

AustMS 2025



LA TROBE
UNIVERSITY

69th Annual Meeting of the
Australian Mathematical Society

December 9–December 12



AustMS Meeting 2025 is sponsored by



LA TROBE
UNIVERSITY



**Australian
Mathematical
Society Inc.**



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UNSW support has been provided by Professor Gary Froyland, ARC Laureate Centre for Dynamical Systems and Data.
Special thanks to Professor Enrico Valdinoci for sponsoring the WIMSIG event.

Contents

Exhibition of Mathematical Art	4
Conference Overview	5
AustMS 2025 Organisation	6
Conference Sponsors	6
Conference Program	7
Conference Registration and Information Desk	8
Events	8
Public lecture	9
Summary timetable	10
List of Registrants	11
Sessions	20
Plenary Lectures in Agora Theatre	20
Session 2: Algebra and Combinatorics	21
Session 3: Applied and Industrial Mathematics	23
Session 4: Category Theory, Homotopy Theory, and K-Theory	24
Session 5: Computational Mathematics	26
Session 6: Differential Geometry and Symmetry	28
Session 7: Dynamical Systems and Ergodic Theory	30
Session 8: Equity, Diversity and Inclusion	31
Session 9: Financial Mathematics	32
Session 10: General Session	34
Session 11: Groups, Actions and Computation	35
Session 12: Harmonic Analysis and Hamiltonian PDE	36
Session 13: Mathematics Education	38
Session 14: Mathematical Methods in Continuum Mechanics and Wave Theory	39
Session 15: Mathematical Physics	40
Session 16: Nonlinear PDEs and their applications	42
Session 17: Number Theory	44
Session 18: Optimisation	46
Session 19: Poster session	48
Session 20: Probability and Mathematical Statistics	49
Session 21: Representation Theory	52
Session 22: Stochastic Differential Equations	54
Session 23: Topology	56
Session 24: Visualisation, Mathematical Art, Engagement and Outreach	58
Conference Days	59
Conference Day 1: Tue 9 December	60
Conference Day 2: Wed 10 December	69
Conference Day 3: Thu 11 December	77
Conference Day 4: Fri 12 December	83
Abstracts	89
1. Plenary Lectures in Agora Theatre	90
2. Algebra and Combinatorics	93
3. Applied and Industrial Mathematics	99
4. Category Theory, Homotopy Theory, and K-Theory	102
5. Computational Mathematics	106
6. Differential Geometry and Symmetry	112
7. Dynamical Systems and Ergodic Theory	117
8. Equity, Diversity and Inclusion	119

9. Financial Mathematics	121
10. General Session	125
11. Groups, Actions and Computation	128
12. Harmonic Analysis and Hamiltonian PDE	132
13. Mathematics Education	136
14. Mathematical Methods in Continuum Mechanics and Wave Theory	139
15. Mathematical Physics	142
16. Nonlinear PDEs and their applications	147
17. Number Theory	152
18. Optimisation	159
19. Poster Session	165
20. Probability and Mathematical Statistics	167
21. Representation Theory	179
22. Stochastic Differential Equations	184
23. Topology	189
24. Visualisation, Mathematical Art, Engagement and Outreach	195
Index of Speakers	197

Exhibition of Mathematical Art

We are excited to be hosting a physical exhibition of contributed mathematical art at the 2025 AustMS meeting.

The exhibition is curated by Adjunct Associate Professor Katherine Seaton (La Trobe University). Detailed artist's statements explain the connections between the thirty pieces of art and the mathematics that underpins each one.

The mathematical artists are: Lashi Bandara, Bethany Caldwell, Ajani De Vas Gunasekera and Miriam Wei Wei Lo, Alexander Elzenaar, Nicole Gammie, Rebecca George, Szilvia Gyorgy, Marcel Jackson, Mathilde Kitsios, Tim McDevitt, Justin McGee Odger, Stephen Nurse, Pierre Perruchaud, Asha Rao, Katherine Seaton, Liz Shreeve, Benjamin Storch, Jane Théau, Peter H. van der Kamp, Marcus Volz, Jasminka Ward-Matievic and Trill White.



***Singular wave* by Peter van der Kamp**

Artist's statement: "Depicted are three curves of an infinite family of cubic curves all going through the same three points. The singular wave is special because it visits one of those points twice. In *Singular wave* something catastrophic is about to happen; a violet blob launches itself into an orange sky."

The exhibition will be open to conference attendees, the La Trobe community and the general public.

- **Where:** TLC-213, La Trobe University, Bundoora Campus
- **When:** December 9–11, between 10AM and 4:30PM
December 12, between 10AM and 1:30PM

Conference Overview

AustMS 2025 Organisation

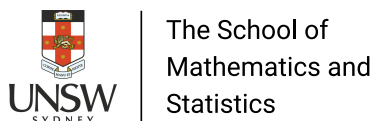
Program Committee

Yuri Nikolayevski (Director) VIC / La Trobe
Luke Bennetts (AustMS VPAC) VIC / Melbourne
Artem Pulemotov QLD / UQ
Hoa Bui WA / Curtin
Jordan Pitt NSW / Sydney
Murray Batchelor ACT / ANU
Phil Broadbridge VIC / La Trobe
Alina Ostafe NSW / UNSW
Melissa Lee VIC / Monash
Zsuzsana Dansco NSW / Sydney
John Roberts NSW / UNSW
David Wood VIC / Monash
Andriy Olenko VIC / La Trobe
Serena Dipierro WA / UWA
Richard Garner NSW / Macquarie
Ivan Guo VIC / Monash
Ray Vozzo SA / Adelaide
Jennifer Flegg VIC (WIMSIG representative) / Melbourne
Valentina Wheeler NSW / Wollongong
James Tener (ANZAMP representative) ACT / ANU
Marcel Jackson (co-Director) VIC / La Trobe
Ed Green (EDI representative) SA / Adelaide

Local Organising Committee

Yuri Nikolayevsky – Director
Marcel Jackson – Co-director
Muntaz Hussain – Treasurer
Chris Taylor – IT
Andriy Olenko – Special Sessions
Olga Minchin – Secretary
Toen Castle – Education Afternoon
Katherine Seaton – Art Exhibition and WIMSIG contact
Hien Nguyen – Sponsorship Chair
Narelle Brack
Geoff Prince
Michael Payne
Rebecca Chisholm
Alysha De Livera
Ian Marquette
Santi Barrera Acevedo
Peter Van Der Kamp
Joel Miller

Conference Sponsors



UNSW support has been provided by Professor Gary Froyland, ARC Laureate Centre for Dynamical Systems and Data.

Special thanks to Professor Enrico Valdinoci for sponsoring the WIMSIG event.

Conference Program

Overview of the Academic Program

There are 393 talks, including 11 plenary lectures and 24 special sessions.

▷ Conference Timetable – page 10

Tue 9 December – page 60

Wed 10 December – page 69

Thu 11 December – page 77

Fri 12 December – page 83

Plenary Lecturers

- ▶ Assoc Prof Cecilia Gonzalez-Tokman (The University of Queensland) – ANZIAM lecturer
- ▶ Dr John Bamberg (The University of Western Australia)
- ▶ Dr Agnese Barbensi (The University of Queensland)
- ▶ Dr Tobin Driscoll (University of Delaware)
- ▶ Assoc Prof Sophie Hautphenne (The University of Melbourne)
- ▶ Prof Theo Johnson-Freyd (Perimeter Institute for Theoretical Physics) – ANZAMP lecturer
- ▶ Dr Anita Liebenau (UNSW Sydney) – Hanna Neumann lecturer
- ▶ Prof Yoshihiro Tonegawa (Institute of Science Tokyo)
- ▶ Dr Caroline Wormell (The University of Sydney) – Early career lecturer
- ▶ Prof Oksana Yakimova (Friedrich Schiller University of Jena)

▷ Timetable of Plenary Lectures – page 10

Special Sessions

1. Plenary – page 90
2. Algebra and Combinatorics – page 93
3. Applied and Industrial Mathematics – page 99
4. Category Theory, Homotopy Theory, and K-Theory – page 102
5. Computational Mathematics – page 106
6. Differential Geometry and Symmetry – page 112
7. Dynamical Systems and Ergodic Theory – page 117
8. Equity, Diversity and Inclusion – page 119
9. Financial Mathematics – page 121
10. General Session – page 125
11. Groups, Actions and Computation – page 128
12. Harmonic Analysis and Hamiltonian PDE – page 132
13. Mathematics Education – page 136
14. Mathematical Methods in Continuum Mechanics and Wave Theory – page 139
15. Mathematical Physics – page 142
16. Nonlinear PDEs and their applications – page 147
17. Number Theory – page 152
18. Optimisation – page 159
19. Poster Session – page 165
20. Probability and Mathematical Statistics – page 167
21. Representation Theory – page 179
22. Stochastic Differential Equations – page 184
23. Topology – page 189
24. Visualisation, Mathematical Art, Engagement and Outreach – page 195

Conference Registration and Information Desk

The registration and information desk for the conference is located on Level 2 of Agora East. This desk will be staffed on Tuesday December 9 from 8AM to 6PM, and from 8:30AM to 6PM for the remaining days of the conference.

Events

WIMSIG Business Meeting

- ▶ Monday December 8, 16:00–17:30
Borchardt Library, Room 1.34

WIMSIG Dinner

- ▶ Monday December 8, 18:00–21:15
Glenn College Dining Hall

Opening Ceremony and Prizes

- ▶ Tuesday December 9, 9:00–11:00
Agora Theatre

Poster Sessions

- ▶ Tuesday December 9 and Wednesday December 10, 15:30–16:00
Agora East, Level 2, near the information desk

Welcome Reception

- ▶ Tuesday December 9, 18:30–20:00
Jenny Graves Lawn

Debate: AI Will Destroy Mathematics

- ▶ Wednesday December 10, 13:00–14:00
Agora Theatre

Education Afternoon

- ▶ Wednesday December 10, 14:00–17:30
TLC-315

Public Lecture presented by Tobin Driscoll (p. 9)

- ▶ Wednesday December 10, 18:00–19:00 (with light refreshments from 17:30)
Agora Theatre

LGBTQIA+ and Allies Lunch

- ▶ Thursday December 11, 12:30–13:00
Agora East, Level 2

AustMS Annual General Meeting

- ▶ Thursday December 11, 16:00–17:00
Agora Theatre

Conference Dinner

- ▶ Thursday December 11, 19:00
Leonda by the Yarra, Hawthorn
Some transport departing from campus at 18:00 will be available with details to be confirmed.

Public lecture

Why Your Calculator Is (Slightly) Lying to You—And Why That's OK

Presented by Tobin Driscoll (University of Delaware)

We trust computers to follow the rules of arithmetic. But even expensive scientific software can fail to uphold the basic principle $(a+b)+c = a+(b+c)$. This is not a glitch—it's a clue to a deep tension between the perfect world of mathematics and the practical world of computation. In this talk, we'll take a journey through the numbers we think we know—from whole numbers to fractions, and onward to the supposedly "imaginary" number $i = \sqrt{-1}$. While these abstract ideas have become indispensable tools, their digital simulations are full of surprising compromises. The climax of our journey will be a mathematical mystery: a simple approximation that fails because of an invisible barrier that lurks in the imaginary direction. This surprising connection is spurring advances in the practical challenge of representing mathematical functions on computers. I will show how both new and old ideas continue to drive new breakthroughs, making these methods faster and more powerful than ever before.

- **Where:** Agora Theatre, La Trobe University, Bundoora Campus
- **When:** Wednesday December 10, from 6PM to 7PM.

Light refreshments will be served in the foyer from 5:30PM.

Summary timetable

	Mon	Tue	Wed	Thu	Fri
09:00		Opening Ceremony and Prizes		Plenary talk: Gonzalez-Tokman (ANZIAM)	Plenary talk: Wormell (Early career)
09:30					
10:00			Plenary talk: Barbensi	Morning Tea	Morning Tea
10:30				Plenary talk: Bamberg	Plenary talk: Liebenau (H. Neumann)
11:00		Morning Tea	Morning Tea		
11:30				Plenary talk: Yakimova	Plenary talk: Johnson-Freyd (ANZAMP)
12:00		Plenary talk: Driscoll	Plenary talk: Tonegawa		
12:30					
13:00		Lunch	Lunch	LGBTQIA+ and Allies Lunch	Lunch
13:30			Debate		
14:00		Special Sessions	Special Sessions & Education Afternoon	Special Sessions	Special Sessions
14:30					
15:00					
15:30					
16:00		Poster Session	Afternoon Tea	Afternoon Tea	Afternoon Tea
16:30	WIMSIG Business Meeting	Special Sessions	Special Sessions & Education Afternoon	AGM	Special Sessions
17:00					
17:30					
18:00	WIMSIG Dinner	Plenary talk: Hautphenne	Refreshments		
18:30			Public lecture		
19:00		Welcome Reception		Conference Dinner	
19:30					

List of Registrants

Current as of Mon 1 Dec 2025

Assoc Prof Paul Abbott	The University of Western Australia
Dr Vyacheslav Abramov	None
Dr Johnathan Adams	Queensland University of Technology
Mr Muhammad Afifurrahman (S)	UNSW Sydney
Dr Reymond Akpanya	The University of Sydney
Ms Maha Alghamdi (S)	La Trobe University
Mrs Noura Alhawiti (S)	The University of Newcastle
Mr Tourki Faddy M Alshammary (S)	University of Technology Sydney
Dr Fatemeh Ansarizadeh	Deakin University
Dr Simran Arora (S)	Kyoto University
Dr Azam Asanjarani	The University of Auckland
Mr Ali Asiri (S)	Flinders University
Dr Michael Assis	The University of Melbourne
Dr Felipe Atenas	The University of Melbourne
Mr Luke Attrill (S)	Monash University
Dr Max Auer	The University of Queensland
Prof Michael Baake	Bielefeld University
Prof Santiago Badia	Monash University
Dr Stephan Baier	Ramakrishna Mission Vivekananda Educational and Research Institute
Dr John Bamberg	The University of Western Australia
Dr Lashi Bandara	Deakin University
Mr Asiri Bandarawickrama (S)	University of Southern Queensland
Dr John Banks	The University of Melbourne
Miss Shahtaj Bano (S)	RMIT University
Dr Agnese Barbensi	The University of Queensland
Prof Andrew David Barbour	Universität Zürich
Dr Nicholas Beaton	The University of Melbourne
Mr Alexander Bednarek (S)	The University of Sydney
Ms Chiara Bellotti (S)	UNSW Canberra
Prof Luke Bennetts	The University of Melbourne
Mr Emrys Berg (S)	The University of Melbourne
Dr Yann Bernard	Monash University
Mr Louie Bernhardt (S)	The University of Melbourne
Dr Subham Bhakta	UNSW Sydney
Mr Saunak Bhattacharjee (S)	UNSW Canberra
Mr Adam Bilchouris (S)	La Trobe University
Mr Mitchell Bonham (S)	The University of Newcastle
Prof Kostya Borovkov	The University of Melbourne
Dr Maher Boudabra	King Fahd University of Petroleum and Minerals
Dr Narelle Brack	La Trobe University
Dr Chris Bradley	The University of Melbourne
Dr Peter Braunsteins	UNSW Sydney
Prof Florian Breuer	The University of Newcastle
Mr Nathan Britt (S)	The University of Melbourne
Prof Philip Broadbridge	La Trobe University
Prof Robert Buckingham	University of Cincinnati
Assoc Prof Pascal R. Buenzli	Queensland University of Technology
Dr Yudhistira Andersen Bunjamin	UNSW Sydney
Assoc Prof Conrad Burden	Australian National University
Mr Blair Butler (S)	The University of Sydney
Dr Timothy Buttsworth	UNSW Sydney
Dr Jim Byrnes	Prometheus Inc.
Dr Difeng Cai	Southern Methodist University
Dr Grant Cairns	La Trobe University
Dr Bethany Caldwell	UNSW Sydney
Miss Shurui(Super) Cao (S)	The University of Sydney

Dr Marco Carfagnini	AMSI/University of Melbourne
Mr Sergio Carrasco (S)	Monash University
Mr Luka Carroll (S)	Western Sydney University
Mr Max Carter (S)	Université Catholique de Louvain
Mr Tiernan Cartwright (S)	The University of Sydney
Dr Toen Castle	La Trobe University
Dr Daniele Celoria	The University of Melbourne
Mr Chang Chen (S)	The University of Queensland
Dr Huan Chen (S)	Monash University
Prof Jein-Shan Chen	National Taiwan Normal University
Ms Yiwen Chen (S)	University of British Columbia, Okanagan
Dr Yuyu Chen	The University of Melbourne
Ms Eve Cheng (S)	Australian National University
Mr Marcus Chijoff (S)	The University of Newcastle
Ms Shashi Chourasiya (S)	UNSW Canberra
Mr Tsun Ho Anson Chung (S)	Australian National University
Prof Florica Corina Cirstea	The University of Sydney
Miss Greta Civani (S)	The University of Melbourne
Dr Nathan Clisby	Swinburne University of Technology
Dr Julie Clutterbuck	Monash University
Dr Andrea Collevocchio	Monash University
Mr Daniel Collison (S)	The University of Sydney
Dr Lewis Combes	The University of Sydney
Mr Chandler Chase Corrigan (S)	UNSW Sydney
Assoc Prof Diarmuid Crowley	The University of Melbourne
Dr Pranendu Darbar	UNSW Sydney
Dr Nick Dashti	The University of Melbourne
Dr Dougal Davis	The University of Melbourne
Prof Jan De Gier	The University of Melbourne
Dr Ajani De Vas Gunasekara	University of Notre Dame
Dr Owen Dearricott	La Trobe University
Miss Christine Deng (S)	Australian National University
Dr Quanling Deng	Yau Mathematical Sciences Center, Tsinghua University
Mr Matthew Di Meglio (S)	University of Edinburgh
Dr Leo Diaz	The University of Melbourne
Dr Reinier Diaz Millan	Deakin University
Ms Natalie DiMichele (S)	The University of Queensland
Dr Peng Ding	UC Berkeley
Mr Qian Ding (S)	La Trobe University
Dr Neil Dizon	UNSW Sydney
Dr Moritz Doll	Macquarie University
Prof Anthony Dooley	University of Technology Sydney
Dr Tobin Driscoll	University of Delaware
Prof Jie Du	UNSW Sydney
Dr Adrian Dudek	The University of Queensland
Mr Daniel Dunmore (S)	UNSW Sydney
Mr Thomas Dunmore (S)	UNSW Sydney
Prof Andrew Craig Eberhard	RMIT University
Prof Murray Elder	University of Technology Sydney
Mr Alec Elhindi (S)	The University of Sydney
Ms Renuka Eliezer	La Trobe University
Mr Alexander Elzenaar (S)	Monash University
Mr Karl Engelund	University of Copenhagen
Mr Victor Fagundes (S)	La Trobe University
Mr Fawwaz Fakhurrozi (S)	The University of Melbourne
Dr Jie Yen Fan	Monash University
Dr Maria Farcaseanu	The University of Sydney
Ms Kaniz Fatema (S)	RMIT University
Mr Tasman Fell (S)	The University of Sydney
Ms Vishmi Fernando (S)	RMIT University
Prof Lilia Ferrario	Australian National University

Dr Laurence Field	Australian National University
Dr Paul Fijn	The University of Melbourne
Mr Marcus Flook (S)	Australian National University
Dr Justin Forlano	Monash University
Dr James Foster	CSIRO
Prof Andrew Francis	UNSW Sydney
Prof David Frazier	Monash University
Mr Matthias Fresacher (S)	Western Sydney University
Dr Han Liang Gan	University of Waikato
Dr Alexandr Garbali	The University of Melbourne
Dr Erik Garcia Neefjes	Macquarie University
Prof Timothy Garoni	Monash University
Mr Cengiz Gazi (S)	AMSI/University of Melbourne
Ms Mashniah A. Gazwani (S)	The University of Newcastle
Dr Jesse Gell-Redman	None
Ms Zoë Gemmell (S)	UNSW Canberra
Dr Xi Geng	AMSI/University of Melbourne
Ms Rebecca George	None
Mr Mohammad Ghasemi (S)	Deakin University
Assoc Prof Alexandru Ghitza	The University of Melbourne
Mr Moshe Giles Uhrig (S)	AMSI/University of Melbourne
Prof Michael Giudici	The University of Western Australia
Mr Emanuel Godfried (S)	AMSI/University of Melbourne
Dr Tom Goertzen	The University of Sydney
Prof Benjamin Goldys	The University of Sydney
Assoc Prof Cecilia Gonzalez-Tokman	The University of Queensland
Assoc Prof Clara Grazian	The University of Sydney
Miss Katherine Green (S)	Monash University
Mr Harrison Greven (S)	Adelaide University
Prof Robert Charles Griffiths	Monash University
Prof Joseph Grotowski	The University of Queensland
Dr Hailong Guo	The University of Melbourne
Assoc Prof Ivan Guo	Monash University
Mr Weiying Guo (S)	AMSI/University of Melbourne
Prof Zihua Guo	Monash University
Mr Dhruv Gupta (S)	The University of Melbourne
Mr William Hadden (S)	UNSW Sydney
Prof Christian Haesemeyer	The University of Melbourne
Mr Bowan Hafey (S)	The University of Melbourne
Mr Yusuf Hafidh (S)	The University of Melbourne
Assoc Prof Jack Hall	The University of Melbourne
Mr Joshua Ham (S)	UNSW Sydney
Dr Lucy Ham	The University of Melbourne
Dr Andy Hammerlindl	Monash University
Mr Jayden Hammet (S)	The University of Melbourne
Prof Kais Hamza	Monash University
Ms Nicola Harif (S)	Monash University
Mr Michael Harm (S)	UNSW Sydney
Dr Elizabeth Harris	The University of Newcastle
Assoc Prof Simon Harris	The University of Auckland
Dr David Hartley	University of Canberra
Prof David Harvey	UNSW Sydney
Prof Erika Hausenblas	Montanuniversitaet Leoben
Assoc Prof Sophie Hautphenne	The University of Melbourne
Dr Jian He	Monash University
Ms Mingqi He (S)	The University of Melbourne
Dr Peter Heiss Synak	Australian National University
Dr Teresa Heiss-Synak	Australian National University
Dr Pedram Hekmati	The University of Auckland
Mr George Henderson-Walshe (S)	AMSI/University of Melbourne
Dr Edmund Xian Chen Heng	The University of Sydney

List of Registrants

Dr Thorsten Hertl	The University of Melbourne
Mr Jared Heymann (S)	The University of Melbourne
Mr Harry Hiatt (S)	The University of Sydney
Dr Liam Hodgkinson	The University of Melbourne
Mr Mohammadali Hosseinimoghaddam (S)	The University of Queensland
Dr Joshua Howie	Monash University
Dr Mi Hu	Monash University
Mr Boris Huang (S)	UNSW Sydney
Mr Stepan Hudecek (S)	The University of Queensland
Dr Connie On Yu Hui (S)	Monash University
Miss Xuejing Huo (S)	Macquarie University
Dr Muntaz Hussain	La Trobe University
Dr Dionne Ibarra	Monash University
Mr Mohamed Hanafy Kotb Ibrahim (S)	UNSW Sydney
Miss Martine Illing-Kelly	The University of Sydney
Mr Clive Jackson	None
Dr Deborah Jackson	La Trobe University
Prof Marcel Jackson	La Trobe University
Miss Thisaakhya Jayakody (S)	The University of Melbourne
Dr Sam Jeralds	The University of Sydney
Mr Paawan Jethva (S)	The University of Adelaide
Dr Qiuye Jia	Australian National University
Dr Chunxi Jiao	UNSW Sydney
Mr Stewart John (S)	The University of Melbourne
Prof Theo Johnson-Freyd	Perimeter Institute for Theoretical Physics
Mr Daniel Johnston (S)	UNSW Canberra
Dr Samuel Johnston	Kings College London
Prof Nalini Joshi	The University of Sydney
Dr Zlatko Jovanoski	UNSW Canberra
Assoc Prof Paul Kabaila	La Trobe University
Dr Alexis Kagan	The University of Auckland
Prof Kenji Kajiwarra	Kyushu University
Assoc Prof Masoud Kamgarpour	The University of Queensland
Miss Ruethaichanok Kardkasem (S)	The University of Queensland
Miss Gurmehar Kaur (S)	Deakin University
Mr James Kerlidis (S)	The University of Melbourne
Dr Bryce Kerr	UNSW Canberra
Mr Paul Kerr (S)	The University of Melbourne
Mr Shahid Khan (S)	La Trobe University
Mrs Mst Shanta Khatun (S)	The University of Sydney
Mr Linus Kirkwood (S)	University of Technology Sydney
Mr Reef Kitaeff (S)	Monash University
Dr Vassili Kitsios	CSIRO
Mr Gustav Kjaerbye Bagger (S)	UNSW Canberra
Prof Fima Klebaner	Monash University
Mr Finn Klein (S)	The University of Sydney
Dr Joachim Koenig	Korea National University of Education
Mr Maximilian Kortge (S)	The University of Melbourne
Mr Miles Koumouris (S)	The University of Melbourne
Ms Udara Kumaranathunga (S)	La Trobe University
Dr Rugare Kwashira	University of the Witwatersrand
Dr Kwok-Kun Kwong	University of Wollongong
Miss Brianna Laird (S)	Deakin University
Mr Benedict Lama (S)	The University of Sydney
Dr Bishnu Lamichhane	The University of Newcastle
Dr Marcello Lanfranchi	Macquarie University
Dr Mat Langford	Australian National University
Prof Finnur Larusson	The University of Adelaide
Dr Ngan Le	Monash University
Assoc Prof Quoc Thong Le Gia	UNSW Sydney
Dr Benjamin Lee	Monash University

Prof Haesung Lee	Kumoh National Institute of Technology
Dr Melissa Lee	Monash University
Dr Jean-Simon Lemay	Macquarie University
Mr Renaud Leplaideur	Université de la Nouvelle Calédonie
Dr Dennis Leung	The University of Melbourne
Miss Shir Levav Porat (S)	Monash University
Assoc Prof Ji Li	Macquarie University
Dr Kelvin Li	Deakin University
Miss Siyu Li (S)	La Trobe University
Dr Yau Wing Li	The University of Melbourne
Dr Yixuan Li	Australian National University
Miss Yuhan Liao (S)	The University of Melbourne
Dr Anita Liebenau	UNSW Sydney
Mr Damian Lin (S)	The University of Sydney
Mr Fangyu Liu (S)	The University of Melbourne
Assoc Prof Jiakun Liu	The University of Sydney
Ms Jayamini Liyanage (S)	La Trobe University
Mr Stanley Luk (S)	University of Technology Sydney
Mr Hongyi Lyu (S)	Monash University
Dr Mengfan Lyu	Western Sydney University
Mr Matthew Mack (S)	University of South Australia
Prof Andrea Macrina	University College London
Dr Svetlana Makarova	Australian National University
Dr Leonardo Maltoni	Australian National University
Dr Daniel Francis Mansfield	UNSW Sydney
Dr Mohd Mahayaudin Mansor	Universiti Teknologi MARA
Mr Jordi Manyer (S)	Monash University
Dr Diego Marcondes	Australian National University
Dr Ian Marquette	La Trobe University
Ms Lavender Marshall (S)	Monash University
Dr Simon Marshall	Retired
Assoc Prof Simon Marshall	The University of Melbourne
Dr Antoine Marteau	Monash University
Dr Dmytro Marushkevych	UNSW Sydney
Mr Dominic Matan (S)	UNSW Sydney
Assoc Prof Daniel Mathews	Monash University
Mx Natalia McAlister Caffarel (S)	Monash University
Prof James McCoy	The University of Newcastle
Prof Scott McCue	Queensland University of Technology
Prof Timothy McDevitt	Elizabethtown College
Mr Bailey Penn McLellan (S)	The University of Melbourne
Ms Emma McQuire (S)	Monash University
Mr William Mead (S)	The University of Melbourne
Mr Euan Mendoza (S)	University of Technology Sydney
Miss Jahne Meyer (S)	The University of Newcastle
Dr Joel Miller	La Trobe University
Mr Jack Mills (S)	Monash University
Prof Terence Mills	La Trobe University
Ms Olga Minchin	La Trobe University
Mrs Sepideh Mohammadi (S)	The University of Melbourne
Dr Sarat Babu Moka	UNSW Sydney
Mr Rakib Mondal (S)	Birla Institute of Technology and Science, Pilani K. K. Birla Goa Campus
Mr Adam Monteleone (S)	The University of Melbourne
Mr James Morgan (S)	The University of Sydney
Dr Kerri Morgan	RMIT University
Mr Riley Moriss (S)	The University of Melbourne
Prof Sidney Morris	La Trobe University
Mr Marko Mrksa (S)	Monash University
Dr Stephen Muirhead	Monash University
Mr Leonard Mushunje (S)	The University of Sydney
Mr Thansidh Kirthan Nadar (S)	RMIT University

List of Registrants

Mr Muhammad Nawaf Nafi (S)	Bangladesh Air Force Shaheen College Dhaka
Dr Kihun Nam	Monash University
Dr Ravindi Nanayakkara	La Trobe University
Prof Makoto Narita	National Institute of Technology, Okinawa College
Mr Mohamad Hosein Nejad-Hagigi (S)	UNSW Sydney
Mr Jonah Nelson (S)	The University of Melbourne
Prof Max Nendel	University of Waterloo
Mr Leor Neuhauser (S)	Hebrew University
Mr Joseph Newton (S)	The University of Sydney
Mr An Ky Duy Nguyen (S)	La Trobe University
Dr Hien Nguyen	Kyushu University/La Trobe University
Mr Tri Khuong Nguyen (S)	Deakin University
Dr Trung Tin Nguyen	Queensland University of Technology
Dr Wenjie Ni	University of New England
Dr Yuri Nikolayevsky	La Trobe University
Prof Rodney Nillsen	University of Wollongong
Dr Andrew Norton	None
Dr Madeline Nurcombe	The University of Sydney
Mr Stephen Nurse	None
Dr Terence O’Kane	CSIRO
Mr Jensen O’Sullivan (S)	The University of Sydney
Mr Nelson Odins-Jones (S)	The University of Sydney
Miss Renee Oldfield (S)	The University of Queensland
Assoc Prof Andriy Olenko	La Trobe University
Dr Todd Oliynyk	Monash University
Prof Uri Onn	Australian National University
Mr Max Orchard (S)	The University of Queensland
Dr Anthony Overmars (S)	La Trobe University
Dr Neea Palojaervi	UNSW Canberra
Ms Xueyu Pan (S)	Monash University
Mr Anthony Parr (S)	The University of Queensland
Mr Mridul Patel (S)	RMIT University
Ms Giulia Pelizzari (S)	UNSW Canberra
Prof Spiridon Penev	UNSW Sydney
Mr Fei Peng (S)	The University of Melbourne
Mr Aram Perez (S)	Monash University
Dr Pierre Perruchaud	Monash University
Miss Jordan Pertile (S)	UNSW Canberra
Dr Paolo Piersanti	The Chinese University of Hong Kong, Shenzhen
Dr Adam Piggott	Australian National University
Dr Guillermo Pineda-Villavicencio	Deakin University
Mx Anthony Pisani (S)	Monash University
Prof Eckhard Platen	University of Technology Sydney
Mr Curren Poulsen (S)	The University of Sydney
Dr Rudi Prihandoko (S)	Australian National University
Mrs Devi Imulia Dian Primaskun (S)	The University of Melbourne
Prof Geoff Prince	La Trobe University
Prof Artem Pulemotov	The University of Queensland
Mr James Punch (S)	UNSW Canberra
Prof Jessica Purcell	Monash University
Dr Thomas Quella	The University of Melbourne
Mr Ruzzel Ragas (S)	The University of Sydney
Prof Wenny Rahayu	La Trobe University
Mr Devesh Rajpal (S)	Australian National University
Mr Virinchi Rallabhandi (S)	University of Edinburgh
Mr Cale Rankin	Monash University
Prof Asha Rao	RMIT University
Dr Sophie Raynor	James Cook University
Dr Lawrence Reeves	The University of Melbourne
Dr Colin David Reid	Western Sydney University
Mr Corbin Reid (S)	Monash University

Mr Joel Richardson (S)	Macquarie University
Dr Janosch Rieger	Monash University
Mr Christian Risco (S)	The University of Queensland
Prof John Roberts	UNSW Sydney
Dr Lindon Roberts	The University of Melbourne
Dr Marcy Robertson	The University of Melbourne
Dr Chris Roe	Retired
Mr Pieter Roffelsen	The University of Sydney
Dr Sergio Rojas	Monash University
Dr Juan Francisco Romero Acosta	Australian National University
Assoc Prof Vera Roshchina	UNSW Sydney
Dr Rene Rossi	Curtin University
Mr Andres Eduardo Rubiano Martinez (S)	Monash University
Dr Volker Schlue	The University of Melbourne
Prof Gerd Schmalz	University of New England
Dr Philip Schrader	Murdoch University
Dr Katherine Seaton	La Trobe University
Dr Amanda Shaker	La Trobe University
Dr Upanshu Sharma	UNSW Sydney
Dr Jordan Shaw-Carmody (S)	The University of Newcastle
Mr Iman Shekarriz (S)	Deakin University
Mr Qing Shen (S)	University of Technology Sydney
Mr Kajanthan Shiyamasuntharam (S)	University of Wollongong
Dr Connor Simpson	Sydney Mathematical Research Institute
Prof Aidan Sims	UNSW Sydney
Mr Chandan Singh (S)	The University of Melbourne
Dr Matthew Paul Skerritt	RMIT University
Mr Brandon Smith (S)	Deakin University
Dr Dave Smith	The University of Newcastle
Mr Agus Soenjaya (S)	UNSW Sydney
Dr Gabor Somlai	The University of Melbourne
Assoc Prof Jonathan Spreer	The University of Sydney
Dr Peter Stacey	La Trobe University
Ms Willow Stewart (S)	The University of Sydney
Mr Kurt Stoeckl	The University of Melbourne
Mr Artem Stoian (S)	The University of Melbourne
Dr Tim Stokes	University of Waikato
Dr Alan Stoneham	UNSW Sydney
Mr Lecheng Su (S)	Monash University
Ms Haruka Suga (S)	Kyushu University
Assoc Prof Nadia Sukhorukova	Swinburne University of Technology
Assoc Prof Jeremy Sumner	University of Tasmania
Miss Ekaterina Suraev (S)	Deakin University
Mr Kiah Swinsburg (S)	University of Tasmania
Dr Ho Man Tai	The University of Sydney
Mr Kiyoshi Takeuchi Romo (S)	Australian National University
Dr Pinsky Tali	Monash University
Miss Tamara Tambyah (S)	Monash University
Dr Chris Taylor	La Trobe University
Prof Peter Gerrard Taylor	The University of Melbourne
Mr justin roy teegala (S)	RMIT University
Mr Simon Thomas (S)	The University of Queensland
Miss Finn Thompson (S)	The University of Queensland
Mr Ameya Tilgul (S)	UNSW Canberra
Prof Stephan Tillmann	The University of Sydney
Mx Liam Timms (S)	The University of Melbourne
Ms Lucy Tobin (S)	The University of Sydney
Dr Joshua Tomlin	The University of Adelaide
Prof Yoshihiro Tonegawa	Institute of Science Tokyo
Mr Thanh Dat Tran (S)	The University of Sydney
Dr TriThang Tran	The University of Melbourne

List of Registrants

Mr Vandit Trivedi (S)	Australian National University
Prof Timothy Trudgian	UNSW Canberra
Prof Neil Trudinger	Australian National University
Mr Thang Truong (S)	RMIT University
Prof Warwick Tucker	Monash University
Mr Sebastian Tudzi (S)	UNSW Canberra
Dr Julien Ugon	Deakin University
Mr Fiaz Ur Rehman (S)	Monash University
Dr Pieter Hubert van der Kamp	La Trobe University
Assoc Prof Patrick Vega	Universidad de Santiago de Chile
Dr Geetika Verma	RMIT University
Prof Kari Vilonen	The University of Melbourne
Mr Noah Vinod (S)	UNSW Sydney
Dr Mircea Voineagu	UNSW Sydney
Mr Liam Walsh (S)	Curtin University
Mr Liang Wang (S)	UNSW Canberra
Dr Yu Wang (S)	Xinjiang University
Mr Zihan Wang (S)	The University of Melbourne
Dr Simon Watt	UNSW Canberra
Prof Martin Wechselberger	The University of Sydney
Mr Jacob Westerhout (S)	The University of Queensland
Dr Glen Edward Wheeler	University of Wollongong
Mr Bailey Whitbread (S)	The University of Sydney
Mx Trillion White (S)	Deakin University
Ms Nemini Yadeesha Jayani Wijesinghe Samarakoon (S)	La Trobe University
Mr Thomas Wilkins (S)	Monash University
Ms Tilda Wilkinson-Finch (S)	The University of Sydney
Dr Ben Wilks	University of South Australia
Ms Sinead Wilson (S)	Australian National University
Prof David Wood	Monash University
Mr Liam Wood-Baker (S)	Monash University
Prof Nick Wormald	Monash University
Dr Caroline Wormell	The University of Sydney
Dr Chenyan Wu	The University of Melbourne
Dr Haotian Wu	The University of Sydney
Prof Aihua Xia	The University of Melbourne
Dr Binzhou Xia	The University of Melbourne
Dr Yixiu Xiao (S)	UNSW Sydney
Dr Jie Xu (S)	Monash University
Mr Jinwen Xu (S)	The University of Melbourne
Assoc Prof Ting Xue	The University of Melbourne
Mr Mathieu Yahiaoui (S)	The University of Melbourne
Prof Oksana Yakimova	Friedrich Schiller University of Jena
Dr Kazutoshi Yamazaki	The University of Queensland
Miss Zhao Yang (S)	University of Wollongong
Dr Lior Yanovski	AMSI/University of Melbourne
Prof Emine Sule Yazici Yuret	Koç University
Dr David Yost	Federation University Australia
Dr Po-Lam Yung	Australian National University
Mr Declan Zammit (S)	The University of Sydney
Mr Jarrod Zammit (S)	The University of Sydney
Mr Nicolas Andres Zamorano Goldrine (S)	Politecnico di Torino
Dr Adriana Zanca	The University of Melbourne
Ms Joshua Zavone (S)	The University of Sydney
Mr Abraham Zhang (S)	The University of Newcastle
Mr Chengjing Zhang (S)	The University of Melbourne
Mr Chuanqi Zhang (S)	University of Technology Sydney
Assoc Prof Erchuan Zhang	Sun Yat-sen University
Mr Qingyuan Zhang (S)	The University of Queensland
Mr Victor Zhang (S)	UNSW Sydney
Miss Xinyi Zhang (S)	University of Wollongong

Dr Yang Zhang
Mr Zhao Zhang (S)
Dr Liangyi Zhao
Mr Weihang Zheng (S)
Mr Qiyu Zhou (S)
Prof Sanming Zhou
Ms Yuyang Zhou (S)
Dr Zili Zhu
Mr Orion Zymaris (S)

The University of Queensland
University of Wollongong
UNSW Sydney
Monash University
Australian National University
The University of Melbourne
The University of Melbourne
CSIRO
Monash University

Sessions

Plenary Lectures in Agora Theatre

▷ Tue 9 December

11:30 Tobin Driscoll (University of Delaware)

Computational approximation by rational functions

AT (p. 90)

17:30 Sophie Hautphenne (The University of Melbourne)

Branching processes in practice: models, inference, and applications

AT (p. 91)

▷ Wed 10 December

10:00 Agnese Barbensi (The University of Queensland)

Mapping the topology of polymer folding: knots, geometry, and data

AT (p. 90)

11:30 Yoshihiro Tonegawa (Institute of Science Tokyo)

Geometric measure theory and mean curvature flow

AT (p. 91)

▷ Thu 11 December

09:00 Cecilia Gonzalez-Tokman (The University of Queensland)

A journey through random dynamical systems and multiplicative ergodic theory

AT (p. 90)

10:30 John Bamberg (The University of Western Australia)

Finite generalised polygons: the final frontier in the classification of spherical buildings

AT (p. 90)

11:30 Oksana Yakimova (Friedrich Schiller University of Jena)

Commutative subalgebras of the enveloping and symmetric algebra of a Lie algebra $\mathfrak{g}$

AT (p. 92)

▷ Fri 12 December

09:00 Caroline Wormell (The University of Sydney)

Computing transfer operators and fractal dimensions

AT (p. 92)

10:30 Anita Liebenau (UNSW Sydney)

From Graphs to Latin Rectangles: Probabilistic Methods in Asymptotic Enumeration

AT (p. 91)

11:30 Theo Johnson-Freyd (Perimeter Institute for Theoretical Physics)

Fermions and categorified algebra closure

AT (p. 91)

Session 2: Algebra and Combinatorics

Organisers: Lawrence Reeves, Binzhou Xia, Sanming Zhou

Contributed Talks

▷ Tue 9 December

- 13:30 Devi Imulia Dian Primaskun (The University of Melbourne)
On the Existence of Deeply Critical Oriented Cliques of Even Order
 TLC-314 (p. 96)
- 14:00 Fawwaz Fakhurrozi (The University of Melbourne)
Cores of circulant graphs
 TLC-314 (p. 94)
- 14:30 Yu Wang (Xinjiang University)
Extremal spectral radius and condition (edge) connectivity
 TLC-314 (p. 98)
- 16:00 Paul Kerr (The University of Melbourne)
Machine Learning for Conjecture Discovery
 TLC-314 (p. 95)
- 16:30 Moshe Giles Uhrig (AMSI/University of Melbourne)
Cycle decompositions of arc-transitive graphs
 TLC-314 (p. 95)
- 17:00 Raymond Akpanya (The University of Sydney)
A census of face-transitive surfaces
 TLC-314 (p. 93)

▷ Wed 10 December

- 14:00 Tim Stokes (University of Waikato)
DR-Semigroups satisfying the ample conditions
 TLC-314 (p. 97)
- 14:30 Matthias Fresacher (Western Sydney University)
Categorical representation of DRC-semigroups
 TLC-314 (p. 95)
- 15:00 Luka Carroll (Western Sydney University)
Presentations for semigroups of full-domain partitions and trivial-cokernel partitions
 TLC-314 (p. 94)
- 16:00 Ruzzel Ragas (The University of Sydney)
Probabilities regarding n -Poncellet pairs over finite fields
 TLC-314 (p. 96)
- 16:30 Nathan Britt (The University of Melbourne)
Inversion Sequences Avoiding Triples of Relations
 TLC-314 (p. 93)
- 17:00 Dominic Matan (UNSW Sydney)
The Sarkisov Program for Surfaces Enriched by a Brauer Class
 TLC-314 (p. 96)

▷ Thu 11 December

- 13:30 Guillermo Pineda-Villavicencio (Deakin University)
Colouring of graphs of polytopes
 TLC-314 (p. 96)
- 14:00 Emine Sule Yazici Yuret (Koç University)
Maximal orthogonal partial Latin squares
 TLC-314 (p. 98)

14:30 Pieter Roffelsen (The University of Sydney)
On monodromy of monodromy surfaces
TLC-314 (p. 97)

15:00 Connor Simpson (Sydney Mathematical Research Institute)
Totally nonnegative matroid Schubert varieties
TLC-314 (p. 97)

▷ Fri 12 December

14:00 Murray Elder (University of Technology Sydney)
Permutation closure for multiple context-free languages
TLC-314 (p. 94)

14:30 Vyacheslav Abramov (N/A)
Classes of functions in the set of circulant matrices and their characterization
TLC-314 (p. 93)

15:00 Marcel Jackson (La Trobe University)
Algebraic Machine Learning
TLC-314 (p. 95)

16:00 Kurt Stoeckl (The University of Melbourne)
Maximal compatibility of G -transfer systems
TLC-314 (p. 97)

16:30 Yudhistira Andersen Benjamin (UNSW Sydney)
Different ways of combining infinite families of group divisible designs with two group sizes
TLC-314 (p. 93)

17:00 Andrew Francis (University of New South Wales)
Phylogenetic encodings
TLC-314 (p. 94)

Session 3: Applied and Industrial Mathematics

Organiser: Simon Watt

Contributed Talks

▷ Wed 10 December

- 14:00 Matthew Mack (University of South Australia)
Actin' on Actin
TLC-216 (p. 99)
- 14:30 Mst Shanta Khatun (The University of Sydney)
Modelling Cancer Evolution with a Voronoi Cell-Based Approach
TLC-216 (p. 99)
- 15:00 Joel Miller (La Trobe University)
Low-dimensional models of “simple contagion” spread in networks
TLC-216 (p. 100)
- 16:00 Fiaz Ur Rehman (Monash University)
Propagation of a viscous fluid atop a Bingham material on a slope
TLC-216 (p. 100)
- 16:30 Leonard Mushunje (The University of Sydney)
Algebraic Independence Tests for Economic Models
TLC-216 (p. 100)

▷ Thu 11 December

- 13:30 Benjamin Lee (Monash University)
Modelling intrusions with multi-layer shallow-water models
TLC-216 (p. 99)
- 14:00 Luke Bennetts (The University of Melbourne)
Broadband absorption of water wave energy using graded arrays of heaving buoys in 3D
TLC-216 (p. 99)
- 14:30 Hien Nguyen (Kyushu University/La Trobe University)
When does the variational measure converge given a convergent measure sequence
TLC-216 (p. 100)
- 15:00 Simon Watt (UNSW Canberra)
Chaotic flow in competitive exothermic-endothermic reaction systems
TLC-216 (p. 101)

Session 4: Category Theory, Homotopy Theory, and K-Theory

Organisers: Jean-Simon Lemay, Marcy Robertson, Mircea Voineagu

Keynote Talks

▷ Thu 11 December

13:30 Christian Haesemeyer (The University of Melbourne)
Fourier - Mukai transforms and t -structures
TLC-412 (p. 102)

Contributed Talks

▷ Tue 9 December

13:30 Chandan Singh (The University of Melbourne)
Cyclic Symmetries of Grothendieck–Teichmüller group
TLC-412 (p. 104)

14:00 Thomas Dunmore (UNSW Sydney)
Algebra Objects in Near-Group Fusion Categories
TLC-412 (p. 102)

14:30 Joshua Ham (UNSW Sydney)
Equivariant cellularity in Bredon motivic homotopy
TLC-412 (p. 102)

15:00 George Henderson-Walshe (AMSI/University of Melbourne)
The K-Theory of Toric Varieties
TLC-412 (p. 103)

16:00 Fei Peng (The University of Melbourne)
Fourier–Mukai transforms and Rouquier dimension for algebraic stacks
TLC-412 (p. 104)

16:30 Joel Richardson (Macquarie University)
Algebras of the Tangent Bundle Monad
TLC-412 (p. 104)

17:00 Jean-Simon Lemay (Macquarie University)
From Abelianization to Tangent Categories
TLC-412 (p. 104)

▷ Thu 11 December

14:30 Marcello Lanfranchi (Macquarie University)
Local categories: a new approach to partiality
TLC-412 (p. 103)

15:00 Mircea Voineagu (University of New South Wales)
About motivic cohomology of real numbers
TLC-412 (p. 105)

▷ Fri 12 December

13:30 Sophie Raynor (James Cook University)
Circuit algebras and classical groups
TLC-412 (p. 104)

14:00 Thorsten Hertl (The University of Melbourne)
Line Bundle Twists for Unitary Bordism are Ghosts
TLC-412 (p. 103)

14:30 Edmund Xian Chen Heng (The University of Sydney)
Finite classifying spaces for normalisers of parabolics in Artin groups
TLC-412 (p. 103)

15:00 Diarmuid Crowley (The University of Melbourne)
Some new homotopy self-equivalences of 4-manifolds

 (p. 102)

Session 5: Computational Mathematics

Organisers: Bishnu Lamichhane, Quoc Thong Le Gia, Sergio Rojas

Contributed Talks

▷ Tue 9 December

- 13:30 Agus Soenjaya (University of New South Wales)
An energy-stable and mass-preserving linear finite element method for a diffuse-interface model of tumour growth
TLC-417 (p. 110)
- 14:00 Noura Alhawiti (The University of Newcastle)
Curve Diffusion Flow of Planar Curves with Inhomogeneous Boundary Conditions
TLC-417 (p. 106)
- 14:30 Sergio Carrasco (Monash University)
Fully mixed finite element methods for a steady thermoelastic contact problem
TLC-417 (p. 106)
- 15:00 Andres Eduardo Rubiano Martinez (Monash University)
Fully mixed virtual element schemes for steady-state poroelastic stress-assisted diffusion
TLC-417 (p. 109)
- 16:00 Elizabeth Harris (The University of Newcastle)
Improvement on the worst case runtime for calculating minimum volume covering ellipsoids
TLC-417 (p. 107)
- 16:30 Nicolas Andres Zamorano Goldrine (Politecnico di Torino)
Flow simulation in fractured media: A study of deep learning methodologies for the discrete fracture networks method
TLC-417 (p. 111)
- 17:00 Jordi Manyer (Monash University)
Geometric Multigrid solvers for non-conforming polytopal hybrid discretization methods.
TLC-417 (p. 108)

▷ Wed 10 December

- 14:00 Noah Vinod (UNSW Sydney)
Error Estimates for a Linear Fully-Discrete Finite Element Scheme for the Ferromagnetic Magnetohydrodynamical Model
TLC-417 (p. 111)
- 14:30 Tamara Tambyah (Monash University)
Developing hp-multigrid methods on cubed sphere meshes
TLC-417 (p. 110)
- 15:00 Terence O’Kane (CSIRO)
A Spherical harmonic neural operator atmospheric general circulation model
TLC-417 (p. 109)
- 16:00 Janosch Rieger (Monash University)
Towards optimal space-time discretisations for reachability analysis
TLC-417 (p. 109)
- 16:30 Santiago Badia (Monash University)
Energy minimisation using overlapping tensor-product free-knot B-splines
TLC-417 (p. 106)
- 17:00 Simon Marshall (Retired)
GNLS: an R Program for Errors-in-Variables Fitting
TLC-417 (p. 108)

▷ Thu 11 December

- 13:30 Erchuan Zhang (sun yat sen university)
De Casteljau Cubic Splines in Curved Spaces
TLC-417 (p. 111)
- 14:00 Difeng Cai (Southern Methodist University)
Energy-based deep distribution transformers for scientific computing
TLC-417 (p. 106)
- 14:30 Bishnu Lamichhane (The University of Newcastle)
A mixed FEM for a triharmonic equation using a biorthogonal system
TLC-417 (p. 107)
- 15:00 Quoc Thong Le Gia (University of New South Wales)
Locking-Free Training of Physics-Informed Neural Network for Solving Nearly Incompressible Elasticity Equations
TLC-417 (p. 107)

▷ Fri 12 December

- 13:30 Antoine Marteau (Monash University)
On the Choice of Polynomial Bases for Shape-Functions and Degrees-of-Freedom Moments
TLC-417 (p. 108)
- 14:00 Patrick Vega (Universidad de Santiago de Chile)
Minimum-residual based a posteriori error estimates for mixed finite element discretizations via superconvergent local postprocessed approximations
TLC-417 (p. 110)
- 14:30 Peter Heiss Synak (Australian National University)
Taming Non-Manifold Meshes and Simulating Bubbles
TLC-417 (p. 107)
- 15:00 Sergio Rojas (Monash University)
A posteriori analysis of Neural Network approximations
TLC-417 (p. 109)

Session 6: Differential Geometry and Symmetry

Organisers: Owen Dearnicott, Ramiro Augusto Lafuente, Mat Langford

Keynote Talks

▷ Thu 11 December

14:30 Yoshihiro Tonegawa (Institute of Science Tokyo)
Some recent regularity results on Brakke flow
TLC-313 (p. 116)

Contributed Talks

▷ Tue 9 December

13:30 Thorsten Hertl (The University of Melbourne)
Isotopy Versus Concordance in Positive Scalar Curvature
TLC-313 (p. 114)

14:00 William Hadden (UNSW Sydney)
A Computationally Assisted Proof of the Kähler-Einstein Metric on the Third del Pezzo Surface.
TLC-313 (p. 113)

14:30 An Ky Duy Nguyen (La Trobe University)
Quadratic Killing tensors on symmetric spaces
TLC-313 (p. 114)

15:00 Max Orchard (The University of Queensland)
Incompressible Euler fluids on Riemannian manifolds with symmetry
TLC-313 (p. 115)

16:00 Harrison Greven (Adelaide University)
Conformally Related Einstein Metrics
TLC-313 (p. 113)

16:30 Stepan Hudecek (The University of Queensland)
Canonical Connections in (almost) Hermitian Geometry
TLC-313 (p. 114)

17:00 Yann Bernard (Monash University)
Structural Equations for Critical Points of Conformally Invariant Curvature Energies in 4d
TLC-313 (p. 112)

▷ Wed 10 December

14:00 Tiernan Cartwright (The University of Sydney)
Definitions of the volume of a big cohomology class
TLC-313 (p. 113)

14:30 Marcus Flook (Australian National University)
Fully nonlinear flows of real hypersurfaces in complex space
TLC-313 (p. 113)

15:00 Devesh Rajpal (Australian National University)
Affine Boosted Gauss Curvature Flow
TLC-313 (p. 115)

16:00 Alexander Bednarek (The University of Sydney)
Fano Fibrations, Twisted Kahler-Einstein Metrics and the Kahler-Ricci Flow
TLC-313 (p. 112)

16:30 Yuri Nikolayevsky (La Trobe University)
Symmetric hypersurfaces in symmetric spaces
TLC-313 (p. 115)

17:00 Qiyu Zhou (The Australian National University)

High codimension mean curvature flow of spacelike-convex submanifolds with one spacelike codimension

TLC-313 (p. 116)

▷ Thu 11 December

13:30 Kwok-Kun Kwong (University of Wollongong)

Fenchel-Willmore inequality for submanifolds in manifolds with non-negative k -Ricci curvature

TLC-313 (p. 114)

14:00 Timothy Buttsworth (University of New South Wales)

Computationally-assisted proofs for mean curvature flow self-shrinkers

TLC-313 (p. 112)

▷ Fri 12 December

13:30 Philip Schrader (Murdoch University)

Curve shortening by Sobolev gradient flow

TLC-313 (p. 115)

14:00 Haotian Wu (The University of Sydney)

Asymptotic behaviour of unstable perturbations of the Fubini–Study metric in Ricci flow

TLC-313 (p. 116)

14:30 Lashi Bandara (Deakin University)

The space of rough Riemannian metrics

TLC-313 (p. 112)

Session 7: Dynamical Systems and Ergodic Theory

Organisers: Cecilia Gonzalez-Tokman, Warwick Tucker

Contributed Talks

▷ Tue 9 December

- 13:30 Martin Wechselberger (The University of Sydney)
The parametrisation method and slow-fast averaging
TLC-415 (p. 118)
- 14:00 Renee Oldfield (The University of Queensland)
Average measure theoretic entropy for a family of expanding on average random Blaschke products
TLC-415 (p. 117)
- 14:30 Jahne Meyer (The University of Newcastle)
Hyperbolic motion of polygons via semi-discrete linear geometric flows
TLC-415 (p. 117)
- 15:00 Mridul Patel (RMIT University)
A Fractal Analysis of Australian Migration Trends
TLC-415 (p. 118)

▷ Thu 11 December

- 13:30 Renaud Leplaideur (Université de la Nouvelle Calédonie)
Limits of equilibrium states for coupled weakly interacting systems
TLC-212 (p. 117)
- 14:00 Pinsky Tali (Monash University)
Heteroclinic connections in the Lorenz equations
TLC-212 (p. 118)
- 14:30 Andy Hammerlindl (Monash University)
Dynamical Incoherence in High Dimensions
TLC-212 (p. 117)
- 15:00 Michael Baake (Bielefeld University)
On the long-range order of the Hat and Spectre monotile systems
TLC-212 (p. 117)

Session 8: Equity, Diversity and Inclusion

Organiser: Marcy Robertson

Contributed Talks

▷ Tue 9 December

14:00 Matthew Mack (University of South Australia)

Workshop: Alt-Text for Mathematicians

TLC-216 (p. 119)

14:30 Yudhistira Andersen Bunjamin (UNSW Sydney)

Adapting outreach workshops for foreign contexts

TLC-216 (p. 119)

15:00 Marcy Robertson (The University of Melbourne)

Panel Discussion: Equity in Mathematics Education

TLC-216 (p. 119)

▷ Fri 12 December

14:30 TriThang Tran (The University of Melbourne)

Mathematics is a human endeavour: What happens when you ask real analysis students to reflect on racism, sexism and ethics?

