life and an infectious enthusiasm. He was a keen mentor of students here at Aorere College, and loved to present the Pullan Trophy for dux every year." "The college has done Andrew and his family a great honour by naming the new science centre after him" said Professor Paterson."If he were here he would be encouraging students to aim high, to set themselves the highest standards, and discover the mysteries of science. It's great that the Professor Andrew Pullan Science Centre will inspire generations of Aorere College students", he said.

Charles Unsworth

DEPARTMENT OF MATHEMATICS

The NZMS congratulates *John Butcher* for his 2013 Queens Birthday honour for services to mathematics. The official citation reads: To be Officers of the said Order (ONZM): Professor John Charles Butcher. For services to mathematics John has made an outstanding contribution to NZ and international mathematics over many decades.

Marston Conder has been selected as one of the University of Waikato's three Distinguished Alumni for 2013, thanks to a nomination from the Mathematics Department there. He is currently hosting two postdoctoral visitors (Rulin Shen (China) and Claude Marion (Switzerland)), and he organised a mini-series of seminars on "Triangle groups" for the month of August.

Alastair Litterick has recently completed a PhD on aspects of algebraic groups at Imperial College, London, and has taken up a 2-year postdoc position with us.

Alison Heard was farewelled as Senior Tutor, in July. *Vaughan Jones* is now based at Vanderbilt University (at Nashville, Tennessee, USA), as Distinguished Professor and Stevenson Professor in the Department of Mathematics. He continues as Adjunct Professor in our Department.

Steven Galbraith had a successful sabbatical leave, and he has now returned to teaching. His bid to host the major international cryptography conference ASIACRYPT 2015 in Auckland was successful. *Ben Martin is on sabbatical leave at the University of York for 5 months. Arkadii Slinko* is on Short Leave for Semester 2, which he will spend mostly in Europe, visiting France, Russia, Spain, Sweden, Poland, Italy, Germany and Belgium. The University of Auckland had a very strong presence at the biennial SIAM Conference on Applications of Dynamical Systems of the Society for Industrial and Applied Mathematics, which was held 19-23 May in Snowbird, (Utah) USA. Three staff members, *Vivien Kirk, Bernd Krauskopf* and *Hinke Osinga*, and six PhD students from the Department of Mathematics were invited to speak in one of the mini-symposia or presented posters at the meeting.

The 2013 SIAM Annual Meeting took place 8-12 July in San Diego, USA. Hinke Osinga was one of its co-chairs. The conference was organised around the overarching theme of Mathematics of Planet Earth (http://www.mpe2013.org). With more than 1100 mathematicians and computational scientists participating from all over the world, it was a perfect setting for discussion of innovative and ground-breaking research in the field, spanning academia, industry and government. The 2014 International Congress of Mathematicians, to take place 13-21 August 2014 in Seoul, Korea, will give visibility to mathematical research happening in New Zealand. Hinke Osinga has been invited to deliver a lecture in the ICM section Mathematics in Science and Technology.

Our 2013 Student Research Conference was held on June 10, with 20-minute lectures presented by 16 graduate students: The Jury awarded the 3 prizes (of $1,000 each) to Jennifer Creaser, Michael Lockyer and Katie Sharp.

Terence Tao's visit as Maclaurin Lecturer (on August 19) was a huge success. His Colloquium Lecture on points and lines was standing-room only, and his Public Lecture on astronomical distances spilt over into 2 overflow rooms. And this when we were in direct competition with Helen Clark's lecture, and with the annual university Robb Lectures.

Recent visitors included Dr Diana Coben (University of Waikato), Prof. Brian Corr (UWA), Prof. Rod Downey (VUW), Prof. Michael Eastwood (ANU), Dr Maria Elisa Fernandes (University of Aveiro), Prof. Emanuel Indrei (ANU and MSRI), Mr Syafiq Johar (Imperial College, on a Summer Scholarship), Dr Daniel Lond (University of Canterbury), Prof. Charles Leedham-Green (Queen Mary, University of London), Dr Claude Marion (Universite de Fribourg), Prof. Simon Marshall (Northwestern University), Prof. Mark McGuinness (VUW), Dr Mark Mixer (Williams College), Prof. Katharina Neusser (ANU), Prof. Alan Schoenfeld (UC Berkeley), Prof. Egon Schulte (Northeastern University), Dr Rulin Shen (Hubei University for Nationalities and Central China Normal University), Prof. Terence Tao (UCLA, Maclaurin Lecturer), Prof. David Terman (Ohio State University) and Dr Leo Tzu (Academy of Finland).

Garry Tee

UNIVERSITY OF WAIKATO

DEPARTMENT OF MATHEMATICS

Preparations for the 2013 NZMS Colloquium are now well advanced. The list of plenary speakers as well as more detailed information about this event may be found in a notice elsewhere in this Newsletter. Previous Colloquia hosted by the Department have been held on the university campus in Hamilton, but this one will be held in Tauranga at the Trinity Wharf Hotel. We look forward to your participation in the 2013 Colloquium.

New colleagues

We welcome *Frederic Effenberger* to the Department where he has a two-year fixed term position as a post-doctoral research fellow. He comes to us from the Ruhr-Universität Bochum, where he completed his PhD there last year with a thesis titled 'Anisotropic Diffusion of Energetic Particles in Galactic and Heliospheric Magnetic Fields.' His research areas tie in nicely with those of Ian Craig, Sean Oughton, and Yuri Litvinenko.

