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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 Marie Graff and Chris Stevens. 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 marie.graff@auckland.ac.nz and/or to chris.stevens@canterbury.ac.nz. LaTeX templates are available upon request from the editors.

The official address of the Society is:

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

However, correspondence should normally be sent to the Secretary:

New Zealand Mathematical Society
Assoc Prof Geertrui Van de Voorde (NZMS Secretary)
School of Mathematics and Statistics
University of Canterbury
Christchurch 8041
New Zealand
geertrui.vandevoorde@canterbury.ac.nz

NZMS Council and officers

Other positions of responsibility

Correspondents

Web Sites

NZMS homepage: nzmathsoc.org.nz (Webmaster: D.J.W.Simpson@massey.ac.nz)

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

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EDITORIAL

Kia ora koutou,

Welcome to the August edition of the newsletter.

As we inch closer to the highly anticipated joint meeting in December between the NZMS, AusMS, and AMS, it's clear that mathematicians on both sides of the Tasman are gearing up for a December to remember! This issue has something for everyone: an excellent piece by the ever-creative Mathscraft team that'll have you crafting solutions like a pro; a delightful profile on Kevin Broughan; and, a special nod to the many PhD students who have successfully defended their theses—proof that math isn't just surviving, but thriving. Plus, there's a nice selection of reports from recent events.

We're also on the hunt for some picture-perfect moments to feature in a special section of our December issue! Whether it's a snapshot of your departmental antics, research group in action, or anything that captures the spirit of mathematical discovery, we'd love to see it. So, dust off those cameras (or dive into your phone's gallery) and send us your best math-related photos from the last few years; We hope to get flooded with them!

Marie Graff and Chris Stevens

PRESIDENT'S COLUMN

In my April column I mentioned, in passing, the concept of a "decently bad talk". What exactly did I mean by that? These are the talks, all too common at maths conferences, which if you are already an expert in the area you can understand provided that you pay close attention. Non-experts are generally lost within the first few minutes. Decently bad talks are unmemorable. Even the experts would be hard pushed to recall anything much about them a day later (if you give an indecently bad talk, you will be remembered; for all the wrong reasons).

So, what should you do to upgrade from a decently bad talk to one that is actually good? Below I've summarised the advice I have previously given to UoA graduate students as part of our 2022 graduate student workshop series.

Define a clear aim for your talk

Before you even sit down to write slides (or notes for the board) spend some time thinking about what you wish to achieve from this talk. As a rule of thumb you should be able to state your aim in one sentence.

Some examples

- I've an exciting new theorem, let me tell you about it.
- Let me tell you about the history of XYZ theory.
- Technique Z is excellent, you should use it.
- Theories A and B intersect in interesting ways, let me tell you about it.

Everything that you put into your talk should go towards achieving this aim. If you are ever in doubt about whether to include a theorem/definition/example refer back to your aim.

Know your audience

Who you are speaking to matters a great deal. Here are some common audiences that you will encounter (in decreasing level of expert ability in your field).

- Your research group.
- People who research the same or very similar problems.
- Your subfield.
- Your subfield plus some related ones.
- Your field.
- A general mathematical audience.

If you are in any doubt about who your audience is, talk to the organisers. Think about the people in that audience. Ask yourself what you think a typical person in that group should know, then halve that. Aim your talk at that typical person. It's tempting to throw in extra technicality in an attempt to impress the experts (or in the hope that the non-experts will see this as evidence of your brilliance). Doing almost always backfires and makes a terrible impression on everyone.

Simplify all your statements

This is not the place to give the most precise and technical version of your theorems. Your talk should be an advertisement for your work. You want the audience to pick up the general idea and feel interested enough to go and look out the details in your paper. The only reason to include a complicated expression is if it is absolutely vital (and be really honest here) to understanding the theorem statement.

Have an underlying structure

Before you put in any details lay out what the top-level structure for your talks will be. One that I use regularly for research seminars where my aim is to present a new result of mine is.

1. A brief introduction of the general area and what types of problems are of interest.
2. What does a prototypical theorem statement look like.
3. What, in general terms, has already been done.
4. Introduce the object/theory that are absolutely necessary to state my theorem.
5. State my theorem.
6. Sketch the proof.
7. Conclusions and thoughts about where I might go next.

Sometimes 2,3,4 go in a different order, it depends on the result. Sometimes it is necessary to introduce a bit of theory and history before I can explain even a prototypical theorem.

Write your slides to support your talk

Your slides are not your talk. They should support what you plan to say, not replace it. Here are some general principles to keep in mind as you write them.

- Keep lots of white space on your slides. Don't shrink the standard fonts sizes to fit more in. The standard is set for a reason, it is visible.
- Wherever possible replace words/equations with pictures/diagrams.
- If in doubt about adding something to your slides refer back to your aim. If it doesn't support your aim, don't put it in.
- Practice with your slides. Then update them as necessary. Identify points where you can speed up/slow down if on the day you are running slow or fast.

Don't do these things

- Overcrowd in any way. This includes the slides (if you are using them) or the board. But it also includes intellectual overcrowding. There is only limited amount of information the audience can take it. Don't ask them to do too much.
- Go overtime. There is no excuse for this, if you have miscalculated and haven't finished everything you planned just give a brief conclusion and stop talking.
- Spend your whole talk looking at the board or at your slides. You need to make eye contact with your audience.
- Overuse colour highlights or other visual effects. Overusing colour leads to what I call "fruit salad slides" where each term has a different colour creating a slide that is just a blur of colour. Using highlights such as colour can be very effective but by overdoing it you dilute the effect.

Think hard before you do these things

- Start with a table of contents. A table of contents on a document allows a reader to access the work in a non-linear fashion, jumping to points that interest them. Talks are by nature linear so while you need a structure you don't need to spend time telling people what it is. I didn't put this in the "don't do" list because there are some circumstances where it can be effective. For instance, if the first half of your talk is theory and the second half applications telling the audience that upfront helps them know what to expect.
- Images of mathematicians. If you are talking about a theorem by Hilbert what value does a picture of Hilbert add? Refer to your aim, any image you put on your slides should advance that aim. An image of the person who proved the theorem doesn't advance your aim. There are exceptions, for example if the image is part of your description of the history of how a theory was developed it may advance the aim of your talk.

- Peek-a-boo slides. Where you show your slides one line at a time (even worse if the other lines are only greyed out). These make your presentation unnecessarily jolty and if you are running out of time it impedes moving quickly through slides. It can be used effectively to hide a punchline until you are ready for it. But only use this option with intent.

I'll finish with a reminded that the Joint Meeting of the NZMS with the AustMS and AMS is coming up this December. I hope to see you all there, giving excellent talks!

Melissa Tacy

And now the ChatGPT Thriller version

It was an ordinary conference, or so it seemed. Scholars from around the globe gathered in the dimly lit lecture halls, ready to engage in the age-old ritual of mathematical discourse. Yet, amidst the buzz of eager anticipation, there was a lurking threat that many had learned to fear but seldom named—a "decently bad talk."

You've seen them before: those innocuous presentations that seem harmless at first. But as the minutes tick by, something shifts. The experts lean in, squinting at the screen, trying to decipher the message. But the non-experts? They're lost, adrift in a sea of jargon, drowning in a flood of incomprehensible symbols. A fog descends, and by the end, even the sharpest minds can barely recall what was said. The talk fades into obscurity, its only legacy being the vague sense of unease it left behind.

But what if I told you there was a way out? A method to break free from the clutches of mediocrity and deliver a talk that not only survives the day but leaves an indelible mark on the minds of your listeners?

The Aim: The Power of a Single Sentence
Before you even think about the slides or the notes, pause. There's a single question that could determine the fate of your entire presentation: What is your aim? A decently bad talk wanders aimlessly, but a good one is laser-focused. Can you encapsulate your purpose in one sentence? Perhaps it's to unveil an exciting new theorem, or to shed light on the history of a theory. Whatever it is, let this aim be your guiding star.

The Audience: Know Them, or Risk Losing Them
Imagine walking into a room blindfolded, not knowing who's there. That's what delivering a talk without knowing your audience feels like. Your research group? They know your lingo. A general mathematical audience? Not so much. The decently bad talk makes the fatal mistake of assuming too much, speaking over the heads of many. To avoid this, imagine the average person in the room—what do they know? Then halve it. Speak to that level, and resist the urge to overwhelm with technicalities. Remember, trying to impress everyone often ends up impressing no one.

Simplification: The Art of Saying Less
There's a sinister allure to complexity. The decently bad talk falls into this trap, layering on detail after detail until even the simplest ideas are buried. But the true skill lies in simplification. Your talk should be an invitation, a teaser that leaves your audience hungry for more. Only introduce complex expressions if they are absolutely vital, and be ruthless in your judgment.

Structure: The Skeleton Beneath the Surface
Without structure, a talk is just a collection of thoughts scattered to the wind. The decently bad talk lacks this backbone, leaving the audience lost. But a well-structured talk? That's a different beast. Start by laying out the framework—a brief introduction, a prototypical theorem, what's been done before, and so on. This structure not only guides you but reassures your audience that they are in capable hands.

Slides: The Silent Partner
Your slides are not the star of the show—you are. The decently bad talk relies too heavily on overcrowded slides, filled to the brim with text and equations. But a good talk uses slides sparingly, with plenty of white space, images, and diagrams that support your narrative. Practice with them, adjust them, and ensure they complement your aim.

The Deadly Don'ts
There are some sins no talk should commit. Don't overcrowd—whether on the slides, the board, or in your ideas. Don't go overtime—know when to stop. And whatever you do, don't spend your whole talk staring at the board. Your audience needs to see your eyes; they need to feel the connection.

The Final Considerations: When to Break the Rules
Not all rules are absolute. Sometimes, starting with a table of contents or including images of mathematicians can work—if it serves your aim. But be cautious. The decently bad talk often errs on the side of unnecessary embellishments, diluting its message. Choose your battles wisely.

As the conference looms, the tension builds. The Joint Meeting of the NZMS with the AustMS and AMS is fast approaching. Will you succumb to the decently bad talk, or will you rise above, delivering a presentation that resonates long after the applause dies down?

The choice is yours.

EDUCATION

Make it count

The Government has highlighted the decline of mathematics in New Zealand schools in announcing "Make it count", its new action plan. The decline was documented in the Royal Society report *Pangarau Mathematics and Tauanga Statistics in Aotearoa New Zealand* (September 2021).

Four key issues were highlighted in that report:

- Slippage: too many students were falling behind.
- Teacher knowledge: too many teachers had insufficient background and confidence to teach mathematics well.
- lack of leadership: teachers were left to their own devices to create school mathematics curricula with insufficient support.
- inequity: there were significant gaps in achievement between students of different ethnic and socioeconomic backgrounds. The gap between top and and bottom students only widened as they progressed through school.

The Government's proposed measures are as follows:

- A new Years 0–8 maths curriculum will be introduced a year early, from Term 1 2025, with resources available to support teachers. Resources, including teacher and student workbooks will be provided into every primary and intermediate school.
- $20 million for professional development in structured maths for teachers. Teaching Council agreed to lift maths entry requirements for new teachers. Teaching Council agreed to strengthen maths component in Initial Teaching Education.
- Twice yearly assessments for maths in primary schools from the start of 2025. Small group interventions to support students who have fallen significantly behind.
- Ministry of Education will intervene earlier and more often to tackle student achievement issues. Education Review Office (ERO) to overhaul reporting with a new focus on student progress, achievement, and assessment.

The proposed measures, on paper, look like a step in the right direction because they address the issues in the Royal Society report. There are some major changes in the teaching and learning of mathematics that incorporate ideas from the Science of Learning, towards more explicit instruction and building fluency through practice.

Will this action plan lift mathematics achievement? Even the best mathematics curriculum can be let down by a hostile environment and poor implementation. It is important to get teachers and school communities on board. A critical factor is whether they will be given sufficient support to implement the changes.

Some concerns have been raised about the Government's action plan (see the links at the end).

One concern is that a one-size-fits-all curriculum doesn't work for everyone. Although every student is different, certain methods and approaches to teaching and learning mathematics will be more effective than others. Through trial and error, teachers get a feel for what works and what doesn't in their classroom. The content itself doesn't change: basic arithmetic and algebra are the same as they were 500 years ago.