TLC-414 (p. 119)

15:00 Adriana Zanca (The University of Melbourne)

Evaluating a Pilot Program Supporting Women, Nonbinary, Trans and Gender Diverse Students in Mathematics and Statistics

TLC-414 (p. 120)

Session 9: Financial Mathematics

Organisers: Jie Yen Fan, Kais Hamza, Fima Klebaner

Keynote Talks

▷ Wed 10 December

- 14:00 Kihun Nam (Monash University)
What does no-arbitrage condition tells about PDEs?
TLC-215 (p. 122)

Contributed Talks

▷ Tue 9 December

- 14:00 Andrea Macrina (University College London)
Arcade Processes for Informed Martingale Interpolation
TLC-215 (p. 122)
- 14:30 Eckhard Platen (University of Technology, Sydney)
Information-Minimizing Stationary Financial Market Dynamics
TLC-215 (p. 122)
- 15:00 Ivan Guo (Monash University)
Partially Ordered Peacocks
TLC-215 (p. 121)
- 16:00 Xinyi Zhang (University of Wollongong)
American Parisian-type Stock Loan
TLC-215 (p. 123)
- 16:30 Zhao Yang (University of Wollongong)
Analytically pricing commodity futures options with seasonality and stochastic liquidity risks
TLC-215 (p. 123)
- 17:00 Huan Chen (Monash University)
Universal mimicking
TLC-215 (p. 121)

▷ Wed 10 December

- 15:00 Ho Man Tai (The University of Sydney)
Incentives of Defined-Contribution Pension Managers
TLC-215 (p. 123)
- 16:00 Chang Chen (The University of Queensland)
A Data-Driven Neural Network Approach for Reward-Risk Portfolio Optimisation in Decumulation
TLC-215 (p. 121)
- 16:30 Zhao Zhang (University of Wollongong)
Enhancing PINNs with Martingale Supervision for Efficient High-Dimensional Option Pricing
TLC-215 (p. 124)
- 17:00 Kajanthan Shiyamasuntharam (University of Wollongong)
An ADI Approach with Coordinate Transformation for Pricing American Options on Coupon Bonds under a Stochastic-Volatility Vasicek Model
TLC-215 (p. 122)

▷ Thu 11 December

- 14:00 Zili Zhu (CSIRO)
Using Large Data to Uncover Causal Interrelationships between Economic Indicators
TLC-215 (p. 124)
- 14:30 Yuyu Chen (The University of Melbourne)
Stochastic dominance for linear combinations of infinite-mean risks

- TLC-215 (p. 121)
- 15:00 Kazutoshi Yamazaki (The University of Queensland)
Nonzero-sum optimal stopping game with continuous vs. periodic exercise opportunities
- TLC-215 (p. 123)

Session 10: General Session

Organiser: Joel Miller

Contributed Talks

▷ Tue 9 December

- 16:00 Adam Bilchouris (La Trobe University)
Nonparametric Estimation of the Autocovariance Function
TLC-317 (p. 125)
- 16:30 Udara Kumaranathunga (La Trobe University)
Meta-Analysis of Quantiles and Functions of Quantiles with Applications to Diabetes
TLC-317 (p. 125)
- 17:00 Jayamini Liyanage (La Trobe University)
Meta-Analysis of High-Dimensional Data
TLC-317 (p. 125)

▷ Wed 10 December

- 16:00 Jeremy Sumner (University of Tasmania)
Towards a representation theory of Lie-Markov semigroups: motivations and examples
TLC-317 (p. 126)
- 16:30 Kiah Swinsburg (University of Tasmania)
Towards a representation theory of Lie-Markov semigroups
TLC-317 (p. 127)
- 17:00 Daniel Francis Mansfield (University of New South Wales)
Area of a Segment in Ancient Mesopotamia
TLC-317 (p. 126)

▷ Fri 12 December

- 13:30 Simon Marshall (Retired)
Some Novel Applications of Matrices in Spherical Trigonometry
TLC-414 (p. 126)
- 14:00 Stephen Nurse (Unaffiliated)
From 1d to 3d with craft sticks
TLC-414 (p. 126)

Session 11: Groups, Actions and Computation

Organisers: Heiko Dietrich, Murray Elder

Contributed Talks

▷ Tue 9 December

- 13:30 Uri Onn (Australian National University)
Spectral Equivalence of p -Groups and the Larsen–Lubotzky Conjecture
 TLC-317 (p. 130)
- 14:00 Colin David Reid (Western Sydney University)
Commensurators of free groups and free pro- p groups
 TLC-317 (p. 130)
- 14:30 Joshua Howie (Monash University)
Lambda lengths in link complements
 TLC-317 (p. 129)
- 15:00 Chuanqi Zhang (University of Technology Sydney)
Diffie–Hellman Key Exchange from Commutativity to Group Laws
 TLC-317 (p. 131)

▷ Wed 10 December

- 14:00 Vandit Trivedi (Australian National University)
A generating set for the commutator subgroup of a twisted right-angled Artin group
 TLC-414 (p. 130)
- 14:30 Yusuf Hafidh (The University of Melbourne)
Perfect r -codes in circulant graphs
 TLC-414 (p. 128)
- 15:00 Max Carter (Université Catholique de Louvain)
Non-Wiener totally disconnected locally compact groups
 TLC-414 (p. 128)
- 16:00 Anthony Pisani (Monash University)
The Saxl hypergraph of a permutation group
 TLC-414 (p. 130)
- 16:30 Adam Piggott (Australian National University)
New constructions of free products and geodesic Cayley graphs
 TLC-414 (p. 130)
- 17:00 Marcus Chijoff (The University of Newcastle)
Determining Properties of (P) -closed Groups Acting On Trees Using Local Action Diagrams
 TLC-414 (p. 128)

▷ Thu 11 December

- 13:30 Joachim Koenig (Korea National University of Education)
Monodromy groups of polynomials and reducibility behavior of variable-separated equations
 TLC-414 (p. 129)
- 14:00 Rugare Kwashira (University of the Witwatersrand)
Central automorphisms in n -abelian groups
 TLC-414 (p. 129)
- 14:30 Edmund Xian Chen Heng (The University of Sydney)
Hyperplane arrangements and normalisers of parabolics in Coxeter groups
 TLC-414 (p. 129)
- 15:00 Michael Giudici (The University of Western Australia)
Multiplication groups of loops
 TLC-414 (p. 128)

Session 12: Harmonic Analysis and Hamiltonian PDE

Organisers: Zihua Guo, Ji Li

Contributed Talks

▷ Tue 9 December

- 13:30 Lashi Bandara (Deakin University)
Harmonic analysis and boundary trace for first-order elliptic operators over vector bundles
 TLC-414 (p. 132)
- 14:00 Emanuel Godfried (AMSI/University of Melbourne)
Mean first escape times on asymptotically hyperbolic surfaces
 TLC-414 (p. 133)
- 14:30 Weihang Zheng (Monash University)
Localized Big Bang Stability of the Kasner-scalar field Metrics
 TLC-414 (p. 135)
- 15:00 Virinchi Rallabhandi (University of Edinburgh)
Energy in spacetimes with negative cosmological constant
 TLC-414 (p. 134)
- 16:00 Louie Bernhardt (The University of Melbourne)
Stability of solutions to the Einstein equations undergoing decelerated expansion
 TLC-414 (p. 132)
- 16:30 Xuejing Huo (Macquarie University)
New endpoint estimates for certain singular integrals with non-smooth kernels
 TLC-414 (p. 133)
- 17:00 Jiakun Liu (The University of Sydney)
Global $C^{1,\alpha}$ regularity for Monge-Ampère equations
 TLC-414 (p. 134)

▷ Wed 10 December

- 14:00 Simon Marshall (The University of Melbourne)
Quantum Ergodicity in the level aspect for locally symmetric spaces
 TLC-412 (p. 134)
- 14:30 Moritz Doll (Macquarie University)
Microlocal analysis of the Klein-Gordon equation
 TLC-412 (p. 132)
- 15:00 Qiuye Jia (The Australian National University)
Non-relativistic limit of Klein-Gordon equations in curved spacetimes
 TLC-412 (p. 133)
- 16:00 Po-Lam Yung (The Australian National University)
Remarks about the local smoothing conjecture
 TLC-412 (p. 135)
- 16:30 Owen Dearnicott (La Trobe University)
Edge-cone singularities on anti-self-dual Einstein spaces in dimension four and 3-Sasakian spaces in dimension seven
 TLC-412 (p. 132)
- 17:00 Cale Rankin (Monash University)
Brunn–Minkowski inequalities for eigenvalues of elliptic operators
 TLC-412 (p. 134)

▷ Fri 12 December

- 16:00 Volker Schlue (The University of Melbourne)
Scattering solutions of the Vlasov-Maxwell system
 TLC-412 (p. 135)

- 16:30 Jesse Gell-Redman (None)
Propagators for evolution equations
TLC-412 (p. 133)
- 17:00 Justin Forlano (Monash University)
The intermediate nonlinear Schrödinger equation
TLC-412 (p. 133)

Session 13: Mathematics Education

Organiser: Adam Piggott

Contributed Talks

▷ Thu 11 December

- 13:30 Ravindi Nanayakkara (La Trobe University)
Enhancing Student Success Through the Maths Hub: Multidisciplinary Mathematics and Statistics Support
PS2-212 (p. 136)
- 14:00 Paul Fijn (The University of Melbourne)
Increasing interactivity in small-group teaching: implementing new technology in a statistics course
PS2-212 (p. 136)
- 14:30 Florian Breuer (The University of Newcastle)
Using the Bloom AI Tutor in a first-year Mathematics Course
PS2-212 (p. 136)
- 15:00 Uri Onn (Australian National University)
Kodály method, Instrumental Enrichment, and Math Education
PS2-212 (p. 137)

▷ Fri 12 December

- 13:30 Adam Piggott (Australian National University)
How to get your mathematics degree accredited by the AustMS
PS2-212 (p. 138)
- 14:00 TriThang Tran (The University of Melbourne)
Mathematical communication and supporting the transition from secondary to tertiary mathematics
PS2-212 (p. 138)
- 14:30 Neea Palojaervi (University of New South Wales Canberra)
The Math Kangaroo Finland: Different topics
PS2-212 (p. 137)
- 15:00 Murray Elder (University of Technology Sydney)
Flipped exams
PS2-212 (p. 136)

Session 14: Mathematical Methods in Continuum Mechanics and Wave Theory

Organisers: Dave Smith, Amy-Rose Westcott, Ben Wilks

Contributed Talks

▷ Tue 9 December

- 16:00 Erik Garcia Neefjes (Macquarie University)
A neural-network surrogate Bayesian algorithm for the Helmholtz inverse-medium problem
 TLC-216 (p. 140)
- 16:30 Luke Bennetts (The University of Melbourne)
Acoustic lattice resonances and generalised Rayleigh–Bloch waves
 TLC-216 (p. 139)
- 17:00 Dave Smith (The University of Newcastle)
Linearized KdV on the line with a metric graph defect
 TLC-216 (p. 141)

▷ Wed 10 December

- 14:00 Paolo Piersanti (The Chinese University of Hong Kong (Shenzhen))
On the Dynamics of Grounded Shallow Ice Sheets: Modelling and Analysis
 PS2-212 (p. 140)
- 14:30 Mitchell Bonham (The University of Newcastle)
Determining Iceberg Elastic Properties Through Resonant Flexure
 PS2-212 (p. 139)
- 15:00 Quanling Deng (Yau Mathematical Sciences Center, Tsinghua University)
A Particle–Continuum Multiscale Modeling Framework with an Application to Sea-Ice Dynamics
 PS2-212 (p. 139)

▷ Fri 12 December

- 13:30 Robert Buckingham (University of Cincinnati)
Suleimanov–Talanov self-focusing in the NLS hierarchy
 TLC-216 (p. 139)
- 14:00 Philip Broadbridge (La Trobe University)
Integrable Nonlinear Wave Equations with Diode Properties
 TLC-216 (p. 139)
- 14:30 Scott McCue (Queensland University of Technology)
KdV solutions and exponential asymptotics
 TLC-216 (p. 140)
- 15:00 Volker Schlue (The University of Melbourne)
Charged elastic bodies in relativistic elasticity
 TLC-216 (p. 141)
- 16:00 Ben Wilks (University of South Australia)
Water wave scattering by a surface-mounted rectangular anisotropic elastic plate
 TLC-216 (p. 141)

Session 15: Mathematical Physics

Organisers: Ian Marquette, William Mead, Pieter Roffelsen, Yang Shi

Contributed Talks

▷ Tue 9 December

- 13:30 Nalini Joshi (The University of Sydney)
Integrable dynamical systems on bi-elliptic surfaces
TLC-115 (p. 144)
- 14:00 Artem Stoian (The University of Melbourne)
Blowup relations and q -Painlevé VI
TLC-115 (p. 146)
- 14:30 Cengiz Gazi (AMSI/University of Melbourne)
Application of Painlevé integrability in Blockchain mining
TLC-115 (p. 143)
- 15:00 Anthony Parr (The University of Queensland)
Algebraic Generation of Painleve Transcendents
TLC-115 (p. 145)
- 16:00 Siyu Li (La Trobe University)
Polynomial deformations of $sl(2)$ and unified algebraic framework for solutions of a class of spin models
TLC-115 (p. 145)
- 16:30 Jared Heymann (The University of Melbourne)
“Lattice translation” symmetry on an open boundary spin chain
TLC-115 (p. 143)
- 17:00 William Mead (The University of Melbourne)
Pfaffian Point Processes from the Half-space Exclusion Process
TLC-115 (p. 145)

▷ Wed 10 December

- 16:00 Fei Peng (The University of Melbourne)
The Keel–Mori theorem for complex Deligne–Mumford superstacks
TLC-115 (p. 146)
- 16:30 Weiyang Guo (AMSI/University of Melbourne)
Puzzle formula for type BC Hall–Littlewood polynomial
TLC-115 (p. 143)
- 17:00 Victor Fagundes (La Trobe University)
Extending the coalgebra formalism for the construction of integrable and superintegrable systems
TLC-115 (p. 142)

▷ Thu 11 December

- 13:30 Jan De Gier (The University of Melbourne)
Inhomogeneous q -deformation of the Tsetlin library
TLC-115 (p. 142)
- 14:00 Yuyang Zhou (The University of Melbourne)
The asymmetric five-vertex model with arbitrary boundary conditions
TLC-115 (p. 146)
- 14:30 Thomas Quella (The University of Melbourne)
Symmetry-protected topological scar subspaces
TLC-115 (p. 146)
- 15:00 Simran Arora (Kyoto University)

Particle physics models of interacting bosonic dark energy and fermionic dark matter in Einstein scalar Gauss-Bonnet gravity

TLC-115 (p. 142)

▷ Fri 12 December

13:30 Kenji Kajiwara (Kyushu University)

Michelle-Prager Type Truss Structures Generated by Integrable Discrete Holomorphic Functions

TLC-115 (p. 144)

14:00 Chris Bradly (The University of Melbourne)

Lattice polymers subject to a force

TLC-115 (p. 142)

14:30 Madeline Nurcombe (The University of Sydney)

Segal–Sugawara vectors for orthosymplectic Lie superalgebras

TLC-115 (p. 145)

15:00 Pieter Hubert van der Kamp (La Trobe University)

Integrable Lotka-Volterra systems, Darboux polynomials, and Hypergraphs

TLC-115 (p. 146)

16:00 Laurence Field (Australian National University)

SLE return probabilities and an integrable system

TLC-115 (p. 143)

16:30 Vassili Kitsios (CSIRO)

QiuckClim-v2: Galerkin projection of the global moist three-dimensional atmosphere

TLC-115 (p. 144)

Session 16: Nonlinear PDEs and their applications

Organisers: Jiakun Liu, Cale Rankin

Keynote Talks

▷ Tue 9 December

13:30 Yoshihiro Tonegawa (Institute of Science Tokyo)
Some existence results for mean curvature flow with forcing
TLC-416 (p. 150)

▷ Thu 11 December

13:30 Neil Trudinger (Australian National University)
Oblique boundary value problems for augmented Hessian equations under degenerate boundary conditions.
TLC-416 (p. 150)

Contributed Talks

▷ Tue 9 December

14:30 James McCoy (The University of Newcastle)
Isoperimetric inequality for multiply-winding curves
TLC-416 (p. 149)

15:00 Glen Edward Wheeler (University of Wollongong)
Isoperimetry via a Sobolev gradient flow
TLC-416 (p. 150)

16:00 Kwok-Kun Kwong (University of Wollongong)
Fenchel-Willmore and Sobolev-type inequalities for submanifolds in non-negatively curved manifolds
TLC-416 (p. 149)

16:30 Weihang Zheng (Monash University)
Localized Big Bang Stability of the Kasner-scalar Field Metrics
TLC-416 (p. 151)

17:00 Mashniah A. Gazwani (The University of Newcastle)
Length-unconstrained, length-constrained and length-penalised curve diffusion flows of planar curves inside cones
TLC-416 (p. 148)

▷ Wed 10 December

14:00 Florica Corina Cirstea (The University of Sydney)
Symmetry of global solutions for nonlinear elliptic equations with mixed reaction terms
TLC-416 (p. 147)

14:30 Maria Farcaseanu (The University of Sydney)
Asymptotic profiles for singular nonlinear elliptic equations
TLC-416 (p. 148)

15:00 Po-Lam Yung (The Australian National University)
Remarks about the Kakeya conjecture
TLC-416 (p. 151)

16:00 Joshua Zavone (The University of Sydney)
Local existence and classification of isolated singularities for nonlinear elliptic equations
TLC-416 (p. 151)

16:30 Johnathan Adams (QUT)
The Impact of Curvature on Travelling Fronts under Non-linear Diffusion.
TLC-416 (p. 147)

17:00 Ji Li (Macquarie University)
Fefferman–Stein type inequality and applications
TLC-416 (p. 149)

▷ Thu 11 December

14:30 Artem Pulemotov (The University of Queensland)
Local solutions to the Poisson equation for G_2 structures on cohomogeneity one manifolds
TLC-416 (p. 150)

15:00 Wenjie Ni (University of New England)
A competition model with nonlocal diffusion and free boundaries
TLC-416 (p. 149)

▷ Fri 12 December

13:30 Julie Clutterbuck (Monash University)
The spectral gap in hyperbolic space
TLC-416 (p. 148)

14:00 Todd Oliynyk (Monash University)
Stable and unstable behaviour in relativistic fluids on cosmological spacetimes
TLC-416 (p. 149)

14:30 Zihua Guo (Monash University)
Well-posedness for the compressible Navier-Stokes equations in critical Besov space
TLC-416 (p. 148)

15:00 Yann Bernard (Monash University)
Analysis of Critical Points of Conformally Invariant Curvature Energies in 4d
TLC-416 (p. 147)

16:00 Haotian Wu (The University of Sydney)
Immortal Ricci flow with Type-IIb singularities
TLC-416 (p. 150)

Session 17: Number Theory

Organisers: Daniel Johnston, Bryce Kerr, Liangyi Zhao

Keynote Talks

▷ Tue 9 December

- 13:30 Stephan Baier (Ramakrishna Mission Vivekananda Educational and Research Institute)
The large sieve for square moduli, revisited
TLC-214 (p. 152)

Contributed Talks

▷ Tue 9 December

- 14:30 Timothy Trudgian (UNSW Canberra)
A is for Averages
TLC-214 (p. 157)
- 15:00 Simon Marshall (The University of Melbourne)
An introduction to the Sarnak–Xue density conjecture
TLC-214 (p. 155)
- 16:00 Gustav Kjaerbye Bagger (UNSW Canberra)
Norm-Euclidean cyclic cubic fields
TLC-214 (p. 154)
- 16:00 Giulia Pelizzari (UNSW Canberra)
Bounds on the Minkowski constants
TLC-212 (p. 156)
- 16:30 Zoë Gemmell (UNSW Canberra)
The functions behind encryption
TLC-212 (p. 154)
- 16:30 Simon Thomas (The University of Queensland)
Sieves and almost primes
TLC-214 (p. 156)
- 17:00 James Punch (UNSW Canberra)
The covering radius of particular logarithmic lattices
TLC-212 (p. 156)
- 17:00 Sebastian Tudzi (University of New South Wales Canberra)
From Elementary to Analytic: Explicit Bounds in the Generalised Divisor Problem
TLC-214 (p. 157)

▷ Wed 10 December

- 14:00 Muhammad Afifurrahman (UNSW Sydney)
Multiplicatively dependent integer vectors on a hyperplane
TLC-214 (p. 152)
- 14:00 Ameya Tilgul (UNSW Canberra)
Smooth analogue of the pair-correlation function
TLC-317 (p. 157)
- 14:30 Chandler Chase Corrigan (University of New South Wales)
Hecke eigenvalues at Piatetski-Shapiro primes
TLC-214 (p. 153)
- 14:30 Liang Wang (UNSW Canberra)
Optimal energy condition for metric Poissonian pair correlation
TLC-317 (p. 157)
- 15:00 Michael Harm (UNSW Sydney)
The reverse Goldbach Conjecture
TLC-317 (p. 154)

- 15:00 Yixiu Xiao (UNSW Sydney)
Least zero of pairs of additive cubic equations
 TLC-214 (p. 157)
- 16:00 Adrian Dudek (The University of Queensland)
Almost Primes Between All Squares
 TLC-214 (p. 153)
- 16:30 Daniel Johnston (UNSW Canberra)
Can the Bombieri–Vinogradov theorem be made effective?
 TLC-214 (p. 154)
- 17:00 Florian Breuer (The University of Newcastle)
Divisibility of the coefficients of modular polynomials
 TLC-214 (p. 153)

▷ Thu 11 December

- 13:30 Chiara Bellotti (UNSW Canberra)
On the number of zeros of the Riemann zeta function
 TLC-317 (p. 152)
- 13:30 Abraham Zhang (The University of Newcastle)
Explicit height bounds on modular polynomials
 TLC-214 (p. 158)
- 14:00 Saunak Bhattacharjee (University of New South Wales Canberra)
Height inequality and an improved larger sieve over number fields
 TLC-317 (p. 152)
- 14:30 Anthony Overmars (La Trobe University)
On fast approximation of quadratic irrationals
 TLC-214 (p. 155)
- 14:30 Maximilian Kortge (The University of Melbourne)
On the inverse volcano problem over non-prime finite fields
 TLC-214 (p. 155)
- 14:30 Jordan Pertile (University of New South Wales Canberra)
On lower bounds for the discriminant of a number field
 TLC-317 (p. 156)
- 15:00 Blair Butler (The University of Sydney)
Magma Vs Ranks of Elliptic Curves
 TLC-214 (p. 153)
- 15:00 Shashi Chourasiya (University of New South Wales Canberra)
A zero density estimate for Dirichlet L -functions
 TLC-317 (p. 153)

▷ Fri 12 December

- 13:30 Lewis Combes (The University of Sydney)
Lifting mod p Bianchi modular forms
 TLC-214 (p. 153)
- 13:30 Neea Palojaervi (University of New South Wales Canberra)
On explicit estimates for the Goldbach summatory functions
 TLC-215 (p. 156)
- 14:00 Subham Bhakta (UNSW Sydney)
Multiplicative dependence in the denominators of points of elliptic curves
 TLC-214 (p. 152)
- 14:00 Rodney Nilsen (University of Wollongong)
Digit properties and convergence estimates for α -fractional numbers
 TLC-215 (p. 155)
- 14:30 Alexandru Ghitza (The University of Melbourne)
Non-existence of some higher-dimensional Galois representations
 TLC-214 (p. 154)

Session 18: Optimisation

Organisers: Minh N. Dao, Nadia Sukhorukova, Julien Ugon

Keynote Talks

▷ Thu 11 December

13:30 Andrew Craig Eberhard (RMIT University)
Monotone Operator Theory: Some recent results and Future Directions
TLC-311 (p. 160)

▷ Fri 12 December

13:30 Jein-Shan Chen (Department of Mathematics, National Taiwan Normal University)
Novel Constructions for Closed Convex Cones Through Inequalities and Support Functions
TLC-311 (p. 159)

Contributed Talks

▷ Tue 9 December

- 13:30 Brianna Laird (Deakin University)
A Steiner Tree Based Genetic Algorithm for Multi-layered Location-Allocation-Routing Problems
TLC-311 (p. 161)
- 14:00 Vishmi Fernando (RMIT University)
Improving Routing and Scheduling for Home-Based Chemotherapy and Infusion Services with a Single Nurse
TLC-311 (p. 161)
- 14:30 Shahtaj Bano (RMIT University)
Optimization of multiobjective chemotherapy treatment regimens with NSGA-II and weighted sum methods
TLC-311 (p. 159)
- 15:00 Iman Shekarriz (Deakin University)
Metaheuristic methods for Soft Happy Colouring
TLC-311 (p. 163)
- 16:00 Mohammadali Hosseinimoghaddam (The University of Queensland)
Generalisations of extreme value theorem
TLC-311 (p. 161)
- 16:30 Jacob Westerhout (The University of Queensland)
Converses of the Extreme Value Theorem
TLC-311 (p. 164)
- 17:00 Nadia Sukhorukova (Swinburne University of Technology)
Nonsmooth Optimisation and neural networks
TLC-311 (p. 163)

▷ Wed 10 December

- 14:00 Vera Roshchina (UNSW Sydney)
Everything is possible: constructing spectrahedra with prescribed facial dimensions
TLC-311 (p. 162)
- 14:30 Fangyu Liu (The University of Melbourne)
Robust estimators for stochastic model-based DFO
TLC-311 (p. 162)
- 15:00 Thang Truong (RMIT University)
A primal-dual splitting algorithm for structured composite monotone inclusions
TLC-311 (p. 163)
- 16:00 Kaniz Fatema (RMIT University)
A DC-based optimization method for solving reverse convex programming problems

- TLC-311 (p. 161)
- 16:30 Liam Timms (The University of Melbourne)
A decentralised forward-backward-type algorithm with heterogenous agent step sizes
 TLC-311 (p. 163)
- 17:00 Yiwen Chen (University of British Columbia, Okanagan)
Randomized subspace methods for high-dimensional model-based derivative-free optimization
 TLC-311 (p. 160)
- ▷ Thu 11 December
- 14:30 Lindon Roberts (The University of Melbourne)
Direct Search for Linearly Constrained Derivative-Free Optimization
 TLC-311 (p. 162)
- 15:00 Sarat Babu Moka (UNSW Sydney)
A Unified Approach for Sparse-Constrained Quadratic Programming
 TLC-311 (p. 162)
- ▷ Fri 12 December
- 14:30 Julien Ugon (Deakin University)
Proximal-point-like algorithms for abstract convex minimisation problems
 TLC-311 (p. 164)
- 15:00 Reinier Diaz Millan (Deakin University)
Frank–Wolfe algorithm for star-convex functions
 TLC-311 (p. 160)
- 16:00 Bethany Caldwell (University of New South Wales)
A primal-dual splitting method for robust convex optimisation
 TLC-311 (p. 159)
- 16:30 Felipe Atenas (The University of Melbourne)
Variable stepsize splitting methods as relocated fixed-point iterations
 TLC-311 (p. 159)
- 17:00 Neil Dizon (UNSW Sydney)
Hierarchy of SDPs for Wasserstein Distributionally Robust Optimization with Piecewise Polynomials
 TLC-311 (p. 160)

Session 19: Poster session

Organiser: Santiago Barrera Acevedo

Contributed Posters

- ▷ Eve Cheng (The Australian National University)
Detecting Reticulate Edges in Large Species Trees Using Topological Data Analysis (p. 165)
- ▷ Alexander Elzenaar (Monash University)
The fractals that parameterise hyperbolic handlebodies (p. 165)
- ▷ Mohammadali Hosseinimoghaddam (The University of Queensland)
The Converses of The Extreme (p. 165)
- ▷ Shahid Khan (La Trobe University)
Exploring the Structure of Anisotropic Random Fields on the Sphere (p. 166)
- ▷ Haruka Suga (Kyushu University)
Simulation of Catheter-Based Treatment for Vascular Stenosis Using a Simplified Mathematical Model
(p. 166)
- ▷ Kiyoshi Takeuchi Romo (Australian National University)
Reconstructing 3D Objects Through 2D Methods via Persistent Homology Transform (p. 166)

Session 20: Probability and Mathematical Statistics

Organisers: Hien Nguyen, Andriy Olenko

Contributed Talks

▷ Tue 9 December

- 13:30 Peter Gerrard Taylor (The University of Melbourne)
First passage probabilities and local times for null recurrent Markov additive processes
 TLC-413 (p. 177)
- 14:00 Clara Grazian (The University of Sydney)
A Bayesian Semiparametric Bernstein–von Mises Theorem for Long-Memory Models
 TLC-212 (p. 170)
- 14:00 Simon Harris (The University of Auckland)
Genealogies of samples from stochastic population models
 TLC-413 (p. 171)
- 14:30 Alexis Kagan (The University of Auckland)
The genealogy of individuals sampled through time in a Galton-Watson tree
 TLC-212 (p. 173)
- 14:30 Diego Marcondes (The Australian National University)
A resolvent approach to the metastability of Markov processes
 TLC-413 (p. 174)
- 15:00 Simon Marshall (Retired)
The Wrapped Hyperbolic Secant Distribution and its Binary Mixtures
 TLC-212 (p. 175)
- 15:00 Jack Mills (Monash University)
Generalised Polya Urns and Preferential Attachment
 TLC-413 (p. 175)
- 16:00 Azam Asanjarani (The University of Auckland)
Structured Subclasses of Markovian Arrival Processes
 TLC-413 (p. 167)
- 16:00 Mohd Mahayaudin Mansor (UNIVERSITI TEKNOLOGI MARA)
Prediction of Stroke Status using Logistic Regression based on Modifiable and Non-Modifiable Risk Factors
 TLC-415 (p. 174)
- 16:30 Mingqi He (The University of Melbourne)
Simulation-based inference of population histories from local gene genealogies
 TLC-415 (p. 171)
- 16:30 Hongyi Lyu (Monash University)
Asymptotic power law of a random graph process
 TLC-413 (p. 174)
- 17:00 Trung Tin Nguyen (Queensland University of Technology)
Mathematical Foundations of AI and Data Science for Trustworthy Systems: Leveraging Multimodality and Sparsity
 TLC-415 (p. 176)
- 17:00 Nemini Yadeesha Jayani Wijesinghe Samarakoon (La Trobe)
Haar-Based Multifractional Processes
 TLC-413 (p. 177)

▷ Wed 10 December

- 14:00 Kostya Borovkov (The University of Melbourne)
On large deviation probabilities for self-normalised sums of random variables
 TLC-413 (p. 167)

- 14:00 Peng Ding (UC Berkeley)
Stratified Permutational Berry–Esseen Bounds and Their Applications to Statistics
 TLC-415 (p. 169)
- 14:30 Spiridon Penev (UNSW Sydney)
Improved confidence intervals for expectiles
 TLC-415 (p. 176)
- 14:30 Liam Wood-Baker (Monash University)
The Glauber Dynamics for the Mean-Field Face-Cubic Model
 TLC-413 (p. 177)
- 15:00 Luke Attrill (Monash University)
The clumsy coupon collector
 TLC-413 (p. 167)
- 15:00 Ruethaichanok Kardkasem (The University of Queensland)
Block Length Selection for Modelling Successive Extremes Using the GEV distribution
 TLC-415 (p. 173)
- 16:00 Xi Geng (AMSI/University of Melbourne)
Long Time Asymptotics of the Parabolic Anderson Model in the Hyperbolic Space
 TLC-413 (p. 170)
- 16:00 Thisaakhya Jayakody (The University of Melbourne)
Analysis of the female family descent tree using the Markovian Binary Tree
 TLC-415 (p. 172)
- 16:30 Peter Braunsteins (UNSW Sydney)
Intrinsic Whittle–Matérn fields and sparse spatial extremes
 TLC-415 (p. 168)
- 16:30 Aram Perez (Monash University)
The Face-Cubic Model on the Complete Graph
 TLC-413 (p. 176)
- 17:00 James Kerlidis (The University of Melbourne)
Existence and non-existence of consistent estimators in supercritical controlled branching processes
 TLC-415 (p. 173)
- 17:00 Qingyuan Zhang (The University of Queensland)
An Inventory System with Two Supply Modes and Lévy Demand
 TLC-413 (p. 178)

▷ Thu 11 December

- 13:30 Andrea Collevocchio (Monash University)
Once-Reinforced Random Walks
 TLC-413 (p. 168)
- 13:30 Fima Klebaner (Monash University)
New approximation in non linear stochastic dynamics with small noise
 TLC-415 (p. 173)
- 14:00 Robert Charles Griffiths (Monash University)
de Finetti Random Walks on a Hypercube and Gaussian Fields
 TLC-413 (p. 170)
- 14:00 Aihua Xia (The University of Melbourne)
Poisson process approximation for subgraph-counting process in general random connection models
 TLC-415 (p. 177)
- 14:30 Kais Hamza (Monash University)
Are random random walks normal?
 TLC-413 (p. 170)
- 14:30 Stephen Muirhead (Monash University)
Poisson approximation of large gaps in Gaussian zeros
 TLC-415 (p. 175)

- 15:00 Conrad Burden (Australian National University)
The Feller diffusion conditioned on a single founder
TLC-413 (p. 168)
- 15:00 Han Liang Gan (The University of Waikato)
Dirichlet approximation of the stationary distribution of the Wright-Fisher model using the prelimit generator comparison approach of Stein's method
TLC-415 (p. 169)

▷ Fri 12 December

- 13:30 David Frazier (Monash University)
Predictively Oriented Posteriors
TLC-413 (p. 169)
- 14:00 Liam Hodgkinson (The University of Melbourne)
Heavy-Tailed Universality in Deep Learning
TLC-413 (p. 171)
- 14:00 Samuel Johnston (Kings College London)
On creating convexity in high dimensions
TLC-415 (p. 172)
- 14:30 Laurence Field (Australian National University)
Brownian processes made recurrent
TLC-415 (p. 169)
- 14:30 Paul Kabaila (La Trobe University)
Unfavorable prior distributions in statistical decision theory
TLC-413 (p. 172)
- 15:00 Maher Boudabra (King Fahd University of Petroleum and Minerals)
Skorokhod energy of planar domains
TLC-415 (p. 167)
- 15:00 Dennis Leung (The University of Melbourne)
Recent advances in normal approximation for U-statistics
TLC-413 (p. 174)

Session 21: Representation Theory

Organisers: Dougal Davis, Yang Zhang

Keynote Talks

▷ Thu 11 December

13:30 Kari Vilonen (The University of Melbourne)
Character Sheaves and Invariant systems
TLC-312 (p. 182)

Contributed Talks

▷ Tue 9 December

13:30 Tom Goertzen (The University of Sydney)
Computing Kazhdan-Lusztig Bases
TLC-312 (p. 179)

14:00 Mengfan Lyu (University of Western Sydney)
A Generalization of the Temperley-Lieb Algebra: Coloured Blob Algebras
TLC-312 (p. 181)

14:30 Willow Stewart (The University of Sydney)
Diagram Monoids and Cryptography
TLC-312 (p. 182)

15:00 Tasman Fell (The University of Sydney)
The Diagrammatic Spherical Category
TLC-312 (p. 179)

16:00 Victor Zhang (UNSW Sydney)
A Diagram Calculus for a few Type-A Lusztig-Vogan Categories
TLC-312 (p. 183)

16:30 Uri Onn (Australian National University)
A PSH-Algebra Approach to Representations of Automorphism Groups of Modules
TLC-312 (p. 182)

17:00 Max Carter (Université Catholique de Louvain)
The type I dichotomy for two-step nilpotent groups
TLC-312 (p. 179)

▷ Wed 10 December

14:00 Finn Klein (The University of Sydney)
Semisimplifying categorical Heisenberg actions, with applications to modular representation theory of finite groups
TLC-312 (p. 180)

14:30 Joseph Newton (The University of Sydney)
 $\mathrm{Ver}_{p^n}(G)?$
TLC-312 (p. 182)

15:00 Edmund Xian Chen Heng (The University of Sydney)
Species and algebras in fusion categories
TLC-312 (p. 180)

16:00 Jensen O'Sullivan (The University of Sydney)
Growth problems of quantum $\mathfrak{sl}_2$
TLC-312 (p. 182)

16:30 Jie Du (University of New South Wales)
Canonical bases for quantum $\mathfrak{gl}_{m|n}$
TLC-312 (p. 179)

17:00 Leonardo Maltoni (The Australian National University)
Filtrations for Rouquier complexes
TLC-312 (p. 181)

▷ Thu 11 December

14:30 Chenyan Wu (The University of Melbourne)
Hecke algebras and Langlands parameters for Bernstein blocks of the metaplectic groups
TLC-312 (p. 183)

15:00 Yau Wing Li (The University of Melbourne)
Endoscopy for Metaplectic Affine Hecke Categories
TLC-312 (p. 180)

▷ Fri 12 December

13:30 Simon Marshall (The University of Melbourne)
Uniform bounds for fixed vectors in representations of a p -adic GL_n
TLC-312 (p. 182)

14:00 Ting Xue (The University of Melbourne)
Level-rank dualities from d -Harish-Chandra series
TLC-312 (p. 183)

14:30 Sam Jeralds (The University of Sydney)
Irreducible components in Hochschild cohomology of flag varieties
TLC-312 (p. 180)

15:00 Svetlana Makarova (Australian National University)
Generalised Pascal recurrence in lattice vertex operator superalgebras
TLC-312 (p. 181)

16:00 Lior Yanovski (AMSI/University of Melbourne)
Generalized induced character formula
TLC-312 (p. 183)

16:30 Yixuan Li (Australian National University)
A McKay correspondence for Type A Lie Superalgebras
TLC-312 (p. 180)

Session 22: Stochastic Differential Equations

Organisers: Beniamin Goldys, Chunxi Jiao, Ngan Le

Keynote Talks

▷ Tue 9 December

13:30 Max Nendel (University of Waterloo)

Chernoff approximation of infinitely divisible distributions and Lévy processes with drift

PS2-330 (p. 187)

Contributed Talks

▷ Tue 9 December

14:30 Haesung Lee (Kumoh National Institute of Technology)

Local elliptic regularity for solutions to stationary Fokker-Planck equations via Dirichlet forms and resolvents

PS2-330 (p. 186)

15:00 Ho Man Tai (The University of Sydney)

Global Well-Posedness of Extended Mean Field Games Depending on Law of Control

PS2-330 (p. 188)

16:00 Quoc Thong Le Gia (University of New South Wales)

Stochastic Navier-Stokes equations in exterior domains

PS2-330 (p. 186)

16:30 Ngan Le (Monash University)

Convergence analysis and error estimates of numerical approximations for stochastic evolution equations with Leray–Lions operator

PS2-330 (p. 186)

17:00 Agus Soenjaya (University of New South Wales)

Finite element approximations of stochastic magnetisation dynamics at elevated temperatures

PS2-330 (p. 188)

▷ Wed 10 December

14:00 Erika Hausenblas (Montanuniversitaet Leoben)

Nonlinear Stochastic Partial Differential equations and cross diffusion

PS2-330 (p. 185)

14:30 Marco Carfagnini (AMSI/University of Melbourne)

Spectral gaps via small fluctuations

PS2-330 (p. 184)

15:00 Boris Huang (UNSW Sydney)

First-passage times of superdiffusive processes arising from compounded random walks

PS2-330 (p. 185)

16:00 Stanley Luk (University of Technology Sydney)

New Analogies for Signatures and Rough Paths

PS2-330 (p. 187)

16:30 Benedict Lama (The University of Sydney)

Nonlinear heat equation with Dirichlet stochastic boundary conditions

PS2-330 (p. 186)

17:00 Maha Alghamdi (La Trobe University)

Multiscaling limit theorems for stochastic FPDE with cyclic long-range dependence

PS2-330 (p. 184)

▷ Thu 11 December

- 13:30 Anthony Dooley (University of Technology Sydney)
Lie Symmetries for Stochastic Differential Equations
PS2-330 (p. 184)
- 14:00 Upanshu Sharma (UNSW Sydney)
Constraints in Stochastic Differential Equations
PS2-330 (p. 187)
- 14:30 Xi Geng (AMSI/University of Melbourne)
Hitting Probabilities for Hypoelliptic Differential Equations Driven by Fractional Brownian Motion
PS2-330 (p. 185)
- 15:00 Chunxi Jiao (UNSW Sydney)
Pathwise solvability and bubbling in 2D stochastic Landau-Lifshitz-Gilbert equations
PS2-330 (p. 185)

▷ Fri 12 December

- 14:00 Justin Forlano (Monash University)
Invariant Gibbs dynamics for the nonlinear Schrödinger equations on the disc
PS2-330 (p. 184)
- 14:30 Pierre Perruchaud (Monash University)
Constructive quantum field theory: an approach via the Brownian loop soup
PS2-330 (p. 187)

Session 23: Topology

Organisers: Daniele Celoria, Diarmuid Crowley, Daniel Mathews

Keynote Talks

▷ Fri 12 December

- 13:30 Pedram Hekmati (The University of Auckland)
New invariants of involutions on rational homology spheres
TLC-315 (p. 190)

Contributed Talks

▷ Tue 9 December

- 13:30 Alexander Elzenaar (Monash University)
Generalised Ford domains arising from peripheral geometry
TLC-315 (p. 189)
- 14:00 Corbin Reid (Monash University)
Highly Geometric Links in General 3-Manifolds
TLC-315 (p. 192)
- 14:30 Emma McQuire (Monash University)
Octahedral links and TV volume conjecture
TLC-315 (p. 192)
- 15:00 Connie On Yu Hui (Monash University)
A new algorithm for constructing knots and links in templates and finding upper hyperbolic volume bounds
TLC-315 (p. 190)
- 16:00 Leor Neuhauser (Hebrew University)
The Multiplicative Structure of Cobordisms
TLC-315 (p. 192)
- 16:30 Lucy Tobin (The University of Sydney)
Sampling Manifolds with Grid Diagrams
TLC-315 (p. 193)
- 17:00 James Morgan (The University of Sydney)
A combinatorial thick-thin decomposition for closed irreducible 3-manifolds
TLC-315 (p. 192)

▷ Wed 10 December

- 14:00 Orion Zymaris (Monash University)
Descartes' Theorem and the Circle Packing Equations
TLC-212 (p. 194)
- 14:30 Chandan Singh (The University of Melbourne)
Grothendieck–Teichmüller Symmetries of Tangles
TLC-212 (p. 193)
- 15:00 Tilda Wilkinson-Finch (The University of Sydney)
Prime Decomposition Theorems for Long Virtual Knots
TLC-212 (p. 194)
- 16:00 Bailey Whitbread (The University of Sydney)
Spectroscopy for knots
TLC-212 (p. 194)
- 16:30 Natalie DiMichele (The University of Queensland)
Unknot Recognition through an Operations Research Lens
TLC-212 (p. 189)
- 17:00 Finn Thompson (The University of Queensland)
Numerically investigating the space writhe and rope length of knots

TLC-212 (p. 193)

▷ Thu 11 December

- 13:30 Paawan Jethva (The University of Adelaide)
Cohomology Rings of Topological and Smooth 4-Manifolds
 TLC-315 (p. 191)
- 14:00 Lavender Marshall (Monash University)
What is a partial Heegaard diagram
 TLC-315 (p. 191)
- 14:30 Masoud Kamgarpour (The University of Queensland)
Differential Equations and Knot Theory
 TLC-315 (p. 191)

▷ Fri 12 December

- 14:30 Marcy Robertson (The University of Melbourne)
Homotopy props in quantization
 TLC-315 (p. 193)
- 14:30 Jonathan Spreer (The University of Sydney)
A Practical Algorithm for Knot Factorisation
 TLC-317 (p. 193)
- 15:00 Thorsten Hertl (The University of Melbourne)
Moduli Spaces of G_2 manifolds may have holes
 TLC-315 (p. 190)
- 15:00 Dionne Ibarra (Monash University)
Cubic Skein Modules
 TLC-317 (p. 191)
- 16:00 Owen Dearnicott (La Trobe University)
The Eells-Kuiper invariant of certain cohomogeneity one 7-manifolds
 TLC-315 (p. 189)
- 16:00 Teresa Heiss-Synak (The Australian National University)
New Method for Analyzing The Hole-Structure of a Crystal: Merge Trees of Periodic Filtrations
 TLC-317 (p. 190)
- 16:30 Lior Yanovski (AMSI/University of Melbourne)
The J -homomorphism and higher additive structure
 TLC-315 (p. 194)
- 17:00 Lashi Bandara (Deakin University)
Cutting and gluing via matching boundary conditions
 TLC-315 (p. 189)

Session 24: Visualisation, Mathematical Art, Engagement and Outreach

Organisers: Paul Fijn, Matthew Paul Skeritt, Pieter Hubert van der Kamp

Contributed Talks

▷ Tue 9 December

- 14:00 Ajani De Vas Gunasekara (University of Notre Dame)
Poetry of Repetition: Constructing verse through Combinatorial Designs
PS2-212 (p. 195)
- 14:30 Katherine Seaton (La Trobe University)
Hitomezashi stitching and mathematical physics
PS2-212 (p. 196)
- 15:00 Stephen Nurse (Unaffiliated)
A Polyhedral Knot Family
PS2-212 (p. 196)
- 16:00 Muhammad Afifurrahman (UNSW Sydney)
Mettamatika: How to Make Illustrated Mathematical Books
PS2-212 (p. 195)
- 16:30 Pieter Hubert van der Kamp (La Trobe University)
How to embed the Riemann surface of $y = x^2$ in $\mathbb{R}^3$, and how to dig lakes of Wada.
PS2-212 (p. 196)
- 17:00 Yudhistira Andersen Bunjamin (UNSW Sydney)
Should we start an Australian version of Talking Maths in Public?
PS2-212 (p. 195)

▷ Wed 10 December

- 16:00 Asha Rao (RMIT University)
Cyberpowers: Attracting Girls to Maths via Cyber Security
PS2-212 (p. 196)
- 16:30 Michael Assis (The University of Melbourne)
Enumerating convex quadrilateral origami waterbomb tiling patterns
PS2-212 (p. 195)

Conference Days

Conference Day 1: Tue 9 December

■ Summary timetable

When	What
09:00–11:00	Event: Opening Ceremony and Prizes
11:00–11:30	Morning tea
11:30–12:30	Plenary: Driscoll – Computational approximation by rational functions (p. 90)
12:30–13:30	Lunch
13:30–14:30	3 special session talks
13:30–14:00	12 special session talks
14:00–14:30	16 special session talks
14:30–15:00	19 special session talks
15:00–15:30	18 special session talks
15:30–16:00	Afternoon tea
16:00–16:30	19 special session talks
16:30–17:00	19 special session talks
17:00–17:30	19 special session talks
17:30–18:30	Plenary: Hautphenne – Branching processes in practice: models, inference, and applications (p. 91)
18:30–20:00	Event: Welcome reception

■ Non-plenary Sessions

2. Algebra and Combinatorics

- 13:30 Devi Imulia Dian Primaskun (The University of Melbourne)
On the Existence of Deeply Critical Oriented Cliques of Even Order
TLC-314 (p. 96)
- 14:00 Fawwaz Fakhurrozi (The University of Melbourne)
Cores of circulant graphs
TLC-314 (p. 94)
- 14:30 Yu Wang (Xinjiang University)
Extremal spectral radius and condition (edge) connectivity
TLC-314 (p. 98)
- 16:00 Paul Kerr (The University of Melbourne)
Machine Learning for Conjecture Discovery
TLC-314 (p. 95)
- 16:30 Moshe Giles Uhrig (AMSI/University of Melbourne)
Cycle decompositions of arc-transitive graphs
TLC-314 (p. 95)
- 17:00 Reymond Akpanya (The University of Sydney)
A census of face-transitive surfaces
TLC-314 (p. 93)

4. Category Theory, Homotopy Theory, and K-Theory

- 13:30 Chandan Singh (The University of Melbourne)
Cyclic Symmetries of Grothendieck–Teichmüller group
 TLC-412 (p. 104)
- 14:00 Thomas Dunmore (UNSW Sydney)
Algebra Objects in Near-Group Fusion Categories
 TLC-412 (p. 102)
- 14:30 Joshua Ham (UNSW Sydney)
Equivariant cellularity in Bredon motivic homotopy
 TLC-412 (p. 102)
- 15:00 George Henderson-Walshe (AMSI/University of Melbourne)
The K-Theory of Toric Varieties
 TLC-412 (p. 103)
- 16:00 Fei Peng (The University of Melbourne)
Fourier–Mukai transforms and Rouquier dimension for algebraic stacks
 TLC-412 (p. 104)
- 16:30 Joel Richardson (Macquarie University)
Algebras of the Tangent Bundle Monad
 TLC-412 (p. 104)
- 17:00 Jean-Simon Lemay (Macquarie University)
From Abelianization to Tangent Categories
 TLC-412 (p. 104)

5. Computational Mathematics

- 13:30 Agus Soenjaya (University of New South Wales)
An energy-stable and mass-preserving linear finite element method for a diffuse-interface model of tumour growth
 TLC-417 (p. 110)
- 14:00 Noura Alhawiti (The University of Newcastle)
Curve Diffusion Flow of Planar Curves with Inhomogeneous Boundary Conditions
 TLC-417 (p. 106)
- 14:30 Sergio Carrasco (Monash University)
Fully mixed finite element methods for a steady thermoelastic contact problem
 TLC-417 (p. 106)
- 15:00 Andres Eduardo Rubiano Martinez (Monash University)
Fully mixed virtual element schemes for steady-state poroelastic stress-assisted diffusion
 TLC-417 (p. 109)
- 16:00 Elizabeth Harris (The University of Newcastle)
Improvement on the worst case runtime for calculating minimum volume covering ellipsoids
 TLC-417 (p. 107)
- 16:30 Nicolas Andres Zamorano Goldrine (Politecnico di Torino)
Flow simulation in fractured media: A study of deep learning methodologies for the discrete fracture networks method
 TLC-417 (p. 111)
- 17:00 Jordi Manyer (Monash University)
Geometric Multigrid solvers for non-conforming polytopal hybrid discretization methods.
 TLC-417 (p. 108)

6. Differential Geometry and Symmetry

- 13:30 Thorsten Hertl (The University of Melbourne)
Isotopy Versus Concordance in Positive Scalar Curvature
 TLC-313 (p. 114)
- 14:00 William Hadden (UNSW Sydney)
A Computationally Assisted Proof of the Kähler-Einstein Metric on the Third del Pezzo Surface.

- TLC-313 (p. 113)
- 14:30 An Ky Duy Nguyen (La Trobe University)
Quadratic Killing tensors on symmetric spaces
TLC-313 (p. 114)
- 15:00 Max Orchard (The University of Queensland)
Incompressible Euler fluids on Riemannian manifolds with symmetry
TLC-313 (p. 115)
- 16:00 Harrison Greven (Adelaide University)
Conformally Related Einstein Metrics
TLC-313 (p. 113)
- 16:30 Stepan Hudecek (The University of Queensland)
Canonical Connections in (almost) Hermitian Geometry
TLC-313 (p. 114)
- 17:00 Yann Bernard (Monash University)
Structural Equations for Critical Points of Conformally Invariant Curvature Energies in 4d
TLC-313 (p. 112)

7. Dynamical Systems and Ergodic Theory

- 13:30 Martin Wechselberger (The University of Sydney)
The parametrisation method and slow-fast averaging
TLC-415 (p. 118)
- 14:00 Renee Oldfield (The University of Queensland)
Average measure theoretic entropy for a family of expanding on average random Blaschke products
TLC-415 (p. 117)
- 14:30 Jahne Meyer (The University of Newcastle)
Hyperbolic motion of polygons via semi-discrete linear geometric flows
TLC-415 (p. 117)
- 15:00 Mridul Patel (RMIT University)
A Fractal Analysis of Australian Migration Trends
TLC-415 (p. 118)

8. Equity, Diversity and Inclusion

- 14:00 Matthew Mack (University of South Australia)
Workshop: Alt-Text for Mathematicians
TLC-216 (p. 119)
- 14:30 Yudhistira Andersen Bunjamin (UNSW Sydney)
Adapting outreach workshops for foreign contexts
TLC-216 (p. 119)
- 15:00 Marcy Robertson (The University of Melbourne)
Panel Discussion: Equity in Mathematics Education
TLC-216 (p. 119)

9. Financial Mathematics

- 14:00 Andrea Macrina (University College London)
Arcade Processes for Informed Martingale Interpolation
TLC-215 (p. 122)
- 14:30 Eckhard Platen (University of Technology, Sydney)
Information-Minimizing Stationary Financial Market Dynamics
TLC-215 (p. 122)
- 15:00 Ivan Guo (Monash University)
Partially Ordered Peacocks
TLC-215 (p. 121)
- 16:00 Xinyi Zhang (University of Wollongong)
American Parisian-type Stock Loan

- TLC-215 (p. 123)
- 16:30 Zhao Yang (University of Wollongong)
Analytically pricing commodity futures options with seasonality and stochastic liquidity risks
 TLC-215 (p. 123)
- 17:00 Huan Chen (Monash University)
Universal mimicking
 TLC-215 (p. 121)

10. General Session

- 16:00 Adam Bilchouris (La Trobe University)
Nonparametric Estimation of the Autocovariance Function
 TLC-317 (p. 125)
- 16:30 Udara Kumaranathunga (La Trobe University)
Meta-Analysis of Quantiles and Functions of Quantiles with Applications to Diabetes
 TLC-317 (p. 125)
- 17:00 Jayamini Liyanage (La Trobe University)
Meta-Analysis of High-Dimensional Data
 TLC-317 (p. 125)

11. Groups, Actions and Computation

- 13:30 Uri Onn (Australian National University)
Spectral Equivalence of p -Groups and the Larsen–Lubotzky Conjecture
 TLC-317 (p. 130)
- 14:00 Colin David Reid (Western Sydney University)
Commensurators of free groups and free pro- p groups
 TLC-317 (p. 130)
- 14:30 Joshua Howie (Monash University)
Lambda lengths in link complements
 TLC-317 (p. 129)
- 15:00 Chuanqi Zhang (University of Technology Sydney)
Diffie–Hellman Key Exchange from Commutativity to Group Laws
 TLC-317 (p. 131)

12. Harmonic Analysis and Hamiltonian PDE

- 13:30 Lashi Bandara (Deakin University)
Harmonic analysis and boundary trace for first-order elliptic operators over vector bundles
 TLC-414 (p. 132)
- 14:00 Emanuel Godfried (AMSI/University of Melbourne)
Mean first escape times on asymptotically hyperbolic surfaces
 TLC-414 (p. 133)
- 14:30 Weihang Zheng (Monash University)
Localized Big Bang Stability of the Kasner-scalar field Metrics
 TLC-414 (p. 135)
- 15:00 Virinchi Rallabhandi (University of Edinburgh)
Energy in spacetimes with negative cosmological constant
 TLC-414 (p. 134)
- 16:00 Louie Bernhardt (The University of Melbourne)
Stability of solutions to the Einstein equations undergoing decelerated expansion
 TLC-414 (p. 132)
- 16:30 Xuejing Huo (Macquarie University)
New endpoint estimates for certain singular integrals with non-smooth kernels
 TLC-414 (p. 133)
- 17:00 Jiakun Liu (The University of Sydney)
Global $C^{1,\alpha}$ regularity for Monge–Ampère equations
 TLC-414 (p. 134)

14. Mathematical Methods in Continuum Mechanics and Wave Theory

- 16:00 Erik Garcia Neefjes (Macquarie University)
A neural-network surrogate Bayesian algorithm for the Helmholtz inverse-medium problem
 TLC-216 (p. 140)
- 16:30 Luke Bennetts (The University of Melbourne)
Acoustic lattice resonances and generalised Rayleigh–Bloch waves
 TLC-216 (p. 139)
- 17:00 Dave Smith (The University of Newcastle)
Linearized KdV on the line with a metric graph defect
 TLC-216 (p. 141)

15. Mathematical Physics

- 13:30 Nalini Joshi (The University of Sydney)
Integrable dynamical systems on bi-elliptic surfaces
 TLC-115 (p. 144)
- 14:00 Artem Stoian (The University of Melbourne)
Blowup relations and q -Painlevé VI
 TLC-115 (p. 146)
- 14:30 Cengiz Gazi (AMSI/University of Melbourne)
Application of Painlevé integrability in Blockchain mining
 TLC-115 (p. 143)
- 15:00 Anthony Parr (The University of Queensland)
Algebraic Generation of Painleve Transcendents
 TLC-115 (p. 145)
- 16:00 Siyu Li (La Trobe University)
Polynomial deformations of $sl(2)$ and unified algebraic framework for solutions of a class of spin models
 TLC-115 (p. 145)
- 16:30 Jared Heymann (The University of Melbourne)
“Lattice translation” symmetry on an open boundary spin chain
 TLC-115 (p. 143)
- 17:00 William Mead (The University of Melbourne)
Pfaffian Point Processes from the Half-space Exclusion Process
 TLC-115 (p. 145)

16. Nonlinear PDEs and their applications

- 13:30 Yoshihiro Tonegawa (Institute of Science Tokyo)
Some existence results for mean curvature flow with forcing
 TLC-416 (p. 150)
- 14:30 James McCoy (The University of Newcastle)
Isoperimetric inequality for multiply-winding curves
 TLC-416 (p. 149)
- 15:00 Glen Edward Wheeler (University of Wollongong)
Isoperimetry via a Sobolev gradient flow
 TLC-416 (p. 150)
- 16:00 Kwok-Kun Kwong (University of Wollongong)
Fenchel-Willmore and Sobolev-type inequalities for submanifolds in non-negatively curved manifolds
 TLC-416 (p. 149)
- 16:30 Weihang Zheng (Monash University)
Localized Big Bang Stability of the Kasner-scalar Field Metrics
 TLC-416 (p. 151)
- 17:00 Mashniah A. Gazwani (The University of Newcastle)
Length-unconstrained, length-constrained and length-penalised curve diffusion flows of planar curves inside cones

TLC-416 (p. 148)

17. Number Theory

13:30 Stephan Baier (Ramakrishna Mission Vivekananda Educational and Research Institute)

The large sieve for square moduli, revisited

TLC-214 (p. 152)

14:30 Timothy Trudgian (UNSW Canberra)

A is for Averages

TLC-214 (p. 157)

15:00 Simon Marshall (The University of Melbourne)

An introduction to the Sarnak–Xue density conjecture

TLC-214 (p. 155)

16:00 Gustav Kjaerbye Bagger (UNSW Canberra)

Norm-Euclidean cyclic cubic fields

TLC-214 (p. 154)

16:00 Giulia Pelizzari (UNSW Canberra)

Bounds on the Minkowski constants

TLC-212 (p. 156)

16:30 Simon Thomas (The University of Queensland)

Sieves and almost primes

TLC-214 (p. 156)

16:30 Zoë Gemmell (UNSW Canberra)

The functions behind encryption

TLC-212 (p. 154)

17:00 Sebastian Tudzi (University of New South Wales Canberra)

From Elementary to Analytic: Explicit Bounds in the Generalised Divisor Problem

TLC-214 (p. 157)

17:00 James Punch (UNSW Canberra)

The covering radius of particular logarithmic lattices

TLC-212 (p. 156)

18. Optimisation

13:30 Brianna Laird (Deakin University)

A Steiner Tree Based Genetic Algorithm for Multi-layered Location-Allocation-Routing Problems

TLC-311 (p. 161)

14:00 Vishmi Fernando (RMIT University)

Improving Routing and Scheduling for Home-Based Chemotherapy and Infusion Services with a Single Nurse

TLC-311 (p. 161)

14:30 Shahtaj Bano (RMIT University)

Optimization of multiobjective chemotherapy treatment regimens with NSGA-II and weighted sum methods

TLC-311 (p. 159)

15:00 Iman Shekarriz (Deakin University)

Metaheuristic methods for Soft Happy Colouring

TLC-311 (p. 163)

16:00 Mohammadali Hosseinimoghaddam (The University of Queensland)

Generalisations of extreme value theorem

TLC-311 (p. 161)

16:30 Jacob Westerhout (The University of Queensland)

Converses of the Extreme Value Theorem

TLC-311 (p. 164)

17:00 Nadia Sukhorukova (Swinburne University of Technology)

Nonsmooth Optimisation and neural networks

TLC-311 (p. 163)

. 20 Probability and Mathematical Statistics

- 13:30 Peter Gerrard Taylor (The University of Melbourne)
First passage probabilities and local times for null recurrent Markov additive processes
 TLC-413 (p. 177)
- 14:00 Simon Harris (The University of Auckland)
Genealogies of samples from stochastic population models
 TLC-413 (p. 171)
- 14:00 Clara Grazian (The University of Sydney)
A Bayesian Semiparametric Bernstein–von Mises Theorem for Long-Memory Models
 TLC-212 (p. 170)
- 14:30 Diego Marcondes (The Australian National University)
A resolvent approach to the metastability of Markov processes
 TLC-413 (p. 174)
- 14:30 Alexis Kagan (The University of Auckland)
The genealogy of individuals sampled through time in a Galton-Watson tree
 TLC-212 (p. 173)
- 15:00 Jack Mills (Monash University)
Generalised Polya Urns and Preferential Attachment
 TLC-413 (p. 175)
- 15:00 Simon Marshall (Retired)
The Wrapped Hyperbolic Secant Distribution and its Binary Mixtures
 TLC-212 (p. 175)
- 16:00 Azam Asanjarani (The University of Auckland)
Structured Subclasses of Markovian Arrival Processes
 TLC-413 (p. 167)
- 16:00 Mohd Mahayaudin Mansor (UNIVERSITI TEKNOLOGI MARA)
Prediction of Stroke Status using Logistic Regression based on Modifiable and Non-Modifiable Risk Factors
 TLC-415 (p. 174)
- 16:30 Hongyi Lyu (Monash University)
Asymptotic power law of a random graph process
 TLC-413 (p. 174)
- 16:30 Mingqi He (The University of Melbourne)
Simulation-based inference of population histories from local gene genealogies
 TLC-415 (p. 171)
- 17:00 Nemini Yadeesha Jayani Wijesinghe Samarakoon (La Trobe)
Haar-Based Multifractional Processes
 TLC-413 (p. 177)
- 17:00 Trung Tin Nguyen (Queensland University of Technology)
Mathematical Foundations of AI and Data Science for Trustworthy Systems: Leveraging Multimodality and Sparsity
 TLC-415 (p. 176)

21. Representation Theory

- 13:30 Tom Goertzen (The University of Sydney)
Computing Kazhdan-Lusztig Bases
 TLC-312 (p. 179)
- 14:00 Mengfan Lyu (University of Western Sydney)
A Generalization of the Temperley-Lieb Algebra: Coloured Blob Algebras
 TLC-312 (p. 181)
- 14:30 Willow Stewart (The University of Sydney)
Diagram Monoids and Cryptography
 TLC-312 (p. 182)
- 15:00 Tasman Fell (The University of Sydney)
The Diagrammatic Spherical Category

- TLC-312 (p. 179)
- 16:00 Victor Zhang (UNSW Sydney)
A Diagram Calculus for a few Type-A Lusztig–Vogan Categories
 TLC-312 (p. 183)
- 16:30 Uri Onn (Australian National University)
A PSH-Algebra Approach to Representations of Automorphism Groups of Modules
 TLC-312 (p. 182)
- 17:00 Max Carter (Université Catholique de Louvain)
The type I dichotomy for two-step nilpotent groups
 TLC-312 (p. 179)

22. Stochastic Differential Equations

- 13:30 Max Nendel (University of Waterloo)
Chernoff approximation of infinitely divisible distributions and Lévy processes with drift
 PS2-330 (p. 187)
- 14:30 Haesung Lee (Kumoh National Institute of Technology)
Local elliptic regularity for solutions to stationary Fokker-Planck equations via Dirichlet forms and resolvents
 PS2-330 (p. 186)
- 15:00 Ho Man Tai (The University of Sydney)
Global Well-Posedness of Extended Mean Field Games Depending on Law of Control
 PS2-330 (p. 188)
- 16:00 Quoc Thong Le Gia (University of New South Wales)
Stochastic Navier-Stokes equations in exterior domains
 PS2-330 (p. 186)
- 16:30 Ngan Le (Monash University)
Convergence analysis and error estimates of numerical approximations for stochastic evolution equations with Leray–Lions operator
 PS2-330 (p. 186)
- 17:00 Agus Soenjaya (University of New South Wales)
Finite element approximations of stochastic magnetisation dynamics at elevated temperatures
 PS2-330 (p. 188)

23. Topology

- 13:30 Alexander Elzenaar (Monash University)
Generalised Ford domains arising from peripheral geometry
 TLC-315 (p. 189)
- 14:00 Corbin Reid (Monash University)
Highly Geometric Links in General 3-Manifolds
 TLC-315 (p. 192)
- 14:30 Emma McQuire (Monash University)
Octahedral links and TV volume conjecture
 TLC-315 (p. 192)
- 15:00 Connie On Yu Hui (Monash University)
A new algorithm for constructing knots and links in templates and finding upper hyperbolic volume bounds
 TLC-315 (p. 190)
- 16:00 Leor Neuhauser (Hebrew University)
The Multiplicative Structure of Cobordisms
 TLC-315 (p. 192)
- 16:30 Lucy Tobin (The University of Sydney)
Sampling Manifolds with Grid Diagrams
 TLC-315 (p. 193)
- 17:00 James Morgan (The University of Sydney)
A combinatorial thick-thin decomposition for closed irreducible 3-manifolds

TLC-315 (p. 192)

24. Visualisation, Mathematical Art, Engagement and Outreach

- 14:00 Ajani De Vas Gunasekara (University of Notre Dame)
Poetry of Repetition: Constructing verse through Combinatorial Designs
PS2-212 (p. 195)
- 14:30 Katherine Seaton (La Trobe University)
Hitomezashi stitching and mathematical physics
PS2-212 (p. 196)
- 15:00 Stephen Nurse (Unaffiliated)
A Polyhedral Knot Family
PS2-212 (p. 196)
- 16:00 Muhammad Afifurrahman (UNSW Sydney)
Mettamatika: How to Make Illustrated Mathematical Books
PS2-212 (p. 195)
- 16:30 Pieter Hubert van der Kamp (La Trobe University)
How to embed the Riemann surface of $y = x^2$ in $\mathbb{R}^3$, and how to dig lakes of Wada.
PS2-212 (p. 196)
- 17:00 Yudhistira Andersen Bunjamin (UNSW Sydney)
Should we start an Australian version of Talking Maths in Public?
PS2-212 (p. 195)

Conference Day 2: Wed 10 December

■ Summary timetable

When	What
10:00–11:00	Plenary: Barbensi – Mapping the topology of polymer folding: knots, geometry, and data (p. 90)
11:00–11:30	Morning tea
11:30–12:30	Plenary: Tonegawa – Geometric measure theory and mean curvature flow (p. 91)
12:30–13:00	Lunch
13:00–14:00	Debate – “AI will destroy mathematics”
14:00–15:30	Event: ACHMS meeting
14:00–15:00	Special session talk
14:00–14:30	17 special session talks
14:30–15:00	16 special session talks
15:00–15:30	17 special session talks
15:30–16:00	Afternoon tea
16:00–16:30	18 special session talks
16:30–17:00	18 special session talks
17:00–17:30	17 special session talks
17:30–18:00	Refreshments before the public lecture
18:00–19:00	Public lecture

■ Non-plenary Sessions

2. Algebra and Combinatorics

- 14:00 Tim Stokes (University of Waikato)
DR-Semigroups satisfying the ample conditions
 TLC-314 (p. 97)
- 14:30 Matthias Fresacher (Western Sydney University)
Categorical representation of DRC-semigroups
 TLC-314 (p. 95)
- 15:00 Luka Carroll (Western Sydney University)
Presentations for semigroups of full-domain partitions and trivial-cokernel partitions
 TLC-314 (p. 94)
- 16:00 Ruzzel Ragas (The University of Sydney)
Probabilities regarding n -Poncellet pairs over finite fields
 TLC-314 (p. 96)
- 16:30 Nathan Britt (The University of Melbourne)
Inversion Sequences Avoiding Triples of Relations
 TLC-314 (p. 93)
- 17:00 Dominic Matan (UNSW Sydney)
The Sarkisov Program for Surfaces Enriched by a Brauer Class
 TLC-314 (p. 96)

3. Applied and Industrial Mathematics

- 14:00 Matthew Mack (University of South Australia)
Actin' on Actin
 TLC-216 (p. 99)
- 14:30 Mst Shanta Khatun (The University of Sydney)
Modelling Cancer Evolution with a Voronoi Cell-Based Approach
 TLC-216 (p. 99)
- 15:00 Joel Miller (La Trobe University)
Low-dimensional models of "simple contagion" spread in networks
 TLC-216 (p. 100)
- 16:00 Fiaz Ur Rehman (Monash University)
Propagation of a viscous fluid atop a Bingham material on a slope
 TLC-216 (p. 100)
- 16:30 Leonard Mushunje (The University of Sydney)
Algebraic Independence Tests for Economic Models
 TLC-216 (p. 100)

5. Computational Mathematics

- 14:00 Noah Vinod (UNSW Sydney)
Error Estimates for a Linear Fully-Discrete Finite Element Scheme for the Ferromagnetic Magnetohydrodynamical Model
 TLC-417 (p. 111)
- 14:30 Tamara Tambyah (Monash University)
Developing hp-multigrid methods on cubed sphere meshes
 TLC-417 (p. 110)
- 15:00 Terence O'Kane (CSIRO)
A Spherical harmonic neural operator atmospheric general circulation model
 TLC-417 (p. 109)
- 16:00 Janosch Rieger (Monash University)
Towards optimal space-time discretisations for reachability analysis
 TLC-417 (p. 109)
- 16:30 Santiago Badia (Monash University)
Energy minimisation using overlapping tensor-product free-knot B-splines
 TLC-417 (p. 106)
- 17:00 Simon Marshall (Retired)
GNLS: an R Program for Errors-in-Variables Fitting
 TLC-417 (p. 108)

6. Differential Geometry and Symmetry

- 14:00 Tiernan Cartwright (The University of Sydney)
Definitions of the volume of a big cohomology class
 TLC-313 (p. 113)
- 14:30 Marcus Flook (Australian National University)
Fully nonlinear flows of real hypersurfaces in complex space
 TLC-313 (p. 113)
- 15:00 Devesh Rajpal (Australian National University)
Affine Boosted Gauss Curvature Flow
 TLC-313 (p. 115)
- 16:00 Alexander Bednarek (The University of Sydney)
Fano Fibrations, Twisted Kahler-Einstein Metrics and the Kahler-Ricci Flow
 TLC-313 (p. 112)
- 16:30 Yuri Nikolayevsky (La Trobe University)
Symmetric hypersurfaces in symmetric spaces
 TLC-313 (p. 115)
- 17:00 Qiyu Zhou (The Australian National University)

High codimension mean curvature flow of spacelike-convex submanifolds with one spacelike codimension

TLC-313 (p. 116)

9. Financial Mathematics

14:00 Kihun Nam (Monash University)

What does no-arbitrage condition tells about PDEs?