Awards

Last, but not least, we congratulate Distinguished Professor *Marston Conder* of the University of Auckland on being a recipient of a 2013 University of Waikato Distinguished Alumni Award. It is perhaps not well-known that Marston completed a Master of Social Sciences degree in Mathematics at this university in 1977. The award is well-deserved recognition of Marston's significant contributions to the mathematical and scientific communities in his actual research, his service, and his leadership (such as being a driving force behind the New Zealand Institute of Mathematics and its Applications). The award will be presented to Marston at a black-tie dinner to be held on 20 September.

Stephen Joe

MASSEY UNIVERSITY

INSTITUTE OF FUNDAMENTAL SCIENCES

After several attempts, never mind how many, *Robert McLachlan* has won a James Cook Fellowship from the Royal Society, for research in geometric numerical integration – specifically, on discrete conservation laws, on constrained integrators, and on multisymplectic integrators. He went to NTNU in Trondheim, Norway, for a month in April, to collaborate on this research, and also gave lectures on geometric integration at Chalmers University in Gothenberg, Sweden. He continues to host visitors from Norway under the EU-funded project CRiSP (Collaborative Research in Structure Preservation – the acronym is so important).

On 27 August he will deliver one of the Royal Society's '10×10' lectures, in Auckland on 'Prediction is difficult, especially about the future' (searching for the origin of this quote on the internet returns the line, 'Which of us has not relied on this quote in a tight spot') and in September he will tour UK universities as the Aitken Lecturer.

New colleagues

In August last year we welcomed *David Simpson* to our group as Lecturer in Mathematics. David joined us from UBC in Vancouver, where he was a Postdoctoral Fellow working with Rachel Kuske. Prior to that, he completed a BSc and an MSc in Applied Mathematics at the University of Auckland, working with Vivien Kirk and James Sneyd, and completed his PhD at the University of Colorado at Boulder in 2008. His PhD advisor was James Meiss.

David's research interests are in dynamical systems, especially piecewise smooth systems. Such systems can describe relay control or impacting systems, and the discontinuities can give rise to interesting dynamics. David lives with his wife Shannon, who is the content manager at Palmerston North City Library.

In July we were joined by *Cami Sawyer* as Senior Tutor in Mathematics. Cami completed her PhD

at the University of North Texas in 1999, working on the cohomology of toral hyperplane arrangements, and then worked as an Assistant Professor at Southwestern. She came to New Zealand with her family in 2006, and has spent the last six years teaching high school in the Manawatū. During this time she was also involved in advising secondary teachers on the new curriculum, and teaching future primary school teachers in both the undergraduate and postgraduate programmes at the Massey College of Education.

Cami is very interested in mathematics education and what it means to teach and learn mathematics, and plans to maintain contact with her mathematics education colleagues. Her husband Greg is a biochemist at Plant and Food Research, and they have two children, Matthew and Addi, who are at secondary and primary school, respectively.

In July we also welcomed back *Luke Fullard* on a fixed term two year contract as Lecturer in Mathematics. Luke's appointment is to cover Robert McLachlan's teaching duties while he is on his James Cook Fellowship. Luke did both his BSc (Hons) and his PhD with us, completing his PhD in 2011. This was on modelling hydrothermal eruptions, and was done under Tammy Lynch's supervision.

Since then Luke has been employed as a postdoctoral fellow at Massey's Riddet Institute. His research there has included topics such as granulated powders, and his collaborators include Graeme Wake, from the Massey Albany campus. Luke lives with his wife Judith, who works at the Palmerston North Hospital.

Departing colleagues

At the end of Semester One we farewelled *Charles Little*, who retired after 31 years of service at Massey University. Charles completed his PhD under Daniel Younger at the University of Waterloo in 1972, and came to Massey from RMIT University in Melbourne in 1982. He completed a DSc at Massey in 2006, and was promoted to full professor in 2007. His research interests are in graph theory, especially perfect matchings, and MathSciNet lists a total of 81 publications, with a total of 193 citations.

Chris Tuffley

INSTITUTE FOR INFORMATION AND MATHEMATICAL SCIENCES

Aldwyn James Anderson Miller was born at 1:35pm on Tuesday, 9 July, 2013, weighing 6 lbs 5 oz (*apparently this is an ancient measurement of mass, equal to approximately 2.87 kg — Ed.*. Baby and parents *Marti Anderson* and *Arden Miller* are all doing well at home.

New colleagues

Emily Harvey has joined the Mathematics group as a postdoctoral fellow at the end of July. An Auckland native, Emily did her undergraduate degrees in Physics, Applied Mathematics, and Psychology at the University of Auckland before narrowing in on a Mathematical Physiology research area for her PhD, working with Vivien Kirk and James Sneyd. Emily's PhD thesis was on investigating the role of fast and slow timescales in the dynamics of intracellular calcium oscillations, and more specifically how to use geometric singular perturbation techniques to analyse the mathematical models of such systems. For the last two years Emily has been based at Montana State University in breathtakingly beautiful Bozeman, Montana (in the USA), learning all about bacterial communities, cross-country skiing, metabolic systems, ice climbing, microbiology, mountain biking, and biofilms while doing a postdoc studying the dynamics of microbial consortia with Tomas Gedeon and Jeff Heys. Emily will be working with Alona Ben-Tal on modelling the respiratory system of birds and mammals and will also be involved in teaching a block course over the summer.

Adam Smith has joined the Statistics group as a lecturer (permanent position) on July 29. Adam is an ecological statistician, having previously held positions at the Department of Conservation (DOC) and the National Institute of Water and Atmospheric Research (NIWA). He has a particular interest in Bayesian and multivariate statistics, particularly as applied to marine ecology, fisheries and conservation. His PhD (of which he is in the final stages) is on improving statistical inferences for evaluating the effects of marine reserves on fishes, and has involved a lot of scuba diving and counting fish. In fact, he is considered by many as simply a glorified fish-counter. Adam will teach statistics papers at all levels. He is currently lecturing a third year paper on Data Mining and is particularly looking forward to developing a new second year paper Data Analysis for Biologists next year.