There will be variations across different schools and communities, and teachers should be encouraged to adapt the action plan to incorporate their best practice and the needs of their local community.

Critics have pointed out that the research around Science of Learning based approaches in Mathematics (called 'structured maths' by the government) is limited and lacks evidence. But sufficient data to provide evidence for or against a policy can only be collected if the policy is actually being implemented on the ground. Mathematics Education data cannot be generated in a lab.

So lack of data is not a reason to not proceed, but it highlights the responsibility to systematically collect data and monitor the effectiveness of the policy. It would also be good to pilot aspects of 'structured maths' in a few

schools that give a representative sample, before rolling it out to the whole country. Going forward, it will be important to study how the changes affect the achievement of Māori, Pacific and other groups that are traditionally underrepresented in Mathematics.

Another concern is that the new curriculum will be too focused on repetition and drills, killing creativity and interest, and turning many children permanently away from mathematics. Actually, one day a week could be set aside for fun activities that complement the more serious learning, without replacing it.

Open-ended problem solving, creativity, puzzles, fun and games, etc. that engage and motivate students can be scheduled under any curriculum. An activity does not need to be strictly focused on mathematics, but might naturally combine with other things. Both mathematical and non-mathematical content (stories, art, music, etc.) can be drawn out over the course of an activity.

Mathematicians and Mathematics Education

Finally, there have been concerns that some members of the Mathematics Advisory Group have a background in Mathematics rather than Mathematics Education.

Professional mathematicians who venture into mathematics education and outreach gain an appreciation of the gap between the world of professional mathematics and the rest of the world. In a way the experience is similar to that of a native speaker of a language, used to interacting with other native speakers, encountering second language speakers that possess a wide range of fluency. This is also true for other specialised fields.

A native speaker is not necessarily a good teacher of the language. Nevertheless, second language learners can benefit a lot from immersion with native speakers who use the language on an everyday basis. Similarly, Mathematics Education can benefit from the fluency of professional mathematicians. (This is not to say that Mathematicians are bad teachers either—members of the NZ Mathematical Society have won Teaching Awards.)

Mathematicians are deeply familiar with the structure of mathematics and how advanced material builds on top of elementary material. While the structure is not fixed as the field continues to develop, there is a more or less standard pathway from basic numeracy in primary school through to algebra and calculus at university, covering core material that is sufficient for all but a minority of specialists.

Mathematicians can help to ensure that pedagogy at each level aligns with mathematical structure, to avoid misconceptions that may cause problems later on.[1] Teachers and educators can give mathematicians pedagogical advice to improve student achievement and make learning more accessible. There lies an opportunity for fruitful interaction.

Links

- Draft of the new Year 0–8 curriculum (released for consultation on 12/8/24). Link
- *'Weak' evidence for advisory group's plan for maths* by Laura Walters. Link
- *The numbers don't add up: why the government needs to slow down on sweeping changes to NZ's maths curriculum* by Lisa Darragh and David Pomeroy. Link

Sione Ma'u

[1] For example: correctly using and interpreting the equal sign.

HOW MATHS CRAFT WOVE ITS WAY INTO OUR TEACHING AND RESEARCH

Dijkstra famously said that there should be no such thing as boring mathematics, and yet students down the ages have slept through more maths lectures than any other subject [citation required]. The truth is that when the mathematics is not scintillating, it is those of us who teach it who must find ways to bring it to life. Whether it's bad maths jokes, musical interludes, corny skits, geeky movie references, or just making a well-timed loud noise, we all have ways of keeping our students alert and engaged. For us (the authors), it's craft. And while unfurling a six metre long crocheted scarf showing the distribution of the 62 primes between 1 and 300 never fails to restore consciousness in the classroom, the deeper question we want to explore in this article is how can we all incorporate our novel mathematical interests into our teaching and research in a more meaningful way.

Our love of mathematics and craft led to the (accidental) formation of Maths Craft New Zealand in 2016 when we created and ran New Zealand's first Maths Craft Festival at the Auckland Museum. Many of you may be aware of our work in the public engagement space since then, but what readers may not know is that Maths Craft has expanded to become more than just an outreach initiative: it is now a central theme in both our research and teaching at the University of Canterbury. In this article, we share some of our experiences with incorporating Maths Craft into our research and teaching, in the hope that they may serve as encouragement, or perhaps even a roadmap, for others wishing to attempt something similar with their own mathematical whimsies.

Our first foray into bringing Maths Craft into our university teaching and research was two-fold: incorporating craft objects into our existing maths courses and supervising Maths Craft summer projects for undergraduate students.

Figure 1: *Left:* The baby blanket. *Right:* Incriminating photo of mathematicians crocheting.

The former is nothing new; using craft objects to illustrate the mathematics being taught is almost commonplace nowadays. We mention it only because it is also possible to use the process of craft to model mathematical thinking, and to make it uniquely yours. For example, in her third year combinatorics course, Jeanette shares the story (with incriminating photos; see Figure 1) of how she persuaded the whole mathematics department to crochet squares for a colleague's baby blanket. She then discusses the agony of trying to arrange 60 squares into a presentable blanket with only the four distinguishable corner squares, to emphasise the intractability of trying all possible combinations in real life. (There are in fact 4!56! ways of arranging the squares, which is $0.00017\times$the number of atoms in the visible universe!) Inspired by the Latin square portion of the same course, Jeanette crocheted the blanket on the right of Figure 2, not only to help the students visualise the relationships in a complete set of mutually orthogonal Latin squares of order 4, but because they are beautiful.

The latter approach, summer projects, was an easy first step towards developing Maths Craft research projects. It started in 2016, when Elizabeth Chesney — a mature student and retired maths teacher with an interest in craft — responded to our first and very general call for a Maths Craft summer student, with the idea of studying knot theory with craft. Together, we decided that her project would also be an exercise in science communication. As with

Figure 2: *Left:* Elizabeth and her prime knots. *Right:* Jeanette's crocheted Latin Square blanket.

many summer projects, we were not too prescriptive about the content, preferring to give Elizabeth some autonomy in both the mathematics and the crafts she used. You can read Elizabeth's excellent project here. Elizabeth has gone on to give talks about her summer project at various public events, including our Maths Craft festivals. In fact, her knitted prime knots (Figure 2), which she donated to us, have become one of the star attractions at our festivals.

Over the years as we have explored more problems, our Maths Craft summer projects have even led to original research. A good example of this is a summer project we did in 2022–23 with the then second-year student, George Henderson-Walshe. He studied the enumeration of the polypolyhedra (edge-transitive compounds of polyhedra), which are intricate and visually appealing objects which can be constructed using modular origami. The existing enumeration, due to Robert Lang in 2016, uses a brute-force computation; with George we found a way to enumerate the polypolyhedra algebraically. This work is available on arXiv, and has just been accepted for publication in the PUMP Journal of Undergraduate Research. A full list of our summer projects can be found here.

With our Maths Craft teaching and summer projects established, we had laid down a foundation from which to grow. All we needed was a prod in the right direction. Luckily for us, our colleagues and students were keen for more, and so with their encouragement and support, we branched out into teaching courses where Maths Craft is the central feature, not just a prop, and to supervising Maths Craft Honours and Masters research projects.

At first we were invited to give guest Maths Craft lectures in courses such as SCIE304, a science communication course and TECP323/423, a maths education course. Then, our university's first year mathematics 'bridging' course, MATH101, started using Maths Craft resources in their tutorials and employed students who we had previously trained to deliver Maths Craft workshops, to both design and teach the tutorials. In 2020 we were invited to help design one of three first year compulsory courses for Arts majors, ARTS102. Originally loosely conceived as "quantitative analysis and critical thinking for societal issues", this course uses Maths Craft to help students overcome maths anxiety and to model mathematical thinking in a non-threatening way through Möbius strips, paper models, and colouring.

Our 'big break' came in Semester 2 of 2020 when, at the instigation of our HoS Clemency Montelle, we designed and delivered half of a third-year mathematics course, using craft. Since then, we have taught the course every year, with class sizes ranging from 40–70 students, and growing every year!

The course (MATH380) has proved a perfect vehicle for Maths Craft. The first term (which is not taught using Maths Craft), covers a global history of mathematics. The second, Maths Craft, term of the course takes students to some deep, unifying results in a rigorous manner complemented by the making and manipulating of craft objects (see, for example, Figure 3). We employed three key principles in the design of the Maths Craft term of the course, drawing on our experiences of running Maths Craft events, supervising Maths Craft research projects, and teaching into the courses mentioned above:

1. capstoning each topic with a deep mathematical result;
2. weaving a story or narrative through each topic;
3. using craft as a scaffold for learning.

The Maths Craft term of the course is split into four topics: Topology and the Möbius strip; map colouring; fractals; and knot theory (inspired by that very first summer project with Elizabeth). Each topic involves both an in-depth study of the underlying mathematical theory, culminating in a capstone theorem, and the construction and exploration of illustrative craft objects in class. (For details on the course content and craft projects, see our journal article.) Forming a large part of the assessment is a written report about either an aspect of mathematics illustrated by a craft project, or a mathematical analysis of a craft to be displayed at a Gallery Day at the end of term (see Figure 4).

Figure 3: Jeanette's creation of a sewn model of a projective plane for MATH380, shown left to right.

This brings us to our postgraduate Maths Craft research, which naturally falls into two categories: pedagogy and mathematics. To date, our pedagogical research has concentrated on MATH380. In 2020 and 2021, we studied the course with Honours student Tess Grant and education researcher David Pomeroy (University of Canterbury), to see if our approach added value to the classroom experience. We received overwhelmingly positive student feedback collected in surveys and focus groups with students reporting that the creation of, and interaction with, mathematical craft objects played a significant role in generating feelings of engagement, reducing stress, and allowing tangible access to mathematical ideas; see our journal article. Tess focussed her Honours research through the lens of inclusive materialism to study the use of craft in MATH380 in a highly interdisciplinary project.

Most recently, together with our colleague and fellow Maths Craft enthusiast Michael Langton, we have developed purely mathematical postgraduate research projects. Interestingly, all of our current projects began as summer projects. For example, our summer student, Abigail Edwards, introduced us to Wang Tiles: sets of coloured tiles which can tile the plane aperiodically and are Turing Complete. We formulated a number of research questions during her summer project, leading to a Masters project and original research by our Masters student Steph Hogan (paper in preparation). Another topic which has generated multiple projects is the mathematics of Mystery Braids: braids constructed from multiple strands whose ends are joined together (see our projects). Brought to us by our summer student Daniel Diamond, who has continued to study them for his Honours project (and potentially beyond), Mystery Braids have proven to be an unexpectedly rich source of mathematical research.

The threads of Maths Craft now extend from tutorials for struggling first years, through summer projects and third year courses, into the original research of postgraduate students. We are discovering that there is a plethora of deep, original mathematics inspired by craft, and a profusion of ways of weaving Maths Craft into tertiary teaching. Moreover, craft is often accessible when mathematics is not, which supports and invigorates learning in the classroom, and gives students the curiosity and confidence to suggest ideas for original projects. We hope that our story encourages you in your own experiments with alternative approaches to teaching and research. Whether you are just starting out or are an old hand, we would love to hear from you!

Jeanette McLeod and Phil Wilson

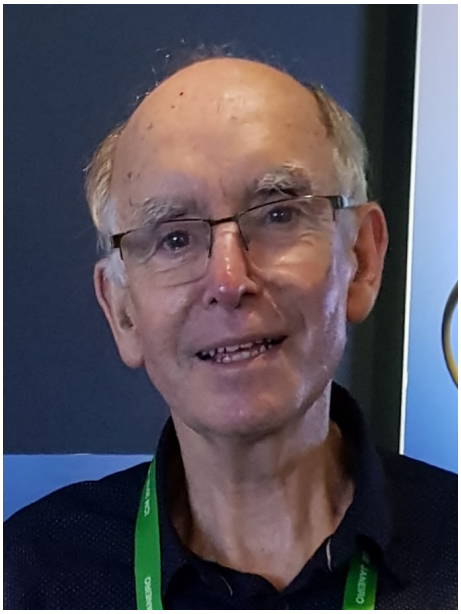
Figure 4: *Left: Temari* made by a MATH380 student for their final project. *Right:* Students presenting and discussing (and wearing) their Maths Craft objects at a MATH380 Gallery Day.