TLC-215 (p. 122)

15:00 Ho Man Tai (The University of Sydney)

Incentives of Defined-Contribution Pension Managers

TLC-215 (p. 123)

16:00 Chang Chen (The University of Queensland)

A Data-Driven Neural Network Approach for Reward-Risk Portfolio Optimisation in Decumulation

TLC-215 (p. 121)

16:30 Zhao Zhang (University of Wollongong)

Enhancing PINNs with Martingale Supervision for Efficient High-Dimensional Option Pricing

TLC-215 (p. 124)

17:00 Kajanthan Shiyamasuntharam (University of Wollongong)

An ADI Approach with Coordinate Transformation for Pricing American Options on Coupon Bonds under a Stochastic-Volatility Vasicek Model

TLC-215 (p. 122)

10. General Session

16:00 Jeremy Sumner (University of Tasmania)

Towards a representation theory of Lie-Markov semigroups: motivations and examples

TLC-317 (p. 126)

16:30 Kiah Swinsburg (University of Tasmania)

Towards a representation theory of Lie-Markov semigroups

TLC-317 (p. 127)

17:00 Daniel Francis Mansfield (University of New South Wales)

Area of a Segment in Ancient Mesopotamia

TLC-317 (p. 126)

11. Groups, Actions and Computation

14:00 Vandit Trivedi (Australian National University)

A generating set for the commutator subgroup of a twisted right-angled Artin group

TLC-414 (p. 130)

14:30 Yusuf Hafidh (The University of Melbourne)

Perfect r -codes in circulant graphs

TLC-414 (p. 128)

15:00 Max Carter (Université Catholique de Louvain)

Non-Wiener totally disconnected locally compact groups

TLC-414 (p. 128)

16:00 Anthony Pisani (Monash University)

The Saxl hypergraph of a permutation group

TLC-414 (p. 130)

16:30 Adam Piggott (Australian National University)

New constructions of free products and geodesic Cayley graphs

TLC-414 (p. 130)

17:00 Marcus Chijoff (The University of Newcastle)

Determining Properties of (P) -closed Groups Acting On Trees Using Local Action Diagrams

TLC-414 (p. 128)

12. Harmonic Analysis and Hamiltonian PDE

- 14:00 Simon Marshall (The University of Melbourne)
Quantum Ergodicity in the level aspect for locally symmetric spaces
TLC-412 (p. 134)
- 14:30 Moritz Doll (Macquarie University)
Microlocal analysis of the Klein-Gordon equation
TLC-412 (p. 132)
- 15:00 Qiuye Jia (The Australian National University)
Non-relativistic limit of Klein-Gordon equations in curved spacetimes
TLC-412 (p. 133)
- 16:00 Po-Lam Yung (The Australian National University)
Remarks about the local smoothing conjecture
TLC-412 (p. 135)
- 16:30 Owen Dearnicott (La Trobe University)
Edge-cone singularities on anti-self-dual Einstein spaces in dimension four and 3-Sasakian spaces in dimension seven
TLC-412 (p. 132)
- 17:00 Cale Rankin (Monash University)
Brunn–Minkowski inequalities for eigenvalues of elliptic operators
TLC-412 (p. 134)

14. Mathematical Methods in Continuum Mechanics and Wave Theory

- 14:00 Paolo Piersanti (The Chinese University of Hong Kong (Shenzhen))
On the Dynamics of Grounded Shallow Ice Sheets: Modelling and Analysis
PS2-212 (p. 140)
- 14:30 Mitchell Bonham (The University of Newcastle)
Determining Iceberg Elastic Properties Through Resonant Flexure
PS2-212 (p. 139)
- 15:00 Quanling Deng (Yau Mathematical Sciences Center, Tsinghua University)
A Particle–Continuum Multiscale Modeling Framework with an Application to Sea-Ice Dynamics
PS2-212 (p. 139)

15. Mathematical Physics

- 16:00 Fei Peng (The University of Melbourne)
The Keel–Mori theorem for complex Deligne–Mumford superstacks
TLC-115 (p. 146)
- 16:30 Weiying Guo (AMSI/University of Melbourne)
Puzzle formula for type BC Hall–Littlewood polynomial
TLC-115 (p. 143)
- 17:00 Victor Fagundes (La Trobe University)
Extending the coalgebra formalism for the construction of integrable and superintegrable systems
TLC-115 (p. 142)

16. Nonlinear PDEs and their applications

- 14:00 Florica Corina Cirstea (The University of Sydney)
Symmetry of global solutions for nonlinear elliptic equations with mixed reaction terms
TLC-416 (p. 147)
- 14:30 Maria Farcaseanu (The University of Sydney)
Asymptotic profiles for singular nonlinear elliptic equations
TLC-416 (p. 148)
- 15:00 Po-Lam Yung (The Australian National University)
Remarks about the Kakeya conjecture
TLC-416 (p. 151)

- 16:00 Joshua Zavone (The University of Sydney)
Local existence and classification of isolated singularities for nonlinear elliptic equations
 TLC-416 (p. 151)
- 16:30 Johnathan Adams (QUT)
The Impact of Curvature on Travelling Fronts under Non-linear Diffusion.
 TLC-416 (p. 147)
- 17:00 Ji Li (Macquarie University)
Fefferman–Stein type inequality and applications
 TLC-416 (p. 149)

17. Number Theory

- 14:00 Muhammad Afifurrahman (UNSW Sydney)
Multiplicatively dependent integer vectors on a hyperplane
 TLC-214 (p. 152)
- 14:00 Ameya Tilgul (UNSW Canberra)
Smooth analogue of the pair-correlation function
 TLC-317 (p. 157)
- 14:30 Chandler Chase Corrigan (University of New South Wales)
Hecke eigenvalues at Piatetski-Shapiro primes
 TLC-214 (p. 153)
- 14:30 Liang Wang (UNSW Canberra)
Optimal energy condition for metric Poissonian pair correlation
 TLC-317 (p. 157)
- 15:00 Yixiu Xiao (UNSW Sydney)
Least zero of pairs of additive cubic equations
 TLC-214 (p. 157)
- 15:00 Michael Harm (UNSW Sydney)
The reverse Goldbach Conjecture
 TLC-317 (p. 154)
- 16:00 Adrian Dudek (The University of Queensland)
Almost Primes Between All Squares
 TLC-214 (p. 153)
- 16:30 Daniel Johnston (UNSW Canberra)
Can the Bombieri–Vinogradov theorem be made effective?
 TLC-214 (p. 154)
- 17:00 Florian Breuer (The University of Newcastle)
Divisibility of the coefficients of modular polynomials
 TLC-214 (p. 153)

18. Optimisation

- 14:00 Vera Roshchina (UNSW Sydney)
Everything is possible: constructing spectrahedra with prescribed facial dimensions
 TLC-311 (p. 162)
- 14:30 Fangyu Liu (The University of Melbourne)
Robust estimators for stochastic model-based DFO
 TLC-311 (p. 162)
- 15:00 Thang Truong (RMIT University)
A primal-dual splitting algorithm for structured composite monotone inclusions
 TLC-311 (p. 163)
- 16:00 Kaniz Fatema (RMIT University)
A DC-based optimization method for solving reverse convex programming problems
 TLC-311 (p. 161)
- 16:30 Liam Timms (The University of Melbourne)
A decentralised forward-backward-type algorithm with heterogenous agent step sizes
 TLC-311 (p. 163)

- 17:00 Yiwen Chen (University of British Columbia, Okanagan)
Randomized subspace methods for high-dimensional model-based derivative-free optimization
 TLC-311 (p. 160)

20. Probability and Mathematical Statistics

- 14:00 Kostya Borovkov (The University of Melbourne)
On large deviation probabilities for self-normalised sums of random variables
 TLC-413 (p. 167)
- 14:00 Peng Ding (UC Berkeley)
Stratified Permutational Berry–Esseen Bounds and Their Applications to Statistics
 TLC-415 (p. 169)
- 14:30 Liam Wood-Baker (Monash University)
The Glauber Dynamics for the Mean-Field Face-Cubic Model
 TLC-413 (p. 177)
- 14:30 Spiridon Penev (UNSW Sydney)
Improved confidence intervals for expectiles
 TLC-415 (p. 176)
- 15:00 Luke Attrill (Monash University)
The clumsy coupon collector
 TLC-413 (p. 167)
- 15:00 Ruethaichanok Kardkasem (The University of Queensland)
Block Length Selection for Modelling Successive Extremes Using the GEV distribution
 TLC-415 (p. 173)
- 16:00 Xi Geng (AMSI/University of Melbourne)
Long Time Asymptotics of the Parabolic Anderson Model in the Hyperbolic Space
 TLC-413 (p. 170)
- 16:00 Thisaakhya Jayakody (The University of Melbourne)
Analysis of the female family descent tree using the Markovian Binary Tree
 TLC-415 (p. 172)
- 16:30 Aram Perez (Monash University)
The Face-Cubic Model on the Complete Graph
 TLC-413 (p. 176)
- 16:30 Peter Braunsteins (UNSW Sydney)
Intrinsic Whittle–Matérn fields and sparse spatial extremes
 TLC-415 (p. 168)
- 17:00 Qingyuan Zhang (The University of Queensland)
An Inventory System with Two Supply Modes and Lévy Demand
 TLC-413 (p. 178)
- 17:00 James Kerlidis (The University of Melbourne)
Existence and non-existence of consistent estimators in supercritical controlled branching processes
 TLC-415 (p. 173)

21. Representation Theory

- 14:00 Finn Klein (The University of Sydney)
Semisimplifying categorical Heisenberg actions, with applications to modular representation theory of finite groups
 TLC-312 (p. 180)
- 14:30 Joseph Newton (The University of Sydney)
 $\text{Ver}_{p^n}(G)$?
 TLC-312 (p. 182)
- 15:00 Edmund Xian Chen Heng (The University of Sydney)
Species and algebras in fusion categories
 TLC-312 (p. 180)
- 16:00 Jensen O’Sullivan (The University of Sydney)

Growth problems of quantum sl_2

TLC-312 (p. 182)

16:30 Jie Du (University of New South Wales)

Canonical bases for quantum $\mathfrak{gl}_{m|n}$

TLC-312 (p. 179)

17:00 Leonardo Maltoni (The Australian National University)

Filtrations for Rouquier complexes

TLC-312 (p. 181)

22. Stochastic Differential Equations

14:00 Erika Hausenblas (Montanuniversitaet Leoben)

Nonlinear Stochastic Partial Differential equations and cross diffusion

PS2-330 (p. 185)

14:30 Marco Carfagnini (AMSI/University of Melbourne)

Spectral gaps via small fluctuations

PS2-330 (p. 184)

15:00 Boris Huang (UNSW Sydney)

First-passage times of superdiffusive processes arising from compounded random walks

PS2-330 (p. 185)

16:00 Stanley Luk (University of Technology Sydney)

New Analogies for Signatures and Rough Paths

PS2-330 (p. 187)

16:30 Benedict Lama (The University of Sydney)

Nonlinear heat equation with Dirichlet stochastic boundary conditions

PS2-330 (p. 186)

17:00 Maha Alghamdi (La Trobe University)

Multiscaling limit theorems for stochastic FPDE with cyclic long-range dependence

PS2-330 (p. 184)

23. Topology

14:00 Orion Zymaris (Monash University)

Descartes' Theorem and the Circle Packing Equations

TLC-212 (p. 194)

14:30 Chandan Singh (The University of Melbourne)

Grothendieck–Teichmüller Symmetries of Tangles

TLC-212 (p. 193)

15:00 Tilda Wilkinson-Finch (The University of Sydney)

Prime Decomposition Theorems for Long Virtual Knots

TLC-212 (p. 194)

16:00 Bailey Whitbread (The University of Sydney)

Spectroscopy for knots

TLC-212 (p. 194)

16:30 Natalie DiMichele (The University of Queensland)

Unknot Recognition through an Operations Research Lens

TLC-212 (p. 189)

17:00 Finn Thompson (The University of Queensland)

Numerically investigating the space writhe and rope length of knots

TLC-212 (p. 193)

24. Visualisation, Mathematical Art, Engagement and Outreach

16:00 Asha Rao (RMIT University)

Cyberpowers: Attracting Girls to Maths via Cyber Security

PS2-212 (p. 196)

16:30 Michael Assis (The University of Melbourne)

Enumerating convex quadrilateral origami waterbomb tiling patterns

Wed 10 December

PS2-212 (p. 195)

Conference Day 3: Thu 11 December

■ Summary timetable

When	What
09:00–10:00	Plenary: Gonzalez-Tokman – A journey through random dynamical systems and multiplicative ergodic theory (p. 90)
10:00–10:30	Morning tea
10:30–11:30	Plenary: Bamberg – Finite generalised polygons: the final frontier in the classification of spherical buildings (p. 90)
11:30–12:30	Plenary: Yakimova – Commutative subalgebras of the enveloping and symmetric algebra of a Lie algebra $\mathfrak{q}$ (p. 92)
12:30–13:30	Event: LGBTQIA+ and Allies Lunch
13:30–14:30	4 special session talks
13:30–14:00	13 special session talks
14:00–14:30	15 special session talks
14:30–15:30	Special session talk
14:30–15:00	18 special session talks
15:00–15:30	18 special session talks
15:30–16:00	Afternoon tea
16:00–17:00	Event: AustMS AGM
19:00–20:00	Event: Conference Dinner

■ Non-plenary Sessions

2. Algebra and Combinatorics

- 13:30 Guillermo Pineda-Villavicencio (Deakin University)
Colouring of graphs of polytopes
 TLC-314 (p. 96)
- 14:00 Emine Sule Yazici Yuret (Koç University)
Maximal orthogonal partial Latin squares
 TLC-314 (p. 98)
- 14:30 Pieter Roffelsen (The University of Sydney)
On monodromy of monodromy surfaces
 TLC-314 (p. 97)
- 15:00 Connor Simpson (Sydney Mathematical Research Institute)
Totally nonnegative matroid Schubert varieties
 TLC-314 (p. 97)

3. Applied and Industrial Mathematics

- 13:30 Benjamin Lee (Monash University)
Modelling intrusions with multi-layer shallow-water models
 TLC-216 (p. 99)
- 14:00 Luke Bennetts (The University of Melbourne)
Broadband absorption of water wave energy using graded arrays of heaving buoys in 3D
 TLC-216 (p. 99)
- 14:30 Hien Nguyen (Kyushu University/La Trobe University)
When does the variational measure converge given a convergent measure sequence
 TLC-216 (p. 100)
- 15:00 Simon Watt (UNSW Canberra)
Chaotic flow in competitive exothermic-endothermic reaction systems
 TLC-216 (p. 101)

4. Category Theory, Homotopy Theory, and K-Theory

- 13:30 Christian Haesemeyer (The University of Melbourne)
Fourier - Mukai transforms and t-structures
 TLC-412 (p. 102)
- 14:30 Marcello Lanfranchi (Macquarie University)
Local categories: a new approach to partiality
 TLC-412 (p. 103)
- 15:00 Mircea Voineagu (University of New South Wales)
About motivic cohomology of real numbers
 TLC-412 (p. 105)

5. Computational Mathematics

- 13:30 Erchuan Zhang (sun yat sen university)
De Casteljau Cubic Splines in Curved Spaces
 TLC-417 (p. 111)
- 14:00 Difeng Cai (Southern Methodist University)
Energy-based deep distribution transformers for scientific computing
 TLC-417 (p. 106)
- 14:30 Bishnu Lamichhane (The University of Newcastle)
A mixed FEM for a triharmonic equation using a biorthogonal system
 TLC-417 (p. 107)
- 15:00 Quoc Thong Le Gia (University of New South Wales)
Locking-Free Training of Physics-Informed Neural Network for Solving Nearly Incompressible Elasticity Equations
 TLC-417 (p. 107)

6. Differential Geometry and Symmetry

- 13:30 Kwok-Kun Kwong (University of Wollongong)
Fenchel-Willmore inequality for submanifolds in manifolds with non-negative k -Ricci curvature
 TLC-313 (p. 114)
- 14:00 Timothy Buttsworth (University of New South Wales)
Computationally-assisted proofs for mean curvature flow self-shrinkers
 TLC-313 (p. 112)
- 14:30 Yoshihiro Tonegawa (Institute of Science Tokyo)
Some recent regularity results on Brakke flow
 TLC-313 (p. 116)

7. Dynamical Systems and Ergodic Theory

- 13:30 Renaud Leplaideur (Université de la Nouvelle Calédonie)
Limits of equilibrium states for coupled weakly interacting systems
 TLC-212 (p. 117)
- 14:00 Pinsky Tali (Monash University)
Heteroclinic connections in the Lorenz equations
 TLC-212 (p. 118)
- 14:30 Andy Hammerlindl (Monash University)
Dynamical Incoherence in High Dimensions
 TLC-212 (p. 117)
- 15:00 Michael Baake (Bielefeld University)
On the long-range order of the Hat and Spectre monotile systems
 TLC-212 (p. 117)

9. Financial Mathematics

- 14:00 Zili Zhu (CSIRO)
Using Large Data to Uncover Causal Interrelationships between Economic Indicators
 TLC-215 (p. 124)
- 14:30 Yuyu Chen (The University of Melbourne)
Stochastic dominance for linear combinations of infinite-mean risks
 TLC-215 (p. 121)
- 15:00 Kazutoshi Yamazaki (The University of Queensland)
Nonzero-sum optimal stopping game with continuous vs. periodic exercise opportunities
 TLC-215 (p. 123)

11. Groups, Actions and Computation

- 13:30 Joachim Koenig (Korea National University of Education)
Monodromy groups of polynomials and reducibility behavior of variable-separated equations
 TLC-414 (p. 129)
- 14:00 Rugare Kwashira (University of the Witwatersrand)
Central automorphisms in n -abelian groups
 TLC-414 (p. 129)
- 14:30 Edmund Xian Chen Heng (The University of Sydney)
Hyperplane arrangements and normalisers of parabolics in Coxeter groups
 TLC-414 (p. 129)
- 15:00 Michael Giudici (The University of Western Australia)
Multiplication groups of loops
 TLC-414 (p. 128)

13. Mathematics Education

- 13:30 Ravindi Nanayakkara (La Trobe University)
Enhancing Student Success Through the Maths Hub: Multidisciplinary Mathematics and Statistics Support
 PS2-212 (p. 136)
- 14:00 Paul Fijn (The University of Melbourne)
Increasing interactivity in small-group teaching: implementing new technology in a statistics course
 PS2-212 (p. 136)
- 14:30 Florian Breuer (The University of Newcastle)
Using the Bloom AI Tutor in a first-year Mathematics Course
 PS2-212 (p. 136)
- 15:00 Uri Onn (Australian National University)
Kodály method, Instrumental Enrichment, and Math Education
 PS2-212 (p. 137)

15. Mathematical Physics

- 13:30 Jan De Gier (The University of Melbourne)
Inhomogeneous q -deformation of the Tsetlin library
 TLC-115 (p. 142)
- 14:00 Yuyang Zhou (The University of Melbourne)
The asymmetric five-vertex model with arbitrary boundary conditions
 TLC-115 (p. 146)
- 14:30 Thomas Quella (The University of Melbourne)
Symmetry-protected topological scar subspaces
 TLC-115 (p. 146)
- 15:00 Simran Arora (Kyoto University)
Particle physics models of interacting bosonic dark energy and fermionic dark matter in Einstein scalar Gauss-Bonnet gravity
 TLC-115 (p. 142)

16. Nonlinear PDEs and their applications

- 13:30 Neil Trudinger (Australian National University)
Oblique boundary value problems for augmented Hessian equations under degenerate boundary conditions.
 TLC-416 (p. 150)
- 14:30 Artem Pulemotov (The University of Queensland)
Local solutions to the Poisson equation for G_2 structures on cohomogeneity one manifolds
 TLC-416 (p. 150)
- 15:00 Wenjie Ni (University of New England)
A competition model with nonlocal diffusion and free boundaries
 TLC-416 (p. 149)

17. Number Theory

- 13:30 Abraham Zhang (The University of Newcastle)
Explicit height bounds on modular polynomials
 TLC-214 (p. 158)
- 13:30 Chiara Bellotti (UNSW Canberra)
On the number of zeros of the Riemann zeta function
 TLC-317 (p. 152)
- 14:00 Anthony Overmars (La Trobe University)
On fast approximation of quadratic irrationals
 TLC-214 (p. 155)
- 14:00 Saunak Bhattacharjee (University of New South Wales Canberra)
Height inequality and an improved larger sieve over number fields
 TLC-317 (p. 152)
- 14:30 Maximilian Kortge (The University of Melbourne)
On the inverse volcano problem over non-prime finite fields
 TLC-214 (p. 155)
- 14:30 Jordan Pertile (University of New South Wales Canberra)
On lower bounds for the discriminant of a number field
 TLC-317 (p. 156)
- 15:00 Blair Butler (The University of Sydney)
Magma Vs Ranks of Elliptic Curves
 TLC-214 (p. 153)
- 15:00 Shashi Chourasiya (University of New South Wales Canberra)
A zero density estimate for Dirichlet L -functions
 TLC-317 (p. 153)

18. Optimisation

- 13:30 Andrew Craig Eberhard (RMIT University)
Monotone Operator Theory: Some recent results and Future Directions
 TLC-311 (p. 160)
- 14:30 Lindon Roberts (The University of Melbourne)
Direct Search for Linearly Constrained Derivative-Free Optimization
 TLC-311 (p. 162)
- 15:00 Sarat Babu Moka (UNSW Sydney)
A Unified Approach for Sparse-Constrained Quadratic Programming
 TLC-311 (p. 162)

20. Probability and Mathematical Statistics

- 13:30 Andrea Collevocchio (Monash University)
Once-Reinforced Random Walks
 TLC-413 (p. 168)
- 13:30 Fima Klebaner (Monash University)
New approximation in non linear stochastic dynamics with small noise
 TLC-415 (p. 173)

- 14:00 Robert Charles Griffiths (Monash University)
de Finetti Random Walks on a Hypercube and Gaussian Fields
 TLC-413 (p. 170)
- 14:00 Aihua Xia (The University of Melbourne)
Poisson process approximation for subgraph-counting process in general random connection models
 TLC-415 (p. 177)
- 14:30 Kais Hamza (Monash University)
Are random random walks normal?
 TLC-413 (p. 170)
- 14:30 Stephen Muirhead (Monash University)
Poisson approximation of large gaps in Gaussian zeros
 TLC-415 (p. 175)
- 15:00 Conrad Burden (Australian National University)
The Feller diffusion conditioned on a single founder
 TLC-413 (p. 168)
- 15:00 Han Liang Gan (The University of Waikato)
Dirichlet approximation of the stationary distribution of the Wright-Fisher model using the prelimit generator comparison approach of Stein's method
 TLC-415 (p. 169)

21. Representation Theory

- 13:30 Kari Vilonen (The University of Melbourne)
Character Sheaves and Invariant systems
 TLC-312 (p. 182)
- 14:30 Chenyan Wu (The University of Melbourne)
Hecke algebras and Langlands parameters for Bernstein blocks of the metaplectic groups
 TLC-312 (p. 183)
- 15:00 Yau Wing Li (The University of Melbourne)
Endoscopy for Metaplectic Affine Hecke Categories
 TLC-312 (p. 180)

22. Stochastic Differential Equations

- 13:30 Anthony Dooley (University of Technology Sydney)
Lie Symmetries for Stochastic Differential Equations
 PS2-330 (p. 184)
- 14:00 Upanshu Sharma (UNSW Sydney)
Constraints in Stochastic Differential Equations
 PS2-330 (p. 187)
- 14:30 Xi Geng (AMSI/University of Melbourne)
Hitting Probabilities for Hypoelliptic Differential Equations Driven by Fractional Brownian Motion
 PS2-330 (p. 185)
- 15:00 Chunxi Jiao (UNSW Sydney)
Pathwise solvability and bubbling in 2D stochastic Landau-Lifshitz-Gilbert equations
 PS2-330 (p. 185)

23. Topology

- 13:30 Paawan Jethva (The University of Adelaide)
Cohomology Rings of Topological and Smooth 4-Manifolds
 TLC-315 (p. 191)
- 14:00 Lavender Marshall (Monash University)
What is a partial Heegaard diagram
 TLC-315 (p. 191)
- 14:30 Masoud Kamgarpour (The University of Queensland)
Differential Equations and Knot Theory

Thu 11 December

TLC-315 (p. 191)

15:00 Finnur Larusson (The University of Adelaide)

Homotopy types of spaces of algebraic and holomorphic maps

TLC-315 (p. 191)

Conference Day 4: Fri 12 December

■ Summary timetable

When	What
09:00–10:00	Plenary: Wormell – Computing transfer operators and fractal dimensions (p. 92)
10:00–10:30	Morning tea
10:30–11:30	Plenary: Liebenau – From Graphs to Latin Rectangles: Probabilistic Methods in Asymptotic Enumeration (p. 91)
11:30–12:30	Plenary: Johnson-Freyd – Fermions and categorified algebra closure (p. 91)
12:30–13:30	Lunch
13:30–14:30	2 special session talks
13:30–14:00	15 special session talks
14:00–14:30	16 special session talks
14:30–15:00	18 special session talks
15:00–15:30	14 special session talks
15:30–16:00	Afternoon tea
16:00–16:30	9 special session talks
16:30–17:00	6 special session talks
17:00–17:30	4 special session talks

■ Non-plenary Sessions

2. Algebra and Combinatorics

- 14:00 Murray Elder (University of Technology Sydney)
Permutation closure for multiple context-free languages
 TLC-314 (p. 94)
- 14:30 Vyacheslav Abramov (N/A)
Classes of functions in the set of circulant matrices and their characterization
 TLC-314 (p. 93)
- 15:00 Marcel Jackson (La Trobe University)
Algebraic Machine Learning
 TLC-314 (p. 95)
- 16:00 Kurt Stoeckl (The University of Melbourne)
Maximal compatibility of G-transfer systems
 TLC-314 (p. 97)
- 16:30 Yudhistira Andersen Benjamin (UNSW Sydney)
Different ways of combining infinite families of group divisible designs with two group sizes
 TLC-314 (p. 93)
- 17:00 Andrew Francis (University of New South Wales)
Phylogenetic encodings
 TLC-314 (p. 94)

4. Category Theory, Homotopy Theory, and K-Theory

- 13:30 Sophie Raynor (James Cook University)
Circuit algebras and classical groups
 TLC-412 (p. 104)
- 14:00 Thorsten Hertl (The University of Melbourne)
Line Bundle Twists for Unitary Bordism are Ghosts
 TLC-412 (p. 103)
- 14:30 Edmund Xian Chen Heng (The University of Sydney)
Finite classifying spaces for normalisers of parabolics in Artin groups
 TLC-412 (p. 103)

- 15:00 Diarmuid Crowley (The University of Melbourne)
Some new homotopy self-equivalences of 4-manifolds
 TLC-412 (p. 102)

5. Computational Mathematics

- 13:30 Antoine Marteau (Monash University)
On the Choice of Polynomial Bases for Shape-Functions and Degrees-of-Freedom Moments
 TLC-417 (p. 108)
- 14:00 Patrick Vega (Universidad de Santiago de Chile)
Minimum-residual based a posteriori error estimates for mixed finite element discretizations via superconvergent local postprocessed approximations
 TLC-417 (p. 110)
- 14:30 Peter Heiss Synak (Australian National University)
Taming Non-Manifold Meshes and Simulating Bubbles
 TLC-417 (p. 107)
- 15:00 Sergio Rojas (Monash University)
A posteriori analysis of Neural Network approximations
 TLC-417 (p. 109)

6. Differential Geometry and Symmetry

- 13:30 Philip Schrader (Murdoch University)
Curve shortening by Sobolev gradient flow
 TLC-313 (p. 115)
- 14:00 Haotian Wu (The University of Sydney)
Asymptotic behaviour of unstable perturbations of the Fubini–Study metric in Ricci flow
 TLC-313 (p. 116)
- 14:30 Lashi Bandara (Deakin University)
The space of rough Riemannian metrics
 TLC-313 (p. 112)

7. Dynamical Systems and Ergodic Theory

8. Equity, Diversity and Inclusion

- 14:30 TriThang Tran (The University of Melbourne)
Mathematics is a human endeavour: What happens when you ask real analysis students to reflect on racism, sexism and ethics?
 TLC-414 (p. 119)
- 15:00 Adriana Zanca (The University of Melbourne)
Evaluating a Pilot Program Supporting Women, Nonbinary, Trans and Gender Diverse Students in Mathematics and Statistics
 TLC-414 (p. 120)

10. General Session

- 13:30 Simon Marshall (Retired)
Some Novel Applications of Matrices in Spherical Trigonometry
 TLC-414 (p. 126)
- 14:00 Stephen Nurse (Unaffiliated)
From 1d to 3d with craft sticks
 TLC-414 (p. 126)

12. Harmonic Analysis and Hamiltonian PDE

- 16:00 Volker Schlue (The University of Melbourne)
Scattering solutions of the Vlasov-Maxwell system
 TLC-412 (p. 135)
- 16:30 Jesse Gell-Redman (None)
Propagators for evolution equations
 TLC-412 (p. 133)
- 17:00 Justin Forlano (Monash University)
The intermediate nonlinear Schrödinger equation
 TLC-412 (p. 133)

13. Mathematics Education

- 13:30 Adam Piggott (Australian National University)
How to get your mathematics degree accredited by the AustMS
 PS2-212 (p. 138)
- 14:00 TriThang Tran (The University of Melbourne)
Mathematical communication and supporting the transition from secondary to tertiary mathematics
 PS2-212 (p. 138)
- 14:30 Neea Palojaervi (University of New South Wales Canberra)
The Math Kangaroo Finland: Different topics
 PS2-212 (p. 137)
- 15:00 Murray Elder (University of Technology Sydney)
Flipped exams
 PS2-212 (p. 136)

14. Mathematical Methods in Continuum Mechanics and Wave Theory

- 13:30 Robert Buckingham (University of Cincinnati)
Suleimanov-Talanov self-focusing in the NLS hierarchy
 TLC-216 (p. 139)
- 14:00 Philip Broadbridge (La Trobe University)
Integrable Nonlinear Wave Equations with Diode Properties
 TLC-216 (p. 139)
- 14:30 Scott McCue (Queensland University of Technology)
KdV solutions and exponential asymptotics
 TLC-216 (p. 140)
- 15:00 Volker Schlue (The University of Melbourne)
Charged elastic bodies in relativistic elasticity
 TLC-216 (p. 141)
- 16:00 Ben Wilks (University of South Australia)
Water wave scattering by a surface-mounted rectangular anisotropic elastic plate
 TLC-216 (p. 141)

15. Mathematical Physics

- 13:30 Kenji Kajiwara (Kyushu University)
Michelle-Prager Type Truss Structures Generated by Integrable Discrete Holomorphic Functions
 TLC-115 (p. 144)
- 14:00 Chris Bradly (The University of Melbourne)
Lattice polymers subject to a force
 TLC-115 (p. 142)
- 14:30 Madeline Nurcombe (The University of Sydney)
Segal-Sugawara vectors for orthosymplectic Lie superalgebras
 TLC-115 (p. 145)
- 15:00 Pieter Hubert van der Kamp (La Trobe University)

Integrable Lotka-Volterra systems, Darboux polynomials, and Hypergraphs

TLC-115 (p. 146)

16:00 Laurence Field (Australian National University)
SLE return probabilities and an integrable system

TLC-115 (p. 143)

16:30 Vassili Kitsios (CSIRO)
QiuckClim-v2: Galerkin projection of the global moist three-dimensional atmosphere

TLC-115 (p. 144)

16. Nonlinear PDEs and their applications

13:30 Julie Clutterbuck (Monash University)
The spectral gap in hyperbolic space

TLC-416 (p. 148)

14:00 Todd Oliynyk (Monash University)
Stable and unstable behaviour in relativistic fluids on cosmological spacetimes

TLC-416 (p. 149)

14:30 Zihua Guo (Monash University)
Well-posedness for the compressible Navier-Stokes equations in critical Besov space

TLC-416 (p. 148)

15:00 Yann Bernard (Monash University)
Analysis of Critical Points of Conformally Invariant Curvature Energies in 4d

TLC-416 (p. 147)

16:00 Haotian Wu (The University of Sydney)
Immortal Ricci flow with Type-IIb singularities

TLC-416 (p. 150)

17. Number Theory

13:30 Lewis Combes (The University of Sydney)
Lifting mod p Bianchi modular forms

TLC-214 (p. 153)

13:30 Neea Palojaervi (University of New South Wales Canberra)
On explicit estimates for the Goldbach summatory functions

TLC-215 (p. 156)

14:00 Subham Bhakta (UNSW Sydney)
Multiplicative dependence in the denominators of points of elliptic curves

TLC-214 (p. 152)

14:00 Rodney Nilsen (University of Wollongong)
Digit properties and convergence estimates for α -fractional numbers

TLC-215 (p. 155)

14:30 Alexandru Ghitza (The University of Melbourne)
Non-existence of some higher-dimensional Galois representations

TLC-214 (p. 154)

18. Optimisation

13:30 Jein-Shan Chen (Department of Mathematics, National Taiwan Normal University)
Novel Constructions for Closed Convex Cones Through Inequalities and Support Functions

TLC-311 (p. 159)

14:30 Julien Ugon (Deakin University)
Proximal-point-like algorithms for abstract convex minimisation problems

TLC-311 (p. 164)

15:00 Reinier Diaz Millan (Deakin University)
Frank-Wolfe algorithm for star-convex functions

TLC-311 (p. 160)

16:00 Bethany Caldwell (University of New South Wales)
A primal-dual splitting method for robust convex optimisation

- TLC-311 (p. 159)
- 16:30 Felipe Atenas (The University of Melbourne)
Variable stepsize splitting methods as relocated fixed-point iterations
 TLC-311 (p. 159)
- 17:00 Neil Dizon (UNSW Sydney)
Hierarchy of SDPs for Wasserstein Distributionally Robust Optimization with Piecewise Polynomials
 TLC-311 (p. 160)

20. Probability and Mathematical Statistics

- 13:30 David Frazier (Monash University)
Predictively Oriented Posteriors
 TLC-413 (p. 169)
- 14:00 Liam Hodgkinson (The University of Melbourne)
Heavy-Tailed Universality in Deep Learning
 TLC-413 (p. 171)
- 14:00 Samuel Johnston (Kings College London)
On creating convexity in high dimensions
 TLC-415 (p. 172)
- 14:30 Paul Kabaila (La Trobe University)
Unfavorable prior distributions in statistical decision theory
 TLC-413 (p. 172)
- 14:30 Laurence Field (Australian National University)
Brownian processes made recurrent
 TLC-415 (p. 169)
- 15:00 Dennis Leung (The University of Melbourne)
Recent advances in normal approximation for U-statistics
 TLC-413 (p. 174)
- 15:00 Maher Boudabra (King Fahd University of Petroleum and Minerals)
Skorokhod energy of planar domains
 TLC-415 (p. 167)

21. Representation Theory

- 13:30 Simon Marshall (The University of Melbourne)
Uniform bounds for fixed vectors in representations of a p -adic GL_n
 TLC-312 (p. 182)
- 14:00 Ting Xue (The University of Melbourne)
Level-rank dualities from d -Harish-Chandra series
 TLC-312 (p. 183)
- 14:30 Sam Jeralds (The University of Sydney)
Irreducible components in Hochschild cohomology of flag varieties
 TLC-312 (p. 180)
- 15:00 Svetlana Makarova (Australian National University)
Generalised Pascal recurrence in lattice vertex operator superalgebras
 TLC-312 (p. 181)
- 16:00 Lior Yanovski (AMSI/University of Melbourne)
Generalized induced character formula
 TLC-312 (p. 183)
- 16:30 Yixuan Li (Australian National University)
A McKay correspondence for Type A Lie Superalgebras
 TLC-312 (p. 180)

22. Stochastic Differential Equations

- 14:00 Justin Forlano (Monash University)
Invariant Gibbs dynamics for the nonlinear Schrödinger equations on the disc
 PS2-330 (p. 184)
- 14:30 Pierre Perruchaud (Monash University)
Constructive quantum field theory: an approach via the Brownian loop soup
 PS2-330 (p. 187)

23. Topology

- 13:30 Pedram Hekmati (The University of Auckland)
New invariants of involutions on rational homology spheres
 TLC-315 (p. 190)
- 14:30 Marcy Robertson (The University of Melbourne)
Homotopy props in quantization
 TLC-315 (p. 193)
- 14:30 Jonathan Spreer (The University of Sydney)
A Practical Algorithm for Knot Factorisation
 TLC-317 (p. 193)
- 15:00 Thorsten Hertl (The University of Melbourne)
Moduli Spaces of G_2 manifolds may have holes
 TLC-315 (p. 190)
- 15:00 Dionne Ibarra (Monash University)
Cubic Skein Modules
 TLC-317 (p. 191)
- 16:00 Owen Dearnicott (La Trobe University)
The Eells-Kuiper invariant of certain cohomogeneity one 7-manifolds
 TLC-315 (p. 189)
- 16:00 Teresa Heiss-Synak (The Australian National University)
New Method for Analyzing The Hole-Structure of a Crystal: Merge Trees of Periodic Filtrations
 TLC-317 (p. 190)
- 16:30 Lior Yanovski (AMSI/University of Melbourne)
The J -homomorphism and higher additive structure
 TLC-315 (p. 194)
- 17:00 Lashi Bandara (Deakin University)
Cutting and gluing via matching boundary conditions
 TLC-315 (p. 189)

Abstracts

1. Plenary	90
2. Algebra and Combinatorics	93
3. Applied and Industrial Mathematics	99
4. Category Theory, Homotopy Theory, and K-Theory	102
5. Computational Mathematics	106
6. Differential Geometry and Symmetry	112
7. Dynamical Systems and Ergodic Theory	117
8. Equity, Diversity and Inclusion	119
9. Financial Mathematics	121
10. General Session	125
11. Groups, Actions and Computation	128
12. Harmonic Analysis and Hamiltonian PDE	132
13. Mathematics Education	136
14. Mathematical Methods in Continuum Mechanics and Wave Theory	139
15. Mathematical Physics	142
16. Nonlinear PDEs and their applications	147
17. Number Theory	152
18. Optimisation	159
19. Poster Session	165
20. Probability and Mathematical Statistics	167
21. Representation Theory	179
22. Stochastic Differential Equations	184
23. Topology	189
24. Visualisation, Mathematical Art, Engagement and Outreach	195

1. Plenary Lectures in Agora Theatre

Bamberg, John. Finite generalised polygons: the final frontier in the classification of spherical buildings

Speaker: John Bamberg (The University of Western Australia)

Time: Thu 10:30

Place(s): Agora Theatre

Author(s): John Bamberg

A building is a geometric object, introduced by Jacques Tits, in order to give a unified description of some simple groups of Lie type. In 1973, Tits produced a classification of the finite irreducible spherical buildings having rank at least 3. The finite generalised polygons are the rank 2 irreducible spherical buildings, and include projective planes and the generalised quadrangles, hexagons, and octagons. Whilst many examples are known, we lack a classification. Since the early work of Ostrom and Wagner on the automorphism groups of finite projective planes, there has been great interest in what the automorphism groups of generalised polygons can be, and in particular, whether it is possible to classify generalised polygons with a prescribed symmetry condition. In this talk, we give an overview of the study of symmetric finite generalised polygons.

Barbensi, Agnese. Mapping the topology of polymer folding: knots, geometry, and data

Speaker: Agnese Barbensi (The University of Queensland)

Time: Wed 09:00

Place(s): Agora Theatre

Author(s): Agnese Barbensi

The last few decades have seen important advances in understanding the consequences of topological constraints in many biological systems. One striking example is the role of knots in biopolymers, which can profoundly influence their folding pathways, structural stability, and functional mechanisms. In this talk, I will explore a range of techniques from computational and applied topology, interpreted broadly, to investigate these phenomena, with a focus on how topological methods provide novel perspectives and tools for analysing the complex behaviour of biopolymers.

Driscoll, Tobin. Computational approximation by rational functions

Speaker: Tobin Driscoll (University of Delaware)

Time: Tue 11:30

Place(s): Agora Theatre

Author(s): Tobin Driscoll

Approximation is a cornerstone of numerical computation. Both the theory and practice of approximation by polynomials, trigonometric functions, and other analytic bases are highly developed. While the theory of approximation by rational functions is equally rich, applications of rational functions in computational practice have lagged, despite their potential for greater efficiency for many functions of interest. Interest has grown rapidly within the last decade, however, and there are now multiple algorithms and software packages that make fast rational approximation routine. This talk will focus on the use of Thiele continued fractions, which are the fastest stable option currently known, by introducing how they are implemented, what is known about their convergence, and their application to problems such as sign functions and differential equations.

Gonzalez-Tokman, Cecilia. A journey through random dynamical systems and multiplicative ergodic theory

Speaker: Cecilia Gonzalez-Tokman (The University of Queensland)

Time: Thu 09:00

Place(s): Agora Theatre

Author(s): Cecilia González-Tokman

Random dynamical systems serve as versatile mathematical models for analysing systems influenced by external factors, such as seasonal variations and stochastic noise. Recent advancements in multiplicative ergodic theory have uncovered fundamental insights into transport phenomena within these systems, shedding light on their long-term behaviour, mixing rates, coherent structures, and limit theorems. In this talk, we will journey through random dynamical systems and multiplicative ergodic theory, beginning with fundamental examples and addressing questions arising from the study of oceanic and atmospheric flows.

Hautphenne, Sophie. Branching processes in practice: models, inference, and applications**Speaker:** Sophie Hautphenne (The University of Melbourne)**Time:** Tue 17:30**Place(s):** Agora Theatre**Author(s):** Sophie Hautphenne

Branching processes are natural and versatile tools for describing the dynamics of populations that evolve randomly over time. However, classical branching processes often make restrictive assumptions that limit their usefulness in applications. In this talk I will present two families of branching processes which extend the classical framework while retaining mathematical tractability: Markovian binary trees, which can capture general lifetime and reproduction patterns, and population-size-dependent branching processes, which can capture competition for limited resources.

I will describe recent progress on fitting these models to data and present real-world applications, including the endangered Chatham Island black robin, demographic studies of female reproduction, phylogenetics, and the progression of chronic myeloid leukemia. These examples illustrate how stochastic models can inform biology and medicine, and how realistic branching processes open new directions for both theory and applications.

Johnson-Freyd, Theo. Fermions and categorified algebra closure**Speaker:** Theo Johnson-Freyd (Perimeter Institute for Theoretical Physics)**Time:** Fri 11:30**Place(s):** Agora Theatre**Author(s):** Theo Johnson-Freyd

I will explain a sense in which the category $\mathbf{Vec}_{\mathbb{C}}$ of complex vector spaces is not “algebraically closed,” but rather has the category $\mathbf{sVec}_{\mathbb{C}}$ of complex **super** vector space ($\mathbb{Z}/2\mathbb{Z}$ -graded vector spaces with Grassmann/Koszul sign rules) as its algebraic closure. From this perspective, the occurrence in quantum physics of both imaginary numbers and of fermionic particles come from the same source. In addition to particle-like excitations, quantum materials can have excitations that behave like strings or higher-dimensional branes, whose fusion and statistics is organized by higher categories. Ideas from classical Galois theory — algebraic closure, cyclotomic and Kummer extensions, etc. — allow to work out the possible statistics of these extended objects. Remarkably, these purely-algebraic questions — what is the algebraic closure of the n -category of “ n -vector spaces”? — have answers that look enticingly geometric, and hint at a deeper meaning of unitarity and the Spin–Statistics Theorem. Time permitting, I will indicate some applications to enforced gaplessness and the classification of topological insulators. This is joint work in progress with David Reutter.

Liebenau, Anita. From Graphs to Latin Rectangles: Probabilistic Methods in Asymptotic Enumeration**Speaker:** Anita Liebenau (UNSW Sydney)**Time:** Fri 10:30**Place(s):** Agora Theatre**Author(s):** Anita Liebenau

Latin rectangles are among the oldest objects in combinatorics, yet their enumeration has resisted precise analysis. Recent joint work develops asymptotics for their number, using methods that we first designed for counting regular graphs of medium density. The key idea is to build a probability space where point probabilities can be evaluated with high accuracy - revealing the normalized count of Latin rectangles as one such probability.

Tonegawa, Yoshihiro. Geometric measure theory and mean curvature flow**Speaker:** Yoshihiro Tonegawa (Institute of Science Tokyo)**Time:** Wed 11:30**Place(s):** Agora Theatre**Author(s):** Yoshihiro Tonegawa

The study of minimal surfaces is one of the central themes in geometric measure theory, and the insights gained from research on the minimal surfaces in particular have had an impact on a wide range of fields of geometry and analysis. Mean curvature flow, which can be considered a time-evolution version of the minimal surface, is a more general problem that also includes minimal surfaces. Compared to the study of minimal surfaces, on the other hand, the amount of research on the mean curvature flow is considerably smaller, and many aspects remain unclear. I will begin by explaining the history of the mean curvature flow in the context of geometric measure theory and Almgren’s works and then introduce the existence and regularity theorem in which I have been involved.

Wormell, Caroline. Computing transfer operators and fractal dimensions

Speaker: Caroline Wormell (The University of Sydney)

Time: Fri 09:00

Place(s): Agora Theatre

Author(s): Caroline Wormell

Transfer operators are an interesting kind of functional operator: they are weighted composition operators, typically associated with dynamical systems. One of their many applications is in studying fractals, and in particular characterising their fundamental properties like dimension. I will explain the connection, and show how some recent numerical approaches to transfer operators facilitate very good rigorous bounds on Hausdorff dimensions of certain fractals of relevance to number theory.

Yakimova, Oksana. Commutative subalgebras of the enveloping and symmetric algebra of a Lie algebra $\mathfrak{q}$

Speaker: Oksana Yakimova (Friedrich Schiller University of Jena)

Time: Thu 11:30

Place(s): Agora Theatre

Author(s): Oksana Yakimova

The enveloping algebra $U(\mathfrak{q})$ has a filtration and by the PBW theorem the associated graded object is the symmetric algebra $S(\mathfrak{q})$ of $\mathfrak{q}$. The Lie–Poisson bracket $\{ , \}$ on $S(\mathfrak{q})$ is obtained from the commutator on $U(\mathfrak{q})$ in a standard way. A subalgebra C of $S(\mathfrak{q})$ is Poisson-commutative if $\{C, C\} = 0$. Interest in these objects originates from integrable systems and they are deeply connected to the geometry of coadjoint orbits. By now, Poisson-commutative subalgebras of $S(\mathfrak{q})$ have been investigated from different perspectives.

There is a natural interplay between commutative subalgebras of $U(\mathfrak{q})$ and Poisson-commutative subalgebras of $S(\mathfrak{q})$, which is profitable for both settings. On the symmetric algebra side, we have methods of commutative algebra and geometry. On the enveloping side, there are applications in representation theory of $\mathfrak{q}$.

We discuss various constructions of (Poisson-)commutative subalgebras and present several important examples, classical, as well as more recent. This includes Gelfand–Tsetlin and Mishchenko–Fomenko subalgebras, Lenard–Magri scheme related to a finite order automorphism or to a splitting of $\mathfrak{q}$, commutative subalgebras C of $U(\mathfrak{q})$ having the maximal transcendence degree.

2. Algebra and Combinatorics

Abramov, Vyacheslav. Classes of functions in the set of circulant matrices and their characterization

Speaker: Vyacheslav Abramov (N/A)

Time: Fri 14:30

Place(s): TLC-314

Author(s): Vyacheslav Abramov

In this talk, we introduce new classes of functions that extend the known classes of functions of complex variable, such as entire functions, meromorphic functions, rational functions and polynomial functions and take values in the set of circulant matrices with complex entries. For these new classes of functions, we extend the recently obtained characterization theorems in [Li, B. Q. Two elementary properties of entire functions and their applications. *Amer. Math. Monthly* 122(2) (2015), 169–172] and [Li, B. Q. A characterization of rational functions. *Amer. Math. Monthly* 132(3) (2025), 269–271] to an algebraic structure of circulant matrices that includes several complex variables. Our characterization theorems lead to the generalization of the variant of the fundamental theorem of algebra established recently in [Abramov, V. M. Extension of the fundamental theorem of algebra for polynomial matrix equation with circulant matrices. *Amer. Math. Monthly* 132(4) (2025), 356–360)].

Akpanya, Reymond. A census of face-transitive surfaces

Speaker: Reymond Akpanya (The University of Sydney)

Time: Tue 17:00

Place(s): TLC-314

Author(s): Reymond Akpanya

A simplicial surface can be seen as the incidence geometry of the vertices, edges and faces of a triangulated 2-manifold. We call such a surface face-transitive if its automorphism group acts transitively on the faces of the given surface. Linking a given simplicial surface to a cubic graph is achieved by recording the incidences between the corresponding faces and edges. Note that the resulting cubic graph does not directly contain any information on the vertices of the corresponding surface. This missing information is obtained by constructing a cycle double cover (CDC) of the corresponding cubic graph, i.e. a collection of cycles of the graph such that every edge of the graph is contained in exactly two cycles. In this talk, we discuss the construction of face-transitive surfaces by providing suitable CDCs of vertex-transitive cubic graphs. We demonstrate that the CDC of a given cubic graph corresponding to a face-transitive surface can be constructed by exploiting suitable subgroups of the automorphism group of the given cubic graph. We use these theoretical results to compute a census of face-transitive surfaces with up to 1280 faces by constructing suitable cycle double covers of cubic vertex-transitive graphs. This is a joint work with Jonathan Spreer (Usyd).

Britt, Nathan. Inversion Sequences Avoiding Triples of Relations

Speaker: Nathan Britt (The University of Melbourne)

Time: Wed 16:30

Place(s): TLC-314

Author(s): Nathan Britt and Nicholas Beaton

An inversion sequence of length n is an integer sequence $(a_1, \dots, a_n)$ such that $0 \leq a_i < i$ for all i . The study of pattern-avoiding inversion sequences was initiated in 2015 by Mansour and Shattuck and in 2016 by Corteel, Martinez, Savage and Weselcouch. Martinez and Savage later defined a new type of pattern, a triple of binary relations, of which there are currently twelve uncounted avoidance classes. We complete the enumeration for all twelve of these classes using generating tree methods “growing on the left” and “growing on the right”, presenting algebraic generating functions for some and asymptotic behaviour for the others.

Bunjamin, Yudhistira Andersen. Different ways of combining infinite families of group divisible designs with two group sizes

Speaker: Yudhistira Andersen Bunjamin (UNSW Sydney)

Time: Fri 16:30

Place(s): TLC-314

Author(s): R. Julian R. Abel, Thomas Britz, Yudhistira A. Bunjamin, Diana Combe, Changyuan Wang

Different ways of constructing infinite families of group divisible designs with two group sizes

A k -GDD, or group divisible design with block size k , is a triple $(X, G, \mathcal{B})$ where X is a set of points, G is a partition of X into subsets (called groups) and $\mathcal{B}$ is a collection of k -element subsets of X (called blocks) such that any two points from distinct groups appear together in exactly one block and no two distinct points from any group appear together in any block. There are a number of known necessary conditions for the existence of a GDD. However, these conditions are not sufficient.

Over the past few years, we have constructed infinite families of 4-GDDs with only two group sizes for several pairs of group sizes. For each of these pairs of group sizes, the work usually requires piecing together several recursive constructions for smaller infinite families of k -GDDs. However, the way in which these recursive constructions are pieced together can vary quite greatly depending on the pair of group sizes.

In this talk, we will compare the different ways in which these constructions of smaller families have been pieced together to obtain constructions for the much larger infinite families. We will discuss the insights into the advantages and disadvantages of these different methods that have been gained through the recent work.

Joint work with R. Julian R. Abel, Thomas Britz, Diana Combe and Changyuan Wang

Carroll, Luka. Presentations for semigroups of full-domain partitions and trivial-cokernel partitions

Speaker: Luka Carroll (Western Sydney University)

Time: Wed 15:00

Place(s): TLC-314

Author(s): Luka Carroll, James East, Matthias Fresacher, Mengfan Lyu, Azeef Muhammed

The partition monoid $\mathcal{P}_n$ extends the notion of a map to include all partial mappings between quotients of the set $\mathbf{n} = \{1, 2, \dots, n\}$. The operation on $\mathcal{P}_n$ resembles composition of maps whilst accommodating the more complex relationships between and within the domain and codomain. The elements of $\mathcal{P}_n$ and its operation have natural graphical representations that make them intuitive to work with. The partition monoid contains many notable submonoids, such as: the full transformation monoid $\mathcal{T}_n$, the set of all self-maps on $\mathbf{n}$ under composition (and which itself contains the symmetric group $\mathcal{S}_n$); the symmetric inverse monoid $\mathcal{I}_n$, consisting of all partial bijections on $\mathbf{n}$; and the dual symmetric inverse monoid $\mathcal{J}_n$, consisting of all block bijections on $\mathbf{n}$. Work by East and Gray in their 2021 paper uncovered two submonoids of $\mathcal{P}_n$, both of which extend $\mathcal{T}_n$ in interesting ways. The first of these is the full-domain partition monoid $\mathcal{P}_n^{\text{fd}}$, which extends $\mathcal{T}_n$ using a *semilattice* (i.e., a set of commuting idempotents) that is isomorphic to the set of all equivalence relations on $\mathbf{n}$ under the *join* operation (where the join of two equivalences combines their intersecting equivalence classes). The second is the trivial-cokernel partition monoid $\mathcal{P}_n^{\text{tc}}$, which extends $\mathcal{T}_n$ using the semilattice of all *partial identities* on $\mathbf{n}$ (i.e., restrictions of the identity map to some subset of $\mathbf{n}$).

This talk will discuss recent work that has been taken to initiate the study of the monoids $\mathcal{P}_n^{\text{fd}}$ and $\mathcal{P}_n^{\text{tc}}$, namely through finding presentations (by generators and relations) of the monoids and some of their subsemigroups. This is joint work with James East, Matthias Fresacher, Mengfan Lyu and Azeef Muhammed.

Elder, Murray. Permutation closure for multiple context-free languages

Speaker: Murray Elder (University of Technology Sydney)

Time: Fri 14:00

Place(s): TLC-314

Author(s): Andrew Duncan, Murray Elder, Lisa Frenkel, Mengfan Lyu

We prove that the *permutation closure* of a multiple context-free language is multiple context-free, which extends work of Okhotin and Sorokin [LATA 2020] who showed closure under *cyclic shift*, and complements work of Brandstädt [1981, RAIRO Inform. Théor.] (resp. Brough *et al.* [2016, Discrete Math. Theor. Comput. Sci.]) who showed the same result for regular, context-sensitive, recursively enumerable (resp. EDT0L and ET0L) languages.

Fakhrurrozi, Fawwaz. Cores of circulant graphs

Speaker: Fawwaz Fakhrurrozi (The University of Melbourne)

Time: Tue 14:00

Place(s): TLC-314

Author(s): Fawwaz Fakhrurrozi, Sanming Zhou, Binzhou Xia

A graph Γ is called a *core* if every endomorphism of Γ is an automorphism of Γ . An induced subgraph Σ of a graph Γ is said to be a *core* of Γ if Σ is a core, Γ has a homomorphism to Σ , and Σ has a homomorphism to Γ . In this talk, we will discuss some conditions to determine cores of circulant graphs. In addition, we will discuss a property of a graph whose core is a complete graph.

Francis, Andrew. Phylogenetic encodings

Speaker: Andrew Francis (University of New South Wales)

Time: Fri 17:00

Place(s): TLC-314

Author(s): Andrew Francis

A number of encodings are in common use for phylogenetic trees and networks. These include those of mathematical simplicity, such as the encoding as a set of vertices and a set of edges, as well as some such as Newick format, that captures important information such as clade structures. In this talk I will describe these as well

as more recently developed encodings such as in partitions, covers, or “folios”, and discuss how their different underlying paradigms can indicate the nature of their specific advantages.

Fresacher, Matthias. Categorical representation of DRC-semigroups

Speaker: Matthias Fresacher (Western Sydney University)

Time: Wed 14:30

Place(s): TLC-314

Author(s): Matthias Fresacher

DRC-semigroups model associative systems with domain and range operations, and contain many important classes, such as inverse, restriction, Ehresmann, regular $*$ -, and $*$ -regular semigroups. In this joint work with James East, Azeef Muhammed and Tim Stokes, we show that the category of DRC-semigroups is isomorphic to a category of certain biordered categories whose object sets are projection algebras in the sense of Jones. This extends the recent groupoid approach to regular $*$ -semigroups of East and Muhammed. We also establish the existence of free DRC-semigroups by constructing a left adjoint to the forgetful functor into the category of projection algebras.

Giles Uhrig, Moshe. Cycle decompositions of arc-transitive graphs

Speaker: Moshe Giles Uhrig (AMSI/University of Melbourne)

Time: Tue 16:30

Place(s): TLC-314

Author(s): Moshe Giles Uhrig

A cycle decomposition of a graph Γ is a set $\mathcal{C}$ of cycles of Γ such that each edge of Γ belongs to exactly one cycle in $\mathcal{C}$. If there exists a group G of automorphisms of Γ that preserves $\mathcal{C}$ setwise, then $\mathcal{C}$ is called a G -invariant cycle decomposition of Γ . We study G -invariant cycle decompositions in the case where G acts transitively on the arcs of Γ , with particular interest in how distinct decompositions interact. In the simplest situation, two such decompositions determine the face set of a surface embedding of Γ , called a map, whose automorphism group is G . We characterise all pairs (Γ, G) for which every pair of G -invariant cycle decompositions gives such a map: these are the connected graphs of valency $2p$ with vertex stabilisers in G dihedral of order $2p$, for a prime p . In this setting, via a natural identification with group elements determined by a fixed arc of Γ , we show that the set of G -invariant cycle decompositions can be viewed as a complete graph admitting an $\text{Aut}(D_p)$ -invariant decomposition into Hamiltonian cycles.

Jackson, Marcel. Algebraic Machine Learning

Speaker: Marcel Jackson (La Trobe University)

Time: Fri 15:00

Place(s): TLC-314

Author(s): Marcel Jackson

Over the past approximately 8 years, a group of researchers attached to the Champalimaud Institute for the Unknown and subsequently the start-up company “Algebraic AI” have been developing a completely novel form of machine learning based in model theory and universal algebra: it “does not use parameters and it does not rely on fitting, regression, backtracking, constraint satisfiability, logical rules, production rules or error minimization”. The team has posted a number of mathematical expositions of their approach on the arXiv, but there has been little engagement from the mathematics community, due in part to the unconventional nature of the approach and constructions, which are built around the new idea of an atomised semilattice.

This talk will present a duality theoretic framework for explaining algebraic machine learning, based on collaboration with one of the lead inventors Fernando Martin-Maroto.

Kerr, Paul. Machine Learning for Conjecture Discovery

Speaker: Paul Kerr (The University of Melbourne)

Time: Tue 16:00

Place(s): TLC-314

Author(s): Paul Kerr

In mathematics research it is often required to analyse mathematical data (e.g. permutations with labels) to determine a conjecture which can serve as a target for future proofs. Our goal is to use the pattern recognition capabilities of machine learning models (such as transformers), paired with mechanistic interpretability, in order to surface candidate conjectures. We are currently demonstrating the viability of this approach on a case study—that the smoothness of Schubert varieties corresponds to avoidance of the patterns 3412 and 4231 in permutations. The question we ask is: pretending we did not know this theorem, would this procedure have led us to conjecture it? Some machine learning models show a high level of accuracy ($> 99.9\%$ on a test dataset) with this problem, but mechanistic interpretability remains challenging. This talk will cover the case study

in detail, the machine learning techniques that work well for such problems, and the progress made so far in interpreting the model.

Matan, Dominic. The Sarkisov Program for Surfaces Enriched by a Brauer Class

Speaker: Dominic Matan (UNSW Sydney)

Time: Wed 17:00

Place(s): TLC-314

Author(s): Dominic Matan

The classical Sarkisov Program provides a systematic way to ‘untwist’ a birational transformation between Mori fibre spaces (special varieties appearing as end results of the minimal model program) into a finite sequence of elementary transformations called *Sarkisov links*. Motivated by the study of noncommutative surfaces arising from maximal orders in central simple algebras, we introduce an enriched version of this program for surfaces equipped with a Brauer class. We describe how birational maps between such Brauer pairs decompose into elementary links compatible with the ramification data of the Brauer class on the surface, and illustrate through examples how the presence of nontrivial Brauer information alters the classical birational geometry – producing new types of obstructions not visible in the commutative case.

Pineda-Villavicencio, Guillermo. Colouring of graphs of polytopes

Speaker: Guillermo Pineda-Villavicencio (Deakin University)

Time: Thu 13:30

Place(s): TLC-314

Author(s): Guillermo Pineda Villavicencio

We explore graph-theoretical colouring problems in the context of graphs of polytopes. Colouring plays a significant role in polytope theory, appearing in various forms depending on the types of faces under consideration. A *face* of a polytope P is either P itself or the intersection of P with a hyperplane that contains P in one of its closed halfspaces. In a d -dimensional polytope, faces of dimension 0 and 1 are referred to as *vertices* and *edges*, respectively. The vertices and edges form the *graph* of a polytope.

The talk will focus on two fundamental types of colourings: *vertex-colouring* (an assignment of a colour to each vertex so that adjacent vertices receive different colours) and *edge-colouring* (two edges receive distinct colours if they share a vertex). The talk will present key results and discuss open questions on colouring of graphs of polytopes.

Primaskun, Devi Imulia Dian. On the Existence of Deeply Critical Oriented Cliques of Even Order

Speaker: Devi Imulia Dian Primaskun (The University of Melbourne)

Time: Tue 13:30

Place(s): TLC-314

Author(s): Devi Imulia Dian Primaskun, Christopher Duffy, Sanming Zhou

An oriented k -colouring of an oriented graph $\vec{G}$ is a homomorphism of $\vec{G}$ to an oriented graph $\vec{H}$ of order k . The oriented chromatic number of $\vec{G}$ is defined as the minimum order of such a target graph $\vec{H}$. We call an oriented graph deeply critical if the removal of any arc decreases its oriented chromatic number by two, and it is an oriented clique if its oriented chromatic number is equal to its order.

Duffy, Pavan, Sandeep, and Sen (2023) resolved an open question posed by Borodin, Fon-Der-Flaass, and Kostochka (2001) by proving the existence of deeply critical oriented cliques for all odd orders $n \geq 9$. For even orders, they conjectured that no such deeply critical oriented cliques exist, a claim they supported by classifying those that are circulant graphs.

In this work, we extend their classification to oriented Cayley graphs of arbitrary groups by providing a new structural characterisation of deeply critical oriented cliques. We prove that no such oriented clique exists for any normal Cayley graph of even order. Furthermore, we disprove the conjecture by constructing a family of Cayley graphs of a non-abelian group of even order that are deeply critical oriented cliques.

Ragas, Ruzzel. Probabilities regarding n-Poncelet pairs over finite fields

Speaker: Ruzzel Ragas (The University of Sydney)

Time: Wed 16:00

Place(s): TLC-314

Author(s): Milena Radnović; Ruzzel Ragas

A pair of conics $(\mathcal{A}, \mathcal{B})$ is called an n -Poncelet pair if an n -gon can be inscribed in $\mathcal{A}$ and circumscribed about $\mathcal{B}$. We present results on the probability of obtaining an n -Poncelet pair in the projective plane over a finite field of characteristic not equal to 2, with emphasis on the cases $n = 3$ and $n = 4$. Specifically, we consider randomly selecting a pair of distinct conics $(\mathcal{A}, \mathcal{B})$, where $\mathcal{A}$ is smooth or singular and $\mathcal{B}$ is smooth, from a fixed

pencil of conics. We do this for all pencils, classified up to projective automorphism, with at least one smooth conic.

Roffelsen, Pieter. On monodromy of monodromy surfaces

Speaker: Pieter Roffelsen (The University of Sydney)

Time: Thu 14:30

Place(s): TLC-314

Author(s): Pieter Roffelsen

Since Harris (1979), there has been a growing interest in the monodromy groups of problems in enumerative geometry. In this talk, I will discuss the monodromy groups of certain enumerative problems concerning monodromy surfaces. These groups turn out to be isomorphic to groups of combinatorial, Galoisian and integrable-systems origins, leading in particular to the solution of an open problem in the theory of Painlevé equations.

Simpson, Connor. Totally nonnegative matroid Schubert varieties

Speaker: Connor Simpson (Sydney Mathematical Research Institute)

Time: Thu 15:00

Place(s): TLC-314

Author(s): Xuhua He, Connor Simpson, Kaitao Xie

Many spaces have natural “positive structures”. Well-known examples include projective toric varieties and flag varieties. In both cases, the non-negative part is homeomorphic to a closed ball and has a natural decomposition into semialgebraic cells, imbuing the non-negative space with the structure of a regular CW complex. We give analogues of these results for another class of varieties, the “non-negative matroid Schubert varieties” of Ardila and Boocher.

Stoeckl, Kurt. Maximal compatibility of G -transfer systems

Speaker: Kurt Stoeckl (The University of Melbourne)

Time: Fri 16:00

Place(s): TLC-314

Author(s): David Demark, Michael Anthony Hill, Yigal Kamel, Nelson Niu, Kurt Stoeckl, Danika Van Niel, and Guoqi Yan

Transfer systems are a combinatorial model for weakly commutative structures in equivariant homotopy theory, such as the additive transfers and multiplicative norms of G -spectra. They let us combinatorially classify all weakly commutative G -structures, and identify when an additive transfer is compatible with a multiplicative norm. In this talk, we shall recall what a transfer system is, before providing novel formulae for identifying which additive transfers are compatible with which multiplicative norms, i.e. given a fixed transfer system we compute its maximal compatible transfer system. We shall also discuss, how (maximal) compatibility is preserved by the inflation map induced by a quotient of groups, and a conjectured expression for the maximal compatible transfer system of an additive/disklike G -transfer system. This material is based upon work supported by the National Science Foundation under Grant Number DMS 1916439, and is joint with DeMark, Hill, Kamel, Niu, Van Niel and Yan.

Stokes, Tim. DR-Semigroups satisfying the ample conditions

Speaker: Tim Stokes (University of Waikato)

Time: Wed 14:00

Place(s): TLC-314

Author(s): Tim Stokes

A *DR-semigroup* is a semigroup S having a distinguished set of idempotents E for which, for all $s \in S$, $D(s) \in E$ is the largest $e \in E$ under the natural order ($e \leq f \Leftrightarrow e = ef = fe$) for which $es = s$, and dually for $R(s)$. DR-semigroups form an equational class of binary semigroups, examples arising from partial functions and binary relations, as well as operator algebras and $*$ -regular semigroups. These examples are generally also DRC-semigroups, which satisfy the additional pair of laws:

- $D(st) = D(sD(t))$ and $R(st) = R(R(s)t)$ (the congruence conditions).

This class has received considerable attention recently, including an ESN-style theorem relating them to categories, generalising long-established results for inverse and Ehresmann semigroups and a recent one for regular $*$ -semigroups.

Here, we consider the class of DR-semigroups satisfying instead the following pair of laws (both of which can be expressed equationally):

- for all $s \in S$ and $e \in E$ there are $f, g \in E$ for which $es = sf$ and $se = gs$ (the ample conditions).

We give examples and characterisations, as well as an ESN-style theorem using so-called partial categories.

Wang, Yu. Extremal spectral radius and condition (edge) connectivity

Speaker: Yu Wang (Xinjiang University)

Time: Tue 14:30

Place(s): TLC-314

Author(s): Yu Wang, Huiqiu Lin, Dan Li

For $l > 1$, the l -edge-connectivity $\kappa'_l(G)$ of a connected graph G is defined as the minimum number of edges whose removal leaves a graph with at least l components. A graph is minimally (k, l) -edge-connected if $\kappa'_l(G) \geq k$ but for any edge $e \in E(G)$ satisfies that $\kappa'_l(G - e) < k$. Motivated by two foundational extremal problems: Brualdi and Solheid's problem [SIAM J. Algebra Discrete Methods (1986)] for graphs of fixed order: determine sharp upper bounds for the spectral radius over graph families and characterize extremal graphs; and its fixed size analogue proposed by Brualdi and Hoffman [Linear Algebra Appl. (1985)], we resolve both problems for minimally (k, k) -edge-connected graphs. Building on the structural framework of Hennayake, Lai, Li, and Mao [J. Graph Theory (2003)], we combine edge-switching method and double eigenvectors skill to characterize the graphs maximizing the spectral radius among all minimally (k, k) -edge-connected graphs of prescribed order or size. Our results generalize the $k = 2$ cases established by Lou, Min, and Huang [Electron. J. Comb. (2023)] and Chen and Guo [Discrete Math. (2019)].

Yazici Yuret, Emine Sule. Maximal orthogonal partial Latin squares

Speaker: Emine Sule Yazici Yuret (Koç University)

Time: Thu 14:00

Place(s): TLC-314

Author(s): D. M. Donovan, M. J. Grannell, E. Şule Yazıcı

Two partial Latin squares of the same order n , having the same filled cells as one another, are said to be orthogonal if, when superimposed, each of the n^2 possible ordered pair of entries appears at most once in the cells of the superimposed square. A pair of orthogonal partial Latin squares that cannot be extended to another pair of orthogonal partial Latin squares with more filled cells by inserting any entry pair into any empty cell in the superimposed square is said to be maximal. We will study maximal orthogonal partial Latin squares, the structures whose classification is crucial for improving bounds for embeddings of orthogonal partial Latin squares. We will present some examples of these structures and a conjecture for the smallest possible number of filled cells in a pair of maximal orthogonal partial Latin squares. This conjecture can also be stated in terms of finding the minimum number of codewords in an n -ary code of length 4 having minimum distance 3 and covering radius 2. Finally, we extend the conjecture to sets of k maximal mutually orthogonal partial Latin squares and hence to n -ary codes of length $k + 2$, minimum distance $k + 1$ and covering radius k .

3. Applied and Industrial Mathematics

Bennetts, Luke. Broadband absorption of water wave energy using graded arrays of heaving buoys in 3D

Speaker: Luke Bennetts (The University of Melbourne)

Time: Thu 14:00

Place(s): TLC-216

Author(s): Amy-Rose Westcott; Natalia Sergienko; Ben Cazzolato; Luke Bennetts

Wave energy converters are devices that are designed to generate power from ocean waves. They need to be deployed in arrays for commercial viability, which creates opportunities for more effective energy capture than would be offered by the same number of devices acting independently. We generate a strategy to obtain broadband power capture over a target band covering two thirds of useable ocean wave frequencies, by arranging a 3D array of heaving buoys with spring-damper power-take-off systems into rows and gradually changing the resonant properties of successive rows. The mathematical model of the array is developed based on linear wave theory, and semi-analytical methods are used to solve for the hydrodynamic interactions. We show that over 90

Khatun, Mst Shanta. Modelling Cancer Evolution with a Voronoi Cell-Based Approach

Speaker: Mst Shanta Khatun (The University of Sydney)

Time: Wed 14:30

Place(s): TLC-216

Author(s): Mst Shanta Khatun, J. Guy Lyons, and Peter S. Kim

Epithelial carcinogenesis progresses through a series of genetic mutations that occur during cell division. These successive mutations trigger unregulated cell growth through excessive cell division, migration, and invasion of the underlying extracellular matrix (ECM) of the tissue. In epithelial carcinogenesis, mutations accumulating in a cell play a critical role by giving rise to heterogeneous cell populations that interact and cooperate with each other and with their microenvironment, such as the ECM. To model cancer, it is crucial to investigate its evolutionary characteristics and behaviours. In this study, we build a Voronoi Cell-Based Model (VCBM) of cancer evolution. Building on this model, we consider four mutations: faster cell-cycling, impaired apoptosis, hyperproliferation, and more invasiveness (possible examples of these mutations are NOTCH, TP53, Hras and Sna2, respectively), that epithelial cells successively acquire to progress to a malignant tumour. These mutations reduce a cell's death rate, increase proliferation, and increase invasion. In addition, we consider two variations of these mutations: cell-autonomous, meaning cells only modify their own behaviour without benefitting other cells around them, and microenvironmental, meaning cells assist other cells by modifying their microenvironment. In the VCBM model, we focus on the microenvironmental effect of mutations in the formation of a tumour. We found that cells acquiring microenvironmental cooperative mutations, in contrast to non-cooperative cell-autonomous mutations, can give rise to a faster-growing tumour by extensively invading the ECM.