Shaun Cooper

CALLAGHAN INNOVATION

About a month ago, on 9 July 2013, Callaghan Innovation CEO Dr Mary Quinn announced that (after 13 September 2013) Callaghan Innovation staff would no longer be able to bid for competitive research (e.g. MBIE, Marsden, Rutherford Discovery) funding. Callaghan Innovation would assist affected staff to relocate to other research organisations. Callaghan Innovation staff will be able to work on MBIE or Marsden projects, but in most cases, only as subcontractors.

The teams most affected are Applied Maths, Photonics, High Temperature Superconductivity, and Carbohydrate Chemistry. The details of which staff will transition into, or out of, Callaghan Innovation are currently being determined. It is understood that staff transitioning out of Callaghan Innovation will be able to take their competitive research funding with them.

The Applied Maths team will cease to exist as a separate entity on 2 September 2013. Two staff are

proposing to transition into the university sector; 3 to GNS; and the remaining staff will be absorbed into another team, and will transition into Callaghan Innovation on 2 September 2013.

Our previous correspondent, *Warwick Kissling*, has already moved to GNS (1 of 3), and so I am acting as the temporary correspondent.

Graham Weir

VICTORIA UNIVERSITY OF WELLINGTON

SCHOOL OF MATHEMATICS, STATISTICS AND OPERATIONS RESEARCH

The School has recently had a bit of a shake-up, quite literally, thanks to the two sizeable earthquakes that were centred a bit south of Wellington on Sunday 21 July and Friday 16 August. Fortunately none of us suffered any major damage, either at home or at work. I think for many people it brought a renewed appreciation of what colleagues in Christchurch have been through in the last few years, and we are very relieved that things weren't any worse.

Another sort of shake-up may be heading our way soon, or not, since from 27 to 29 August we went through a review of our three programmes: Mathematics, Statistics and Operations Research. The Head of School and the Programme Directors (Peter Donelan, Mark McGuinness and Ivy Liu) put a lot of time into preparations for the review, as did nearly all members of the school's academic and general staff. The external review panel members were Hyam Rubinstein, Thomas Lumley and Alona Ben-Tal, with Professor of English, Peter Whiteford, the Victoria-based convenor. We look forward to receiving their completed review and recommendations in due course.

One of the most significant mathematical announcements I've had the pleasure to pass on via this column concerns *Geoff Whittle*'s recent announcement that he, Jim Geelen and Bert Gerards have achieved all the essential ingredients to prove Rota's Conjecture. (*We intend to cover this more in the next issue - Ed.*)

Another link to Geoff Whittle is through the origami mathematical art made by one of Geoff's former MSc students, Rhiannon Hall. After completing her PhD, Rhiannon is now a lecturer at Brunel University, London. One of Rhiannon's artistic creations has been used in the new line of art that has been placed around our school.

There are a couple of recent successes to report concerning our students. Congratulations to *Michael Snook* who successfully completed his PhD thesis, "Matroids, complexity, and computation," under the supervision of Dillon Mayhew. Our congratulations also to our PhD graduate *Sione Paea*, who has been appointed to a lectureship in Mathematics at the University of the South Pacific in Fiji. Sione did his PhD developing a multiscale simulation method for the growth of nanocrystals in solution. He was supervised by Shaun Hendy (Physics and McDiarmid Institute). Sione also has a Masters in Mathematics from Victoria, on modelling the pyrolysis of coal, again under the supervision of Mark McGuinness.

John Haywood, Estate Khmaladze and *Ginny Whatarau* organised a half-day Workshop on Demography and Actuarial Science, held 26 June 2013. The Workshop included a celebration of the April 2013 publication of Estate's book, Statistical Methods with Applications to Demography and Life Insurance. Invited speakers came from academia and the actuarial profession, in both the public and private sectors. Around 60 people attended and the event was very successful. Further details, including the programme, are available via http://msor.victoria.ac.nz/Events/. The Workshop was opened by Professor David Bibby as one of his last official functions as the Pro Vice Chancellor and Dean of Science at Victoria.

The Fourth Wellington Workshop in Probability and Mathematical Statistics (WWPMS4) will be held at Victoria University of Wellington early in December 2013. Planning is well under way and more details are available via http://msor.victoria.ac.nz/Events/. The Workshop Program Committee (chaired by Estate Khmaladze) includes statisticians from around the country and the Organising Committee Co-Chairs are John Haywood and Ivy Liu.

The 12th Asian Logic Conference was held at Victoria in December 2011, a major international conference organised by the School in a highly successful event that attracted over 100 researchers from around the globe. The proceedings of the conference have now been published (in 2013) by World Scientific, in an attractive volume prepared by a team of editors including *Rod Downey* (chair) and *Rob Goldblatt*. The book contains 18 research articles by 32 conference participants, covering a wide range of topics of current interest in mathematical and philosophical logic.

To view a listing of recent seminars in the school, complete with abstracts, please enter an appropriately-old date in the School's seminar web page: http://msor.victoria.ac.nz/Events/Seminars.

