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NEWSLETTER

OF THE

NEW ZEALAND MATHEMATICAL SOCIETY

Contents

PUBLISHER'S NOTICE

This newsletter is the official organ of the New Zealand Mathematical Society Inc. This issue was edited by Fabien Montiel and Melissa Tacy. Editorial enquiries and items for submission to this journal should be submitted as plain text or LaTeX files with "NZMS newsletter" in the title of the email to nzmsnews@maths.otago.ac.nz. LaTeX templates are available upon request from the editors.

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EDITORIAL

New Zealand just experienced its warmest July since temperature records began. The rest of the world followed suit as last month was the hottest month ever recorded, despite the absence of an El Niño event (surprise, surprise!). Of particular note is the 0.5 mm of global sea level rise caused by the melting Greenland ice sheet alone during that month and two successive heat waves in Europe. During that time the Universitat de Valéncia (Spain) hosted the International Congress on Industrial and Applied Mathematics (ICIAM) with over 4000 delegates. A significant NZ contingent made the trip to attend this event, which is held every four years. Although a broad range of disciplines were represented at the meeting, the advent of artificial intelligence and deep learning clearly stood out. The next ICIAM meeting will be held in Tokyo (Japan) in August 2023.

Offering first-year maths courses that include service papers for a general science crowd and caters to mathematics major students is a well-accepted challenge. This topic has sparked many discussions in the last couple of years, not only within the NZMS Education group but also throughout our community as evidenced by the well-attended workshop at the last NZMS Colloquium in December 2018. In this issue's education column, Dr. Sione Ma'u reflects on the process of restructuring the University of Auckland's first-year mathematics offerings This discussion will surely be valuable to the wider community as other maths departments in NZ currently or plan to implement similar changes.

Have you some interesting mathematics, or comments on life as a mathematician you'd like to share with the New Zealand mathematics community? Do you know someone who does? We are looking to expand our pool of regular column writers and are keen to hear from you. Contact the editors at `nzmsnews@maths.otago.ac.nz`.

Just a reminder that this year's New Zealand Mathematics Society Colloquium will be held at Massey Palmerston North December 3-5, see webpage . Registration will open soon.

Fabien Montiel and Melissa Tacy

PRESIDENT'S COLUMN

There are many in our community who make enormous contributions to the cause or profession of mathematics, through outreach activities, contributions to teaching and education, research leadership, engagement with government bodies, supporting diversity, providing service to professional societies, mentoring, or communication of mathematics to a general audience. The NZMS Council has been considering ways in which extraordinary contributions of this type might be recognized, and is considering the establishment of an award for service to the NZ mathematics community. If you have comments about the suggestion that such an award be established or suggestions for the selection criteria that might be used, please email me. Ideas for the name for an award would be particularly welcome. The Council will discuss this matter at its meeting in September and I will report on progress at the AGM in December. If an award is established, it would likely be offered first in 2020.

I am delighted to announce that Julia Wolf of the University of Cambridge will be the 2020 Forder Lecturer. I am grateful to Brendan Creutz from the University of Canterbury for agreeing to be the NZ coordinator for the lecture tour, as well as to the local organisers in each university who will assist with local arrangements.

It is not too early to start thinking about how you might celebrate the International Day of Mathematics (IDM) on March 14th next year. The International Mathematical Union has been leading a campaign to have UNESCO designate March 14th as the International Day of Mathematics, and it is looking promising that the General Conference of UNESCO in November 2019 will do so. You can read more about the campaign here. The intention is to have countries around the world organise activities for students and the general public, in schools, museums, libraries and other spaces. Ideas for activities and resources to support them will be available from the IDM website in due course. In the meantime, please mark the date in your diaries and think about what kinds of activities you might want to be involved in in your community.

Lastly, for those who have not heard yet, the next International Congress of Mathematicians will be held in St Petersburg, Russia in 2022.

Vivien Kirk

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EDUCATION

There is broad agreement on what an undergraduate maths major ought to know. But it is usually impossible to cover all topics in the necessary depth due to course constraints and available teaching hours. We need to prioritise the most important material and deliver it successfully, bearing in mind the backgrounds of our students.

It is helpful to see what departments and institutions around the country are doing in this regard. How do our various programmes compare?

Education Day at the NZMS Colloquium

At the 2018 Mathematics colloquium at Otago, a group of about 15 mathematicians from all NZ's mathematics programmes met to discuss undergraduate curriculum during the Wednesday afternoon Education Day. There was a high degree of commonality between institutions about the preparation level of students, as well as the curriculum design for those advancing in mathematics. The attached table (Figure 1) summarises the situation (and reflects planned changes that are being implemented by some departments). It seems that we have all made similar decisions around a core of calculus, linear algebra and differential equations at second year. Some programmes are more prescriptive about the inclusion of statistics, computing and/or discrete mathematics.

Rua Murray

Education News

From time to time this column will detail important developments on the maths teaching front around New Zealand. Please contact me or anyone in the Education Group if anything is happening in your department or institution that should be followed up for a report. Our first report is on a restructure of stage 1 and 2 mathematics at the University of Auckland.

Restructure at the University of Auckland

The core undergraduate stage 1 and 2 maths courses at Auckland have remained the same for many years, but are now in the middle of a restructure which is to be completed by the end of 2020. A number of factors are behind this change, but the main catalyst has been a restructure of the BSc degree by the Faculty of Science in 2017.

The redesigned BSc would reinforce innovative pedagogy, respond to the University's new graduate profile and simplify pathways for students. A number of specific changes were made to the degree prescriptions. One of these was that three stage one courses could be prescribed for a given major. At stage 1, we only had one core course in pure maths: Maths 150 (algebra and calculus); for applied maths, there were two core courses: Maths 150 and Maths 162 (computational and applied mathematics). We could now take advantage of the new prescriptions and offer another course.

Another influencing factor was student feedback from an external review of the department's research and teaching in 2017. Both the undergraduate and postgraduate groups who met with the review committee called for an earlier introduction to mathematical rigour. The committee also recommended that more discrete maths be introduced into the undergraduate curriculum.

Following a special departmental workshop and a number of meetings involving all the different teaching units (pure maths, applied maths, and maths education) we agreed on the following guiding principles:

1. Make space in our courses at stages 1 and 2, and put greater focus on critical thinking, meta-mathematical thinking, and giving students authentic mathematical experiences.
2. First year courses should contain enjoyable mathematical experiences, so that our stage one courses inspire and encourage students to pursue a maths major.
3. Assessment should be authentic and thorough.
4. Split the content of Maths 150 (algebra and calculus) into two courses that treat linear algebra and calculus separately.

100 and 200 level requirements for Mathematics majors at New Zealand Universities

From discussions at the 2018 Mathematics Colloquium Education Day, University of Otago, 5/12/2018

	Auckland	AUT	Waikato	Massey	Victoria	Canterbury	Otago
Level 3 NCEA entry:	Diff + Int	UE (preference for math)	16 Calc (>=2 of Alg,Diff,Int)	16 ext calc (or 24 Calc/Stat)	16 incl Diff+Int (>=2 M/E)	14 AS Math (Calc/Stat)	UE
Other pathways:	(102 ->) 108 (-> 208 if <B-)		165 (->102, >=B- -> 101)	103 or 132	132 -> 141 -> 142	101	151
100 level	**120 *Algebra*** **130 *Calculus*** **162 *Computational math.***	**Comm501 *Appl. communic* Math500 *Math concepts* Math501 *Calculus* Math502 *Algebra+discrete* 2x Phys/Astr 3x Comp/programming Stat500 *Appl. statistics*	**101 *Intro to calculus*** **102 *Intro to algebra***	**101 *Single var calc*** **102 *Algebra*** **1xx *Computer science*** **1xx *Statistics***	**142 *Calculus 1B*** **151 *Algebra*** **161 *Discrete math + logic***	**102 *Calculus (and matrices)*** **103 *Lin alg, DEs, Series, ..***	**160 *Calc + alg*** **170 *Calc +alg + disc*** Stat110 or Stat115
100 req'd points:	45	90	30	60 (>=2020)	45	30	54
200 level	**250 *Calculus and Algebra*** 253 *Further calc+algebra* 255 *Principles of math (pfs* 260 *Differential eqns* 270 *Numerical comp.*	**602 *Multivar calculus*** **603 *Differential eqns*** 601 *Linear algebra* 604 *Financial math.*	**201 *Multivar calculus*** **202 *Linear algebra*** 203 *Diff eqns + modelling* Stat2xx (any)	**203 *Calculus*** **204 *Differential eqns I*** **211 *Linear algebra*** **212 *Discrete math***	212 *Intro to Analysis* 243 *Multivar calc* 244 *Modelling with DEs* 245 *Computational Math* 251 *Linear Algebra* 261 *Discrete Math* 277 *Mathematical Statistics*	**201 *Multivar calculus*** **202 *Differential eqns*** 203 *Linear algebra* 220 *Discrete math* 240 *Analysis and groups*	**201 *Real analysis*** **202 *Vector spaces*** **203 *Multivar calculus***
200 req'd points:	45	45	45	60	60	45 (incl 201, >= 202/203)	54
Options	202 *Learning math via teaching* Comp225 *Discrete math* Intro Alg+Calc 102/108/208		135 *Discrete structures*			120 *Discrete math* 270 *Modelling+Comp*	115 *Intro to math* Como101 *Intro modelling* Como204 *Differential eqns* 272 *Discrete math*
300 req'd points:	45+capstone(15)	45+project(30)	60	60	60 (or 45@200 +75@300)	60	72

Notes:

(1) Required courses in bold
(2) All courses 15 points (except 18 at UoO)
(3) Non-bold courses to be selected from, within minimum points total
(4) Additional options in last row result in increased points
(5) Typical hours: 36 lecture + 12 tutorial, except VUW 30+11, UC 48(+12) at 100 level, AUT 36(+24) at 100 level, Otago 65(+11) at 100 level, 32-39(+12) elsewhere
(6) NCEA level 3: Alg=AS91577, Diff=AS91578, Int=AS91579

Figure 1: Requirements for Mathematics majors at New Zealand Universities.

