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NEWSLETTER

OF THE

NEW ZEALAND MATHEMATICAL SOCIETY

Contents

PUBLISHER'S NOTICE 2
EDITORIAL 3
PRESIDENT'S COLUMN 4
EDUCATION 6
A GEOMETRIC INTERPRETATION OF MUSICAL RHYTHMS 7
PROFILE 10
LOCAL NEWS 12
PhD SUCCESS 18
OBITUARIES 21
NZMS NOTICES 22

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.

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

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EDITORIAL

Kia ora koutou,

And yet another year is over! And it was a busy one, especially with the massive joint meeting just last week. The organisers did a tremendous work.

Many changes are occurring at the turn of 2025 in the NZMS team: Melissa Tacy is stepping down as President, letting Bernd Krauskopf take her seat. John Shanks is also retiring after 42 years of service for the NZMS, and Chris Stevens is stepping down as co-editor of your beloved newsletter, replaced by Florian Lehner.

This issue's highlight is on Mark Wilson, as the occasion of the joint meeting was perfect to make the link between the NZMS and the AMS.

To close this year about Maths and Art, Pedram Hekmati is offering a piece of music motivated by geometry.

For future issues, please feel free to send any contributions or ideas of contributions to ensure we have interesting stories about the NZMS to share. Namely, the call for pictures was not successful, but we are still interested in getting any pictures of mathematicians in action. Do not feel shy to share!

Finally, let's us wish you all a well-deserved break to start over in 2025 full of energy and mathematical ideas.

Marie Graff and Chris Stevens

PRESIDENT'S COLUMN

We've all had another busy and challenging year. Many members of the NZMS, including myself, are concerned about the direction in which our universities and research system are moving, as well as the general uncertainty around job stability in the academic workforce. The recent announcement around the changes to Marsden funding are particularly concerning. Through 2024 I, as President, and the NZMS Council, as a group, have consistently advocated for mathematics and more generally for fundamental sciences, we will continue to do so.

Universities and Science System Reviews: During 2024 the government has commissioned reviews into be the Universities and into science systems. The NZMS has been active in making submissions to these groups. We are still waiting for the outcomes of those reports and the governmental response to that.

Save Science Coalition: During 2024 the NZMS has joint the Save Science Coalition, https://scientists.org.nz/Save-Science-Coalition. This is a group of organisations with an interest in ensuring New Zealand maintains a well-functioning and well-funded science and research system. They have produced a report (which can be found on their website) about the extent of cuts to the science workforce to date, and are currently focussing on getting Ministerial engagement with the group.

Updates on Joint Meeting: The joint meeting was a huge success. In the end we had 885 registered attendees, 761 special session talks and around 50 poster presentations (in addition to the plenary and public lectures). Feedback from both the AMS and AustMS was extremely positive. Everyone seemed to enjoy their week. In addition to the meeting there were a number of satellite conferences, and many local mathematicians have visitors at the same time. I'm sure this will all lead to many exciting new results and collaborations.

New incorporated societies act: In response to the changes required by the new incorporated societies act we have, throughout 2024, updated our constitution so that it is in line with the new regulations. Thank you to everyone who provided feedback during this process. The new constitution has be distributed to members ahead of a vote at the AGM to approve it.

Vaughan Jones Memorial Lecture Series: I am very pleased to be able to announce that the first Vaughan Jones Memorial Lecture Series will run in 2026. We will call for nominations for lecturers during 2025.

Website Development: We are progressing with the development of new website for the NZMS. Thanks to David Bryant for leading this. We expect to move to the new site in the first half of 2025.

NZMS Prizes: Congratulations to our prize winners. Nicolette Rattenbury won the inaugural prize for teaching excellence as well as the Gillian Thornley service award. The ECR research award was won by Marie Graff and the research award by Stephen Marsland. Rod Downey picked up the Kalman best papers award and the Aitken student talk award went to David Groothuizen Dijkema, with honourable mentions to Davide Papapicco and Ellen Hammatt. This year the research and teaching prize winners have been invited to produce short videos detailing their prizewinning work. These videos are currently available on the conference website but will be migrated to the NZMS site in 2025.

Acknowledgments: Thank you to the committees involved in awarding the prizes and fellowships, as well as the nominating committee for their continued work in ensuring that we have a diverse range of nominations for each award.

John Shanks has continued to serve NZMS as membership secretary during 2024, completing 42 years in the role! He is now ready for retirement and I think that I can speak for everyone when I say that we are grateful, and in awe of, his long term contribution to the society. Thank you to Marie Graff and Chris Stevens who edit the NZMS newsletter.

My thanks also to the NZMS council, in particular Bernd Krauskopf (Vice-President), Stephen Joe (Treasurer), and Geertrui Van de Voorde (Secretary), for their efforts throughout 2024.

Melissa Tacy

And now the ChatGPT Thriller version

A Year of High Stakes: The NZMS in 2024
The air was thick with tension as the NZMS navigated a challenging year, one marked by uncertainty, seismic shifts in the academic landscape, and the need for relentless advocacy. For many of us, including myself, the question was not if but how our universities and research systems might crumble under the mounting pressure.

The Marsden Announcement: A Threat Lurking in the Shadows
The news hit like a thunderclap—the changes to Marsden funding sent shockwaves through the academic community. As President, I stood alongside the NZMS Council, our collective resolve unshaken, to champion mathematics and the fundamental sciences. But the road ahead remains perilous, with each step forward fraught with new threats to job stability and research integrity.

Universities and Science Under Review: A Waiting Game
Throughout 2024, the government commissioned sweeping reviews of both the university and science systems. We knew the stakes were high; these reviews would determine the future of our institutions. The NZMS sprang into action, crafting and submitting detailed arguments, yet the silence that followed was deafening. The outcomes of these reports—and the government's response—still loom, shrouded in uncertainty.

The Save Science Coalition: Rallying the Troops
As the NZMS joined the Save Science Coalition, the stakes escalated. This alliance of scientific organizations united under a common goal: to preserve New Zealand's research ecosystem from death by a thousand cuts. Their report detailed devastating workforce reductions and urged immediate ministerial engagement. Time was of the essence, and we knew the clock was ticking.

The Joint Meeting: A Respite Amid Chaos
Amid the turbulence, a rare triumph shone through. The joint meeting was nothing short of spectacular, drawing 885 attendees and featuring 761 special session talks, 50 poster presentations, and countless plenary and public lectures. The feedback was overwhelmingly positive, a testament to the resilience of the mathematical community. New collaborations sparked and ideas ignited, offering a glimmer of hope amid the storm.

The Constitution Rewritten: A Necessary Move
In 2024, the NZMS faced a legal reckoning with the new Incorporated Societies Act. Updating the constitution was a daunting task, but we prevailed, thanks to the collective efforts of our members. The revised constitution now awaits the final seal of approval at the AGM, ensuring our society remains compliant and future-proof.