John Haywood

UNIVERSITY OF CANTERBURY

DEPARTMENT OF MATHEMATICS AND STATISTICS

Congratulations to *Rua Murray*, recipient of one of 10 awards in 2013 from AKO Aotearoa for sustained excellence in tertiary teaching. Rua's citation describes him as having "a heart of gold that inspires passion for complex ideas amongst learners of all abilities". It goes on to say that Rua firmly believes that "to learn

mathematics, you do it; to do it you need motivation". Rua has been that motivation for the thousands of students he has taught from foundation to graduate level over the last 15 years, students who are highly-talented and passionate about mathematics as well as those who lack confidence and see mathematics as a challenge. Rua inspires his students with insightful and engaging lessons, making learning complex concepts fun and interesting and promoting an environment for learning that involves students as actively as possible. He communicates high expectations but always strives to provide the learning opportunities that make this possible. Rua's full citation can be found via https://akoaotearoa.ac.nz.

Congratulations to *Douglas Bridges* and *Maarten McKubre-Jordens* for their success as the NZ members of a consortium of academics that applied for funding by an EU Marie Curie IRSES (International Research Staff Exchange Scheme) grant to support a wide-ranging project on constructive mathematics and related fields. The consortium was largely from EU countries, with external members from Canterbury, ANU, Pittsburgh, and JAIST (Japan Advanced Institute of Science and Technology). The money for the Canterbury researchers - roughly 1/4m dollars over 5 years - comes from the NZ government, through the RSNZ. Starting from early next year, the Department will host academic visitors (including some familiar faces) from various EU countries on this project.

Emeritus Professor *Roy Kerr* headed to Europe in May to become the first New Zealander to receive the Einstein Medal from the Albert Einstein Society in Switzerland. The award ceremony was held at the University of Bern on May 28. Roy discovered a specific solution to Einstein's field equations which describes a structure now termed a Kerr black hole. The Einstein Medal is awarded annually by the Einstein Society "to deserving individuals for outstanding scientific findings, works, or publications related to Albert Einstein". The medal was first awarded to Stephen Hawking in 1979 and, since then, many distinguished scientists have received the medal including six Nobel laureates.

At the end of May we welcomed *Jenny Harlow* as a 3-year fixed-term Senior Tutor. Jenny is well known in the department. She is a graduate of the University of Canterbury and completed her MSc earlier this year. She had been working in the department as a part-time tutor and supported staff with online tools. Jenny will support the work in 100-level courses with student engagement.

Welcome to *Helen Rowley*, who commenced a 12-month fixed-term position in the Maths office on 13 May. Helen grew up in Christchurch and has just moved back after five years working at Victoria University as an administrator in the Chemistry and Physics department. She has a BSc from Otago University majoring in Chemistry, which she finished with a year studying here at UC.

Jane Clucas left the department in April. She has been a part-time Senior Tutor for many years, but continues teaching in the University with Bridging Programmes.

Peter Renaud had his last day in the department on 12 July after a long distinguished career of nearly 45 years at the University, including several years as head of department. The department thanks Peter for his many contributions. He promised to be around the department occasionally as he is still involved in the supervision of two PhD students.

Best wishes to *Sarah Vincent* and Scott Fairbairn on the birth of their first child, Millar Rose, born 17th April.

Sha (Joe) Zhu successfully defended his PhD in May via live video stream from the UK. Joe, who is now based at Oxford University, returned to New Zealand briefly in March for a ceremony at the Chinese Embassy in Wellington where he was presented with an overseas student fellowship awarded by the China Scholarship Council. Sha was supervised by *Mike Steel* and *James Degnan*, and his thesis was on "Stochastic tree models and probabilistic modelling of gene trees of given species networks".

Liene Daukste completed her PhD in May. She was supervised by David Wall, and her thesis was on "Mathematical modelling with applications to medicine". David and Liene have been attracting considerable interest in the cancer cell behaviour research they have been undertaking in collaboration with the Auckland Cancer Society Research Centre. Their research focuses on modelling the dynamics of cancer cell populations that have been exposed to cancer treatment, such as irradiation, chemotherapy or a combination of both, and to model cancer cell populations that have not been exposed to any cancer treatment, which leads to a better understanding of how cancer grows and can be used to predict the most effective cancer treatment option.

Daniel Lond successfully defended his PhD degree in July. His thesis was "On Reductive Subgroups of Algebraic Groups and a Question of Külshammer". Daniel is based in Wellington where he works for Weta Digital. His supervisor was Ben Martin, formerly of this department but now with the University of Auckland.

Can money buy you happiness? Our Waiheke Island-based PhD student *Lisa Henley* has been attracting media attention of late in both the Press (19 April) and on radio for her statistical research with Jennifer Brown and David Conradson (Geography) on alternative measures to GDP for assessing the nation's progress. Lisa is looking at such measures as equality, political freedom, sustainability, and life satisfaction to see where New Zealand sits in relation to other countries. You can hear one of her interviews on the following link: http://www.95bfm.com/assets/sm/210728/3/LisaHenley.mp3

Visitors

In July the department welcomed two Erskine visitors, Prof Elizabeth Allman (University of Alaska, Fairbanks) and Prof Carey Priebe (John Hopkins University Baltimore). Elizabeth's fields of interest include

tree construction methods and statistical models, modelling of evolutionary processes, mathematical biology, algebraic statistics, computational algebra, Galois theory, Brauer groups and mathematics education. She is hosted by James Degnan but will also be interacting with Mike Steel, and is teaching in MATH102. Elizabeth is accompanied by her husband, John Rhodes, from the same university.

Carey's special fields of interest are computational statistics, kernel and mixed models, statistical pattern recognition, statistical image analysis and statistical inference for high-dimensional and graph data. He is hosted by Dominic Lee, and is teaching in STAT213, giving two seminars, and participating in postgraduate research supervision on this his second Erskine Fellowship.