About Us:

Maths Craft New Zealand is a non-profit public outreach initiative which brings maths to the masses by celebrating the links between mathematics and craft (www.mathscraftnz.org). *Founded and run by authors Jeanette and Phil, Maths Craft's aim is threefold: to showcase the creativity and beauty inherent in mathematics through the medium of craft; to demonstrate just how much mathematics there is in craft; and to enable people to experience what it means to think like a mathematician, by doing craft. Since its inception in 2016, Maths Craft has run festivals and workshops across New Zealand, and has reached over 16,000 people at our events, and over 20,000 school students through Maths Craft in a Box, making it the largest mathematics outreach programme in the country.*

PROFILE

Kevin Broughan



Emeritus Professor Kevin Broughan has been at the University of Waikato since 1971. Although he retired in July 2011, he has continued with his academic work.

Kevin was born in Wellington and attended St Bernard's College, being Dux in 1960 and 1961 and being Awarded a National NZ scholarship. He entered the Marist Brothers teaching order, and remained in this for nine years, teaching for some of this time at St Paul's College in Auckland, and leaving the order in 1970. He completed a first class Honours degree in Mathematics at the University of Auckland, spent most of 1968 as a Junior Lecturer at the University of Auckland, and then headed to New York, taking up a Faculty Fellowship in mathematics at Columbia University. After two years he returned to New Zealand, taking up a lectureship at the then quite new University of Waikato in Hamilton.

In 1973, Kevin was elected by NZ mathematicians assembled at the Mathematics Colloquium to serve on a working party with Donald Joyce of Massey University and David Vere-Jones of Victoria University, to establish a New Zealand Mathematical Society. Kevin wrote its first draft constitution and served on its Council for over 10 years, for a period as its Secretary, and later being elected Fellow and a Life Member.

His research in the seventies was mainly in the topology of metrizable spaces. He developed a classification for range-dependent topologies and along the way proved that every metrizable space could be decomposed into at most a continuum of closed dense subsets. He completed the Columbia University PhD in 1975, having returned to NY with his wife Jackie during study leave to write his thesis. This was supervised by Edgar Lorch, a functional analyst, who had a deep knowledge of metrizable spaces. The thesis was published by Springer-Verlag.

In the latter part of the 20th century, the University of Waikato was a small university, greatly in need of development. During a study leave at Cambridge UK in 1980 with his family, which now included two young children, Jude and Beck, he was quite taken with the emerging field of symbolic computation and the related field of computer algebra. Returning to NZ, he established a working party which had as its aim to create what was to become the School of Computing and Mathematical Sciences at the University of Waikato. The academic basis was that mathematics and computing had roots and applications throughout the whole of the university and society and not just in the physical and natural sciences. The School has now been in existence for over three decades.

For his own academic work, Kevin established a Mathematical Software Project in the 1980's and 1990's. It was to develop a fully interactive symbolic computation system which included Risch integration, finite element analysis, interfaces to the NAG Library of numeric subroutines and Numerical Recipes. Although it provided thesis work and publications for students and received grants including from the NZ Development Finance Corporation and NAG Ltd, it was difficult to sustain. He believed this was, in part, because mathematicians were slow to recognize computers were much more than mere "number crunchers". During this period Kevin had a close connection with Richard Fateman of the University of California at Berkeley, with several visits exchanged. The project and its relationship with Berkeley was to provide a foundation, because of its software needs, for the University of Waikato to become New Zealand's gateway to the Internet through the work of John Houlker.

During the 1990's, Kevin undertook, with Alfred Sneyd, a contract to model the scheduling of power from the eight hydro stations on the Waikato River. The goal was to determine the water flow down the river to generate a specified pattern of power output from the 50 generators for a two day period in advance. This was a fascinating challenge with the model having over four thousand variables and constraints. Being a mixed integer and real number optimisation problem, it was certainly NP hard. The solution Alfred and Kevin developed was to iterate from a large database of good solutions to a range of common schedule types to a close approximation to the required schedule.

The late 1990's were spent, first with Alfred as co-chairperson, and then as chairperson of the Department of Mathematics, working to restore the student numbers of the Department. This was achieved, with a doubling of the student enrolment over the 6 year period. Part of this endeavour was to join with a small group of other members of the University to establish engineering degrees. Howell Round from Physics and Kevin wrote the original submission, but others made very significant contributions to what has grown to become a very strong part of the University's teaching and research components.

While chairperson of department, Kevin started work in number theory, an accessible field with many unsolved problems. He had three excellent collaborators, Ross Barnett, an expert in the computation and properties of special functions, Florian Luca, a genius-level number theorist with over 600 publications, and Dorian Goldfeld, a Columbia University mathematician. With the latter, following several visits to Columbia University, Kevin wrote a suite of mathematical functions to go with Goldfeld's book on automorphic forms and L-functions. With Luca he worked on a range of arithmetical problems in number theory. With Barnett and Frances Kuo he evolved the theory of holomorphic flows, with applications to the zeta and related functions. Fundamental to this, Kevin showed that limit cycles do not exist, even for meromorphic flows, enabling good classifications to be made of the basins of zeros.

Following retirement in 2011, Kevin started work of a different nature. This was the production of expository books which would enable a student, starting out on their research, to gain sufficiently deep knowledge of an unsolved problem to have a hope of making progress towards a solution. Three volumes of "Equivalents of the Riemann Hypothesis" (over 2000 pages in all published by Cambridge in 2017 and 2023) and a single volume "Bounded Gaps Between Primes" (also published by Cambridge in 2021) were written in just over a dozen years. Although the final volume of Equivalents laid foundations for a proof that the Riemann Hypothesis was decidable, this proof was not completed until after the book was published and, at the time of writing, is being refereed.

Stephen Joe

LOCAL NEWS

AUCKLAND UNIVERSITY OF TECHNOLOGY

SCHOOL OF ENGINEERING, COMPUTER AND MATHEMATICAL SCIENCES

New Colleagues

Dr Parul Tiwari completed her PhD at the Lincoln University in Mathematical and Computational Modelling which compliments her previous PhD in Applied Mathematics. Currently, Parul is a Lecturer in Mathematical Sciences at Auckland University of Technology. Her research interest includes mathematical modelling, numerical computing, modelling of stochastic processes and complex systems, machine learning and artificial intelligence. She has an extensive teaching and research experience in several areas of mathematics and statistics.

Figure 5: *Dr Parul Tiwari*

Dr Yiming Ma earned his bachelor's and master's degrees in China before teaching experimental courses in Geophysics at East China University of Technology. In 2018, he began his PhD studies in Applied Mathematics and Statistics at the University of Otago under the supervision of Dr. Fabien Montiel and Associate Professor Ting Wang. After completing his PhD study in 2022, he joined Stats NZ in the unit of Methods & Design until he joined AUT in 2024 as a lecturer in Department of Mathematical Sciences. Yiming's research specializes in earthquake modelling and change-point detection in time series.

Figure 6: *Dr Yiming Ma*

New Book

The book entitled "Separate and Joint Continuity", written by Prof Jiling Cao and his co-author Prof Warren B. Moors (from The University of Auckland), has recently been published by Taylor & Francis in July 2024, in its Monographs and Research Notes in Mathematics series. The book provides a systematic treatment of the "separate vs joint continuity" problem which can be dated back to the year 1821 from famous French mathematician, engineer, and physicist Augustin- Louis Cauchy. Jiling and Warren started to plan and work on this book in 2015, and they are glad that the book was finally published.

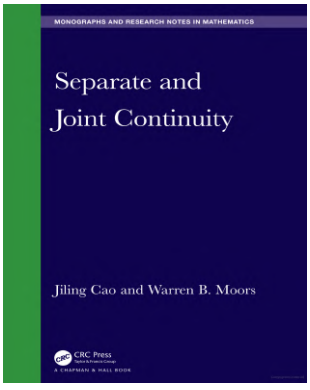


Figure 7: *New book "Separate and Joint Continuity" by Prof Jiling Cao and Prof Warren B. Moors*

Event

In the first week of July, Dr Ryan Ip and Dr Cathy Hassell Sweatman joined 75 staff and students at the University of Canterbury for the 2024 Mathematics-in-Industry New Zealand (MINZ) meeting. The previous

MINZ was held in 2019. It was good to be back. This meeting is designed to bring mathematicians, statisticians, data scientists, computer scientists, engineers and those in similar disciplines together to tackle real life problems shared by companies and organisations. The problems were presented by the New Zealand Police, Tait Communications, Dairy NZ, Orion Energy and Fonterra. Groups were formed and brainstorming began on the Monday. Data was examined and plotted, ideas formed, models developed and reports given on the Friday. It was a busy week. This collaborative approach has great benefits for problem-solving and networking. It is an excellent way for students to get involved and make connections. The event will be held at the University of Canterbury next year, at a similar time.

A/Prof Sergiy Klymchuk is in Europe on his sabbatical from the mid of May to the mid of September. He strengthened ties with international mathematics education research community after not travelling outside New Zealand for the past five years. During his sabbatical, he presented papers and published in the proceedings at two international conferences in Spain in June and Italy in August. In July, he gave two plenary addresses at the national conferences of mathematics teachers in Wales and Portugal. He gave four research seminars: at the National Institute of Education of the Nanyang Technological University, Singapore; University of Bristol, England; Swansea University, Wales; and University of Algarve, Portugal. He wrote and submitted an article to a Q1 international journal with his research collaborator Professor Chris Sangwin, University of Edinburgh. Currently, he is working on another journal article where he is the sole author.

Dr Nuttanan Wichitaksorn's research and study leave is in the second half of 2024 in which he has several commitments. In July and August, he visited the Thailand Development Research Institute and the Ohio Education Research Center at Ohio State University in the U.S. In both places, he had a chance to discuss some possible research collaborations and gave a talk and a workshop. Dr Wichitaksorn also gave a presentation at the 7th International Conference on Econometrics and Statistics at Beijing Normal University in China. Since June this year, Dr Wichitaksorn has also been a guest editor for a special issue of a Q2 open-access journal.

Dr Kerri Spooner attended the ICME15 (The 15th International congress on Mathematical Education) held in Sydney form 7-14 July where she conducted a workshop on "Using popular culture for mathematical modelling". The following week, 17 – 21 July, she attended PME47 (Psychology of Mathematics Education Conference) hosted in Auckland at Massey University where she gave an oral communication on "What does Interpretive Description have to offer mathematics education as a research methodology". Kerri was a member of the local organising committee for Psychology of Mathematics Education Conference (PME47).

Seminars of the Mathematics, Modelling and Analytics Research Centre

Associate Professor Shahab Ramhormozian from School of Engineering, Computer & Mathematical Sciences, AUT, delivered a talk "Recent and ongoing Research, Developments, and Implementations of Low-Damage Friction-Sliding Earthquake Resistant Systems in New Zealand" on 18th April 2024.

Dr Hammed Fatoyinbo from School of Engineering, Computer & Mathematical Sciences, AUT, delivered a talk "Dynamical Systems Analysis in Life and Physical Sciences" on 4th June 2024.

Kerri Spooner successfully defended her PhD theses. The title of Kerri's PhD thesis "Exploring Tertiary Students' Mathematical Modelling Experiences: Insights for Practice", supervised by Assoc. Prof. Sergiy Klymchuk, Assoc. Prof. Nicola Naismith, and Dr. Felicity Bright.

Wenjun Zhang

UNIVERSITY OF AUCKLAND

DEPARTMENT OF MATHEMATICS

Staff News

In honour of Bernd Krauskopf on the occasion of his 60th birthday, the workshop "Frontiers in Applied Dynamical Systems" was held 18–20 June at University College Cork, Ireland. [*Ed.: see report in Events section*]

Steven Galbraith attended the "Algorithmic Number Theory (ANTS)" conference at MIT in Boston and has been selected for a 2-year term as Chair of the Steering Committee for this conference series.

Jeroen Schillewaert is invited to give a talk at "Buildings 2024" annual meeting in Munster, Germany in September.