Lee, Benjamin. Modelling intrusions with multi-layer shallow-water models

Speaker: Benjamin Lee (Monash University)

Time: Thu 13:30

Place(s): TLC-216

Author(s): Benjamin Lee

Intrusions occur when a fluid propagates horizontally through a different, stratified ambient fluid. One approach to modelling intrusions is to use a single-layer shallow-water model for the intruding fluid. In this simplified model, density changes over time in the stratified ambient fluid are neglected. However, direct numerical simulations show that density changes occur in the stratified fluid above the intrusion, which affect how fast the intrusion propagates. An alternative approach to model these stratified fluid flows is to use a multi-layer, shallow-water model. We analyse and discuss numerical solutions to this model.

Mack, Matthew. Actin' on Actin

Speaker: Matthew Mack (University of South Australia)

Time: Wed 14:00

Place(s): TLC-216

Author(s): Matthew Mack

In wound healing the body's Extracellular Actin Scavenging System aims to break down residual actin fragments from dead cells that would otherwise inhibit other processes from healing affected areas. That said, there does exist other proteins that impact on this system, but practical considerations limits the number of viable lab experiments.

In this talk I'll present what I've been up to in the first year of my PhD in attempting to model this as a dynamical system and fitting this to experimental data, a fascinating mix of differential equations and statistics!

Miller, Joel. Low-dimensional models of “simple contagion” spread in networks

Speaker: Joel Miller (La Trobe University)

Time: Wed 15:00

Place(s): TLC-216

Author(s): Joel C. Miller

SIR and SIS diseases are special cases of so-called “simple contagions”. In a simple contagion, each individual has a status which can change in time either due to internal processes (such as recovery from infection) or due to pair-wise interactions (such as infection from a neighbour). Simple contagions can be used to model many processes spreading in contact networks.

In this talk I will give a simple characterisation of a broad class of simple-contagions which can be modelled using the “Edge-based Compartmental Modelling” approach. The number of equations is proportional to the number of possible statuses. I will also demonstrate algorithms in the Epidemics on Networks (EoN) python package that automate stochastic simulation and the derivation and solution of the EBCM equations.

Mushunje, Leonard. Algebraic Independence Tests for Economic Models

Speaker: Leonard Mushunje (The University of Sydney)

Time: Wed 16:30

Place(s): TLC-216

Author(s): Leonard Mushunje

Causal inference in economics often relies on identifying independent sources of variation and testing for structural dependencies among economic variables. However, existing statistical methods may fail to capture deep, non-linear dependencies and structural relationships, especially in complex systems. This paper introduces an algebraic approach to independence testing—rooted in the concept of algebraic independence from algebraic geometry and field theory—to provide a robust alternative for testing independence among economic variables in causal models. The approach aims to enhance model validation, discover hidden relations, and improve identification strategies in structural economic models.

Nguyen, Hien. When does the variational measure converge given a convergent measure sequence

Speaker: Hien Nguyen (Kyushu University/La Trobe University)

Time: Thu 14:30

Place(s): TLC-216

Author(s): Hien Nguyen; Jacob Westerhout; Julyan Arbel; Thomas Guilmeau

In Bayesian statistics, a sequence of measures $(\mu_n)_n$ is called consistent for a point θ_0 if it weakly converges to the delta measure at θ_0 . An approximation approach is often taken whereby, for each μ_n , one approximates μ_n by a ν_n that is a minimiser of the Kullback–Leibler (KL) divergence over some approximation family. An elementary question that arises in such a setting is whether the sequence $(\nu_n)_n$ converges to the same delta measure as the original sequence $(\mu_n)_n$. We provide necessary and sufficient conditions for this to hold on Polish spaces, assuming that the minimal KL divergence is eventually finite, and we give sufficient conditions guaranteeing this eventual finiteness.

Ur Rehman, Fiaz. Propagation of a viscous fluid atop a Bingham material on a slope

Speaker: Fiaz Ur Rehman (Monash University)

Time: Wed 16:00

Place(s): TLC-216

Author(s): Fiaz Ur Rehman, Edward M. Hinton, Anja C. Slim

This study presents the dynamics of a fixed volume of a two-dimensional gravity current propagating above a dense viscoplastic layer on an inclined plane. The viscous deposit initiates the yielding of Bingham layer by depressing it under the action of gravitational shear force acting down the slope. The vis-coplastic material is pushed outwards as levees, and viscous deposit spreads under free-surface gradient down the slope. The levee formation depends on the initial deposit of the viscous liquid, density difference, yield criteria and angle of inclination. These factors contribute to the pooling of the viscous deposit. For very small angle, some portion of the viscous deposit is trapped into two ponds to the left of the quasi-rigid levees, and rest of the viscous liquid slowly spreads like a thin layer down the slope. Long-time results suggest similarity solution for the shape of the thicknesses. The self-similar evolution of the thicknesses increases with time like $t^{1/5}$ on a flat surface, and $t^{1/3}$ on an inclined plane.

Watt, Simon. Chaotic flow in competitive exothermic-endothermic reaction systems

Speaker: Simon Watt (UNSW Canberra)

Time: Thu 15:00

Place(s): TLC-216

Author(s): Simon Watt

We study the effects of two-dimensional chaotic advection on a chemical system characterised by competitive exothermic and endothermic reactions. In previous studies, in which advective flow and reaction processes were assumed to dominate weak diffusive effects, two distinct behaviours were observed in the system. The first, when the stirring is fast and the reaction is slow. In this case, flame quenching occurs. In contrast, when the stirring is slow and the reaction is fast, local temperature perturbations lead to a stationary flame with a complex filament structure. When the diffusion process is more influential, as for example in many microfluidic contexts, a third type of behaviour is possible, in which an expanding swirling travelling wave develops. Previous studies, the chaotic advection has been modelled using a two-phase blinking vortex terms. We explore the behaviour as the number of phases is changed.

4. Category Theory, Homotopy Theory, and K-Theory

Crowley, Diarmuid. Some new homotopy self-equivalences of 4-manifolds

Speaker: Diarmuid Crowley (The University of Melbourne)

Time: Fri 15:00

Place(s): TLC-412

Author(s): Diarmuid Crowley, Daniel Kasprowski, Mark Powell and Arunima Ray

In the classification of topological 4-manifolds it is often helpful to have collections of homotopy self-equivalences which are not normally bordant to the identity.

“Novikov point-pinch maps” and “Stong S^1 -pinch maps” provide such homotopy self-equivalences which allow us to pass from classifications up to homotopy to classifications up to homomorphisms in some situations. However in general one may hope for more, and in this talk I will present an extension of S^1 -pinching, discuss examples and outline some applications.

Dunmore, Thomas. Algebra Objects in Near-Group Fusion Categories

Speaker: Thomas Dunmore (UNSW Sydney)

Time: Tue 14:00

Place(s): TLC-412

Author(s): Thomas Dunmore

Fusion categories show up all over mathematical physics, but not many are known to exist outside of a few special families. One approach to finding new examples that has had some success is to classify the algebra objects in your fusion category of choice, then try to find constraints on the dual fusion categories. In this talk, I would like to discuss the current state of this program for the near-group fusion categories, including some recent findings.

Haesemeyer, Christian. Fourier - Mukai transforms and t-structures

Speaker: Christian Haesemeyer (The University of Melbourne)

Time: Thu 13:30

Place(s): TLC-412

Author(s): David Gepner and Christian Haesemeyer*

Given an algebraic variety X , some t-structures on its derived category $D(X)$ (for example, the standard one) arise as global sections of a sheaf, while others may not. The push forward of the standard t-structure under a Fourier-Mukai equivalence, in particular, typically does not arise in this way. In this talk we discuss work with D. Gepner computing the (aisle) sheafification of this push forward in terms of the Fourier-Mukai kernel.

Ham, Joshua. Equivariant cellularity in Bredon motivic homotopy

Speaker: Joshua Ham (UNSW Sydney)

Time: Tue 14:30

Place(s): TLC-412

Author(s): Joshua Ham

In 2005, Dugger and Isaksen introduced notions of $\mathcal{A}$ -cellularity for a set $\mathcal{A}$ of elementary cells in an arbitrary pointed model category. Applied to Morel-Voevodsky’s motivic spaces and spectra with respect to the standard motivic spheres, Dugger-Isaksen showed that the motivic spectrum KGL representing algebraic K-theory is cellular. Moreover, they showed that the classes of finitely cellular objects and linear objects possess tri-graded Künneth spectral sequences.

The equivariant analogues for Morel-Voevodsky’s categories were developed in the 2010’s by Jeremiah Heller and his collaborators. We produce C_2 -equivariant analogues of Dugger-Isaksen’s notions of cellularity. Using an equivariant analogue of a method developed by Matthias Wendt, we explore the relationship between these homotopical notions of C_2 -cellularity and the traditional geometric notions of equivariant affine stratifications. As a result, we obtain the C_2 -cellularity of the Bredon motivic spectrum KGL^{C_2} representing C_2 -equivariant algebraic K-theory. Moreover, we show that the classes of finitely C_2 -cellular and C_2 -linear Bredon motivic spectra possess penta-graded Künneth spectral sequences.

Henderson-Walshe, George. The K-Theory of Toric Varieties

Speaker: George Henderson-Walshe (AMSI/University of Melbourne)

Time: Tue 15:00

Place(s): TLC-412

Author(s): George Henderson-Walshe

Algebraic K-theory is homotopy invariant for smooth varieties, but not in general. Conversely, it is not known exactly to what extent the observance of homotopy invariance in K-theory implies smoothness. Ton Vorst conjectured that smoothness is implied by homotopy invariance of the first $d + 1$ K groups (d being the Krull dimension), and this was proved in Characteristic 0 by Cortiñas, Haesemeyer, and Weibel. The amenability of toric varieties to combinatorial study allows us to improve upon this bound.

There is a beautiful, unexpected connection between homotopy-invariant K-theory and sheafification in the cdh-topology, which allows the obstruction to homotopy invariance of K-theory to be understood and computed in terms of Hochschild homology, and the difference between the Kahler differentials and their cdh-sheafification — the latter of which we were able to understand via the associated lattice fan of the toric variety. Our results complement the recent work of Wanchun Shen on the homotopy invariance of K-theory for LCI rings.

Heng, Edmund Xian Chen. Finite classifying spaces for normalisers of parabolics in Artin groups

Speaker: Edmund Xian Chen Heng (The University of Sydney)

Time: Fri 14:30

Place(s): TLC-412

Author(s): Owen Garnier, Edmund Heng, Oded Yacobi, Tony Licata

One of the (many) well-celebrated result of Deligne is the asphericity of complexified hyperplane complements coming from finite simplicial arrangements. As a corollary, Deligne answers a question posed by Brieskorn for finite Coxeter groups, nowadays known as the $K(\pi, 1)$ conjecture, which states that the complexified hyperplane arrangements associated to Coxeter groups are classifying spaces for Artin(—Tits) groups (which include classical braid groups as examples). The aim of this talk is to show that Deligne’s result has in fact proven more. Namely, I will show that normalisers (quotients) of parabolic subgroups of Artin groups are also fundamental groups of complexified hyperplane complements coming from finite simplicial arrangements. This is done via relating Deligne’s arrangement groupoid and Godelle’s ribbon groupoid associated to Garside categories.

Hertl, Thorsten. Line Bundle Twists for Unitary Bordism are Ghosts

Speaker: Thorsten Hertl (The University of Melbourne)

Time: Fri 14:00

Place(s): TLC-412

Author(s): Thorsten Hertl

Classical theorems of Conner-Floyd and Hopkins-Hovey say that complex K -theory is completely determined by unitary bordism and $Spin^c$ bordism respectively. The isomorphisms appearing in these theorems are induced by the maps that send a bordism class to its orientation-class in complex K -theory. Despite this geometric description, the proofs that they are indeed isomorphism are rather abstract and homotopy-theoretical.

Motivated by theoretical physics, Baum, Joachim, Khorami and Schick extend Hopkins and Hovey’s result in a forthcoming paper to twisted $Spin^c$ bordism and twisted K -theory. Here, the twists are given by (representatives of) elements in third integral cohomology.

Since every almost complex structure induces a $Spin^c$ structure and since the classical Conner-Floyd orientation factors through the Hopkins-Hovey orientation, one may wonder whether there is a twisted unitary bordism theory and a twisted Conner-Floyd orientation that extends the result of Baum, Joachim, Khorami and Schick ‘to the left’. In this talk, I answer this question in the negative.

Lanfranchi, Marcello. Local categories: a new approach to partiality

Speaker: Marcello Lanfranchi (Macquarie University)

Time: Thu 14:30

Place(s): TLC-412

Author(s): Marcello Lanfranchi, Jean-Simon Lemay

When we learn calculus, we often encounter functions which are only defined on a subset of the real line, an example being $1/x$ or the logarithmic function, despite being treated as functions from $\mathbb{R}$ to $\mathbb{R}$. Restriction categories offer a categorical context for partially-defined functions. In this talk, we present a new categorical approach to treat partiality: local categories. In a local category, the objects are resources which are only partially accessible. We prove that local categories are 2-equivalent to restriction categories, and we translate concepts of restriction categories into this new language.

Lemay, Jean-Simon. From Abelianization to Tangent Categories

Speaker: Jean-Simon Lemay (Macquarie University)

Time: Tue 17:00

Place(s): TLC-412

Author(s): Ikonikoff, S., Lemay, J.-S. P., Van der Linden, T.

A tangent category is a category with an endofunctor, called the tangent bundle functor, which is equipped with various natural transformations that capture essential properties of the classical tangent bundle of smooth manifolds. There are many interesting examples of tangent categories relating to (synthetic) differential geometry, algebraic geometry, commutative algebra, operads, etc. In this talk I will explain how, surprisingly, the category of groups is a tangent category whose tangent bundle functor is induced by abelianization. I will also explain how to generalize this example to the setting of any finitely cocomplete regular unital category, which has a canonical abelianization functor. This allows us to provide multiple new examples of tangent categories including monoids, pointed magmas, loops, non-unital rings, Jonsson–Tarski varieties, and pointed Mal'tsev varieties.

Peng, Fei. Fourier–Mukai transforms and Rouquier dimension for algebraic stacks

Speaker: Fei Peng (The University of Melbourne)

Time: Tue 16:00

Place(s): TLC-412

Author(s): Fei Peng

In this talk, I will briefly explain how to obtain variants of Orlov's representability theorem for algebraic stacks over an arbitrary Noetherian ring. I will also discuss some results on the Rouquier dimension of the bounded derived categories of coherent sheaves on certain algebraic stacks.

Raynor, Sophie. Circuit algebras and classical groups

Speaker: Sophie Raynor (James Cook University)

Time: Fri 13:30

Place(s): TLC-412

Author(s): Sophie Raynor

Bar-Natan and Dancso introduced circuit algebras as a framework for studying finite-type invariants of virtual tangles. They are a symmetric version of Jones's planar algebras, corresponding to algebras over certain operads of wiring diagrams. In this talk, I will provide some equivalent descriptions of circuit algebras and explain how they relate to algebras over the classical groups.

Richardson, Joel. Algebras of the Tangent Bundle Monad

Speaker: Joel Richardson (Macquarie University)

Time: Tue 16:30

Place(s): TLC-412

Author(s): Joel Richardson

Tangent categories generalise the tangent bundle construction beyond differential geometry. Each tangent category carries a canonical tangent bundle monad, whose algebras (Eilenberg–Moore category) have proved difficult to characterise. In this talk, we examine the tangent bundle monad arising in algebraic geometry and show that each of its algebras induces a kind of square-zero linear map on the tangent bundle – a result that extends to all tangent categories.

Singh, Chandan. Cyclic Symmetries of Grothendieck–Teichmüller group

Speaker: Chandan Singh (The University of Melbourne)

Time: Tue 13:30

Place(s): TLC-412

Author(s): Chandan Singh

In 2008, Budney showed that the operad of framed little disks admits a natural cyclic structure. In this talk, I will explain how this structure lifts to a cyclic structure on a groupoid model for framed little disks: the operad of parenthesized ribbon braids. We extend the classical action of the Grothendieck–Teichmüller group (GT) on the operad of parenthesized ribbon braids to its cyclic refinement. This yields a new characterization of GT as the automorphism group of the prounipotent cyclic operad of parenthesized ribbons. As an application, we use this GT action to give a streamlined proof of the formality of the cyclic framed little disks operad. This is joint work with Marcy Robertson.

Voineagu, Mircea. About motivic cohomology of real numbers

Speaker: Mircea Voineagu (University of New South Wales)

Time: Thu 15:00

Place(s): TLC-412

Author(s): Bill Deng, Mircea Voineagu

We describe the Bredon motivic cohomology ring of real numbers and $RO(C_2 \times C_2)$ graded cohomology ring of a point in terms of generators and relations. This is a generalization of Voevodsky's theorem that identifies motivic cohomology of real numbers with the positive cone of $RO(C_2)$ graded cohomology of a point.

5. Computational Mathematics

Alhawiti, Noura. Curve Diffusion Flow of Planar Curves with Inhomogeneous Boundary Conditions

Speaker: Noura Alhawiti (The University of Newcastle)

Time: Tue 14:00

Place(s): TLC-417

Author(s): Noura Alhawiti, Bishnu P. Lamichhane, James McCoy

We develop a new finite element (FE) scheme using a biorthogonal system for the open curve diffusion flow problem with three types of generalized inhomogeneous boundary conditions. This approach improves both accuracy and efficiency compared to existing methods.

Badia, Santiago. Energy minimisation using overlapping tensor-product free-knot B-splines

Speaker: Santiago Badia (Monash University)

Time: Wed 16:30

Place(s): TLC-417

Author(s): Santiago Badia and Alexandre Magueresse

Accurately solving PDEs with localised features requires refined meshes that adapt to the solution. Traditional numerical methods, such as finite elements, are linear in nature and often ineffective for such problems, as the mesh is not tailored to the solution. Adaptive strategies, such as h- and p-refinement, improve efficiency by sequentially refining the mesh based on a posteriori error estimates. However, these methods are geometrically rigid – limited to specific refinement rules – and require solving the problem on a sequence of adaptive meshes, which can be computationally expensive. Moreover, the design of effective a posteriori error estimates is problem-dependent and non-trivial. In this work, we study a specific nonlinear approximation scheme based on overlapping tensor-product free-knot B-spline patches, where knot positions act as nonlinear parameters controlling the geometry of the discretisation. We analyse the corresponding energy minimisation problem for linear, self-adjoint elliptic PDEs, showing that, under a mild mesh size condition, the discrete energy satisfies the structural properties required for the local and global convergence of the constrained optimisation scheme developed in our companion work [Magueresse, Badia (2025, arXiv:2508.17687)]. This establishes a direct connection between the two analyses: the adaptive free-knot B-spline space considered here fits into the abstract framework, ensuring convergence of projected gradient descent for the joint optimisation of knot positions and coefficients. Numerical experiments illustrate the method’s efficiency and its ability to capture localised features with significantly fewer degrees of freedom than standard finite element discretisations.

Cai, Difeng. Energy-based deep distribution transformers for scientific computing

Speaker: Difeng Cai (Southern Methodist University)

Time: Thu 14:00

Place(s): TLC-417

Author(s): Difeng Cai

Generating point distributions with certain structures is frequently encountered in scientific computing. Examples include quasi-Monte Carlo, adaptive meshing, geometric methods for low rank matrix approximations, etc. Existing methods such as low discrepancy sequence can sometimes produce undesired distributions and can become invalid due to issues like parameter sensitivity or geometric challenges. In this talk, we present a flexible energy-based framework to improve distribution quality. By modeling the desired distribution via deep neural networks governed by a particle system, the approach is able to handle irregular input and complex geometry. The method can be used as a tool for quasi-random point generation on complicated geometries.

Carrasco, Sergio. Fully mixed finite element methods for a steady thermoelastic contact problem

Speaker: Sergio Carrasco (Monash University)

Time: Tue 14:30

Place(s): TLC-417

Author(s): Sergio Carrasco, Franz Chouly, Alberto F. Martín, Ricardo Ruiz Baier

We address the unique solvability and propose suitable mixed finite element spaces for the numerical approximation of nonlinear static contact problems including thermal effects. The fully mixed formulation solves for Cauchy stress, displacement, temperature, and heat flux, and the model nonlinearities are encoded in the thermo-mechanical coupling. The proposed weak formulation can be analysed using the theory of perturbed saddle-point problems in Banach spaces, together with fixed-point arguments and employing appropriately defined variational inequalities. We derive error bounds for generic Galerkin discretisations and specify rates of convergence for Arnold-Falk-Winther elements for the mechanical variables, together with Brezzi-Douglas-Marini and piecewise polynomials for the unknowns of the thermal model.

Harris, Elizabeth. Improvement on the worst case runtime for calculating minimum volume covering ellipsoids

Speaker: Elizabeth Harris (The University of Newcastle)

Time: Tue 16:00

Place(s): TLC-417

Author(s): Elizabeth Harris

The Minimum Volume Ellipsoid (MVCE) Problem seeks the ellipsoid of smallest volume containing a set of n points in $\mathbb{R}^d$. In this talk, I introduce the MVCE problem, as well as its dual problem, the D-optimal design problem. I then briefly introduce the Frank-Wolfe algorithm, which can be used to solve MVCEs. I then present my new theoretical result: an improved upper bound for the initial optimality gap when using Khachiyan's initialisation (which places equal weights on all points). As an immediate consequence, this improves the worst case runtime for the Frank-Wolfe algorithm.

Heiss Synak, Peter. Taming Non-Manifold Meshes and Simulating Bubbles

Speaker: Peter Heiss Synak (Australian National University)

Time: Fri 14:30

Place(s): TLC-417

Author(s): Peter Heiss Synak, Aleksei Kalinov, Malina Strugaru, Arian Etemadi, Huidong Yang, Chris Wojtan, Sadashige Ishida

In simulations, representing soft matter using surface meshes offers exceptional level of surface detail. Unfortunately, mesh geometries can easily enter faulty states, such as colliding, inverting, self-overlapping and more, making it necessary to occasionally correct mesh topology in order to maintain physical plausibility. I will illustrate these issues for the case of simulating soap bubbles. Then, I will present a surface-tracking algorithm we developed to tackle these problems in a non-manifold setting. Our algorithm combines surface detail preservation, characteristic of mesh-based methods, while reliably handling diverse topological changes, similar to level set methods. I will also touch on the aspects that make our algorithm numerically robust.

Lamichhane, Bishnu. A mixed FEM for a triharmonic equation using a biorthogonal system

Speaker: Bishnu Lamichhane (The University of Newcastle)

Time: Thu 14:30

Place(s): TLC-417

Author(s): Bishnu Lamichhane and Avijit Das

We present a mixed finite element method (FEM) for solving a triharmonic problem with Cahn-Hilliard boundary conditions. The mixed FEM is formulated as a saddle point problem, which allows the use of a biorthogonal system. This method reduces the computational cost of solving a sixth-order problem to that of a second-order Poisson problem. The approach demonstrates not only computational efficiency but also significant benefits in terms of storage, particularly for time-dependent problems. We discuss the well-posedness and error estimates of the proposed scheme.

Le Gia, Quoc Thong. Locking-Free Training of Physics-Informed Neural Network for Solving Nearly Incompressible Elasticity Equations

Speaker: Quoc Thong Le Gia (University of New South Wales)

Time: Thu 15:00

Place(s): TLC-417

Author(s): J. Dick, S. Ko, Q. T. Le Gia, K. Mustapha, S. Park

Due to divergence instability, the accuracy of low-order conforming finite element methods for nearly incompressible homogeneous elasticity equations deteriorates as the Lamé coefficient $\lambda \rightarrow \infty$, or equivalently as the Poisson ratio $\nu \rightarrow 1/2$. This phenomenon, known as locking or non-robustness, remains not fully understood despite extensive investigation. In this paper, we propose a robust method based on a fundamentally different, machine-learning-driven approach. Leveraging recently developed Physics-Informed Neural Networks (PINNs), we address the numerical solution of linear elasticity equations governing nearly incompressible materials. The core idea of our method is to appropriately decompose the given equations to alleviate the extreme imbalance in the coefficients, while simultaneously solving both the forward and inverse problems to recover the solutions of the decomposed systems as well as the associated external conditions. We will carry out a rigorous convergence analysis of the new method to further enhance the reliability of the proposed approach. Moreover, through various numerical experiments, including constant, variable and parametric Lamé coefficients, we illustrate the efficiency of the proposed methodology.

Manyer, Jordi. Geometric Multigrid solvers for non-conforming polytopal hybrid discretization methods.

Speaker: Jordi Manyer (Monash University)

Time: Tue 17:00

Place(s): TLC-417

Author(s): Santiago Badia, Jordi Manyer*, Jai Tushar

Polytopal methods are a class of finite element methods that can be applied on polytopal meshes, i.e, meshes that are composed of general polygons or polyhedra. Polytopal methods have become increasingly popular since they can deal with complex geometries without the need for complex meshing tools. These often involve hybrid spaces, where degrees of freedom are attached to mesh entities of different dimensions.

The design of efficient, robust, scalable solvers for linear systems arising from this kind of discretization is important to make them competitive with traditional methods on real world applications. One family of such scalable preconditioners are Geometric Multigrid (GMG) methods.

GMG methods rely on a hierarchy of meshes, and intergrid transfer operators between them. At each level, smoothers are used to efficiently reduce high-frequency components of the error, while a coarse-level solver addresses low-frequency components. The combination of these components, along with proper restriction and prolongation operators, enables GMG methods to achieve optimal convergence rates independent of the problem size.

GMG methods have been successfully applied to a wide range of problems within the traditional Finite Element Method (FEM) framework. However, their application to polytopal hybrid discretization methods presents unique challenges due to the lack of hierarchical mesh refinement strategies, the complexity of the mesh structure, and the hybrid nature of the spaces involved.

In this talk, we will present recent advances on the design of GMG preconditioners for non-conforming polytopal hybrid discretization methods. We will also present numerical experiments that demonstrate the scalability and efficiency of the proposed methods on large-scale problems. All experiments are performed using the open-source finite-element library Gridap, and run on the GADI supercomputer using resources provided by the Australian Government through NCI under the NCMAS Merit Allocation Scheme.

Marshall, Simon. GNLS: an R Program for Errors-in-Variables Fitting

Speaker: Simon Marshall (Retired)

Time: Wed 17:00

Place(s): TLC-417

Author(s): Simon L. Marshall

The R programming language, together with its numerous packages for specialized applications, has become firmly established as a preferred vehicle for exploratory data analysis and statistical modelling. The built-in `nls()` function available for nonlinear parameter estimation relies on (i) the distinction between regressor and response variables; (ii) the existence of an explicit functional relationship between them, and (iii) absence of errors in the regressors; since these assumptions are not always justified, the present article addresses the need for a more general treatment that avoids them. This formulates the generalized least squares problem as a constrained minimization of the weighted sum of squared residuals, to be solved iteratively for the regressors and parameters. The key inputs are a subprogram evaluating the scalar or vector function to be fitted, a matrix containing the covariances of the regressors at each design point, and an initial estimate of the parameters - all the required partial derivatives are approximated by central differences. The program is suitable for application to models defined by one or more nonlinear, implicit relationships between parameters and regressors at each datum, arising in a diverse range of fields. Application to data reduction problems in physical chemistry and chemical physics is demonstrated.

Marteau, Antoine. On the Choice of Polynomial Bases for Shape-Functions and Degrees-of-Freedom Moments

Speaker: Antoine Marteau (Monash University)

Time: Fri 13:30

Place(s): TLC-417

Author(s): Antoine Marteau, Jordi Manyer, Santiago Badia

This study compares different ways of implementing shape-function and degree-of-freedom bases for most of the elements of the Periodic Table of the Finite Elements. Indeed, the change of basis matrix required to have shape-function and degree-of-freedom bases dual from each other increases in size with the order, leading to greater floating point error propagation during interpolation and computation of system matrices. Geometrically-decomposed polynomial bases have the advantage to be usable as shape-functions because they have the right trace vanishing properties required for them to be glued in a conforming global finite element space. Such bases are implemented for the spaces of the element in families $\mathcal{P}_r^-\Lambda^k(\Delta_D)$, $\mathcal{P}_r\Lambda^k(\Delta_D)$, and $\mathcal{Q}_r^-\Lambda^k(\Delta_D)$ for $k \in \{0 : D\}$, and $\mathcal{S}_r\Lambda^0(\Delta_D)$, for $r > 0$ and $D = 1, 2, 3$. We compares monomial and Bernstein bases on simplices,

and monomial, Bernstein and modal- C^0 bases on n-cubes. We numerically show that using the geometrically-decomposed basis as shape function and using a change of basis for the degrees-of-freedom is always better in terms of conditioning and floating point precision of the mass matrix computation.

O’Kane, Terence. A Spherical harmonic neural operator atmospheric general circulation model

Speaker: Terence O’Kane (CSIRO)

Time: Wed 15:00

Place(s): TLC-417

Author(s): Terence O’kane, Mark Collier, Yue Sun

We present LUCIE+: a spherical harmonic neural operator model of the global atmosphere. This talk will outline the architectural design, objective function(s), regularization, and choices of prognostic and forcing input variables. We demonstrate the model and its performance in training and inference over the period 1984–2025. The model is trained on daily observational data and tested and validated by in-sample and out-of-sample predictions at lead times of up to a decade. We conclude with a discussion of future developments and specific applications to climate prediction.

Rieger, Janosch. Towards optimal space-time discretisations for reachability analysis

Speaker: Janosch Rieger (Monash University)

Time: Wed 16:00

Place(s): TLC-417

Author(s): Janosch Rieger, Kyria Wawryk

Reachable sets of control systems play a major role in safety-oriented applications like collision avoidance, plant stability control and model verification. They are notoriously hard to compute because at every point in time and space the vector field is multivalued.

We analyse an algorithm that adaptively refines a space-time discretisation to reduce the complexity of these computations in the nonlinear case. In addition, we discuss how this approach can be transferred to boundary-tracking methods.

Rojas, Sergio. A posteriori analysis of Neural Network approximations

Speaker: Sergio Rojas (Monash University)

Time: Fri 15:00

Place(s): TLC-417

Author(s): Thomas Fuhrer, Sergio Rojas

In this talk, we discuss a general framework for a posteriori error estimation of neural network approximations of Partial Differential Equations (PDEs). We will demonstrate that the error can be expressed as the sum of two residual contributions whenever the underlying variational formulation is well-posed. The first is a projection onto a finite-dimensional space and is therefore computable, while the second can be reliably bounded in many practical situations. These results open up new possibilities for optimisation and learning: error estimators can be used to monitor accuracy during solver iterations, or directly incorporated into the loss functional to enforce control over the error. As a model problem, we focus on second-order elliptic PDEs, exploring several variational formulations and different strategies for handling boundary conditions. I will present a series of numerical experiments that illustrate the reliability and flexibility of the proposed estimators.

Rubiano Martinez, Andres Eduardo. Fully mixed virtual element schemes for steady-state poroelastic stress-assisted diffusion

Speaker: Andres Eduardo Rubiano Martinez (Monash University)

Time: Tue 15:00

Place(s): TLC-417

Author(s): Isaac Bermudez, Bryan Gomez-Vargas, Andres E. Rubiano, Ricardo Ruiz-Baier

We propose a fully mixed virtual element method for the numerical approximation of the coupling between stress-altered diffusion and linear elasticity equations with strong symmetry of total poroelastic stress (using the Hellinger–Reissner principle). A novelty of this work is that we introduce a less restrictive assumption on the stress-assisted diffusion coefficient, requiring an analysis of the perturbed diffusion equation using Banach spaces. The solvability of the continuous and discrete problems is established using a suitable modification of the abstract theory for perturbed saddle-point problems in Banach spaces (which is in itself a new result of independent interest). In addition, we establish optimal a priori error estimates. The method and its analysis are robust with respect to the poromechanical parameters. We also include a number of numerical examples that illustrate the properties of the proposed scheme.

Soenjaya, Agus. An energy-stable and mass-preserving linear finite element method for a diffuse-interface model of tumour growth

Speaker: Agus Soenjaya (University of New South Wales)

Time: Tue 13:30

Place(s): TLC-417

Author(s): Agus Soenjaya, Ping Lin, Thanh Tran

We develop a fully discrete structure-preserving finite element method for a diffuse-interface model of tumour growth. The system couples a Cahn-Hilliard type equation with a nonlinear reaction-diffusion equation for nutrient concentration and admits a dissipative energy law at the continuous level. For the discretisation, we employ a scalar auxiliary variable (SAV) formulation together with a mixed finite element method for the Cahn-Hilliard part and standard conforming finite elements for the reaction-diffusion equation in space, combined with a first-order semi-implicit time-stepping scheme. The resulting method is unconditionally energy-stable, mass-preserving, and inherits a discrete energy dissipation law associated with the SAV-based approximate energy functional, while requiring the solution of only linear systems at each time step. To obtain optimal-order error estimates, a key step is the proof of L^∞ -stability of the iterates. Under suitable regularity assumptions on the exact solution, we derive rigorous error estimates in L^2 , H^1 , and L^∞ norms, establishing first-order accuracy in time and optimal-order accuracy in space. Numerical experiments are performed to validate the theoretical convergence rates.

Tambyah, Tamara. Developing hp -multigrid methods on cubed sphere meshes

Speaker: Tamara Tambyah (Monash University)

Time: Wed 14:30

Place(s): TLC-417

Author(s): Tamara Tambyah, Alberto F. Martín, David Lee, Santiago Badia

Numerical simulation of partial differential equations on manifolds is applicable to atmospheric modelling, which often involves geometrically complex computational domains that represent the surface of the earth, and capture topographical features, such as mountains. In this study, we consider the parametric representation of an orientable manifold of co-dimension 1, which is closed and compact, and construct finite element approximations in the parametric space for several examples on the sphere, including the Poisson equation, advection equation and shallow water equations. In all cases, solving in the parametric domain means numerical solutions do not incur geometric errors related to curvature. Using the Gridap.jl ecosystem, we design a two dimensional cubed sphere mesh to model surface dynamics, and a three dimensional mesh with topography to model both surface and vertical dynamics. The cubed sphere mesh is generated by projecting the six faces of a cube onto the sphere, which alleviates the ‘pole problem’ incurred by traditional orthogonal latitude-longitude meshes. Our mesh construction is novel as it leverages progressive h -refinement of a coarse cubic topology to yield an oriented mesh with no duplicate nodes, and a hierarchy of h -refined models. Thus, the development of hp -multigrid methods with patch refinement is also considered.

Vega, Patrick. Minimum-residual based a posteriori error estimates for mixed finite element discretizations via superconvergent local postprocessed approximations

Speaker: Patrick Vega (Universidad de Santiago de Chile)

Time: Fri 14:00

Place(s): TLC-417

Author(s): Liliana Camargo, Ignacio Muga, Sergio Rojas, Patrick Vega

We propose a methodology for constructing postprocessed approximations associated with finite element discretizations for a class of mixed formulations to solve partial differential equations involving a diffusion term through residual minimization. It combines local postprocessing techniques for the primal variable with adaptive finite element discretizations via residual minimization on discrete dual norms. Such a residual minimization procedure is performed on local postprocessing schemes, commonly used in the context of mixed finite element methods, that provide postprocessed approximations with superconvergence properties. Given the local nature of that approach, the underlying saddle point problems associated with residual minimizations can be solved with minimal computational effort. We propose and study a posteriori error estimators which incorporate the built-in residual representative associated with residual minimization schemes, residual term quantifying the mismatch between discrete fluxes, and the interelement jumps of the postprocessed solution. We present numerical experiments in two dimensions using Brezzi-Douglas-Marini elements for a diffusion model problem and a hybridizable discontinuous Galerkin discretization for the Helmholtz equation as inputs for our methodology. The experiments align perfectly with our key theoretical findings, suggesting that our estimates are accurate.

Vinod, Noah. Error Estimates for a Linear Fully-Discrete Finite Element Scheme for the Ferromagnetic Magnetohydrodynamical Model

Speaker: Noah Vinod (UNSW Sydney)

Time: Wed 14:00

Place(s): TLC-417

Author(s): Noah Vinod, Thanh Tran

Ferromagnetic magnetohydrodynamics concerns the study of conducting fluids with intrinsic magnetisation under the influence of a magnetic field. It is a generalisation of the magnetohydrodynamical equations and takes into account the dynamics of the magnetisation of a fluid. First proposed by Lingam [1], the usual equations of magnetohydrodynamics, namely the Navier-Stokes equation and the induction equation, are coupled with the Landau-Lifshitz equation. Theoretical discussions related to the well-posedness of solutions to this coupled system have been carried out in the past [2], but no rigorous numerical study has been conducted. Here, we discuss the error estimates for a linearised finite element scheme that uses continuous piecewise polynomial finite elements. The error estimates are developed using induction and the pointwise constraint for the Landau-Lifshitz equation is achieved asymptotically.

[1] Lingam, M., 2015. Dissipative effects in magnetohydrodynamical models with intrinsic magnetization. *Communications in Nonlinear Science and Numerical Simulation* 28, 223–231.

[2] Vinod, N., Tran, T., 2026. Local-in-Time Well-Posedness for a Magnetohydrodynamical Model with Intrinsic Magnetisation. *Nonlinear Analysis: Real World Applications* 87: 104446.

Zamorano Goldrine, Nicolas Andres. Flow simulation in fractured media: A study of deep learning methodologies for the discrete fracture networks method

Speaker: Nicolas Andres Zamorano Goldrine (Politecnico di Torino)

Time: Tue 16:30

Place(s): TLC-417

Author(s): Nicolas Zamorano, Sergio Rojas, Stefano Berrone

Fluid flow in low-permeability fractured porous media can be effectively modeled using discrete fracture networks (DFNs), which play a crucial role in applications such as water resource management, pollutant transport, and oil recovery. Traditional approaches for simulating flow in DFNs often face challenges related to mesh generation and computational cost, as well as the incorporation of experimental data. In this work, we propose deep-learning-based methodologies to model hydraulic potential in DFNs, leveraging variational principles. The proposed methods are validated, aiming to provide an alternative framework for simulating flows in fractured media.

Zhang, Erchuan. De Casteljau Cubic Splines in Curved Spaces

Speaker: Erchuan Zhang (sun yat sen university)

Time: Thu 13:30

Place(s): TLC-417

Author(s): Erchuan Zhang

Since Ken Shoemake's SLERP construction, there has been a lot of attention to generalizing the de Casteljau algorithm for Bézier curves in Euclidean space $\mathbb{R}^m$, so as to define curves in Riemannian manifolds M . Especially when geodesics in M are readily constructed, the generalised de Casteljau cubics are natural geometrical interpolants between given endpoints in M with given initial and terminal velocities that are tangent to the endpoints. As a practical matter it has been difficult to construct generalised de Casteljau cubic splines, namely C^2 track sums of generalised de Casteljau cubics through more than 2 points on M with given initial and terminal velocities. The difficulty is to find velocities at the internal junctions: this is more easily achieved in the classical case by solving a tridiagonal system of linear equations. This talk comes very close to a similarly effective construction of generalised de Casteljau cubic splines for a general Riemannian manifold. This talk is based on joint work with Prof. Lyle Noakes (UWA).

6. Differential Geometry and Symmetry

Bandara, Lashi. The space of rough Riemannian metrics

Speaker: Lashi Bandara (Deakin University)

Time: Fri 14:30

Place(s): TLC-313

Author(s): Lashi Bandara, Anisa Hassan

Motivated by numerous examples in analysis, geometry and topology, a general class of measurable-coefficient metrics called rough Riemannian metrics are identified. These generalise the smooth and continuous setting. The entire set of rough Riemannian metrics are endowed with a distance metric structure which relates to important known problems. Results pertaining to this space, such as completeness and path-connected components, will be presented. Finally, an important group which acts on the space of rough Riemannian metrics, and subject to ongoing study, will be discussed.

Bednarek, Alexander. Fano Fibrations, Twisted Kahler-Einstein Metrics and the Kahler-Ricci Flow

Speaker: Alexander Bednarek (The University of Sydney)

Time: Wed 16:00

Place(s): TLC-313

Author(s): Alexander Bednarek

We consider the Ricci flow on a compact Kahler manifold with a rational initial metric developing a singularity in finite time. This setting induces a Fano fibration of the Kahler manifold over an irreducible, analytic variety in projective space. We construct a (1,1)-form on the regular part of the base which is closely related to the Weil-Petersson metric arising from the deformation of the complex structure of the fibres. Moreover, it is shown that the singular Kahler metric on the base constructed by Song, Tian, Zhang, Zhang, satisfies a twisted Kahler-Einstein equation involving this (1,1)-form.

Furthermore, we prove a precise C^0 -estimate for the potential of the Kahler-Ricci flow which implies the C^0 -convergence, in the sense of potentials, of the Kahler-Ricci flow metric to the pullback of the singular Kahler metric when the Fano fibres are Kahler-Einstein. In this case, under the assumption that the volume form along the Kahler-Ricci flow collapses uniformly at the cohomological rate of $(T - t)^{n-m}$, we are able to prove that the Type I scalar curvature conjecture holds in any compact set away from singular fibres and holds globally when the fibration is a holomorphic submersion.

Bernard, Yann. Structural Equations for Critical Points of Conformally Invariant Curvature Energies in 4d

Speaker: Yann Bernard (Monash University)

Time: Tue 17:00

Place(s): TLC-313

Author(s): Yann Bernard

We consider the Euler-Lagrange equations satisfied by the critical points of a large class of conformally invariant extrinsic energies for 4-manifolds immersed into $\mathbb{R}^{m \geq 5}$. Using invariances and Noether's theorem, we convert the Euler-Lagrange equation in a system of equations with analytically favourable structures. This generalises to the four-dimensional setting ideas originally developed by Tristan Riviere in his study of the Willmore energy in two dimensions

Buttsworth, Timothy. Computationally-assisted proofs for mean curvature flow self-shrinkers

Speaker: Timothy Buttsworth (University of New South Wales)

Time: Thu 14:00

Place(s): TLC-313

Author(s): Timothy Buttsworth, Liam Hodgkinson, Jason D. Lotay and Qiu Shi Wang

The study of embedded surfaces in Euclidean 3-space that initiate homothetically shrinking solutions of the mean curvature flow (MCF) is a popular topic in geometric analysis. Notable examples of such solutions include the Angenent torus (a rotationally-invariant genus 1 self-shrinker) and Ketover's Platonic shrinkers (five shrinkers that have the same symmetry groups as the five Platonic solids). Despite the small dimension of the problem, a number of important questions remain about these special solutions. In this talk, I will discuss recent attempts to use computer-assisted methods to address two of these questions: (1) Is the Angenent torus unique amongst all rotationally-invariant MCF self-shrinkers in Euclidean 3-space that have genus 1? (2) Are the Platonic shrinkers compact?

Cartwright, Tiernan. Definitions of the volume of a big cohomology class**Speaker:** Tiernan Cartwright (The University of Sydney)**Time:** Wed 14:00**Place(s):** TLC-313**Author(s):** Tiernan Cartwright

In 2002, Boucksom discovered an analytic formula for the volume of a big (or more generally, pseudoeffective) line bundle over a compact Kähler manifold. This formula only depends on the line bundle's first Chern class, and thus extends to give a definition of the volume of an arbitrary cohomology class on a compact Kähler manifold. Today, such volumes are usually instead defined using the non-pluripolar product, a weak wedge product defined for closed positive $(1, 1)$ -currents with possibly unbounded potentials. I will summarise my recent preprint which provides an exposition and proof of why these definitions are equivalent. I will also discuss connections to degenerate complex Monge–Ampère equations.

Flook, Marcus. Fully nonlinear flows of real hypersurfaces in complex space**Speaker:** Marcus Flook (Australian National University)**Time:** Wed 14:30**Place(s):** TLC-313**Author(s):** Marcus Flook and Ben Andrews

In $\mathbb{C}^n$, domains of holomorphy with sufficiently regular boundary can be characterised by (Levi) pseudoconvexity, which is defined by the positive-semidefiniteness of the Levi form. Inspired by research from Huisken and Klingenberg [1], we discuss results on fully nonlinear flows of CR hypersurfaces by symmetric functions of the eigenvalues of the Levi form. These flows are analogous to other extrinsic flows, including mean curvature flow, however with an additional degeneracy which yields different conditions on short term existence. We also discuss future directions of the work.

[1] G. Huisken, W. Klingenberg, Flow of real hypersurfaces by the trace of the Levi form, *Math. Res. Lett.* 6 (1999), no. 5-6, 645–661.

Greven, Harrison. Conformally Related Einstein Metrics**Speaker:** Harrison Greven (Adelaide University)**Time:** Tue 16:00**Place(s):** TLC-313**Author(s):** Harrison Greven

A conformal structure on a manifold is a class of metrics defined up to scale such that the angles between tangent vectors are preserved amongst representatives. Of particular interest are conformal structures with some symmetry condition imposed. We study conformal classes admitting multiple linearly independent Einstein metrics, that is, metrics proportional to their Ricci curvature. Such spaces were first locally classified by Brinkmann a century ago, and globally by others in the following decades. The key to this classification was the study of spaces admitting concircular vector fields. One of the most significant developments in conformal geometry in recent decades is the introduction of the tractor calculus. Replacing the role of the Levi-Civita connection in semi-Riemannian geometry, the conformal Tractor connection provides a conformally invariant connection on the so-called conformal tractor bundle. Parallel sections of this connection correspond (almost) precisely to Einstein metrics in the conformal class. We will study the holonomy of the tractor bundle in an attempt to recover and extend the results of Brinkmann, particularly in the indefinite case.

Hadden, William. A Computationally Assisted Proof of the Kähler-Einstein Metric on the Third del Pezzo Surface.**Speaker:** William Hadden (UNSW Sydney)**Time:** Tue 14:00**Place(s):** TLC-313**Author(s):** Timothy Buttsworth, William Hadden, Ellie Heyes, Daniel Platt, Toby Wiseman

The third del Pezzo surface is known to admit a unique Kähler–Einstein metric, though no closed-form expression for this metric is known. Finding this Einstein metric amounts to solving a complex Monge–Ampère equation, for which only approximate numerical solutions have been obtained. Therefore, while we know such a metric exists, we are unable to make conclusions about relevant geometric quantities, such as the size of the first Laplacian eigenvalue. In this talk, I will present ongoing work towards proving that the true Kähler-Einstein metric is close to a certain numerical approximation, thereby allowing us to make definitive statements about the geometry of this Einstein metric. I will also discuss the prospects of applying these techniques to the study of other four-dimensional Einstein manifolds.

Hertl, Thorsten. Isotopy Versus Concordance in Positive Scalar Curvature

Speaker: Thorsten Hertl (The University of Melbourne)

Time: Tue 13:30

Place(s): TLC-313

Author(s): Georg Frenck, Thorsten Hertl

Positive Scalar Curvature (psc) metrics can be studied from the perspective of two different notions: Isotopy and Concordance. Two psc metrics are isotopic if they can be connected by a path of psc metrics, and they are concordant if there is a positive scalar curvature metric on a cylinder with the given metrics on the boundary. So far, positive scalar curvature metrics have only been studied from the perspective of isotopies in the pursuit of trying to understand the global topological properties of the space $\mathcal{R}^+(M)$ of all psc metrics on a given closed manifold M . This endeavour has been actively pursued over the last years, and it has been shown with the help of index theory that this space is highly non-trivial if the underlying manifold is spin and at least six-dimensional.

In this talk, I will study $\mathcal{R}^+(M)$ through the lens of concordances, by comparing the spaces of interest, $\mathcal{R}^+(M)$, to comparison spaces $\tilde{\mathcal{R}}^+(M)$ whose homotopy groups are concordance classes of psc metrics. This novel approach, in contrast to index theory, allows me to derive many non-triviality results of $\mathcal{R}^+(M)$ for spin and for non-spin manifolds alike.

This talk is based on ongoing joint work with Georg Frenck.

Hudecek, Stepan. Canonical Connections in (almost) Hermitian Geometry

Speaker: Stepan Hudecek (The University of Queensland)

Time: Tue 16:30

Place(s): TLC-313

Author(s): Stepan Hudecek, Kyle Broder

In Riemannian geometry there is a unique canonical connection - the Levi-Civita connection. In Hermitian geometry Gauduchon (1997) discovered a one-dimensional family of canonical connections, which attracted considerable attention. Motivated by ideas from Bryant, we have discovered a three-parameter family of canonical connections that contain the Gauduchon connections. This is a joint work with Kyle Broder.

Kwong, Kwok-Kun. Fenchel-Willmore inequality for submanifolds in manifolds with non-negative k-Ricci curvature

Speaker: Kwok-Kun Kwong (University of Wollongong)

Time: Thu 13:30

Place(s): TLC-313

Author(s): Meng Ji, Kwok-Kun Kwong

In this talk, I will prove a sharp Fenchel-Willmore inequality for closed immersed submanifolds of arbitrary dimension and codimension in a complete Riemannian manifold with non-negative intermediate Ricci curvature. In the hypersurface case, this condition reduces to non-negative Ricci curvature. The result extends relatively recent work of Agostiniani, Fogagnolo, and Mazzieri, as well as classical results of Chen, Fenchel, Willmore, and others. If time permits, I will also present an unexpected connection between this inequality and a logarithmic Sobolev inequality on submanifolds. This is joint work with Meng Ji.

Nguyen, An Ky Duy. Quadratic Killing tensors on symmetric spaces

Speaker: An Ky Duy Nguyen (La Trobe University)

Time: Tue 14:30

Place(s): TLC-313

Author(s): Kyan Nguyen

We will present some recent results on the structure of the algebra of Killing tensors on Riemannian symmetric spaces. The fundamental question (Bolsinov -Matveev-Miranda-Tabachnikov, 2018), is whether any Killing tensor field on a Riemannian symmetric space is decomposable, that is, is a polynomial in Killing vector fields. For spaces of constant curvature, the answer is in the positive, as has been known for quite some time. The same is true for the complex projective space (Eastwood, 2023). For other rank one symmetric spaces, the answer is almost always in the negative (Matveev-Nikolayevsky, 2024). We show that for several classes of symmetric spaces, all quadratic Killing tensors are decomposable. This is a joint project with my PhD supervisors Y.Nikolayevsky (La Trobe University, Australia) and V.Matveev (University of Jena, Germany).

Nikolayevsky, Yuri. Symmetric hypersurfaces in symmetric spaces**Speaker:** Yuri Nikolayevsky (La Trobe University)**Time:** Wed 16:30**Place(s):** TLC-313**Author(s):** Jihun Kim, Yuri Nikolayevsky, Ruy Tojeiro

Previously, a substantial work has been done on the study of hypersurfaces locally isometric to products of spaces of constant curvature in products of spaces of constant curvature. We complete this classification and then generalise it to a full classification of (intrinsically) locally symmetric hypersurfaces in globally symmetric spaces.

The main classification result states that any (non-product embedded) intrinsically locally symmetric hypersurface of dimension $n \geq 3$ is one of the following:

- (1) A hypersurface locally isometric to $\mathbb{CP}^2$ (respectively, to $\mathbb{CH}^2$) in the space $SU(3)/SO(3)$ (respectively, in $SL(3)/SO(3)$).
- (2) A rotational hypersurface of constant curvature in the product of a line and a space of constant curvature.
- (3) A “double-rotational” hypersurface of constant curvature in the product of two spaces of constant curvature.

We give explicit description of the embeddings in all three cases.

This is a joint work with Jihun Kim (Korea) and Ruy Tojeiro (Brasil).

Orchard, Max. Incompressible Euler fluids on Riemannian manifolds with symmetry**Speaker:** Max Orchard (The University of Queensland)**Time:** Tue 15:00**Place(s):** TLC-313**Author(s):** Max Orchard

Given a Riemannian manifold (M, g) , the Euler fluid equation is a nonlinear PDE for a time-varying vector field $u(t)$ which governs the flow of ideal (incompressible and inviscid) fluids. A common problem in the study of Euler fluids is to determine whether or not an initially smooth solution can develop a singularity in finite time. This question has been well-studied in case M is a submanifold of $\mathbb{R}^3$ and g is the Euclidean metric (e.g., Elgindi (2021) found a blowup solution in $\mathbb{R}^3$ that is initially $C^{1,\alpha}$, while Chen and Hou (2023) found a blowup solution on a periodic cylinder $B_0(1) \times \mathbb{T}^2$), but has seen comparatively little attention for more general Riemannian manifolds. In this talk, we will discuss the so-called “blow up” problem for more general Riemannian manifolds, and will demonstrate that solutions never develop finite-time singularities if the isometry group of (M, g) is large enough. This is joint work with Timothy Buttsworth.

Rajpal, Devesh. Affine Boosted Gauss Curvature Flow**Speaker:** Devesh Rajpal (Australian National University)**Time:** Wed 15:00**Place(s):** TLC-313**Author(s):** Ben Andrews, Devesh Rajpal

We introduce a modified Gauss curvature flow designed for sub-affine exponents with better convergence properties. In the sub-affine regime, a generic Gauss curvature flow is expected to not converge due to the lack of a uniform isoperimetric ratio bound. We observe that the entropy functionals associated to Gauss curvature flows are convex along the affine orbit for sub-affine powers. Exploiting this convexity, we construct a Gauss curvature flow optimized in the affine orbit with convergence properties. It also allows construction of new self-similar solutions. This is joint work with Ben Andrews.

Schrader, Philip. Curve shortening by Sobolev gradient flow**Speaker:** Philip Schrader (Murdoch University)**Time:** Fri 13:30**Place(s):** TLC-313**Author(s):** Phil Schrader

The classical curve shortening flow, or one-dimensional mean curvature flow, is the gradient descent of the length functional on curves when the gradient is taken with respect to a parametrisation invariant L^2 metric. In this talk I will discuss the gradient flows of length with respect to a family of parametrisation invariant H^1 Sobolev metrics with different degrees of homogeneity. The family of flows all turn out to be equivalent under time reparametrisations. Solutions preserve embeddedness, converge to points and appear to become round while converging, like the classical flow. But unlike the classical flow, we do not encounter singularities.

Tonegawa, Yoshihiro. Some recent regularity results on Brakke flow

Speaker: Yoshihiro Tonegawa (Institute of Science Tokyo)

Time: Thu 14:30

Place(s): TLC-313

Author(s): Yoshihiro Tonegawa

I will explain a few recent results on the regularity of Brakke flow; the end-time ϵ -regularity theorem (with Stuvard), a result of Motegi which shows that C^1 implies the strong PDE solution, and the ϵ -regularity theorem of triple junction singularity (with Stuvard), which is the parabolic generalisation of Leon Simon's regularity theorem for stationary varifold with cylindrical tangent cones.

Wu, Haotian. Asymptotic behaviour of unstable perturbations of the Fubini–Study metric in Ricci flow

Speaker: Haotian Wu (The University of Sydney)

Time: Fri 14:00

Place(s): TLC-313

Author(s): Haotian Wu

We describe numerical simulations which indicate that Ricci flow solutions originating at unstable perturbations of the Fubini–Study metric develop local Type-I singularities modelled by the FIK soliton.

Zhou, Qiyu. High codimension mean curvature flow of spacelike-convex submanifolds with one spacelike codimension

Speaker: Qiyu Zhou (The Australian National University)

Time: Wed 17:00

Place(s): TLC-313

Author(s): Ben Andrews and Qiyu Zhou

I'll discuss the recent development of the mean curvature flow of a natural analogue of convex hypersurfaces, the results include pinching estimate, noncollapsing, stability and Huisken's theorem. This is joint work with Ben Andrews.

7. Dynamical Systems and Ergodic Theory

Baake, Michael. On the long-range order of the Hat and Spectre monotile systems

Speaker: Michael Baake (Bielefeld University)

Time: Thu 15:00

Place(s): TLC-212

Author(s): Michael Baake

The recently discovered aperiodic monotiles (Hat and Spectre) define planar tilings with a specific long-range order: they are quasiperiodic, and topologically conjugate to dynamical systems with an inflation symmetry. In particular, they can be described by projection from a 4D lattice. The key properties are reviewed, and the spectra are derived. The proofs involve a combination of topological tools, the projection method, and some harmonic analysis. This is joint work with Franz Gähler, Jan Mazáč and Lorenzo Sadun.

Hammerlindl, Andy. Dynamical Incoherence in High Dimensions

Speaker: Andy Hammerlindl (Monash University)

Time: Thu 14:30

Place(s): TLC-212

Author(s): Andy Hammerlindl

In a partially hyperbolic dynamical system, the existence of a center foliation aids greatly in understanding the nature of the dynamics. I will show that for systems in dimension four and higher, there are many examples of systems for which no center foliation exists. This means that the problem of classifying partially hyperbolic systems in dimensions four and higher is significantly more complicated than the three-dimensional setting.

Leplaideur, Renaud. Limits of equilibrium states for coupled weakly interacting systems

Speaker: Renaud Leplaideur (Université de la Nouvelle Calédonie)

Time: Thu 13:30

Place(s): TLC-212

Author(s): Renaud Leplaideur

We prove that for a global system given by two independent sub-systems linked by a hole, and for a Lipschitz continuous potential, the global equilibrium state converges, as the hole shrinks, to a convex combination of the two independent equilibria in each component. Two kinds of convergence occur, depending on the assumptions on how long an orbit has to stay in each well.

As a by-product, we show that this can be applied to a geometrical system given by two piecewise expandings maps linked by a small hole and for the measure of maximal entropy.

Meyer, Jahne. Hyperbolic motion of polygons via semi-discrete linear geometric flows

Speaker: Jahne Meyer (The University of Newcastle)

Time: Tue 14:30

Place(s): TLC-415

Author(s): Jahne Meyer, James McCoy

Chow and Glickenstein introduced a semi-discrete linear analogue of the curve shortening flow for closed polygons in the plane and higher codimensions, which we previously extended to a polyharmonic curve diffusion analogue. In this talk, we explore a hyperbolic version of that framework, examining hyperbolic motion (damped and undamped) of closed polygons in $\mathbb{R}^p$. We also present a semi-discrete hyperbolic version of the Yau curvature difference flow, in which an polygonal curve evolves to any prescribed target polygon over infinite time. Comparisons between the semi-discrete parabolic and hyperbolic evolutions reveal distinctive behaviours of the hyperbolic case, including the ability to specify an intermediate polygonal configuration at a distinct time before exponential convergence to limiting state. This is joint work with James McCoy.

Oldfield, Renee. Average measure theoretic entropy for a family of expanding on average random Blaschke products

Speaker: Renee Oldfield (The University of Queensland)

Time: Tue 14:00

Place(s): TLC-415

Author(s): Cecilia González-Tokman, Renee Oldfield

We give a computable formula for the average measure theoretic entropy of a family of expanding on average random Blaschke products, generalizing work by Pujals, Roberts and Shub to the random setting. In doing so, we describe the random invariant measure and associated measure theoretic entropy for a class of admissible random Blaschke products, allowing for maps which are not necessarily expanding and may even have an attracting fixed point.

Patel, Mridul. A Fractal Analysis of Australian Migration Trends

Speaker: Mridul Patel (RMIT University)

Time: Tue 15:00

Place(s): TLC-415

Author(s): Mridul Patel, Geetika Verma, Andrew Eberhard, Asha Rao

This study examines the long-term dynamics of Australia's net overseas migration (NOM) from Sept-04 to Sept-24 and reveals a persistent time series structure, with a Hurst exponent of $H = 0.814$, indicating long-range correlations. Box-dimensional analysis shows that inclusion of major global crises elevates structural complexity: the full period yields a box dimension of 1.663, compared to 1.367 when both the Global Financial Crisis (GFC) and COVID-19 periods are excluded. Sliding-window permutation entropy (PE) (window sizes 8–20 quarters) reveals a window-invariant trough in 2020–2021 aligned with pandemic border closures, followed by a post-2022 rebound that is strong at short horizons yet stabilizes below pre-2019 complexity at longer horizons. Event-aligned magnitudes confirm this pattern: The ΔPE for GFC is positive (standardized effects 0.7–1.5), the ΔPE for COVID-19 is negative (standardized effects down to -2.1), and the ΔPE is positive for post-2022 (up to 1.7, reducing with window length). These results indicate that global shocks induce short-term structural reorganizations in migration dynamics, temporarily increasing irregularity before returning to a stable, persistent trend.

Tali, Pinsky. Heteroclinic connections in the Lorenz equations

Speaker: Pinsky Tali (Monash University)

Time: Thu 14:00

Place(s): TLC-212

Author(s): Tali Pinsky

I will show an analysis of the Lorenz equations at the parameters of the first two T-points. At these parameters there is a heteroclinic knot connecting all singular points, and removing it results in a nonsingular flow. I will prove that at these parameters the equations carry infinitely many periodic orbits. The proof goes through deforming the flow to a hyperbolic flow, through the use of two tools from two dimensional dynamics. This is joint work with Yara Hatoom.

Wechselberger, Martin. The parametrisation method and slow-fast averaging

Speaker: Martin Wechselberger (The University of Sydney)

Time: Tue 13:30

Place(s): TLC-415

Author(s): Bob Rink, Theodore Vo, Martin Wechselberger

This talk provides a rigorous and constructive connection between the classical averaging result of Pontryagin and Rodygin and the modern framework of Geometric Singular Perturbation Theory (GSPT).

By employing the *parametrisation method*, we develop a coordinate-independent and systematic procedure for computing, to any desired order of accuracy, the slow drift along a perturbation of a normally hyperbolic manifold filled with periodic orbits.

Our core contribution is a constructive proof that an averaged, skew-product dynamical system exists, which governs the dynamics on the persisting invariant manifold.

This is joint work with Bob Rink (VU Amsterdam) and Theodore Vo (Monash).

8. Equity, Diversity and Inclusion

Bunjamin, Yudhistira Andersen. Adapting outreach workshops for foreign contexts

Speaker: Yudhistira Andersen Bunjamin (UNSW Sydney)

Time: Tue 14:30

Place(s): TLC-216

Author(s): Jason Atnip, Yudhistira A. Bunjamin, Diana Combe, Sean Gardiner, Michal Jex, Ondřej Kořistka

Since 2018, a large team in the School of Mathematics and Statistics at UNSW Sydney have been working on designing several interactive mathematics outreach workshops for primary and secondary school students. These workshops are motivated by promoting mathematical thinking rather than by introducing a particular area or application of mathematics.

Over the years, the workshops have been presented almost exclusively to audiences in New South Wales. However, in 2025, the workshops were run overseas for the first time. In particular, we worked closely with a team at the Czech Technical University in Prague to enable them to run Czech versions of two of our workshops. In this talk, we will share our experience in working with the team in Prague to adapt the workshops for a Czech audience. We will reflect on the challenges that were faced in ensuring that the learning outcomes of the workshops remain accessible in a foreign context and share what we learnt about the ways that mathematics transcends culture.

Mack, Matthew. Workshop: Alt-Text for Mathematicians

Speaker: Matthew Mack (University of South Australia)

Time: Tue 14:00

Place(s): TLC-216

Author(s): Matthew Mack

Images and diagrams enhance written expression by presenting mathematical content in alternative ways. However for people that rely on screen-readers, these images require accompanying alt-text so that such people can appreciate what these images are attempting to convey.

In this workshop we'll investigate images and diagrams that pop up in more advanced areas of mathematics and in unorthodox scenarios. This is intended to be an interactive session where the audience is encouraged to submit ideas and contribute to discussion on how to describe visual ideas to people using screen readers.

This talk is inspired by a similar talk that Ashley Anderson gave to the Mathematics & Statistics Learning Centre at the University of Melbourne.

Robertson, Marcy. Panel Discussion: Equity in Mathematics Education

Speaker: Marcy Robertson (The University of Melbourne)

Time: Tue 15:00

Place(s): TLC-216

Author(s): Marcy Robertson

I will moderate a panel discussion on current issues surrounding equity in mathematics education.

Tran, TriThang. Mathematics is a human endeavour: What happens when you ask real analysis students to reflect on racism, sexism and ethics?

Speaker: TriThang Tran (The University of Melbourne)

Time: Fri 14:30

Place(s): TLC-414

Author(s): TriThang Tran

Students can often have the view that mathematics is about truth – using formal (or informal) logic to deduce fundamental truths about the universe as theorems, and their proofs. In this way, mathematics can be viewed as existing in a separate idealised world. An important part of developing as a mathematician is a recognition that there is a social element to mathematics – it is inherently a human endeavour. These ideas however, do not often make it into learning activities, and learning outcomes in mathematics subjects. I wondered then, what would happen if students were exposed to these ideas explicitly? Would this help or hinder their learning? As part of a recent Real Analysis course, I set as assignment tasks, reflective writing tasks that had students read papers, blogs, articles (and even view a play) around themes of: what constitutes good mathematical writing; mathematics is a social compact; what is progress in mathematics?; racism and sexism in mathematics; and ethics. This forms part of a continuing and broader study, which is joint work with Duffy and Kuhlmann, though this talk will focus predominantly on my reflections on my real analysis course.

Zanca, Adriana. Evaluating a Pilot Program Supporting Women, Nonbinary, Trans and Gender Diverse Students in Mathematics and Statistics

Speaker: Adriana Zanca (The University of Melbourne)

Time: Fri 15:00

Place(s): TLC-414

Author(s): Adriana Zanca, Paul Fijn, TriThang Tran, Alba Santin Garcia

The School of Mathematics and Statistics at The University of Melbourne, as part of a diversity and inclusion initiative, is piloting tutorial classes specifically for women, nonbinary, trans and gender diverse students. The tutorials are designed to address a number of reports (both internal and independent) which indicated women, nonbinary, trans and gender diverse students were (a) more likely to experience microaggressions; (b) had a reduced sense of belonging; and (c) feeling less able to participate when tutorials/groups were dominated, most commonly by men. The pilot is currently running a single tutorial in each of the three largest first-year subjects (MAST10005: Calculus 1, MAST10006: Calculus 2, and MAST10007: Linear Algebra). This work seeks to evaluate the experiences of students both in and beyond the tutorials. For students in the tutorials, effectiveness will be measured using: positive experience, increased sense of belonging, lasting impact, increased confidence, and willingness to participate in future mathematics and statistics classes, in conjunction with academic success. For other students in these subjects (not in the tutorials), effectiveness will be measured using their perceptions and attitudes towards the tutorials. In this presentation, we will share experiences of the pilot so far.