Recent visitors include: Antony Unwin (University of Augsburg), John Rhodes (University of Alaska, Fairbanks), Zach Weber (University of Otago), Michael Trosset (Indiana University), Nam-Hyun Kim (University of Adelaide), Graeme Wake (Centre for Mathematics-in-Industry, Massey University, & Gravida-National Centre for Growth and Development, Auckland)

Günter Steinke

UNIVERSITY OF OTAGO

DEPARTMENT OF MATHEMATICS AND STATISTICS

Departing colleagues

Four esteemed colleagues have retired during the past few months.

John Clark is leaving the department after 43 years of service. His contribution to algebra, in particular the theory of rings and modules, is being recognized by an International Conference in Algebra in Honour of Patrick Smith's (a friend of John's) and John's 70th birthdays.

John Curran has been at the department for 37 years. His main mathematical interest is in group theory. John also initiated the Problem Challenge Competition for NZ intermediate level schools, which is now successfully running in its 21st year.

Bram Evans retires after 36 years of full-time service (or 43 years including part-time). Bram's research focused on general relativity, theoretical cosmology, foundations of quantum mechanics, and mathematical modelling.

The fourth retiree is *John Shanks*, who was appointed in 1974. John is the author of several computer software packages. He also has been the Membership Secretary of the NZMS for 30 years. We are happy that John is continuing on a part-time basis with 1 day/week.

We will miss your professional expertise and your friendship. Best wishes for a very happy retirement!

Florian Beyer and his wife Kirsten have become proud parents of a baby girl. Rosalie was born on 28 May, a few weeks early, but both mother and baby are doing well. Congratulations, Florian and Kirsten!

The Department's *Jessica Leigh* and our former postdoc *Steffen Klaere* got married in July, at a drive-through in Las Vegas. Much love, health and happiness to you both on this happy occasion.

Janine Wright, who was a lecturer in statistics at the department, resigned in May. Janine went to New Plymouth with her family, where her husband Kelvin has become the general manager at Mercer Stainless Ltd. All the best for your future, Janine.

Visitors

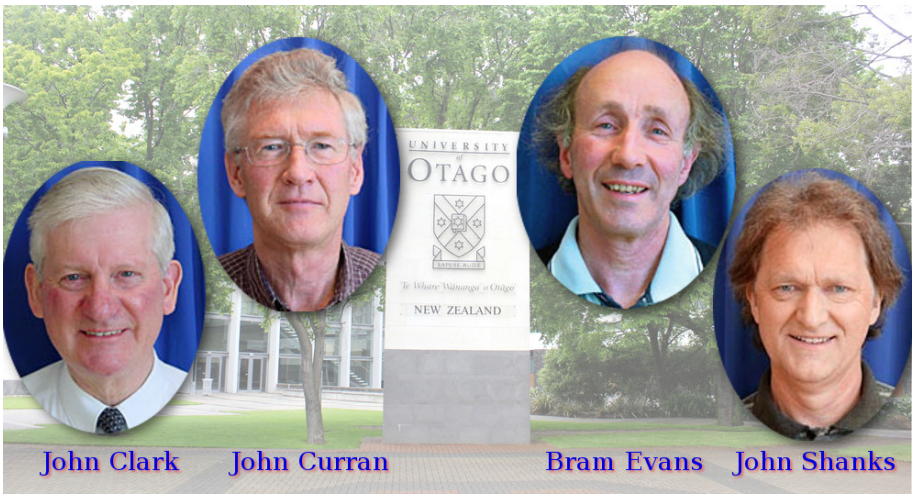
Yao Sheng and Heng Zheng, who are students at Beijing Normal University, are visiting for three months in order to work with Ting Wang as part of their PhD project. They are investigating the relationship between carbon dioxide emissions and global warming with statistical methods.

Another visitor was David Swafford from Duke University, who was working with David Bryant and Mike Hendy on new algorithms for computing phylogenetic trees.

Visitors over the last few months have been Robert Archbold (University of Aberdeen), Laura Cowen (University of Victoria, Canada), Attila Házy (University of Miskolc), Ernesto Nungesser (KTH Royal Institute of Technology, Stockholm), Peter Otto (Willamette University, Oregon) and David Pask (University of Wollongong).

Jörg Hennig

Four retirees from Maths at Otago.



The Hon. Stephen Joyce presenting Rua Murray with an AKO Aotearoa Tertiary Teaching Excellence Award at Parliament on 9 July.

The IMO team on the way to the closing ceremony. Back, left to right: Jaehwan Kim, Ian Seong, Vincent Qi, Natalia Chen, Peter Nelson. Front: George Han, Byung-Cheol Cho.

Performers at the IMO opening ceremony.

Graeme Wake at Charles Pearce memorial — Charles pictured on slide

REPORTS ON EVENTS

Memorial meeting for Charles Pearce (1940 – 2012)

On 17 June Graeme Wake was privileged to be invited to present a talk at the Charles Pearce Memorial symposium at the University of Adelaide. Professor Pearce was one of NZ's much-loved and distinguished mathematicians, and he is pictured on the concluding slide of Graeme's talk.

Nearly 100 people from many countries came to honour this occasion for one of NZ's famous mathematical sons, who served for over 30 years at the University of Adelaide, and was one of their senior mathematical professors at the time of his tragic death, as a result of a motor accident, in June 2012. Graeme Wake, three years his junior, was a contemporary of Charles at Victoria University of Wellington in the early 1960s. They became close friends working together both on probabilistic modelling and in the formative years of the two-country grouping ANZIAM (Australia and New Zealand Industrial and Applied Mathematics) even before 1993, when it was first formed as we now know it. Charles was the founding editor of the ANZIAM Journal and served in this role for nearly 20 years. Such was Charles' dedication to trans-Tasman activities he was one of the very few Australasians to become a Fellow of both the NZ and Australian Mathematical Societies. Charles was a NZer with both Maori and Pakeha ancestry and spent considerable time tracing the 800 year-old long Polynesian migration to our land, and was indeed on such another such quest at the time of his untimely death in Westland in June 2012.