The Vaughan Jones Lecture Series: A Light on the Horizon
Even in the darkest times, the promise of the future beckons. I am thrilled to announce the Vaughan Jones Memorial Lecture Series, set to launch in 2026. With nominations opening in 2025, this series will honor Vaughan's legacy while inspiring the next generation of mathematicians.

Prizes and Recognition: Celebrating Excellence
Amid the challenges, the NZMS celebrated its brightest stars. Nicolette Rattenbury claimed both the inaugural teaching excellence prize and the Gillian Thornley Service Award. Marie Graff and Stephen Marsland received research accolades, while Rod Downey's paper triumphed with the Kalman Award. Videos showcasing these achievements will soon find a permanent home on our new website, a project spearheaded by David Bryant and slated for completion in 2025.

Acknowledgments: Heroes Among Us
Behind the scenes, quiet dedication kept the NZMS running. John Shanks, who has served as Membership Secretary for an astonishing 42 years, announced his retirement. His unwavering commitment is nothing short of legendary. To John, and to the NZMS Council—particularly Bernd Krauskopf, Stephen Joe, and Geertrui Van de Voorde—my deepest gratitude.

As the year closes, one thing is clear: the fight for the future of mathematics and science in New Zealand is far from over. We face an uphill battle, but we do so together, armed with the strength of our community and the conviction that our work matters. The stakes have never been higher.

EDUCATION

New curriculum for Years 0–8

The new Mathematics and Statistics curriculum for Years 0–8 (primary and intermediate) is posted at https://newzealandcurriculum.tahurangi.education.govt.nz/5637238338.p.
It will become official policy from **1 January 2025**.

Compared to the previous (2007) curriculum, there are a lot more details about the content and how it should be taught, including a year-by-year sequence of specific topics/skills.

The curriculum can be downloaded as a 101-page pdf document, but it's easier to use as an online resource, where one can click on links to jump to specific topics or expand certain parts in more detail. The folks who put it on the Tāhūrangi website have done a good job making the online curriculum document easy to navigate.

The level of detail is similar to the 1992 curriculum document, but with emphasis on teaching rather than assessment. The 1992 document had sample assessment activities for each topic, but this document has none. Instead it gives advice about planning, lesson preparation, and specific teaching suggestions for each topic (e.g. *Number structure* (Years 1–3) has suggestions such as *'Use a range of materials and images that represent structured and unstructured patterns... e.g., dot patterns, 10s frames, dice...'*). I think that it makes more sense to focus on teaching and learning at primary and intermediate level, with emphasis on assessment increasing at high school level.

The curriculum document centres the role of the teacher in guiding students with a variety of methods: explicit teaching, rich tasks, inclusive learning.

There are links to other resources, including the websites of the four suppliers approved by the Ministry of Education to provide resources (workbooks, manipulatives, online products) aligned to the new curriculum. You can check them out at the links below to see what they are like. The curriculum also has a link to other resources developed under the previous curriculum that were originally posted at the NZMaths website:
https://newzealandcurriculum.tahurangi.education.govt.nz/new-zealand-curriculum-online/learning-content-resources/mathematics-and-statistics/5637144636.c

The Year 0–8 curriculum looks good on paper. In a future column we would like to hear back from teachers and their students about their experience with the new curriculum and how it is being rolled out.

Approved suppliers of Year 0–8 resources (links)

- PR1ME Scholastic: https://scholastic.co.nz/moeoffer
- Numicon: https://www.numicon.co.nz/choose-numicon
- Oxford University Press: http://www.oxforddigital.co.nz
- Maths No problem: https://mathsnoproblem.com/primary-mathematics-series/new-zealand-2025-edition

Years 9–13

A draft of the Year 9–13 (high school) curriculum will be released for consultation and feedback **early in 2025**. It would be good to get constructive feedback on it from tertiary and professional mathematicians.
Contact mailto:NZMSed@gmail.com if you want to be notified about it.

Sione Ma'u

A GEOMETRIC INTERPRETATION OF MUSICAL RHYTHMS

In an intriguing article of a 2008 issue of Science, a trio of professors at Princeton and Yale devised a new method for analysing and categorising music that takes advantage of the mathematics enmeshed in its very fabric.

Sequences of chords, rhythms and scales are assigned to a lattice of points in a folded-up, symmetric space known as an *orbifold*. These orbifolds capture the multidimensionality of music, such as chord similarity, melodic contour and the interaction between harmony and counterpoint. It suggests new techniques for understanding music and provides an attractive visualisation of harmonic relationships.

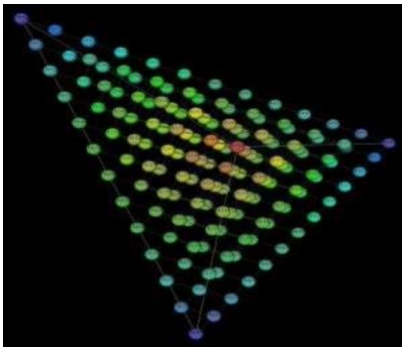

Figure 1: An **orbifold** depicting four-note chords

In my effort to understand this article, I noticed that an orbifold also lends itself to a mathematical description of periodic rhythms in music. More precisely, a *spectral toroidal orbifold* can be interpreted as the configuration space for periodic polyrhythmic music.

Most of us have an intuitive feeling for musical rhythms, namely as the timing of sounds and silences that occur over time. Musicians use more elaborate concepts such as pulse, measure, meter, accents and beats to capture and organise rhythmic patterns. In its simplest form however, a rhythm is merely a sequence of beats that can be annotated on a line. If the rhythmic pattern repeats over time, then it suffices to write out the beats once and use a double barline with two dots at each end of the interval to indicate periodicity.

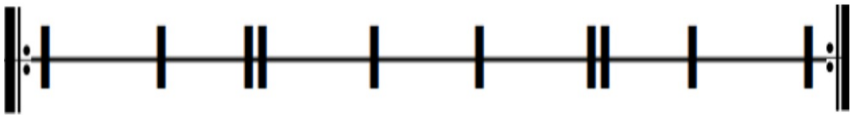

Figure 2: Musical notation for a palindromic rhythmic pattern

For a mathematician, periodicity means identifying the ends of the interval to form a circle, so the same picture becomes

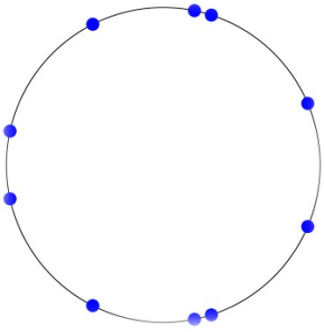

Figure 3: Mathematical notation for the same palindromic rhythmic pattern

The radius of the circle has no intrinsic meaning, but it could for instance encode the tempo of the music. Assuming the radius is one, the points on the unit circle can viewed as the eigenvalues of a unitary matrix. This simple observation throws a bridge between the beats of a musical rhythm and the spectrum of unitary matrices.