5. Closer integration of pure maths and applied maths students in stage 1 and stage 2.
6. Make sure that all student groups are appropriately treated (top 5%, forgotten middle, C-grade students, students majoring in other subjects).

By the end of September 2017, Maths 120 (algebra) and 130 (calculus) had been officially conceived with widespread approval:

"A first year programme of three compulsory courses (MATHS 120, 130 and 162) emerged as a viable way to create space, address the graduate profile, develop engaging and accessible courses, provide a common core for pure and applied students, and address the other concerns of the department review."

Creating and implementing a plan for stage 2 would be a bit much for the department to do all at once, so Stage 2 courses in 2019 would be unchanged. The core courses at stage 2 are currently under development for 2020.

The first core course at stage 2 (Maths 250 — algebra and calculus) will be covered at a higher theoretical level in 2020. A new pure maths course (Maths 254) that covers topics from discrete maths, probability, geometry and symmetry is also under development, and addresses the recommendation of the departmental review to do more discrete maths.

In May 2019 the Department ran a competition to find a name for Maths 254. The winning name is: *Fundamental concepts of mathematics*. It will replace Maths 255 (principles of mathematics) which teaches students mathematical proof using logic, elementary set theory, number theory and linear algebra. This basic material is now covered in Maths 120 and 130.

I should also mention that a number of topics in discrete maths have recently been introduced into our Stage 1 applied maths course (Maths 162 — computational mathematics). It is now less calculus oriented (compared to a traditional applied maths course) and more modern in terms of content. As mentioned above, Maths 162 has become a core course for pure maths students as well.

Issues with other undergraduate courses

The department caters to students in other degrees and majors. The sequence of service courses Maths 108–208 covers algebra and calculus at stages 1–2. The content is similar to the old 150–250 sequence, with the emphasis on computation and application rather than mathematical theory. About half of the enrolments in 108–208 are other (non-maths) BSc students, and about 40% are students from the Business School. In the past, a number of them would switch to 150–250, e.g. because they discovered that they enjoy maths. Students who have only done Maths 108 and 208, even with high grades, struggle with the higher theoretical level of Maths 250. After the restructure, students wanting to switch from 208 to 120–130–250 can really only start the latter sequence from the beginning. There has been some concern that this will discourage such students from pursuing a Maths major. We will see what happens!

The Department also provides an opportunity for good secondary maths students to take University level maths via the MAX programme (Mathematics Acceleration and eXtension). Until the changes, Maths 153 was the version of Maths 150 for MAX. Since Maths 150 is no more, the department has decided to replace Maths 153 by a new course, Maths 199, that has a more computational flavour (similar to Maths 162). This new MAX course is being developed jointly with Engineering Science and will be co-taught by both departments.

Progress 2018–Present

The details of content, learning outcomes and assessment for Maths 120 and 130 were finalised and approved through official channels over the course of 2018. A big job has been to write new coursebooks. Similar work on the stage 2 courses is currently underway in 2019.

Maths 120 and 130 were rolled out this past semester (Semester 1, 2019). Anecdotal indications are that students have been happy with the design of these courses, and have found the content interesting. However, students struggled in the tests and final exams, and the initial pass rates for both courses were a bit low for our liking. We are putting this down to growing pains, and the fact that students traditionally struggle with proofs coming out of secondary school. On the other hand, we still believe that it is better to expose them to proofs sooner rather than later. A few changes to the content of these courses have been made for Semester 2.

By this time next year we will have more data on Maths 120–130, and the new courses at Stage 2 will also be underway. I hope to give an update on these developments in a future column.

Sione Ma'u

MATHEMATICAL MINIATURE

Mathematical miniature MM48: Pythagoras

I was very pleased to have received two reactions to MM47. Jörg Henning (Otago) sent me a finely crafted solution to the homogeneous Diophantine equation

$$\begin{bmatrix} a & b & c \end{bmatrix} M \begin{bmatrix} a \\ b \\ c \end{bmatrix} = n^2, \quad \text{where} \quad M = \begin{bmatrix} 1 & -1 & -1 \\ -1 & 1 & -1 \\ -1 & -1 & 1 \end{bmatrix}. \tag{1}$$

Rick Laugesen (Illinois, Urbana-Champaign), had some comments on LaTeX tables and on a useful package for making them beautiful.

It is difficult to look at (1), without being reminded of three simpler equations

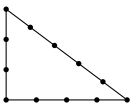
$$ab = cd, \quad (2) \qquad ab = c^2, \quad (3) \qquad a^2 + b^2 = c^2. \quad (4)$$

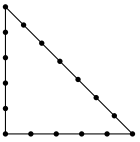
I plan to discuss integer solution to (1), (2), (3) and (4) next time, based on the ideas of Jörg Henning. Today I will say something about (4), in geometry rather than algebra. I will also pass on the ideas of Rick Laugesen on how to construct beautiful LaTeX tables.

There are many reasons why children convert a natural love of mathematics into a deep and unnatural antipathy. At my high school, many boys (I speak only of boys because girls had different classrooms and different teachers) might have changed from love of mathematics to fear of mathematics, because of the difficulty of understanding Euclidean geometry, especially the wonderful Theorem of Pythagoras. Theorems like this were never actually explained; instead, corporal punishment was applied to those who were judged not to have learnt them by rote well enough.

I don't know the best way to teach this gem of classical mathematics but I offer a simple idea, with pictures.

But first, two right-angled triangles with integer sides, to see if Pythagoras works in practice. The triangles are drawn using the graphics package `\usepackage{tikz}`.





The commands to produce the picture on the left are

```
\begin{tikzpicture}[radius=1pt,x=4mm,y=4mm]
\draw (0,0)--(4,0)--(0,3)--(0,0);
\fill (0,0) circle; \fill (1,0) circle; \fill (2,0) circle;
\fill (3,0) circle; \fill (4,0) circle;
\fill (0,1) circle; \fill (0,2) circle; \fill (0,3) circle;
\fill (0.8,2.4) circle; \fill (1.6,1.8) circle;
\fill (2.4,1.2) circle; \fill (3.2,0.6) circle;
\end{tikzpicture}
```

This example of `tikz` is intended to be self-explanatory.

The picture on the left gives the famous solution to (4), $3^2 + 4^2 = 5^2$. But the isosceles right-angled triangle on the right is a little strange because $5^2 + 5^2 \neq 7^2$. Does this mean that the Theorem of Pythagoras is not true? You are welcome to tell me what, if anything, is wrong and also tell me why $2a^2 = c^2$ cannot have any non-zero integer solutions.

Now Figures (1) and (2), to show to anybody who missed out on a love for Pythagoras as a child.

Figure (1)

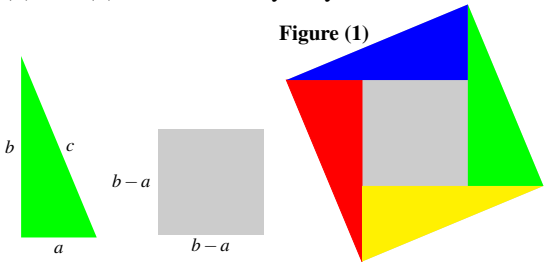
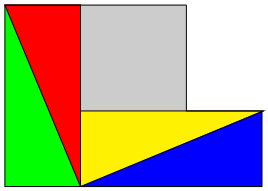


Figure (2)



At the far left is a triangle with sides of length a, b, c, followed by a square with side $b-a$. In Figure (1) four copies of the triangle are joined to the square as shown, to give a total area of c^2. In Figure (2), the blue and green triangles have ben moved to form a diagram consisting of two squares with areas b^2 and a^2 respectively. This is one of many possible proofs of the Theorem of Pythagoras $a^2+b^2=c^2$. Make cardboard cutouts of the four triangles, and the $(b-a)\times(b-a)$ square, to add a tactile component to the enjoyment of the proof.

Rick Laugesen recommends using `\usepackage{booktabs}`, written by Simon Fear, and maintained by Danie Els, (see here), to provide tools, such as rules of varying thickness, for constructing beautiful tables. An additional resource is "Small Guide to Making Nice Tables" by Markus Püschel. Rick offers some additional comments

- Never use vertical lines in a table. (Really. Never. Ever.)
- If in doubt, align to the left rather than center or right.
- Use `\toprule` at the top, `\midrule` before the main body of the table, and `\bottomrule` at the bottom.