(Report by Graeme Wake)

The 54th International Mathematical Olympiad, Santa Marta, Colombia

The 2013 IMO team returned a solid performance at this year's IMO, placing 48$^{\text{th}}$ equal of 97 countries (tied with Austria and host country Colombia), and bringing home two bronze medals and three honourable mentions. The team and their results were as follows (individual scores out of 42):

Student	Score	Percentile	Award
George Han (Westlake Boys' High School)	22	71.48	Bronze medal
Byung-Cheol Cho (Auckland Grammar School)	16	55.70	Bronze medal
Vincent Qi (Auckland International College)	14	47.15	Hon. mention
Ian Seong (Macleans College)	14	47.15	Hon. mention
Jaehwan Kim (King's College)	10	38.97	Hon. mention
Natalia Chen (St Cuthbert's College)	1	10.08	
Team result: 48^{th} equal of 97 countries	77	51.04	

In percentile terms this is our 7^{th} best team result, and our 12^{th} best in terms of number and quality of awards. George, Byung-Cheol and Natalia were returning members of the 2012 team; George and Byung-Cheol both improved from honourable mentions last year to bronze medals this year, but unfortunately Natalia was unable to match her bronze medal awarded last year. Vincent and George are both eligible for selection next year. At only two points away from silver this year, and with two more years of eligibility ahead of him, George is definitely one to watch.

The IMO was held this year in Santa Marta over 18 – 28 July, and accompanying the team were Stephen McConnachie (Middleton Grange School) as team manager, Peter Nelson (VUW) as deputy leader, and me as team leader. After a long journey via Santiago and Bogota we arrived in Santa Marta, the oldest existing city in Colombia and the second oldest in South America, just less than a week before the opening ceremony, and settled in to a hostel for some final training. Located 11 degrees north of the equator on the Caribbean coast, Santa Marta was warm and tropical, and the architecture reflected this: all of our hostel's windows and the main door to the street were simply ornamental grilles, allowing the air to flow right through to an interior courtyard. Palm trees were everywhere, and despite some initial apprehensions about security, we soon found that the locals simply went about their business and left us to go about ours.

The IMO started for me two days after our arrival, and leaving the team to continue training I headed south to the city of Barranquilla to join the other team leaders for the jury meetings. These were held at Hotel El Prado, a beautiful building from the 1930s with a large palm-tree filled courtyard, and soon after arrival I was in problem solving heaven, happily tackling problems from the shortlist of 27 from which the six for the contest would be chosen. As usual I traded notes with Dutch leader Quintijn Puite; he had a bit of a head start on me, having arrived a bit earlier, but after sorting out a few of the "easy" problems I'd at least partly caught up, and we settled down to tackle some of the harder ones together. As usual, most of the problems were very difficult! By the time the solutions were made available I'd solved five of the problems, and Quintijn and I had made partial progress on several others.

The next few days were spent in jury meetings to select the problems, translate them into the 53 languages represented at the IMO, and set the marking schemes. A new problem selection procedure was used this year, with the goal of producing a more balanced paper, both in terms of difficulty and topic areas; I certainly felt it achieved this, but we will see next year whether the rest of the jury agrees, and is willing to use it again! Among the problems selected was the following, which appeared as problem two (a "medium" problem) on the contest paper:

> **Problem.** A configuration of 4027 points in the plane is called *Colombian* if it consists of 2013 red points and 2014 blue points, and no three of the points of the configuration are collinear. By drawing some lines, the plane is divided into several regions. An arrangement of lines is *good* for a Colombian configuration if the following two conditions are satisfied:
>
> - no line passes through any point of the configuration;
> - no region contains points of both colours.
>
> Find the least value of k such that for any Colombian configuration of 4027 points, there is a good arrangement of k lines.

I have a feeling I may have established an early lead in the stakes for the Golden Microphone (awarded to the leader who makes the most speeches)... but once again I managed to dodge that honour, and it went to Australian leader Angelo di Pasquale, with UK leader Geoff Smith only one speech behind.

The opening ceremony was a colourful affair, with dancers from the Baranquilla Carnival accompanying the contestants during the parade of teams, and was followed by the first and second days of contest. With the contest over the jury could relocate from Baranquilla to the main IMO site in Santa Marta, and finally see our teams again. The IMO site was an enormous resort, set along a kilometre of beach, and the local fauna included iguanas! But for my first few days there Peter and I were kept busy marking the team's work and preparing for

"coordination": meetings with representatives of the host country to agree on the marks for each script. Our most rewarding moment here was our defence of George's solution to problem 5, which we successful argued deserved five marks out of seven — at least two if not more points than the coordinators had initially had in mind.

Once coordination was over we were all on tenterhooks waiting to see what the medal cuts would be. The result displays are always partially obscured during coordination, to make it difficult to guess these, but for the last three years the silver cut had been 21 or 22, and bronze is typically around 14–16. Moreover, I had the impression that this was going to be a low scoring IMO, so thought we might be in with a chance of some very good results! Alas, when the full results went up at the jury meeting to decide the medal cuts it was immediately clear that the numbers we really wanted weren't even going to be up for discussion, and the silver cut came in at 24, and bronze at 15. Disappointing for us, but the higher silver cut was perhaps further evidence that we'd succeeded in creating a more balanced paper this year. The closing ceremony took place outdoors the next day at the Panteon de la Patria, and then after another day in Santa Marta proper we were on our way home again.