Pedram Hekmati is organising a workshop on "The Shapes of Music" at the INSPIRE Festival, held in Nelson, 5-6 September 2024. INSPIRE is STEAMS-based and aims to inspire future innovators and encourage young people to think dynamically and creatively:

https://ministryofinspiration.org/inspire-festival-2024/

Other News

The Mathematics Education Unit had an exceptionally busy and productive July, highlighted by hosting the 47th conference on the Psychology of Mathematics Education. This prestigious annual international conference made its debut in New Zealand, marking a significant milestone in its 47-year history. The event drew nearly 400 participants from 39 countries, showcasing the global interest and engagement in mathematics education. Researchers presented their latest findings through a series of oral communications, plenaries, working groups, and research reports, which have been published in the conference proceedings (four volumes) and can be accessed here

https://www.igpme.org/publications/current-proceedings/

The organisation of this large-scale event was a collaborative effort among academics from Massey University, AUT, and the University of Auckland. The conference was held at Massey University's Albany campus from July 17-21, with a special pre-conference for early career researchers on 16-17 July. The extensive planning and coordination by the local organising committee, which included Tanya Evans (Co-chair), Ofer Marmur, and Igor' Kontorovich, ensured a seamless and enriching experience for all attendees.

The conference was deemed a tremendous success, not only in terms of participation but also in the quality of discussions and exchanges that took place. It attracted internationally recognised researchers in the field of mathematics education, providing a valuable platform for knowledge sharing and networking. Following the conference, several esteemed researchers visited the Mathematics Education Unit, further enriching the local academic environment. They delivered seminars on cutting-edge topics, which have been recorded and are available for public viewing on the Mathematics Education YouTube channel.

These seminars provide an invaluable resource for educators, researchers, and students alike, extending the impact of the conference beyond its immediate participants. Overall, the successful hosting of the 47th conference on the Psychology of Mathematics Education not only highlighted New Zealand's capabilities in organising international academic events but also reinforced the country's commitment to advancing research in mathematics education.

UoA was well represented at the 11th European Nonlinear Dynamics Conference ENOC 2024, held 22–26 July in Delft, the Netherlands. There were 11 participants from NZ at this meeting and at least 7 were from Auckland. The selfie below shows a rowdy bunch in a late-night search for a Karaoke Bar after the conference dinner. Shown are, back to front, from left to right: Dana C'Julio, Sam Bolduc-St-Aubin, Lorenzo Anoè, Bernd Krauskopf, Hinke Osinga, Peter Langfield (Inria, Bordeaux, France), Kyoung Huyn Lee, Saigan Hayashi (U Canterbury), Andrus Giraldo (KIAS, Seoul, Korea), and Renzo Mancini. [*Ed.: see report in Events section*]

Figure 8: The rowdy bunch at the Nonlinear Dynamics Conference

The department hosted a number of other visitors in the second quarter of the year, including the Kalman Teaching Fellow Dr Gareth Tracey (University of Warwick), Prof Matt Gursky (University of Notre Dame), Prof Boris Koichu (Weizmann Institute of Science) and Prof Chao Liu (Northeastern University, China).

Sir Michael Berry (FRS), Emeritus Professor of Bristol University and renowned mathematical physicist, known for the Berry phase which arises in a cyclic adiabatic evolution in quantum mechanics and in optics, is visiting Auckland and giving a colloquium talk joint with Physics on Monday 26 August as part of his James and Jean Davis Prestige Visitor tour in NZ. The title of the talk is "Four geometrical-optics illusions" and here is the intriguing abstract:

Centuries after the laws of geometrical optics were established, they still have nontrivial and varied applications. This will be illustrating with some illusions. Mirages, and Raman's error. Understanding why Raman denied the applicability of geometrical optics requires careful exploration of the continuum limit of a discretely stratified medium, to reveal its nonuniform convergence. Oriental magic mirrors and the Laplacian image. The optics of these several-millennia old objects involves the unfamiliar regime of pre-focal brightening. The transmission analogue ('Magic windows') raises a challenge for freeform optics. The squint moon and the witch ball. The moon sometimes appears to point the wrong way because we perceive the sphere of directions as a distorted 'skyview', on which geodesics

appear curved. This can be conveniently viewed and analysed by viewing the sky in a reflecting sphere. Distorted and topologically disrupted reflections in curved mirrors. Mirror-reflected rays from each point of a continuous object form caustic surfaces in the air. Images are organised by those points whose caustics intersect our eyes, and can be systematically understood in terms of the elementary catastrophes of singularity theory.

Behrooz Yousefzadeh will be visiting UoA from 18 August until the end of the year. Behrooz is an Assistant Professor in the Department of Mechanical, Industrial and Aerospace Engineering at Concordia University, Montreal, Canada. He is interested in vibrations and acoustics, with a focus on nonlinear vibrations and wave propagation in periodic materials, and he has very cool experimental results that can be explained with dynamical systems theory.

We congratulate Valerie Jeong, Harris Pok Hei Leung, Georgina Liversidge and Kim Locke for successfully defending their PhD theses. Kim has been placed on the Dean of Graduate Studies List (Dean's List) "in recognition of excellence achievement with your PhD thesis. This award is made to only a few recipients each year from the large number of doctoral students completing their theses."

Pedram Hekmati

DEPARTMENT OF ENGINEERING SCIENCE AND BIOMEDICAL ENGINEERING

The department welcomes Dr Liam Fisher, who has joined the department as a part-time Professional Teaching Fellow. Liam completed a PhD in Biomedical Engineering at the National University of Singapore in 2022. His thesis *The Biomechanical Effects of Eye Movement* investigated the mechanics of the optic nerve head during eye movements and the potential consequences for glaucoma and other ocular disorders. Liam holds a second appointment at the University of Auckland as a Software Developer at the Auckland Bioengineering Institute, creating anatomical scaffold models.

The department has welcomed two research internship students from the Department of Engineering Science at the University of Toronto. Katie Bian and Alfred Xue received a Mitacs Globalink Research Award and equal support from the hosting department to work on explainable time-series classification models. During their two-month stay in Auckland, Katie and Alfred contributed to the open-source machine learning project `tsfresh`, which implements systematic time-series feature engineering for time-series classification and regression problems.

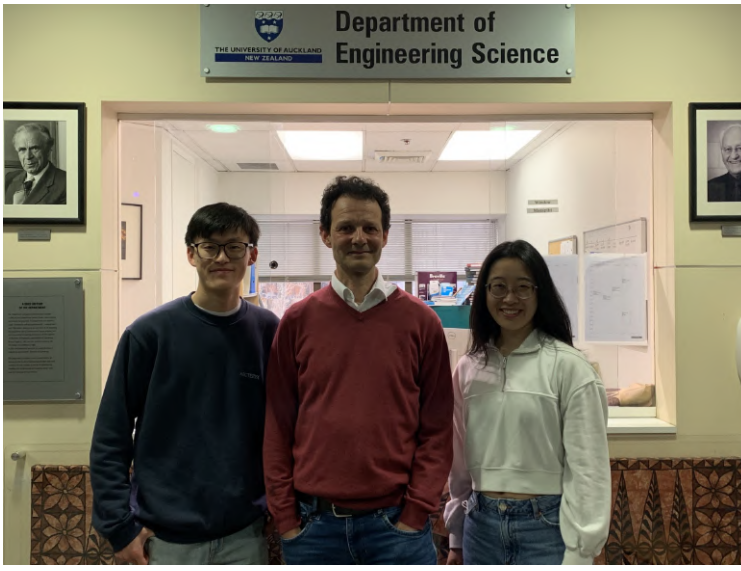


Figure 9: Alfred Xue and Katie Bian together with Assoc Prof Andreas Kempa-Liehr.

Andreas Kempa-Liehr

UNIVERSITY OF WAIKATO

DEPARTMENT OF MATHEMATICS AND STATISTICS

It's been a quiet period in the department over the past few months. There are no staff currently on leave and so it's all hands on deck. As reported previously, Tim Stokes attended several conferences in the UK during his study leave period in the first half of the year. Additionally, he gave talks at UCL, York University, and Heriot-Watt University. Though his actual study leave was great, his travel was less than ideal. He was on a flight headlined in the media as an '11-hour trip to nowhere' and his luggage was lost twice!

Stephen Joe

MASSEY UNIVERSITY

SCHOOL OF MATHEMATICAL AND COMPUTATIONAL SCIENCES

Annalisa Conversano gave a one-hour invited talk at the "Beijing Model Theory Conference", 8–12 July 2024 at the Chinese Academy of Sciences in Beijing (China).

In April David Simpson travelled to England, funded by a Marsden grant, where he attended the British Applied

Mathematics Colloquium at the University of Newcastle, attended the Dynamics and Piecewise Smooth Systems Workshop at the University of Manchester, and visited the University of Bristol and the University of Bath to work on collaborative projects.

Carlo Laing was an invited speaker at Dynamics Days Europe, held in Bremen, Germany, July 29–August 2. He also visited the University of Potsdam while in Berlin.

Winston Sweatman and Indranil Ghosh attended MINZ 2024 at the University of Canterbury, 1–5 July.

Carlo Laing

VICTORIA UNIVERSITY OF WELLINGTON

SCHOOL OF MATHEMATICS AND STATISTICS

We have some interesting news from Te Herenga Waka in Wellington:

Some success stories come from Prof. Rod Downey. In July, Rod was at CiE (Computabiltiy in Europe) in Amsterdam where he gave a plenary lecture and received the S. Barry Cooper Prize. Furthermore, he published a new textbook with title "Computability and Complexity: Foundations and tools pursuing scientific applications" available through Springerlink at: https://link.springer.com/book/10.1007/978-3-031-53744-8.

The next Women in Data Science (WiDS) NZ event will be held on Monday, September 30th from 4:15 pm to 8:30 pm. Organized by AProf. Ivy Liu and the Centre for Data Science and Artificial Intelligence at Victoria University of Wellington, the event offers a chance to learn about the latest data science research and applications. While all genders are welcome, WiDS NZ is particularly dedicated to supporting women in the field. The applications deadline is Monday 2 September. For more information please visit: https://ecs.wgtn.ac.nz/Events/WiDSNZ2024/.

In July, Shonaugh Wright fullfilled all the requirements for the award of the degree of Doctor of Philosophy. She worked with Astrid an Huef (primary supervisor) and Lisa Orloff Clark.

Dimitrios Mitsotakis

UNIVERSITY OF CANTERBURY

SCHOOL OF MATHEMATICS AND STATISTICS

We warmly welcome Dr Sinéad Moylett who flew in from Belgium in July. Sinéad is starting as a Lecturer in Data Science and has extensive expertise in biostatistics, epidemiology, and big healthcare data, who has worked in both academia and private industry. Throughout her tenure in academia, she has held various postdoctoral roles in the UK and Belgium, focusing on diverse areas such as epidemiology, public health, and neuroimmunology.

Figure 10: Dr Sinéad Moylett.

We are also pleased to extend a warm welcome to Chenyang (Alice) Zhao, who joins us as a senior tutor for UCOnline, supporting the online postgraduate ADS programs. Alice, already well-known for her excellent tutoring over the past couple of years, will be based in our School and will assist our staff with all aspects of course development and delivery.

As part of strengthening our connections with Qufu Normal University we welcomed two visiting academics to our school the week beginning 12th August. Our two invited faculty members are Professor Hu (Applied Mathematics) and Professor Zhao (Statistics/Biological Sciences).

Günter Steinke has retired after spending 34 years at UC. From Günter:

I came to UC in 1990 as a postdoc funded under the Feodor Lynen programme from the Alexander von Humboldt foundation, and continuing staff in 1992. I spent nearly 10 years as Deputy Head of School. I plan to spend more time at, what was so far, our weekend retreat on Banks Peninsula and enjoy the rural lifestyle.

We will all miss having you around, and you have definitely set a high bar for my new office neighbour!

On 31st July, our school hosted the Industry Advisory Board on campus. The choca agenda included indus-

Figure 11: Günter Steinke.

try insights on GenAI and graduate attributes, a showcase of DATA423, updates on our DATA601 projects, and a visit from Faculty of Engineering Execute Dean Saurabh and our own Assoc. Prof. Alex Gavryushkin to discuss faculty strategy. We also highlighted an upcoming Data Science/IEEE event in collaboration with Business Christchurch.