I want my LaTeX tables to look as good as possible and I have thought about these ideas. Naturally, further comments on the aesthetics of LaTeX table-making are welcome.

J.C. Butcher

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CYBERMATH

When writing the last column I expected that the topic of this one would be the relaunch of the New Zealand Journal of Mathematics, but unusual circumstances have delayed the relaunch, which is still expected to happen by the end of 2019. The NZJM is a classic example of a scholar-run journal with almost zero budget, subsidised easily by universities and the NZMS because its costs are so low. An argument often made by vested interests in the publishing industry is that high quality journals are expensive (many journals make income of thousands of dollars per published paper). A recent study (fittingly published as a PeerJ preprint) shows that US$200 per paper should be an upper bound.

I have spent some time on Twitter recently, but not for mathematical purposes (I run the accounts @oa_math and @freejournalnet). A substantial number of mathematicians have Twitter accounts, although many seem to use them more for political purposes than to discuss mathematics (for example, Ian Stewart (@JoatStewart) and even Timothy Gowers (@wtgowers) who has been using it for less than a year, after the demise of Google+ necessitated another forum.) This list of mathematicians on Twitter is a useful starting point.

Of course there is a large representation of experts in public outreach, such as Steven Strogatz (@steven-strogatz), Hannah Fry (@FryRsquared), Marcus du Sautoy (@marcusdusautoy). Interesting feeds relating to the politics of academia include those by Izabella Laba @ilaba.

Some other accounts that caught my eye and focus more on mathematics include: Numberphile (@number-phile) from MSRI (there is also a Youtube channel and other resources) and Fermat's Library (@fermatslibrary). These channels are focused more at the undergraduate level. Research-level mathematics is not as well represented. The first mathematical blogger John Carlos Baez has a nice feed at @johncarlosbaez.

The American Mathematical Society (and also London Mathematical Society @LondMathSoc and Australian Mathematical Society @AustMS) are there, but not the New Zealand Mathematical Society yet. The University of Auckland Department of Mathematics is there: @mathsmatter - are any other departments? Antipodean mathematicians I found include Nalini Joshi (@monsoon0) and our own Steven Galbraith (@EllipticKiwi).

Twitter of course has its downsides. The pace at which tweets appear requires a lot of discipline in whom to follow and how to read - at times it is like looking at a library of newspapers but only reading the headlines. This goes against the traditions of mathematics. The 140 (now 280) character limit favours concision. LaTeX is not yet supported; mathematical formulae can be embedded as pictures if necessary. Perhaps the medium is simply not (yet) well adapted for mathematicians. Will we ever see Terence Tao on Twitter? Somehow I doubt it. But overall I think it is worth exploring, and I welcome feedback from readers (if I have any - at least on Twitter I can get some idea about that).

We finish with some brief notes that may help to feed your procrastination.

- Youtube has a lot of mathematically related content which I may survey in future. I have dipped my toes in by recording some (I claim) high-quality lectures at Stage 2 level.
- Proof assistants are not just useful for proving things we already believe to be obvious: "Sébastien Gouëzel, when formalising Vladimir Shchur's work on bounds for the Morse Lemma for Gromov-hyperbolic spaces, found an actual inequality which was transposed at some point causing the proof (which had been published in 2013 in J. Funct. Anal., a good journal) to collapse. Gouëzel then worked with Shchur to find a new and correct (and in places far more complex) argument, which they wrote up as a joint paper.?" See the discussion at mathoverflow.
- Karen Uhlenbeck became the first female winner (out of 20 so far) of the Abel Prize.
- If you are interested in showing the human diversity of mathematicians, this Instagram account may be useful.
- I found the reminiscences by a student (Thomas Hales) of Langlands very interesting.

Mark C. Wilson

MATHEMATICAL MISEPONYMY

Euler's polyhedron formula

I guess pretty well everyone reading this will be familiar with Euler's polyhedron formula:

$$v - e + f = 2,$$

where v, e and f denote respectively the number of vertices, edges and faces of a convex polyhedron. The faces can be any polygon, from a triangle on up: cutting a small piece off near a vertex of a cube by a planar cut, for example, yields a polyhedron with $v = 10$, $e = 15$ and $f = 7$, with one face being a triangle, three quadrilaterals and three pentagons. The polyhedron need not be convex but should not have any holes through it: topologically the boundary must be homeomorphic to the sphere $\{(x,y,z) \,/\, x^2+y^2+z^2 = 1\}$. Similar formulae apply when the polyhedron does have holes. Indeed the topological type of the boundary of the polyhedron is determined by what is called the Euler characteristic, $v - e + f$, often denoted $\chi(P)$, where P is the boundary: the number of holes is $\dfrac{2-\chi(P)}{2}$. The Euler characteristic can be generalised to other topological spaces and there is a whole host of ways to define it in various contexts. For example, I remember a visitor to the Maths Dept at Auckland, maybe in the 1970s, presenting six different ways of calculating the Euler characteristic, and her list was by no means exhaustive.

Where did Euler's formula come from? There is a nice description in [1]. Two results from Euler are described there:

- In every solid bounded by planar faces the number of solid angles together with the number of faces is greater by two than the number of edges.
- In every solid bounded by planar faces the sum of all the plane angles, which make up the corners of the solid, is equal to four times as many right angles as there are solid angles, minus eight.

The first of these is the formula given above provided one thinks of a solid angle as being represented by a vertex and insists that the solid is convex. Euler noted that the second is equivalent to the first. Indeed, using the notation above, the second says that the sum of the plane angles is $\frac{\pi}{2}(4v-8) = \pi(2v-4)$. Since the sum of the angles of a polygon of n sides is $2n-4$ right angles, ie $\pi(n-2)$, the sum of the plane angles is obtained by adding such numbers face by face, so will be $\pi(2e-2f)$. Equating as in the second of Euler's results and cancelling gives Euler's first result.

Phillips in [1] notes that "Euler was extremely and justifiably proud of this work but mistaken when he states that it is surprising that no one before now has thought of these basic principles of solid geometry."

As Phillips explains, around 1620 Descartes had already formulated the second of Euler's versions. The trouble was that Descartes never published his *Elementary Treatise on Polyhedra* and it disappeared and reappeared from time to time until becoming better known about the middle of the nineteenth century, long after Euler died.

To be fair, not everyone calls it Euler's formula. For example in the Wolfram description, [2], it is noted that 'it is also known as the Descartes-Euler polyhedral formula.'

References

[1] Tony Phillips, *Descartes's Lost Theorem*, http://www.ams.org/publicoutreach/feature-column/fcarc-descartes1

[2] Eric W Weisstein, *Polyhedral Formula* From MathWorld–A Wolfram Web Resource. http://mathworld.wolfram.com/PolyhedralFormula.html

David Gauld

PROFILE

Jörg Frauendiener

Jörg Frauendiener has been Professor of Applied Mathematics and Chair of Applied Mathematics in the Department of Mathematics & Statistics at the University of Otago since 2007. His research focuses on mathematical physics, and he is particularly interested in general relativity and Einstein's equations, as well as numerics of partial differential equations, and topics in differential geometry like Riemann surfaces and air-water interfaces. Interestingly, all of this was probably caused by an unidentified little blue book from a German library...

In 1958, Jörg was born in the picturesque Swabian university town of Tübingen in south-west Germany. His secondary school in Tübingen was the Kepler-Gymnasium (often just called "Kepi"), named after the famous astronomer and mathematician Johannes Kepler. This may well have been an early sign that Jörg, like Kepler, would one day reach for the stars and try to understand the secrets of our universe. Indeed, it was in year 11 or 12 of secondary school that Jörg, a regular visitor to the local library, discovered the above-mentioned blue book in the rear shelves of the library. This book about Einstein and relativity impressed him and laid the foundation for his interest in the geometry of space and time, which eventually inspired him to study physics. Unfortunately, Jörg's later attempts to identify and recover this book were futile.

From 1976–1987, Jörg studied at the Eberhard Karls University of Tübingen and completed his Diploma and PhD in Theoretical Physics. Once he told us the story of the time when he struggled with his PhD topic and was stuck with a problem he just couldn't figure out (certainly something that happens to all of us once in a while). The answer finally came to him while he was jogging through Tübingen: he showed that there simply was no solution to the fundamental question in his PhD project. Given this life changing moment and the new insights obtained from this, the title of his PhD was eventually changed, and the article *Nonexistence of stationary axisymmetric dust solutions of Einsteins field equations on spatially compact manifolds* was published in Phys. Letters A.

Afterwards, Jörg had several fixed-term positions, in Pittsburgh, Munich, Oxford, and Potsdam. In Oxford it was none other than the famous Roger Penrose that he had the pleasure to work with, as a postdoc in his group.

In 1997 Jörg returned to Tübingen for his Habilitation (the qualification to conduct university teaching in many European countries). Later, in 2001, he took up the position as a University Lecturer in Tübingen. Jörg particularly likes to remember the enthusiasm of the people in the research group of the late Hans Ruder and, in particular, Ruder himself. This was also the time of a "renaissance of general relativity" in Germany, shortly after the Max Planck Institute for Gravitational Physics was founded and a special research programme on gravitational wave astronomy was established. The latter combined the research efforts at several universities including the one in Tübingen.