Our thanks go to Igor Klep (University of Auckland) and Malcolm Granville (Harvard University; member of the 2009–2011 IMO teams) for their help with team training, and to the Royal Society of New Zealand, Science OlympiaNZ, and the New Zealand Mathematics Enrichment Trust for their support. Full results of the IMO can be found at imo-official.org.

(Report by Chris Tuffley)

Maths Quest 2013

The Maths Quest on Thursday 29 August did not start out well, with mechanical problems cancelling the Hamilton planes scheduled flight, potentially stranding two students; fog in Hamilton cancelling Terry Tao's flight out of Palmerston North; and the barrier arms at the entrance to Te Papa's parking building being too low (ouch) for our 12 seater vans. However, these three issues were resolved, and all 16 students and their supporters did assemble in Te Papa by 10:30am, for what was an amazing day. Images of the day are available on the NZAMT and NZMS websites, and at `http://bit.ly/mathsquest`.

Dr Karyne Rogers from GNS showed the Maths Quest over Te Papa, covering the local geology, history, lead rubber bearings, and also providing all with some awesome rides and excellent food.

The prize giving at parliament was a special occasion, with Master of Ceremonies and NZAMT President Jen Hudson acknowledging all of the sponsors, and introducing the presenters (Minister Nikki Kaye, Nicky Nelson (AWC), Terry Tao, Di McCarthy (CEO, RSNZ), Uli Zuelicke (MacDiarmid Inst), BD Kim (VUW), Robin Hankin (AUT), Grant Gothard (Casio) and Graham Weir. The students really enjoyed meeting Terry Tao, and are treasuring their photo with Terry, along with their iPad Mini prize. Over 40 students, supporters and sponsors were present at the prize giving.

The trip to Weta Digital and the Weta Cave was magical. You could hear a pin drop while Weta Digital experts (Guy Williams, JP Lewis and Andreas Soderstrom) demonstrated the magic which occurs to turn the initial images into the final images, in filmmaking. The importance of mathematics, computing and design in the film industry was put clearly by the presenters, and this message was of much interest to the educators present.

Finally, the Maths Quest was made possible through an excellent interaction between NZMS and NZAMT, and the generosity of our sponsors, many of whom are represented in this image. There has already been a call from teachers to repeat the Maths Quest next year.

The winners in the 2013 Maths Quest were: Kate Anderson (Fairfield Int.), Lakshitha Singhalage (Remuera Int.), Jack Milne (Ross Int.), Jessica Hansen (Woodfield House), Henna Shah (Al-Madinah), Cameron Baxter (Massey H.S.), Ruben Krueger (Nayland College), Ethan Gerrard (Rangiora H.S.), Sonna Narayanan (Botany Bay Sec. Sch.), Samantha OConnor (Palmerston North Girls H.S.), Stuart Rayner-Nielsen (Fielding H.S.), Brooke Varney (ACG Strathallan), Mathew Schweikert (Fielding H.S.), Connor Coll (TeKuiti H.S.), Kyra van Geffen (Opaki School), Stella Graydon (Pitt Island School). Each of these winners received an iPad Mini, as do their teachers.

(Report by Graham Weir)

David Ryan's retirement

David Ryan is no doubt well known to many members — see the Local News report from Charles Unsworth for more information. The retirement dinner held on 13 August featured several guests from the NZMS community, and many speeches. Andy Philpott's speech contained the following excerpts.

I had been acquainted with degeneracy in Cambridge, but on coming back to New Zealand in 1986*, I saw that David was afflicted with this on a massive scale. Now, I am not alluding to anything salacious here, or to the activities of Tim Watson, Engineering Science's most bacchanalian alumnus. Nor does this have anything to do with collecting and drinking high quality pinot noir or single malt whiskey, activities that David has spent many years perfecting.*

Rather, degeneracy is a phenomenon in large-scale optimization problems that seriously hinders the search for the solution. Its effect is like occasionally mixing up some of the hay you have already searched through with the rest of the hay that contains the needle. Without a cure for this, much large-scale optimization is impossible. David and his student Julie Falkner (along with Mike Osborne) figured out how to resolve this problem cheaply and effectively, leading the way to the solution of massive scheduling problems. These methods were reported in a series of papers in the 1980*s and early* 1990*s that established David's work in air-crew scheduling as the state of the art.*

A little later:

So, enough technicalities. Now your eyes have all glazed over, you might be saying so what? Heres the thing figuring out the maths saves Air New Zealand $15 *million a year in reduced crew costs, enables Optima corporation (that David helped found) employ* 3 *PhD graduates and* 3 *Masters graduates from Engineering Science, and sell their Siren software to ambulance companies all around the world, and saves Rio Tinto an undisclosed figure in maximizing aluminium purity (no doubt helping them reduce their government electricity subsidy to a mere* $30 *million).*

These sorts of figures are trotted out when mathematicians want to demonstrate to granting bodies that mathematics is useful. But making these savings does not just amount to doing the maths. Even if you show people in a company the estimated savings they will be skeptical. You have to convince the decision makers in the company to take the actions recommended by the model. Faculty members here will agree that David is one of the most relentlessly persuasive people in the University if he believes in something then he does not give up arguing until he wins the day. This drive and commitment is needed to make the decision makers convert the maths into money.