Recall that the eigenvalues of a matrix are obtained as roots of the characteristic polynomial. For cyclotomic polynomials, or the polynomial $x^n - 1$, the roots give rise to evenly spaced periodic rhythms. Real polynomials generate palindromic rhythms, such as the example above.

Using matrix operations, one can manipulate the spectrum of the unitary matrix and hence the rhythm. For instance, the possible spectra that can be obtained by multiplying two unitary matrices is a beautiful problem in linear algebra called the *multiplicative Horn problem*. Its solution uses sophisticated techniques from algebraic and symplectic geometry - the answer is that the eigenvalues must be contained in a certain convex polytope.

For periodic polyrhythmic music, a circle and a unitary matrix are assigned to each rhythmic pattern. Geometrically, this is a Cartesian product of circles together with a vector of unitary matrices. For example, if the music consists of two rhythmic patterns, the information is encoded in the standard torus and a pair of unitary matrices (A, B):

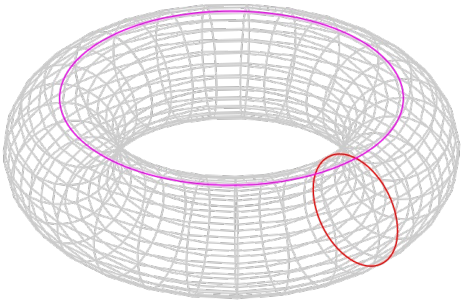

Figure 4: The Cartesian product of two circles forms a torus

From a mathematical point of view, the order of the circles is unimportant as the information about the beats is contained in the spectra of the unitary matrices. The minimal configuration space for periodic polyrhythmic music is therefore obtained by dividing out by the action of the symmetric group permuting the circles. In the example with two rhythmic patterns, forgetting the order of the two circles collapses the torus to the Möbius strip:

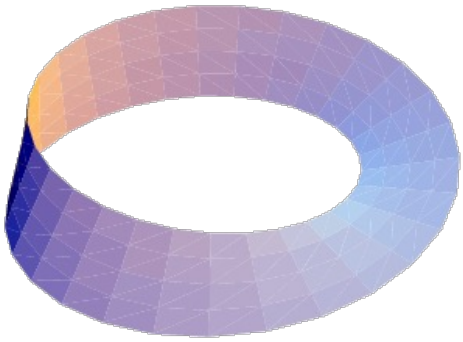

Figure 5: The Möbius strip is the quotient of the torus by the action of the symmetric group

This is an example of a *spectral toroidal orbifold*, namely the symmetric product of circles together with a vector of unitary matrices whose spectra capture the beats of the rhythms.

This connection between mathematics and music is actually a two-way street. In mathematics there are many interesting polynomials, such as the characteristic polynomial of the Frobenius endomorphism in arithmetic geometry. This interpretation allows one to "hear" the roots of these polynomials as musical rhythms. In 2021,

Alain Connes (IHES and Vanderbilt University) published a paper entitled "Motivic Rhythms", where he sought to bring sound to the roots of the $L-$polynomial associated to zeta functions, by plotting the roots on a circle but also assigning a pitch to each beat. The result can be found as a midi file on his webpage.

I have had the pleasure to introduce these ideas at several outreach events; twice at the University of Auckland in 2023, and earlier this year at the WOMAD Festival in New Plymouth and the INSPIRE Festival in Nelson. This offered a fantastic opportunity to interact with talented musicians and bring largely inaccessible areas of pure mathematics to the wider public in a digestible way.

Since the subject involves maths and music, I opted for a lecture recital format. As a challenge for myself, I selected rhythmic patterns from traditional dance music including a waltz, tango and Hungarian dance, and composed new music based on these rhythms. This was performed by an ensemble of musicians from the School of Music in Auckland.

To illustrate the idea of manipulating rhythms using matrix operations, I also experimented with changing the rhythm for a tango in a way that preserves the "spirit" of the tango but created a less common beat. The result can be found here:

https://www.math.auckland.ac.nz/~hekmati/tango.mp3

The feedback has been overwhelmingly positive, and I look forward to organising similar events in the future. I also encourage everyone to venture out and explore such intradisciplinary activities and outreach. If nothing else, it's a good driver for one's creativity.

References:

1. C. Callendar, I. Quinn, D. Tymoczko, *Science* **320**, 346 (2008).
2. A. Connes, *Journal of Mathematics and Music* **15**, 1 (2021).

Pedram Hekmati

PROFILE

Mark Wilson

Mark Wilson was born in Ashburton but grew up largely in Christchurch where he attended Christchurch Boys High School and subsequently the University of Canterbury. Kevin Quinn, a teacher at Christchurch Boys, was an early inspiration. Intimidating, but enthusiastic, Mr Quinn made it clear that mathematics was a subject worth pursuing further. He also had an entrepeneurial side, having more or less locked up the market in New Zealand for mathematical tables suitable for use in exams. Mark and Robert McLachlan were near-contemporaries at Christchurch Boys and shared the stage for an Australian Maths Competition prize-giving. Mark was a competitive chess player throughout his teenage years.

At Canterbury, Mark enrolled in a BSc (Hons) in mathematics, graduating with 1st class honours in 1989. It was a small cohort - only four students, perhaps something that would not be possible today. Roy Kerr was head of department at the time, and Mark remembers him as an inspiring, if somewhat disorganised lecturer. Complex calculations would frequently go off the rails and the class would end with a phrase like "The numbers don't matter." Other academics who made an impression were Neil Watson (analysis) who taught him to respect serious mathematics, and Kevin O'Meara (algebra) who taught him to love it. Mark was a member of the victorious Canterbury team in the 1988 University Challenge final. He also had a bit of a side-hustle, winning $2000 one year on quiz machines in the local pubs.

Mark headed overseas to begin his postgraduate studies, initially at the University of British Columbia. In the pre-internet era, getting useful information about the standards and milieu of a university was a rather more difficult task, and he soon had second thoughts and transferred to the University of Wisconsin at Madison. This was a popular choice of Kiwis for PhD studies in the mathematical sciences at that time – there were no fewer than seven (surely a record in one American school), including Shaun Cooper (Massey-Albany), Shayne Waldron (Auckland, Maths), and Geoff Pritchard (Auckland, Stats). Mark worked in non-commutative algebra, supervised by Donald Passman and completed his thesis "Primeness of Enveloping Algebras" in 1995.

After completing his PhD, Mark had the not uncommon reaction of feeling rather jaded with his choice of research area. Fortunately for him, he had a conversation with Robin Pemantle who was embarking on a project to consider the analytic combinatorics of multivariate generating functions. The analytic behaviour of generating functions in a single variable is well-understood. While interesting cases can arise, there is a very large tool chest

that will handle most standard questions in the area. However, the analytic theory of multi-variable functions is, to say the least, rather a wilder beast. Very little was known about how to employ it in the context of finding useful combinatorial information such as asymptotics. What results did exist were piecemeal and ad hoc – finding general results that applied to families of functions was a pressing need. Their long and fruitful collaboration literally wrote the book in the area: "Analytic Combinatorics in Several Variables" first appeared in 2013, and a second edition was published in 2024.