9. Financial Mathematics

Chen, Chang. A Data-Driven Neural Network Approach for Reward-Risk Portfolio Optimisation in Decumulation

Speaker: Chang Chen (The University of Queensland)

Time: Wed 16:00

Place(s): TLC-215

Author(s): Chang Chen, Duy-Minh Dang, Peter A. Forsyth

We study the portfolio optimisation problem for Defined Contribution (DC) pension plans in the decumulation phase. Our objective is to maximize expected total withdrawals while minimizing Conditional Value-at-Risk. With a data-driven neural network approach, we determine the optimal asset allocation and withdrawal amounts. We prove that the learned strategies converge to the theoretical optimal controls under mild assumptions satisfied in practice. Numerical experiments confirm the convergence and show that the neural network achieves accuracy comparable to PDE-based benchmark solutions.

Chen, Huan. Universal mimicking

Speaker: Huan Chen (Monash University)

Time: Tue 17:00

Place(s): TLC-215

Author(s): Huan Chen, Kais Hamza, Jie Yen Fan, Fima Klebaner

We are interested in constructing new martingales that share the same marginal distribution as an existing martingale. The new martingales, known as mimics of the original martingale, are preserving the prices of European vanilla options but might have different properties. In this talk, I will review some previous results on martingale mimicking and discuss martingales formed by functions of Brownian motions, which can be mimicked by changing the time of the Brownian motions.

Joint work with Kais Hamza, JieYen Fan, and Fima Klebaner.

Chen, Yuyu. Stochastic dominance for linear combinations of infinite-mean risks

Speaker: Yuyu Chen (The University of Melbourne)

Time: Thu 14:30

Place(s): TLC-215

Author(s): Yuyu Chen, Taizhong Hu, Seva Shneer, Zhenfeng Zou

In this paper, we establish a sufficient condition to compare linear combinations of independent and identically distributed (iid) infinite-mean random variables under usual stochastic order. We introduce a new class of distributions that includes many commonly used heavy-tailed distributions and show that within this class, a linear combination of random variables is stochastically larger when its weight vector is smaller in the sense of majorization order. We proceed to study the case where each random variable is a compound Poisson sum and demonstrate that if the stochastic dominance relation holds, the summand of the compound Poisson sum belongs to our new class of distributions.

Guo, Ivan. Partially Ordered Peacocks

Speaker: Ivan Guo (Monash University)

Time: Tue 15:00

Place(s): TLC-215

Author(s): Anna Aksamit, Ivan Guo, Jan Oblój

The celebrated Kellerer's Theorem asserts that one can embed a peacock (PCOC, or measures in increasing convex order) with a Markovian martingale that attains the measures as marginals. This is a fundamental result underpinning martingale optimal transport, mimicking of martingales, and Skorokhod's embedding, with applications in mathematical finance. We consider the problem of embedding a family of measures in partial increasing convex order (a partially ordered peacock), with a martingale that attains them at stopping times constrained by the same partial ordering. In general, such embeddings do not always exist, and even simple cases can exhibit non-trivial interactions. By focusing on the subclass of "minimum-preserving" optimal embeddings, where the embedding extends to the lower semilattice completion of the measures, we will provide necessary and sufficient conditions for their existence. We will also present a convex-concave decomposition of measure pairs, as well as geometric characterisations of such embeddings.

Macrina, Andrea. Arcade Processes for Informed Martingale Interpolation

Speaker: Andrea Macrina (University College London)

Time: Tue 14:00

Place(s): TLC-215

Author(s): Georges Kassis and Andrea Macrina

Arcade processes are a class of continuous stochastic processes that interpolate in a strong sense, i.e., omega by omega, between zeros at fixed pre-specified times. Their additive randomisation allows one to match any finite sequence of target random variables, indexed by the given fixed dates, on the whole probability space. The randomised arcade processes (RAPs) can thus be interpreted as a generalisation of anticipative stochastic bridges. The filtrations generated by these processes are utilised to construct a class of martingales that interpolate between the given target random variables. These so-called filtered arcade martingales (FAMs) are almost-sure solutions to the martingale interpolation problem and reveal an underlying stochastic filtering structure. In the special case of conditionally Markov randomised arcade processes, the dynamics of FAMs are informed by Bayesian updating. Several explicit examples for RAPs and FAMs are provided and simulated. Aside from considering the problem of building an asset price process that matches a term structure of option prices, or the development of interest rate dynamics that interpolates in-between rate-setting decisions by monetary policy committees, an exciting avenue leads to net zero climate finance. While the carbon emissions net zero target has been set for 2050, there is considerable uncertainty about what the realized emissions will amount to, eventually. We shall discuss carbon emission targets modelled by a discrete sequence of random variables, and the construction of RAPs which generate interpolating trajectories towards the uncertain 2050 net zero target.

Nam, Kihun. What does no-arbitrage condition tells about PDEs?

Speaker: Kihun Nam (Monash University)

Time: Wed 14:00

Place(s): TLC-215

Author(s): Kihun Nam, Yunxi Xu

In this talk, we establish necessary and sufficient conditions under which a function transforms a continuous Markov semimartingale into a semimartingale. This characterisation implies, via the no-arbitrage principle, that continuously evolving asset prices must be “differentiable” in a weak sense with respect to the underlying noise whenever the driving process is a continuous Markov semimartingale.

Combining these results with techniques from forward-backward stochastic differential equations, we further prove existence and uniqueness results for semilinear parabolic PDEs with measurable—possibly discontinuous—coefficients. This is joint work with Yunxi Xu.

Platen, Eckhard. Information-Minimizing Stationary Financial Market Dynamics

Speaker: Eckhard Platen (University of Technology, Sydney)

Time: Tue 14:30

Place(s): TLC-215

Author(s): Eckhard Platen

The talk derives the dynamics of a financial market from basic mathematical principles. It models the market dynamics using independent stationary scalar diffusions, assumes the existence of its growth optimal portfolio (GOP), interprets the market as a communication system, and minimizes, in an information-theoretical sense, the joint information of the risk-neutral pricing measure with respect to the real-world probability measure. In this information-minimizing market, its basic independent securities, their sums, minimum variance portfolio, and GOP, as well as the GOP of the entire market, represent squared radial Ornstein-Uhlenbeck processes with additivity and self-similarity properties.

Shiyamasuntharam, Kajanthan. An ADI Approach with Coordinate Transformation for Pricing American Options on Coupon Bonds under a Stochastic-Volatility Vasicek Model

Speaker: Kajanthan Shiyamasuntharam (University of Wollongong)

Time: Wed 17:00

Place(s): TLC-215

Author(s): Kajanthan Shiyamasuntharam and Xiaoping Lu

In this study, we develop a numerical approach for pricing American options on coupon-paying bonds under the Vasicek interest rate model with stochastic volatility. Unlike options on stocks, bond option pricing requires solving both the partial differential equations (PDEs) for the underlying bond price and for the option itself. The correlation between the short interest rate and stochastic volatility introduces a mixed-derivative term in the governing PDEs, which can pose challenges for numerical solution schemes. To address this, we introduce a global coordinate transformation to eliminate the mixed-derivative term and then apply the Alternating

Direction Implicit (ADI) finite difference scheme with the Thomas algorithm to solve the PDEs numerically, thereby improving both the efficiency and stability of the solution process. Numerical experiments demonstrate the effectiveness of our enhanced ADI approach and illustrate the properties of American options on continuously coupon-paying bonds under the Vasicek model with stochastic volatility.

Tai, Ho Man. Incentives of Defined-Contribution Pension Managers

Speaker: Ho Man Tai (The University of Sydney)

Time: Wed 15:00

Place(s): TLC-215

Author(s): Paolo Guasoni, Bohan Li, Ho Man Tai, Tak Kwong Wong and Sheung Chi Phillip Yam

This talk discusses the implications of asset management fee structures for defined-contribution pension funds. We develop a model where a manager with intertemporal preferences invests pension contributions over members' working lives. Contrary to typical risk-shifting behaviors documented in the literature, we find that managers with the same preferences as plan members take less risk than plan members would choose for themselves. This result is due to the consumption-smoothing motive and the misalignment arising from calculating fees as a proportion of current assets rather than total wealth. Our findings reveal an overlooked aspect of delegated portfolio management and underscore the significance of intertemporal utility in pension fund management. We establish the well-posedness of the value function and the optimal trading strategy through the corresponding fully nonlinear Hamilton–Jacobi–Bellman equation; we also develop an efficient numerical scheme to approximate the solutions, overcoming the challenges associated with its non-linearity and unbounded domain.

Yamazaki, Kazutoshi. Nonzero-sum optimal stopping game with continuous vs. periodic exercise opportunities

Speaker: Kazutoshi Yamazaki (The University of Queensland)

Time: Thu 15:00

Place(s): TLC-215

Author(s): José Luis Pérez, Neofytos Rodosthenous and Kazutoshi Yamazaki

We introduce a new nonzero-sum game of optimal stopping with asymmetric exercise opportunities. Given a stochastic process modeling the value of an asset, one player observes and can act on the process continuously, whereas the other player can act on it only periodically at independent Poisson arrival times. The first one to stop receives a reward, different for each player, whereas the other one gets nothing. We study how each player balances the maximization of gains against the maximization of the likelihood of stopping before the opponent. In such a setup driven by a Lévy process with positive jumps, we not only prove the existence but also explicitly construct a Nash equilibrium with values of the game written in terms of the scale function. Numerical illustrations with put-option payoffs are also provided to study the behavior of the players' strategies as well as the quantification of the value of available exercise opportunities.

Yang, Zhao. Analytically pricing commodity futures options with seasonality and stochastic liquidity risks

Speaker: Zhao Yang (University of Wollongong)

Time: Tue 16:30

Place(s): TLC-215

Author(s): Zhao Yang

In this study, an enhanced pricing framework for commodity derivatives is developed by extending the conventional two-factor model to incorporate seasonal effects and liquidity risk. The main theoretical contribution lies in deriving a tractable semi-analytical pricing solution under this generalized specification—a result achieved through a carefully structured modeling approach and the application of advanced analytical methods. The solution significantly improves computational efficiency over Monte Carlo simulations, while preserving high pricing accuracy.

Zhang, Xinyi. American Parisian-type Stock Loan

Speaker: Xinyi Zhang (University of Wollongong)

Time: Tue 16:00

Place(s): TLC-215

Author(s): Xinyi Zhang and Xiaoping Lu

A stock loan is a financial contract that allows a borrower to obtain a loan from a lender using stocks as collateral. Various types of stock loans exist. In this study, we study Parisian-type stock loans. The Parisian feature protects the lender when the stock value declines and remains below a certain level for a specified period, while also preventing an immediate one-touch knock-out for the borrower.

The mechanism of stock loans has been shown to resemble that of American call options, as both the borrower in a stock loan and the holder of an American call derive their value from the underlying stock and may exit

the contract or exercise their right to buy the stock before maturity. We show that an American Parisian-type stock loan can be formulated as a special case of an American-style Parisian down-and-out call option, which is solved using an integral equation approach.

Numerical examples are presented to illustrate the effects of various parameters on the value of the stock loan, the service fee, and—most importantly—the optimal exit price.

Zhang, Zhao. Enhancing PINNs with Martingale Supervision for Efficient High-Dimensional Option Pricing

Speaker: Zhao Zhang (University of Wollongong)

Time: Wed 16:30

Place(s): TLC-215

Author(s): Zhao Zhang, Xiaoping Lu

Physics-Informed Neural Networks (PINNs) are a well-established class of machine learning algorithms for solving problems governed by partial differential equations (PDEs). PINNs have broad applications across various domains, including financial mathematics. However, training PINNs presents several challenges, such as slow convergence, high computational cost, and reduced accuracy in high-dimensional settings. To address these limitations, numerous variants of PINNs have been proposed. In this work, we introduce an extension of PINNs by introducing a martingale supervision term into the loss function. This additional constraint, derived from the Feynman-Kac representation, serves as an effective variance reduction mechanism. Numerical experiments demonstrate that our martingale-augmented PINN (M-PINN) offers an efficient framework for solving high-dimensional PDEs, particularly in the context of high-dimensional option pricing.

Zhu, Zili. Using Large Data to Uncover Causal Interrelationships between Economic Indicators

Speaker: Zili Zhu (CSIRO)

Time: Thu 14:00

Place(s): TLC-215

Author(s): Htoo Wai Aunga, Zili Zhu, Geoffrey Lee, Ying Guo, Jiaming Li

In this study, by using historical data and without relying on any prior economic knowledge, we apply a Peter-Clark (PC) framework to automatically generate causal interrelationship between key economic indicators in Australia. Such a data-driven approach is suitable for identifying the ever-changing inter-relationships between economic parameters that are difficult to discern qualitatively and quantitatively. The PC framework is extended to incorporate time-lag in the interrelationship structure. The causal relationship revealed about major economic indicators such as CPI, interest rates and housing index can assist in formulating more effective and timelier economic and monetary policies and strategies. Temporal causal interrelationship maps offer actionable insights, and hierarchical causal graphs derived provide interpretable network structures into a complex economic landscape.

10. General Session

Bilchouris, Adam. Nonparametric Estimation of the Autocovariance Function

Speaker: Adam Bilchouris (La Trobe University)

Time: Tue 16:00

Place(s): TLC-317

Author(s): A.Bilchouris, A.Olenko (La Trobe University)

The estimation of the autocovariance function is an important statistical problem in time series and spatial analysis. Many widely used nonparametric estimators have surprising drawbacks which are not always considered when applying them, such as bias, positive-definiteness and constant summation effects. Several nonparametric estimators and their properties will be discussed, alongside their potential drawbacks. Those nonparametric estimators were implemented in the R package, CovEsts. The package provides several nonparametric estimators of the autocovariance function through a unified interface and output. The package also includes methods for bootstrap confidence intervals, estimator transforms, estimator corrections, and several metric functions to compare obtained estimates. In this presentation, we discuss theoretical and methodological approaches and demonstrate their computational applications using the R package CovEsts and some real and simulated data. [1] Bilchouris, A. and Olenko, A. (2025). On Nonparametric Estimation of Covariogram. *Austrian Journal of Statistics*, 54(1), 112–137. [2] Bilchouris, A. and Olenko, A. (2025). CovEsts: Nonparametric Autocovariance Estimation and Analysis. Submitted.

Kumaranathunga, Udara. Meta-Analysis of Quantiles and Functions of Quantiles with Applications to Diabetes

Speaker: Udara Kumaranathunga (La Trobe University)

Time: Tue 16:30

Place(s): TLC-317

Author(s): Udara S Kumaranathunga, Luke Prendergast, Jonathan E Shaw and Alysha M De Livera

Meta-analysis of continuous outcomes has traditionally relied on methods that use moment-based statistical measures such as means and standard deviations. However, it is found that in practical scenarios, outcome measures are often skewed. Diabetes-related biomarkers, such as triglycerides, urinary albumin, and albumin-to-creatinine ratio (ACR) are several examples among many that commonly display skewed underlying distribution. For such skewed outcome measures, we introduce meta-analyses of medians, other quantiles, and functions of quantiles to comprehensively synthesise information. We consider commonly reported scenarios of quantiles, (minimum, first quartile, median, third quartile, maximum) with sample sizes. Within a novel density-based framework, without making any prior assumptions about the underlying distributions, we use flexible quantile-based distributions with percentile matching to estimate the unknown parameters. We conduct simulation studies to evaluate the approaches and present results for varying number of studies, study sizes, distributions of the outcome measures, and heterogeneity. Together with the simulation results, we report results from an empirical study of meta-analysis of quantiles and interquartile range widths, using real-world data from the Australian Diabetes, Obesity, and Lifestyle (AusDiab) study. We further present our CRAN-based R package (metaquant), which contains the necessary code for straightforward implementation of the introduced approaches.

Liyanage, Jayamini. Meta-Analysis of High-Dimensional Data

Speaker: Jayamini Liyanage (La Trobe University)

Time: Tue 17:00

Place(s): TLC-317

Author(s): Jayamini C. Liyanage, Luke Prendergast, and Alysha M. De Livera

Meta-analysis of high-dimensional data, such as those in omics, have focused on synthesizing quantitative evidence from studies reporting multiple effect sizes across several correlated outcomes. A challenge for researchers is that there is often a large number of variables of interest, and hence this high-dimensional setting needs further attention above and beyond what is traditionally considered for multivariate meta-analysis. We have previously introduced a multivariate meta-analysis model for high-dimensional metabolomics data (MetaHD), which accommodates the correlation between metabolites, within- and between-study variances, and missing values. MetaHD however, is limited by its computational cost when applied to other omics fields with higher dimensionality. In this work we introduce fastMetaHD- a memory-efficient, fast version of MetaHD, and compare traditional and more recent meta-analysis methods, evaluating their relative strengths, limitations, and applicability across various high-dimensional contexts. Through a combination of simulation studies and multiple diverse real-world omics datasets, we assess performance in terms of true positive rate, false positive rate, area under the receiver operating curve, false discovery rate, top-ranked fraction, root-mean-square error, and

computational efficiency. Based on the findings, we offer practical guidance for selecting appropriate meta-analysis methods depending on research questions and data at hand, thereby making reliable high-dimensional meta-analysis approaches more accessible to applied researchers.

Mansfield, Daniel Francis. Area of a Segment in Ancient Mesopotamia

Speaker: Daniel Francis Mansfield (University of New South Wales)

Time: Wed 17:00

Place(s): TLC-317

Author(s): Daniel Mansfield

We discuss artifacts from Mesopotamia which show how the relationship between arc length and the area of a segment was understood in ancient times. That the area of a segment was understood at all is surprising, since the concept of angle had not yet developed.

This talk is suitable for a general audience.

Marshall, Simon. Some Novel Applications of Matrices in Spherical Trigonometry

Speaker: Simon Marshall (Retired)

Time: Fri 13:30

Place(s): TLC-414

Author(s): Simon L. Marshall

The emphasis in traditional developments of spherical trigonometry is on the application of the cosine and sine rules, and their rearrangements in the form of various product identities, to the determination of the sides and internal angles of triangles. Much less attention has typically been devoted to problems in which it is desired to find the coordinates (spherical polar or Cartesian) of the vertices, which arise in a variety of practical contexts. Modern treatments differ most significantly in the identification of the vertices as vectors, to which various concepts and operations of linear algebra - such as scalar and vector products, reciprocal bases, and multiplication by matrices - can be applied. In this paper, some apparently novel applications of rotation matrices in spherical trigonometry are described, leading to compact and efficient solutions of triangles. Applications of these matrix methods to problems in geodesy and celestial navigation are described.

Nurse, Stephen. From 1d to 3d with craft sticks

Speaker: Stephen Nurse (Unaffiliated)

Time: Fri 14:00

Place(s): TLC-414

Author(s): Stephen Nurse

This talk is about using craft sticks and 3d printed jigs to make frames for use as platonic solid sides. By joining the frames all the platonic solids can be made. As well as making interesting, sizeable constructions (up to 70cm in diameter), making the solids teaches manual skills, strength of materials, geometric calculations, symmetry and number type. Techniques include making truncated polyhedra, and using a jig to make compatible radial- and reflection- symmetrical frames. The creations use only craft sticks and drinking straws. 3d printed jigs and fold back clips are used in construction, and glue is optional. The talk demonstrates a creative, inexpensive use of everyday mathematics.

Sumner, Jeremy. Towards a representation theory of Lie-Markov semigroups: motivations and examples

Speaker: Jeremy Sumner (University of Tasmania)

Time: Wed 16:00

Place(s): TLC-317

Author(s): Jeremy Sumner and Kiah Swinsburg

While there are several prior works establishing important links between Markov chain theory and various algebraic structures, there does not currently exist a comprehensive representation theory for non-commutative Markov semigroups (analogous to the well-developed representation theory of Lie groups). In this talk I will provide our motivations for developing such a theory and walk through a few compelling examples motivated from biological applications and elsewhere.

This is a companion talk to Kiah Swinsburg's talk with the same title.

Swinsburg, Kiah. Towards a representation theory of Lie-Markov semigroups

Speaker: Kiah Swinsburg (University of Tasmania)

Time: Wed 16:30

Place(s): TLC-317

Author(s): Kiah Swinsburg and Jeremy Sumner

Recent developments have highlighted deep connections between Markov chains and various algebraic structures. In particular, the dynamics of inhomogeneous Markov chains—where transition rates evolve over time—are encoded in the Lie algebraic properties of the associated sequence of Markov matrices. In this talk we will expound on this connection, focusing on algebraic analogies between otherwise dissimilar Markov process. To this end we present initial steps toward a representation theory for Lie-Markov semigroups, aiming to unify the analysis of seemingly disparate Markov processes.

11. Groups, Actions and Computation

Carter, Max. Non-Wiener totally disconnected locally compact groups

Speaker: Max Carter (Université Catholique de Louvain)

Time: Wed 15:00

Place(s): TLC-414

Author(s): Max Carter and Jared T. White

It is a classical result of Norbert Wiener in Fourier analysis, known as “Wiener’s Tauberian theorem”, that a function $f \in L^1(\mathbb{R}^d)$ generates a dense ideal if and only if the Fourier transform of f vanishes nowhere. More generally, every locally compact group has a Fourier transform and one can ask whether it satisfies an analogue of Wiener’s Tauberian theorem. Groups which have a Fourier transform satisfying an analogous property are called *Wiener groups*.

It is a classical question in harmonic analysis to determine which groups are Wiener. This question has been studied extensively for connected locally compact groups and discrete groups. It is known, for example, that all nilpotent locally compact groups and compactly generated groups of polynomial growth are Wiener.

In this talk, I will discuss recent work of myself and Jared White which shows that many non-discrete totally disconnected locally compact (tdlc) groups are not Wiener. We show that as soon as a tdlc group acts sufficiently transitively on a suitable graph/building, then it cannot be Wiener. We also produce some example of non-Wiener solvable tdlc groups, modelling some arguments from the classical Lie-theoretic setting.

Chijoff, Marcus. Determining Properties of (P)-closed Groups Acting On Trees Using Local Action Diagrams

Speaker: Marcus Chijoff (The University of Newcastle)

Time: Wed 17:00

Place(s): TLC-414

Author(s): Marcus Chijoff, Michal Ferov, Stephan Tournier

Recently Reid-Smith parametrised all closed groups acting on trees with Tits’ Property (P). They did this with relatively simple combinatorial objects called local action diagrams. Properties of the original group can be determined from its associated local action diagram. We have shown how a group being discrete, uniserial, unimodular, and the scale values of the group can be determined from its associated local action diagram and implemented these results in the computer algebra system GAP.

Giudici, Michael. Multiplication groups of loops

Speaker: Michael Giudici (The University of Western Australia)

Time: Thu 15:00

Place(s): TLC-414

Author(s): Michael Giudici

A loop is a set Q with a binary operation whose multiplication table is a latin square and there is an identity element. Right multiplication by an element gives a permutation of Q and similarly for left multiplication. The permutation group generated by the set of all the left and right multiplication maps is called the multiplication group of the loop. Moreover, a loop is simple if and only if the multiplication group is primitive. This raises the question of which primitive permutation groups can be the multiplication group of a loop. In this talk I will discuss some recent work with Michael Kinyon which looks at which actions of the symmetric and alternating groups can be the multiplication group of a loop.

Hafidh, Yusuf. Perfect r -codes in circulant graphs

Speaker: Yusuf Hafidh (The University of Melbourne)

Time: Wed 14:30

Place(s): TLC-414

Author(s): Yusuf Hafidh, Binzhou Xia, Sanming Zhou

A perfect r -code in a graph G is an independent set C such that every vertex in $V(G) \setminus C$ is at distance at most r from a unique vertex in C . I will first discuss a “general” form for perfect 1-codes in circulant graphs (Cayley graphs over a cyclic group). Almost all known perfect 1-codes in circulant graphs are special cases of this general form. This form also characterizes several new families of circulant graphs that admit a perfect 1-code and classifies all such codes. I will also discuss perfect r -codes in circulant graphs with small degrees d , specifically for the parameters $(r, d) = (2, 3)$, $(2, 4)$, and $(2^l, 3)$.

Heng, Edmund Xian Chen. Hyperplane arrangements and normalisers of parabolics in Coxeter groups

Speaker: Edmund Xian Chen Heng (The University of Sydney)

Time: Thu 14:30

Place(s): TLC-414

Author(s): Owen Garnier, Edmund Heng, Oded Yacobi, Tony Licata

Coxeter groups and hyperplane arrangements are closely related to one another. The aim of this talk is to present a similar story for the normalisers of parabolic subgroups of Coxeter groups. The arrangements in play are certain intersection arrangements known as the Tits cone intersections, which came from the study of 3-fold flops from algebraic geometry. Nonetheless, I will show how these hyperplane arrangements provide geometric realisations of the groupoids introduced by Brink and Howlett in their Inventiones paper that describes normalisers of parabolic subgroups.

Howie, Joshua. Lambda lengths in link complements

Speaker: Joshua Howie (Monash University)

Time: Tue 14:30

Place(s): TLC-317

Author(s): N Harif, J Howie, C Hui, D Ibarra, D Mathews, L Su.

Mathews showed that there is an $SL_2(\mathbb{C})$ -equivariant correspondence between nonzero spinors and decorated horospheres in hyperbolic 3-space. Lambda lengths measure geodesic segments between horospheres and can be calculated using a bilinear form on spinors. We study the actions of link groups on horospheres and on spinors to understand the set of lambda lengths in link complements. Associated to each hyperbolic 3-manifold is a number field called the trace field. We show that the set of lambda lengths in several arithmetic link complements is the ring of integers in their trace field, up to multiplication by a unit. We also consider some non-arithmetic cases.

Koenig, Joachim. Monodromy groups of polynomials and reducibility behavior of variable-separated equations

Speaker: Joachim Koenig (Korea National University of Education)

Time: Thu 13:30

Place(s): TLC-414

Author(s): Angelot Behajaina, Joachim Koenig, Danny Neftin

The so-called Davenport-Lewis-Schinzel problem, going back to around 1960, asks to classify pairs of complex polynomials (f, g) such that the bivariate polynomial $f(X) - g(Y)$ is reducible. While the question is of an arithmetic nature, the tools to answering it come mainly from permutation group theory and combinatorics, via analyzing monodromy groups of polynomials. Previously, only the case of indecomposable polynomials (corresponding to the case of primitive monodromy groups) was solved, due to work of Fried from the 1970s. The general case was previously inaccessible due to the more obscure structure of imprimitive monodromy groups. Developing and using far-reaching new results on the structure of such groups (while also relying on somewhat extensive computer calculations dealing with groups of low permutation degree), we solve the problem in full, showing in particular that all “non-trivial” examples of reducible pairs (f, g) derive (either from a well-known example in degree 4, or) from Fried’s indecomposable examples. Joint with Angelot Behajaina and Danny Neftin.

Kwashira, Rugare. Central automorphisms in n -abelian groups

Speaker: Rugare Kwashira (University of the Witwatersrand)

Time: Thu 14:00

Place(s): TLC-414

Author(s): Rugare Kwashira

Let $n = 2l + 1$ be a positive integer, where l is an odd integer, and let G_l be a non-commutative n -abelian group. We describe the central automorphisms in this class of non-commutative n -abelian groups. We explore the central automorphism group of pullbacks involving groups of the form G_l . We extend our study to central automorphisms of groups G , in which the map $f : x \mapsto x^n$ is an automorphism. We show that, for such groups, the group of central automorphisms that fix the center element-wise can be described through $\text{Hom}(G/M, Z(G))$, the group of homomorphisms from the quotient group G/M onto the center $Z(G)$ where, M is normal in G and M is a maximal subgroup such that G/M is abelian. We show that the group of central automorphisms of G , that fix the center element-wise is isomorphic to the cyclic group of order p .

Onn, Uri. Spectral Equivalence of p -Groups and the Larsen–Lubotzky Conjecture

Speaker: Uri Onn (Australian National University)

Time: Tue 13:30

Place(s): TLC-317

Author(s): Uri Onn

The representation growth of a group is the sequence enumerating the number of irreducible representations of a given dimension. Larsen and Lubotzky conjectured that the degree of polynomial representation growth rate of irreducible lattices in higher-rank semisimple Lie groups depends only on the ambient group and not on the lattices. In this talk, I will describe a framework relating this conjecture to spectral equivalence of certain families of p -groups.

Piggott, Adam. New constructions of free products and geodetic Cayley graphs

Speaker: Adam Piggott (Australian National University)

Time: Wed 16:30

Place(s): TLC-414

Author(s): Joshua Abraham, Murray Elder, Adam Piggott, Kane Townsend

We introduce a systematic method for constructing new presentations of free products that give rise to previously unknown geodetic Cayley graphs. This framework provides new infinite families of geodetic Cayley graphs and extends the toolkit for investigating long-standing conjectures on geodetic groups.

Pisani, Anthony. The Saxl hypergraph of a permutation group

Speaker: Anthony Pisani (Monash University)

Time: Wed 16:00

Place(s): TLC-414

Author(s): Melissa Lee, Anthony Pisani

A *base* for a permutation group $G \leq \text{Sym}(\Omega)$ is a subset B of Ω with trivial pointwise stabiliser in G ; the minimum cardinality of a base is termed the *base size* $b(G)$ of G . In the notable case $b(G) = 2$, Burness and Giudici introduce the *Saxl graph* of G , the graph on Ω with 2-point bases as edges. Freedman et al. later generalise this concept to groups for which $b(G) > 2$, taking as edges the 2-element subsets of $b(G)$ -element bases. In this talk, we consider properties of an alternative generalisation, the *Saxl hypergraph* (where edges are the bases of size $b(G)$ themselves), including the groups with complete Saxl hypergraphs and analogues of a striking conjecture of Burness and Giudici. This is joint work with Melissa Lee.

Reid, Colin David. Commensurators of free groups and free pro- p groups

Speaker: Colin David Reid (Western Sydney University)

Time: Tue 14:00

Place(s): TLC-317

Author(s): Y. Barnea, M. Ershov, A. Le Boudec, C. D. Reid, M. Vannacci and Th. Weigel

The commensurator of a group is a group that encapsulates (up to a suitable equivalence) all isomorphisms between finite index subgroups of the group. We study the commensurator of a free group F and of a free pro- p group, and also the p -commensurator of F (which is the subgroup of the commensurator that respects the pro- p topology on F), with a focus on normal subgroup structure, especially identifying simple subgroups.

Trivedi, Vandit. A generating set for the commutator subgroup of a twisted right-angled Artin group

Speaker: Vandit Trivedi (Australian National University)

Time: Wed 14:00

Place(s): TLC-414

Author(s): Vandit Trivedi

A twisted right-angled Artin group (T-RAAG) is defined by a mixed graph, which is obtained from a simple undirected graph by choosing some edges to be directed. The presence of directed edges distinguishes T-RAAGs from right-angled Artin groups (RAAGs) by introducing a twisted relation between pairs of generators. We discuss the conditions on a mixed graph under which the commutator subgroup of a T-RAAG is finitely generated and those under which the commutator subgroup has finite index in the T-RAAG. We obtain a generating set for the commutator subgroup of a T-RAAG and conjecture that it is minimal.

Zhang, Chuanqi. Diffie–Hellman Key Exchange from Commutativity to Group Laws

Speaker: Chuanqi Zhang (University of Technology Sydney)

Time: Tue 15:00

Place(s): TLC-317

Author(s): Dung Hoang Duong, Youming Qiao, and Chuanqi Zhang

In Diffie–Hellman key exchange, the commutativity of power operations is instrumental in the agreement of keys. Viewing commutativity as a law in abelian groups, we propose Diffie–Hellman key exchange in the group action framework (Brassard–Yung, *Crypto*’90; Ji–Qiao–Song–Yun, *TCC*’19), for actions of non-abelian *groups with laws*. The security of this protocol is shown, following Fischlin, Günther, Schmidt, and Warinschi (*IEEE S&P*’16), based on a pseudorandom group action assumption. A concrete instantiation is proposed based on the monomial code equivalence problem.

12. Harmonic Analysis and Hamiltonian PDE

Bandara, Lashi. Harmonic analysis and boundary trace for first-order elliptic operators over vector bundles

Speaker: Lashi Bandara (Deakin University)

Time: Tue 13:30

Place(s): TLC-414

Author(s): Christian Bär, Lashi Bandara

Real-variable harmonic analysis techniques have recently been used to understand the maximal domain of first-order elliptic operators in smooth geometric contexts in terms of boundary data. Distilled from the seminal work of Atiyah-Patodi-Singer on their index theorem and based on extensions by Bär-Ballmann to characterise the maximal domain of Dirac-type operators, modern harmonic analysis techniques have made it possible to study the non-compact boundary case and to fully dispense with the Dirac-type assumption when the boundary is compact. These results will be explained with a focus on these techniques and the way in which they pave the path to study non-smooth boundary.

Bernhardt, Louie. Stability of solutions to the Einstein equations undergoing decelerated expansion

Speaker: Louie Bernhardt (The University of Melbourne)

Time: Tue 16:00

Place(s): TLC-414

Author(s): Louie Bernhardt

In this talk I will discuss recent work on the stability problem for cosmological solutions to the Einstein equations undergoing decelerated expansion. One mechanism by which decelerated expansion occurs in general relativity is by coupling the Einstein equations to a nonlinear scalar field with an exponential potential. This system admits Friedmann-Lemaître-Robertson-Walker solutions undergoing decelerated expansion, with $\mathbb{T}^3$ spatial topology and scale factor $a(t) = t^p$ for $1/3 < p < 1$. I will present a new result which establishes future-stability of these FLRW solutions with expansion exponent $p \in (2/3, 1)$, as solutions to the Einstein-nonlinear scalar field system. More specifically, solutions to the ENSF system with initial data close to FLRW data are geodesically complete to the future, and remain close to the FLRW spacetime for all time. I will discuss the key ideas behind the proof of this statement, as well as the long-time dynamics of the perturbed solutions.

Dearricott, Owen. Edge-cone singularities on anti-self-dual Einstein spaces in dimension four and 3-Sasakian spaces in dimension seven

Speaker: Owen Dearricott (La Trobe University)

Time: Wed 16:30

Place(s): TLC-412

Author(s): Owen Dearricott

Atiyah and Le Brun describe the notion of edge-cone spaces as mildly singular spaces that are smooth Riemannian manifolds everywhere, but for a codimension two submanifold where the metric has a transnormal polar coordinate system for that allows for a cone angle about the singularity other than 360 degrees.

In this talk we display some explicit edge-cone anti-self-dual Einstein metrics in dimension four and explain the restrictive behaviour this places on edge-cone metrics that occur on the seven dimensional 3-Sasakian spaces canonically associated with them.

Doll, Moritz. Microlocal analysis of the Klein-Gordon equation

Speaker: Moritz Doll (Macquarie University)

Time: Wed 14:30

Place(s): TLC-412

Author(s): Dean Baskin, Moritz Doll, Jesse Gell-Redman

We consider the Klein-Gordon equation on asymptotically Minkowski space with a class of space-time potentials that decay sufficiently fast in spatial directions and approach a limiting potential as $t \rightarrow \infty$. Building on previous work of Vasy for many-body scattering problems, we show that the Klein-Gordon operator admits a description as a non-elliptic Fredholm operator as a map between anisotropic Sobolev spaces. We prove the global existence of both the causal propagators as well as the Feynman propagator.

The talk is based on joint work with Dean Baskin and Jesse Gell-Redman

Forlano, Justin. The intermediate nonlinear Schrödinger equation**Speaker:** Justin Forlano (Monash University)**Time:** Fri 17:00**Place(s):** TLC-412**Author(s):** Justin Forlano

In this talk, I will discuss recent results regarding the intermediate nonlinear Schrödinger equation (INLS). Analytically speaking, INLS is a completely integrable nonlinear Schrödinger equation with a cubic derivative nonlinearity and is L^2 -critical. A limiting form of INLS is the continuum Calogero-Moser equation (CCM), which is also completely integrable. Interestingly, CCM keeps the Hardy space L^2_+ invariant and, under this assumption, tools from complete integrability have recently resolved the well-posedness problem for CCM in L^2_+ . I will discuss progress on the well-posedness for INLS and CCM (not relying on complete integrability), outside of the Hardy space and in low-regularity. Our approach combines a gauge transformation, bilinear Strichartz estimates and a refined decomposition for smooth solutions. This is based on joint work with A. Chapouto (CNRS, UVSQ) and T. Laurens (UW-Madison).

Gell-Redman, Jesse. Propagators for evolution equations**Speaker:** Jesse Gell-Redman (None)**Time:** Fri 16:30**Place(s):** TLC-412**Author(s):** Jesse Gell-Redman

I will discuss some work related to the construction of global spacetime propagators for wave equations.

Godfried, Emanuel. Mean first escape times on asymptotically hyperbolic surfaces**Speaker:** Emanuel Godfried (AMSI/University of Melbourne)**Time:** Tue 14:00**Place(s):** TLC-414**Author(s):** Joint work with: Jesse-Gell Redman, Justin Tzou & Leo Tzou

Calculating the mean escape time of a random particle confined to a domain through a small window is a well-known problem in molecular biology. Mathematically, the mean first escape time of a Brownian particle is modelled by an elliptic boundary value problem with mixed boundary conditions depending on some parameter ϵ approaching 0. The goal is to provide the asymptotics of the solution u_ϵ of the boundary value problem as the parameter ϵ approaches 0. Difficulty comes from the need to find the asymptotics of the full Cauchy data of the solutions u_ϵ . In this talk we discuss the mean first escape time of Brownian motion on asymptotically hyperbolic surfaces. We show using boundary layer techniques, that the mean first escape time $u_\epsilon(x)$ satisfies the estimate $u_\epsilon(x) \sim -\log \epsilon$ as $\epsilon \rightarrow 0$ for each fixed $x \in M$.

Huo, Xuejing. New endpoint estimates for certain singular integrals with non-smooth kernels**Speaker:** Xuejing Huo (Macquarie University)**Time:** Tue 16:30**Place(s):** TLC-414**Author(s):** Xuejing Huo

Let L be a closed, densely defined operator of type ω in $L^2(\mathbb{R}^n)$, with $0 \leq \omega < \pi/2$, satisfying certain heat kernel upper bounds. In this paper, we will discuss new endpoint estimates for singular integrals associated with L , such as the vertical square function and spectral multipliers of Laplace transform type. As applications, we obtain new endpoint estimates for singular integrals associated with the Hardy operators and the Kolmogorov operators.

Jia, Qiuye. Non-relativistic limit of Klein-Gordon equations in curved spacetimes**Speaker:** Qiuye Jia (The Australian National University)**Time:** Wed 15:00**Place(s):** TLC-412**Author(s):** Andrew Hassell, Qiuye Jia, Ethan Sussman, Andras Vasy

We introduce a robust second-microlocalization framework for analyzing the non-relativistic limit of Klein-Gordon equations with time-dependent coefficients.

Roughly speaking, the second-microlocalization means constructing a phase space that is suitable for the multi-scale analysis appearing in the non-relativistic limit.

Liu, Jiakun. Global $C^{1,\alpha}$ regularity for Monge-Ampère equations

Speaker: Jiakun Liu (The University of Sydney)

Time: Tue 17:00

Place(s): TLC-414

Author(s): Jiakun Liu

In this talk, we will introduce the global Hölder estimate for solutions to the Dirichlet problem of the Monge-Ampère equation on strictly convex but not uniformly convex domains. This is a recent joint work with Qing Han and Yang Zhou.

Marshall, Simon. Quantum Ergodicity in the level aspect for locally symmetric spaces

Speaker: Simon Marshall (The University of Melbourne)

Time: Wed 14:00

Place(s): TLC-412

Author(s): Farrell Brumley, Simon Marshall, Jasmin Matz, and Carsten Peterson

I will discuss a variant of Quantum Ergodicity in which the underlying manifold varies, known as Quantum Ergodicity in the level aspect. This was originally established for finite regular graphs by Anantharaman-Le Masson, before being extended to compact hyperbolic manifolds by Le Masson-Sahlsten and Abert-Bergeron-Le Masson. I will present a proof of Quantum Ergodicity in the level aspect for sequences of compact locally symmetric spaces whose associated Lie group has a restricted root system that is either of classical type, or type E_7 . In particular, this includes all groups of classical type.

Rallabhandi, Virinchi. Energy in spacetimes with negative cosmological constant

Speaker: Virinchi Rallabhandi (University of Edinburgh)

Time: Tue 15:00

Place(s): TLC-414

Author(s): Virinchi Rallabhandi

This talk will discuss energy in the context of general relativity with a negative cosmological constant. The first half of the talk will take a global perspective and a general positive energy theorem will be developed for asymptotically, locally AdS spacetimes with boundary geometry admitting compact cross-sections with parallel or Killing spinors. The second half of the talk will take a local perspective and a new quasilocal mass will be defined for generic, compact, 2D, spacelike surfaces in 4D spacetimes with negative cosmological constant. The new quasilocal mass will be shown to have a number of physically desirable properties.

Rankin, Cale. Brunn–Minkowski inequalities for eigenvalues of elliptic operators

Speaker: Cale Rankin (Monash University)

Time: Wed 17:00

Place(s): TLC-412

Author(s): Cale Rankin

In this talk I discuss some ongoing joint work with Julie Clutterbuck and Paul Bryan. The Brunn–Minkowski inequality is a fundamental inequality in convex geometry which says for $\Omega_0, \Omega_1 \subset \mathbf{R}^n$ there holds

$$|(1-t)\Omega_0 + t\Omega_1|^{1/n} \geq (1-t)|\Omega_0|^{1/n} + t|\Omega_1|^{1/n},$$

where $|\cdot|$ denotes the n -dimensional Hausdorff measure. A number of other set functions, such as the first Dirichlet eigenvalue for a domain Ω , p -capacity, and eigenvalues of Monge–Ampère operators also satisfy Brunn–Minkowski type inequalities determined by their homogeneity. As an example, Brascamp and Lieb proved the first Dirichlet eigenvalue of Ω , denoted $\lambda(\Omega)$, satisfies

$$\lambda((1-t)\Omega_0 + t\Omega_1)^{-1/2} \geq (1-t)\lambda(\Omega_0)^{-1/2} + t\lambda(\Omega_1)^{-1/2},$$

which is equivalent to the convexity of λ :

$$\lambda((1-t)\Omega_0 + t\Omega_1) \leq (1-t)\lambda(\Omega_0) + t\lambda(\Omega_1).$$

In this talk I discuss new proofs of these inequalities, their relation to log-concavity of eigenfunctions, and their extension to Riemannian manifolds.

Schlue, Volker. Scattering solutions of the Vlasov-Maxwell system**Speaker:** Volker Schlue (The University of Melbourne)**Time:** Fri 16:00**Place(s):** TLC-412**Author(s):** Volker Schlue

We study radiative properties of a collection of charged particles as described by the Vlasov–Maxwell system. In joint work with Martin Taylor (Imperial College), we have obtained an inverse modified scattering result for the Vlasov–Maxwell system describing a situation of particles in-coming from infinity. We further investigate the validity of the dipole formula in this setting. This problem is motivated by the study of gravitational radiation in general relativity.

Yung, Po-Lam. Remarks about the local smoothing conjecture**Speaker:** Po-Lam Yung (The Australian National University)**Time:** Wed 16:00**Place(s):** TLC-412**Author(s):** Po-Lam Yung

I'll reflect upon the celebrated proof of the local smoothing conjecture for the wave equation in 2+1 dimensions, by Larry Guth, Hong Wang and Ruixiang Zhang.

Zheng, Weihang. Localized Big Bang Stability of the Kasner-scalar field Metrics**Speaker:** Weihang Zheng (Monash University)**Time:** Tue 14:30**Place(s):** TLC-414**Author(s):** Florian Beyer, Todd A. Oliynyk, Weihang Zheng

In the theory of general relativity, there is a family of exact solutions to the Einstein-scalar field equations, called the Kasner solutions. The solutions in the sub-critical range of the Kasner family give us the quiescent Big Bang singularity characterized by asymptotic decaying, curvature invariants blowup and etc. One important result proved by Fournodavlos-Rodnianski-Speck(FRS) is that the solutions in the sub-critical range are stable under nonlinear perturbations. In this talk, I will discuss a stronger result of the FRS's work by establishing the localized stability, i.e. the stability on a truncated cone domain. This is a joint work with Florian Beyer and Todd Oliynyk.

13. Mathematics Education

Breuer, Florian. Using the Bloom AI Tutor in a first-year Mathematics Course

Speaker: Florian Breuer (The University of Newcastle)

Time: Thu 14:30

Place(s): PS2-212

Author(s): Florian Breuer, Karen Blackmore, Saiful Islam, Gary Liang

We tailored the Bloom AI Tutor for use in our Mathematics for Science and Engineering 2 (MATH1120) course at the University of Newcastle and made it available to 472 students across both semesters of 2025. I will report on the data obtained via pre- and post-experiment surveys and reflect on lessons learned.

Elder, Murray. Flipped exams

Speaker: Murray Elder (University of Technology Sydney)

Time: Fri 15:00

Place(s): PS2-212

Author(s): Murray Elder

I will describe some recent attempts to run in-class mathematics assessments where students have some time for individual writing, and time to discuss the same questions together and with the instructor on whiteboard. This method is known in the literature by many names: two-stage exams, collaborative testing, or as my students have called it “the Squid Game method”. I will report on pros and cons, and why I think mixing up assessment is a good idea.

Fijn, Paul. Increasing interactivity in small-group teaching: implementing new technology in a statistics course

Speaker: Paul Fijn (The University of Melbourne)

Time: Thu 14:00

Place(s): PS2-212

Author(s): Paul W T Fijn

As part of a pilot program to test “Next Generation” tutorial spaces equipped with electronic whiteboards, small-group teaching for a large (over 500 enrolments) introductory statistics subject was extensively re-designed. This was an opportunity to increase the opportunities for active learning and authentic experiences of working with data through incorporating more technology use (including statistical software and online resources such as GeoGebra) within classes designed for small-group collaboration. This provided opportunities to foster greater collaboration between students, particularly for technology-based tasks which students previously would complete independently. The re-design in 2022 was based on constructive alignment, and subsequently refined over the following years, based on both formal and informal feedback from staff and students, and direct observations from classes.

This reflective talk will focus on the practical considerations underlying the re-design (choice of software, design of tasks) and how the technology enabled the approaches which aligned with our aims. We will also outline how we managed the feedback and refinement process, such as providing additional individual “pre-lab” tasks to ensure all students learn how to use the software. Some lessons learned from the implementation are necessarily specific to this particular context, but there are broader implications for implementing similar re-designs incorporating technology applicable to a wide range of subject areas.

Nanayakkara, Ravindi. Enhancing Student Success Through the Maths Hub: Multidisciplinary Mathematics and Statistics Support

Speaker: Ravindi Nanayakkara (La Trobe University)

Time: Thu 13:30

Place(s): PS2-212

Author(s): Dr. Ravindi Nanayakkara, Dr. Deborah Jackson

Mathematics and statistics are integral to learning across a wide range of disciplines, yet many students enter university with diverse educational backgrounds, varying levels of preparedness, and differing confidence levels in these areas [2,3,4]. The Maths Hub is La Trobe University’s multi-campus, multidisciplinary mathematics and statistics support centre. It was established in 2018 as an inclusive, multidisciplinary support initiative to address these challenges by providing personalised, innovative, and accessible assistance that enhances student success across both STEM and non-STEM disciplines. This talk aims to reflect on the journey of the Maths Hub since its establishment, highlighting key achievements in enhancing student success as well as the challenges encountered along the way.

The Maths Hub serves as a central resource for tutoring, workshops, and online asynchronous resources designed to enhance students’ understanding and application of quantitative skills. It offers a range of student support

services, including help with understanding subject content and clarifying doubts; developing skills in mathematics, statistics, and data science; improving R programming and data analysis using Jamovi; weekly quizzes, lab sheets with analyses, and practice class problems; weekly workshops and materials; discipline-specific modules with certificates; and support for exam revision and preparation. The Maths Hub offers drop-in sessions that may be one-on-one or group consultations, with support available both face-to-face and via Zoom, ensuring accessibility across campuses, states, and globally. The Hub runs year-round and provides blended support that ensures equitable access and fosters confidence across diverse student cohorts [1].

The Maths Hub offers dynamic, student-centred academic support through active learning, problem-based approaches, real-world applications, and gamified quizzes such as Kahoot. The Hub also provides instructional videos, giving students the flexibility to learn at their own pace without time pressure or competition. The Maths Hub demonstrates its impact by consistent student participation, high-quality feedback, and transformative student outcomes. From 2020 to 2025, the Hub supported more than 3,200 unique students through over 14,000 visits and received consistently outstanding feedback. With numerous student success stories, including improved mathematics and statistics skills, successful completion of assessments and final examinations, and increased retention, the Maths Hub continues to play a pivotal role in empowering students to achieve academic success and confidence in quantitative disciplines.

Keywords: Mathematics Education, Multidisciplinary Mathematics Support, Blended Learning, Maths Hub, Student Success, Inclusive Learning

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Onn, Uri. Kodály method, Instrumental Enrichment, and Math Education

Speaker: Uri Onn (Australian National University)

Time: Thu 15:00

Place(s): PS2-212

Author(s): Uri Onn

Zoltán Kodály was a Hungarian composer, musicologist, music educator, linguist, and philosopher who developed the so-called Kodály method for music education in the 1930s. Reuven Feuerstein was a Romanian-born Israeli clinical, developmental, and cognitive psychologist. Working with child survivors of the Holocaust, starting in 1945, he developed the theory of structural cognitive modifiability and mediated learning experience, which resulted in practical tools for improving deficient cognitive functions in children. In this talk, I will draw parallels between these methods and math education.

Palojaervi, Neea. The Math Kangaroo Finland: Different topics

Speaker: Neea Palojaervi (University of New South Wales Canberra)

Time: Fri 14:30

Place(s): PS2-212

Author(s): Neea Palojarvi, Mika Koskenoja, Anne-Maria Ernvall-Hytönen

The Math Kangaroo is one of the biggest international mathematics competitions. In Finland, the number of participants has been around 15,000 in recent years. The competition is free and available for schools from the second grade through the end of high school.

In this talk, I will discuss about how Finnish 2nd-9th graders performed in different topics (number, algebra, geometry, data & probability and other) in the Math Kangaroo Finland 2011, 2015, 2019 and 2023. I will also briefly compare these results to Finnish TIMSS (Trends in International Mathematics and science study) with respective years.

Piggott, Adam. How to get your mathematics degree accredited by the AustMS

Speaker: Adam Piggott (Australian National University)

Time: Fri 13:30

Place(s): PS2-212

Author(s): Adam Piggott

The (revised) AustMS Accreditation of Degree Programs is up and running. We discuss why you should consider this for the degree program at your university, and how to make it happen.

Tran, TriThang. Mathematical communication and supporting the transition from secondary to tertiary mathematics

Speaker: TriThang Tran (The University of Melbourne)

Time: Fri 14:00

Place(s): PS2-212

Author(s): TriThang Tran

In the mathematics education literature, the secondary to tertiary transition (STT) is a continuing area of research due to the many challenges that students face in this period. The work of Tall and his three worlds model has had a lasting impact on describing the many cognitive challenges that students face. More recently, researchers have explored the many affective factors impacting STT such as the learners' identity, self-efficacy, and view of themselves as creative agents. Mathematical communication can play an important part in a successful STT, in part because it has the potential touch on both the cognitive and affective domains. This talk will describe some recent work with Santin Garcia, and Murfett on conceptions of academics and students of mathematical communication, comparing these two perspectives. We then describe some ideas for mathematical communication tasks that have developed from these studies.

14. Mathematical Methods in Continuum Mechanics and Wave Theory

Bennetts, Luke. Acoustic lattice resonances and generalised Rayleigh–Bloch waves

Speaker: Luke Bennetts (The University of Melbourne)

Time: Tue 16:30

Place(s): TLC-216

Author(s): GJ Chaplain; TA Starkey; MA Peter; SC Hawkins; K Matsushima; LG Bennetts

Rayleigh–Bloch waves are modes localised to periodic arrays of scatterers with unbounded unit cells. We study them for line arrays of sound-hard scatterers embedded in an acoustic medium above the cut-off, both theoretically and experimentally, in which we observe the first generalised Rayleigh–Bloch waves in the radiative regime.

Bonham, Mitchell. Determining Iceberg Elastic Properties Through Resonant Flexure

Speaker: Mitchell Bonham (The University of Newcastle)

Time: Wed 14:30

Place(s): PS2-212

Author(s): Mitchell Bonham

The mechanical response of icebergs to ocean forcing is strongly influenced by their elastic stiffness, yet the Young’s modulus of glacial ice is often treated as an uncertain tuning parameter in calving models. In this work, we explore the use of resonant flexural motion to estimate the effective Young’s modulus of an iceberg. Observations show that icebergs can vibrate at discrete frequencies with amplitudes exceeding those predicted by simple bending. We present a coupled iceberg–ocean model that reproduces these resonant modes and enables the modulus to be inferred from surface strain observations. This approach offers a new way to constrain iceberg elasticity directly from measurable vibrational spectra.

Broadbridge, Philip. Integrable Nonlinear Wave Equations with Diode Properties

Speaker: Philip Broadbridge (La Trobe University)

Time: Fri 14:00

Place(s): TLC-216

Author(s): P. Broadbridge

A known class of conditionally integrable partial differential equations is extended to include those that can be reduced by a non-classical symmetry to a linear Kirchhoff equation. From any steady solution to that linear equation, there follows an exact time-dependent solution to a nonlinear hyperbolic equation. An example solution is constructed in two space dimensions and one time dimension. By a change of variable, in one space dimension these nonlinear partial differential equations are equivalent to a nonlinear wave equation with diode-like properties that break reciprocity. These properties are illustrated by an exact solution in one dimension. An example solution has an interpretation as an acoustic wave in a tapered solid medium.

Buckingham, Robert. Suleimanov–Talanov self-focusing in the NLS hierarchy

Speaker: Robert Buckingham (University of Cincinnati)

Time: Fri 13:30

Place(s): TLC-216

Author(s): Robert Buckingham

The Talanov solution of the dispersionless NLS system models a certain type of finite-time blowup associated with rogue waves. Recently, Suleimanov identified a solution of the full dispersive NLS equation that formally regularizes the blowup. Using the semiclassical soliton ensemble approach, we prove Suleimanov’s conjecture for a suitable class of initial conditions. We also establish analogous results for other flows in the NLS hierarchy. This is joint work with Robert Jenkins and Peter Miller.

Deng, Quanling. A Particle–Continuum Multiscale Modeling Framework with an Application to Sea-Ice Dynamics

Speaker: Quanling Deng (Yau Mathematical Sciences Center, Tsinghua University)

Time: Wed 15:00

Place(s): PS2-212

Author(s): Quanling Deng

We present a particle–continuum multiscale modeling framework for the dynamics of sea-ice floes that bridges discrete mechanics with continuum descriptions. At the small scale level, individual floes are treated as interacting particles whose size, position, and velocity evolve under Newtonian mechanics with contact forces and ocean drag. From this Lagrangian particle system, we derive a Boltzmann–type kinetic equation governing the phase-space distribution of floes, and then obtain a hydrodynamic formulation through velocity moments

and an appropriate closure. This hierarchy—from particle to kinetic to continuum—provides a rigorous mathematical pathway to describe sea-ice dynamics across scales. The continuum model captures large-scale flow and stress patterns, while the particle representation resolves localized interactions. Our analysis highlights the preservation of key conservation laws and clarifies how small-scale collisions and drag effects feed back into macroscopic rheology. This particle–continuum multiscale approach offers an alternative to classical continuum models, enabling efficient simulation and improved prediction of sea-ice behavior under changing climatic conditions. The framework exemplifies how mathematical methods in continuum mechanics can integrate kinetic theory and discrete-element modeling to unify fine-scale physics with large-scale geophysical dynamics.

Garcia Neefjes, Erik. A neural-network surrogate Bayesian algorithm for the Helmholtz inverse-medium problem

Speaker: Erik Garcia Neefjes (Macquarie University)

Time: Tue 16:00

Place(s): TLC-216

Author(s): Erik García Neefjes, Stuart C. Hawkins, Mahadevan Ganesh

We present a novel approach to the inverse problem of reconstructing the refractive index of an inhomogeneous two-dimensional medium from noisy far-field data. The far-field data in our model is generated by multiple incident waves interacting with the inhomogeneous medium, mathematically modeled using the Helmholtz equation. For reconstruction, we employ a Bayesian framework and use Markov Chain Monte Carlo (MCMC) sampling to explore the posterior distribution since the dependence of the far-field data on the refractive index is nonlinear.

To address the computational challenges posed by the high-dimensional prior space, we introduce a physics-property informed (PPI) neural network (NN) surrogate model for the forward problem. The forward scattering problem is solved using an efficient coupled finite-element/boundary-element method (FEM-BEM), which ensures exact satisfaction of the Sommerfeld radiation condition while maintaining flexibility for the inhomogeneous interior. The refractive index is represented using an expansion in high-order Logan–Shepp polynomials, which provide an efficient orthogonal basis on the disk without requiring axis-symmetry assumptions. The PPI component of the algorithm facilitates training of the NN using far-field data from just one incident wave, with the PPINN-surrogate model leveraging symmetries in the prior space for efficient evaluation across multiple incident directions. Furthermore, the differentiable nature of the PPINN enables efficient gradient computation for Hamiltonian Monte Carlo sampling, significantly improving MCMC performance.

We showcase our method’s effectiveness by demonstrating excellent reconstruction for a range of test media with both continuous and discontinuous refractive index variations.

McCue, Scott. KdV solutions and exponential asymptotics

Speaker: Scott McCue (Queensland University of Technology)

Time: Fri 14:30

Place(s): TLC-216

Author(s): Scott W McCue

Solutions of the KdV equation $u_t + 6uu_x + u_{xxx} = 0$ on the real line exhibit dispersive waves that travel in the negative x -direction. For initial conditions that are analytic functions of x , the amplitude of these waves is exponentially small as $t \rightarrow 0^+$, and therefore the wave cannot be captured by a naive algebraic expansion in powers of t . Instead, these dispersive waves can be described by considering exponentially small corrections to the algebraic series and employing Stokes phenomenon in complex x -plane, as shall be explained.

This is work done in collaboration with Christopher J Lustri, S Jonathan Chapman and John R King.

Piersanti, Paolo. On the Dynamics of Grounded Shallow Ice Sheets: Modelling and Analysis

Speaker: Paolo Piersanti (The Chinese University of Hong Kong (Shenzhen))

Time: Wed 14:00

Place(s): PS2-212

Author(s): Paolo Piersanti and Roger Temam

In this talk, which is based on joint work with Roger Temam, we will study a model describing the evolution of the thickness of a grounded shallow ice sheet. Since the thickness is constrained to be nonnegative, the problem at hand is an obstacle problem. Our rigorous modeling shows that this time-dependent model is governed by a set of variational inequalities that involve nonlinearities in both the time derivative and the elliptic term. To establish the existence of solutions, we begin with a penalized relaxation of the model and demonstrate, through time discretization, that the corresponding relaxed problem admits at least one solution.

Schlue, Volker. Charged elastic bodies in relativistic elasticity

Speaker: Volker Schlue (The University of Melbourne)

Time: Fri 15:00

Place(s): TLC-216

Author(s): Volker Schlue

This talk reviews the development of relativistic elasticity, and is motivated by the theoretical description of neutron stars. I will present recent progress on the dynamics of charged elastic bodies in special relativity, and their emission of electromagnetic waves, and discuss their relevance to questions in general relativity.

Smith, Dave. Linearized KdV on the line with a metric graph defect

Speaker: Dave Smith (The University of Newcastle)

Time: Tue 17:00

Place(s): TLC-216

Author(s): Dave Smith

We study the small amplitude linearization of the Korteweg de Vries equation on the line, but with a defect at $x=0$ represented by a network of finite intervals adjoined at that point, scattering waves. For a representative collection of examples, we obtain explicit contour integral representations of the solution and obtain existence and unicity results for piecewise smooth data. We also discuss extensions to more complex metric graph domains and introduce a serial version of the unified transform method which may be more efficient for such problems.

Wilks, Ben. Water wave scattering by a surface-mounted rectangular anisotropic elastic plate

Speaker: Ben Wilks (University of South Australia)

Time: Fri 16:00

Place(s): TLC-216

Author(s): Ben Wilks, Michael H. Meylan, Zachary J. Wegert, Vivien J. Challis and Ngamta Thamwattana

Piezoelectric plates, which become electrically polarised in response to bending, have recently been proposed for water wave energy conversion. However, piezoelectric materials (e.g. Polyvinylidene Fluoride) can be anisotropic, which makes them challenging to model in three dimensions. This paper considers the simpler problem of water wave scattering by an anisotropic elastic plate, i.e., the piezoelectric effect is ignored. The problem is obtained as an expansion over the elastic plate modes. In turn, the component diffraction and radiation problems are solved by formulating a boundary integral equation and solving numerically using a constant panel method. Results are presented to highlight the resonant responses of the plate under different forcing scenarios. In particular, we illustrate how the excitation of certain modes can be forbidden due to symmetry. Although not considered in this paper, the method we present is applicable to piezoelectric plates, and thereby facilitates the extension of piezoelectric wave energy converter models to the three dimensional water wave setting.

15. Mathematical Physics

Arora, Simran. Particle physics models of interacting bosonic dark energy and fermionic dark matter in Einstein scalar Gauss-Bonnet gravity

Speaker: Simran Arora (Kyoto University)

Time: Thu 15:00

Place(s): TLC-115

Author(s): Simran Arora, Saddam Hussain, Benjamin Rose, Anzhong Wang

We explore a cosmological framework in which a Gauss-Bonnet (GB) coupled scalar field, acting as dark energy, interacts with a fermionic dark matter field through a coupling obtained from the point of view of particle physics. This setup is inspired by string/M-theory, and two representative scalar field potentials are investigated: exponential and power-law. A distinctive feature of the GB-coupled models is their potential to alter the propagation speed of gravitational waves (GWs), a property with significant implications in light of recent multi-messenger astrophysical observations. To account for this, we analyze models under two scenarios: one where the GW speed differs from that of light and the other where they are equal, but all consistent with current observational constraints. The dynamical evolution of the system is investigated by reformulating the field equations into an autonomous dynamical system, enabling a detailed analysis of the Universe's long-term behavior, including the radiation-, matter- and dark energy-dominated epochs. We constrain the model parameters using a broad set of recent observational data, including mock high-redshift measurements from the Roman Space Telescope. Our findings indicate that both potentials yield cosmologies that are in excellent agreement with current data, closely tracking the expansion history predicted by the standard Λ CDM model, while still allowing room for subtle deviations that could be tested by future observations.

Bradly, Chris. Lattice polymers subject to a force

Speaker: Chris Bradly (The University of Melbourne)

Time: Fri 14:00

Place(s): TLC-115

Author(s): CJ Bradly, NR Beaton, AL Owczarek

Lattice models of long chain polymers often accommodate an applied force in addition to energetic interactions, leading to complex behaviour. However, the critical and scaling behaviour of the applied force alone is less well studied, such as characterising the nature of the phase transition and particularly the values of the associated exponents. We investigate a self-avoiding walk model of lattice polymers subject to forced extension. Using well established scaling arguments we show that the crossover exponent ϕ for the finite-size model is identical to the well-known metric exponent ν_d , which controls the scaling of the size of the polymer in d -dimensions. When the force is applied towards the surface the situation is more complicated. If the force is applied at the endpoint, then that end is effectively pinned to the surface, but the rest of the chain is free. However, if the walk is compressed between two surfaces, the compressed state is expected to behave like a lower dimensional system, but we show that there are key difference in the scaling of long chains. We also verify the scaling exponents using extensive Monte Carlo simulations.

De Gier, Jan. Inhomogeneous q -deformation of the Tsetlin library

Speaker: Jan De Gier (The University of Melbourne)

Time: Thu 13:30

Place(s): TLC-115

Author(s): Arvind Ayyer, Sarah Brauner, Jan de Gier, Anne Schilling

The Tsetlin library is a random-to-top shuffle process on permutations. A q -deformation using the Hecke algebra can also be implemented on flags over the finite field $\mathbb{F}_q^n$. The semigroup underlying the random-to-top Markov chain on flags is a left regular band, which provides a method to compute the stationary distribution. We consider a further generalisation by introducing inhomogeneous rates.

Fagundes, Victor. Extending the coalgebra formalism for the construction of integrable and superintegrable systems

Speaker: Victor Fagundes (La Trobe University)

Time: Wed 17:00

Place(s): TLC-115

Author(s): Victor Fagundes

Starting from a dynamical system with a Casimir invariant, the coalgebra formalism is an algebraic means to 'deform' this system into an infinite family of systems, with deformations of the Casimir resulting in integrals of motion for these systems. In 2011, Ballesteros et al. effectively applied this to the 3D Lotka-Volterra system. In this talk, I will summarise this formalism and present my research on how Ballesteros's setup can be enlarged

to higher dimensions, producing entirely new families of higher-dimensional deformed systems, as well as the integrability and superintegrability of these systems. This is a joint work with Ian Marquette and Peter van der Kamp.

Field, Laurence. SLE return probabilities and an integrable system

Speaker: Laurence Field (Australian National University)

Time: Fri 16:00

Place(s): TLC-115

Author(s): Laurence Field

Recent work has established a close relation between a special case of the Calogero-Moser integrable system and certain multiple SLE_κ configurations in the limit as $\kappa \rightarrow 0$, considered as deterministic SLE_0 curves. Using joint work with Greg Lawler on the return probability of SLE curves, it has recently been established that the Loewner energy is an LDP rate function for the shapes of SLE_κ curves in the low-energy limit. We will outline these developments.