John C. Butcher ONZM

In the Queen's Birthday Honours list, John Butcher was awarded the Officer of the New Zealand Order of Merit (ONZM), for "services to mathematics." At most 80 ONZM awards can be made each year in all fields of human activity. The Wikipedia page tells us that ONZM is awarded "for those persons who in any field of endeavour, have rendered meritorious service to the Crown and nation or who have become distinguished by their eminence, talents, contributions or other merits." It also informs us that "The Badge for the three highest classes is a gold and white enamel cross with curved edges bearing at its centre the coat of arms of New Zealand within a green enamel ring bearing the motto For Merit Tohu Hiranga, topped by a royal crown. The badge for Officers and Members are similar, but in silver-gilt and silver respectively." John has not yet been spotted wearing his badge.

NZMS NOTICES

New Zealand Mathematical Society Colloquium 2–5 December 2013: Trinity Wharf Hotel, Tauranga

The registration and abstract submission portal opened in August. An early-bird discount applies to NZMS members who register before November 1, 2013.

The deadline for registration and abstracts (including posters) is 13 November. (Registrations after this date may be accepted at the discretion of the Organisers.) We cannot guarantee that every abstract will be accepted, but we hope to be able to accept most of them.

The confirmed plenary speakers are

- Assoc. Prof. Tom ter Elst, University of Auckland, New Zealand.
- Prof. Jörg Frauendiener, University of Otago, New Zealand.
- Prof. Graeme Hocking, Murdoch University, Australia.
- Prof. Rachel Kuske, University of British Columbia, Canada (ANZIAM speaker).
- Prof. Said Sidki, University of Brasilia, Brazil.
- Prof. Matt Visser, Victoria University of Wellington, New Zealand.

Attendees should make their own accommodation bookings. There are several suggestions on the conference website.

The Aitken and ANZIAM Poster Prizes will be awarded for the best student talks and the best student posters (see website). Students are strongly encouraged to attend the conference and to present a talk or poster.

An approximate timetable for the event, including social activities, is available from the conference website. Social events will include a welcoming function on the Monday evening (2 December) and the Colloquium dinner on Wednesday evening.

For the most up-to-date information on the speakers, program, accommodation, etc please keep checking the website:

http://nzmathsoc.org.nz/colloquium2013/home.php

We look forward to you participating in the Colloquium in sunny Tauranga.

colloquium@math.waikato.ac.nz

Notice of Annual General Meeting

The Annual General Meeting of the New Zealand Mathematical Society will be held during the New Zealand Mathematics Colloquium in Tauranga, on 3 December, 2014.

Items for the Agenda should be forwarded by 27 November to the New Zealand Mathematical Society Secretary.

Call for nominations for NZMS Council positions

Nominations are called for Councillors on the New Zealand Mathematical Society Council. The term of office of a Council member is three years. Council members may hold office for two (but no more than two) consecutive terms. Nominations should be put forward by two proposers. The nominee and the two proposers should be current Ordinary or Honorary members of the New Zealand Mathematical Society. The nominations, including the nominee's consent, should be forwarded by 27 November to the New Zealand Mathematical Society Secretary. If nominations are sent by email, the two proposers and the nominee should each send separate email messages to the Secretary

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 .....

Date membership started .....

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)	.....

.....

Please outline the purpose of this application and how you intend to use the funds (include any appropriate dates)

.....

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.....

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

.....

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Other sources of assistance sought/approved:

.....

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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 application)

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Please attach and include the following supporting evidence to your application:

- For student applicants, a brief supporting statement from your supervisor outlining the relevance of the activity to your studies.
- For non-student applicants, a brief statement of support from your Head of Department.
- A statement outlining the benefit of the activity for which funds are being sought (this must be written by the applicant).
- Quotes for flights and accomodation if these are included in the total expenditure.
- Conference details if this application is supporting attendance at a conference including details of any presentation (oral or poster).

Applications without **all** the supporting material will be returned and not considered.

Please email your complete application as a single pdf file to the NZMS secretary alex.james@canterbury.ac.nz. Alternatively you may send a hard copy to:

Dr Alex James, Secretary, NZ Mathematical Society,
Dept of Maths and Stats
University of Canterbury,
Private Bag 4800,
Christchurch.

The NZMS Council normally considers these applications at its meetings in June and December each year.

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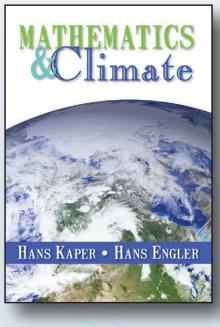

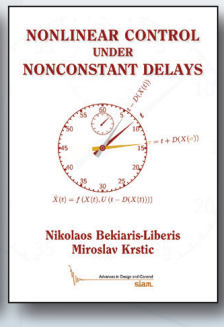

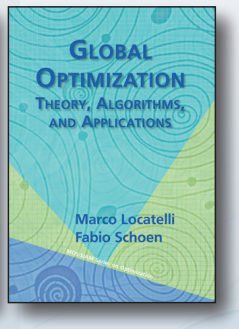

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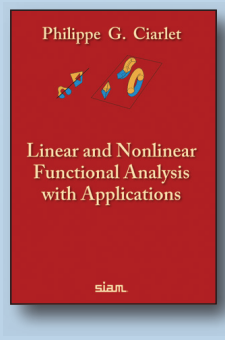

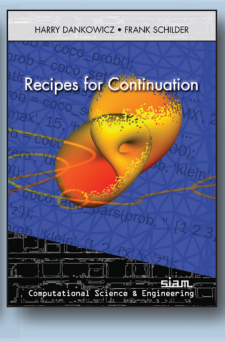

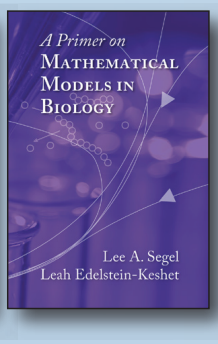

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