More recently, much of Mark's research has been in computational and mathematical social choice theory after Arkadii Slinko at Auckland introduced it to him. This is an area with significant and important social implications, and one which has been somewhat neglected by the mathematical community. This may have been a reaction to Arrow's Impossibility Theorem which states that certain desirable collections of properties of community-wide ranked preferences cannot be achieved simultaneously. However, such choices have to be made in the real world, and understanding how different choice mechanisms compare, and how vulnerable they are to manipulation is still a very significant problem.

Another phase of Mark's career began in 2012 when he read Tim Gowers's blog post "Elsevier — my part in its downfall". Characteristically, Mark decided to take on an active role in the area of academic publishing reform. With others, he founded the Math Open Access initiative, as well as the Free Journal Network where he remains president. While academic publishing is still, in places, a morass these initiatives have definitely showed that positive models are possible and feasible.

Of course, Mark's involvement in editorial roles needs to be mentioned. He was the editor of this newsletter from 2013-2015 and contributed a column called "Cybermath" from 2015-2019. He has been involved in various editorial roles with the New Zealand Journal of Mathematics, currently as a Subject Editor, and he was a major contributor to its revamp in 2020-2021. He is the incoming Editor in Chief of the Notices of the American Mathematical Society. Mark chose to apply because of his concern for future of learned societies and the necessity to make their communications attractive and relevant in the modern world. Although he's only been in the role for a short time he has observed that it includes an interesting balancing act. The Notices must represent a large and diverse community while also protecting the reputation of the society. In dealing with controversies that might arise, he stresses the importance of advisory and editorial boards. He put in place a systematic procedure for the selection of his first editorial board, ensuring that there was a balance of skills, backgrounds and opinions. In this process diplomacy was definitely required. According to him: "Anyone who knows me would find this hilarious". However, his experience and doggedness helped.

Mark seems to have boundless energy and works at a high pace. A friend remarks: "Mark is usually in a hurry. He and I once arranged to meet a colleague in France; on the appointed evening we had a little spare time, so he suggested we have dinner first. I was halfway through the soup when Mark, who had finished his main course, left to meet our French colleague, introduce himself (and me, in absentia), arrange the next day's program, and return to the restaurant for dessert - and he still finished eating before me."

Throughout his career Mark has taken up roles that many of us recognise as important, but would rather not do. When he takes up such a responsibility he makes sure that he fulfils it, and leaves the space tidier and easier to work in for the next incumbent. I wish him all the best in his role at the Notices, and whatever else he undertakes.

Michael Albert

LOCAL NEWS

AUCKLAND UNIVERSITY OF TECHNOLOGY

SCHOOL OF ENGINEERING, COMPUTER AND MATHEMATICAL SCIENCES

New Colleague

Matthew Pawley was appointed "Associate Professor in Statistics and Analytics". Associate Professor Matthew Pawley is a statistician specializing in the analysis of ecological data, with emphasis on multivariate methods. Matthew comes from a biological background - he completed his first post-doc at the Leigh Marine Lab (monitoring the effects of sedimentation on marine communities of organisms) before moving to Massey University. His interest in ecological monitoring led to theoretical research focused on multivariate control charts, with a general aim of developing regularized distance-based methods for analyse ecological abundance data. His current applied research is varied—he has an ongoing collaboration with the Anaesthesiology Department at the University of Auckland (UoA) assessing honeybee behaviour. This team was awarded a 2024 Marsden Grant examining the importance of colony 'clocks' for honeybee behaviour. Matthew also collaborates with computer and engineering scientists and biologists (at Unitech) to develop and apply machine learning methods to biological data.

Associate Professor Matthew Pawley

Top Honour from Royal Society

Royal Society Te Apārangi has awarded Professor Sergei Gulyaev the Thomson Medal in recognition of his leadership and contributions to radio astronomy, science education, and international collaboration. The Thompson Medal is awarded annually for outstanding contributions to the organisation, support and application of science, technology, or the humanities in New Zealand.

Events

The 9th Mathematical Modelling and Analytics (MMARC) Symposium was held at Auckland University of Technology, City Campus, on 3 - 4 December 2024, hosted by the Mathematical Modelling & Analytics Research Centre. It was an excellent opportunity to meet and connect with fellow statisticians, mathematicians, engineers and students, under the summer sunshine at Auckland.

The 9th Mathematical Modelling and Analytics (MMARC) Symposium

The main themes of MMARC 2024 were:

- Statistical programming
- Statistical methodology
- Stochastic modelling
- Data science
- Computational and mathematical modelling
- Financial analytics, Financial mathematics

The Organizing Committee would like to extend their thank you the invited speakers for addressing these topics, Dr Roslyn Hickson, Associate Professor Eric Ulm, Professor Wai Keung Li, and Professor Xiao Hui Cui, as well as to our delegates for their interesting contributions at different parallel sessions showcasing these topics and their applications to real-world practical problems.

The AUT Mathematical Modelling and Analytics Research Centre focuses on research in the areas of mathematical modelling, industrial optimisation and data analytics, and provides a collaborative research environment through regular seminars, and workshops. The

next MMARC Symposium is planned for November 2025. We hope to see you there !

The Department of Mathematical Sciences hosted the 2024 Auckland Mathematical Association (AMA) Teachers Day on 22 November. There were various workshops for teachers to attend to share ideas of teaching.

Travel and Conference Participation

Professor Jiling Cao was invited to the University of Macau (UM) Global Academic Symposium, taking place from 1 to 3 December 2024. During this Symposium, The Faculty of Science and Technology (FST) presented the sub-theme “Connecting Ideas – Global Perspectives in Science and Technology," which aims to foster international collaboration and innovative thinking across various scientific disciplines. The sub-symposium organized by FST gathered leading scientists, engineers, and technologists from around the world, including distinguished guests from Australia, New Zealand, and Singapore.

Dr Nuttanan Wichitaksorn has spent the second half of 2024 on his first research and study leave visiting Thailand Development Research Institute in Bangkok, Ohio State University in the U.S., Lincoln University in Christchurch, and University of Sydney in Australia. He also gave a talk at the 2024 International Econometric and Statistic Conference organized by Beijing Normal University in China and helped organize the 2024 Time Series and Forecasting Symposium at University of Sydney.

Drs Catherine Hassell Sweatman, Hammed Fatoyinbo and Kerri Spooner are attending the Joint Meeting of the NZMS, AustMS and AMS 8 – 13 December 2024 University of Auckland and present talks about their recent researches.

Wenjun Zhang

UNIVERSITY OF AUCKLAND

DEPARTMENT OF MATHEMATICS

Staff News

Rod Gover was awarded a Marsden Standard Grant on "Conformal techniques in geometry, analysis, and physical theories".