A big congratulations to two of our students, Will Durkin (supervised by Taylor Winter) and Nate Hartman (supervised by Clemency Montelle), who represented our School at the Faculty of Engineering 3-Minute Thesis heats. We are thrilled to announce that Will was named the winner of the Faculty of Engineering heats with his presentation, "Cold Kids, Hot Topic" and will be competing in the UC event on August 14th. Well done Will!

During the mid-year break, we successfully hosted the MINZ workshop. A big thanks to James W, Miguel, and Scott for their excellent organization, and to Elena for connecting us with a project from the NZ Police. Special appreciation goes to Fabian, Philipp, and Hannes Diener for their role as project moderators throughout the week. The workshop brought together academics and postgraduates from across New Zealand to address industry challenges provided by the New Zealand Police, Fonterra, Dairy New Zealand, Allied Telesis, and Orion, who also offered financial support. We had 98 online registrations and 79 attendees, showcasing fantastic industry engagement for our staff and students. The event was such a success that we're excited to host it again next year. [*Ed.: see report in Events section*]

In early June we also hosted the Combinatorics in Christchurch conference "Combinatorics in Christchurch

Figure 12: MINZ 2024 group photo.

aims to bolster the combinatorial community in New Zealand by bringing together mathematicians working in combinatorics and related fields."

Figure 13: Combinatorics in Christchurch 2024 group photo.

Erskine fellows Prof. Denis Pollney and Prof. Timothy Robinson arrived in July working with Chris Stevens and Jennifer Brown respectively.

To round off our local news, we were given the surprise visit by a possum at the end of semester 1, who was happy to join a MATH110 lecture.

Chris Stevens

UNIVERSITY OF OTAGO

DEPARTMENT OF MATHEMATICS AND STATISTICS

The University of Otago has welcomed its new Vice Chancellor, *Grant Robertson*, who took up his position in July. For New Zealand's former Deputy Prime Minister, this was a journey back home to the place where he grew up, later studied philosophy and politics, and eventually was elected president of the Otago University Students' Association (OUSA). After completing

Figure 14: Maths for all.

his BA and first class honours, he became first Vice-President, then Co-President of the NZ University Students' Association. Subsequently, he joined the Ministry of Foreign Affairs and worked in Samoa and at the UN in New York. After returning to NZ, Grant became a Senior Ministerial Advisor for PM Helen Clark. This was followed by a position as Senior Research Marketing Manager for the University of Otago's Research and Enterprise office in Wellington, but then he returned to politics. He already had a strong association with the Labour Party, when he won the seat as Wellington MP — a seat he held for 15 years. But finally, Grant came home to Dunedin. He said "I come with an ability to understand balance sheets and the financial challenges they may pose. I also understand the work of academia and I will always be a champion for our staff and their work." Welcome, Grant!

Congratulations to *Phil Wilcox* on securing $450,000 for a flagship project funded by the Maurice Wilkins Centre. Together with *Alastair Lamont*, Phil aims to identify gene variants associated with metabolic diseases in Māori and Pacific peoples for further studies on gene function and potential gene based interventions, and to develop a Māori-oversighted ethics and data governance environment for the corresponding health and genomic data.

Warmest congratulations also to our students *Ben Wilks*, *Anna Redmond*, and *Louis Davis*. Ben and Anna's PhD theses made it onto the list of Exceptional Doctoral Theses. Details of their projects can be found in section PhD Success in this newsletter. Moreover, Louis completed his Master's project "Seismic Fractional Hawkes Process Models" with distinction. Well done!

Jörg Hennig

PhD SUCCESS

Kerry Manson (University of Canterbury. 2024)

Title: Mathematical aspects of phylogenetic diversity measures.
Supervisors: Charles Semple and Mike Steel (both University of Canterbury)

Abstract:
Phylogenetic diversity (PD) is a popular measure of biodiversity, with particular applications to conservation management. The mathematical properties of PD, and a suite of methods derived from it, have been studied since its introduction in the early 1990's. In this thesis, we explore these properties further using combinatorial and algorithmic approaches.

The first strand of the thesis covers the study and comparison of the PD values of sets of a fixed size. We characterise those sets of species that obtain the extreme PD scores for sets of their size. This leads to a polynomial-time algorithm for calculating the number of maximum PD sets of each size by applying a generating function. We then use this characterisation to maximise a linear function on the leaves of a phylogenetic tree, subject to the solution being a maximum PD set.

The second strand involves phylogenetic diversity indices, a type of function that partitions the PD of a set of species among its constituent members. We show that rankings derived from these measures are susceptible to being disrupted by the extinction of some of the species being measured and introduce new measures that avoid this disruption to a greater extent than existing approaches.

The third strand deals with the link between PD and feature diversity (FD), another means of measuring biodiversity. We provide models for evolution of features on phylogenetic trees that account for loss of features, such as the loss of flight in some bird species. Doing so highlights key differences between these measures unless feature loss is (unrealistically) ignored.

The distinct parts of this thesis are linked by an aim to better understand what is meant by the concept of biodiversity and to investigate how that understanding is reflected in the way that we measure this idea. We provide a mathematical approach, complemented by a number of algorithms that enable these ideas to be put into practice.

Kerri Spooner (Auckland University of Technology. 2024)

Title: Exploring Tertiary Students' Mathematical Modelling Experiences: Insights for Practice.
Supervisors: Sergiy Klymchuk, Nicola Naismith, and Felicity Bright (all Auckland University of Technology)

Abstract:
The purpose of this study is to investigate tertiary student learning experiences for mathematical modelling. This study is based in New Zealand and involves three different tertiary modelling courses. For students participating in these modelling courses, this was their first-time studying modelling at tertiary level. This study uses Interpretive Description as the methodology to look at the student experience with the aim of establishing a better understanding of student experiences with mathematical modelling, the role the lecturer plays in these experiences, and how any new insights can better inform teaching practices.

This study aims: to provide new insights and understandings of the student perspective to inform and advance tertiary teaching practices; to gain a deeper understanding of the lecturer's role in the student experience; to contribute to the general discussion on how to provide rich student learning experiences in mathematical modelling; and to inform the general discussion for students to be able to contribute to society through mathematical modelling.

One overarching theme and three subthemes were constructed from the data. The overarching theme pushing our boundaries, captures how all students had experiences that are new, unfamiliar, and outside their normal range of experiences with mathematics while mathematically modelling. Subtheme one, moving forward on our own,

captures how students needed to learn how to move forward on their own in order to make progress. Moving forward involved taking responsibility, both individually and as a group, to actively find ways forward. Subtheme two, being moved forward, focusses on the use of resources and the lecturer's role in moving students forward, while also enabling student groups to work independently of the lecturer. Subtheme three, going forward together as a collective, captures the interwoven and collective nature of learning to mathematical model.

This research shows how modelling is a change of culture for students and the lecturer has a role to play. This research presents nuances of the dynamics between independent student work and the lecturer's role.

The findings of this study suggest students can undertake modelling without the lecturer or teacher being present if they have prepared for the experience beforehand and have access to appropriate resources. Lecturer behaviours that help students to take responsibility for their own modelling process include: providing students with material to refer to; using facilitatory questions/prompts aligned with the modelling process; and creating environments for students to share their thoughts and workings. Lecturer support needs to allow for students to experience struggle, explore, be creative and become self-reliant. Experiencing these key student behaviours allows students to move from being uncertain to finding direction and thus take responsibility and ownership for their own modelling process.

Implications of this research for general mathematics education practices include the suggestion of lecturers and teachers incorporating connecting mathematics to context as a normal part of their teaching practice and to develop a learning environment where being uncertain and the need for exploration is a normal and valued part of learning mathematics.

Valerie Jeong (University of Auckland. 2024)

Title: Effect of noise on a heteroclinic cycle and its use in an evolutionary robotics task.

Supervisors: Claire Postlethwaite and Matthew Egbert (both University of Auckland)

Abstract:
A heteroclinic cycle is a dynamical structure consisting of saddle-type equilibria and heteroclinic connections between them. Trajectories close to a heteroclinic cycle spend a long time near the equilibria, followed by a relatively fast transition between the equilibria. It has been observed that similar dynamics appear in a number of physical systems, including fluid dynamics, population dynamics, and brain information processing.

In this thesis, we consider the use of a heteroclinic cycle as a controller in an evolutionary robotics task. In the field of evolutionary robotics, the control system of a robot is optimised using a genetic algorithm that is analogous to natural evolution. The robots generally receive inputs from an environment, where these inputs can be thought of as perturbations to the control system. Also, controllers are not free from noise in realistic settings. This raises the need to understand the dynamics of a heteroclinic cycle when inputs and noise are present. However, the combined effect of inputs and noise on the dynamics near a heteroclinic cycle is not well understood. In particular, the addition of noise to a system that contains a periodic orbit near a heteroclinic cycle leads to a non-intuitive result: there is a range of noise levels for which the mean residence time near the equilibria of the heteroclinic cycle increases as the noise level increases to a given threshold.

We first explain how the interaction between noise and inputs gives rise to this phenomenon by combining analytical results from constructing a Poincaré map with a simple stochastic system. We support our results with numerical simulations. Then, we illustrate the use of a heteroclinic cycle as a controller for an evolutionary robotics task. We study the dynamics of the evolved system and link this with our results on the effects of noise on residence times of a heteroclinic cycle.

Georgina Liversidge (University of Auckland. 2024)

Title: New Computational Methods for Analysing Finitely-Presented Groups.

Supervisors: Marston Conder and Gabriel Verret (both University of Auckland)

Abstract:
In this thesis, Gina presented three new or improved methods for the analysis of finitely-presented groups, and showed their usefulness in a variety of contexts, as follows:

1 A procedure for finding expressions for subgroup elements in terms of given generators, applied to finding generating sets for torsion-free subgroups of finite index in ordinary triangle groups, with implications for the study of regular maps and automorphism groups of compact Riemann surfaces.

2 Improvements to the package PEACE (by Havas and Ramsay), for obtaining a proof for subgroup inclusion, and applied to finding new generating sets and 2-generator presentations for the special linear group SL(3,$\mathbb{Z}$).

3 n adaptation of the low-index subgroups algorithm, with added capabilities for finding specific types of subgroups by way of avoiding the inclusion of specified words, and applied to find torsion-free subgroups of minimum possible index in certain Coxeter groups, with implications for the construction of small-volume hyperbolic manifolds.

Harris Pok Hei Leung (University of Auckland. 2024)

Title: Group actions and metric aspects of buildings of low rank.

Supervisors: Jeroen Schillewaert, Marston Conder and Gabriel Verret (all University of Auckland)

Abstract:
Schillewaert, Struyve and Thomas proved a local-to-global fixed-point theorem for certain (non-discrete) 2-dimensional Euclidean buildings. Their proof requires a result showing that the distance is attained between fixed-point sets of any two isometries. We provide a novel proof of the latter result. In particular, we develop some new results on Euclidean buildings using CAT(0) theory, and introduce a technique involving larger metrically complete Euclidean buildings arising from ultrafilters. Our other main results pertain to Jørgensen theory in a non-archimedean setting. Jørgensen's inequality provides a necessary condition for two elements of SL2($\mathbb{R}$) to generate a discrete group. We prove an analogous inequality with R replaced by a non-archimedean local field as well as results regarding algebraic convergence analogous to those of Jørgensen, and Jørgensen and Klein.

Kim Locke (University of Auckland. 2024)

Title: Making Sense of International Students' Experiences when Transitioning to Undergraduate Mathematics: An Exploration of Mathematical Identities.

Supervisors: Igor' Kontorovich and Lisa Darragh (both University of Auckland)

Abstract:
For international students, the transition to university mathematics may demand a significantly higher level of adaptation than would typically be required of students transitioning to university in their home countries. Adopting a critical realist approach, my study uses mathematical identity to illuminate tensions that can arise when cultural understandings of being a mathematics learner interact with the institutional structures of first-year mathematics in a foreign country. Findings show how mathematical identities might be threatened by restricted access to learning resources. They further show how cultural resources provided by home country experiences can resource resilient mathematical identities that accommodate these tensions. The findings further offer evidence that mathematical identities constructed by international students might shift towards local norms, helping to resolve tensions in collaborative contexts. I argue that these findings have implications for both teachers of international students and mathematics departments at host universities. I contend that teachers should be mindful that cultural backgrounds may restrict access to some learning resources and I call on mathematics departments to recognise the difficulties encountered by some international students and to implement structures that might address these.