Gazi, Cengiz. Application of Painlevé integrability in Blockchain mining

Speaker: Cengiz Gazi (AMSI/University of Melbourne)

Time: Tue 14:30

Place(s): TLC-115

Author(s): Cengiz Gazi, Jan de Gier, Peter Taylor

We present a CTMC model describing the dynamics of a Blockchain mining process. The model presents itself as a semi-infinite system of coupled non-linear first-order IVPs; where the n th coupling describes the distribution function of miners at height n in the chain. We approximate the system by a second-order non-linear advection-reaction-diffusion equation. This equation is shown to be of Painlevé type for a special wave speed and we present its integrable solution. Secondly, we provide an explicit formula for the travelling wave speed of the original system - by a physics heuristic argument originally due to Brunet, Derrida 1997. Our results indicate that that convergence to consensus is guaranteed independently of the choice of parameters of the model.

Guo, Weiyang. Puzzle formula for type BC Hall–Littlewood polynomial

Speaker: Weiyang Guo (AMSI/University of Melbourne)

Time: Wed 16:30

Place(s): TLC-115

Author(s): Weiyang Guo

In this talk, we study the expansion coefficients expressing the type BC_n Hall–Littlewood polynomials in the basis of type A_n Hall–Littlewood polynomials. Our goal is to obtain a combinatorial formula for these coefficients. We begin by introducing the rational symmetric functions of type BC_n at the fundamental level, together with their type A_n counterparts. Using these constructions, we compute the corresponding expansion coefficients at the rational (fundamental) level. By subsequently applying the fusion procedure, we lift these results to the Hall–Littlewood setting and derive an explicit combinatorial formula for the expansion coefficients from the type BC_n Hall–Littlewood polynomials into the type A_n Hall–Littlewood polynomials.

Heymann, Jared. “Lattice translation” symmetry on an open boundary spin chain

Speaker: Jared Heymann (The University of Melbourne)

Time: Tue 16:30

Place(s): TLC-115

Author(s): Jared Heymann, Thomas Quella

With the advent of generalised symmetries, there has been a surge of interest in understanding how lattice symmetries and their anomalies flow to their continuum counterparts. One lattice symmetry of particular interest is lattice translation. In the continuum, lattice translation corresponds to a discrete internal symmetry distinct from continuum translation. In 1+1d conformal field theories that describe critical spin chains, the discrete symmetry corresponding to lattice translation is well understood and we can find conformal boundary conditions that are invariant under this discrete symmetry i.e. these boundary conditions transform trivially under the action of lattice translation. This begs the question: can we find boundary conditions in critical lattice models that are also invariant under lattice translation? In this talk, I report on progress of disentangling lattice translation from its continuum counterpart and how this can, in principle, be used to better understand the dimer and Haldane phase of the spin-1 bilinear-biquadratic spin chain.

Joshi, Nalini. Integrable dynamical systems on bi-elliptic surfaces**Speaker:** Nalini Joshi (The University of Sydney)**Time:** Tue 13:30**Place(s):** TLC-115**Author(s):** Nalini Joshi, Frank W. Nijhoff, Allan Steel

The family of mappings of the plane possessing a biquadratic invariant, which is known as the QRT maps, is composed of two involutions, one preserving a vertical shift and the other preserving a horizontal shift in the plane. In this talk, we outline an extension when each shift is replaced by the group homomorphism on each of two interlacing elliptic pencils.

Kajiwara, Kenji. Michelle-Prager Type Truss Structures Generated by Integrable Discrete Holomorphic Functions**Speaker:** Kenji Kajiwara (Kyushu University)**Time:** Fri 13:30**Place(s):** TLC-115**Author(s):** Kentaro Hayakawa (Nihon University), Kazuki Hayashi (Kyoto University), Yoshiki Jimukaru (Toyo University), Kenji Kajiwara (Kyushu University), Motoki Masada (Kyushu University), Yohei Yokosuka (Kagoshima University)

In this talk, we consider the a class of truss structures called the “Michelle structure” which is a classical structure in architecture originated by the pioneer work of A.G.M. Michelle (1904). It is characterised by the variational principle minimising the sum of $|(\text{axial force})| \times (\text{length of each edge})$. It is well-known that Michelle structures have the property that $|(\text{axial force})| \times (\text{length of each edge})$ is a constant. We call such structures “Michell-Prager type structures”. In this talk, we show that the Michell-Prager type structures can be generated systematically from the integrable discrete holomorphic functions. Also, their mechanical properties can be governed by the geometry of discrete isothermic surfaces[1].

For example, the discrete exponential function gives rise to a discrete version of the original Michelle’s structure, and it is numerically shown that it is approximately minimise the Michell’s functional[2]. Since the basic property of the discrete holomorphic function is preserved under Möbius transformation, one can transform the structure on the sphere to construct a 3D Michelle structure.

We present another example of the Michell-Prager type structures generated by the discrete power functions, which arise in the lattice of the Bäcklund transformations of the Painlevé VI equation, having the explicit formula in terms of its hypergeometric τ functions[3]. We show that the truss structures give approximate Michell structures under suitable boundary conditions.

References

- [1] W. K. Schief, Integrable structures in discrete shell membrane theory, Proc. R. Soc. A, **470** (2014), 20130757.
- [2] K. Hayashi et al., Parametric generation of optimal structures through discrete exponential functions: unveiling connections between structural optimality and discrete isothermicity. Struct. Multidiscip. Optim., **67**(3)(2024), 41.
- [3] H. Ando et al., An explicit formula for the discrete power function associated with circle patterns of Schramm type, Funkcial. Ekvac., **57**(1)(2014), 1-41.

Kitsios, Vassili. QuickClim-v2: Galerkin projection of the global moist three-dimensional atmosphere**Speaker:** Vassili Kitsios (CSIRO)**Time:** Fri 16:30**Place(s):** TLC-115**Author(s):** Vassili Kitsios, Laurent Cordier, Terence O’Kane

Our previous reduced-order model (ROM) of the climate, QuickClim (<https://doi.org/10.1038/s43247-023-01011-0>), was a physically-inspired machine learning approach learnt from freely running numerical simulations of the coupled global atmosphere and ocean. Here we take an alternate approach, where our ROM is now physically-constrained and learnt from numerical simulations that have been persistently corrected by real-world observations using data assimilation. A ROM of the global atmosphere is then developed by solving the moist hydrostatic equations of motion projected onto a multi-variate set of three-dimensional singular value decomposition (SVD) modes learnt from the underlying data. This Galerkin projection approach transforms the atmospheric equations of motion, which is a system of partial differential equations dependent upon time and space, into a system of ordinary differential equations dependent upon only time and SVD mode index. This massively reduces the dimensionality of the problem. The ROM coefficients are optimised to best match the temporal evolution of the contribution of each SVD mode. Any remaining errors are accounted for via a data-driven stochastic parameterisation. Temporal integrations of our ROM over the historical period demonstrate excellent agreement with the underlying data at a fraction of the computational cost. Our ROM is also shown to stably simulate plausible future climates of both high and low radiative (i.e. greenhouse gas) forcing.

Li, Siyu. Polynomial deformations of $sl(2)$ and unified algebraic framework for solutions of a class of spin models

Speaker: Siyu Li (La Trobe University)

Time: Tue 16:00

Place(s): TLC-115

Author(s): Siyu Li Ian Marquette Yao-Zhong Zhang

We introduce novel polynomial deformations of the Lie algebra $sl(2)$. We construct their finite-dimensional irreducible representations and the corresponding differential operator realizations. We apply our results to a class of spin models with hidden polynomial algebra symmetry and obtain the closed-form expressions for their energies and wave functions by means of the Bethe ansatz method. The general framework enables us to give an unified algebraic and analytic treatment for three interesting spin models with hidden cubic algebra symmetry: the Lipkin-Meshkov-Glick (LMG) model, the molecular asymmetric rigid rotor, and the two-axis countertwisting squeezing model. We provide analytic and numerical insights into the structures of the roots of the Bethe ansatz equations (i.e. the so-called Bethe roots) of these models. We give descriptions of the roots on the spheres using the inverse stereographic projection. The changes in nature and pattern of the Bethe roots on the spheres indicate the existence of different phases of the models. We also present the fidelity and derivatives of the ground-state energies (with respect to model parameters) of the models. The results indicate the presence of critical points and phase transitions of the models. In the appendix, we show that, unlike the so-called Bender-Dunne polynomials, the set of polynomials in the energy E , $P_\ell(E)$, corresponding to each of the three spin models has two critical polynomials whose zeros give the quasi-exact energy eigenvalues of the model. Such types of polynomials seem new.

Mead, William. Pfaffian Point Processes from the Half-space Exclusion Process

Speaker: William Mead (The University of Melbourne)

Time: Tue 17:00

Place(s): TLC-115

Author(s): Jan de Gier, William Mead, Daniel Remenik and Michael Wheeler

Quantum integrable systems have historically generated much interest not only for their elegant mathematical properties, but also for their capacity to describe real-world universal non-equilibrium phenomena. I will outline the storied history of how determinantal expressions in certain integrable systems teach us about universal distributions beyond the Gaussian distribution. I will then introduce a new Pfaffian formalism which generalises the famous determinantal procedure. Along the way, connections will be made to random matrix theory, symmetric functions and orthogonal polynomials.

Nurcombe, Madeline. Segal–Sugawara vectors for orthosymplectic Lie superalgebras

Speaker: Madeline Nurcombe (The University of Sydney)

Time: Fri 14:30

Place(s): TLC-115

Author(s): Alexander Molev, Madeline Nurcombe

Given a finite-dimensional simple Lie algebra or Lie superalgebra, a classic problem in representation theory is to find its Casimir elements: central elements of the universal enveloping algebra whose eigenvalues can distinguish between different irreducible modules. For affine Lie (super)algebras at the critical level, the analogues of Casimir elements are the Segal–Sugawara vectors of the Feigin–Frenkel centre. Beyond pure representation theory, the Feigin–Frenkel centre is closely tied to W-algebras in conformal field theory, and higher Hamiltonians of the Gaudin model in statistical mechanics. We give an explicit construction for Segal–Sugawara vectors of orthosymplectic Lie superalgebras, using symmetrisers and generalised trace operators in the Brauer algebra. Specialising this construction yields a simplified treatment of the already-known symplectic case.

Parr, Anthony. Algebraic Generation of Painleve Transcendents

Speaker: Anthony Parr (The University of Queensland)

Time: Tue 15:00

Place(s): TLC-115

Author(s): Anthony Parr

Every one-dimensional exactly solvable potential, up to variable or gauge transformation is one of four types, namely simple harmonic oscillator, singular oscillator, Morse potential and Poschl-Teller. The eigenfunctions of each of these models corresponds to one of the families of orthogonal polynomials satisfying a second-order ODE classified by Bocher: Hermite, Laguerre, Bessel and Jacobi respectively. We show that potential functions involving the six Painleve Transcendents satisfy the exact same spectral properties and are but the second in an infinite hierarchy of such models. Furthermore, all such models can be extended to higher dimensions to generate superintegrable Hamiltonians.

Peng, Fei. The Keel–Mori theorem for complex Deligne–Mumford superstacks

Speaker: Fei Peng (The University of Melbourne)

Time: Wed 16:00

Place(s): TLC-115

Author(s): Fei Peng

In classical moduli theory, the Keel–Mori theorem states that every separated Deligne–Mumford stack admits a coarse moduli space. In this talk, I will briefly explain how to obtain a variant of this result for all complex Deligne–Mumford superstacks. This includes the moduli superstacks of super Riemann surfaces with various punctures and the moduli superstacks of stable supermaps, which are of great interest to both algebraic geometers and mathematical physicists.

Quella, Thomas. Symmetry-protected topological scar subspaces

Speaker: Thomas Quella (The University of Melbourne)

Time: Thu 14:30

Place(s): TLC-115

Author(s): Chihiro Matsui, Thomas Quella, Naoto Tsuji

Scar states are excited states in a quantum many-body system that exhibit unusually small entanglement. We introduce the concept of symmetry-protected topological phases in connection with scar subspaces. As an example we discuss scar subspaces associated with the AKLT state and they inherit the topological properties from the ground state.

Stoian, Artem. Blowup relations and q -Painlevé VI

Speaker: Artem Stoian (The University of Melbourne)

Time: Tue 14:00

Place(s): TLC-115

Author(s): Artem Stoian

This talk is based on the preprint arXiv:2509.10938 and concerns the study of blowup relations satisfied by the partition functions of five-dimensional $\mathcal{N} = 1$ (quiver) supersymmetric Yang–Mills theories with $SU(2)$ gauge group and four flavors. I will present these relations and describe the action of the Weyl group on them. I will also explain how they can be used to derive bilinear relations for the q -Painlevé VI tau functions.

van der Kamp, Pieter Hubert. Integrable Lotka–Volterra systems, Darboux polynomials, and Hypergraphs

Speaker: Pieter Hubert van der Kamp (La Trobe University)

Time: Fri 15:00

Place(s): TLC-115

Author(s): Peter H van der Kamp, Reinout Quispel, Dave McLaren, Ian Marquette

An n -component Lotka–Volterra (LV) systems is characterised by the existence of n linear Darboux polynomials. In theory each extra Darboux polynomial gives rise to an integral. We have identified a connection between trees on n vertices and multi-parameter classes of superintegrable LV systems. We have explored a similar connection between LV systems and hypergraphs, and we have studied a certain class of non-homogeneous LV systems with respects to other types of integrability.

Zhou, Yuyang. The asymmetric five-vertex model with arbitrary boundary conditions

Speaker: Yuyang Zhou (The University of Melbourne)

Time: Thu 14:00

Place(s): TLC-115

Author(s): Yuyang Zhou

We give a determinantal formula for the partition function of the fully inhomogeneous asymmetric five vertex model with arbitrary boundary conditions. Our result is an integrable deformation of Schur polynomials and generalises a special case by Burenev and Pronko. The determinantal formula can be used to analyse poorly understood phase behaviour and limit shapes fluctuations as a function of the asymmetry parameter. This is joint work with Jan de Gier and Rick Kenyon.

16. Nonlinear PDEs and their applications

Adams, Johnathan. The Impact of Curvature on Travelling Fronts under Non-linear Diffusion.

Speaker: Johnathan Adams (QUT)

Time: Wed 16:30

Place(s): TLC-416

Author(s): Johnathan Adams and Pascal Buenzli

Reaction-diffusion waves describe the propagation of entities in many physical, ecological, and biological systems. It is known that when diffusion is linear, the propagation speed of these waves depends on the curvature of the wave front. However, no such result is currently known when diffusion is nonlinear. Nonlinear diffusion, in which diffusivity depends on density, is an important consideration since it produces sharp fronts and is often a more desirable model of density propagation. In this contribution, we examine the influence of curvature on the speed of travelling fronts with non-linear diffusivity in two-dimensional domains. We derive effective curvature flows of inward-propagating travelling fronts based on an exact, non-perturbative analysis of the transverse contribution of the nonlinear diffusion operator, and on long-time asymptotic analyses. We find different curvature flow regimes in a travelling-wave-like phase and in the long-time regime, where the influence of reaction dominates. These results are compared with numerical simulations using several nonlinear diffusion problems, such as porous media diffusion and fast diffusion. In the long-time regime where density tends to become uniform, the behaviours obtained are consistent with results previously obtained for linear diffusion, except for a class of diffusivities that tend to zero as density becomes uniform.

Bernard, Yann. Analysis of Critical Points of Conformally Invariant Curvature Energies in 4d

Speaker: Yann Bernard (Monash University)

Time: Fri 15:00

Place(s): TLC-416

Author(s): Yann Bernard

We consider critical points of a conformally invariant energy of the type

$$\int_{\Sigma} |\pi_{\vec{h}} d\vec{H}|^2 + \mathcal{O}(|\vec{h}|^4),$$

for a submanifold $\Sigma^4 \subset \mathbb{R}^{m \geq 5}$ with $\vec{h}$ the second fundamental form and $\vec{H}$ the mean curvature. We show that assuming the immersion lies in the critical space $W^{3,2} \cap W^{1,\infty}$ is sufficient to give a meaning to the Euler-Lagrange equation $\vec{W} = \vec{0}$, which is a quasilinear system of sixth-order equations in the immersion. Using a reformulation ultimately stemming from Noether's theorem, we show that weak solutions are smooth and we deduce an ϵ -regularity estimate. We also consider local Palais-Smale sequences and show they converge to a solution of the constrained equation $\vec{W} = -\langle T, \vec{h} \rangle$, for some divergence-free traceless symmetric 2-tensor T acting as a Lagrange multiplier.

Cirstea, Florica Corina. Symmetry of global solutions for nonlinear elliptic equations with mixed reaction terms

Speaker: Florica Corina Cirstea (The University of Sydney)

Time: Wed 14:00

Place(s): TLC-416

Author(s): Florica-Corina Cirstea

In this talk, we describe the set of *all* positive distributional $C^1(\mathbb{R}^N \setminus \{0\})$ -solutions of elliptic equations with mixed reaction terms of the form

$$(1) \quad \mathbb{L}_{\rho,\lambda,\tau}[u] := \Delta u - (N - 2 + 2\rho) \frac{x \cdot \nabla u}{|x|^2} + \lambda \frac{u^\tau |\nabla u|^{1-\tau}}{|x|^{1+\tau}} = |x|^\theta u^q \quad \text{in } \mathbb{R}^N \setminus \{0\},$$

where $\rho, \lambda, \theta \in \mathbb{R}$ are arbitrary, $N \geq 2$, $q > 1$ and $\tau \in [0, 1)$. We show that Eq (1) has positive solutions if and only if $f((\theta + 2)/(q - 1)) > 0$, where $f(t) = t(t + 2\rho) + \lambda|t|^{1-\tau}$ for $t \in \mathbb{R}$. Under this optimal condition, we classify the asymptotic behaviour near zero and at infinity for all positive solutions of Eq (1) and show that they are radially symmetric. We reveal new and surprising phenomena, such as two new families of bounded solutions, which have no analogue in the case $\tau = 1$ studied by Cirstea and Fărcăşanu (2021).

This is joint work with Huyuan Chen and Aleksandar Miladinovic.

Clutterbuck, Julie. The spectral gap in hyperbolic space

Speaker: Julie Clutterbuck (Monash University)

Time: Fri 13:30

Place(s): TLC-416

Author(s): Julie Clutterbuck

We study the difference between two smallest eigenvalues of the operator $-\Delta + V$ with Dirichlet boundary conditions—the spectral gap. For a fixed convex bounded domain in $\mathbb{R}^n$, and in the class of convex potentials V , then the spectral gap is minimised by a constant potential. We show that for convex domains in hyperbolic space, the constant potential cannot minimise the spectral gap. This is joint work with Frieder Jäckel and Xuan Hien Nguyen.

Farcaseanu, Maria. Asymptotic profiles for singular nonlinear elliptic equations

Speaker: Maria Farcaseanu (The University of Sydney)

Time: Wed 14:30

Place(s): TLC-416

Author(s): Maria Farcaseanu

In this talk, we present recent results on the existence of different asymptotic profiles near the origin for all positive radial solutions to a broad class of nonlinear elliptic equations involving singular potentials and gradient-dependent nonlinearities. This is joint work with Florica Cîrstea.

Gazwani, Mashniah A.. Length-unconstrained, length-constrained and length-penalised curve diffusion flows of planar curves inside cones

Speaker: Mashniah A. Gazwani (The University of Newcastle)

Time: Tue 17:00

Place(s): TLC-416

Author(s): Mashniah Ali Gazwani

We study families of smooth, embedded, regular planar curves $\alpha : [-1, 1] \times [0, T) \rightarrow \mathbb{R}^2$ with generalised Neumann boundary conditions inside cones, satisfying four variants of the fourth-order nonlinear curve diffusion flow: (1) length-unconstrained curve diffusion flow, (2) curve diffusion flow with a length penalisation, (3, 4) two forms of constrained curve diffusion flow with fixed length. Assuming neither end of the evolving curve reaches the cone tip, existence of smooth solutions for all time given quite general initial data is well known for cases (1), (3) and (4), but classification of limiting shapes is generally not known. We prove in cases (1), (3) and (4) smooth exponential convergence of solutions in the C^∞ -topology to a circular arc centred at the cone tip with the same length as the initial curve. In case (2), we show smooth exponential convergence under suitable rescaling to a circular arc. In all cases the limiting arc is centred at the cone tip. This is based on joint work with Professor James McCoy.

Guo, Zihua. Well-posedness for the compressible Navier-Stokes equations in critical Besov space

Speaker: Zihua Guo (Monash University)

Time: Fri 14:30

Place(s): TLC-416

Author(s): Zihua Guo

The Cauchy problem to the barotropic compressible Navier-Stokes equation in critical Besov spaces is considered. I will talk about two recent results obtained in (I) arXiv:2409.01031 and (II) arXiv:2509.17005

I. Local well-posedness

We prove the continuity of the solution map by combining the frequency envelope method and the Lagrangian approach. This result bridges the Eulerian and Lagrangian methods in the study of compressible Navier-Stokes equation.

II. Global well-posedness

We prove global well-posedness with small data in the optimal critical Besov space assuming some low frequency condition on the initial density and momentum. The main ingredients of the proof consist of: a novel nonlinear transform that uses momentum formulation for low-frequency and effective velocity method for high frequency, and estimate of parabolic-dispersive semigroup that enables a L^q -framework for low frequency.

Kwong, Kwok-Kun. Fenchel-Willmore and Sobolev-type inequalities for submanifolds in non-negatively curved manifolds

Speaker: Kwok-Kun Kwong (University of Wollongong)

Time: Tue 16:00

Place(s): TLC-416

Author(s): Kwok Kun Kwong and Meng Ji.

I will show a novel connection between the classical Fenchel–Willmore inequality and a logarithmic Sobolev inequality for mean-convex submanifolds immersed in non-negatively curved manifolds with Euclidean volume growth. This leads to extensions of the Fenchel–Willmore inequality to submanifolds with boundary or complete non-compact submanifolds. Time permitting, I will also present a sharp Sobolev-type inequality under the same geometric assumptions. These Sobolev-type inequalities admit a number of applications, including topological consequences in the surface case. This is joint work with Meng Ji.

Li, Ji. Fefferman–Stein type inequality and applications

Speaker: Ji Li (Macquarie University)

Time: Wed 17:00

Place(s): TLC-416

Author(s): Ji Li

Let $u(x, t)$ be a harmonic function in $\mathbb{R}^n \times (0, \infty)$. The non-tangential maximal function $u^*(x) = \sup_{|x-y|<t} |u(y, t)|$ and area integral $S(u)(x)^2 = \int_{|x-y|<t} |\nabla u(y, t)|^2 t^{1-n} dy dt$ are two fundamental tools in the theory of singular integrals and the related function spaces. Fefferman and Stein first showed that $\|u^*\|_{L^p(\mathbb{R}^n)} \approx \|S(u)\|_{L^p(\mathbb{R}^n)}$, $0 < p \leq 1$, when $u(x, t) \rightarrow 0$ as $t \rightarrow \infty$. The key objects in their proof are the following inequality

$$|\{x \in \mathbb{R}^n : S(u)(x) > \lambda\}| \lesssim |\{x \in \mathbb{R}^n : u^*(x) > \lambda\}| + \frac{1}{\lambda^2} \int_0^\lambda s |\{x \in \mathbb{R}^n : u^*(x) > s\}| ds$$

and the corresponding inequality of the same type but with u^* and $S(u)$ interchanged.

We establish such an inequality in certain multiparameter settings. Our technique bypasses the use of Fourier or the dependence of group structure. Direct applications include the (global) weak type endpoint estimate for multi-parameter Calderón–Zygmund operators and maximal function characterisation of multi-parameter Hardy spaces.

This talk is mainly based on the recent progresses:

Ji Li, “Fefferman–Stein type inequality”, *Annali della Scuola Normale Superiore di Pisa, Classe di Scienze*, 2024.

Yongsheng Han, Ming-Yi Lee, Ji Li and Brett Wick, “Endpoint Estimate for Calderón–Zygmund Operators in the Multiparameter Flag Setting”, *Advances in Mathematics*, 2025

McCoy, James. Isoperimetric inequality for multiply-winding curves

Speaker: James McCoy (The University of Newcastle)

Time: Tue 14:30

Place(s): TLC-416

Author(s): James McCoy, Yong Wei, Glen Wheeler

I’ll discuss some old and new results for the isoperimetric inequality in the plane, for closed curves of positive integer winding number. In particular, I will outline some recent work with Yong Wei and Glen Wheeler on a new nonlinear fourth order parabolic curvature flow that may be used to prove an isoperimetric inequality for multiply winding curves of sufficiently small oscillation of curvature. Of interest in the proof is an argument that “upgrades” linearised stability to geometric stability for flow solutions sufficiently close to the equilibrium.

Ni, Wenjie. A competition model with nonlocal diffusion and free boundaries

Speaker: Wenjie Ni (University of New England)

Time: Thu 15:00

Place(s): TLC-416

Author(s): Wenjie Ni

We investigate the long-time dynamics of a two-species competition model of Lotka–Volterra type with nonlocal diffusions. In this setting, a native species occupies the whole environment, while an invading species spreads with two moving fronts, forming a habitat that expands over time. The system is modeled by a reaction–diffusion equation with free boundaries, and the key question is whether the invaded region eventually remains bounded or grows without limit.

Oliynyk, Todd. Stable and unstable behaviour in relativistic fluids on cosmological spacetimes

Speaker: Todd Oliynyk (Monash University)

Time: Fri 14:00

Place(s): TLC-416

Author(s): Todd Oliynyk

Relativistic fluids with linear equations of state $p = K\rho$ are among the most important and widely used matter models in cosmology. The parameter K that appears in the linear equation of state is the square of the fluid sound speed and for physical reasons is restricted to lie in the range $0 \leq K \leq 1$. In recent years, the stability of spatially homogenous families of cosmological solutions to the relativistic Euler equations have been intensively

studied and much progress has been made. The most well analysed family of spatially homogenous solutions are the Friedmann-Lemaître-Robertson-Walker (FLRW) fluid filled cosmologies with a positive cosmological constant, which are distinguished by being spatially isotropic and undergoing accelerated expansion. This family of solutions has been shown to be nonlinearly stable to the future (expanding direction) for sound speeds $0 \leq K \leq 1/3$, and in the first part of the talk, I will review these stability results. In the second part of the talk, I will present recent results regarding the future nonlinear stability of FLRW fluid cosmologies with non-accelerated expansion for sound speeds $0 \leq K < 1/3$, and the future nonlinear stability of a family of spatially homogenous, but non-isotropic, solutions to relativistic Euler equations for $1/3 < K < 1$. Additionally, I will discuss a recent result that rigorously establishes the future instability of the FLRW family of solutions to the relativistic Euler equations for sound speeds $1/3 < K < 1$. This instability is characterized by the blow-up of the fractional density gradient at timelike infinity, a behaviour that was first conjectured by Rendall in 2004. If time permits, I will conclude the talk by discussing similar phenomena that occur towards the past (contracting direction).

Pulemotov, Artem. Local solutions to the Poisson equation for G_2 structures on cohomogeneity one manifolds

Speaker: Artem Pulemotov (The University of Queensland)

Time: Thu 14:30

Place(s): [TLC-416](#)

Author(s): Timothy Buttsworth, Stepan Hudecek, Artem Pulemotov

We will discuss the classification of local solutions to the Poisson equation for G_2 structures on cohomogeneity one manifolds with principal orbits isomorphic to the six-dimensional sphere. Joint work with Timothy Buttsworth (The University of New South Wales) and Stepan Hudecek (The University of Queensland).

Tonegawa, Yoshihiro. Some existence results for mean curvature flow with forcing

Speaker: Yoshihiro Tonegawa (Institute of Science Tokyo)

Time: Tue 13:30

Place(s): [TLC-416](#)

Author(s): Yoshihiro Tonegawa

I will explain some existence results of mean curvature flow with forcing, some old results in which one can obtain the solution via the Allen-Cahn equation and more recent result using time-discrete approximation.

Trudinger, Neil. Oblique boundary value problems for augmented Hessian equations under degenerate boundary conditions.

Speaker: Neil Trudinger (Australian National University)

Time: Thu 13:30

Place(s): [TLC-416](#)

Author(s): Neil S Trudinger

Abstract: In this talk, we consider boundary regularity and classical existence for oblique boundary value problems for augmented Hessian equations under degenerate versions of the boundary curvature conditions, introduced in previous research with Feida Jiang. The key structural assumption is a quadratic gap between the maximum and minimum eigenvalues of the principal coefficients of the linearised operators. We also consider the application to conformal geometry.

Wheeler, Glen Edward. Isoperimetry via a Sobolev gradient flow

Speaker: Glen Edward Wheeler (University of Wollongong)

Time: Tue 15:00

Place(s): [TLC-416](#)

Author(s): Phil Schrader, Shinya Okabe, Glen Wheeler and Valentina-Mira Wheeler

In this talk I use a (flat) Sobolev gradient flow to derive the sharp parametrised isoperimetric inequality. I will also discuss generalisation of the method to other settings.

Wu, Haotian. Immortal Ricci flow with Type-IIb singularities

Speaker: Haotian Wu (The University of Sydney)

Time: Fri 16:00

Place(s): [TLC-416](#)

Author(s): Haotian Wu

We construct immortal solutions to Ricci flow with Type-IIb singularities and describe the asymptotic properties of these solutions as $t \nearrow \infty$.

Yung, Po-Lam. Remarks about the Kakeya conjecture

Speaker: Po-Lam Yung (The Australian National University)

Time: Wed 15:00

Place(s): TLC-416

Author(s): Po-Lam Yung

I'll reflect upon the recent celebrated proof of the Kakeya set conjecture in 3 dimensions by Hong Wang and Josh Zahl.

Zavone, Joshua. Local existence and classification of isolated singularities for nonlinear elliptic equations

Speaker: Joshua Zavone (The University of Sydney)

Time: Wed 16:00

Place(s): TLC-416

Author(s): J. Zavone, supervised by F. C. Cirstea

This talk discusses a sharp asymptotic classification near 0 for all positive C^1 (distributional) solutions $u = u(x)$ of the following nonlinear elliptic equation, with an isolated singularity at $x = 0$:

$$(2) \quad \mathbb{L}_{\rho,\lambda,\tau}[u] := \Delta u - (N - 2 + 2\rho) \frac{x \cdot \nabla u}{|x|^2} + \lambda \frac{u^\tau |\nabla u|^{1-\tau}}{|x|^{1+\tau}} = \frac{u^q}{|x|^2} \quad \text{for } x \in \Omega \setminus \{0\}.$$

Here $\Omega \subseteq \mathbb{R}^N$ (with $N \geq 2$) is an open set containing 0, and ρ, λ, τ, q are real parameters with $\tau \in [0, 1)$ and $q > 1$. We consider the methods used to prove both the classification itself, and the existence of classical radial solutions of (2) exhibiting all viable behaviours in the classification. As an application, we determine sufficient conditions under which the isolated singularity in (2) is removable (in the sense that $\mathbb{L}_{\rho,\lambda,\tau}[u] = |x|^{-2}u^q$ as distributions in Ω , not just in $\Omega \setminus \{0\}$). By a modified Kelvin transform, we also obtain a classification of the behaviour near ∞ for solutions of $\mathbb{L}_{\rho,\lambda,\tau}[u] = |x|^{-2}u^q$ in exterior domains. This work extends the results of [1], which solves the same local classification problem for $\mathbb{L}_{\rho,\lambda,\tau}[u] = |x|^\theta u^q$ when $\theta < -2$.

References

- [1] H. Chen, F. C. Cirstea, and A. Miladinovic, “*Classification and symmetry of global solutions for nonlinear elliptic equations with mixed reaction terms*” (preprint).

Zheng, Weihang. Localized Big Bang Stability of the Kasner-scalar Field Metrics

Speaker: Weihang Zheng (Monash University)

Time: Tue 16:30

Place(s): TLC-416

Author(s): Florian Beyer, Todd Oliynyk, Weihang Zheng

In the theory of general relativity, there is a family of exact solutions to the Einstein-scalar field equations, called the Kasner solutions. The solutions in the sub-critical range of the Kasner family give us the quiescent Big Bang singularity characterized by asymptotic decaying, curvature invariants blowup and etc. One important result proved by Fournodavlos-Rodnianski-Speck(FRS) is that the solutions in the sub-critical range are stable under nonlinear perturbations. In this talk, I will discuss a stronger result of the FRS's work by establishing the localized stability, i.e. the stability on a truncated cone domain. This is a joint work with Florian Beyer and Todd Oliynyk.

17. Number Theory

Afifurrahman, Muhammad. Multiplicatively dependent integer vectors on a hyperplane

Speaker: Muhammad Afifurrahman (UNSW Sydney)

Time: Wed 14:00

Place(s): TLC-214

Author(s): Muhammad Afifurrahman, Valentio Iverson, Gian Cordana Sanjaya

We obtain several asymptotic formulae and upper bounds for the number of multiplicatively dependent vectors of integers that lie on a fixed hyperplane and whose entries are of bounded height, extending Pappalardi-Sha-Shparlinski-Stewart. Joint work with Gian Cordana Sanjaya and Valentio Iverson (University of Waterloo).

Baier, Stephan. The large sieve for square moduli, revisited

Speaker: Stephan Baier (Ramakrishna Mission Vivekananda Educational and Research Institute)

Time: Tue 13:30

Place(s): TLC-214

Author(s): Stephan Baier

We revisit the large sieve for square moduli and obtain conditional improvements under hypotheses on higher additive energies of modular square roots.

Bellotti, Chiara. On the number of zeros of the Riemann zeta function

Speaker: Chiara Bellotti (UNSW Canberra)

Time: Thu 13:30

Place(s): TLC-317

Author(s): Chiara Bellotti

In this talk, based on a joint work with Peng-Jie Wong, I will present new explicit bounds for the zero-counting function $N(T)$, which counts the number of non-trivial zeros of the Riemann zeta function with imaginary part up to T . Our results improve a recent estimate of Hasanlizada, Shen, and Wong by reducing the error term in the classical approximation for $N(T)$. The main innovation comes from introducing new subconvexity bounds for the Riemann zeta function along selected lines inside the critical strip.

Bhakta, Subham. Multiplicative dependence in the denominators of points of elliptic curves

Speaker: Subham Bhakta (UNSW Sydney)

Time: Fri 14:00

Place(s): TLC-214

Author(s): Attila Bérczes, Subham Bhakta, Lajos Hajdu, Alina Ostafe, Igor E. Shparlinski

In this talk, we discuss multiplicative dependence among rational points on elliptic curves. Given several elliptic curves over the rationals, with non-torsion points P_i and arbitrary points Q_i , we give an upper bound for tuples of the form $n_i P_i + Q_i$, with n_i in an interval of length N , whose denominators or x -coordinates are multiplicatively dependent.

Bhattacharjee, Saunak. Height inequality and an improved larger sieve over number fields

Speaker: Saunak Bhattacharjee (University of New South Wales Canberra)

Time: Thu 14:00

Place(s): TLC-317

Author(s): Saunak Bhattacharjee

Let K be a number field and $H(\alpha)$ denote the multiplicative height of an algebraic number $\alpha \in K$. It is well-known that $H(\alpha + \beta) \leq 2^{[K:\mathbb{Q}]} H(\alpha)H(\beta)$, when $\alpha, \beta \in K$. If $A \subseteq O_K$ is a set of algebraic integers of height up to H , we show that there exists a subset A' of A of cardinality $\gg_K \frac{|A|}{(\log H)^r}$ such that for every $\alpha, \beta \in A'$ we have $H(\alpha + \beta) \leq C_K(H(\alpha) + H(\beta))$, where C_K is a constant only depending on the number field K . As a result, we improve on the previous versions of larger sieve over O_K . We also obtain a two-dimensional larger sieve of Helfgott and Venkatesh type over $O_K \times O_K$ and apply it to produce a Bombieri-Pila type bound over O_K .

Breuer, Florian. Divisibility of the coefficients of modular polynomials**Speaker:** Florian Breuer (The University of Newcastle)**Time:** Wed 17:00**Place(s):** TLC-214**Author(s):** Florian Breuer

For every positive integer N there exists a modular polynomial $\Phi_N(X, Y)$ with integer coefficients which vanishes exactly at pairs of j -invariants of elliptic curves linked by a cyclic isogeny of degree N . These polynomials play an important role in various cryptographic algorithms. The coefficients are known to grow very rapidly with N . In this talk, I will show that the coefficients are also divisible by large powers of small primes.

Butler, Blair. Magma Vs Ranks of Elliptic Curves**Speaker:** Blair Butler (The University of Sydney)**Time:** Thu 15:00**Place(s):** TLC-214**Author(s):** Blair Butler

The main method to determine the rank of an arbitrary elliptic curve is to use a descent argument. We can use Magma to determine the rank of an elliptic curve relatively quickly. However, this can fail if the Tate–Shafarevich group of the specific elliptic curve is non-trivial, and so we also discuss some theoretical methods of how to get past this roadblock, both using algebraic and analytic means. In addition, we also present computations on the distributions of ranks of elliptic curves of height up to 10^{45} .

Chourasiya, Shashi. A zero density estimate for Dirichlet L -functions**Speaker:** Shashi Chourasiya (University of New South Wales Canberra)**Time:** Thu 15:00**Place(s):** TLC-317**Author(s):** Shashi Chourasiya, Habiba Kadiri, Nathan Ng, and Do Nhat Tan Vo

In 2015, Ramaré established explicit bounds for the number of zeros of Dirichlet L -functions when summing only over primitive characters. In this talk, we discuss an extension to all Dirichlet characters modulo q , providing explicit bounds for $\sum_{\chi \bmod q} N(\sigma, T, \chi)$, required for applications to primes in arithmetic progressions. This is based on an ongoing project with Kadiri, Ng and Tan.

Combes, Lewis. Lifting mod p Bianchi modular forms**Speaker:** Lewis Combes (The University of Sydney)**Time:** Fri 13:30**Place(s):** TLC-214**Author(s):** Lewis Combes

Over imaginary quadratic fields, there are often classes in the mod p cohomology of arithmetic groups that don't lift to characteristic 0, the so-called genuine (or ethereal) Bianchi modular forms. Sometimes these classes can still be lifted to characteristic 0 at a higher level, but it is unknown if this is always possible. In this talk we report on work ongoing to systematically find lifts or rule them out up to some bound. We hope that these data will help inform conjectures and strategies to resolve the question of lifting at higher level, one way or the other.

Corrigan, Chandler Chase. Hecke eigenvalues at Piatetski-Shapiro primes**Speaker:** Chandler Chase Corrigan (University of New South Wales)**Time:** Thu 14:00**Place(s):** TLC-214**Author(s):** Chandler Chase Corrigan

We discuss some recent progress on the analog of the Piatetski-Shapiro prime number theorem for Hecke eigenvalues of congruence subgroups. Joint work with Y. T. Zhao (Beihang University).

Dudek, Adrian. Almost Primes Between All Squares**Speaker:** Adrian Dudek (The University of Queensland)**Time:** Wed 16:00**Place(s):** TLC-214**Author(s):** Adrian Dudek

Legendre's Conjecture is like many of number theory's open problems: simple to state but painful to prove! The conjecture asserts that there is a prime between any two consecutive square numbers. In 1975, Chen proved that between any two *sufficiently large* square numbers there exists a number with at most two prime factors. In recent joint work with D. R. Johnston, we examined what can be done upon the removal of "sufficiently

large”. We were able to prove that between *any* two consecutive square numbers, there exists a number with at most four prime factors. I’ll outline the key ideas in this talk as well as some guidance for further work.

Gemmell, Zoë. The functions behind encryption

Speaker: Zoë Gemmell (UNSW Canberra)

Time: Tue 16:30

Place(s): [TLC-212](#)

Author(s): Zoe Gemmell and Tim Trudgian

This talk briefly touches upon techniques used in encryption, a generalisation of functions crucial for modern encryption and recent work which strengthens results concerning Carley’s Conjecture. This is the background and motivation behind a joint project with my supervisor Prof Tim Trudgian.

Ghitza, Alexandru. Non-existence of some higher-dimensional Galois representations

Speaker: Alexandru Ghitza (The University of Melbourne)

Time: Fri 14:30

Place(s): [TLC-214](#)

Author(s): Alexandru Ghitza and Takuya Yamauchi

Modularity statements (proved or conjectured) in number theory can be thought of as describing correspondences between two sets of different-looking objects. An interesting special case is to show that when one of the sets is known to be empty, so is the other one. I will discuss an instance of this, namely the non-existence of moderate-dimensional Galois representations modulo a small prime p that are only ramified at this prime. The focus will be on providing some context for this result, including some of the algebraic and analytic number theoretic tools used in its proof.

Harm, Michael. The reverse Goldbach Conjecture

Speaker: Michael Harm (UNSW Sydney)

Time: Wed 15:00

Place(s): [TLC-317](#)

Author(s): Michael Harm, Daniel Johnston

Let $b \geq 2$. We show that any sufficiently large integer is the sum of a prime and two digital reverses of primes in base b .

Johnston, Daniel. Can the Bombieri–Vinogradov theorem be made effective?

Speaker: Daniel Johnston (UNSW Canberra)

Time: Wed 16:30

Place(s): [TLC-214](#)

Author(s): Daniel R. Johnston

The Bombieri–Vinogradov theorem is a central tool in analytic number theory. For many applications, it has the same strength as the Generalised Riemann hypothesis, and has allowed us to get very close to the Twin Prime and Goldbach conjectures.

In its standard form, the Bombieri–Vinogradov theorem is ineffective. That is, all of the implied constants involved cannot be explicitly computed. However, in most applications there are tricks to get around this. In this talk, we will showcase some of these tricks, exploring all the recent efforts to make the Bombieri–Vinogradov and its applications effective.

Kjaerbye Bagger, Gustav. Norm-Euclidean cyclic cubic fields

Speaker: Gustav Kjaerbye Bagger (UNSW Canberra)

Time: Tue 16:00

Place(s): [TLC-214](#)

Author(s): G. K. Bagger, A. R. Booker, B. Kerr, K. McGown, V. Starichkova, T. Trudgian

It is known on the Generalised Riemann Hypothesis that there are precisely 13 cyclic cubic fields that are norm-Euclidean. Unconditionally, there was previously a gap between analytic estimates which hold for all sufficiently large discriminants and computational techniques. Via a result by Heilbronn, the problem can be restated in terms of finding small cubic non-residues modulo a prime. In this talk, I will outline some of the techniques we used to completely classify all norm-Euclidean cyclic cubic fields.

Kortge, Maximilian. On the inverse volcano problem over non-prime finite fields

Speaker: Maximilian Kortge (The University of Melbourne)

Time: Thu 14:30

Place(s): TLC-214

Author(s): Alexandru Ghitza, Dhruv Gupta, Maximilian Kortge

The graph of ℓ -isogenies between elliptic curves over finite fields has connected components called volcanoes. The inverse volcano problem asks whether, given such a volcano, one can find a finite field $\mathbb{F}_{p^k}$ and a prime ℓ such that the graph of ℓ -isogenies contains the volcano. Over $\mathbb{F}_p$ it is known that the answer is affirmative. I will discuss some results in the non-prime field case.

Marshall, Simon. An introduction to the Sarnak–Xue density conjecture

Speaker: Simon Marshall (The University of Melbourne)

Time: Tue 15:00

Place(s): TLC-214

Author(s): Simon Marshall and Sug Woo Shin

The Sarnak–Xue density conjecture is an active area of study in the analytic theory of automorphic forms. I will state the conjecture, survey what is known, and give some applications to problems including finding small elements of $\mathrm{SL}_N(\mathbb{Z})$ in a prescribed congruence class, bounding the Betti numbers of arithmetic manifolds, and designing gates in quantum computation.

Nilsen, Rodney. Digit properties and convergence estimates for α -fractional numbers

Speaker: Rodney Nilsen (University of Wollongong)

Time: Fri 14:00

Place(s): TLC-215

Author(s): Rodney Nilsen

Let $0 \leq x \leq 1$ and let x have an expansion to base 2 given by $x = \sum_{j=1}^{\infty} d_j/2^j$. Letting $|A|$ be the number of elements in a finite set A , and with $n \in \mathbb{N}$, let $A(0, n) = \{j : 1 \leq j \leq n \text{ and } d_j = 0\}$. Then, if $0 \leq \alpha \leq 1$ we say that x is α -fractional if

$$\lim_{n \rightarrow \infty} n^{-1} |A(0, n)| = \alpha.$$

In the case $\alpha = 1/2$, the $1/2$ -fractional numbers are called *simply normal* and they are a set of measure 1. Two main questions are:

- (i) the characterisation of α -fractional numbers, and
- (ii) when x is α -fractional, the rate of convergence of $|A(0, n)|/n$ to α as $n \rightarrow \infty$.

Considering when $x \in (0, 1/2)$, the expansion of x may be written as

$$x = 0^{\ell_1} 1^{m_1} 0^{\ell_2} 1^{m_2} 0^{\ell_3} \dots,$$

for some $\ell_1, m_1, \ell_2, m_2, \dots \in \mathbb{N}$ where 0^ℓ denotes a run of ℓ 0s and 0^m denotes a run of m 1s. Then for $0 < \alpha < 1$, x is α -fractional if and only if

$$\lim_{j \rightarrow \infty} \ell_j \left(\sum_{k=1}^{j-1} \ell_k \right)^{-1} = 0 \quad \text{and} \quad \lim_{j \rightarrow \infty} \left(\sum_{k=1}^j \ell_u \right) \left(\sum_{k=1}^j m_u \right)^{-1} = \alpha(1 - \alpha)^{-1}.$$

The rate of convergence of $|A(0, n)|/n$ to α can be estimated in terms of the rates of convergence for these limits. The cases $\alpha = 0$ and $\alpha = 1$ are special, and some characterisations and estimates can be simplified when x is a non-Liouville number.

MSC: 11K16, 11K36

Overmars, Anthony. On fast approximation of quadratic irrationals

Speaker: Anthony Overmars (La Trobe University)

Time: Thu 14:00

Place(s): TLC-214

Author(s): Anthony Overmars, Marcel Jackson, Peter van der Kamp

We provide fast algorithms to compute convergents of quadratic irrationals. We show that, provided Galais refinement of Lagrange’s theorem holds, for square roots certain decimations of the sequence of convergents are signed Chebyshev sequences, which can be also be generated by a Householder method.

Palojaervi, Neea. On explicit estimates for the Goldbach summatory functions

Speaker: Neea Palojaervi (University of New South Wales Canberra)

Time: Fri 13:30

Place(s): TLC-215

Author(s): Gautami Bhowmik, Anne-Maria Ernvall-Hytönen and Neea Palojarvi

A very well-known conjecture, Goldbach's conjecture, asks if every even integer greater than two can be expressed as a sum of two prime numbers. The problem itself seems to be currently out of research although calculations support its to be true up to $4 \cdot 10^{18}$. One way to study the number of Goldbach representations of an even integer n , is to study the function

$$G(n) = \sum_{l+m=n} \Lambda(l)\Lambda(m),$$

where Λ is the von Mangoldt function. If the function $G(n)$ is large enough, then the Goldbach's conjecture is true. However, this seems to be currently out of reach. A natural follow-up question would be to study "average" values of the function $G(n)$. Namely, to investigate the function $S(x) = \sum_{n \leq x} G(n)$ that is called the *Goldbach summatory function*. An unconditional form $S(x) = x^2/2 + O(x^{3/2+\epsilon})$, as $x \rightarrow \infty$, for all $\epsilon > 0$ would imply the Riemann Hypothesis. In this talk, I will discuss about explicit estimates for the Goldbach summatory function and a similar function defined in arithmetic progressions. The talk is based on the joint work with Gautami Bhowmik and Anne-Maria Ernvall-Hytönen.

Pelizzari, Giulia. Bounds on the Minkowski constants

Speaker: Giulia Pelizzari (UNSW Canberra)

Time: Tue 16:00

Place(s): TLC-212

Author(s): Giulia Pelizzari, James Punch

Using elementary techniques, we find explicit bounds on functions appearing in the study of abelian varieties. In 1887, Minkowski determined the least common multiple of the orders of all finite subgroups of $GL_n(\mathbb{Q})$; we refer to this number as $M(n)$. We recover the asymptotic behaviour of $M(n)$, provided by Katznelson in 1994, and find explicit upper and lower bounds. Our results immediately imply explicit bounds on functions closely related to $M(n)$.

Pertile, Jordan. On lower bounds for the discriminant of a number field

Speaker: Jordan Pertile (University of New South Wales Canberra)

Time: Thu 14:30

Place(s): TLC-317

Author(s): Jordan Pertile

This talk revisits the discriminant problem through explicit formula methods. I will describe new optimised bounds arising from control of kernel functions and parameter choices. These refinements yield improved explicit lower bounds for the root discriminant. I will present comparative tables illustrating for each signature which method achieves the strongest bounds, potential applications, and future work.

Punch, James. The covering radius of particular logarithmic lattices

Speaker: James Punch (UNSW Canberra)

Time: Tue 17:00

Place(s): TLC-212

Author(s): James Punch

The covering radius of a lattice $\Lambda \subset \mathbb{R}^m$ is the least distance r such that, given any point of $\mathbb{R}^m$, the distance from that point to Λ is not more than r . In this talk I will discuss lattices that arise from cyclotomic number fields (i.e. $\mathbb{Q}(\zeta_n)$) via the logarithmic embedding. Results of (de Araujo, 2024) provide upper bounds on the covering radius of these lattices, in terms of n and the number of its distinct prime factors. I will describe various improvements to these results.

Thomas, Simon. Sieves and almost primes

Speaker: Simon Thomas (The University of Queensland)

Time: Tue 16:30

Place(s): TLC-214

Author(s): Simon N. Thomas

We will discuss some recent results using sieve methods to detect almost primes, i.e. integers with a small number of prime factors. In particular, we will consider the explicit linear sieve as well as various weighting procedures which improve our control over almost primes in short intervals. We will also touch on further

applications of these techniques and how they are increasingly being used to prove striking results in analytic number theory. This is based on joint work with Daniel Johnston, Jonathan Sorenson, and Jonathan Webster.

Tilgul, Ameya. Smooth analogue of the pair-correlation function

Speaker: Ameya Tilgul (UNSW Canberra)

Time: Wed 14:00

Place(s): TLC-317

Author(s): Ameya Tilgul

The classical version of the pair-correlation function for sequences modulo 1 is defined using characteristic functions. Being discontinuous, these limit the use of the vast analytic machinery developed for continuous functions. Thus, we define “smooth” analogues of the pair-correlation function using continuous functions whose Fourier transforms have compact support. This brings along with it the theory of Fourier analysis, which leads us to exponential sums.

The Weyl criterion for uniform distribution vastly simplifies the process of checking whether a sequence is uniformly distributed. Thus, in my Master’s Thesis, my aim was to find a Weyl-type criterion for (the smooth version of) the pair-correlation function. In this talk, I would like to present my work on this topic. In particular, we will look at a sufficient condition that helps us check whether a sequence admits the Poissonian pair-correlation function using exponential sums.

Trudgian, Timothy. A is for Averages

Speaker: Timothy Trudgian (UNSW Canberra)

Time: Tue 14:30

Place(s): TLC-214

Author(s): Tim Trudgian and Neea Palojärvi

Saying something about the behaviour of a function at a point is hard; saying something about an average is easier. For all we know, the Riemann zeta-function $\zeta(1/2 + it)$ *may well be* large at some values of t ; but, since we know its average is well behaved, such extreme behaviour can only happen rarely.

A *much* weaker version of the Riemann hypothesis is equivalent to our knowing the moments $\int_0^T |\zeta(1/2 + it)|^{2k} dt$ for *all* integers $k \geq 1$. Embarrassingly, we just know the moments for $k = 1$ and $k = 2 \dots$ the Riemann hypothesis is only infinitely far away!

I shall outline some recent work, joint with Neea Palojärvi, which improves on results for the $k = 2$ case, and, in doing so, makes a slight improvement on what is known when $k = 6$. Make Averages Great Again!

Tudzi, Sebastian. From Elementary to Analytic: Explicit Bounds in the Generalised Divisor Problem

Speaker: Sebastian Tudzi (University of New South Wales Canberra)

Time: Tue 17:00

Place(s): TLC-214

Author(s): Sebastian Tudzi

In this talk, I will briefly review established explicit results for the Generalised Divisor Problem, with particular emphasis on my recent work employing elementary methods to obtain explicit bounds for the associated error term. I will also discuss the analytic approach to addressing the same problem

Wang, Liang. Optimal energy condition for metric Poissonian pair correlation

Speaker: Liang Wang (UNSW Canberra)

Time: Wed 14:30

Place(s): TLC-317

Author(s): Bryce Kerr and Hongliang Wang

Poissonian pair correlation is a fine-scale statistic that captures strong pseudo-randomness in deterministic sequences. In this talk, I will present partial progress toward a sharp sufficient condition, expressed in terms of additive energy, for the metric Poissonian pair correlation property. This is joint work with Bryce Kerr.

Xiao, Yixiu. Least zero of pairs of additive cubic equations

Speaker: Yixiu Xiao (UNSW Sydney)

Time: Wed 15:00

Place(s): TLC-214

Author(s): Yixiu Xiao, Hongze Li

An effective upper bound is established for the least non-trivial integer solution to the system of cubic forms

$$(3) \quad \begin{cases} F = c_1 x_1^3 + c_2 x_2^3 + \cdots + c_n x_n^3 = 0, \\ G = d_1 x_1^3 + d_2 x_2^3 + \cdots + d_n x_n^3 = 0, \end{cases}$$

under the “ M -good” condition for $n \geq 16$, where $c_1, \dots, c_n$ and $d_1, \dots, d_n$ are integers. Additionally, a range is derived for the probability that randomly selected simultaneous equations satisfy the M -good condition.

Zhang, Abraham. Explicit height bounds on modular polynomials

Speaker: Abraham Zhang (The University of Newcastle)

Time: Thu 13:30

Place(s): TLC-214

Author(s): Abraham Zhang

The classical modular polynomials Φ_N characterise isogenies between elliptic curves. This is useful in cryptography, for example isogeny-based cryptography and efficient point counting on elliptic curves. The coefficients of Φ_N are large enough that storing them is difficult, so one may want to work with the modular polynomials Φ_N^g for other modular functions g .

To compute Φ_N^g , one needs good bounds on the size of their coefficients. Also, with good bounds we can estimate how many polynomials we can store. In this talk I will give new height bounds for modular polynomials for the j -invariant, cube root of j , and Weber $\mathfrak{f}$ function.

18. Optimisation

Atenas, Felipe. Variable stepsize splitting methods as relocated fixed-point iterations

Speaker: Felipe Atenas (The University of Melbourne)

Time: Fri 16:30

Place(s): TLC-311

Author(s): F. Atenas, H. H. Bauschke, M. N. Dao, and M. K. Tam

Splitting methods exploit model structures to decompose complex problems into simpler pieces easier to handle. One prominent instance is the Douglas-Rachford algorithm, which stands out due to its simplicity and numerical stability. Traditional convergence guarantees assume constant stepsizes, while the theory with variable stepsizes is scarce. The fundamental challenge in varying this parameter stems from the stepsize-dependence of the fixed-point set of the Douglas-Rachford operator, preventing the use of classical arguments to guarantee convergence. To address this limitation, we propose a novel variant of the Douglas-Rachford algorithm that allows updating the stepsize between iterations, by composing the original Douglas-Rachford iteration with a ‘fixed-point relocater’ operator. For finding a zero of the sum of two maximally monotone operators in a Hilbert space, we show that the resulting relocated Douglas-Rachford method converges weakly to a solution under mild assumptions on the asymptotic behaviour of the sequence of stepsizes. We also examine the improvement in the numerical performance when using the relocated fixed-point variant, and extensions to distributed settings and to methods of forward-backward type.

Bano, Shahtaj. Optimization of multiobjective chemotherapy treatment regimens with NSGA-II and weighted sum methods

Speaker: Shahtaj Bano (RMIT University)

Time: Tue 14:30

Place(s): TLC-311

Author(s): Shahtaj Bano, Minh N.Dao, Andrew Eberhard

Cancer is a life threatening disease that requires a proper and timely treatment. It can be cured by various treatments such as immunotherapy, chemotherapy, and radiology. Chemotherapy treatment planning can be influenced by doses of drugs and multiple conflicting factors. In this study, we formulate a multi-objective optimization framework for designing personalized treatment plans. Our model focus on four conflicting objectives, such as maximization of efficacy of treatment, minimization of side effects, cost, and risk of relapse from chemotherapy. We employ a weighted sum approach and the evolutionary algorithm NSGA-II to explore the Pareto front of optimal treatment regimens. The result shows the balanced trade-off between conflicting objectives, cancerous cells reductions and long-term chemotherapy treatment effects. The model also shows how involving economic and biological constraints refers to more clinically feasible and cost-effective treatment regimens. This framework is flexible and provide a robust method for handling the complexities of chemotherapy planning.

Caldwell, Bethany. A primal-dual splitting method for robust convex optimisation

Speaker: Bethany Caldwell (University of New South Wales)

Time: Fri 16:00

Place(s): TLC-311

Author(s): B I Caldwell, N. D. Dizon, V. Jeyakumar, G. Li

Robust convex optimisation problems arise in a broad range of decision-making applications because of their ability to model problems with data uncertainty. We study a class of constrained best approximation problems with data uncertainty. In this setting, the problems require a solution to satisfy all constraints for every parameter in the prescribed spectrahedral sets, giving rise to a computationally difficult infinite dimensional problem that may also involve infinitely many constraints. Leveraging duality and semidefinite programming techniques, we will reformulate these problems into finite dimensional semidefinite programs and solve using a primal-dual splitting method. Finally, we present the results of numerical experiments that validate this proposed approach.

Chen, Jein-Shan. Novel Constructions for Closed Convex Cones Through Inequalities and Support Functions

Speaker: Jein-Shan Chen (Department of Mathematics, National Taiwan Normal University)

Time: Fri 13:30

Place(s): TLC-311

Author(s): Jein-Shan Chen

This talk presents two novel ways to generate closed convex cones, which are fundamental elements in conic optimization. The first approach constructs closed convex cones via inequalities, while the second is based on

support functions. The contribution of this presentation is twofold: it opens new perspectives for examining the structures of closed convex cones and provides novel approaches and tools for exploring conic optimization.

Chen, Yiwen. Randomized subspace methods for high-dimensional model-based derivative-free optimization

Speaker: Yiwen Chen (University of British Columbia, Okanagan)

Time: Wed 17:00

Place(s): TLC-311

Author(s): Yiwen Chen, Warren Hare, Amy Wiebe

Derivative-free optimization (DFO) is the mathematical study of optimization algorithms that do not use derivatives. Model-based DFO methods are widely used in practice but are known to struggle in high dimensions. This talk provides a brief overview of recent research that addresses this issue by searching for decreases within randomly sampled low-dimensional subspaces. In particular, we examine the requirements for model accuracy and subspace quality in these methods, and compare their convergence guarantees and complexity bounds. This talk concludes with a discussion of some promising future directions in this area.

Diaz Millan, Reinier. Frank–Wolfe algorithm for star-convex functions

Speaker: Reinier Diaz Millan (Deakin University)

Time: Fri 15:00

Place(s): TLC-311

Author(s): R. Díaz Millán, O. P. Ferreira, J. Ugon

We study the Frank–Wolfe algorithm for minimising a differentiable function with Lipschitz continuous gradient over a compact convex set. To extend classical complexity bounds to certain non-convex functions, we focus on the class of *star-convex functions*, which retain essential geometric properties despite the lack of convexity. We establish iteration-complexity bounds of $\mathcal{O}(1/k)$ for both the objective values and the duality gap under star-convexity, using diminishing, Armijo-type, and Lipschitz-based stepsize rules. Notably, the diminishing and Armijo strategies do not require prior knowledge of Lipschitz or curvature constants. These results demonstrate that the Frank–Wolfe method preserves optimal complexity guarantees beyond the convex setting.

Dizon, Neil. Hierarchy of SDPs for Wasserstein Distributionally Robust Optimization with Piecewise Polynomials

Speaker: Neil Dizon (UNSW Sydney)

Time: Fri 17:00

Place(s): TLC-311

Author(s): Neil Dizon

This talk presents a new framework for Wasserstein distributionally robust expectation problems with piecewise polynomial objectives, a class that captures many practical decision-making models. We develop a hierarchy of semidefinite relaxations that approximates these infinite-dimensional problems and establish its asymptotic convergence. The key insight is a lifted positivity certificate showing that piecewise polynomials positive on Archimedean sets admit sum-of-squares representations. Under suitable convexity assumptions, the hierarchy achieves finite convergence, and under SOS-convexity, it attains one-step convergence with exact solution recovery for worst-case expectation problems. Applications in data-driven decision making demonstrate the practical relevance and effectiveness of the approach.

Eberhard, Andrew Craig. Monotone Operator Theory: Some recent results and Future Directions

Speaker: Andrew Craig Eberhard (RMIT University)

Time: Thu 13:30

Place(s): TLC-311

Author(s): A.Eberhard and R. Wenczel

The study of maximal monotone operators has undergone a rapid period of development in the last two decades and despite their wide use in optimisation theory and algorithms the theory of maximal monotone operators has only achieved full maturity in the context of a reflexive Banach spaces. Many properties of maximal monotone operators, such as almost convexity of domains (i.e. convexity of the closure of the domain), the FPV property for general maximal operators and the validity of the sum theorem in the Rockafellar qualification condition, in the context of general Banach spaces have resisted a full description. Many partial results exist but they often assume extra “interiority conditions” on the domain of the operator which may not hold in general. Despite this incremental progress has continued to occur and in this talk we will try and summaries the issues and the tools that are starting to hint at directions that might be avenues to resolving these issues. These include the emergence of the role of the normal cone operator to the closure of domains, the recession operator for a maximal operator and some variation approximations. The talk will try and survey the landscape of recent (and not so recent) work of various authors.

Fatema, Kaniz. A DC-based optimization method for solving reverse convex programming problems

Speaker: Kaniz Fatema (RMIT University)

Time: Wed 16:00

Place(s): TLC-311

Author(s): Kaniz Fatema, Sona Taheri, Adil. M. Bagirov, Andrew Eberhard

Reverse convex programming (RCP) problems are considered and a method based on the difference of convex (DC) representations of constraint functions and sharp augmented Lagrangians is developed to solve them. First, the sharp Lagrangians are applied to formulate the dual problem. A method based on the ε -subdifferentials of DC components is developed to approximate the global minimizers of the Lagrangians with respect to the primal variables. A subgradient of the dual function is computed, which provides the ascent direction of this function. A new method is the combination of the ε -subdifferential for approximating global minimizers with respect to primal variables and the subgradient method for solving the dual problem. In addition, we apply a local method to refine the final solution. The proposed method is evaluated using academic test problems and compared with other methods. One application of this method is also considered.

Fernando, Vishmi. Improving Routing and Scheduling for Home-Based Chemotherapy and Infusion Services with a Single Nurse

Speaker: Vishmi Fernando (RMIT University)

Time: Tue 14:00

Place(s): TLC-311

Author(s): Vishmi Fernando, Melih Ozlen, Sona Taheri

This study addresses a routing and scheduling problem for home-based chemotherapy and infusion services with a single nurse, focusing on patients who require multiple visits with unique cyclic patterns. This research extends previous work on fixed treatment days for existing patients in the system by Fernando et al. (2025), by allowing flexibility in rescheduling existing patients. We show that by adjusting the treatment days of existing patients just once, the system can accommodate more priority-weighted new patients. We formulate the problem as a Mixed Integer Linear Programming model and utilise a pattern-based approach to effectively capture the cyclical nature of treatments over a long period of time. We introduce a novel two-phase matheuristic to solve the resulting complex model. In the first phase, existing patients are grouped based on their spatial and temporal requirements to minimise nurse travel. The second phase employs a filtering and decomposition-based matheuristic paired with commercially available solvers. As demonstrated by computational experiments, this methodology produces high-quality solutions within a short timeframe.

Keywords: routing, scheduling, chemotherapy infusions, multi-period, cyclical treatment patterns

Hosseinimoghaddam, Mohammadali. Generalisations of extreme value theorem

Speaker: Mohammadali Hosseinimoghaddam (The University of Queensland)

Time: Tue 16:00

Place(s): TLC-311

Author(s): Jacob Westerhout & Mohammadali Hoss.

We approach Weierstrass' extreme value theorem through generalisations that weaken its hypotheses to provide full, necessary-and-sufficient characterisations of infimum attainment. We address this problem from two perspectives: attainment on the entire domain and uniform attainment on families of subsets. For global attainment, we provide a pointwise characterisation based on the existence of convergent minimising sequences. We also show how various known weak continuity conditions, when combined with suitable weak compactness assumptions, become necessary and sufficient for attainment. For uniform attainment, we develop what appears to be the first complete characterisation for when a function attains its infimum on every member of a prescribed family of subsets. This uniform framework yields practical, checkable criteria. For instance, we establish that attainment on all sequentially compact subsets is equivalent to a simple condition on strictly decreasing sequences converging to a point.

Laird, Brianna. A Steiner Tree Based Genetic Algorithm for Multi-layered Location-Allocation-Routing Problems

Speaker: Brianna Laird (Deakin University)

Time: Tue 13:30

Place(s): TLC-311

Author(s): Brianna Laird, Chathurika Ranaweera, Julien Ugon

The evolution toward Beyond 5G (B5G) networks demands efficient optical transport network design that jointly considers infrastructure placement, user association, and routing. We address this challenge through a multi-layered Location Allocation Routing Problem (LARP), which integrates these decision layers within a unified optimisation framework. Due to the combinatorial complexity, exact mixed-integer formulations become intractable for realistic network scales. We first establish a theoretical result showing that when the highest

network tier contains a single facility, the routing subproblem reduces to a minimum-cost Steiner tree spanning all active terminals. This insight enables a structural characterisation of optimal solutions and informs the design of a tailored Genetic Algorithm (GA) framework. The proposed GA incorporates greedy initialisation, problem-specific crossover and mutation operators, and an embedded exact search step grounded in Steiner tree theory. Computational experiments on two datasets show that the proposed approach achieves near-optimal solutions and significantly outperforms CPLEX-based benchmarks in both solution quality and scalability. The framework is extensible to other hierarchical infrastructure optimisation problems beyond telecommunications.