Eventually, in 2007, he successfully applied for a position at the University of Otago. (Once he admitted to us that at that time he had never heard of Otago and this University before). When Jörg, together with his wife and daughter, arrived in New Zealand, he immediately started building up a research group. In particular, he was able to get us (Florian Beyer and Jörg Hennig) to Otago as permanent lecturers. Over the years, a number of people have been part of the group and then left to pursue their careers elsewhere, including the postdocs Ben Whale (now lecturer at the University of Wollongong) and Robert Thompson. Joerg has strongly influenced all of us in this group and beyond, and he helped us to become better researchers and teachers. With his knowledge, interests, skills, enthusiasm and his always friendly personality, he has always been a role model for us.

Jörg is well-known in the field of mathematical and numerical relativity and beyond for many important contributions, in particular for his pioneering numerical work on a conformal representation of Einstein's equations where spacetimes of infinite extent are represented on finite computer grids in a mathematically well-defined manner. This is crucial for the unambiguous and accurate modelling of gravitational waves. His first publication covering this topic is from 1998. This subject has never let him go ever since and has become an even bigger focus for him in recent years since the observational discovery of gravitational waves in 2015 — one hundred years after these tiny ripples in the fabric of space and time were predicted by Albert Einstein himself.

Jörg has extraordinary broad perspective, knowledge and interests, which becomes evident from the research covered in his over 100 research articles, book chapters and conference proceedings. This is one of the reasons why it is particularly enjoyable to work with him: with his great experience, he is able to see and exploit connections between fundamentally different aspects of mathematics and physics. In 2013, Jörg was deservedly elected a Fellow of the Royal Society of New Zealand.

While Jörg tries to deceive us with his youthful appearance, we have indeed celebrated his 60th birthday last year with an international Birthday Colloquium. Renowned speakers from New Zealand and overseas gathered to celebrate this anniversary and his internationally recognised contributions to Einstein's theory of gravitation.

When we asked Jörg what he particularly enjoys in his work at the University of Otago, he immediately responded that it is the intense contact with students. As a consequence, students can feel that he really cares for them and supports them in every possible way. This was recently acknowledged with a *Supervisor of the Year Award* from OUSA, Otago's student association.

Occasionally, Jörg is neither working on problems from mathematics or physics nor teaching. Then he particularly enjoys reading (especially Scandinavian detective stories), and listening to music (everything from techno to Jazz and classical music).

Luckily, New Zealand professors (unlike those from Germany) are not forced to retire at a certain age. Hence we are sure that your colleagues and students can continue to enjoy fruitful collaboration, inspiring discussions and enthusiastic lectures for many more years to come!

Florian Beyer and Jörg Hennig

LOCAL NEWS

AUCKLAND UNIVERSITY OF TECHNOLOGY

SCHOOL OF ENGINEERING, COMPUTER AND MATHEMATICAL SCIENCES

Events

The 5th annual MYM C4SKA Colloquium was held in AUT on 10th July. This event focuses on the science and computing challenges presented by the Square Kilometre Array (SKA), globally one of the 21st century's biggest and most ambitious Astronomy projects. The project has recently completed the Pre-Construction Design Phase and is currently in the transition towards Construction. The NZA team participates in 2 work areas, namely the Central Signal Processors (CSP) and Science Data Processors (SDP). CSP solutions will be based on Field Programmable Gate Array (FPGA) technologies and SDP solutions will be based on Commercial Off-the-Shelf PC technologies. NZ is involved in hardware, software, and co-design. Open standards and open source are emphasised.

Dr Michael Lockyer, Dr Catherine Sweatman and several postgraduate students from AUT went to the University of Auckland to participate in the Maths in Industry NZ Study Group (MINZ) to work on 4 challenges proposed by the industry.

News

The International Mathematical Modelling Challenge is for high school students all over the world and for New Zealand entries is administered by Kerri Spooner from AUT. This is the fourth year New Zealand teams have competed, and the first time a New Zealand team has been awarded in the top five. The team from Manurewa High school; Aimee Lew, Aaron Lew, Ella Guiao and John Chen will travel to Hong Kong for the conference and presentation from the 23 July.

Kerri was interviewed on TV1 Seven Sharp, along with the team of students from Manurewa High School. The link of the interview is available here.

Travel and Conference Participation

Between 26 April and 13 May, Professor Jiling Cao visited China Jiliang University (CJLU) in Hangzhou, China, and Xi'an Jiaotong-Liverpool University in Suzhou, China. During his visit, Jiling gave some guest lectures on non-linear optimization for the first year postgraduate students at CJLU, and discussed with Prof Baolin Zhang (Dean of Science College at CJLU) about potential collaboration in Mathematical Sciences between AUT and CJLU. In addition, Jiling also presented a seminar talk on his research in Financial Mathematics at each of these universities.

Dr Sarah Marshall attended the 11th International Conference on Mathematical Methods in Reliability from 3rd - 7th June in Hong Kong. The conference was hosted by City University of Hong Kong. She presented a paper entitled "Geometric-Like Processes: An Overview and Some Applications".

Dr Wenjun Zhang presented the paper titled "Path-dependent leveraged exchange-traded fund option pricing" at the 3rd International Conference on Computational Finance , A Coruna, 8-12 July, 2019.

Dr Hyuck Chung will attend the 9th International Congress on Industrial and Applied Mathematics (ICIAM 2019), which will be held in Valencia, Spain, on 15th-19th July 2019. The Congress will take place at the "Campus de Blasco Ibáñez" of the Universitat de València. As in previous editions of this series of congresses, ICIAM 2019 will serve as a showcase for the most recent advances in industrial and applied mathematics, covering interdisciplinary topics relating mathematics and other disciplines and demonstrating the applicability of this discipline to science, engineering and industry. ICIAM 2019 is, again, a great opportunity for young researchers and graduate students to discover the vast potential of applied mathematics and get in touch with its most recent trends and topics.

Associate Professor Sergiy Klymchuk presents papers at two international conferences in July-August: on using provocative mathematics questions in teaching and assessment at the 71st Conference of the International Commission for the Study and Improvement of Mathematics Teaching in Portugal; and on integrating pen-enabled tablet PCs in teaching engineering mathematics at the 15th International Conference of The Mathematics Education for the Future Project in Ireland. While in Europe, he will also visit two members of the advisory committee – Professor Barbara Jaworski, UK and Professor Merrilyn Goos, Ireland – of the large New Zealand project "Investigating the Impact of Non-routine Problem Solving on Creativity, Engagement and Intuition of STEM Tertiary Students" that he has been leading along with Professor Emeritus Mike Thomas from the University of Auckland.

Seminars

Professor John Hearne, School of Science, RMIT University, "Modelling to mitigate wildfire hazard".

Wenjun Zhang

UNIVERSITY OF AUCKLAND

DEPARTMENT OF ENGINEERING SCIENCE

Events

Mathematics-in-Industry for NZ

Andreas Kempa-Liehr and Richard Clarke from the Department of Engineering Science organised this year's Mathematics-In-Industry NZ (MINZ) workshop, which saw over 100 researchers from across NZ and overseas work on four industry challenges over the course of a week in late June. This was the fifth year the event took place, and the first time it was held at the University of Auckland.

This year's challenges were brought by four of New Zealand's leading companies: Fonterra, Sanford, Transpower and Mercury. The problems presented ranged from better design of mussel farm buoys to the analysis of energy consumption data. The workshop also enjoyed two invited talks from Dr Stefan Schliebs of Quantiful, and Prof. Rosalind Archer from the Department of Engineering Science, University of Auckland.

It was evident by the end of the week that impressive progress had been made on all four challenges, and we look forward to reading the equation-free summaries which will be available later in the year on the MINZ website. The organisers would like to express their gratitude to Kiwinet for their continued support of the event, in particular Seumas McCroskery, as well as the Faculty of Engineering's Communications and Marketing team for their invaluable help with the event logistics.

NZ Uncertainty Quantification and Inverse Problems Workshop

At the start of July, our department hosted the inaugural New Zealand Workshop on Uncertainty Quantification and Inverse Problems (NZUQIP). This was organized by Ruanui Nicholson, Oliver Maclaren and Mike O'Sullivan (Snr.), all from the Department of Engineering Science. The workshop was well attended by both local and international researchers at all levels, including several leaders in the field. Dr. Tiangang Cui of Monash University, Australia and Prof. Karen Willcox of the University of Texas at Austin, U.S.A., gave invited talks.

Topics covered during the workshop included Kalman filtering, Bayesian inference, Markov chain Monte Carlo methods, machine learning and model reduction techniques, while applications varied from the calibration of geothermal reservoir models to combustion in rocket engines.

Postgraduate Research Showcase

Engineering Science hosted an event in July to showcase postgraduate research carried out in our department. This was organised by Michael Gravatt, a current Ph.D student in the department and Golbon Zakeri, an associate professor in the department. The centrepiece of the event was a presentation competition for postgraduates.

Second-year Engineering Science Ph.D student Alberto Ardid won the first prize, worth $300, and first-year Engineering Science Ph.D student Nico Reichenbach won second prize, worth $200.