Shonaugh Wright (Victoria University of Wellington. 2024)

Title: Minimal Inclusions of C*-algebras of Groupoids.
Supervisors: Astrid an Huef and Lisa Orloff Clark (both Victoria University of Wellington)

Abstract:
A non-degenerate inclusion of C*-algebras $B \subset A$ is considered minimal if the only fully normalised ideals are trivial. An ideal is fully normalised if the set of normalisers of B are contained in the set of normalisers of the ideal.

We begin by considering when the inclusions $C_0(G^{(0)}) \subset C_r^*(G)$ and $C_0(G^{(0)}) \subset C^*(G)$ are minimal inclusions for an étale groupoid G. Then we consider étale groupoids graded by a cocycle $c : G \to \Gamma$ for a discrete group Γ, writing G_e for the identity-graded subgroupoid. We investigate the inclusions $C_r^*(G_e) \subset C_r^*(G)$ and $C^*(G_e) \subset C^*(G)$ of groupoid C*-algebras. We give conditions on the groupoids G and G_e under which the inclusions are minimal.

We generalise these results by considering non-degenerate inclusions of twisted groupoid C*-algebras and graded twisted groupoid C*-algebras. We finds conditions on G (and G_e for the twisted graded inclusion), which make the inclusions minimal. We conclude by applying our results to higher rank-graphs.

In their 2020 paper Crytser and Nagy found simplicity criteria for the ambient C*-algebras depending on the type of inclusion. We use this criteria to show how some of our results align literature results.

Anna Redmond (University of Otago. 2024)

Title: Statistical models for analysis of spatial patterns in muscle fibre type distributions.
Supervisors: Tilman Davies, Matthew Schofield and Phil Sheard (all University of Otago)

Abstract:
Individual skeletal muscle fibres exist in several different types, distinguished by the myosin they produce in order to contract. The type of fibres a muscle contains, as well as their locations, impacts the properties of the muscle as a whole. Fibre types are largely a function of recent usage history, controlled by the nervous system. This means fibres are able to change type over time, especially due to exercise patterns or advancing age. It is therefore important to be able to quantify the spatial distributions of muscle fibres so that the biological drivers of ageing can be better understood.

Much of the previous work to analyse spatial patterns in muscle fibres has focussed on assessing clustering behaviour in the binary fibre types. We review and discuss several approaches that aim to test whether the distribution is random or there is evidence of spatial dependence between neighbouring fibres.

In reality, fibre types exist on a continuum and fibres do not switch types immediately. Instead, this is a gradual process, and while a fibre is changing types it contains more than one type of myosin. These hybrid fibres are of interest because they give insight into the areas where fibres are undergoing type transitions. To account for the hybrid fibres and utilise the extra information they provide, we choose to model the continuous values obtainedthrough the staining process, which measure the amount of slow myosin a fibre has.

Mixture models are a powerful tool that allow us to assume the stain value for each fibre depends on a latent fibre type, with spatial patterns in the values for each type. This thesis develops models for the stain values, utilising mixture models to assume they come from two underlying subpopulations of fibres. We discuss two classes of models to describe the spatial patterns in the stain values for each type. Conditional autoregressive (CAR) models include a trend based on spatial covariates as well as local dependence between neighbouring fibres. The spatial dependence parameters can be usefully interpreted to summarise the level of correlation between neighbouring fibres across the muscle as a whole. Generalised additive models (GAMs) are a flexible extension to generalised linear models. They permit a non-linear trend in the stain values and the spatial dependence is incorporated through this trend and the inclusion of a smoothing parameter. The parameters of a GAM are not as easy to interpret but they allow visualisation to identify any areas in the muscle with particularly high or low stain values.

By also incorporating hierarchical structure in both of these models we are able to summarise the overall spatial trends in the stain values for a group of muscles. In order to demonstrate the utility of these models to describe

the spatial distribution of the fibres, we apply the analyses to three groups of soleus muscles from mice differing in age and exercise status.

Ben Wilks (University of Otago. 2024)

Title: Topics in resonant wave scattering: From rainbow reflection of water waves to time-domain scattering by acoustic resonators.

Supervisors: Fabien Montiel and Sarah Wakes (both University of Otago)

Abstract:
The rainbow reflection effect describes the gradual slowing down of a wave and the simultaneous spatial separation of its spectral components, which occurs in spatially graded arrays of resonators. Although it has been studied more frequently in the context of electromagnetic and acoustic metamaterials, the potential applications of rainbow reflection to water waves are promising. In particular, the underlying principles could be used to design smart coastal technologies, such as wave energy parks for electricity generation or breakwaters for coastal protection.

Part I of this thesis investigates the rainbow reflection of water waves in a two-dimensional fluid (one horizontal and one vertical) by arrays of surface-piercing vertical barriers, in which the submergence depth of the barriers is graded. The problem is studied using linear water wave theory, and time-harmonic fluid motions are assumed. The rainbow reflection effect arises naturally in the graded array of vertical barriers, as wave energy becomes amplified at different locations depending on frequency. A local Bloch wave approximation (LBWA), which assumes that the wave can be locally represented as a superposition of propagating wave solutions of the cognate infinite periodic media (the so-called Bloch waves), is developed and implemented numerically. The LBWA accurately predicts the free surface elevation at most frequencies, and large errors occurring at certain frequencies are shown to be a consequence of our implementation of the LBWA, rather than a consequence of the underlying assumptions. This indicates that it is valid to locally describe the wave as a superposition of propagating Bloch waves. Band diagram calculations are used to show that the local Bloch waves gradually slow down throughout the array, leading to local energy amplification.

In order to demonstrate the potential applications of rainbow reflection to water wave energy conversion, Part I also introduces a model of a wave energy converting device, in which heave-restricted, rectangular floating pistons equipped with a linear power take-off mechanism are positioned between each adjacent pair of vertical barriers in a graded array. This model was chosen in light of the low-frequency resonant mode of a pair of vertical barriers without a piston, which consists of a vertical fluid motion. Constrained optimisation techniques are used to determine the parameters of the wave energy converting device so that near-perfect energy absorption can be achieved (i) over a discrete set of frequencies and (ii) over a continuous frequency interval.

Part II of this thesis pivots to time-domain wave scattering. Two methods for solving time-domain problems are considered, namely the generalised eigenfunction expansion method (GEM) and the singularity expansion method (SEM). The GEM expresses the time-domain solution in terms of the frequency-domain solutions, whereas the SEM expands the time-domain solution over the discrete set of unforced, complex resonant modes of the scatterer. The normalisation of the complex resonant modes is achieved by regularising divergent integrals (i.e. by analytic continuation). The GEM and SEM are implemented numerically and applied to canonical problems in one and two dimensions. In particular, we consider the scattering of waves on a stretched string by a point mass, and the scattering of two-dimensional acoustic waves by bounded scatterers. The results show that while the SEM is usually inaccurate at $t = 0$, it converges rapidly to the GEM solution at all spatial points in the computational domain, with the most rapid convergence occurring inside the resonant cavity.

Bethany Macdonald (University of Otago. 2024)

Title: Modelling and inference for spatial point patterns.

Supervisors: Tilman Davies (University of Otago), Martin Hazelton (University of Otago) and Adrian Baddeley (Curtain University)

Abstract:
Modelling and inference are difficult but crucial tasks in spatial statistics. Exact likelihood based methods are desirable, but for clustered processes such as the log-Gaussian Cox process and Neyman-Scott processes, such methods are unavailable. This thesis makes important contributions to modelling and inference for spatial point patterns.

Intensity estimation, often achieved through kernel smoothing, is a key component of modelling spatial point patterns. Current methods of selecting the bandwidth, which controls the amount of smoothing, can lead to conflicting conclusions. We provide more reliable bandwidth selection methods for spatial intensity estimation by adapting methods previously developed for general multivariate density estimation.

In addition to estimating the intensity, we also wish to estimate the parameters that describe potential interaction between points. As the likelihood is intractable, one option is to approximate it using Monte Carlo methods. However, this is widely regarded as impractical, hence has rarely been implemented. We provide a comprehensive study of the computational properties of Monte Carlo maximum likelihood estimation for log-Gaussian Cox processes and compare it to other commonly used estimation methods.

The intractability of the likelihoods for clustered processes also leads to difficulties in inference. As a result, fundamental tasks such as a parametric test of clustering are out of reach. We leverage recent insights into Neyman-Scott processes to contribute formal hypothesis tests for such processes. Crucially, these tests can be used to conduct a test of clustering. A version of the likelihood ratio test can be performed using the Palm likelihood, however, the null distribution of the resulting test statistic does not behave as in the case of a true likelihood. In addition, when testing for clustering the test takes place on the boundary of the parameter space. We determine the appropriate adjustment for different hypotheses. These adjustments contain quantities that are intractable and must be replaced by estimates. We assess the performance of these adjustments empirically.

Overall, the contributions in this work advance and improve practical aspects of exploring and modelling spatial point patterns, and suggest avenues of future research.

OBITUARIES

Garry Tee (1932 March 28 – 2024 February 2)

Garry Tee, *photo provided*

Garry was born in Whanganui (then called Wanganui) and spent much of his childhood on South Island railway camps, as his father was an engineer. He attended Seddon Memorial Technical College (on whose site AUT now sits). At age 16, more than a year younger than the average pupil, he scored the highest marks in the whole country for the New Zealand University Junior Scholarship exams. His school principal described him as "particularly brilliant in mathematics and science".

Garry completed an MSc with First Class Honours from Auckland University College in 1954. John Butcher recalls meeting him at O'Rorke Hall at the start of the 1952 academic year, and describes him as "the first person I ever met who cared about mathematics and he became my unofficial mentor, as he was for many other younger students over the years". More details of his early life can be found in a Profile of him in the NZMS Newsletter number 54, from April 1992.

After completing his Masters, Garry went to Australia to work on data analysis for oil exploration, and later to the UK. He worked as a mathematician at the English Electric Company from 1958 to 1964. There he was involved in the development of the DEUCE computer based on Alan Turing's Bletchley-era design for the ACE computer.

He was then hired as a foundation member of the Department of Mathematics at the University of Lancaster in 1964, where he worked until 1968. He visited the Computer Science Department at Stanford University in 1965. He was appointed Senior Lecturer in Mathematics at the University of Auckland in 1968. He was a founding member of the Computer Science Department at Auckland, when it was formed in 1980. He returned to the Mathematics Department in 1989, and retired in 1998, enjoying an Honorary Academic affiliation and still coming to the department most days until 2018.

Garry was a pioneer in Computing and Numerical Linear Algebra and was always willing to share any new knowledge he gained with members of his large mailing list. He studied new publications, expounded the work for his followers and, in many cases, added to the technical knowledge of each new topic.

For large sparse linear systems, such as those formed by semi-discretisation of partial differential equations, direct solution is inefficient and should be replaced by Gauss–Seidel or Jacobi iterations. A hot topic early in

Garry's career was an iterative method known as successive over-relaxation and this was one of the main interests Garry had for many years. Choosing the best relaxation factor was a major interest and this could be analysed in problems like the Poisson equation with the Laplacian approximation using the 5-point stencil. Garry became an expert and an expositor on this important topic.

In those days Garry used to say that if a computer were stopped at random, it would most likely be in the middle of a linear equations solution. This observation was intriguing and partly true.

Garry took it as a great honour when Richard Bellman invited him to do a PhD at the University of Southern California. The topic he concentrated on was the efficient multiplication of large matrices. Everyone assumed that this is an n^3 problem, but everyone was wrong. Volker Strassen showed how to lower the this to $n^{\log_2(7)}$. Unfortunately, because of Bellman's illness and disability, Garry had to return to Auckland without a doctorate. But he brought back with him an elegant implementation of the algorithm.

In 2003 he was awarded an Honorary Doctorate from AUT.

Throughout his long career, which went well past his formal retirement, Garry published on a range of mathematical topics including many aspects of linear algebra, surface area of ellipsoids in n dimensions using elliptic integrals, permutable polynomials and rational functions, and many more.

Garry taught himself Russian and translated five books by Russian mathematicians. Arkadii Slinko recalls inviting Garry and Boris Pavlov to his house for dinner of home-made Borscht, during which Garry instructed the two Russians on the correct ingredients for Borscht.