Pedram Hekmati was awarded an ARC Discovery Project Grant on "Geometry of character varieties" jointly with David Baraglia, Masoud Kamgarpour, Ian Le and Uri Onn.

Florian Lehner was an invited speaker at the 46th Australasian Combinatorics Conference at the University of Queensland.

Jeroen Schillewaert was invited to give talks at the conference "Combinatorial aspects of nonpositive curvature" in Banff, at the conference "Buildings" in Munster and in the geometric group theory seminar in Louvain-La-Neuve in September.

Other News

Priya Subramanian and Matt Parry organised a satellite workshop to the NZMS-AustMS-AMS joint meeting on "Pattern formation" from 4-6 December 2024. Pattern formation is a field of study that is applicable to diverse physical systems from fluids to biophysics. The workshop brought together researchers working in different methodologies related to pattern formation for a joint meeting focusing on transfer of the latest developments in each area of expertise from amongst these three aspects of pattern formation.

Lauren Smith co-organised the Asian Oceanian Women in Mathematics (AOWM) Workshop, 6th – 8th December. Prior to the joint meeting, this workshop provided a great opportunity to network, build new connections, and discuss issues related to being a woman in mathematics.

Rod Gover, Pedram Hekmati and Melissa Tacy are organising the workshop "At the Interface of Geometry and Analysis" from 19-21 February 2025:

Workshop website

The workshop will feature a lecture series and a public lecture by Richard B. Melrose (MIT), who is visiting the department as an Erceg Visiting Fellow. Prof. Melrose is a highly influential differential geometer and analyst, known for solving several outstanding problems in diffraction theory and scattering theory and developing analytical tools that are being used extensively in these fields. Qiongling Li (Chern Insitute of Mathematics) will be visiting Auckland from 3-27 February 2025 as the Kalman Visiting Fellow and is also a speaker at this meeting.

Yancong Xu from China Jiliang University, Hangzhou, China will visit Auckland from 23 February 2025 until 22 March 2025, hosted by Hinke Osinga. His research interests are in dynamical systems and mathematical biology, with particular interest in predator-prey systems.

The department hosted a number of visitors in the third quarter of the year, including

- Peter Brooksbank (Bucknell)

- Sira Busch (Munster)
- Mingjie Chen (KU Leuven)
- Heiko Dietrich (Monash)
- Yi-Fu Lai (Ruhr-Universität Bochum)
- Mark Pengitore (Warsaw)
- Piotr Przytycki (McGill)
- Iveta Semoradova (Czech Technical)
- Hendrik Van Maldeghem (Ghent)
- Valentian Wheeler (Wollongong)
- James Wilson (Colorado State)

We congratulate Dana C'Julio, Harris Leung and Nelson Wong, for successfully defending their PhD theses.

Pedram Hekmati

DEPARTMENT OF ENGINEERING SCIENCE AND BIOMEDICAL ENGINEERING

The department congratulates Dr Ruanui (Ru) Nicholson, who was awarded a Marsden research grant for *Building better models of glacier and ice sheet flow*.

Dr Moritz Kroll, Head of Battery Data Science at Fraunhofer Institute for Solar Energy Systems in Freiburg, Germany, visited the Department from September to December. In March, Moritz started co-supervising two BHons projects, which were successfully concluded during his visit. He also gave a guest lecture in ENGSCI 712, Computational Signal Processing, and a seminar on *Battery Data Science*. During his visit, the Faculty of Engineering and the Fraunhofer Institute signed a five-year collaboration agreement. The joint efforts focus on exploring AI-supported Time Series Data Analysis within the context of Battery Technology.

The department also welcomed Prof Richard Lusby, DTU Denmark, who gave a seminar on *Split-delivery Routing Problems*.

In December, the department organised two conferences: The 46th New Zealand Geothermal Workshop with 350 local and international attendees from industry, government and academia, and the 56th Annual Conference of the Operations Research Society New Zealand. The department congratulates the prize winners of the Young Practitioner Prize (YPP) and the JAG memorial prize for the best application of OR for improving lives. The YPP best paper award was awarded to Dominic Keehan for *Estimation of Shifting Probability Distributions using the Wasserstein Distance*. The YPP best presentation award was awarded to Ahmed Abdelhadi for *Simulation-optimization approach for charging setup for electric taxi adoption using dynamic charger swapping for optimal distribution and location*. The JAG Memorial Prize was awarded to Zainab Rizvi for her work on *Towards Multi Scale Analysis of Energy Systems with Microgrids* and Juliette Foley for her work on *Minimisation of Cost and Emissions for Supermarket Product Purchases Across Recipes*.

Several colleagues and students presented at the Joint Meeting of the NZMS, AMS, and AustMS in Auckland:

Alys Clark *Mathematical modelling to understand the effect of mask design on non-invasive ventilation*

Andreas Kempa-Liehr *Complex bound states of dissipative solitons in three-component reaction-diffusion systems*

Dominic Keehan *Epi-Consistent Approximation of Stochastic Dynamic Programs*

Oliver Maclaren *Identifiability and reparameterisation methods for inverse problems*

Ruanui (Ru) Nicholson *On joint inversion in the Bayesian framework: is ignorance always bliss?*

Josephine Greenwood presented a poster on *Self-organised machine learning in coupled reaction-diffusion systems*, which was highly commended in the ANZIAM Poster Competition.

Many thanks to the organisation team! The Joint Meeting was an impressive and well-received event!

Andreas Kempa-Liehr

UNIVERSITY OF WAIKATO

DEPARTMENT OF MATHEMATICS AND STATISTICS

We congratulate Zac Isaac on his recent successful defence of his PhD thesis. His thesis title was 'Modelling external light transmission through to the human fetus'. He was supervised by Jacob Heerikhuisen from Mathematics and Vincent Reid from Psychology.

We also congratulate Fu Lin Hong on being the top New Zealand competitor in the 2024 Simon Marais Mathematics Competition. As a Year 13 student in 2023, he took second year Mathematics papers with us. As a

university student this year, he has included third year and graduate papers in Mathematics in his programme of study.

Both Sean Oughton and Jacob are attending the December American Geophysical Union Annual Meeting in Washington DC. Sean is presenting a talk titled 'Spontaneous formation of helical magnetic flux tubes'. He will spend a week after the meeting working with collaborators at the University of Delaware. Jacob is giving a talk titled 'Interstellar helium distributions at 1 au from global simulations and implications for IMAP'.

Stephen Joe was made an Honorary Fellow of the University of Waikato in September. He came out of retirement in November to work 80% time in an administrative position for ten months. This is to provide cover for a staff member on maternity leave.

Stephen Joe

MASSEY UNIVERSITY

SCHOOL OF MATHEMATICAL AND COMPUTATIONAL SCIENCES

Annalisa Conversano gave a 1-hour invited tutorial at the Australasian Association for Logic Conference that took place at the University of Sydney, November 26-28.