Alberto's Ph.D research is focused on the uncertain estimation of clay cap boundaries and isotherms for geothermal fields, with application to the Wairākei Geothermal Field (Taupo, New Zealand). The methodology being developed is based on stochastic inversion of Magnetotelluric data (MT) constrained by methylene blue data (MeB), and involves joint modelling of temperature, electrical resistivity and lithology. Details of Alberto's prize-winning presentation are below.

Title: Uncertain Estimation of Clay Cap Boundaries and Isotherms by MT data, Temperature and MeB logs in wells: Applications to Wairakei Geothermal Field.

Authors: Alberto Ardid[1], David Dempsey[1], Rosalind Archer[1], Ted Bertrand[2] and Fabian Sepulveda[3]

1. University of Auckland, New Zealand
2. GNS Science, New Zealand
3. Contact Energy ltd., New Zealand

Nico's presentation was on deployable space structures, and based on research carried out for his Master's thesis. Nico is continuing this work as part of his Ph.D in Engineering Science at the University of Auckland focusing on developing deployable and inflatable structures for Cube Satellites with the intention that these will be used as deorbiting devices or antennas. This is motivated by the increasing amount of space debris threatening spaceflight. Nico's Ph.D work is supervised by Dr. John Cater (Department of Engineering Science, University of Auckland), Dr. Nicholas Rattenbury (Department of Physics, University of Auckland), in collaboration with Dr. Thomas Sinn (CEO of Deployables Cubed in Munich, Germany). Details of Nico's prize-winning presentation are below.

Title: Deployable Space Structures.

Authors: Nico Reichenbach[1,3,4,5], Thomas Sinn[1,2], Martin Schimmerohn[3], Martin Langer[4], Nicholas Rattenbury[5], John Cater[5].

1. HPS High Performance Space Structure Systems GmbH, Germany
2. Deployables Cubed GbR, Munich, Germany.
3. Fraunhofer Institute for High-Speed Dynamics, Ernst-Mach-Institut, EMI, Germany
4. Technical University of Munich, Germany
5. University of Auckland, New Zealand

Staff Updates/Awards

Caroline Jagtenberg, a senior research fellow in the Department of Engineering Science working on logistics and optimisation, led a team of six people to third place in the 2019 VeRoLog Solver Challenge. This international vehicle routing competition required solving a challenging routing optimisation problem, which involved both distribution and subsequent installation of equipment.

The prize included a giant novelty cheque for €250 and a trophy, and was presented during the VeRoLog conference in Seville, Spain in June, 2019. At least some of the money was spent on cake.

All team members were based in the Department of Engineering Science, and consisted of two undergraduate students, Michael Sundvick and Kevin Shen, as well as Caroline and three other staff members: Oliver Maclaren, Andrew Mason and Andrea Raith. Michael and Kevin performed this work as part of their summer studentships in the department, and are currently undertaking their third year of study in the Engineering Science programme.

Department Seminars

The following seminars were hosted in the department over the last few months:

- How to integrate electric vehicles synergistically into the energy system - Dr. Patrick Jochem, Karlsruhe Institute of Technology (KIT).
- Opportunities, Issues, and Challenges in Big Data Analytics: India-New Zealand Perspective - Dr Rahul Katarya, Delhi University of Technology.
- A Refined Methodology for Quantifying Estimates of Extractable Geothermal Energy - Anthony E. Ciriaco, Ph.D Candidate, Engineering Science.
- Reservoir simulation and risk assessment on CO2 geological storage: A case study in Taiwan - Dr Bieng-Zih Hsieh, National Cheng Kung University, Taiwan.

Upcoming workshop: 6th International Workshop on Planning of Emergency Services (February 17 - 19, 2020)

The aim of this workshop is to bring together practitioners and scientists from different research areas related to the planning of emergency services. This covers a range of topics from ambulance logistics to emergency department management. We invite you to join the workshop to present your work and/or stimulate discussions around interdisciplinary approaches.

The workshop will be held at the University of Auckland, with keynote talks given by Prof. Shane Henderson, Cornell University (USA) and Prof. Peter Taylor, University of Melbourne (Australia).

Important dates:

- The deadline for abstract submission (approx. 500 words) is December 1st, 2019.
- The registration deadline is January 15th, 2020.

For both abstract submission and registration information, please send an email to c.jagtenberg@auckland.ac.nz or melanie.reuter@kit.edu.

Oliver MacLaren

DEPARTMENT OF MATHEMATICS

New arrivals

John Mitry (formerly teaching at Macquarie University International College, and with a PhD in Mathematical Biology from 2016 from the University of Sydney) has joined the department as a Professional Teaching Fellow.

Stefan Ruschel is a post-doctoral research fellow working with Bernd Krauskopf and Neil Broderick (Physics) funded by the Dodd-Walls Centre. He comes to us from the Technical University of Berlin.

Other news

Sina Greenwood has taken up the Associate Dean (Pacific) role in the Faculty of Science. She joins our other influential department members Vivien Kirk, Associate Dean (Doctoral), and Julia Novak, Associate Dean (Teaching and Learning).

Tristan Pang graduated with his BSc in Mathematics and Physics at the age of 17.

Major awards

Distinguished Professor Sir Vaughan Jones was awarded the International Cooperation Award of the International Congress of Chinese Mathematicians (ICCM). The award is for “his significant contributions in nurturing and mentoring a number of outstanding Chinese mathematicians, and his strong support of the

Chinese mathematical community throughout his career."

Rachel Passmore has been awarded the Goldstone Travelling Award to investigate challenges around Capstone courses internationally. The award is for up to $5000 and four weeks of approved leave.

Distinguished Professor Marston Conder was awarded a Research Excellence Medal from the University of Auckland.

Marston Conder (third from left), photo credit Tanya Evans

Our PhD student Andrus Giraldo was one of the seven winners of the famous Red Sock Award for best poster at the biennial SIAM Conference on Applied Dynamical Systems, held with over 1000 participants in Snowbird, Utah. The award consists of a pair of red socks and a cash prize, handed over in person by Prof James A Yorke (University of Maryland, famous for his paper "Period three implies Chaos"), who wears only red socks himself.

Red Sock Awardees (Andrus Giraldo far left), photo credit: Andrew Bernoff

Other news

Phil Kane organised the Auckland Maths Olympiad, held at the University on Saturday May 11. It was a great success with about 150 students from 21 schools. Arkadii Slinko and Chris Wong prepared the questions.

Professor Keith Devlin from Stanford University visited the Department from March 18 to April 6, supported by the Seelye Foundation. He gave a public lecture titled "What do mathematicians do now that machines can 'do (all) the maths'?" and several seminars.

Rod Gover was an invited speaker at the 2019 Abel Symposium on Geometry, Lie Theory and Applications, in Norway.

From 1 December, Rafal Bogacz will be visiting Hinke Osinga and the Applied Mathematics Unit for nine months. His area of expertise is computational neuroscience and his research concerns models of brain decision networks in both health and (Parkinson's) disease. He wants to learn more about dynamical systems theory with the aim of developing "closed-loop" brain stimulation devices that could help patients with neurological disorders.

Hinke is giving an invited presentation at the SciCADE 2019 Conference; this International Conference on Scientific Computation and Differential Equations, will be hosted by the University of Innsbruck, Austria, 22-26 July. She is also an invited speaker at Dynamics, Equations and Applications 2019 held at the AGH University of Science and Technology to celebrate its 100th founding anniversary, 16-20 September. This is a very large meeting and 5 of the 6 first tier plenary speakers are Field Medallists. Hinke is in the second tier of invited speakers.

Jeroen Schillewaert has been successful (in a joint bid with Alice Devillers (UWA), Anne Thomas (Sydney) and James Parkinson (Sydney)) to organise a Matrix workshop '"Groups and geometries" in November-December 2020. Jeroen is also an invited speaker at the 9th Summer School on Discrete Mathematics in Rogla, Slovenia; has been invited to a meeting on Groups and geometry in Banff in August; and has hosted a visit by Anne Thomas (Sydney).

Tom ter Elst was an invited speaker at the conference Parabolic evolution equations, harmonic analysis and spectral theory in Bad Herrenalb in Germany (May 2019). He also hosted visitors Prof. Wolfgang Arendt (Ulm, Germany) from 8 December 2018 till 18 January 2019, and Dr Bernhard Haak (Bordeaux) from 28 March 2019 till 4 April 2019.

Steven Galbraith

DEPARTMENT OF STATISTICS

Autumn graduation day: for the Faculty of Science saw around 100 students from Statistics in the ceremonies, including two PhDs (Niffe Hermansson and Victor Miranda-Soberanis) and 15 Masters students.

Kids count: CensusAtSchool / TautarangaKiTeKura is back! The biennial statistical literacy project, run by the Department of Statistics on behalf of the Ministry of Education and Statistics New Zealand, launched on Monday March 4. We'll hear loud and clear the voices of Kiwi kids on issues as wide-ranging as climate change, the amount of time they spend on digital

devices, and how they handle interpersonal issues. Details.