Garry was deeply interested in the history of Mathematics, Computing, and Science. He wrote many articles published in leading journals of the history of science. He wrote monographs on the electromagnetics of Michael Faraday, and on the extensive correpondence between Charles Darwin and NZ scientists.

A particular interest of his was the work of Charles Babbage, some of whose relatives migrated to Australia and New Zealand. In the 1980s he wrote a detailed description of the manuscripts in The Babbage Collection in the Whanganui Regional Museum. He identified that a rusty piece of machinery on a farm in Whanganui was part of a Difference Engine built by Charles Babbage.

Garry supervised one PhD student, William Hawkins, who in 1982 wrote a PhD thesis entitled "The mathematical work of John Napier". Based on this research, technicians in Auckland University built a working Promptuarium Multiplicationis from Hawkins's translation of Napier's Latin text. Garry demonstrated this copy of Napier's Promptuary at the University of Auckland in 2017 before it was donated to Napier University in Edinburgh, where it is now on display. You can read more about this in the December 2017 issue of the NZMS Newsletter (Number 131).

Garry studied the lives and works of some of the great woman mathematicians, such as Sofya Vasilyevna Kovalevskaya. His article "The pioneering women mathematicians" was published in the Mathematical Chronicle in 1981 (an Auckland Maths Department pre-cursor to the New Zealand Journal of Mathematics) and later republished by The Mathematical Intelligencer in 1983.

He wrote articles on topics as diverse as "The Dunedin Arabic Manuscript of Euclid's Elements", and "Science on the map: Places in New Zealand named after scientists".

He encouraged Catherine Caughey, who worked with the Colossus computer at Bletchley Park during World War II, to publish her story. She did this in her book "World Wanderer", published in 1994. Garry kept this book close by him in his later years at Jervois Residential Care in Herne Bay.

Garry devoted his life to scholarship. His careful proof-reading was legendary. He wrote detailed letters and book reviews, and his contributions are acknowledged in many works.

Garry was for many years the correspondent for the University of Auckland Mathematics Department for the NZMS Newsletter, only handing on this duty in 2018.

Outside of mathematics and computing, Garry was a keen diver and underwater photographer. He lived in Devonport for over 50 years. The Devonport Flagstaff newspaper published an Obituary entitled "Computer pioneer was familiar figure on the ferry" on March 8, 2024.

Authors: Steven Galbraith, John Butcher
Comments: David Gauld

REPORTS ON EVENTS

Frontiers in Applied Dynamical Systems

Workshop in honour of Bernd Krauskopf

Bernd Krauskopf (University of Auckland) turned 60 this year. To mark this special occasion, his former PhD student Sebastian Wieczorek (University College Cork, Ireland) hosted the workshop "Frontiers in Applied Dynamical Systems" in his honour and invited many former students, postdocs, and collaborators to Cork.

The workshop celebrated the significant impact worldwide of Bernd's contributions, and a select number of invited talks emphasised the collaborative and multidisciplinary nature of Bernd's research into dynamical systems, with applications stretching across science and engineering. Participants came from a variety of fields, including biology, climate science, engineering, industrial mathematics, physics, and more. For the students and early-career researchers, it provided an ideal opportunity to network, be informed of the latest developments in the field, as well as a having in-depth scientific discussions and cross-fertilisation of theory, techniques and ideas between mathematicians, scientists and engineers.

Participants get ready for the first day of talks.

Over the three-day programme, participants enjoyed sixteen talks in which each speaker was asked to end their 30-minute talk with an additional 5-minute personal note. Several talks emphasised the lasting impact of Bernd's research on the dynamics of lasers: Bernd's first collaborator on the topic is Daan Lenstra (Eindhoven University of Technology, the Netherlands), who presented new and intriguing experimental results on excitability in coupled lasers; Soizic Terrien (Le Mans University, CNRS, France) talked about the organisation of resonance tongues in an excitable laser with delayed feedback, which is follow-up research from her time as a postdoc at the University of Auckland; Sylvain Barbay (Université Paris-Saclay, CNRS, France) showed experimental work on excitable micropillar lasers; and Kathy Lüdge (Universität Ilmenau, Germany) exhibited her successful applications of using lasers for reservoir computing.

Bernd's research endeavours in the realm of mathematical biology were represented by talks from Jonathan Rubin (University of Pittsburgh, USA), who presented his ideas of using timescale separation as a control for generating particular neuronal bursting patterns; Pablo Aguirre (Universidad Técnica Federico Santa María, Chile), who showed the importance of global invariant manifolds in models of population dynamics; and John Terry (University of Birmingham, UK), who spoke about the application of dynamical systems theory for the diagnosis and treatment of epilepsy. There was also a talk on industrial mathematics, given by James Knowles (Loughborough University, UK) who discussed the application of bifurcation analysis in the aerospace sector. Chris Budd (University of Bath, UK) gave a talk on dynamic tipping in climate models and Harry Dankowicz (University of Maryland, USA) emphasised Bernd's work on algorithm development by speaking on using COCO for parameter continuation and uncertainty quantification.

Bernd with Dana's gift.

Dana C'Julio (University of Auckland), who had submitted her PhD thesis only two weeks before the conference, presented the computational part of her PhD research with a talk on the numerical identifation of blenders in a three-dimensional Hénon-like map. The personal contribution at the end of her talk was a particularly hilarious criticism on the quality of Bernd's handwriting! She made it clear that it is well known among PhD students who choose to have Bernd as PhD supervisor that this means accepting not only the challenge of performing top-quality research, but also dealing with the stress of deciphering the generous amount of comments and corrections on any written work. To help future students cope, she compiled a comprehensive collection of scribbles and their meanings in a small booklet. She presented Bernd with *Bernd's Lexicon* and asked him to check a few entries. To the delight of the audience, Bernd found himself squinting, turning the booklet upside down, and eventually exclaiming that one would need to read the words in the appropriate context.

Other talks covered more theoretical topics: John Guckenheimer (Cornell University, USA) spoke on a Devil's staircase of principal foliations; Ale Jan Homburg (University of Amsterdam, the Netherlands) spoke on iterated function systems; and Tony Humphries (McGill University, Canada) presented collaborative work on state-dependent delay differential equations. The main organiser Sebastian Wieczorek (University College Cork, Ireland) also gave a presentation, on rate-induced tipping points. Another highlight was the presentation by Rajarshi Roy (University of Maryland, USA) who gave an almost philosophical talk on the physics of aging; his present for Bernd was a book by Irish philosopher John O'Donohue on the Celtic concept of the "soul friend" which emphasises the mutual respect and admiration between them. Raj was not the only one who travelled from far to be present at this special workshop and help celebrate Bernd's 60th birthday.

Raj's present *Anam Cara*.

Participating former and current PhD students: back row, starting right, Johan Dubbeldam (PhD 2000), Sebastian Wieczorek (PhD 2002), David Barton (PhD 2006), Thorsten Rieß (PhD 2008), Piotr Słowiński (PhD 2011), Pablo Aguirre (PhD 2012), James Knowles (PhD 2012), Stefanie Hittmeyer (PhD 2014), Jen Creaser (PhD 2015), and Peter Langfield (PhD 2015); front row, starting left, Andrew Keane (PhD 2016), Andrus Giraldo (PhD 2017), Cris Hasan (PhD 2018), and current students Dana C'Julio, Renzo Mancini, and Juan Patiño.

Participants were given the opportunity to present their own research in a poster session that also featured a band playing traditional Irish music, along with snacks and drinks. A large breadth of research was shown by the posters of: David Barton (University of Bristol, UK) on a scalable uncertainty quantification framework; Hassan Alkhayuon (University College Cork) on a cancer model that can reproduce breast cancer data; Rafal Bogacz (University of Oxford, UK) on Arnold tongues in the brain; Dana C'Julio on the geometry of wild chaos; Hinke Osinga (University of Auckland) on geometric models of wild chaos; Juan Patiño on wild chaos in a 4D Lorenz-like system; Cris Hasan (University of Glasgow) on multi-objective optimisation; James Knowles with a study of tyre friction; and Renzo Mancini with a two-delay model for the Atlantic Meridional Overturning Circulation.

Bernd thanks the organisers, from left to right: Sebastian, Jen, Andrew, Jan, Johan, and Soizic.

The workshop ended with an amazing conference dinner at the Hayward Manor in Cork. To thank the workshop organisers Sebastian Wieczorek and Andrew Keane (also from Cork), as well as the members of the Scientific committee Jen Creaser (National Grid, Bristol, UK), Johan Dubbeldam (Delft University of Technology, the Netherlands), Jan Sieber (University of Exeter, UK) and Soizic Terrien (Le Mans University, CNRS, France). Bernd had brought a bottle of aged port wine from the Moana vineyard that, sadly, did not survive the recent devastating floods in Hawke's Bay. Staff at Hayward Manor were very happy to supply the group with port glasses so all participants could have a taste. The quality was confirmed by a (Portuguese!) expert on the subject and all particpants went home with a huge sense of satisfaction of this superbly organised workshop.

Group photo of almost all participants, taken in the Aula Maxima, University College Cork.

MINZ 2024

University of Canterbury

In the first week of July the annual MINZ workshop took place directed by James Williams and Miguel A. Moyers Gonzales. The event was well-attended with participants ranging from honours students to retired professors. During the week, we collaborated on challenges brought by New Zealand Police, Tait Communications, Dairy NZ, Orion Energy and Fonterra. These projects were interesting, enjoyable and well-supported by data and industry expertise. The environment at the University of Canterbury was excellent: we were well-looked after as we engaged with the challenges.

This was the sixth edition of MINZ (https://minz.org.nz). The series of workshops was initiated by Graeme Wake at Massey University in Auckland in 2015. They are one of many such Study Group series worldwide. The Canterbury workshop followed a hiatus during the COVID period and is the first time MINZ has come to the South Island.

It was instructive and enjoyable and I am looking forward to returning to Canterbury at a similar time next year for MINZ 2025. If you've not experienced one of these study group workshops, then come along and try it. Bring your colleagues, students and teachers. Thank you to the team at Canterbury for a great week.

Winston L. Sweatman

Impressions from the European Nonlinear Dynamics Conference (ENOC 2024) in Delft, July 2024

The European Nonlinear Dynamics Conference is organised every three years to bring together the nonlinear dynamics research community across the fields of Mathematics, Physics and Engineering. You may notice that the acronym ENOC does not match. This is because this series of conferences started out as the European Nonlinear Oscillations Conference, and the acronym was kept (likely because it is easier to pronounce) when its scope was widened and the name was changed in 2005. The ENOC series has been organised since 1992 by the European Mechanics Society (EuroMech) with the goal of bringing together researchers from the West and the East, and its history goes back to the International Conferences on Nonlinear Oscillations in Eastern Europe that started in the 1960s.

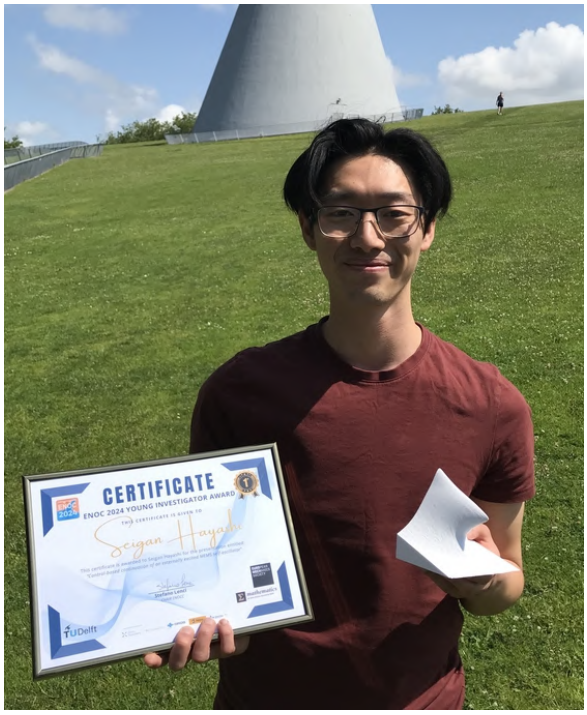
Since 1992, the conference has been oscillating between Western and Eastern European locations, and ENOC 2024 was held in July at the Technical University of Delft, perfectly timed in between the European Football Championship and the Olympics. There is traditionally a considerable emphasis on applications of dynamical systems methods to engineering systems, and the local organisers hailed from TU Delft's Faculties of Mechanical, Civil and Electrical Engineering, as well as from Mechanical Engineering at TU Eindhoven and the University of Twente.