In August Indranil Ghosh gave two invited talks at the University of Auckland and the Auckland University of Technology. In September he participated in an in-person workshop at Mt. Lyford in the beautiful Canterbury region. This workshop was on "Perception Networks of Climate Change" organised by a group of TPM Whānau members. In November, he visited the University of Tasmania to work closely with Dr. Courtney Quinn. He also gave a seminar on his Ph.D. work in robust chaos in piecewise-linear maps during his visit.

Carlo Laing and Winston Sweatman attended the 9th AUT Mathematical Modelling and Analytics Symposium in early December. Winston had the distinction of speaking in a session where all other speakers were family members, namely Iain and Cathy.

Carlo Laing

VICTORIA UNIVERSITY OF WELLINGTON

SCHOOL OF MATHEMATICS AND STATISTICS

Exciting Updates from Te Herenga Waka–Victoria University of Wellington:

While our focus remains on the highly successful AMS-AustMS-NZMS Joint Meeting, we are proud to announce that two of our professors have been recognized for their outstanding research achievements, earning prestigious NZMS prizes:

Prof. Stephen Marsland was awarded the **2024 NZMS Research Award** for his multidisciplinary research spanning geometry, analysis, algebra, computational mathematics, machine learning and more. His work addresses modern challenges with significant applications for New Zealand and beyond.

Additionally, **Prof. Rod Downey** received the **2024 NZMS Kalman Prize** for his outstanding work, *"A Hierarchy of Turing Degrees: A Transfinite Hierarchy of Lowness Notions in the Computably Enumerable Degrees, Unifying Classes, and Natural Definability"*, co-authored with **Prof. Noam Greenberg** and published by Princeton University Press. Details on the awarded book can be found on the publisher's website.

Video presentations of the awarded works can be found on the joint meeting website.

Back to Wellington news, this year marks a record-high achievement in Marsden Funding success for our school. We are proud to celebrate the following awardees and their remarkable projects:

- **Astrid an Huef and Lisa Orloff Clark** for *"Contributing to the debate on the definition of C^*-algebras of semigroups, the mathematical foundation of quantum mechanics."*
- **Pete Smith (with R. Senanayake)** for *"How continuous antenna arrays affect communication over Gaussian fields."*
- **Ivy Liu and Richard Arnold (with Daniel Fernandez)** for *"Methods for identifying clusters and predicting cluster membership in survey data analysis."*
- **Marcus Frean and Stephen Marsland** for *"Ensuring reputation can be measured in a nuanced way in survey scores."*
- **Becky Armstrong (with B. Steinberg)** for *"A twisted groupoid approach to solving problems in abstract and operator algebra, advancing the mathematical framework of quantum mechanics."*

Congratulations to all successful grant recipients for their contributions to advancing knowledge in their respective fields!

We warmly congratulate:

- **Prof. Ivy Liu** on her successful promotion to Professor,
- **Brendan Harding** and **Louise McMillan** on their promotions to Senior Lecturers.

Celebrating Student Success: Our student, **Adam Gluckman**, has been awarded a **Best Student Presentation Prize (Highly Commended category)** at the New Zealand Statistical Association 2024 Conference. Adam presented his Honours project, *"The subjective wellbeing of first-in-family university students: A multivariate re-evaluation of common narratives"*. This year's conference featured over 25 student talks, making the competition exceptionally strong. Congratulations, Adam!

Finally, congratulations to **Malcolm Jones**, who successfully defended his PhD thesis titled *"Path and boundary-path groupoids of nonfinitely aligned higher-rank graphs over weakly quasi-lattice ordered groups"*. Malcolm was supervised by Prof. Lisa Orloff Clark (primary supervisor) and Prof. Astrid An Huef.

We celebrate these achievements and thank everyone for their continued dedication to excellence in teaching, research, and academic leadership.

Dimitrios Mitsotakis

UNIVERSITY OF CANTERBURY

SCHOOL OF MATHEMATICS AND STATISTICS

Kicking off UC's local correspondence is a massive congratulations to Distinguished Professor Charles Semple, who was recently awarded the Hector Medal by the Royal Society of New Zealand *for ground-breaking mathematical research in phylogenetics and matroid theory*. Tino pai rawa atu!

There was also Marsden success in our school this year. Mike Plank as PI has been awarded a Marsden grant on *Refining mathematical models of infectious diseases so we can better understand transmission in different population groups*. Varvara Vetrova as co-PI has been a warded a Marsden grant on *Do local conditions around estuaries and lagoons amplify, preserve or diminish heating extremes from the ocean?*. Finally, Taylor Winter has been awarded a Marsden Fast-Start grant as AI on *Ngā Hua o Tōna Ahurea Māori: measuring the adaptive outcomes of Māori cultural embeddedness*. Well done all, ka pai!

A massive congratulations to Leighton Watson, who has been awarded one of the inaugural Mana Tūāpapa Fellowships, and *will develop advanced tools for detecting and forecasting snow avalanches. His research aims to enhance safety and reduce economic impacts in alpine regions by improving monitoring capabilities.* Excellent effort Leighton!

There was a large presence at the recent NZMS joint meeting, with a number of staff and students attending and enjoying the diverse range of talks to attend.

There has been a shift in leadership in the school, with Chris Price stepping down after a 5-year stint as Deputy Head. Thanks for all your hard work in this space over such a long period Chris! In his place, two new Associate Heads have been appointed – Associate Professors Miguel Moyers and Brendan Cruetz – who will take up Associate Head of School Academic and Research respectively.

Chris Stevens

UNIVERSITY OF OTAGO

DEPARTMENT OF MATHEMATICS AND STATISTICS

Our department has been buzzing with achievements recently. Firstly, two new postdoctoral fellows, *Yifu Tang* and *Clare Adams*, have started their positions. A warm welcome to both of you!

We also celebrated several successful promotions. Congratulations to *Florian Beyer* and *Peter Dillingham* on their promotions to Associate Professor, and to *Dominic Searles* and *Fabien Montiel*, who were promoted to Senior Lecturer beyond the bar. This is a well-deserved recognition of your outstanding accomplishments.

Congratulations to *Xun Xiao*, who was awarded a Marsden Fast-Start grant for his project "Statistical methods for mitigating uncertainty in complex networks of infrastructure assets". Excellent work, Xun!

Continuing with grant success, congratulations to *Conor Kresin* on his University of Otago Research Grant (UORG) "Feasible causal inference with observational spatiotemporal data". Well done, Conor!

More congratulations are in order, namely to *Tilman Davies*, recipient of this year's Littlejohn Research Award by the NZ Statistical Association. This prestigious honour recognises his excellent original statistical research published in the last five calendar years. Well done, Tilman!

Ufnotrunatley, tihs paargarph hree is comlpeetly meainnglses. Nevrethleess, sicne you hvae fonud and decihpeerd it, cognrautlaitons on bieng one of abuot trhee reaedrs of the lcoal Otgao nwes! By the wya, itnersetignly, the nubmer of wodrs in tihs paargrpah is a

pirme nubmer, and so is the avreage nubmer of lteters per wrod.