Boosting rangatahi wellbeing: Department of Statistics lecturer Andrew Sporle is one of three people leading ambitious research that aims to boost the health and wellbeing of rangatahi Māori – young Māori. Details

Preserving species: James Russell is part of an international collaboration of scientists, researchers and conservationists that has drawn up a list of 107 islands that could help stem extinctions - and NZ has five islands on the list. "We already know islands are a vital conservation opportunity but this study gives us the bigger picture; a list of locations where the most progress could be made," says James. Details

Study-buddy success: Susan Wingfield (Ngāti Porou, Ngāti Maniapoto) is in charge of a programme in Statistics that turbo-charges Māori and Pacific students. Since 2004, the Professional Teaching Fellow has been the department's coordinator of Tuākana, a type of buddy system where, she says, "Māori and Pacific students come together, to study together, learn together, achieve together, succeed together and celebrate together. Not just in statistics, but also in other subject areas too". Details

Return of the Ihaka Lecture Series: Whether labelled as machine learning, predictive algorithms, statistical learning or artificial intelligence, the ability of computers to make real-world decisions is rising every year. The 2019 Ihaka Lecture Series, from March 13-April 3, brought together four experts at the interface of statistics and computer science to discuss how computers do it, and how much we should let them.

- Bernhard Pfahringer spoke about the design and development of Weka and more recent projects.
- Thomas Lumley spoke about how deep convolutional nets are structured and gave some intuition for how they can be effective, but also why they are brittle and can fail in remarkably alien ways.
- Kristian Lum spoke about algorithmic fairness, and about ways in which policy, rather than data science, influence the development of these models and their choice over non-algorithmic approaches.
- Robert Tibshirani spoke about modern sparse supervised learning approaches that extend the lasso.

Some successes to share:

- Associate Professor Rachel Fewster has won the New Zealand Statistical Association's Campbell Award, which recognises her sustained contribution to the promotion and development of statistics.

Bernhard Pfahringer (left) and Thomas Lumley

Kristian Lum (left) and Robert Tibshirani

- Dr Claudia Rivera-Rodriguez has won the Worsley Award, also from the NZSA. The award recognises outstanding recent published research from a New Zealand statistician in the early stages of his or her career.
- Dr Beatrix Jones has been elected to join the Board of the International Society of Bayesian Analysis. This is in recognition of Beatrix's international standing within this community and the hard work she puts into this society.

With thanks to Atakohu Middleton for allowing me to extensively plagiarise the last 3 department newsletters she wrote during 2018!

Emma Wilson

MASSEY UNIVERSITY

INSTITUTE OF FUNDAMENTAL SCIENCES

It has been a fairly quiet year for the mathematics group at Massey University Palmerston North with a major focus for our group being the development of new and updated courses for next year's refreshed B.Sc. offering. Preparations are also well underway for the colloquium in December, we look forward to seeing many NZMS newsletter readers there!

Robert McLachlan will visit the Isaac Newton Institute, Cambridge, in July and August as a Simons Fel-

low. He is a participant in the programme in Geometry, compatibility and structure preservation in computational differential equations. This programme aims to foster interactions between research in geometric numerical integration and in the discrete exterior calculus used in geometric PDE. Like Vincent Lafforgue, he is also concerned about the global ecological crisis. You can see some of his work in this area at blog.planetaryecology.org.

PhD student Christian Offen has been selected as one of 200 emerging researchers worldwide to attend the Heidelberg Laureate Forum in September. This forum allows young people to meet Fields Medallists and Abel, Nevanlinna, and Turing prizewinners. High quality videos of lectures from previous years are available at the Forum's website and are well worth a look.

David Simpson was a visitor for three weeks at The University of Manchester to work with Paul Glendinning. David also attended two conferences in the same period of travel: the Fourth International Conference on Recent Advances in Nonlinear Mechanics, in Lodz, Poland, and the SIAM Conference on Applications of Dynamical Systems, in Snowbird, Utah.

Richard Brown

SCHOOL OF NATURAL AND COMPUTATIONAL SCIENCES

In the third week of June, *Graeme Wake* attended and presented at, by invitation, the symposium in Applications of Nonlinear Diffusion Equations (ANDE) in La Trobe University, Melbourne. There were only two NZers invited (the other was Professor *Mark McGuinness* of VUW) along with 50 others from around the world. His talk was entitled "Beating the big C" using the joint work with PhD grad (Ali Zaidi) and Massey colleague (*Bruce van-Brunt*). The occasion was held in honour of the "retirement" of Professor Emeritus Phil Broadbridge, who is a leading figure in this area.

Mick Roberts visited the UK in April. He gave invited seminars at Imperial College in London and Warwick University in Coventry. He then spent two weeks at Utrecht University working with Hans Heesterbeek, the AI on his Marsden grant.

Carlo Laing visited the Technical University of Berlin and Potsdam University in late April, giving a seminar at the latter. He then went on to be a lecturer at the school and workshop on Patterns of Synchrony: Chimera States and Beyond, held at the Abdus Salam International Centre for Theoretical Physics near Trieste, Italy.

Carlo Laing

VICTORIA UNIVERSITY OF WELLINGTON

SCHOOL OF MATHEMATICS AND STATISTICS

Stephen Marsland and partner Monika spent two weeks over Easter helping out with the Kakapo Recovery Program on Whenua Hou (Codfish Island, off Stewart Island) during the biggest breeding season ever recorded for the birds. They were lucky enough to spend time weighing and measuring chicks in the nests, hand-rearing some, and helping to catch and monitor some of the adults.

The School hosted the annual Maths Challenge sponsored by Wellington Mathematics Association on April 15. We invited teams of college-aged students to compete and participate in our free fun-filled day on campus. It was a brilliant day and would not have been possible without the help of staff and students alike. This was our largest Maths Challenge yet with 177 registered attendees and 12 schools in attendance on the day.

On Sunday May 26, Richard Arnold, Michal Salter-Duke, Lingyan Han and Grace Jacobs Corban travelled to Martinborough to volunteer at the Martinborough Maths Craft Day. MathsCraft events are dedicated to engaging the public with maths by exploring the mathematics of various crafts such as knitting, crochet, knots and origami. Activities for this event included flexagons, mobius strips, fractal menger sponges and origami polyhedra. Staff and students thought we could use several of the activities they learned about at our Open Day.

Geoff Whittle and Dillon Mayhew organised a conference in Baton Rouge from July 10-12 to celebrate the 65th birthday of James Oxley, who is a frequent visitor to the School. James Oxley has made many contributions to matroid theory over his lifetime and this conference highlighted and celebrated his work.

Peter Donelan has started a period of Research and Study Leave, initially attending the World Congress of the International Federation for the Theory of Machines and Mechanisms (IFToMM) in Krakow, Poland. His PhD student, Hamed Amirinezhad, presented a paper on joint work, "Input and Output Singularities for Parallel Mechanisms". Peter is then visiting Andreas Müller at the Institut für Robotik, Johannes Kepler Universität, Linz, Austria where he is a guest lecturer at the IEEE Summer School Singularities of Mechanisms and Robotic Manipulators, and Marco Carricato at the Department of Industrial Engineering, Universita di Bologna in Italy.

Emma Greenbank will start a 2-year Senior Tutor position in early September. Emma is currently finalising her PhD thesis under the supervision of Mark McGuinness. Emma has been a student at Victoria since 2010,

first as an undergraduate and then moving onto a Masters and the PhD. She has already worked for the School in various roles such as tutoring, outreach and conference organisation.

Astrid an Huef

UNIVERSITY OF CANTERBURY

SCHOOL OF MATHEMATICS AND STATISTICS

Rosie Cameron

A number of congratulations are in order for major achievements of staff in the School.

Mike Steel has been awarded an International Leader Fellowship (funded by MBIE via the Royal Society of NZ) to support his work with Daniel Huson from the University of Tübingen, Germany, in a project titled Algorithms and Software to Transform Genomes into Biological Knowledge.

Thomas Li has been awarded a KiwiNet Emerging Innovator award. The KiwiNet's Emerging Innovator Programme provides targeted support to early stage career scientists, "fast tracking them to become the future innovators of New Zealand". It enables scientists to build industry connections. The award includes project funding as well as a programme of mentoring, professional development and publicity.

Marco Reale is one of the five authors of a paper selected to receive the 2019 AgResearch Science Prize. This is AgResearch's premier recognition of outstanding achievement in research quality and comes with a substantive monetary prize to support future science endeavours. The Science Prize is for a foremost science publication from AgResearch authors within the last five years. The selected paper is "Intensified agriculture favors evolved resistance to biological control" by Federico Tomasetto (AgResearch, Christchurch), Jason M. Tylianakis (School of Biological Sciences, UC, and Imperial College London), Marco Reale, Steve Wratten (Lincoln University), and Stephen L. Goldson (AgResearch and Lincoln University) and appeared in Proceedings of the National Academy of Sciences of the United States of America, April 11, 2017, 114 (15) 3885-3890.

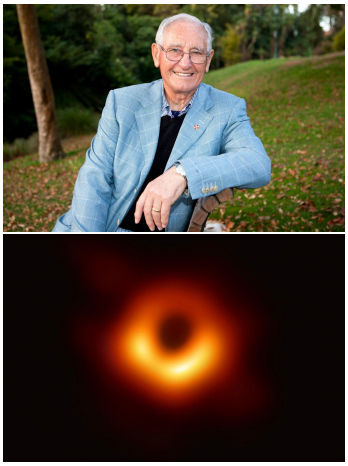
Paul Brouwers finished the Christchurch marathon on 2 June in freezing rain and wind in an impressive time of 3:03. Well done!