Liu, Fangyu. Robust estimators for stochastic model-based DFO

Speaker: Fangyu Liu (The University of Melbourne)

Time: Wed 14:30

Place(s): TLC-311

Author(s): Fangyu Liu

Derivative-free optimisation (DFO) methods are widely used when objective functions are expensive, noisy, or lack derivative information. In stochastic settings, model-based DFO algorithms typically rely on sample means to aggregate repeated noisy evaluations. However, under heavy-tailed or outlier-prone noise, mean-based estimators can become unreliable and require many samples. In this talk, I will present a robust alternative using median-based estimators within stochastic trust-region frameworks. I will show that the median achieves comparable accuracy to the mean in light-tailed noise, while providing significantly better robustness in heavy-tailed regimes, supported by theoretical error bounds and sample complexity analysis.

Moka, Sarat Babu. A Unified Approach for Sparse-Constrained Quadratic Programming

Speaker: Sarat Babu Moka (UNSW Sydney)

Time: Thu 15:00

Place(s): TLC-311

Author(s): Sarat Moka, Matias Quiroz, Zdravko Botev

We present a unified optimisation framework for best subset selection problems through maximization of quadratic forms under cardinality constraints. This formulation encapsulates diverse applications including sparse linear regression, portfolio selection, and kernel approximation. We develop a novel optimization method that efficiently addresses this NP-hard problem class, demonstrated with empirical performance. Our work offers practitioners a general toolkit for seemingly different sparse learning problems.

Roberts, Lindon. Direct Search for Linearly Constrained Derivative-Free Optimization

Speaker: Lindon Roberts (The University of Melbourne)

Time: Thu 14:30

Place(s): TLC-311

Author(s): Lindon Roberts and Clément Royer

Direct search methods are a popular technique used for derivative-free optimization (DFO). A key benefit of direct search is its flexibility, being suitable for constrained, nonsmooth and mixed integer problems, for example. However, the existing theory for direct search with linear constraints does not allow steps to be taken towards nearby constraints, despite such steps being very helpful in practice. In this talk, I will outline a new convergence theory for direct search, how it justifies these practical choices, and explain the theoretical links to other DFO methods.

Roshchina, Vera. Everything is possible: constructing spectrahedra with prescribed facial dimensions

Speaker: Vera Roshchina (UNSW Sydney)

Time: Wed 14:00

Place(s): TLC-311

Author(s): Vera Roshchina, Levent Tunçel

Given any finite set of nonnegative integers, there exists a closed convex set whose facial dimension signature coincides with this set of integers, that is, the dimensions of its nonempty faces comprise exactly this set of integers. We show that such sets can be realised as solution sets of systems of finitely many convex quadratic inequalities, and hence are representable as second-order cone programming problems, and are, in particular, spectrahedral. It also follows that these sets are facially exposed, in contrast to earlier constructions. We obtain a lower bound on the minimum number of convex quadratic inequalities needed to represent a closed convex set with prescribed facial dimension signature, and show that our bound is tight for some special cases. Finally, we relate the question of finding efficient representations with indecomposability of integer sequences and other topics, and present a substantial number of open questions.

Shekarraz, Iman. Metaheuristic methods for Soft Happy Colouring

Speaker: Iman Shekarraz (Deakin University)

Time: Tue 15:00

Place(s): TLC-311

Author(s): Iman Shekarraz

We investigate the Soft Happy Colouring (SHC) problem, an NP-hard objective. For a graph G and $0 \leq \rho \leq 1$, an SHC σ extends a partial colouring that maximises the number of vertices with at least $\rho \deg(v)$ neighbours sharing their colour. This problem is strongly linked to the community structure of networks, particularly in models like the Stochastic Block Model, where the parameter ρ critically influences the accuracy of community detection and the quality of solutions. Given its intractability, our focus shifts to developing advanced solution techniques. While surveying existing heuristic and local search algorithms, we propose and evaluate several novel metaheuristic frameworks, including evolutionary algorithms, particularly the highly effective Iterated Local Search (ILS) approach. We demonstrate that these sophisticated metaheuristics, with ILS as a prime example, significantly enhance solution quality by effectively navigating the complex search space and escaping local optima, yielding robust and high-quality solutions for the SHC problem.

Sukhorukova, Nadia. Nonsmooth Optimisation and neural networks

Speaker: Nadia Sukhorukova (Swinburne University of Technology)

Time: Tue 17:00

Place(s): TLC-311

Author(s): Nadezda Sukhorukova, Vinesha Peiris

In this project, we study neural networks from the point of view of nonsmooth optimisation, namely, quasidifferential calculus. We restrict ourselves to the case of uniform approximation by a neural network without hidden layers, the activation functions are restricted to continuous strictly increasing functions. We develop an algorithm for computing the approximation with one hidden layer through a step-by-step procedure. The nonsmooth analysis techniques demonstrated their efficiency. In particular, they partially explain why the developed step-by-step procedure may run without any objective function improvement after just one step of the procedure.

Timms, Liam. A decentralised forward-backward-type algorithm with heterogeneous agent step sizes

Speaker: Liam Timms (The University of Melbourne)

Time: Wed 16:30

Place(s): TLC-311

Author(s): Matthew K Tam, Liam Timms, Lele Zhang

Consider the problem of finding a zero of a finite sum of maximally monotone operators, where some operators are Lipschitz continuous and the rest are potentially set-valued. We propose a forward-backward-type algorithm for this problem suitable for decentralised implementation. In each iteration, agents evaluate a Lipschitz continuous operator and the resolvent of a potentially set-valued operator, and then communicate with neighbouring agents. The agents choose their step sizes independently using only local information, and the step size upper bound has no dependence on the communication graph. We demonstrate the advantages of these properties with numerical results for matrix games.

Truong, Thang. A primal-dual splitting algorithm for structured composite monotone inclusions

Speaker: Thang Truong (RMIT University)

Time: Wed 15:00

Place(s): TLC-311

Author(s): Minh N. Dao, Hung M. Phan, Matthew K. Tam, Thang D. Truong

In this paper, we propose a primal-dual splitting algorithm for a broad class of structured composite monotone inclusions that involve finitely many set-valued operators, compositions of set-valued operators with bounded linear operators, and single-valued operators possibly without cocoercivity. The proposed framework is not only a unification for several contemporary algorithms but also a blueprint to generate new algorithms with graph-based structures. Our approach reduces dimensionality compared with the standard product space technique, which typically reformulates the original problem as the sum of two maximally monotone operators in order to apply splitting methods. It also allows different cocoercive or Lipschitz constants, resolvent parameters and can derive a larger step-size range than using traditional product space reformulation. We demonstrate the practicality of the approach by a numerical experiment on the decentralized fused lasso problem.

Ugon, Julien. Proximal-point-like algorithms for abstract convex minimisation problems

Speaker: Julien Ugon (Deakin University)

Time: Fri 14:30

Place(s): TLC-311

Author(s): R. Diaz Millan and J. Ugon

Abstract Convexity generalises convexity by concerning itself with functions representable as maxima of not-necessarily linear functions. While the theory is well developed and many classical results have been generalised, there do not exist many algorithms exploiting abstract convex structures.

The purpose of this talk is to describe one such conceptual algorithm, which generalised the mirror descent method. We will start by generalising the proximal point method before describing our main one, and discuss the assumptions necessary to prove convergence of these two methods. We then will show a few numerical examples of nonconvex functions that can be minimised using our methods.

Westerhout, Jacob. Converses of the Extreme Value Theorem

Speaker: Jacob Westerhout (The University of Queensland)

Time: Tue 16:30

Place(s): TLC-311

Author(s): Jacob Westerhout and Mohammadali Hoss.

The Extreme Value Theorem states that a continuous function on a compact set attains its minimum and maximum values. A slight generalisation asserts that if a function $f : \mathcal{X} \rightarrow \mathbb{R}$ admits a compact metric on $\mathcal{X}$ under which f is continuous, then f attains its infimum and supremum.

In this talk, we explore the converse: if f attains its infimum and supremum, does there exist a compact metric on $\mathcal{X}$ making f continuous? We show that this is not true in general, as it hinges on the fine structure of f . However, it does hold for a large class of functions.

First, we show that if $\mathcal{X}$ is a separable Banach space (such as $\mathbb{R}^n$) and $f : \mathcal{X} \rightarrow \mathbb{R}$ is continuous and attains its infimum and supremum, then $\mathcal{X}$ admits a new compact metric that preserves the continuity of f . Second, by only searching for metrics that make f lower semi-continuous, we find a much larger class of functions. We show that if $\mathcal{X}$ is a Polish space (such as $\mathbb{R}^n$) and $f : \mathcal{X} \rightarrow \mathbb{R}$ is Borel-measurable function that attains its infimum, then there exists a compact metric on $\mathcal{X}$ that makes f lower semi-continuous.

19. Poster Session

Cheng, Eve. Detecting Reticulate Edges in Large Species Trees Using Topological Data Analysis

Speaker: Eve Cheng (The Australian National University)

Time: Wed and Thu 15:30

Place(s): Agora East, level 2

Author(s): Eve Cheng, Xia Hua, Christine Deng

Topological Data Analysis (TDA) applies concepts from algebraic topology to extract key structural features from complex datasets. By constructing filtrations such as the Rips filtration, which grows k -dimensional balls around data points and tracks topological changes as the radius increases, TDA captures the “shape” of data in a way that is robust to small geometric variations in distance or angle.

In phylogenetics, detecting reticulate edges of hybridization, introgression, or lateral gene transfer remains one of the most computationally challenging problems. Traditional methods, even when simplified, scale poorly with the number of lineages. In contrast, TDA provides a powerful alternative by identifying topological “holes” that represent reticulation events: trees showing purely vertical evolution collapse into a single point (a 0-dimensional object), whereas reticulate events introduce higher-dimensional holes that reveal complex ancestral relationships.

Chan et al [1] demonstrated that persistent homology can detect such reticulation events in viral evolution, yet extending this framework to large species trees requires overcoming several challenges. We aim to develop an improved TDA-based algorithm that accounts for substitution rate variation along branches and incorporates richer information from genetic sequences beyond pairwise distance matrices. The new approach will also test the capacity of TDA to detect ancient reticulation events using only present-day lineages.

We implement weighted persistent homology to construct “dressed” genetic distance matrices, where k -dimensional balls expand at rates linked to molecular clock estimates, and extend SiPhyNetwork to simulate different forms of reticulation—hybridization, lateral gene transfer, and introgression—under the multispecies coalescent and ProSSE frameworks. The method will be evaluated on both simulated data and empirical datasets from whiptail lizards, a system with well-documented hybridization histories, providing a robust test of TDA’s potential in detecting deep reticulate signals in complex evolutionary lineages.

References

- [1] Joseph Minhow Chan, Gunnar Carlsson, and Raul Rabadan. Topology of viral evolution. *Proceedings of the National Academy of Sciences*, 110(46):18566–18571, 2013.

Elzenaar, Alexander. The fractals that parameterise hyperbolic handlebodies

Speaker: Alexander Elzenaar (Monash University)

Time: Wed and Thu 15:30

Place(s): Agora East, Level 2

Author(s): A. Elzenaar

We present some computational pictures of the $\mathrm{PSL}(2, \mathbb{C})$ -character varieties of free groups, showing the subset corresponding to the holonomy groups of hyperbolic handlebodies.

Hosseinimoghaddam, Mohammadali. The Converses of The Extreme

Speaker: Mohammadali Hosseinimoghaddam (The University of Queensland)

Time: Wed and Thu 15:30

Place(s): Agora East, Level 2

Author(s): Jacob Westerhout & Mohammadali Hoss.

The Extreme Value Theorem states that a continuous function on a compact set attains its minimum and maximum values. A slight generalisation asserts that if a function $f : \mathcal{X} \rightarrow \mathbb{R}$ admits a compact metric on $\mathcal{X}$ under which f is continuous, then f attains its infimum and supremum.

We explore the converse: if f attains its infimum and supremum, does there exist a compact metric on $\mathcal{X}$ making f continuous? We show that this is not true in general, as it hinges on the fine structure of f . However, it does hold for a large class of functions.

We show that if $\mathcal{X}$ is a separable Banach space (such as $\mathbb{R}^n$) and $f : \mathcal{X} \rightarrow \mathbb{R}$ is continuous and attains its infimum and supremum, then $\mathcal{X}$ admits a new compact metric that preserves the continuity of f .

Furthermore, by only searching for metrics that make f lower semi-continuous, we find a much larger class of functions. We show that if $\mathcal{X}$ is a Polish space (such as $\mathbb{R}^n$) and $f : \mathcal{X} \rightarrow \mathbb{R}$ is Borel-measurable function that attains its infimum, then there exists a compact metric on $\mathcal{X}$ that makes f lower semi-continuous.

Khan, Shahid. Exploring the Structure of Anisotropic Random Fields on the Sphere

Speaker: Shahid Khan (La Trobe University)

Time: Wed and Thu 15:30

Place(s): Agora East, Level 2

Author(s): Andriy Olenko and Shahid Khan

This research addresses fundamental questions about the existence of isotropic and anisotropic spherical random fields, as well as the properties of composite transformations of isotropic fields. It introduces classes of anisotropic random fields using geometric and spectral approaches. It then determines feasible and infeasible isotropic and anisotropic scenarios, in contrast to Euclidean random fields. Lastly, it establishes connections between geometric properties and spectral representations. The results provide foundations for applications in statistics and data analysis, providing guidance on feasible models, their spectral representations, and appropriate sampling sets for parameter estimation or hypothesis testing for spherical data.

Suga, Haruka. Simulation of Catheter-Based Treatment for Vascular Stenosis Using a Simplified Mathematical Model

Speaker: Haruka Suga (Kyushu University)

Time: Wed and Thu 15:30

Place(s): Agora East, Level 2

Author(s): Haruka Suga

In this study, we developed a mathematical model for catheter-based treatment of vascular stenosis. Vascular stenosis can lead to life-threatening diseases such as myocardial infarction. Previous studies have simulated blood flow using the Navier–Stokes equations in cases where a single stenosis is present. However, vascular networks are highly complex. Therefore, in this study, we fitted the complex equations and expressed them in a simplified form, allowing us to consider cases with two successive stenoses. This study has the potential to contribute to treatment planning and simulation support in the medical field.

Takeuchi Romo, Kiyoshi. Reconstructing 3D Objects Through 2D Methods via Persistent Homology Transform

Speaker: Kiyoshi Takeuchi Romo (Australian National University)

Time: Wed and Thu 15:30

Place(s): Agora East, Level 2

Author(s): Kiyoshi Takeuchi Romo

The Persistent Homology Transform (PHT) and its extension (XPHT) are transforms that allow us to analyze n-dimensional shapes. The information it provides us is both topological and geometrical. We count n-dimensional topological features as the object changes through a parameter. A big feature of the PHT is that it fully characterizes a shape. It can be used to analyze data that has geometrical/topological properties. Some problems encountered with normal persistence are fixed by using extended persistence.

20. Probability and Mathematical Statistics

Asanjarani, Azam. Structured Subclasses of Markovian Arrival Processes

Speaker: Azam Asanjarani (The University of Auckland)

Time: Tue 16:00

Place(s): TLC-413

Author(s): Azam Asanjarani; Sophie Hautphenne; Yoni Nazarathy

We investigate structured subclasses of Markovian Arrival Processes (MAPs), focusing on their relationships and modelling properties. In particular, we study a subclass of Markov Modulated Poisson Processes (MMPPs) and a subclass of the Markov Switched Poisson Process (MSPP) known as Markovian Transition Counting Processes (MTCPs).

Our main motivation is to understand how MTCPs relate to the widely used MMPP models. A key distinction lies in the fact that, in MTCPs, each increment in the counting process corresponds to a change in the background Markov process, whereas in MMPPs, transitions of the background process are not directly observable.

This distinction leads us to explore methods for approximating MMPPs using MTCPs. As a result, we introduce a hierarchy of subclasses of MAPs and investigate their structural and modelling properties.

Attrill, Luke. The clumsy coupon collector

Speaker: Luke Attrill (Monash University)

Time: Wed 15:00

Place(s): TLC-413

Author(s): Luke Attrill, Tim Garoni

We present an extension of the coupon collector problem that exhibits a transition from Gumbel- to exponential-shaped collection time. Instead of collecting one coupon per day, the collector is clumsy and he suffers $p \in [0, 1]$ likelihood of dropping all coupons of the type he would have picked up. We concern ourselves with the first time T that a full set of m coupons is held. The mean and variance of T are found exactly through language-generating functions and, with the clumsiness $p = p_m$ treated as a function of m , we observe contrasting $m \rightarrow \infty$ asymptotic behaviours of T . These behaviours depend on the asymptotics of p .

Borovkov, Kostya. On large deviation probabilities for self-normalised sums of random variables

Speaker: Kostya Borovkov (The University of Melbourne)

Time: Wed 14:00

Place(s): TLC-413

Author(s): K. Borovkov

Self-normalised random sums appear in a number of problems related to mathematical finance and risk theory. Examples include testing hypotheses on mean returns when volatility is unknown and analysing the Sharpe ratio. This makes the study of large deviations relevant to these areas of mathematics. We reduce the large deviation problem for a self-normalised random walk to one for an auxiliary usual bivariate random walk. This enables us to prove the classical theorem for self-normalised walks by Q.-M. Shao (1997) under slightly more general conditions and, moreover, to provide a graphical interpretation for the emerging limit in terms of the rate function for the bivariate problem. Furthermore, using this approach, we obtain exact (rather than just logarithmic) large deviation asymptotics for the probabilities of interest. Extensions to more general self-normalising setups, including the multivariate case, are discussed.

Boudabra, Maher. Skorokhod energy of planar domains

Speaker: Maher Boudabra (King Fahd University of Petroleum and Minerals)

Time: Fri 15:00

Place(s): TLC-415

Author(s): Mrabet Becher, Maher Boudabra, Fathi Hagui

In this talk, we introduce the concept of Skorokhod energy for simply connected planar domains containing the origin, defined via the kinetic energy of the boundary function arising from a conformal mapping of the unit disc. We establish that among all domains solving the planar Skorokhod embedding problem for a given probability distribution μ , the Gross solution, generated by symmetric decreasing rearrangement, minimizes the Skorokhod energy. Specifically, we prove that if U is any μ -domain and G is the corresponding Gross domain, then $\Lambda(G) \leq \Lambda(U)$. For distributions with bounded support and continuous density, we derive a closed integral formula for the Skorokhod energy in terms of the quantile function of μ . We also show that finite Skorokhod energy implies finite area and perimeter, and provide explicit computations for several examples, including uniform and arcsine distributions. Our work connects geometric function theory, Brownian motion, and shape optimization, and suggests further directions in extremal domain problems.

Braunsteins, Peter. Intrinsic Whittle–Matérn fields and sparse spatial extremes**Speaker:** Peter Braunsteins (UNSW Sydney)**Time:** Wed 16:30**Place(s):** TLC-415**Author(s):** Peter Braunsteins, David Bolin, Sebastian Engelke, and Raphael Huser

Intrinsic Gaussian fields are a class of models whose finite-dimensional distributions have densities that do not integrate to 1. They are widely used, with applications in areas such as environmental science, disease mapping, and brain imaging. However, several factors prevent intrinsic fields from being more broadly applied: (1) there are few existing parametric models, and those that do exist impose restrictive assumptions; (2) some of the key methods developed for proper (non-intrinsic) fields are unavailable for intrinsic ones; and (3) there are connections between intrinsic fields and other areas of statistics that are underexplored.

To make progress in these directions, we (1) introduce a new flexible class of models called intrinsic Whittle–Matérn fields and derive some of their properties; (2) adapt the stochastic partial differential equation approach developed for proper fields to these models to obtain sparse approximations for efficient high-dimensional likelihood inference; and (3) develop connections between intrinsic fields and kriging, and between intrinsic fields and spatial extremes. As applications, we apply intrinsic Whittle–Matérn fields to study kidney failure risk and marine heat waves off the Eastern coast of Australia.

Burden, Conrad. The Feller diffusion conditioned on a single founder**Speaker:** Conrad Burden (Australian National University)**Time:** Thu 15:00**Place(s):** TLC-413**Author(s):** Conrad J. Burden, Robert C. Griffiths

The Feller diffusion $(X(\tau))_{\tau \in [0, t]}$ is a stochastic process defined by the generator

$$\mathcal{L} = \frac{1}{2}x \frac{\partial^2}{\partial x^2} + \alpha x \frac{\partial}{\partial x}, \quad x \geq 0, \alpha \in \mathbb{R}.$$

This process was introduced by Feller as the continuum analogue of a classical branching process, primarily with the intention of modelling the growth of a population of statistically independently reproducing individuals.

We examine the distributional properties of a Feller diffusion conditioned on the current population $X(t)$ having a single ancestor at time zero. Our approach exploits Feller’s original solution interpreted as a Poisson number of exponentially distributed families, each descended from a single ancestor. The following properties are determined [1]:

- the distribution of the number of ancestors at intermediate times and joint density of coalescent times given initiation from a single ancestor at a specified time in the past and for a uniform prior on the time since initiation
- the distribution of the time since the most recent common ancestor of two randomly chosen individuals in the current population given initiation from a single ancestor at a specified time in the past
- the joint distribution of the time since the most recent common ancestor of the current population and contemporaneous population size at that time under different assumptions on the time since initiation
- asymptotic forms of distributions in the limit of unbounded exponential growth as $t \rightarrow \infty$ for a supercritical diffusion.

References

- [1] Burden, C. J. and Griffiths, R. C. (2025). The Feller diffusion conditioned on a single ancestral founder. *Theor. Popul. Biol.* 166, 1–15.

Collecchio, Andrea. Once-Reinforced Random Walks**Speaker:** Andrea Collecchio (Monash University)**Time:** Thu 13:30**Place(s):** TLC-413**Author(s):** Andrea Collecchio (Joint Work With Pierre Tarrès)

We present the first rigorous quantitative analysis of once-reinforced random walks (ORRW) on general graphs, based on a novel change of measure formula. This enables us to prove large deviations estimates for the range of the walk on multidimensional euclidean lattices.

Ding, Peng. Stratified Permutational Berry–Esseen Bounds and Their Applications to Statistics**Speaker:** Peng Ding (UC Berkeley)**Time:** Wed 14:00**Place(s):** TLC-415**Author(s):** Peng Ding

The stratified linear permutation statistic arises in various statistics problems, including stratified and post-stratified survey sampling, stratified and post-stratified experiments, conditional permutation tests, etc. Although we can derive the Berry–Esseen bounds for the stratified linear permutation statistic based on existing bounds for the non-stratified statistics, those bounds are not sharp, and moreover, this strategy does not work in general settings with heterogeneous strata with varying sizes. We first use Stein’s method to obtain a unified stratified permutational Berry–Esseen bound that can accommodate heterogeneous strata. We then apply the bound to various statistics problems, leading to stronger theoretical quantifications and thereby facilitating statistical inference in those problems. <https://arxiv.org/abs/2503.13986>

Field, Laurence. Brownian processes made recurrent**Speaker:** Laurence Field (Australian National University)**Time:** Fri 14:30**Place(s):** TLC-415**Author(s):** Laurence Field

Recently there has been substantial interest in random walks reflected at infinity, used as a tool for analysing many objects of interest in discrete probability. The simplest continuous analogy to this is to consider versions of Brownian motion reflected at infinity. This has the effect of converting a transient process into a recurrent one. Depending on the geometry of the ambient space, this can have many interesting consequences which will be discussed.

Frazier, David. Predictively Oriented Posteriors**Speaker:** David Frazier (Monash University)**Time:** Fri 13:30**Place(s):** TLC-413**Author(s):** Yann McLatchie, Badr-Eddine Cherief-Abdellatif, David T. Frazier, Jeremias Knoblauch

We advocate for a new statistical principle that combines the most desirable aspects of both parameter inference and density estimation. This leads us to the PrO posterior, which expresses uncertainty as a consequence of predictive ability. Doing so leads to inferences which predictively dominate both classical and generalised Bayes posterior predictive distributions: up to logarithmic factors, PrO posteriors converge to the predictively optimal model average at rate $n^{-1/2}$. Whereas classical and generalised Bayes posteriors only achieve this rate if the model can recover the data-generating process, PrO posteriors adapt to the level of model misspecification. This means that they concentrate around the true model at rate $n^{1/2}$ in the same way as Bayes and Gibbs posteriors if the model can recover the data-generating distribution, but do *not* concentrate in the presence of non-trivial forms of model misspecification. Instead, they stabilise towards a predictively optimal posterior whose degree of irreducible uncertainty admits an interpretation as the degree of model misspecification—a sharp contrast to how Bayesian uncertainty and its existing extensions behave. Lastly, we show that PrO posteriors can be sampled from by evolving particles based on mean field Langevin dynamics, and verify the practical significance of our theoretical developments on a number of numerical examples.

Gan, Han Liang. Dirichlet approximation of the stationary distribution of the Wright-Fisher model using the prelimit generator comparison approach of Stein’s method**Speaker:** Han Liang Gan (The University of Waikato)**Time:** Thu 15:00**Place(s):** TLC-415**Author(s):** Han L. Gan

The Wright-Fisher model is a model used in mathematical population genetics to study how genetic type frequencies evolve in time. In this talk we bound the rate of convergence of the stationary distribution for a finite population Wright-Fisher Markov chain with parent independent mutation to the Dirichlet distribution. Our result improves the rate of convergence established in Gan Rollin & Ross 2017 from $O(1/\sqrt{N})$ to $O(1/N)$. The results are derived using Stein’s method, in particular, the prelimit generator comparison method. This is joint work with Anton Braverman (Northwestern University).

Geng, Xi. Long Time Asymptotics of the Parabolic Anderson Model in the Hyperbolic Space**Speaker:** Xi Geng (AMSI/University of Melbourne)**Time:** Wed 16:00**Place(s):** TLC-413**Author(s):** Xi Geng, Sheng Wang and Weijun Xu

In this talk, we investigate the long time asymptotic behaviour of the parabolic Anderson model in the hyperbolic space with a time-independent, regular Gaussian potential. The moment asymptotics turns out to be identical to the Euclidean case. An interesting point is that the fluctuation exponent is determined by a variational problem associated with the Euclidean rather than hyperbolic Laplacian. On the other hand, the almost sure growth is drastically different from the Euclidean situation; the logarithmic growth rate is $t^{5/3}$ in contrast to $t\sqrt{\log t}$ as in the Euclidean case and the exact growth constant is determined through an explicit optimisation procedure. Our methodology also reveals a stronger non-Euclidean localisation mechanism for the solution. This is based on joint work with Weijun Xu (Peking University) and my PhD student Sheng Wang.

Grazian, Clara. A Bayesian Semiparametric Bernstein–von Mises Theorem for Long-Memory Models**Speaker:** Clara Grazian (The University of Sydney)**Time:** Tue 14:00**Place(s):** TLC-212**Author(s):** Clara Grazian

Long-memory time series, characterised by hyperbolically decaying autocorrelations, arise in fields such as astronomy, finance, and environmental science. While frequentist approaches to long-memory modelling are well developed, they often face difficulties in delivering coherent uncertainty quantification. We develop a Bayesian semiparametric framework that combines a parametric long-memory component with a nonparametric prior for the short-memory structure. Within this framework, we establish posterior consistency for both components and prove a semiparametric Bernstein–von Mises theorem for the memory parameter, showing that its marginal posterior is asymptotically normal with the semiparametric efficient variance. This result provides a formal justification for Bayesian uncertainty quantification in long-memory models and integrates naturally with modern algorithms for nonparametric Bayesian computation, ensuring both theoretical rigour and practical feasibility.

Griffiths, Robert Charles. de Finetti Random Walks on a Hypercube and Gaussian Fields**Speaker:** Robert Charles Griffiths (Monash University)**Time:** Thu 14:00**Place(s):** TLC-413**Author(s):** Robert Griffiths

This talk will discuss a random walk on the infinite hypercube,

$$X_{t+1} = X_t + Z_t \pmod{2}.$$

The increments (Z_t) are *i.i.d.* with entries that form an infinite exchangeable $\{0,1\}$ sequence, a de Finetti sequence. There is geometric killing in the random walk. A Gaussian free field $(g_x)_{x \in \{0,1\}^\infty}$ is associated with the random walk by taking the covariance function to be proportional to the Green function of the random walk. The Green function and a strong representation for (g_x) are characterized by a negative binomial point process which involves the de Finetti measure of the increments of the random walk.

Hamza, Kais. Are random random walks normal?**Speaker:** Kais Hamza (Monash University)**Time:** Thu 14:30**Place(s):** TLC-413**Author(s):** K. Hamza, L. Tournier

Given a symmetric simple random walk $(X_n)_{n \geq 0}$, the family of symmetric simple random walks $(Y_n)_{n \geq 0}$ adapted to the filtration of $(X_n)_{n \geq 0}$ was studied in Collecchio et al. (2022). In particular, the authors established necessary and sufficient conditions under which a suitably normalized two-dimensional process $((X_n, Y_n))_{n \geq 0}$ converges weakly to a two-dimensional Brownian motion.

When this occurs, we say that the random walk is *normal*. In this paper, we investigate whether a “randomly selected” $(Y_n)_{n \geq 0}$ is normal. We consider two randomization procedures, referred to as the *i.i.d.* and *dependent* cases.

Harris, Simon. Genealogies of samples from stochastic population models

Speaker: Simon Harris (The University of Auckland)

Time: Tue 14:00

Place(s): TLC-413

Author(s): Simon C. Harris

Consider some population evolving stochastically in time. Conditional on the population surviving until some large time T , take a sample of individuals from those alive. What does the ancestral tree drawn out by this sample look like? Some special cases were known, e.g. Durrett (1978), O’Connell (1995), but we will discuss some more recent advances for Bienyame-Galton-Watson (BGW) branching processes conditioned to survive. In near-critical or in critical varying environment BGW settings, the same universal limiting sample genealogy always appears up to some deterministic time change (which only depends on the mean and variance of the offspring distributions). This genealogical tree has the same binary tree topology as the classical Kingman coalescent, but where the coalescent (or split) times are quite different due to stochastic population size effects, with a representation as a mixture of independent identically distributed times. In contrast, in critical infinite variance offspring settings, we find that more complex universal limiting sample genealogies emerge that exhibit multiple-mergers, these being driven by rare but massive birth events within the underlying population (eg. ‘superspreaders’ in an epidemic). Some ongoing work, open problems, and potential downstream applications will be discussed.

This talk is based on collaborative work with Juan Carlos Pardo (CIMAT), Samuel Johnston (Kings College London) in *Annals of Probability* (2024), with Sandra Palau (UNAM), J.C.Pardo in *Annals of Applied Probability* (2024), and with Matt Roberts (Bath), S.Johnston in *Annals of Applied Probability* (2020). I would also like to acknowledge the support of the New Zealand Royal Society Te Apārangi Marsden fund.

He, Mingqi. Simulation-based inference of population histories from local gene genealogies

Speaker: Mingqi He (The University of Melbourne)

Time: Tue 16:30

Place(s): TLC-415

Author(s): Mingqi He, Sophie Hautphenne, Damjan Vukcevic, Stephen Leslie

Genetic variation is strongly shaped by demographic processes, such as population size changes and population splits. Understanding the nature and effect of these processes is a central goal of population genetics. With the advent of high-throughput genetic data and large sample sizes, reconstructing population histories becomes more challenging due to the increased model complexity. To avoid the massive calculations required for estimating the likelihood of large-scale genomic data, we consider Approximate Bayesian Computation (ABC), a simulation-based approach for estimating parameters. To cope with model complexity, we used a robust ABC method coupled with sequential Monte Carlo and neural network. We further leveraged a succinct data structure, “tree sequences”, to efficiently process large genomic dataset and to extract summary statistics directly from the genealogical structure. Our results demonstrate that the sequential step significantly improves both parameter inference and quantile estimation for higher-dimensional parameter vectors. Simulation studies show that ABC gives better accuracy in inferring population size changes and splits when incorporating genealogy-based statistics, rather than only using statistics based on the tips of the genealogy.

Hodgkinson, Liam. Heavy-Tailed Universality in Deep Learning

Speaker: Liam Hodgkinson (The University of Melbourne)

Time: Fri 14:00

Place(s): TLC-413

Author(s): Liam Hodgkinson, Zhichao Wang, Michael W. Mahoney

Recent theoretical and empirical successes in deep learning, including the celebrated neural scaling laws, are punctuated by the observation that many objects of interest tend to exhibit some form of heavy-tailed or power law behavior. In particular, the prevalence of heavy-tailed spectral densities in Jacobians, Hessians, and weight matrices has led to the introduction of the concept of *heavy-tailed mechanistic universality* (HT-MU). Multiple lines of empirical evidence suggest a robust correlation between heavy-tailed metrics and model performance, indicating that HT-MU may be a fundamental aspect of deep learning efficacy. In this talk, I will propose a general family of random matrix models—the high-temperature Marchenko-Pastur (HTMP) ensemble—to explore attributes that give rise to heavy-tailed behavior in trained neural networks. Under this model, spectral densities with power laws on (upper and lower) tails arise through a combination of three independent factors (complex correlation structures in the data; reduced temperatures during training; and reduced eigenvector entropy), appearing as an implicit bias in the model structure, and they can be controlled with an “eigenvalue repulsion” parameter. Implications of our model on other appearances of heavy tails, including neural scaling laws and the five-plus-one phases of neural network training, will be discussed.

Jayakody, Thisaakhya. Analysis of the female family descent tree using the Markovian Binary Tree

Speaker: Thisaakhya Jayakody (The University of Melbourne)

Time: Wed 16:00

Place(s): TLC-415

Author(s): Sophie Hautphenne, Thisaakhya Jayakody, Peter Taylor

Descent trees generated by individual women vary from one country to another. These differences can be investigated using stochastic models. We apply matrix analytic methods and show that the time-inhomogeneous Markovian binary tree (MBT) model is suitable for modelling the lifetime of a woman and the long-term behaviour of a female family line generated by a single woman. Using the MBT we analyse two properties of a family line: the distribution of the total number of female descendants ever born from the woman who initiates the family line, and the probability of extinction of a woman's family line. We analyse these characteristics across various time periods and perform a cross country comparison of these properties.

Keywords: Branching processes, family sizes, extinction, criticality

Johnston, Samuel. On creating convexity in high dimensions

Speaker: Samuel Johnston (Kings College London)

Time: Fri 14:00

Place(s): TLC-415

Author(s): Samuel Johnston

Given a subset $A \subset \mathbb{R}^n$, let $\text{conv}_k(A)$ denote the set of all k -fold convex combinations of points in A ; that is, vectors of the form $\lambda_1 a_1 + \dots + \lambda_k a_k$ with $a_i \in A$, $\lambda_i \geq 0$, and $\lambda_1 + \dots + \lambda_k = 1$. Carathéodory's theorem in convex geometry states that the convex hull of A is precisely $\text{conv}_{n+1}(A)$: in other words, every point in the convex hull can be written as a convex combination of at most $n + 1$ points from A .

In the 1990s, Talagrand asked whether large convex subsets can already be constructed from large sets using only a bounded number $k < n$ of convex combinations, independent of the dimension. In a Gaussian formulation: if g_n denotes the standard Gaussian measure on $\mathbb{R}^n$, does there exist a universal k such that for every set A with $g_n(A) > 0.9$, the set $\text{conv}_k(A)$ contains a convex subset B with $g_n(B) > 0.1$?

Although this problem lies in convex geometry, I will discuss how, in the preprint <https://arxiv.org/abs/2502.10382>, ideas from probability and optimal transport provide new perspectives and some initial inroads on Talagrand's question.

Kabaila, Paul. Unfavorable prior distributions in statistical decision theory

Speaker: Paul Kabaila (La Trobe University)

Time: Fri 14:30

Place(s): TLC-413

Author(s): Assoc Prof Paul Kabaila

I provide a historical overview of the contrast between least favorable and unfavorable prior distributions, in terms of statistical decision theory results and the computation of these prior distributions.

In the 1940's Abraham Wald invented statistical decision theory. He proved that some problems in statistics that concerned simple decision procedures, such as point estimators, could be solved by finding a least favorable prior distribution. Some of logic used in this proof provides, through the employment of an unfavorable prior distribution, a very useful bound on the performance of any such decision procedure. We note a fundamental difference between the computation of least favorable and unfavorable prior distributions.

In the late 1980's Peter Kempthorne extended statistical decision theory to the case that there is an added inequality constraint on a specified risk function. He also proved that some problems in statistics, that concerned decision procedures such as hypothesis tests or confidence intervals, could be solved by finding a least favorable prior distribution. Kabaila and Tuck (2008) used some of the logic in this proof to provide, through the employment of an unfavorable prior distribution, a very useful bound on the performance of such decision procedures. As noted by Kabaila and Kong (2016), there is a fundamental difference between the computation of least favorable and unfavorable prior distributions in this context. This difference is crucial for the successful computation of unfavorable prior distributions, as illustrated by the work of Kabaila and Wijethunga (2024).

References

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- Kabaila, P. and Kong, Y. (2016). Lower bounds on integrated risk, subject to inequality constraints. *Australian & New Zealand Journal of Statistics*, 58, 293–315.
- Kabaila, P. and Wijethunga, C. (2024). Confidence intervals centred on bootstrap smoothed estimators: an impossibility result. *Statistical Papers*, 65, 1531–1551.

Kagan, Alexis. The genealogy of individuals sampled through time in a Galton-Watson tree

Speaker: Alexis Kagan (The University of Auckland)

Time: Tue 14:30

Place(s): TLC-212

Author(s): Alexis Kagan

Pick uniformly, in time interval $[0, T]$, a random number of individuals in a continuous-time Galton-Watson tree. What does their genealogical tree look like? We try to answer this question for fixed T as well as $T \rightarrow \infty$.

Kardkasem, Ruethaichanok. Block Length Selection for Modelling Successive Extremes Using the GEV distribution

Speaker: Ruethaichanok Kardkasem (The University of Queensland)

Time: Wed 15:00

Place(s): TLC-415

Author(s): Ruethaichanok Kardkasem, Meagan Carney

The block maxima (BM) method is commonly used in extreme value theory to model the maximum values across blocks of data using the Generalised Extreme Value (GEV) distribution. However, its effectiveness depends on the choice of block size: small blocks can bias estimates, while large blocks reduce sample size and increase variance. Estimating parameters, particularly by maximum likelihood, can also be unstable with limited data. In the real world, extremes often occur consecutively, violating the assumption of independence and discarding useful information under the BM framework. This study addresses these challenges by proposing a block size selection method specifically designed for consecutive extremes, thereby improving inference for applications such as hydrology, climate, and finance.

Kerlidis, James. Existence and non-existence of consistent estimators in supercritical controlled branching processes

Speaker: James Kerlidis (The University of Melbourne)

Time: Wed 17:00

Place(s): TLC-415

Author(s): Peter Braunstains, Sophie Hautphenne, James Kerlidis

Given a single trajectory of observed population size counts generated from a supercritical controlled branching process, we consider the problem of consistently estimating the process' parameters. We show that, when the control function of the branching process is known, only the offspring mean and variance can be consistently estimated. When the control function itself must also be estimated, only the process' one-step transition mean and variance are consistently estimable. Under the alternative observation scheme where both population size counts and progeny counts are observed, four parameters of the process can be consistently estimated. For each consistently estimable parameter, we derive an explicit expression for its estimator. We conclude with a discussion of the consequences of these results for the estimation of real-world population properties.

Klebaner, Fima. New approximation in non linear stochastic dynamics with small noise

Speaker: Fima Klebaner (Monash University)

Time: Thu 13:30

Place(s): TLC-415

Author(s): Klebaner F., Chigansky P., Bauman N.

It has been suggested since 1950s that stochastic dynamics with small noise first grows like a linear stochastic process and then follows the non linear deterministic dynamics from where first stochastic process stopped. This heuristic was proved by Barbour et al 2015. In this paper we put forward an alternative and, in fact, more accurate approximation which suggests that the stochastic dynamics behaves as a special nonlinear transformation of the linear stochastic process from the very beginning.

We illustrate this on the model of population size dependent branching process with high carrying capacity.

References.

A. D. Barbour, K. Hamza, Haya Kaspı, and F. C. Klebaner. Escape from the boundary in Markov population processes. *Adv. in Appl. Probab.*, 47(4):1190–1211, 2015.

Naor Bauman, Pavel Chigansky, Fima Klebaner An approximation of populations on a habitat with large carrying capacity. *J. Mathematical Biology* 2024, 88:44

Leung, Dennis. Recent advances in normal approximation for U-statistics

Speaker: Dennis Leung (The University of Melbourne)

Time: Fri 15:00

Place(s): TLC-413

Author(s): Dennis Leung

Due to applications such as uncertainty inference in ensemble-based predictions, there has been a resurgence of interest in normal approximation theory for U-statistics, both for their complete and incomplete variants and in both low-dimensional and high-dimensional settings. An overview of the state-of-the-art Berry-Esseen-type normal error bounds is provided for U-statistics, with a particular focus on their optimality with respect to the dependence on the kernel's degree and moment properties.

Lyu, Hongyi. Asymptotic power law of a random graph process

Speaker: Hongyi Lyu (Monash University)

Time: Tue 16:30

Place(s): TLC-413

Author(s): Andrea Collecchio, Hongyi Lyu, Nick Wormald

We consider a random graph evolution model proposed by Richards and Wormald (2014) defined as follows: at each time step a new vertex is added to the graph by first joining to an existing vertex u and then a neighbour of u , where both choices are made uniformly at random. It has been conjectured that the degree distribution obeys a power law asymptotically. We study the neighbourhood growth of each vertex v by coupling it with a randomly evolving tree. As a result, we obtain power-law upper and lower bounds on the asymptotic degree distribution of the original graph model.

Mansor, Mohd Mahayaudin. Prediction of Stroke Status using Logistic Regression based on Modifiable and Non-Modifiable Risk Factors

Speaker: Mohd Mahayaudin Mansor (Universiti Teknologi Mara)

Time: Tue 16:00

Place(s): TLC-415

Author(s): Umi Kalsum Kamaruddin, Mahayaudin M. Mansor*, Sukhminder Kaur, Muhammad Asmu'i Abdul Rahim

Stroke remains a major global cause of mortality and disability, emphasising the importance of early prediction to support preventive and intervention strategies. This study aimed to predict individual stroke risk using logistic regression models that incorporated both modifiable and non-modifiable risk factors. A dataset of 4,603 individuals was analysed, with an initial imbalance of 7.86% stroke-positive cases. A hybrid manual approach combining random oversampling and undersampling created a balanced 50-50% dataset and enhanced model stability. Four logistic regression techniques, namely the full model, forward selection, backward elimination, and stepwise selection, were evaluated across 70-30%, 80-20%, and 90-10% training-to-validation splits. Model performance was assessed using accuracy, precision, sensitivity, specificity, F1 score, mean squared error, root mean squared error, and the ROC index, with gap values utilised to examine generalisability. The stepwise selection model under the 90-10% partition produced the strongest performance, with an accuracy of 69.60%, an F1 score of 91.13%, a sensitivity of 91.70%, a specificity of 74.16%, and an ROC index of 93.98%. This analysis identified key modifiable predictors, including BMI, blood pressure, triglycerides, fasting glucose, glycohemoglobin, dietary intake variables, smoking behaviour, high cholesterol, and hypertension. Key non-modifiable predictors included age, race, and marital status. Individuals aged 18-40 showed 1.13 times increased odds of stroke, and individuals reporting fair general health exhibited 1.86 times greater risk. Non-Hispanic White individuals showed 1.20 times increased odds of stroke, and Non-Hispanic Black individuals experienced a 1.42 times elevation in risk. Separated marital status increased stroke odds by 1.41 times, and never married status increased odds by 1.22 times. Each unit increase in triglycerides raised stroke probability by 1.10 times. We recommend that ongoing targeted interventions focusing on key modifiable risk factors may help reduce stroke probability and improve population health outcomes.

Marcondes, Diego. A resolvent approach to the metastability of Markov processes

Speaker: Diego Marcondes (The Australian National University)

Time: Tue 14:30

Place(s): TLC-413

Author(s): Diego Marcondes

Metastability is a phenomenon observed in stochastic systems that remain in a false equilibrium within a region of their state space until a sequence of rare events triggers a sudden transition to another region. In this talk, I will present a formal definition of metastability for Markov processes and establish a necessary and sufficient condition for its occurrence, expressed in terms of a property of the solutions of the resolvent equation. Examples

of applications in interacting particle systems and stochastic differential equations will be discussed. This is joint work with Claudio Landim and Insuk Seo.

References

- [1] Claudio Landim, Diego Marcondes, and Insuk Seo. Metastable behavior of weakly mixing markov chains: The case of reversible, critical zero-range processes. *The Annals of Probability*, 51(1):157–227, 2023.
- [2] Claudio Landim, Diego Marcondes, and Insuk Seo. A resolvent approach to metastability. *Journal of the European Mathematical Society*, 27(4):1563–1618, 2023.

Marshall, Simon. The Wrapped Hyperbolic Secant Distribution and its Binary Mixtures

Speaker: Simon Marshall (Retired)

Time: Tue 15:00

Place(s): TLC-212

Author(s): Simon L. Marshall

Bimodal circular data are commonly analysed by assembling binary mixtures of von Mises distributions, or by use of the Generalized von Mises distribution. While the latter function has the advantage of being of exponential class, the cumulative probability function is not easily calculated for either distribution, since it involves infinite series of modified Bessel functions. In this article, it is shown that the wrapped hyperbolic secant distribution exhibits similar qualitative behavior to the von Mises distribution, but possesses the additional advantage of being analytically integrable. Rapidly converging series representations of the probability density function are derived, leading to particularly simple expressions for the circular moments of arbitrary order, and computationally robust application of the method of moments to the determination of parameters in binary mixtures of such distributions is described. The use of these distributions in representing bimodal wind direction data is demonstrated.

Mills, Jack. Generalised Polya Urns and Preferential Attachment

Speaker: Jack Mills (Monash University)

Time: Tue 15:00

Place(s): TLC-413

Author(s): Jack Mills

We study a generalised Polya Urn model and show a new phase transition. Consider a single urn containing a single ball, at each time two new balls are added to the system. One ball is added to a new urn and one ball is added to an existing urn chosen with probabilities proportion to a weight function applied to the number of balls in each urn. Depending on the tail behaviour of the weight function, this process exhibits different long term behaviour. We show that there are three phases of behaviour. When the reinforcement is sufficiently weak, all urns will receive infinitely many balls. When the reinforcement is sufficiently strong, the process will localise on a single urn meaning there is a random time after which a single urn will receive all new balls. When the reinforcement is not too strong and not too weak, there is a unique (random) urn which will receive infinitely many balls but the process will not localise on this urn. No monotonicity or regularity assumptions are made on the strength of the reinforcement.

Muirhead, Stephen. Poisson approximation of large gaps in Gaussian zeros

Speaker: Stephen Muirhead (Monash University)

Time: Thu 14:30

Place(s): TLC-415

Author(s): Renjie Feng and Stephen Muirhead

It is a classical result, going back to the 1980s, that the longest runs in a sequence of coin tosses obey a Poisson point process approximation. We show that the Poisson approximation remains true for the gaps between successive zeros of a general stationary Gaussian process with at least polynomial decay of correlations. The main novelty in the proof is to establish an approximate splitting property, with multiplicative error, for gap events in well-separated intervals. This is relatively simple if correlations decay rapidly, but is less straightforward for processes with slow, even non-integrable, polynomial decay of correlations.

Nguyen, Trung Tin. Mathematical Foundations of AI and Data Science for Trustworthy Systems: Leveraging Multimodality and Sparsity

Speaker: Trung Tin Nguyen (Queensland University of Technology)

Time: Tue 17:00

Place(s): TLC-415

Author(s): TrungTin Nguyen

In this talk, I reflect on my research, motivated by a fundamental question: what is life, and what constitutes intelligence—natural and artificial? My work primarily addresses the artificial dimension through trustworthy AI that is scalable, robust, and interpretable, grounded in mathematical and statistical principles. A central thread is multimodality, studied via mixture-of-experts models, and sparsity, explored through feature and model selection, token merging via graph coarsening with spectral preservation, and sparse optimal transport. These methods span applications in natural language processing (large language models), biological data (genomics, transcriptomics, proteomics), computer vision (image segmentation), and quantum chemistry and drug discovery (molecular modeling). I place particular emphasis on parameter estimation and model selection in mixture-of-experts—long-standing challenges due to covariates in gates and experts that induce intricate parameter interactions, which can be described by partial differential equations. To address them, I introduce Voronoi-based loss functions that capture heterogeneous estimation rates and propose general selection frameworks: Bayesian nonparametrics that avoid pre-specifying the number of experts, and dendrogram-based methods on mixing measures that reduce sensitivity to hyperparameters. Finally, I outline how the MACSYS project opens a path to the natural dimension of the question by building a whole-cell computational simulation that integrates modular deep learning (mixture-of-experts, large language models, biologically informed networks) with statistical learning (Bayesian inference, probabilistic graphical models, principled handling of missing data, and multi-omics integration), all grounded in mechanisms derived from real biology. This talk is based on joint work with my main collaborators: Christopher Drovandi (Queensland University of Technology), Hien Duy Nguyen (La Trobe University), Florence Forbes (Inria), Faicel Chamroukhi (IRT SystemX), Nhat Ho (University of Texas at Austin), Geoff McLachlan (University of Queensland), Julyan Arbel (Inria), Huy Nguyen (University of Texas at Austin), Ho Minh Duy Nguyen (Max Planck Research School for Intelligent Systems & DFKI), Dat Do (University of Chicago), and Dung Ngoc Nguyen (CSIRO). I also gratefully acknowledge funding from the Australian Research Council Centre of Excellence for the Mathematical Analysis of Cellular Systems (CE230100001).

Penev, Spiridon. Improved confidence intervals for expectiles

Speaker: Spiridon Penev (UNSW Sydney)

Time: Wed 14:30

Place(s): TLC-415

Author(s): Spiridon Penev and Yoshihiko Maesono

Expectiles were introduced in statistics around 40 years ago but gained renewed interest recently due to their relevance in financial risk management. The 2007–2009 global financial crisis highlighted the need for more robust risk evaluation tools, leading to the adoption of inference methods for expectiles. While first-order asymptotic inference results for expectiles are well established, higher-order asymptotic results remain underdeveloped. We fill this gap by deriving higher-order asymptotic results for expectiles, ultimately improving the accuracy of confidence intervals. First, we outline the derivation of the Edgeworth expansion for both the standardized and studentized versions of the kernel-based estimator of the expectile, using large deviation results on U-statistics. The expansion is then inverted to construct more precise confidence intervals for the expectile. These theoretical results are illustrated with applications to the construction of confidence intervals for moderate sample sizes ranging from 20 to 200. Our enhanced confidence intervals consistently outperform those based on the first-order normal approximation. Our methodology is fully nonparametric and can be applied to any distribution with not too heavy tails.

Perez, Aram. The Face-Cubic Model on the Complete Graph

Speaker: Aram Perez (Monash University)

Time: Wed 16:30

Place(s): TLC-413

Author(s): Timothy M. Garoni, Zongzheng Zhou

The d -component face-cubic model is a generalisation of the Ising model, with a single spin state space consisting of $2d$ vectors pointing towards the face centres of the d -cube. In this talk, we discuss the phase transitions of the model on the complete graph with integer $d \geq 1$, where both continuous ($d \leq 3$) and discontinuous ($d \geq 4$) phase transitions occur, and with $d = 3$ exhibiting tricritical behaviour. We also present various limit theorems describing the fluctuations of the magnetisation at different temperatures and external fields.

Taylor, Peter Gerrard. First passage probabilities and local times for null recurrent Markov additive processes

Speaker: Peter Gerrard Taylor (The University of Melbourne)

Time: Tue 13:30

Place(s): TLC-413

Author(s): Guy Latouche and Peter Taylor

We consider Markov additive processes that are skip-free in the negative direction: M/G/1-type Markov chains and spectrally-positive Markov-modulated Lévy processes.

For M/G/1-type Markov chains, two matrices play an important role: G , the elements of which are rates of transition from level 0 to a lower level, and R whose entries contain information about occupation times at a negative level, per unit of time at level 0. It is known that G and R are algebraically similar and, when the stationary drift is non-zero, a simple relation connects the two, through the expected local time at level 0.

In this talk, we focus on the case when the stationary drift is equal to zero, which has the consequence that the expected local time at level 0 is infinite. We generalise the relation between G and R to this case and we give its physical interpretation. We go on to establish analogous results for spectrally-positive Markov-modulated Lévy processes with zero drift.

Our results are easily adapted to processes skip-free in the positive direction.

Wijesinghe Samarakoon, Nemini Yadeesha Jayani. Haar-Based Multifractional Processes

Speaker: Nemini Yadeesha Jayani Wijesinghe Samarakoon (La Trobe)

Time: Tue 17:00

Place(s): TLC-413

Author(s): Andriy Olenko, Nemini Samarakoon (La Trobe University)

Fractional Brownian motion (fBm) has found numerous applications in finance, physics, and statistics. fBm can incorporate long-range dependence using different constant Hurst parameters. However, the regularity of the trajectories of fBm remains unchanged with time. To overcome this limitation, several multifractional processes were introduced with a time-varying Hurst function allowing to model the regularity of trajectories over time. This talk introduces a new class of multifractional processes, Gaussian Haar-based multifractional processes (GHBMP) [1] based on their Haar wavelet series representation. It is computationally efficient and can capture abrupt changes in the roughness of trajectories. We also introduce the R package Rmfrac that facilitates the simulation of multifractional processes [2]. Moreover, the package provides a collection of tools for analysing and visualising multifractional processes.

References

[1] Ayache, A., Olenko, A., and Samarakoon, N. (2025). On construction, properties and simulation of Haar-based multifractional processes. submitted.

[2] Olenko, A. and Samarakoon, N. (2025). Simulation and statistical analysis of multifractional processes. <https://github.com/Nemini-S/Rmfrac>. R package version 0.1.1.

Wood-Baker, Liam. The Glauber Dynamics for the Mean-Field Face-Cubic Model

Speaker: Liam Wood-Baker (Monash University)

Time: Wed 14:30

Place(s): TLC-413

Author(s): Liam Wood-Baker

The face-cubic model is a generalisation of the Ising model, an important model in statistical mechanics. On a graph $G = (V, E)$, the Ising model is defined by the probability measure

$$\mu(\sigma) \propto e^{-\beta H(\sigma)},$$

where $H(\sigma) = -\sum_{\{i,j\} \in E} \sigma_i \sigma_j$ is the energy of the configuration σ , and σ is an assignment of “spins” drawn from the set $\{-1, +1\}$ to the vertices V .

The face-cubic model generalises the Ising model by extending the set of available spins to the set of vectors which point to the $2d$ faces of a unit d -dimensional hypercube. In less convoluted terms, if $\{e_i\}_{i \in [d]}$ are the standard unit basis vectors for $\mathbb{R}^d$, then a d -dimensional face-cubic configuration assigns a spin from $\{\pm e_i\}_{i \in [d]}$ to each vertex. The energy of a face-cubic configuration is then given by $H(\sigma) = -\sum_{\{i,j\} \in E} \sigma_i \cdot \sigma_j$.

This talk will discuss the Glauber dynamics for the face-cubic model on the complete graph. One of the features of interest is that, in contrast to other related models (e.g., the Potts model, the Blume-Emery-Griffiths model) the face-cubic exhibits a phase transition in each of its two parameters, and a tri-critical point. These phase transitions have a large effect on the mixing time of the dynamics. Of particular interest is the mixing time at the tri-critical point, as the mixing time of such models at tri-critical points is not well-studied.

Xia, Aihua. Poisson process approximation for subgraph-counting process in general random connection models

Speaker: Aihua Xia (The University of Melbourne)

Time: Thu 14:00

Place(s): TLC-415

Author(s): Tianshu Cong, Qingwei Liu, Adrian Röllin and Aihua Xia

Random events in space and/or time can be recorded as a point process, and geometric structures in the point patterns often carry a wealth of useful information about the driving random system. In this talk, we will adopt

a more general perspective to assess the errors in the law of small numbers concerning the statistics of geometric structures. We will implement this idea by considering the subgraph-counting point process of a graph formed by a set of random points in a complete and separable metric space, where any pair of points is connected by an edge with a certain probability, independent of other pairs. The main tools used are the Stein-Chen method and the coupling technique, and the result covers a range of general simple point processes. (Based on a joint work with Tianshu Cong, Qingwei Liu and Adrian Röllin.)

Zhang, Qingyuan. An Inventory System with Two Supply Modes and Lévy Demand

Speaker: Qingyuan Zhang (The University of Queensland)

Time: Wed 17:00

Place(s): TLC-413

Author(s): José-Luis Pérez, Kazutoshi Yamazaki, Qingyuan Zhang

We consider a continuous-review inventory model for a single item with two replenishment modes. Replenishments may occur continuously at any time with a higher unit cost, or at discrete times governed by Poisson arrivals with a lower cost. From a practical standpoint, the model represents an inventory system with random deal offerings. Demand is modeled by a spectrally positive Lévy process (i.e., a Lévy process with only positive jumps), which greatly generalizes existing studies. Replenishment quantities are continuous and backorders are allowed, while lead times, perishability, and lost sales are excluded. Using fluctuation theory for spectrally one-sided Lévy processes, the optimality of a hybrid barrier policy incorporating both kinds of replenishments is established, and a semi-explicit expression for the associated value function is computed. Numerical analysis is provided to support the optimality result.

21. Representation Theory

Carter, Max. The type I dichotomy for two-step nilpotent groups

Speaker: Max Carter (Université Catholique de Louvain)

Time: Tue 17:00

Place(s): TLC-312

Author(s): Max Carter and Pierre-Emmanuel Caprace

A locally compact group G is called *type I* if every unitary representation of G generates a type I von Neumann algebra. It is well known that being type I is equivalent to the following statements: (i) the unitary dual $\widehat{G}$ is a standard Borel space when equipped with the Mackey-Borel structure; (ii) every unitary representation of G *uniquely* decomposes into a direct integral of irreducible unitary representations.

In the case that G is not type I, and hence the above properties do not hold, it is essentially impossible to classify the (irreducible) unitary representations of G . The question of which groups are type I has been studied extensively in the literature, particularly for Lie/algebraic groups over local fields. One exception to this, however, is that it is still unknown whether unipotent groups over positive characteristic local fields are type I. In this talk I will discuss ongoing work regarding determining which contraction groups are type I. Contraction groups are an important class of group which arise in the theory of totally disconnected locally compact groups. They include, for example, various unipotent groups over local fields. In this work, joint with Pierre-Emmanuel Caprace, we prove that many two-step nilpotent unipotent groups over positive characteristic local fields are type I. We also exhibit an uncountable class of two-step nilpotent torsion contraction groups which are not type I. The results rely on an algebraic characterisation of the type I property for two-step nilpotent groups that we produce.

Du, Jie. Canonical bases for quantum $\mathfrak{gl}_{m|n}$

Speaker: Jie Du (University of New South Wales)

Time: Wed 16:30

Place(s): TLC-312

Author(s): Jie Du, Haixia Gu, and Zhongguo Zhou

Using quantum differential operators, we construct a quantum $\mathfrak{gl}_{m|n}$ supermodule structure on a certain polynomial superalgebra. We then extend this representation to its formal power series algebra which contains a submodule isomorphic to the regular representation of this quantum supergroup. In this way, we obtain a new presentation for quantum $\mathfrak{gl}_{m|n}$ by a basis together with explicit multiplication formulas by generators. This allows us to introduce the canonical basis for the $\pm$ -part.

On the other hand, we extend the supermodule structure on the polynomial superalgebra to a (partial) Laurent polynomial superalgebra which induces the regular representation of the modified quantum $\mathfrak{gl}_{m|n}$. In this way, a new presentation and its canonical basis theory are developed for this modified case.

Fell, Tasman. The Diagrammatic Spherical Category

Speaker: Tasman Fell (The University of Sydney)

Time: Tue 15:00

Place(s): TLC-312

Author(s): Tasman Fell

The diagrammatic Hecke category, constructed by Libedinsky, Khovanov, Elias and Williamson, provides a categorification of the Hecke algebra. In this talk I will present another diagrammatic category which categorifies a certain module over the Hecke algebra, called the spherical module. We call this category the diagrammatic spherical category.

Goertzen, Tom. Computing Kazhdan-Lusztig Bases

Speaker: Tom Goertzen (The University of Sydney)

Time: Tue 13:30

Place(s): TLC-312

Author(s): Tom Goertzen and Geordie Williamson

The Kazhdan-Lusztig basis of the Hecke algebra has several important consequences and applications in geometric representation theory and related fields. In this talk, I will present a new conjectural approach to computing the Kazhdan-Lusztig basis evaluated at $v = 1$. For symmetric groups, I will present specialised methods, including a technique for calculating KL left cell representations for Specht modules. I will provide evidence for the conjectures, highlighting open cases, interesting connections and possible generalisations.

Heng, Edmund Xian Chen. Species and algebras in fusion categories

Speaker: Edmund Xian Chen Heng (The University of Sydney)

Time: Wed 15:00

Place(s): TLC-312

Author(s): Edmund Heng, Mateusz Strojinski

In the theory of finite dimensional algebras, a fundamental theorem by Gabriel shows that every algebra is Morita equivalent to a quotient of a quiver algebra. Moreover, the algebra is hereditary (all of its modules have projective dimension ≤ 1) if and only if Morita equivalent to a quiver algebra, i.e. the ideal of the quotient is the trivial ideal.

In this talk, I will speak about its generalisation to algebras in a nice class of monoidal categories known as fusion categories. These will include finite dimensional G -graded algebras (G is a finite group), and many other interesting classes of algebras that I would like to use to answer problems in Coxeter theory (where my main motivation lies).

Jeralds, Sam. Irreducible components in Hochschild cohomology of flag varieties

Speaker: Sam Jeralds (The University of Sydney)

Time: Fri 14:30

Place(s): TLC-312

Author(s): Sam Jeralds

For G a simple, simply-connected complex algebraic group and G/B the associated flag variety, the Hochschild cohomology $HH^*(G/B)$ is a geometric invariant related to its generalized deformation theory. Among its many algebraic properties, $HH^*(G/B)$ admits a $\mathfrak{g} = \text{Lie}(G)$ -module structure. We use classical representation-theoretic techniques, along with a novel connection to a conjecture of Kostant, to understand the irreducible representations appearing in $HH^*(G/B)$.

Klein, Finn. Semisimplifying categorical Heisenberg actions, with applications to modular representation theory of finite groups

Speaker: Finn Klein (The University of Sydney)

Time: Wed 14:00

Place(s): TLC-312

Author(s): Chris Hone, Finn Klein, Bregje Pauwels, Alex Sherman, Oded Yacobi, Victor Zhang

The Duflo-Serganova functor is an indispensable tool in the representation theory of Lie superalgebras. We introduce OTI functors, which generalise this construction to the setting of categorical Heisenberg actions. Applied to classical categorifications of Fock space, OTI functors yield a global construction of periodic equivalences which have been studied by Henke-Koenig and Harman, providing a conceptual source for these phenomena. In this talk, we will motivate and introduce OTI functors and demonstrate applications to the representation theory of symmetric groups.

Li, Yau Wing. Endoscopy for Metaplectic Affine Hecke Categories

Speaker: Yau Wing Li (The University of Melbourne)

Time: Thu 15:00

Place(s): TLC-312

Author(s): Gurbir Dhillon, Yau Wing Li, Zhiwei Yun, Xinwen Zhu

The Hecke category is central in representation theory. A natural generalization considers sheaves on the enhanced affine flag variety with fixed monodromy along orbits of a centrally extended torus. In joint work with Gurbir Dhillon, Zhiwei Yun, and Xinwen Zhu, we show that these monodromic affine Hecke categories are equivalent to non-monodromic affine Hecke categories of smaller groups, extending results of Lusztig and Yun for finite Hecke categories. I will also explain applications of these equivalences to the metaplectic derived Satake equivalence and Gaiety's conjectures in the quantum geometric Langlands program.

Li, Yixuan. A McKay correspondence for Type A Lie Superalgebras

Speaker: Yixuan Li (Australian National University)

Time: Fri 16:30

Place(s): TLC-312

Author(s): Yixuan Li

This is joint work with Mina Aganagic, Jinghang Miao and Spencer Tamagni.

For complex simple Lie algebras of type ADE, the McKay correspondence states that their Weyl groups and root systems can be reconstructed from the geometry of the ADE surface singularities. More precisely, the configuration of exceptional projective lines in the minimal resolution of the ADE singularities give the ADE Dynkin diagrams. The Weyl group action on the root system can be categorified to the braid group action

on coherent sheaves on the minimal resolution, generated by spherical twists by structure sheaves on each exceptional projective line.

In this talk we seek to generalize this to the Lie superalgebra $gl(m|n)$. The singularity in question is $xy = z^m w^n$. In the three dimensional case, there will be many non-isomorphic minimal resolutions related to each other by finitely many flops. This corresponds to the fact there are many inequivalent choices of simple roots because of the existence of odd roots. Corresponding to this fact, the Weyl/braid group is generalized to Weyl/braid groupoid. We'll discuss how to categorify the Weyl groupoid action on roots to derived equivalences of coherent sheaves on these minimal resolutions induced by flops.

Lyu, Mengfan. A Generalization of the Temperley-Lieb Algebra: Coloured Blob Algebras

Speaker: Mengfan Lyu (University of Western Sydney)

Time: Tue 14:00

Place(s): TLC-312

Author(s): Mengfan Lyu

In this talk, I will introduce the coloured blob algebra $CB_{r,n}$, a multi-parameter generalization of the classical Temperley-Lieb algebra that incorporates blobs of $r-1$ distinct colours. I will begin by defining its diagrammatic basis and the relations that govern it.

The main focus will be on establishing the algebraic foundations of $CB_{r,n}$. In particular, I will show that it arises as a quotient of the cyclotomic Hecke algebra $H_{r,1,n}$. This result extends the well-known relationship between the original blob algebra and the Hecke algebra of type B, situating the coloured blob algebra naturally within the broader family of cyclotomic Hecke algebra quotients.

I will also demonstrate that $CB_{r,n}$ is a cellular algebra. This structural property ensures a tractable representation theory and facilitates the explicit construction of its simple modules. The framework developed here opens up new directions for research in diagram algebras, representation theory, and related areas.