Finally, this newsletter's Otago correspondent has won the biannual Division of Sciences Outstanding Teacher award, which recognises "his exceptional dedication to student learning through innovative teaching methods, clear communication, and personalised support. His use of the quiz 'Who wants to be a mathematician' is a popular and engaging element that lightens the lectures and helps reinforce learning."

Jörg Hennig

PhD SUCCESS

Dana C'Julio (University of Auckland. 2024)

Title: Emergence of blenders with different orientation properties.
Supervisors: Hinke Osinga and Bernd Krauskopf (both University of Auckland)

Abstract:
Wild chaos is a new type of nonhyperbolic dynamics characterised by specific robust properties that emerge in diffeomorphisms of dimension at least three. Central to this phenomenon is the concept of a blender—a hyperbolic set with invariant manifolds that seem higher-dimensional than expected. The manifold of a blender may imply the presence of robust, nontransverse heterodimensional cycles, that is, there exist robust tangencies between manifolds that do not have a combined dimension equal to that of the phase space; this is a form of wild chaos. While blenders have a great impact as a tool for the theory of wild chaos, they largely remain abstract constructions, with only a few explicit examples in the literature.

In this thesis, we consider an explicit three-dimensional Hénon-like map H that exhibits a blender generated by a three-dimensional horseshoe. We developed an algorithm to compute one-dimensional manifolds as arclength-parameterised curves. Using this tool, we compute the one-dimensional manifolds of fixed and periodic points of H and explore the geometric properties of the emergence of blenders by studying the intersection points of the manifolds with a plane and how they change with a key parameter for different orientation properties of H.

This numerical approach allows us to investigate how the transition towards wild chaos and the structure of the blender depends on the orientation properties of the map. We discover a pattern governing the emergence of a blender, which allows us to give estimates for when the blender arises for all possible orientation properties of the map. Shedding light on the intricate mechanisms that govern the creation of a blender in this way contributes to a deeper understanding of the broader mechanisms that drive the emergence of robust chaotic dynamics.

Nelson Wong (University of Auckland. 2024)

Title: Bifurcations of heterodimensional cycles.
Supervisors: Hinke Osinga and Bernd Krauskopf (both University of Auckland)

Abstract:
Mathematical models of real-world systems can exhibit highly complicated phenomena that organize observed behavior or dynamics. In this thesis, we study one such phenomenon known as a heterodimensional cycle.

A heterodimensional cycle consists of two saddle periodic orbits that have unstable manifolds of different dimensions–together with connecting orbits from one periodic orbit to the other, and vice versa. A system with a heterodimensional cycle is structurally unstable, meaning its dynamics is sensitive to arbitrarily small parameter changes. Nevertheless, the existence of a heterodimensional cycle can be a "robust" phenomenon, in which case it is known to generate highly complex dynamics, also called wild chaos. Heterodimensional cycles are complicated structures, and all the known examples have been constructed abstractly without a realistic application in mind. However, Zhang, Kirk and Krauskopf (2012) found and computed a codimension-one heterodimensional cycle of the Atri model, which is an explicit, four-dimensional vector field model of intracellular calcium oscillations. This forms our starting point, and we use advanced numerical methods, including Lin's method, to compute new and more complicated heterodimensional cycles. With the continuation software AUTO, we explore a two-parameter region of the Atri model where heterodimensional cycles are found, and we show how the loci (curves) of these new heterodimensional cycles fit together in an overall bifurcation structure, which also involves local and global bifurcations of equilibria and periodic orbits.

Specifically, we discover that the heterodimensional cycle found by Zhang et al. undergoes a sequence of geometrical transformations, which implies new dynamical phenomena, such as a strong homoclinic orbit. Furthermore, we find two novel codimension-two bifurcations: a heterodimensional cycle at a period-doubling bifurcation, and a resonant heterodimensional cycle. The former bifurcation generates new heterodimensional cycles

involving the period-doubled orbit, and the latter gives rise to infinitely many families of codimension-one homoclinic tangencies.

Finally, we relate our research back to the theory of structural stability and discuss the existence of a robust heterodimensional cycle of the Atri model. We show how heterodimensional cycles can be abundant in the limit of a period-doubling cascade. Moreover, we identify a codimension-two organizing center (called a 3DL bifurcation), whose existence suggests that heterodimensional cycles can exist throughout a large two-parameter region.

Malcolm Jones (Victoria University of Wellington. 2024)

Title: Path and boundary-path groupoids of nonfinitely aligned higher-rank graphs over weakly quasi-lattice ordered groups.

Supervisors: Liso Orloff Clark and Astrid An Huef (both Victoria University of Wellington)

Abstract:
Given a weakly quasi-lattice ordered group (Q,P) and a P-graph Λ (not necessarily finitely aligned), we construct a locally compact Hausdorff path space $\mathscr{F}_c(\Lambda)$ inside the space $\mathscr{F}(\Lambda)$ of filters in Λ. When Λ is finitely aligned, $\mathscr{F}_c(\Lambda)$ coincides with $\mathscr{F}(\Lambda)$. We construct a semigroup action T of P on $\mathscr{F}_c(\Lambda)$ whose semidirect product groupoid G_Λ is a Hausdorff ample groupoid. We call G_Λ the path groupoid of Λ, which is in general distinct from the one that Spielberg associates to nonfinitely aligned left cancellative small categories. We show G_Λ coincides with the Toeplitz groupoid of Renault and Williams and with the path groupoid of Yeend under each of their hypotheses. If Q is countable and amenable, then G_Λ is amenable by a theorem of Renault and Williams. We also define a boundary-path space $\partial\Lambda$ that is a closed invariant subset of the unit space of G_Λ. The reduction $G_{\partial\Lambda}$ of G_Λ to $\partial\Lambda$ is the boundary-path groupoid of Λ, which too we reconcile with the relevant groupoids of Renault-Williams and Yeend. For a particular nonfinitely aligned P-graph Λ_0, we show that our path groupoid G_Λ and Spielberg's groupoid of Λ_0 have C*-algebras with different ideal structures.

Zac Isaac (University of Waikato. 2024)

Title: Modelling external light transmission through to the human fetus.

Supervisors: Jacob Heerikhuisen and Vincent Reid (both University of Waikato)

Abstract:
Little is known about the visual experience of human fetuses within the womb. For many years, the uterus was assumed to be a dark environment, limited only to illumination under intense radiation. Recent research, however, shows that the human fetus exhibits brain activity when presented with visual stimuli and displays a preference for face-like stimuli presented via laser diode application to the maternal abdominal exterior. Despite growing evidence to support the notion of a visually engaged fetus during gestation, there has been minimal research undertaken to determine the extent to which the human uterus is illuminated by external light sources. Beyond aiding with experimental research in fetal vision, an understanding of uterine illumination begins to reveal the impact of varying environmental conditions on the fetal visual experience, with direct relevance to ongoing research across fields such as fetal vision, photoacoustics, and ectogenesis. This thesis outlines a mathematical model developed for the purposes of simulating the propagation of light sources through maternal tissue to the human fetus, with applications exploring the effect of adipose on transdermal monochromatic stimuli, the degree of uterine illumination imposed by natural light, and an extension to the illumination of a full maternal abdomen via a model that can account for curvature, varying tissue layer thicknesses, and the temporal aspects of pregnancy.