At the beginning of May the School welcomed **Rosie Cameron** as continuing teaching lecturer. Rosie completed her PhD in 2017 at Monash University with a research focus on graph theory and combinatorial design theory. Previously she held a post-doc at Memorial University of Newfoundland. One of her current projects in the School is co-writing a numeracy course to help weaker mathematics students transition to the new Product Design programme.

At the end of April the School bode farewell to **Hannes Diener** whose 5-year contract sadly came to an end. Hannes is still involved in the supervision of his PhD student, who is in the final stages of submitting his thesis, and will remain associated with the School as an Adjunct Fellow.

Congratulations to former staff member and Head of Department **Roy Kerr** on his election to become a Fellow of the Royal Society (UK), for his exceptional contributions to science, placing him among the world's most eminent scientists. New Fellows are formally admitted to the Society at the Admissions Day ceremony in July, when they sign the Charter Book and the Obligation of the Fellows of the Royal Society.

Roy, who retired in 1993, had been in the news in April after astronomers captured the first image of a black hole, proving correct Roy's 56-year-old exact solution of Albert Einstein's equations that describe rotating black holes. The picture shows a halo of dust and gas, tracing the outline of a colossal black hole, at the heart of the Messier 87 galaxy, 55-million light-years from Earth. In the wake of this discovery Roy also appeared on national TV.



Roy Kerr and the image of a black hole

Günter Steinke

UNIVERSITY OF OTAGO

DEPARTMENT OF MATHEMATICS AND STATISTICS

We welcomed **Darryl MacKenzie** as a new part-time Associate Professor in Statistics. Darryl completed his PhD in 2002 on methods to assess the fit of mark-recapture models. At the same time, he also worked at the Patuxent Wildlife Research Center (Maryland, USA). Since then, Darryl has run his own consulting company Proteus, which specialises in the development and application of statistical methods to ecological problems. Darryl's main research interests are in the realm of population estimation.

Welcome to Darryl MacKenzie

Congratulations to **Katrina Sharples** for receiving funding of $450,000 as part of a research team at the Otago Global Health Institute. The project, which is funded by the e-Asia Joint Research Programme and the Health Research Council of New Zealand, aims to help improve the management of tuberculosis in Indonesia, and, in particular, to increase the number of cases of tuberculosis being publicly notified.

Warmest congratulations to **Ting Wang** and her husband Marco on the birth of their baby girl Efra Yanxi. We are very happy for you and wish you all the best in this exciting new stage of your lives. Welcome to parenthood, where going to the grocery store by yourself is now considered a vacation!

The department welcomed **Lisa Avery** back to Dunedin as a fixed term lecturer. Lisa has a Masters in Statistics from Otago and is currently a PhD candidate at York University, Canada. Lisa's research is concerned with regression methods in respondent driven sampling data, a surveying strategy that aims to sample from otherwise hard to reach populations. A warm welcome to you, Lisa!

Jörg Hennig

Ting and Marco with their baby girl

Welcome to Lisa Avery

PhD SUCCESS

John Griffith Moala (University of Auckland)

Title: Exploring mechanisms by which student-invented algorithms in mathematics emerge

Supervisors: Caroline Yoon and Igor Kontorovich

Abstract:

Discrete mathematics is ever-growing in prominence due to its significance in computer science and the many real-world applications of its sub-branches. Central to discrete mathematics is the algorithmatizing approach, which entails finding a solution for a given problem, and more importantly creating (explicitly articulating) an algorithm that would (when implemented) find a solution for the given problem. The growing prominence of discrete mathematics coupled with the significance of algorithms in discrete mathematics, have led many to argue that enhancing students' competence in algorithmatizing will benefit students' mathematics learning as a whole.

Towards developing students' competence in the algorithmatizing approach, the overarching aim of this thesis is to explore some mechanisms by which students create algorithms (algorithmatizing mechanisms), and explicate how these mechanisms might contribute to some problematic aspects of students' experiences with the algorithmatizing approach. The core of this thesis comprises three exploratory case studies each of which focuses on different (but interrelated) problematic aspects of students' engagement with the algorithmatizing approach. I conduct fine-grained analyses of secondary students' and post-secondary students' (either working in groups or individually) activity on discrete mathematics tasks which invite them to create their own algorithms.

Findings from this research revolve around five different algorithmatizing mechanisms. In Study 1, I introduce and explicate the mechanisms of patching and localized considerations which help explain why a faulty feature of an initial algorithm persists through multiple testing-and-revising iterations. In Study 2, I explore the mechanism of accounting for features of the solution (to the given problem) which helps explain why some students can find the correct solution(s) to the given problem(s), but then create an algorithm that cannot (when implemented) actually re-find the correct solution(s) they found. In Study 3, I explore the mechanisms of narrowing the domain of validity (while fixing the set of instructions) and revising the set of instructions (while fixing the domain of validity) which help explain why mathematically equivalent counterexamples do not always facilitate a transition from an incorrect algorithm to a correct (generalized) algorithm. Suggestions for future research on students' algorithmatizing activity, and enhancing students' algorithmatizing competencies are discussed.

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Iresha Gayani Ratnayake (University of Auckland)

Title: Teaching Algebra with Digital Technology: Factors Influencing Secondary Mathematics Teachers' Task Development and Implementation

Supervisors: Mike Thomas, Barbara Kensington-Miller and Greg Oates

Abstract:

Research suggests using digital technology (DT) has the potential to support students' mathematical understanding and that rich tasks enhance the effectiveness of using such technology in the classroom. Tasks, carefully designed by educators, inevitably need adapting during teacher implementation. Thus, this research considered it important to support teachers in designing rich DT tasks themselves for their students. To do this, the benefits of collaborative work in small teacher communities in the same school or educational zone were investigated. This study sought to identify what teacher factors influence secondary mathematics teachers in designing and implementing DT tasks, and how. Design-based research methodology was adopted within a sociocultural constructivist paradigm to identify these teacher factors. Further, a professional development (PD) programme was designed and conducted to investigate its supportive benefits for teachers. Four groups of three teachers collaboratively designed a preliminary task before participating in the PD researcher intervention. Then, the groups modified and implemented their tasks and then participated in an interview. Data was collected using a questionnaire comprising open and closed questions and Likert- style attitude scales, semi-structured interviews, task development video- and audio-recordings, and observations. Both tasks were analysed using the Task Richness Framework developed for the research. The observations and data recordings were translated into English and transcribed before being coded. The theories of Mathematical Knowledge for Teaching, instrumental genesis (IG), resources, orientations and goals, group dynamics, and the FOCUS framework were used to develop codes for the qualitative data. The findings suggest that the task richness after the PD intervention had significantly increased for all groups. Further, the PD

programme's supportive nature improved teacher attitudes towards using technology in teaching and encouraged confidence in developing tasks. Teachers having higher IG, positive attitudes and confidence are more likely to design quality tasks. Among the four groups, members of groups homogeneous in age and experience showed more willingness to share ideas, with greater flexibility in approaching DT. The evidence suggested higher success of PD programmes with communities of inquiry where age and experience are homogenous. The study showed that conducting similar DT PD programmes may be effective in supporting teacher producing better tasks.

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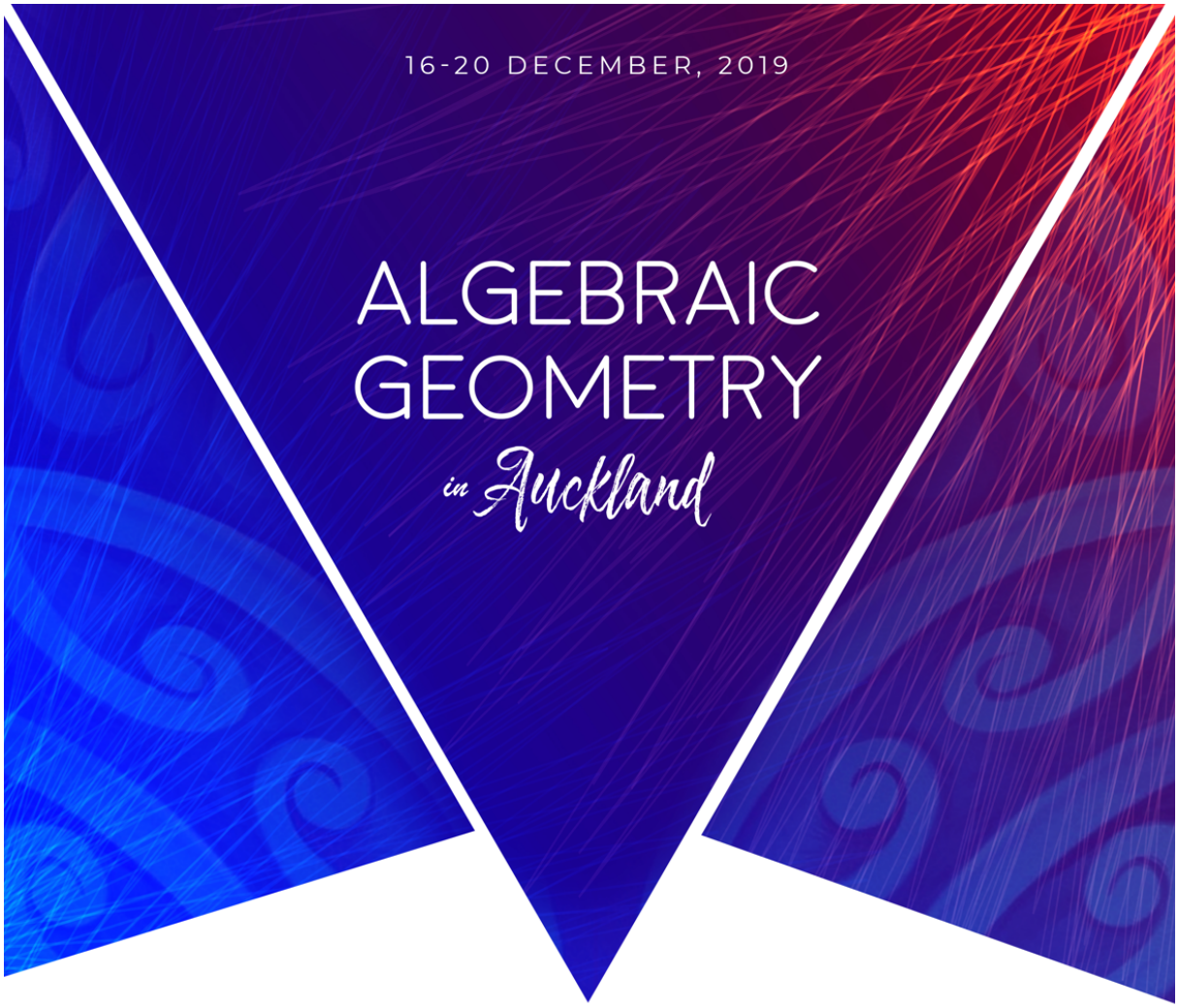
GENERAL NOTICES