Makarova, Svetlana. Generalised Pascal recurrence in lattice vertex operator superalgebras

Speaker: Svetlana Makarova (Australian National University)

Time: Fri 15:00

Place(s): TLC-312

Author(s): Svetlana Makarova

I will present a part of a joint ongoing work with Darlayne Addabbo, Angela Gibney, Lilit Martirosyan and Ava Mock that focuses on the study of vertex operator superalgebras (VOSAs). Lattice VOSAs are a particular type of VOSAs that have appeared in various areas of mathematics: from studying the Monster group, to homology of moduli spaces of objects in abelian categories. Over complex numbers, starting from a lattice L , a lattice VOSA V_L is defined as a tensor product of the Heisenberg representation associated to the commutative Lie algebra $L \otimes \mathbb{C}$ with the group algebra $\mathbb{C}[L]$. Recently, Dong and Griess proved that V_L possesses an integral form $(V_L)_{\mathbb{Z}}$, and Qiang Mu used this integral form to define a lattice VOSA over an arbitrary field $\mathbb{F}$ (possibly of finite characteristic) as $(V_L)_{\mathbb{Z}} \otimes \mathbb{F}$.

We introduce an alternative, axiomatic, definition of a lattice VOSA over an arbitrary field. To obtain it, we use the natural basis of V_L suggested by Dong and Griess, and derive structure constants for vertex operators in this basis. It turns out that some structure constants satisfy a recurrent relation that generalises the Pascal recurrence and has been studied by algebraic combinatorialists; however, we are not aware of this recurrence appearing in representation theory or algebraic geometry.

Maltoni, Leonardo. Filtrations for Rouquier complexes

Speaker: Leonardo Maltoni (The Australian National University)

Time: Wed 17:00

Place(s): TLC-312

Author(s): Leonardo Maltoni

Rouquier complexes provide a categorification of the braid groups. They allow one to refine the study of braid group actions on categories of interest in representation theory, such as, for instance, $\mathcal{D}^b(\mathcal{O}_0)$, the derived category of the principal block of category $\mathcal{O}$. In this talk I will introduce certain filtrations of positive Rouquier complexes that provide a tool to understand them. For example, they seem (work in progress) to produce the minimal complexes in dihedral type.

Marshall, Simon. Uniform bounds for fixed vectors in representations of a p -adic GL_n

Speaker: Simon Marshall (The University of Melbourne)

Time: Fri 13:30

Place(s): TLC-312

Author(s): Rahul Dalal, Mathilde Gerbelli-Gauthier, and Simon Marshall

Let F be a p -adic field with ring of integers $\mathcal{O}$ and maximal ideal $\mathfrak{p}$, and let q be the order of the residue field. Fix a $n \geq 1$. For $\ell \geq 0$, let $K(\ell)$ be the standard principal congruence subgroup of $\mathrm{GL}_n(\mathcal{O})$ consisting of matrices congruent to the identity modulo $\mathfrak{p}^\ell$.

Let π be an irreducible admissible representation of $\mathrm{GL}_n(F)$. My talk will discuss the problem of bounding the growth of the invariants $\dim \pi^{K(\ell)}$ for large ℓ . The Gelfand–Kirillov dimension $d_{\mathrm{GK}}(\pi)$ of π determines this growth, by $\dim \pi^{K(\ell)} \asymp q^{d_{\mathrm{GK}}(\pi)\ell}$, where the implied constants depend on π . I will prove a uniform bound,

$$\dim \pi^{K(\ell)} < C_\varepsilon q^{(d_{\mathrm{GK}}(\pi) + \varepsilon)\ell},$$

where C_ε only depends on n and ε .

Newton, Joseph. $\mathrm{Ver}_{p^n}(G)$?

Speaker: Joseph Newton (The University of Sydney)

Time: Wed 14:30

Place(s): TLC-312

Author(s): Joseph Newton

The Verlinde category Ver_p , an unusual tensor category in characteristic p constructed by semisimplifying tilting modules of SL_2 , has two generalisations. The first is $\mathrm{Ver}_p(G)$, obtained by replacing SL_2 with a simple algebraic group G , and the second is Ver_{p^n} , obtained by quotienting by a different tensor ideal of tilting modules of SL_2 . Previously, it was not clear how to define a category $\mathrm{Ver}_{p^n}(G)$ combining the two generalisations, since the ideals in tilting modules of G were not well understood. In this talk I will propose such a definition, and argue why this definition is the most canonical generalisation. The construction of $\mathrm{Ver}_{p^n}(G)$ also uses new methods that give further insights into $\mathrm{Ver}_{p^n}(\mathrm{SL}_2)$, including a non-monoidal embedding into representations of SL_2 .

O’Sullivan, Jensen. Growth problems of quantum $\mathfrak{sl}_2$

Speaker: Jensen O’Sullivan (The University of Sydney)

Time: Wed 16:00

Place(s): TLC-312

Author(s): Jensen O’Sullivan, Daniel Tubbenhauer

Growth problems in representation theory exhibit asymptotic behaviour closely connected to familiar counting questions in combinatorics, especially random walks. In this friendly talk, we recast tensor power growth in (quantum) $\mathfrak{sl}_2$ as a one-dimensional random walk with a simple “quantum” component, and we use analytic combinatorics to read off the large-scale behaviour. We finish with a bird’s-eye discussion of the general case.

Onn, Uri. A PSH-Algebra Approach to Representations of Automorphism Groups of Modules

Speaker: Uri Onn (Australian National University)

Time: Tue 16:30

Place(s): TLC-312

Author(s): Uri Onn

In 1981, Andrey Zelevinsky developed a Hopf-algebraic approach for organising representations of families of groups such as the symmetric groups and the general linear groups over finite fields. In this talk I will describe a joint work with Tyrone Crisp and Ehud Meir that extends this approach to the family of automorphism groups of finite modules over finite rings.

Stewart, Willow. Diagram Monoids and Cryptography

Speaker: Willow Stewart (The University of Sydney)

Time: Tue 14:30

Place(s): TLC-312

Author(s): Willow Stewart, Dani Tubbenhauer

The linear decomposition attack bypasses the underlying algorithmic problem of a cryptographic protocol, targeting representations of the platform group or monoid. Platform monoids with only large simple representations, which is made more precise in the talk, are more robust against such attacks. We consider diagram monoids such as the Temperley–Lieb, Motzkin, and Rook monoids, along with variations thereof.

Vilonen, Kari. Character Sheaves and Invariant systems

Speaker: Kari Vilonen (The University of Melbourne)

Time: Thu 13:30

Place(s): TLC-312

Author(s): Kari Vilonen

I will discuss character sheaves for vector spaces with a linear action of a reductive group. In some setting the theory has been worked out. I will explain how the theory works in those settings and will make some suggestions for a more general theory.

Wu, Chenyan. Hecke algebras and Langlands parameters for Bernstein blocks of the metaplectic groups

Speaker: Chenyan Wu (The University of Melbourne)

Time: Thu 14:30

Place(s): TLC-312

Author(s): Volker Heiermann, Chenyan Wu

We study the Bernstein blocks of representations of the metaplectic group (a central extension of the symplectic group) in the p -adic setting. First we show that they are equivalent to the categories of right modules over certain Hecke algebras and that the parameters occurring in the Hecke algebras can be expressed in terms of the Langlands parameters of the supercuspidal support of the Bernstein blocks. Based on these, we relate these Bernstein blocks to unipotent Bernstein blocks of quasisplit classical groups, where the representations theory and Langlands parameters are well-known. This is a joint work with Volker Heiermann.

Xue, Ting. Level-rank dualities from d-Harish-Chandra series

Speaker: Ting Xue (The University of Melbourne)

Time: Fri 14:00

Place(s): TLC-312

Author(s): Ting Xue

We explain a conjectural generalisation of Uglov's level-rank (Koszul) duality that arises from d-Harish-Chandra series introduced by Broué-Malle-Michel. We discuss connections with character sheaves for graded Lie algebras and Oblomkov-Yun's construction of rational Cherednik algebra modules using affine Springer fibres. This is based on joint work with Minh-Tam Trinh.

Yanovski, Lior. Generalized induced character formula

Speaker: Lior Yanovski (AMSI/University of Melbourne)

Time: Fri 16:00

Place(s): TLC-312

Author(s): Lior Yanovski

From the categorical perspective, a representation of a group G is a functor from the one-object groupoid BG to a category $\mathcal{C}$. If $\mathcal{C}$ is rigid (symmetric monoidal), to any representation $V: BG \rightarrow \mathcal{C}$ one can associate a character map $\chi_V: G/\text{conj} \rightarrow \text{End}(1_{\mathcal{C}})$. When $\mathcal{C}$ is semiadditive, like the category of finite dimensional vector spaces, to an inclusion of a finite index subgroup $H \rightarrow G$, one can write the character of the induced G -representation in terms of the character of the given H -representation. I will present a joint work with Carmeli, Cnossen, and Ramzi that provides a vast generalisation of this theory replacing $\mathcal{C}$ with a rigid ∞ -category and BG with an arbitrary ∞ -groupoid A . I will explain under which conditions on $\mathcal{C}$ and a map $A \rightarrow B$, there is an induced character formula and what is its general form.

Zhang, Victor. A Diagram Calculus for a few Type-A Lusztig–Vogan Categories

Speaker: Victor Zhang (UNSW Sydney)

Time: Tue 16:00

Place(s): TLC-312

Author(s): Victor Zhang

The Kazhdan–Lusztig conjecture (1979) connects bases of the Hecke algebra to decomposition numbers of important representations of complex semisimple Lie algebras. As an approach to proving the conjecture, a complete diagrammatic language was developed for the category of Soergel bimodules, following the effort of various people throughout the 2000s and 2010s. This diagrammatic theory culminated in an algebraic proof of the conjecture, whose existing proofs rely on the heavy machinery of D -modules, in a more general setting. In the analogous world of real reductive Lie groups, a similar question was asked by Lusztig and Vogan (1983) and proven with geometry. Now, the obvious question is this: can we use diagrammatics here? In view of an answer, we give the beginnings of a diagram calculus, for some real Lie groups of type A.

22. Stochastic Differential Equations

Alghamdi, Maha. Multiscaling limit theorems for stochastic FPDE with cyclic long-range dependence

Speaker: Maha Alghamdi (La Trobe University)

Time: Wed 17:00

Place(s): PS2-330

Author(s): M.M.A. Alghamdi and A.Olenko

In this talk, we discuss multiscaling limit theorems for stochastic partial differential equations with random initial conditions. We consider cases where the initial conditions are subordinated to random processes with cyclic long-range dependence. First, we study the classical heat equation and show that, after appropriate rescaling of time and space and renormalisation, the solution converges to a zero-mean Gaussian random field with an explicitly derived covariance function. We then examine the fractional Riesz–Bessel equation and demonstrate that, under a different scaling, the renormalised solution also converges to a Gaussian limit field, whose covariance involves a Mittag–Leffler function. Finally, we discuss why analogous results do not hold for other cases, in particular, with Hermite rank greater than one, and how to deal with those cases.

The talk is based on joint results [1] with Prof. N.Leonenko (Cardiff University, UK).

References.

[1] M.M.A. Alghamdi, N. Leonenko, and A.Olenko. Multiscaling Limit Theorems for Stochastic FPDE With Cyclic Long-Range Dependence, (2025), will appear in Brazilian Journal of Probability and Statistics.

Carfagnini, Marco. Spectral gaps via small fluctuations

Speaker: Marco Carfagnini (AMSI/University of Melbourne)

Time: Wed 14:30

Place(s): PS2-330

Author(s): Marco Carfagnini

In this talk we will discuss spectral gaps of second order differential operators and their connection to limit laws such as small deviations and Chung’s laws of the iterated logarithm. The main focus is on hypoelliptic diffusions such as horizontal Brownian motions on Carnot groups. If time permits, we will discuss spectral properties and existence of spectral gaps on general Dirichlet metric measure spaces. This talk is based on joint works with Maria (Masha) Gordina and Alexander (Sasha) Teplyaev.

Dooley, Anthony. Lie Symmetries for Stochastic Differential Equations

Speaker: Anthony Dooley (University of Technology Sydney)

Time: Thu 13:30

Place(s): PS2-330

Author(s): Anthony Dooley

The traditional notion of Lie Symmetries is extended to SDE’s, via the backwards Kolmogorov equation.

Forlano, Justin. Invariant Gibbs dynamics for the nonlinear Schrödinger equations on the disc

Speaker: Justin Forlano (Monash University)

Time: Fri 14:00

Place(s): PS2-330

Author(s): Justin Forlano

In 1983, Zakharov posed a question regarding the numerical observations that solutions to nonlinear dispersive PDEs possess a “returning property”: solutions return close to their initial data after a long time. Explaining this phenomenon has partly motivated the program of constructing invariant Gibbs dynamics for nonlinear dispersive PDEs, which presents considerable analytical and probabilistic difficulties. Nonetheless, there has been dramatic progress in this study for equations posed on (flat) tori; a canonical example being the nonlinear Schrödinger equation (NLS), studied in this context by Bourgain, McKean, Tzvetkov, and Deng-Nahmod-Yue. In particular, Tzvetkov (2006) initiated the study of Gibbs dynamics for NLS on other compact manifolds, such as the unit disc with radial symmetry. On the disc, he proved almost sure global well-posedness for sub-quintic nonlinearities, and Bourgain-Bulut (2014) provided weak solutions for all powers. In this talk, I will discuss recent work with Y. Wang (Univ. Birmingham) where we completed this program by constructing a strong global-in-time solution theory for NLS on the disc with respect to the Gibbs measure for all power type-nonlinearities.

Geng, Xi. Hitting Probabilities for Hypoelliptic Differential Equations Driven by Fractional Brownian Motion**Speaker:** Xi Geng (AMSI/University of Melbourne)**Time:** Thu 14:30**Place(s):** PS2-330**Author(s):** Xi Geng and Sheng Wang

In this talk, we establish quantitative upper and lower bounds of hitting probabilities for a hypoelliptic SDE driven by fractional Brownian motion in terms of Newtonian-type capacities associated with a sub-Riemannian metric. Our technique relies on sharp local estimates of the density of solution, which is largely based on Malliavin's calculus from the quantitative perspective of Kusuoka-Stroock. The talk is based on a recent joint work with Sheng Wang.

Hausenblas, Erika. Nonlinear Stochastic Partial Differential equations and cross diffusion**Speaker:** Erika Hausenblas (Montanuniversitaet Leoben)**Time:** Wed 14:00**Place(s):** PS2-330**Author(s):** Erika Hausenblas

Nonlinear partial differential equations naturally arise in many biological and chemical systems. Here, one has to mention cross-diffusion systems, in particular chemotaxis. On the other side, noisy random fluctuations are ubiquitous in the real world. The randomness leads to various new phenomena and may have a non-trivial impact on the behaviour of the solution. The presence of the stochastic term (or noise) in the model often leads to qualitatively new types of behaviour, which helps to understand the real processes and is also often more realistic. Due to the interplay of noise and nonlinearity, noise-induced transitions, stochastic resonance, metastability, or noise-induced chaos may appear.

In our talk, we introduce a chemotaxis system with proliferation, verify the existence and uniqueness of the solution using fixed-point theorems, and present some results on the long-time behavior.

This is a joint work with Debopriya Mukherjee.

Huang, Boris. First-passage times of superdiffusive processes arising from compounded random walks**Speaker:** Boris Huang (UNSW Sydney)**Time:** Wed 15:00**Place(s):** PS2-330**Author(s):** Boris Huang

Numerous mathematical models have been derived through the concept of random walks. These models give useful insight into physical properties, such as first-passage times and reaction dynamics, within biological and chemical processes. It has recently been demonstrated that models which exhibit superdiffusivity on unbounded domains while also being well defined in the bounded domain may be derived via a compounded random walk. In this talk, we formulate the governing equations, which include a space-fractional spectral Fokker-Planck operator, for these models and examine their first-passage properties. Due to the incorporation of compounding in the stochastic formulation, many of the unusual phenomena which arise cannot be obtained from existing models.

Jiao, Chunxi. Pathwise solvability and bubbling in 2D stochastic Landau-Lifshitz-Gilbert equations**Speaker:** Chunxi Jiao (UNSW Sydney)**Time:** Thu 15:00**Place(s):** PS2-330**Author(s):** Ben Goldys, Chunxi Jiao, Christof Melcher

We investigate the stochastic Landau-Lifshitz-Gilbert (LLG) equation on a periodic 2D domain, driven by infinite-dimensional Gaussian noise in a Sobolev class. We establish strong local well-posedness in the energy space and characterize blow-up at random times in terms of energy concentration at small scales (bubbling). By iteration, we construct pathwise global weak solutions, with energy evolving as a càdlàg process, and prove uniqueness within this class. These results offer a stochastic counterpart to the deterministic concept of Struwe solutions. The approach relies on a transformation that leads to a magnetic Landau-Lifshitz-Gilbert equation with random gauge coefficients. This talk is based on joint work with Ben Goldys (USYD) and Christof Melcher (RWTH Aachen University).

Lama, Benedict. Nonlinear heat equation with Dirichlet stochastic boundary conditions

Speaker: Benedict Lama (The University of Sydney)

Time: Wed 16:30

Place(s): PS2-330

Author(s): Benedict Lama, Ben Goldys

We investigate a class of nonlinear heat equations with Dirichlet stochastic boundary conditions on a 1-dimensional domain, formulated as stochastic differential equations on a certain weighted L^p -space with a non-standard weight. By exploiting conditions for the embedding of these spaces, as well as some regularizing properties of the heat semigroup, we establish the existence and uniqueness of mild solutions to the SPDE. A sequence of approximating problems is constructed by approximating the stochastic integral, and by exploiting a dissipative estimate for the generator of the semigroup Δ that holds for appropriately chosen weight. We obtain uniform estimates for the approximations which by compactness of the solution operator imply the existence of solutions. Finally we prove uniqueness of solutions.

Le, Ngan. Convergence analysis and error estimates of numerical approximations for stochastic evolution equations with Leray–Lions operator

Speaker: Ngan Le (Monash University)

Time: Tue 16:30

Place(s): PS2-330

Author(s): Ngan Le

The gradient discretization method (GDM) is a unified framework that encompasses many classical numerical methods—such as finite element, finite volume, and discontinuous Galerkin schemes—for the design and analysis of diffusion models. In this talk, we discuss the application of the GDM to a general stochastic evolution problem governed by a Leray–Lions type operator. The convergence of the gradient scheme (GS) solutions is established using discrete functional analysis techniques together with the monotonicity properties of the Leray–Lions operator. Under additional regularity assumptions on the exact solution, error estimates are also derived. In particular, we provide an independent proof of the existence of strong solutions to the problem in the stochastic sense. This is a joint work with Huateng Zhu.

Le Gia, Quoc Thong. Stochastic Navier-Stokes equations in exterior domains

Speaker: Quoc Thong Le Gia (University of New South Wales)

Time: Tue 16:00

Place(s): PS2-330

Author(s): Z. Brzezniak, Q. T. Le Gia, M. Mohan

We consider the stochastic Navier-Stokes equations on an exterior domain with multiplicative transport noise with slip boundary conditions. Under certain assumptions, we prove the existence of weak martingale solutions to the equations. A key technical difficulty in exterior domains is ensuring the compactness of approximating solutions. In our proof, we use tightness arguments and the Skorokhod theorem to extract a convergent subsequence of approximate solutions, leading to the existence of a global weak solution.

Lee, Haesung. Local elliptic regularity for solutions to stationary Fokker-Planck equations via Dirichlet forms and resolvents

Speaker: Haesung Lee (Kumoh National Institute of Technology)

Time: Tue 14:30

Place(s): PS2-330

Author(s): Haesung Lee

We present a regularity result for the stationary Fokker-Planck equation with general coefficients, emphasizing its connection to the regularity of invariant measures for solutions to the associated stochastic differential equations. The continuity and differentiability of the density of an invariant measure are crucial for its qualitative analysis. Assuming the solution is given as a measure with an L^2 -density, we show that this density exhibits both $W^{1,2}$ -regularity and Hölder continuity. Our approach uses a reference measure associated with a sectorial Dirichlet form and applies elliptic regularity results for both divergence and non-divergence form equations. We further show that the solution density can be approximated by $W^{1,2}$ -functions via the resolvent operator. Our results highlight the central role of Dirichlet form theory in establishing regularity results for invariant measures.

Luk, Stanley. New Analogies for Signatures and Rough Paths**Speaker:** Stanley Luk (University of Technology Sydney)**Time:** Wed 16:00**Place(s):** PS2-330**Author(s):** Stanley Luk

Rough path theory is an integral calculus on finite p -variation continuous functions with $p \geq 2$, through which one is able to integrate with respect to sample paths of various stochastic processes such as Brownian motion, fractional Brownian motions, to name a few. As an alternative to the study of SDEs, in this deterministic framework one solves ODEs driven by such rough paths, called Rough Differential Equations (RDEs). We present aspects of our work on generalising the algebraic and geometric setting where rough paths and signatures of paths live. Morally, an irregular sample path cannot be uniquely determined by its trace alone and requires additional higher order geometric data living in some rigid algebra structure in order to be usefully defined. Although the main ingredients are Hopf algebras and the differential geometry of fibre bundles, we will eschew the technical details for simple examples of other objects this general setting encompasses. There are links to group theory, quantum algebra, and Lie groups in the geometry of physics, all of which provide a rich source of analogies which can be related back to rough paths. With this, we hope to provide new insights into what a rough path fundamentally is.

Nendel, Max. Chernoff approximation of infinitely divisible distributions and Lévy processes with drift**Speaker:** Max Nendel (University of Waterloo)**Time:** Tue 13:30**Place(s):** PS2-330**Author(s):** Max Nendel

The first part of the talk is concerned with a sufficient and necessary condition for families of probability measures, indexed by positive real numbers, to give rise to a convolution semigroup via a Chernoff approximation on the space of bounded continuous functions, equipped with the mixed topology. We provide explicit criteria for both the convergence of subsequences and the entire family. In a second step, we add a deterministic displacement of the initial position of the process over time to the approximation scheme. In this case, the Chernoff approximation leads to the transition semigroup of a Lévy process with drift.

Perruchaud, Pierre. Constructive quantum field theory: an approach via the Brownian loop soup**Speaker:** Pierre Perruchaud (Monash University)**Time:** Fri 14:30**Place(s):** PS2-330**Author(s):** Pierre Perruchaud and Isao Sauzedde

In the standard model of particle physics, the main mathematical protagonists are sections of vector bundles (modelling e.g. the electron field) and connections on these bundles (modelling e.g. the electromagnetic potential). Although they are well-understood by the geometry community, theoretical physics describes some sort of evolution equation for those, and the question of existence of a solution is widely open. In fact, even the Yang–Mills simplification is an unsolved millennium prize problem.

It is believed that we can approach problems of this type by constructing a random measure on a space of pairs (section, connection). In this talk, we will discuss the stochastic analysis approach to the construction of such measures. In particular, we will see how Brownian motion, and more specifically the Brownian loop soup, provides many tools which we can combine to express more and more complex physical theories.

Sharma, Upanshu. Constraints in Stochastic Differential Equations**Speaker:** Upanshu Sharma (UNSW Sydney)**Time:** Thu 14:00**Place(s):** PS2-330**Author(s):** Carsten Hartmann, Lara Neureither, Upanshu Sharma

Sampling probability measures on submanifolds is an important task in molecular dynamics. This is typically achieved by adding constraints to a stochastic differential equations (SDEs). This work deals with the analysis of soft-constrained problem for the Langevin dynamics (which corresponds to the kinetic Fokker-Planck equation). In particular, we analyse the so-called 'soft-constrained' Langevin dynamics in the limit of infinite scale-separation and analyse the steady-state behaviour.

Soenjaya, Agus. Finite element approximations of stochastic magnetisation dynamics at elevated temperatures

Speaker: Agus Soenjaya (University of New South Wales)

Time: Tue 17:00

Place(s): PS2-330

Author(s): Agus Soenjaya, Ben Goldys, Thanh Tran

The stochastic Landau-Lifshitz-Bloch (sLLB) and stochastic Landau-Lifshitz-Baryakhtar (sLLBar) equations describe the dynamics of magnetisation in bounded ferromagnets at elevated temperatures, with the sLLBar equation serving as a physically meaningful regularisation of the sLLB model. In this work, we develop and analyse fully discrete finite element methods (FEM) for these nonlinear stochastic systems. We first construct a mixed FEM for the sLLBar equation, which effectively provides a numerical approach to the sLLB equation through its regularised formulation. To overcome the analytical difficulties due to nonlinearities and stochastic forcing, we employ a ‘truncate-then-discretise’ strategy, where the nonlinear term is truncated before spatial and temporal discretisation. We show that the strong solution of the truncated problem converges in probability to that of the original equation, and we establish both convergence in probability and strong convergence of the scheme with quantitative rates. In the special case $d = 1$, the sLLB equation possesses sufficient regularity to allow direct discretisation (without regularisation), and we design a linear finite element scheme accordingly. Numerical experiments are presented to verify the theoretical rates of convergence.

Tai, Ho Man. Global Well-Posedness of Extended Mean Field Games Depending on Law of Control

Speaker: Ho Man Tai (The University of Sydney)

Time: Tue 15:00

Place(s): PS2-330

Author(s): Alain Bensoussan, Bohan Li, Ho Man Tai, Tak Kwong Wong, and Sheung Chi Phillip Yam

This talk discusses a class of extended mean field games with common noise, where the nonlinear drift and cost functions are nonseparable in the mean field terms of both the state and the control. We first fix the mean field terms and apply the stochastic maximum principle to derive the associated forward-backward stochastic differential equations (FBSDE) along with the first-order optimality condition. Due to the nonseparability of the control variable and its distribution in this first-order condition, we employ Schauder’s fixed point theorem on a convex compact subset of the 2-Wasserstein space to ensure the consistency between the distribution of the optimal control and the given exogenous mean field input. To establish global well-posedness of the McKean–Vlasov functional FBSDE, we derive an upper bound on the sensitivity of the costate with respect to the initial condition, which enables the concatenation of local solutions. Our analysis applies to two distinct cases: one assumes strict convexity in the control and state variables, as well as their distributions; the other does not require convexity in the state or its law. The former guarantees well-posedness for any finite horizon, while the latter ensures it over a finite horizon which is not small.

23. Topology

Bandara, Lashi. Cutting and gluing via matching boundary conditions

Speaker: Lashi Bandara (Deakin University)

Time: Fri 17:00

Place(s): TLC-315

Author(s): Christian Bär, Lashi Bandara

The Bär-Ballmann approach to the relative index theorem originally proved by Gromov-Lawson was through the innovation of a set of tools to cut along 2-sided compact hypersurfaces while retaining index information of the original and induced operators. These results, originally restricted to a special class of operators, have now been obtained for general first-order elliptic operators. These results will be explained with a focus on cutting and gluing useful in topological applications.

Dearrictott, Owen. The Eells-Kuiper invariant of certain cohomogeneity one 7-manifolds

Speaker: Owen Dearrictott (La Trobe University)

Time: Fri 16:00

Place(s): TLC-315

Author(s): Owen Dearrictott

Consider a 7-dimensional Riemannian manifold M on which $\mathrm{Sp}(1) \times \mathrm{Sp}(1)$ acts isometrically with finite principal isotropy, and a pair of codimension two singular orbits $M_{\pm}$. Consider a normal geodesic $c : [-1, 1] \rightarrow M$ linking M_- to M_+ ; let $H_{\pm} = \lim_{t \rightarrow \pm 1} G_{c(t)}$ where $G_{c(t)}$ is the (finite) isotropy of the point $c(t)$. Let $C_{(p,q)}^a \equiv \{(e^{ap\theta}, e^{bq\theta}) : \theta \in \mathbb{R}\}$, where a is a unit imaginary quaternion. Further suppose the singular isotropies, $K_- = G_{c(-1)} \equiv C_{(p_-, q_-)}^i \cdot H_-$ and $K_+ = G_{c(1)} \equiv C_{(p_+, q_+)}^j \cdot H_+$ and, moreover, that $|C_{(p_-, q_-)}^i \cap H_-| = 4$ and $|C_{(p_+, q_+)}^j \cap H_+| = \kappa$ where $\kappa = 4$ when both p_+ and q_+ are odd and $\kappa = 2$ if one is odd and the other even.

In this talk, following the work of Sebastian Goette, we calculate the Eells-Kuiper invariant of M in some special cases. Namely (i) when $p_- = q_- = 1$, $p_+ = k$ is odd and $q_+ = k + 2$; (ii) when $p_- = q_- = 1$, $p_+ = k$ is even and $q_+ = k + 1$; (iii) when $p_- = q_- = 1$, $p_+ = k$ is odd and $q_+ = k + 1$; and the two ugly ducklings (iv) $p_- = q_- = 1$, $p_+ = 5$ and $q_+ = 9$; and (v) $p_- = q_- = 1$, $p_+ = 4$ and $q_+ = 7$.

Following Goette and Crowley, we show the ugly duckling in (iv) is diffeomorphic to a 3-sphere bundle over the 4-sphere.

DiMichele, Natalie. Unknot Recognition through an Operations Research Lens

Speaker: Natalie DiMichele (The University of Queensland)

Time: Wed 16:30

Place(s): TLC-212

Author(s): Natalie DiMichele, Michael Forbes

Unknot recognition is a fundamental problem in computational topology: determining whether a given knot can be untangled into a simple unknotted loop. Previously, commercial optimisation solvers have not been used to solve this problem due to the uncertainties of floating-point arithmetic. In this talk I will discuss our approach to unknot recognition, which includes a framework to utilise commercial solvers with mathematical certainty.

Elzenaar, Alexander. Generalised Ford domains arising from peripheral geometry

Speaker: Alexander Elzenaar (Monash University)

Time: Tue 13:30

Place(s): TLC-315

Author(s): A. Elzenaar

Let M be a geometrically finite hyperbolic 3-manifold that supports quasi-isometric deformations. The holonomy groups of these deformations form an open subset of the set of representations $\pi_1(M) \rightarrow \mathrm{Conf}^+(\mathbb{S}^2) \simeq \mathrm{PSL}(2, \mathbb{C})$. We describe some constructions of explicit fundamental domains for the representations in this quasi-isometry locus; these domains move smoothly, capture information about the conformal action, and can be used for discreteness and isomorphism-type certifications. The work is motivated by generalisations of domains studied in the context of four-punctured sphere and once-punctured torus bundles.

Heiss-Synak, Teresa. New Method for Analyzing The Hole-Structure of a Crystal: Merge Trees of Periodic Filtrations

Speaker: Teresa Heiss-Synak (The Australian National University)

Time: Fri 16:00

Place(s): TLC-317

Author(s): Herbert Edelsbrunner, Teresa Heiss-Synak

Periodic data is abundant in materials science; for example, the atoms of a crystalline material repeat periodically. Additionally, periodic boundary conditions are used in many simulations, for example in molecular dynamics simulations of materials, to remove boundary effects. However, it is unclear how to deal with the periodicity of the data when computing topological descriptors, like the merge tree or persistent homology, which track connected components or holes at different length scales. A classical approach is to compute the respective descriptor simply on the torus. However, this does not give the information needed for many applications and is even unstable under certain types of noise. Therefore, we suggest decorating the merge tree gained from the torus with additional information, describing for each connected component on the torus how many components of the infinite periodic space map to it. As there are often infinitely many, we describe their density and growth rate inside a growing sphere. The resulting periodic merge tree and its induced periodic 0-th persistence barcode carry the desired information and satisfy the desired properties, in particular: stability and efficient computability (under mild assumptions, the running time is of order $(n + m)\log(m)$, where n and m are the number of vertices and edges per fundamental domain). This is joint work with Herbert Edelsbrunner.

Hekmati, Pedram. New invariants of involutions on rational homology spheres

Speaker: Pedram Hekmati (The University of Auckland)

Time: Fri 13:30

Place(s): [TLC-315](#)

Author(s): Pedram Hekmati

There has recently been a surge of interest in gauge theoretic invariants of 3- and 4-manifolds equipped with an involution, i.e. a periodic diffeomorphism of order 2. Equivariant Seiberg-Witten Floer theory of rational homology spheres gives rise to different families of numerical invariants depending on the spin^c structure involved. In this talk, I will discuss these invariants and some of their applications, such as for detecting non-smoothable and non-extendable involutions on 4-manifolds with boundary. This is joint work with David Baraglia.

Hertl, Thorsten. Moduli Spaces of G2 manifolds may have holes

Speaker: Thorsten Hertl (The University of Melbourne)

Time: Fri 15:00

Place(s): [TLC-315](#)

Author(s): Diarmuid Crowley, Sebastian Goette, and Thorsten Hertl

In his two seminal articles, Dominic Joyce not only constructed the first examples of closed manifolds with G2-holonomy metrics, but also proved that the moduli space of all G2-metrics on a closed manifold is itself a finite-dimensional manifold. The statement is, however, only a local one, and the global topological properties of these moduli spaces have remained quite mysterious ever since. Indeed, up to now, we only know that they may be disconnected by the work of Crowley, Goette, and Nordström; the question whether all path components are contractible or not has not been answered yet.

In this talk, I will outline how to construct elements in the second homotopy group of the moduli space of G2 metrics on Joyce's examples and present along the way a homotopy-theoretical result that guarantees their non-triviality. This talk is based on joint work with Diarmuid Crowley and Sebastian Goette.

Hui, Connie On Yu. A new algorithm for constructing knots and links in templates and finding upper hyperbolic volume bounds

Speaker: Connie On Yu Hui (Monash University)

Time: Tue 15:00

Place(s): [TLC-315](#)

Author(s): Connie On Yu Hui

In the 1970s, Williams developed an algorithm that has been used to construct and study modular links in the Lorenz template. We introduce an improved algorithm, which we call the bunch algorithm, to provide more insights into the geometry of modular links and Lorenz links. Using the machinery developed for the bunch algorithm, we provide the first upper volume bound that is independent of word exponents and quadratic in the braid index of the Lorenz link component for all modular link complements. We later discovered that the bunch algorithm and volume bound results can be generalised to infinitely many Lorenz-like templates, and thus provide upper volume bounds for all link complements in the 3-sphere.

Ibarra, Dionne. Cubic Skein Modules

Speaker: Dionne Ibarra (Monash University)

Time: Fri 15:00

Place(s): [TLC-317](#)

Author(s): Rhea Palak Bakshi, Anthony Christiana, Huizeng Guo, Dionne Ibarra, Louis H. Kauffman, Gabriel Montoya-Vega, Sujoy Mukherjee, Jozef H. Przytycki, and Xiao Wang

The study of linear and quadratic skein modules over the last thirty-seven years has led to a very rich skein theory that is connected to many disciplines of mathematics and physics. In this talk we discuss another class of skein modules defined using a cubic skein relation $b_0L_0 + b_1L_1 + b_2L_2 + b_3L_3 + b_\infty L_\infty$. Tsukamoto and Przytycki studied the cubic skein module for $b_\infty = 0$. For b_∞ invertible, a Dubrovnik and Kauffman 2-variable cubic skein relation can be recovered. In this talk we will explore restrictions to the coefficients with the goal of obtaining a cubic skein relation that cannot be reduced to a quadratic or linear skein relation and we conjecture an new invariant of 3-algebraic links.

Jethva, Paawan. Cohomology Rings of Topological and Smooth 4-Manifolds

Speaker: Paawan Jethva (The University of Adelaide)

Time: Thu 13:30

Place(s): TLC-315

Author(s): Paawan Jethva

In the theory of manifolds, dimension 4 occupies a special place: it lies at the boundary between the high- and low- dimensional worlds and behaves wildly differently from both. In particular, it is the first dimension where the topological and smooth theories diverge. A powerful classical invariant we have for studying 4-manifolds is the cohomology ring. Freedman showed that this invariant almost completely classifies simply-connected 4-manifolds, while Donaldson established strong constraints on it in the smooth setting.

In this talk, we will describe the algebraic structure of cohomology rings of (not necessarily simply-connected) 4-manifolds, investigate when such structures arise from actual manifolds, and discuss the restrictions in the smooth case. We find that a certain subclass of these algebraic structures is always topologically realisable, but there are known and conjectured obstructions in smooth realisability. Conversely, a part of the structure is always smoothly realisable—a phenomenon that persists in all dimensions $n \geq 3$. For $n = 3$, this yields a new proof of a theorem of Sullivan.

Kamgarpour, Masoud. Differential Equations and Knot Theory

Speaker: Masoud Kamgarpour (The University of Queensland)

Time: Thu 14:30

Place(s): TLC-315

Author(s): Masoud Kamgarpour

In this talk, I will present a striking connection between linear ordinary differential equations and braid theory. To every such equation, one can naturally associate a braid, and by closing this braid, a link. Remarkably, subtle invariants of this link—such as the triply graded Khovanov–Rozansky homology—encode deep information about the equation’s solutions. This emerging viewpoint offers a new geometric framework for understanding the analytic behaviour of differential equations.

Joint work in progress with Konstantin Jakob.

Larusson, Finnur. Homotopy types of spaces of algebraic and holomorphic maps

Speaker: Finnur Larusson (The University of Adelaide)

Time: Thu 15:00

Place(s): TLC-315

Author(s): Finnur Larusson

Let X and Y be smooth algebraic varieties (over the complex numbers) and let $\mathcal{A}$, $\mathcal{O}$, and $\mathcal{C}$ be the spaces of algebraic, holomorphic, and continuous maps $X \rightarrow Y$, respectively, with the compact-open topology. What are the homotopy types of these spaces and how do they compare? I will present recent joint work with Antonio Alarcón and Franc Forstnerič on this question and describe the broader context of our work. Under certain conditions, the inclusion $\mathcal{O} \hookrightarrow \mathcal{C}$ is a weak homotopy equivalence and sometimes even a genuine homotopy equivalence. Under more restrictive conditions, the inclusion $\mathcal{A} \hookrightarrow \mathcal{C}$ is a weak homotopy equivalence, except it need not be a π_0 -epimorphism.

Marshall, Lavender. What is a partial Heegaard diagram

Speaker: Lavender Marshall (Monash University)

Time: Thu 14:00

Place(s): TLC-315

Author(s): Lavender Marshall

Bordered sutured Heegaard diagrams were introduced by Zarev, relating bordered Heegaard Floer homology to sutured Floer homology. I give an alternative interpretation by which a sutured manifold is associated with bordered sutured Heegaard diagram.

McQuire, Emma. Octahedral links and TV volume conjecture**Speaker:** Emma McQuire (Monash University)**Time:** Tue 14:30**Place(s):** TLC-315**Author(s):** Emma McQuire, Dionne Ibarra, Jessica Purcell

The Turaev-Viro invariants are real-valued invariants of a 3-manifold, defined from a triangulation. There is a volume conjecture, due to Qingtao Chen and Tian Yang, which states that a certain limit of these invariants coincides with the hyperbolic volume of the corresponding manifold. We study this conjecture in relation to fully augmented links, a family of links in the 3-sphere with well known geometric properties. We relate certain fully augmented links to fundamental shadow links, a family of links which are known to satisfy the Turaev-Viro volume conjecture. This is joint work with Dionne Ibarra and Jessica Purcell.

Morgan, James. A combinatorial thick-thin decomposition for closed irreducible 3-manifolds**Speaker:** James Morgan (The University of Sydney)**Time:** Tue 17:00**Place(s):** TLC-315**Author(s):** James Morgan, Stephan Tillmann

Thick-thin decompositions provide a controlled way to study hyperbolic 3-manifolds. Each component of the thin part consists of Margulis tubes and cusps and there are finitely many homeomorphism types of thick parts of all hyperbolic 3 manifolds up to some volume $V > 0$.

In this talk we introduce a combinatorial thick thin decomposition of closed, orientable, irreducible 3-manifolds with non-trivial $\mathbb{Z}_2$ homology. We do this by building on previous work of Jaco, Rubinstein, Spreer, and Tillmann which provides lower bounds on the complexity of such 3 manifolds via a $\mathbb{Z}_2$ analogue of Thurston's norm.

This is joint work with Stephan Tillmann

Neuhauser, Leor. The Multiplicative Structure of Cobordisms**Speaker:** Leor Neuhauser (Hebrew University)**Time:** Tue 16:00**Place(s):** TLC-315**Author(s):** Shai Keidar, Leor Neuhauser, Lior Yanovski

Cobordisms, a fundamental concept from differential topology, play a deep role in both homotopy theory and higher category theory. In homotopy theory, (framed) n -manifolds up to cobordism are isomorphic to the n -th stable homotopy group of spheres. This isomorphism preserves the graded ring structure, with addition corresponding to disjoint union of manifolds and multiplication corresponding to products of manifolds.

In the context of higher categories, there is an (∞, n) -category Bord_n of (framed) 0-manifolds, with 1-bordisms between them, 2-bordism between bordisms, and so on up to dimension n . The *cobordism hypothesis* posits that Bord_n is the free fully-dualizable (∞, n) -category on a single generator. While the additive structure of disjoint union naturally lifts to a symmetric monoidal structure on Bord_n , lifting the multiplicative structure is more subtle. In this talk, I will describe how we construct this multiplicative structure, and how it relates to the cobordism hypothesis.

Reid, Corbin. Highly Geometric Links in General 3-Manifolds**Speaker:** Corbin Reid (Monash University)**Time:** Tue 14:00**Place(s):** TLC-315**Author(s):** Corbin Reid

Fully augmented links are a class of links that are widely used in knot theory for their highly geometric structure, which is simple to explore from their planar diagrams in the 3-sphere. Recently, there has been growing interest in knots with diagrams on different surfaces and in other 3-manifolds, and fully augmented links generalise to this setting; however, the simple tools relating their diagrams to their geometry do not. Some of the rigid geometry is expected to carry over, but determining exactly how much requires new approaches. We find by applying combinatorial (rather than geometric) techniques that many of the useful geometric properties of these links are retained in this new setting.

Robertson, Marcy. Homotopy props in quantization**Speaker:** Marcy Robertson (The University of Melbourne)**Time:** Fri 14:30**Place(s):** TLC-315**Author(s):** Marcy Robertson

In their 2009 work on the quantisation of coboundary Lie bialgebras, Enriquez and Halbout introduced “quasi-categories” and “quasi-props”. From today’s perspective, these can be seen as early instances of 2-Segal spaces and commutative monoids in a category of 2-Segal spaces. I will sketch this reinterpretation, explain how it reframes Enriquez’s constructions in modern homotopy-theoretic language, and suggest how it opens the door to new applications.

Singh, Chandan. Grothendieck–Teichmüller Symmetries of Tangles**Speaker:** Chandan Singh (The University of Melbourne)**Time:** Wed 14:30**Place(s):** TLC-212**Author(s):** Chandan Singh

The Grothendieck–Teichmüller group GT , introduced by Drinfeld in the 1990s, is an automorphism group of certain completion of braids that satisfies certain algebraic equations. The profinite version of GT is conjectured to be isomorphic to the absolute Galois group of rationals. In recent years, there has been significant progress in understanding GT using operads – algebraic structures that model operations with multiple inputs and one output. In this talk I will present a new characterization of the profinite GT using cyclic operads and explain how GT acts on tangles. This is a joint work with Marcy Robertson.

Spreer, Jonathan. A Practical Algorithm for Knot Factorisation**Speaker:** Jonathan Spreer (The University of Sydney)**Time:** Fri 14:30**Place(s):** TLC-317**Author(s):** Jonathan Spreer

We present an algorithm for computing the prime factorisation of a knot, which is practical in the following sense: using Regina, we give an implementation that works well for inputs of reasonable size, including prime knots from the 19-crossing census. The main new ingredient in this work is an object that we call an “edge-ideal triangulation”, which is what our algorithm uses to represent knots.

This is joint work with Alex He and Eric Sedgwick.

Thompson, Finn. Numerically investigating the space writhe and rope length of knots**Speaker:** Finn Thompson (The University of Queensland)**Time:** Wed 17:00**Place(s):** TLC-212**Author(s):** Finn Thompson

The space writhe of a knot measures how ‘coiled’ a knot is in 3-space, and is taken as the average writhe of a configuration of a knot from all viewing points. By performing dynamical simulations, we can model a knot as a polymer to explore the relation between the space writhe and ‘standard’ writhe for various configurations.

Additionally, we will discuss a method for determining upper bounds on the rope length of (nQ, Q) torus links by optimising a superhelical ‘building block’ of Q helices. This is joint work with Alexander Klotz.

Tobin, Lucy. Sampling Manifolds with Grid Diagrams**Speaker:** Lucy Tobin (The University of Sydney)**Time:** Tue 16:30**Place(s):** TLC-315**Author(s):** Lucy Tobin

If you ask a topologist to name their favourite 3- or 4-manifold, chances are they’ll give you a nice answer - a well-behaved, easy to understand manifold, but not really a generic one. So we ask: is it possible to make a program - a “press for random manifold” button - that can generate you something genuinely generic, presented in a form you can work with computationally? This would both give insight into what a “typical” manifold looks like, and be a useful resource for testing conjectures.

I’ll introduce a new approach to this problem, which involves sampling random links using grid diagrams, interpreting these links as Kirby diagrams, and using a construction of Casali and Cristofori to build triangulations of the corresponding 3- or 4-manifolds. We can then discuss its successes, complications, and early data and results.

Whitbread, Bailey. Spectroscopy for knots**Speaker:** Bailey Whitbread (The University of Sydney)**Time:** Wed 16:00**Place(s):** TLC-212**Author(s):** Bailey Whitbread

This talk is about using the representation theory of finite groups to attack a problem concerning the Jones polynomial. A non-trivial relation between two innocent matrices would give rise to a non-trivial link with trivial Jones polynomial. We will see how the search for a non-trivial relation is susceptible to the tools of representation theory of finite groups.

Wilkinson-Finch, Tilda. Prime Decomposition Theorems for Long Virtual Knots**Speaker:** Tilda Wilkinson-Finch (The University of Sydney)**Time:** Wed 15:00**Place(s):** TLC-212**Author(s):** Tilda Wilkinson-Finch, Zsuzsanna Dancso, and Hans Boden

We present a prime decomposition theorem for long virtual knots. The uniqueness of prime decompositions for round virtual knots (Matveev, 2012) is subject to a caveat, as the connected sum of two trivial virtual knots is not necessarily trivial (the key example is due to Kishino). We show that this obstacle is eliminated when passing to long virtual knots, and in this case both existence and uniqueness hold. On the way, we survey results on prime decompositions of classical, surface and virtual knots. Our proof is based on the general scheme set out by Matveev, which uses the Diamond Lemma in graph theory to streamline prime decomposition proofs in low-dimensional topology in general. We outline possible directions for future research. This talk is based on joint work with Hans Boden and Zsuzsanna Dancso.

Yanovski, Lior. The J -homomorphism and higher additive structure**Speaker:** Lior Yanovski (AMSI/University of Melbourne)**Time:** Fri 16:30**Place(s):** TLC-315**Author(s):** Lior Yanovski

The real J -homomorphism is a map $KO \rightarrow \mathrm{gl}_1(\mathbb{S})$ from the real K -theory spectrum to the sphere of units of the sphere spectrum $\mathbb{S}$. Geometrically, it comes from taking a real vector space V to its one-point compactification S^V , and it is a homomorphism since direct sums of vector spaces are mapped to smash products of the corresponding spheres. The image of J in stable homotopy captures the first chromatic layer of the stable stems. In joint work in progress with Shachar Carmeli, we show that after completion at a prime p , the J -homomorphism admits a refinement as a homomorphism for a certain “higher additive structure”. This connects the Hopkins-Lurie notion of ambidexterity in chromatic localisations with generalised forms of the Segal conjecture.

Zymaris, Orion. Descartes' Theorem and the Circle Packing Equations**Speaker:** Orion Zymaris (Monash University)**Time:** Wed 14:00**Place(s):** TLC-212**Author(s):** Orion Zymaris and Daniel Mathews

A classical result (due originally to Descartes) gives a simple algebraic relation on the Euclidean 3-flower, a simple arrangement of 3 petal circles arranged around a fourth such that all four are mutually tangent. Recent work of Daniel Mathews and myself generalises this algebraic relation to any Euclidean n -flower, and further provides gluing and compatibility conditions to combine n -flowers so that a broad range of circle packings can be parameterised by solutions to a set of polynomials, the circle packing equations.

24. Visualisation, Mathematical Art, Engagement and Outreach

Afifurrahman, Muhammad. Mettamatika: How to Make Illustrated Mathematical Books

Speaker: Muhammad Afifurrahman (UNSW Sydney)

Time: Tue 16:00

Place(s): PS2-212

Author(s): Muhammad Afifurrahman

This talk presents Mettamatika, a pop-culture project of illustrated mathematical books and zines in Bahasa Indonesia. The project has resulted in three series of zines and two illustrated books since 2023 which are released in Comic Frontier, Indonesia's largest comic & fanwork convention market. I will present the background and results of this project with some illustrations (when time permits).

Presented as part of Spearhead Circle, an Indonesian pop-culture collaborative circle.

Assis, Michael. Enumerating convex quadrilateral origami waterbomb tiling patterns

Speaker: Michael Assis (The University of Melbourne)

Time: Wed 16:30

Place(s): PS2-212

Author(s): Sukanya Deshmukh, Benjamin Parker, Michael Assis

Origami waterbomb crease patterns have been explored in design and proposed for use in architecture since the 1960s. Waterbomb patterns are made up of repeating polygonal units such that after folding, the perimeter of the units are all co-planar. Most patterns found involve convex regular polygon units (equilateral triangles, squares, and regular hexagons) or rectangles. With recent interest in rigidly foldable patterns in engineering, enumerating and finding waterbomb patterns that are less symmetric can open up new possibilities for applications. We aim, therefore, to enumerate all convex quadrilateral waterbomb patterns in origami.

Here we present many new families of patterns involving square, parallelogram, rhombus, trapezium, and general quadrilateral units. Some quadrilateral units can create two tilings, and some families of patterns have extra tilings when the unit has special lengths. Higher order irregular polygons, as well as concave polygons, remain to be explored systematically.

Bunjamin, Yudhistira Andersen. Should we start an Australian version of Talking Maths in Public?

Speaker: Yudhistira Andersen Bunjamin (UNSW Sydney)

Time: Tue 17:00

Place(s): PS2-212

Author(s): Yudhistira A. Bunjamin

Earlier this year, I had the opportunity to attend the 2025 Talking Maths in Public (TMiP) conference in the UK. This conference is run by a community of mathematics communicators and people who work in mathematics outreach in the UK, also known as TMiP.

I will briefly talk about the TMiP community in the UK and my experience at the TMiP conference. However, this session is primarily intended to be a group discussion about the possibility of establishing a similar community of people who are involved in mathematics communication and outreach here in Australia.

De Vas Gunasekara, Ajani. Poetry of Repetition: Constructing verse through Combinatorial Designs

Speaker: Ajani De Vas Gunasekara (University of Notre Dame)

Time: Tue 14:00

Place(s): PS2-212

Author(s): Ajani De Vas Gunasekara, Miriam Wei Wei Lo

This talk presents a mathematical approach to poetic construction based on combinatorial design theory, focusing on Steiner triple systems as structural frameworks for verse. We formalize a method of mapping words to elements of a finite set and constructing incidence structures that determine line composition and pairwise word interactions. Variations on the $(7,3,1)$ -designs and $(9,3,1)$ -designs are used to generate five example poems, each satisfying the defining properties of these systems. The resulting structures illustrate how combinatorial constraints yield balanced repetition and connectivity, properties central to both design theory and poetic rhythm. I will also offer a short reflective commentary, co-authored from mathematical and literary perspectives, and demonstrate how formal combinatorial systems can function as generative frameworks for structured creative expression.

Nurse, Stephen. A Polyhedral Knot Family

Speaker: Stephen Nurse (Unaffiliated)

Time: Tue 15:00

Place(s): PS2-212

Author(s): Stephen Nurse

This presentation is about a connection between equilateral-triangle-sided polyhedra and knots, discovered through making and modelling. It is about exploring topology through engaging, inexpensive, enjoyable construction. Equilateral-triangle-sided polyhedra (tetrahedra, octohedra, icosahedra and antiprisms) were made from craft sticks and drinking straws with the assistance of 3d printing. Polyhedra sides are from two sticks which cross, are joined at the crossing point and have ends on equilateral triangle edges. By arranging these sides in pairs, the sticks form knots, links and loops with topology and appearance dependent on the polyhedron and how pairs cover its surface. Pairs of sides can have vertical or slanted orientations, or combinations of both, and the presentation describes the resulting knots. A direct link between equilateral triangle sided polyhedra and knots is made by demonstrating constructions which are both.

Rao, Asha. Cyberpowers: Attracting Girls to Maths via Cyber Security

Speaker: Asha Rao (RMIT University)

Time: Wed 16:00

Place(s): PS2-212

Author(s): Asha Rao

The number of students doing higher level maths in high school has been declining over the years. This has implications for not only the harder sciences but also the applications that depend on mathematical knowledge. Mathematical literacy helps in more ways than just numerical literacy. This lack of students in coupled with the prevalent view that some disciplines are inherently male. One such discipline is cybersecurity, where the image is a male in a hoodie spending inordinate amounts of time hunched over a computer.

In reality, cybersecurity needs a diverse range of skills, many of which are maths related, such as problem solving and pattern recognition. Since early 2023, a team of us from RMIT Maths have been involved with Monash Tech School to offer a 1-day program to year 7 to 9 students who identify as female or non-binary. Named Cyberpowers, the program aims to showcase the myriad non-technical and mathematical skills required in cyber security. At the same time, we provide these students with the skills to be not only more resilient against cybercrime themselves, but to also help family of friends to be more aware of the dangers of cyberspace. In this talk, I will detail what the program entails and our plans to take it wider.

Seaton, Katherine. Hitomezashi stitching and mathematical physics

Speaker: Katherine Seaton (La Trobe University)

Time: Tue 14:30

Place(s): PS2-212

Author(s): Katherine Seaton

The traditional Japanese stitching form hitomezashi contains much intrinsic mathematics - too much for one short talk! Corner percolation and permutation matrices (a subset of the alternating sign matrices) will be the focus of this talk. In particular, we will trace how drawing attention to the mathematics of hitomezashi has stimulated new work on corner percolation by the mathematical community.

van der Kamp, Pieter Hubert. How to embed the Riemann surface of $y = x^2$ in $\mathbb{R}^3$, and how to dig lakes of Wada.

Speaker: Pieter Hubert van der Kamp (La Trobe University)

Time: Tue 16:30

Place(s): PS2-212

Author(s): Peter van der Kamp

I will describe the mathematics and the construction of the works *Parabolas* and *Embrace* which are on display in the Exhibition of mathematical art. Whereas *Parabolas* is based on the (standard) immersion of the Riemann surface in $\mathbb{R}^3$, it is also possible to provide an embedding.

Index of Speakers

- Abramov, Vyacheslav, 93
Adams, Johnathan, 147
Afifurrahman, Muhammad, 152, 195
Akpanya, Reymond, 93
Alghamdi, Maha, 184
Alhawiti, Noura, 106
Arora, Simran, 142
Asanjarani, Azam, 167
Assis, Michael, 195
Atenas, Felipe, 159
Attrill, Luke, 167

Baake, Michael, 117
Badia, Santiago, 106
Baier, Stephan, 152
Bamberg, John, 90
Bandara, Lashi, 112, 132, 189
Bano, Shahtaj, 159
Barbensi, Agnese, 90
Bednarek, Alexander, 112
Bellotti, Chiara, 152
Bennetts, Luke, 99, 139
Bernard, Yann, 112, 147
Bernhardt, Louie, 132
Bhakta, Subham, 152
Bhattacharjee, Saunak, 152
Bilchouris, Adam, 125
Bonham, Mitchell, 139
Borovkov, Kostya, 167
Boudabra, Maher, 167
Bradly, Chris, 142
Braunsteins, Peter, 168
Breuer, Florian, 136, 153
Britt, Nathan, 93
Broadbridge, Philip, 139
Buckingham, Robert, 139
Bunjamin, Yudhistira Andersen, 93, 119, 195
Burden, Conrad, 168
Butler, Blair, 153
Buttsworth, Timothy, 112

Cai, Difeng, 106
Caldwell, Bethany, 159
Carfagnini, Marco, 184
Carrasco, Sergio, 106
Carroll, Luka, 94
Carter, Max, 128, 179
Cartwright, Tiernan, 113
Chen, Chang, 121
Chen, Huan, 121
Chen, Jein-Shan, 159
Chen, Yiwen, 160

Chen, Yuyu, 121
Cheng, Eve, 165
Chijoff, Marcus, 128
Chourasiya, Shashi, 153
Cirstea, Florica Corina, 147
Clutterbuck, Julie, 148
Collevocchio, Andrea, 168
Combes, Lewis, 153
Corrigan, Chandler Chase, 153
Crowley, Diarmuid, 102

De Gier, Jan, 142
De Vas Gunasekara, Ajani, 195
Dearricott, Owen, 132, 189
Deng, Quanling, 139
Diaz Millan, Reinier, 160
DiMichele, Natalie, 189
Ding, Peng, 169
Dizon, Neil, 160
Doll, Moritz, 132
Dooley, Anthony, 184
Driscoll, Tobin, 90
Du, Jie, 179
Dudek, Adrian, 153
Dunmore, Thomas, 102

Eberhard, Andrew Craig, 160
Elder, Murray, 94, 136
Elzenaar, Alexander, 165, 189

Fagundes, Victor, 142
Fakhrurrozi, Fawwaz, 94
Farcaseanu, Maria, 148
Fatema, Kaniz, 161
Fell, Tasman, 179
Fernando, Vishmi, 161
Field, Laurence, 143, 169
Fijn, Paul, 136
Flook, Marcus, 113
Forlano, Justin, 133, 184
Francis, Andrew, 94
Frazier, David, 169
Fresacher, Matthias, 95

Gan, Han Liang, 169
Garcia Neefjes, Erik, 140
Gazi, Cengiz, 143
Gazwani, Mashniah A., 148
Gell-Redman, Jesse, 133
Gemmell, Zoë, 154
Geng, Xi, 170, 185
Ghitza, Alexandru, 154

- Giles Uhrig, Moshe, 95
Giudici, Michael, 128
Godfried, Emanuel, 133
Goertzen, Tom, 179
Gonzalez-Tokman, Cecilia, 90
Grazian, Clara, 170
Greven, Harrison, 113
Griffiths, Robert Charles, 170
Guo, Ivan, 121
Guo, Weiying, 143
Guo, Zihua, 148
- Hadden, William, 113
Haesemeyer, Christian, 102
Hafidh, Yusuf, 128
Ham, Joshua, 102
Hammerlindl, Andy, 117
Hamza, Kais, 170
Harm, Michael, 154
Harris, Elizabeth, 107
Harris, Simon, 171
Hausenblas, Erika, 185
Hautphenne, Sophie, 91
He, Mingqi, 171
Heiss Synak, Peter, 107
Heiss-Synak, Teresa, 189
Hekmati, Pedram, 190
Henderson-Walshe, George, 102
Heng, Edmund Xian Chen, 103, 129, 180
Hertl, Thorsten, 103, 114, 190
Heymann, Jared, 143
Hodgkinson, Liam, 171
Hosseinimoghaddam, Mohammadali, 161, 165
Howie, Joshua, 129
Huang, Boris, 185
Hudecek, Stepan, 114
Hui, Connie On Yu, 190
Huo, Xuejing, 133
- Ibarra, Dionne, 190
- Jackson, Marcel, 95
Jayakody, Thisaakhya, 172
Jeralds, Sam, 180
Jethva, Paawan, 191
Jia, Qiuye, 133
Jiao, Chunxi, 185
Johnson-Freyd, Theo, 91
Johnston, Daniel, 154
Johnston, Samuel, 172
Joshi, Nalini, 144
- Kabaila, Paul, 172
Kagan, Alexis, 173
Kajiwara, Kenji, 144
Kamgarpour, Masoud, 191
Kardkasem, Ruethaichanok, 173
Kerlidis, James, 173
Kerr, Paul, 95
Khan, Shahid, 166
Khatun, Mst Shanta, 99
Kitsios, Vassili, 144
- Kjaerbye Bagger, Gustav, 154
Klebaner, Fima, 173
Klein, Finn, 180
Koenig, Joachim, 129
Kortge, Maximilian, 155
Kumaranathunga, Udara, 125
Kwashira, Rugare, 129
Kwong, Kwok-Kun, 114, 148
- Laird, Brianna, 161
Lama, Benedict, 186
Lamichhane, Bishnu, 107
Lanfranchi, Marcello, 103
Larsson, Finnur, 191
Le Gia, Quoc Thong, 107, 186
Le, Ngan, 186
Lee, Benjamin, 99
Lee, Haesung, 186
Lemay, Jean-Simon, 103
Leplaideur, Renaud, 117
Leung, Dennis, 174
Li, Ji, 149
Li, Siyu, 145
Li, Yau Wing, 180
Li, Yixuan, 180
Liebenau, Anita, 91
Liu, Fangyu, 162
Liu, Jiakun, 134
Liyanage, Jayamini, 125
Luk, Stanley, 187
Lyu, Hongyi, 174
Lyu, Mengfan, 181
- Mack, Matthew, 99, 119
Macrina, Andrea, 122
Makarova, Svetlana, 181
Maltoni, Leonardo, 181
Mansfield, Daniel Francis, 126
Mansor, Mohd Mahayaudin, 174
Manyer, Jordi, 108
Marcondes, Diego, 174
Marshall, Lavender, 191
Marshall, Simon, 108, 126, 134, 155, 175, 181
Marteau, Antoine, 108
Matan, Dominic, 96
McCoy, James, 149
McCue, Scott, 140
McQuire, Emma, 192
Mead, William, 145
Meyer, Jahne, 117
Miller, Joel, 100
Mills, Jack, 175
Moka, Sarat Babu, 162
Morgan, James, 192
Muirhead, Stephen, 175
Mushunje, Leonard, 100
- Nam, Kihun, 122
Nanayakkara, Ravindi, 136
Nendel, Max, 187
Neuhauser, Leor, 192
Newton, Joseph, 182

- Nguyen, An Ky Duy, 114
 Nguyen, Hien, 100
 Nguyen, Trung Tin, 175
 Ni, Wenjie, 149
 Nikolayevsky, Yuri, 115
 Nillsen, Rodney, 155
 Nurcombe, Madeline, 145
 Nurse, Stephen, 126, 196

 O’Kane, Terence, 109
 O’Sullivan, Jensen, 182
 Oldfield, Renee, 117
 Oliynyk, Todd, 149
 Onn, Uri, 130, 137, 182
 Orchard, Max, 115
 Overmars, Anthony, 155

 Palojaervi, Neea, 137, 156
 Parr, Anthony, 145
 Patel, Mridul, 118
 Pelizzari, Giulia, 156
 Penev, Spiridon, 176
 Peng, Fei, 104, 146
 Perez, Aram, 176
 Perruchaud, Pierre, 187
 Pertile, Jordan, 156
 Piersanti, Paolo, 140
 Piggott, Adam, 130, 138
 Pineda-Villavicencio, Guillermo, 96
 Pisani, Anthony, 130
 Platen, Eckhard, 122
 Primaskun, Devi Imulia Dian, 96
 Pulemotov, Artem, 150
 Punch, James, 156

 Quella, Thomas, 146

 Ragas, Ruzzel, 96
 Rajpal, Devesh, 115
 Rallabhandi, Virinchi, 134
 Rankin, Cale, 134
 Rao, Asha, 196
 Raynor, Sophie, 104
 Reid, Colin David, 130
 Reid, Corbin, 192
 Richardson, Joel, 104
 Rieger, Janosch, 109
 Roberts, Lindon, 162
 Robertson, Marcy, 119, 193
 Roffelsen, Pieter, 97
 Rojas, Sergio, 109
 Roshchina, Vera, 162
 Rubiano Martinez, Andres Eduardo, 109

 Schlue, Volker, 135, 141
 Schrader, Philip, 115
 Seaton, Katherine, 196
 Sharma, Upanshu, 187
 Shekariz, Iman, 163
 Shiyamasuntharam, Kajanthan, 122
 Simpson, Connor, 97
 Singh, Chandan, 104, 193

 Smith, Dave, 141
 Soenjaya, Agus, 110, 188
 Spreer, Jonathan, 193
 Stewart, Willow, 182
 Stoeckl, Kurt, 97
 Stoian, Artem, 146
 Stokes, Tim, 97
 Suga, Haruka, 166
 Sukhorukova, Nadia, 163
 Sumner, Jeremy, 126
 Swinsburg, Kiah, 127

 Tai, Ho Man, 123, 188
 Takeuchi Romo, Kiyoshi, 166
 Tali, Pinsky, 118
 Tambyah, Tamara, 110
 Taylor, Peter Gerrard, 176
 Thomas, Simon, 156
 Thompson, Finn, 193
 Tilgul, Ameya, 157
 Timms, Liam, 163
 Tobin, Lucy, 193
 Tonegawa, Yoshihiro, 91, 116, 150
 Tran, TriThang, 119, 138
 Trivedi, Vandit, 130
 Trudgian, Timothy, 157
 Trudinger, Neil, 150
 Truong, Thang, 163
 Tudzi, Sebastian, 157

 Ugon, Julien, 164
 Ur Rehman, Fiaz, 100

 van der Kamp, Pieter Hubert, 146, 196
 Vega, Patrick, 110
 Vilonen, Kari, 182
 Vinod, Noah, 111
 Voineagu, Mircea, 105

 Wang, Liang, 157
 Wang, Yu, 98
 Watt, Simon, 101
 Wechselberger, Martin, 118
 Westerhout, Jacob, 164
 Wheeler, Glen Edward, 150
 Whitbread, Bailey, 194
 Wijesinghe Samarakoon, Nemini Yadeesha Jayani, 177
 Wilkinson-Finch, Tilda, 194
 Wilks, Ben, 141
 Wood-Baker, Liam, 177
 Wormell, Caroline, 92
 Wu, Chenyan, 183
 Wu, Haotian, 116, 150

 Xia, Aihua, 177
 Xiao, Yixiu, 157
 Xue, Ting, 183

 Yakimova, Oksana, 92
 Yamazaki, Kazutoshi, 123
 Yang, Zhao, 123

Index of Speakers

Yanovski, Lior, 183, 194
Yazici Yuret, Emine Sule, 98
Yung, Po-Lam, 135, 151

Zamorano Goldrine, Nicolas Andres, 111
Zanca, Adriana, 120
Zavone, Joshua, 151
Zhang, Abraham, 158
Zhang, Chuanqi, 131
Zhang, Erchuan, 111

Zhang, Qingyuan, 178
Zhang, Victor, 183
Zhang, Xinyi, 123
Zhang, Zhao, 124
Zheng, Weihang, 135, 151
Zhou, Qiyu, 116
Zhou, Yuyang, 146
Zhu, Zili, 124
Zymaris, Orion, 194