The venue of ENOC was the AULA Conference Centre of TU Delft, which is a massive and still somewhat futuristic-looking concrete building, giving the impression that a very heavy UFO just landed. The TU Delft campus is extensive with many new buildings, and it is located conveniently within a short walk of the city centre of Delft. If you have not visited Delft, I highly recommend it as a very Dutch experience: it is not very big but of huge importance for Dutch history. To name just a few highlights, it is well known for Delft-blue ceramics, Vermeer lived and painted here, and the first king William of Orange has been buried in the Royal Burial Vaults of the New Church. We are talking here about history from the heydays of the Middle Ages. The New Church is actually from 1496 and there is indeed also the Old Chuch dating back to 1246. So old and new are interesting concepts in Delft.

Anyway, back to ENOC 2024. There were almost 400 participants from around the world, and the programme featured 6 keynote presentations and 20 mini-symposia over five days. Despite being the furthest from Delft, New Zealand was represented very well at ENOC 2024 with 11 participants according to the organisers. In particular, there were several mathematicians from New Zealand or with connections to it, participating in the mini-symposia 'Computational Methods', Slow-Fast Systems and Phenomena', 'Nonlinear Dynamics for Engineering Systems', 'Time-Periodic Systems' and 'Systems with Time Delays'.

Back row, left to right: Jan Sieber (University of Exeter and Marsden AI), Behrooz Yousefzadeh (Concordia University and sabbatical visitor at UoA), Dana C'Julio, Renzo Mancini, Lorenzo Anoè amd Sam Doak (PhD students at UoA), Hinke Osinga (UoA), Peter Langfield (INRIA Bordeaux, PhD from UoA), Bernd Krauskopf (UoA); front row, left to right: Andrus Giraldo (Korean Institute of Science and Technology, PhD from UoA), Kyoung Lee (Postdoc at UoA), Soizic Terrien (University of Le Mans, former Postdoc at UoA), Seigan Hayashi (PhD student at UC).

The stated goal of ENOC is to "promote the cross-fertilization of ideas and stimulate international interactions in various areas of nonlinear dynamics", and the 2024 edition appears to have achieved this. While the programme was very dense with parallel mini-symposia, the coffee breaks, the lunches and the evenings provided ample opportunity for discussing present developments and open problems with colleagues and friends, old and new. A very special opportunity for networking was the conference dinner, which was actually held in the New Church. Dinner in a church was definitely a new experience for most participants.



Seigan Hayashi with the 1st prize of the ENOC 2024 Young Investigator Award and his 3D-printed measured frequency response surface.

The talks were generally of high quality, especially those of PhD students and early-career researchers. Maybe I am a bit biased here, but I really enjoyed their generally higher (strictly on average, of course) enthusiasm levels. Possibly this was encouraged by the opportunity to win first, second or third prize of the ENOC 2024 Young Investigator Award for best presentation? A staggering 15 speakers were shortlisted, based on criteria including clarity of presentation, relevance of the research, design of their slides and answering questions from the audience. ... (excited drum roll) ... and the winner of the 1st Prize was: Seigan Hayashi from the University of Canterbury for his presentation ‘Control-based continuation of an externally excited MEMS self-oscillator’. Well done Seigan!

Bernd Krauskopf

NZMRI NEWS

As many readers will know, the New Zealand Mathematics Research Institute (NZMRI) Inc. was established over 25 years ago, under the leadership of the late Sir Vaughan Jones, with the dual aims of promoting research in mathematics and its applications in NZ, and promoting the dissemination within NZ of worldwide developments in mathematical research.

It has run a series of summer meetings over that time, each on a particular theme (chosen by the NZMRI's directors from suggestions made by members of the mathematical community), with expert invited speakers giving short courses of lectures on various aspects of the chosen theme. Details of these meetings can be seen at the NZMRI's website https://www.nzmri.org.

Most of these meetings were supported intellectually, financially and personally by Vaughan Jones, and for the last few years they have also been supported by an annual donation from the Margaret and John Kalman Trust.

The next two meetings will be as follows:

- A meeting on *Wave propagation phenomena: theory and computations*, at Hanmer Springs 12–18 January 2025, being organised by Marie Graff (U Auckland), Dimitrios Mitsotakis (VU Wellington) and Fabien Montiel (U Otago); see https://sites.google.com/aucklanduni.ac.nz/nzmri2025 *[Ed.: see Notice section]*
- A second 'Early Career Researchers' meeting, at a venue to be determined, in early 2026, following up on the first such meeting held at Napier in January 2021 (when Covid made it difficult to arrange for speakers from overseas).

People wishing to organise future meetings are very welcome to make preliminary suggestions to any one of the NZMRI's directors at any time. (See https://www.nzmri.org for names and details.)

Also the NZMRI and Vaughan Jones's widow Martha (also known to many of us as Wendy) have been providing the prize money for the Jones Medal, awarded every two years by the Royal Society of New Zealand (Te Apārangi) for lifetime achievement in pure or applied mathematics or statistics, by a person with substantial connections to New Zealand.

We are very happy to announce that Wendy has made a very generous donation to the Society to ensure funding for the Jones Medal Prize in perpetuity. She saw this as entirely appropriate, given Vaughan's love of New Zealand and his very clear wish to do what he could to support mathematics in this part of the world.

Gaven Martin (Chair), Rod Gover (Secretary), Marston Conder (Treasurer)

GENERAL NOTICES

Asian-Oceanic Women in Mathematics Workshop 2024

The Asian-Oceanic Women in Mathematics (AOWM) Workshop will be held 6th to 9th December 2024 at the University of Auckland as a satellite event and prequel of the joint NZMS/AustMS/AMS meeting.

The AOWM was established in 2022 to facilitate interactions among women mathematicians in these regions. The Workshop will provide a number of career/research development activities and networking opportunities which can be built on during the joint conference. It is planned to hold the AOWM AGM at the event.

More details and registration are available on: https://forms.gle/3sLWjutspnPwQEWr5

Annalisa Conversano
(NZ Coordinator for AOWM)

La Mathematica – Call for papers

There will be a volume of AOWM by La Mathematica partly based on the conference held in ICTS, Bangalore last year.

Here is a link to the "call for papers" page for the collection https://link.springer.com/journal/44007/updates/27204712

We look forward to having a lot of interesting articles in this volume.

Sanoli Gun
(On behalf of AOWM)

FiNZ 2025 University of Otago, Dunedin - Save the dates

We are planning to host Fluids in New Zealand 2025 at the University of Otago in Dunedin on:

29th – 31st January 2025.

The plan is to start mid-morning on the Wednesday and end at lunchtime on the Friday.

The aim is to bring together the fluids community in New Zealand to share their research, network and enjoy summer in Dunedin.

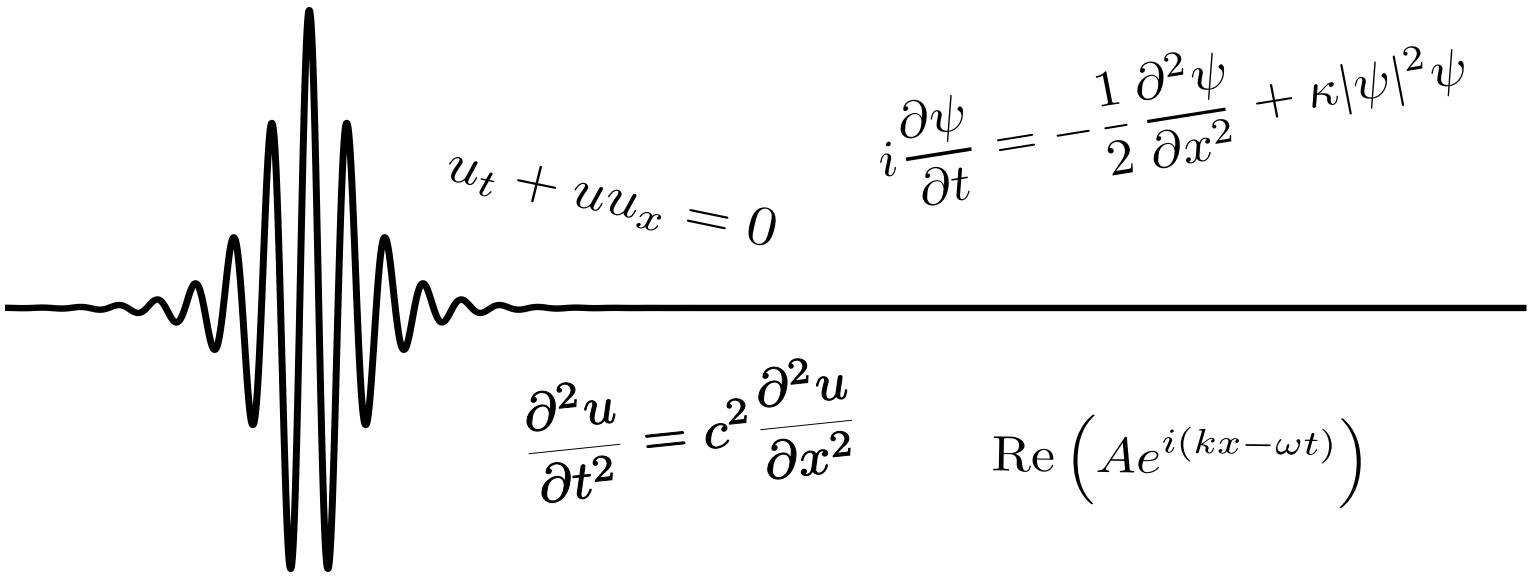
We are interested in suggestions for keynote speakers, either in New Zealand or who might be visiting New Zealand at the time. We are looking for a gender balance in our keynote speakers so please bear this in mind.

Please pass this onto any colleagues and students who might be interested.

Sarah Wakes, Jono Squire, Fabien Montiel, Sam Lowery and Kirill Misiiuk
FiNZ 2025 Organising Committee

NZMRI summer meeting 2025

Wave propagation phenomena: theory and computation



The 2025 NZMRI summer meeting will be held on **12-18 January2025** at the Hanmer Springs Hotel, in **Hanmer Springs**.

Plenary speakers

- Prof Hongqiu Chen (University of Memphis, USA)
- Prof Paul Martin (Colorado School of Mines, USA)
- Prof Eldad Haber (University of British Colombia, Canada)
- Dr Emily Lane (NIWA, NZ)
- Dr Stuart Hawkins (Macquarie University, Australia)

For more information and registration, visit the website:

https://sites.google.com/aucklanduni.ac.nz/nzmri2025

New Zealand Mathematics Research Institute (Inc.)

NZMS NOTICES

NZMS Awards

We would like to draw your attention to the newly established

- NZMS Teaching Excellence Award.

This award will recognise an outstanding teaching practice of mathematics lecturers in the New Zealand tertiary sector. More information, including eligibility rules and application form, can be found on the awards page: https://nzmathsoc.org.nz/?awards

We are also seeking nominations for

- Fellows of the NZMS,
- the NZMS Research Award,
- the NZMS Early Career Research Award,
- the Gillian Thornley award
- the Kalman Prize.

Nominations for Fellows and awards need to be emailed to the NZMS President (melissa.tacy@auckland.ac.nz) **on or before the 31st August**.
Any unsuccessful applicants from last year are warmly encouraged to update their applications and resubmit.

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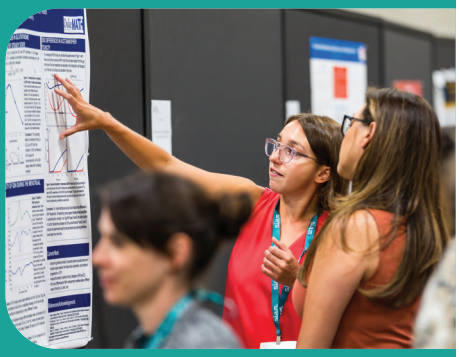

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- Advocate for increased funding for research and education

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— Sven Leyffer, SIAM President, Argonne National Laboratory

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