Indranil Ghosh (Massey University. 2024)

Title: Robust chaos in piecewise-linear maps.

Supervisors: David Simpson and Robert McLachlan (both Massey University)

Abstract:
Piecewise-linear maps describe the dynamical behaviour of a wide variety of physical systems that switch between different modes of evolution, such as optimal control systems, mechanical systems with contact events, and social and economics systems involving decisions or constraints. This thesis focuses on a canonical form for two-dimensional continuous piecewise-linear maps, known as the border-collision normal form. Recent work showed that where the normal form is orientation-preserving it can exhibit chaotic dynamics that is robust in the sense that it occurs throughout an open region of four-dimensional parameter space. In this thesis we first use renormalisation to partition this region by the number of connected components of the chaotic attractor, revealing previously undescribed bifurcation structure in a succinct way. Next, we prove that in part of this region the attractor satisfies Devaney's definition of chaos, strengthening existing results. Here we also show that the one-dimensional stable manifold of a fixed point densely fills a two-dimensional area of phase space, and identify a heteroclinic bifurcation, not described previously, at which the attractor undergoes a crisis and may be destroyed. We then generalise the results to the orientation-reversing and non-invertible parameter regimes of the normal form by developing new ways of constructing trapping regions and invariant expanding cones that establish the existence of chaotic attractors. Bifurcations of the attractor are explored numerically by using Eckstein's greatest common divisor algorithm and comparing the results to those generated through renormalisation. Finally we extend the study to higher dimensional maps by constructing a novel trapping region for the N-dimensional border-collision normal form.

OBITUARIES

David Vere-Jones (1936 April 17– 2024 October 31)

As you may know, David Vere-Jones passed during the last few months.

David was a founder and founding president of the NZMS.

We contacted Peter Thomson and Robert Davies, and they kindly provided us with a link to the article published in *Journal of the Royal Statistical Society Series A: Statistics in Society*:

https://academic.oup.com/jrsssa/advance-article/doi/10.1093/jrsssa/qnae149/7932062

Corresponding author: Peter Thomson peter@statsresearch.co.nz.

Marie Graff.

NZMS NOTICES

Draft minutes of the 50th Annual General Meeting of the NZMS

University of Auckland, Auckland, 9th December 2024: 5:10pm-5.40pm

Welcome and apologies.

Apologies: John Butcher, Marston Conder, Robert McLachlan, Rua Murray, Graeme Wake

Present (from names on attendance sheet): Melissa Tacy, Geertrui Van de Voorde, Stephen Joe, Tammy Lynch, Chris Tuffley, Nick Bretell, Han Gan, Philipp Wacker, Dimitrios Mitsotakis, Brendan Harding, Becky Armstrong, Lisa Orloff Clark, Ilija Tolich, Marie Graff, Dominic Searles, Jonny Stephenson, Jeroen Schillewaert, Catherine Hassell Sweatman, Winston Sweatman, Miguel Moyers-Gonzalez, Hinke Osinga, Carlo Laing, David Simpson, David Bryant, Bernd Krauskopf, Gabriel Verret, Nicolette Rattenbury, Florian Lehner, Sarah Wakes, Vivien Kirk, Mark Wilson, Lauren Smith, Mark McGuiness, Boris Baumer, Tom ter Elst, Stephen Marsland, Astrid an Huef, Alona Ben-Tal, Jörg Frauendiener, Florian Beyer, John Mahony.

1. The minutes of the 49th Annual General Meeting were approved.

2. President's report
   The President's Report (see Agenda documents, and President's Column) was accepted. A few comments were made at the meeting:

   - The report was written before the government announcement about the restructuring of the Marsden fund. The current evolution is worrying. When given the opportunity, the NZMS will continue to put in submissions highlighting the importance of mathematics and fundamental research in general.
   - NZMS became a member of the Save Science coalition earlier this year; this group has keeping track of scientists being made redundant or leaving the country; they are also trying to get an appointment to talk with government representatives but the latter has proved to be very difficult.
   - Both NZMS and AustMS have contributed 10000NZD to the organisation of the joint meeting as a contingency measure. Given the success of the joint meeting this amount will be refunded to the societies.
   - All changes to the constitution and policies will need to be finished by 2026. The main point dealt with this year was the constitution. Changes to the financial year are coming up next year to comply with the new rules.
   - The new website will go online early next year. We are looking for a webmaster.

3. Treasurer's report
   The treasurer's report (see Agenda documents), and the proposed new subscriptions, were accepted. The Society is in good financial health.

   - To comply with the new rules about the start and end to a financial year, the subscriptions for 2025-2026 will be set as follows for ordinary members:
     - 45NZD for first half of 2025, and 90 NZD for the next financial year (July 2025-June 2026), or
     - 120NZD for 18 months (January 2025-June 2026).

4. The motion to reappoint Nirmala Nath as auditor was approved. It was noted that, with the upcoming changes to the societies requirements, this is the last year that NZMS will be required to appoint an auditor at the AGM.

5. The membership secretary's report (see Agenda documents) was accepted. A formal vote of thanks was given to John Shanks who served as a membership secretary for the society for 42 years.

6. The composition of the NZMS Council for 2025 was approved. Melissa Tacy finished her term as President of the Society in 2024.

   (a) Bernd will move from vice-president to president, starting on January 1, 2025.

   (b) Stephen Joe was co-opted as Treasurer.

(c) Geertrui Van de Voorde will remain Secretary.

(d) Jeroen Schillewaert and Dimitrios Mitsotakis finished their first terms on the council and are re-elected for their second term.

(e) NZMS is looking for a webmaster for the new website. This person would be co-opted as council member.

7. Forthcoming colloquia
2025: University of Waikato (Hamilton Campus), November 26–28, 2025

8. Adoption of the NZMS constitution (see Agenda documents). As legally required, the new constitution had been circulated to all member for over four weeks before the AGM.
The 41 NZMS members present at the meeting voted unanimously to accept the new constitution.

9. Information on Vaughan Jones Lecturer (see Agenda documents)
This lectureship will replace the Forder lecturer. The first call for nominations will go out in 2025, for the first lecture tour to go ahead in 2026.

10. Report on the NZ Journal of Mathematics.
The report was accepted. The NZMS thanks Charles Semple as chief editor of the journal.

11. No correspondence or general business.

The meeting closed at 5:40pm.

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