ORGANISERS

Ivan Cheltsov, Sione Ma'u, Frédéric Mangolte

SPEAKERS

Valery Alexeev, David Baraglia, Fedor Bogomolov, Ugo Bruzzo, Frederic Campana, Jungkai Chen, Sung Rak Choi, Will Donovan, Eric Edo, Kento Fujita, Andrei Gabrielov, Yoshinori Gongyo, Liana Heuberger, DongSeon Hwang, Jun-Muk Hwang, Ilia Itenberg, Michael Kemeny, Ludmil Katzarkov, Masayuki Kawakita, Yujiro Kawamata, JongHae Keum, Takashi Kishimoto, Igor Klep, Conan Leung, Alvaro Liendo, Ivan Loseu, Ernesto Lupercio, Grigory Mikhalkin, Takuzo Okada, Jihun Park, Justin Sawon, Behrouz Taji, Misha Verbitsky, Jaroslaw Wisniewski, Susanna Zimmermann, Francesco Zucconi, Robin Havea, Victor Przyjalkowski.

Location : The University of Auckland, New Zealand

NZMS NOTICES

Notice of Annual General Meeting

The Society's AGM will be held at 5pm, December 3rd 2019 during the New Zealand Mathematics Colloquium at Massey University in Palmerston North. Please send any potential agenda items to the NZMS Secretary by November 19, 2019 (rua.murray@canterbury.ac.nz).

Call for nominations for NZMS Council positions

Nominations are called for two Councillor positions on the New Zealand Mathematical Society Council. The term of office of a Council member is three years. Council members may hold office for two (but no more than two) consecutive terms. Please consider the current makeup of the Council and give particular thought to the nomination of candidates who will help maintain a diverse Council that represents the NZ mathematics community (e.g. mix of career stages, areas of mathematics, geographic locations, genders, types of institutes). Existing Council members, and their terms, can be found on the website.

Nominations should be put forward by two proposers. The nominee and the two proposers should be current Ordinary members (including Student members) or Honorary members of the New Zealand Mathematical Society. There is no nomination form. Nominations, including the nominee's consent, should be sent by email to the NZMS Secretary, no later than November 5 2019. The two proposers and the nominee should each send separate messages to the NZMS Secretary.

Applications for Financial Assistance (final deadline for 2019: November 15)

The NZ Mathematical Society has quarterly deadlines for financial assistance applications. Applications must be made well in advance (at least one month before the funded activity, but the earlier the better) and retrospective applications will not be considered. The deadlines for applications for 2019 are: February 15, May 15, August 15, and November 15. You will hear back from the Council within a month of the deadline. The types of grants are as follows.

NZMS Student Travel Grants (for travel commencing after December 15, 2019)

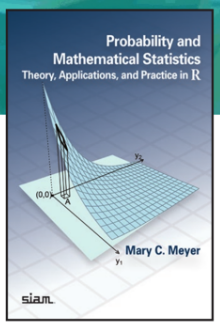
The NZMS invites applications from students for financial support for the presentation of research at conferences, attending workshops, and developing new collaborations. Typical grants for travel within NZ and Australia are in the range $200–$600. For travel further overseas, larger grants may be considered. To be eligible, a student must be based at an institution in New Zealand and be active within the New Zealand mathematical community. NZMS Student Travel Grants can contribute to costs including: flights, conference registration, accommodation, and travel-related costs associated with family responsibilities.

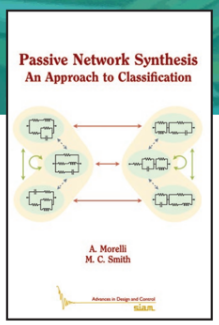
NZMS Student Travel Grants are generously supported by an annual grant from the Margaret and John Kalman Charitable Trust .

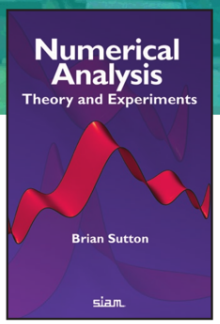
NZMS Financial Assistance

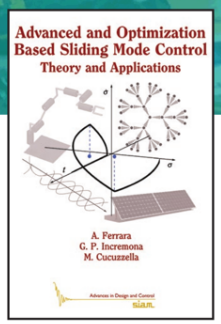
The NZMS invites applications for financial assistance with the costs of mathematical research-related activity. Any research-related activity will be considered. For example: hosting mathematical visitors; organising conferences, workshops, or outreach activities; and conference attendance, including costs associated with family responsibilities. Further information and application details can be found on the NZMS website.

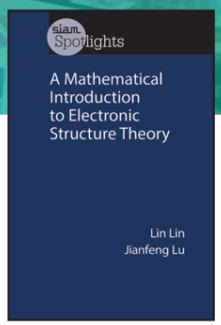
SIAM Books











Probability and Mathematical Statistics: Theory, Applications, and Practice in *R*

Mary C. Meyer

This book develops the theory of probability and mathematical statistics with the goal of analyzing real-world data. Throughout the text, the R package is used to compute probabilities, check analytically computed answers, simulate probability distributions, illustrate answers with appropriate graphics, and help students develop intuition surrounding probability and statistics. Examples, demonstrations, and exercises in the R programming language serve to reinforce ideas and facilitate understanding and confidence.

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Passive Network Synthesis: An Approach to Classification

A. Morelli and M. C. Smith

A resurgence of interest in network synthesis in the last decade, motivated in part by the introduction of the inerter, has led to the need for a better understanding of the most economical way to realize a given passive impedance. This monograph outlines the main contributions to the field of passive network synthesis and presents new research into the enumerative approach and the classification of networks of restricted complexity. It serves as both an ideal introduction to the topic and a definitive treatment of the Ladenheim catalogue.

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Numerical Analysis: Theory and Experiments

Brian Sutton

This textbook develops the fundamental skills of numerical analysis: designing numerical methods, implementing them in computer code, and analyzing their accuracy and efficiency. A number of mathematical problems—interpolation, integration, linear systems, zero finding, and differential equations—are considered, and some of the most important methods for their solution are demonstrated and analyzed. Notable features include the development of Chebyshev methods alongside more classical ones, a dual emphasis on theory and experimentation, the use of linear algebra to solve problems from analysis, and many examples and exercises.

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Advanced and Optimization Based Sliding Mode Control: Theory and Applications

A. Ferrara, G. P. Incremona, and M. Cucuzzella

A compendium of the authors' recently published results, this book discusses sliding mode control of uncertain nonlinear systems, with a particular emphasis on advanced and optimization based algorithms. The authors survey classical sliding mode control theory and introduce four new methods of advanced sliding mode control. They analyze classical theory and advanced algorithms, with numerical results complementing the theoretical treatment. Case studies examine applications of the algorithms to complex robotics and power grid problems.

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A Mathematical Introduction to Electronic Structure Theory

Lin Lin and Jianfeng Lu

Based on first principle quantum mechanics, electronic structure theory is widely used in physics, chemistry, materials science, and related fields and has recently received increasing research attention in applied and computational mathematics. This book provides a self-contained, mathematically oriented introduction to the subject and its associated algorithms and analysis. It will help applied mathematics students and researchers with minimal background in physics understand the basics of electronic structure theory and prepare them to conduct research in this area. The book is written for advanced undergraduate and beginning graduate students, specifically those with mathematical backgrounds but without a priori knowledge of quantum mechanics, and can be used for self-study by researchers, instructors, and other scientists.

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