AustMS 2018

62nd Annual Meeting of the Australian Mathematical Society

4-7 December, University of Adelaide

Program and Abstracts

The abstracts of the talks in this handbook were provided individually by the authors. Only minor typographical changes have been made by the editors. The opinions, findings, conclusions and recommendations in this book are those of the individual authors.

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Cover Design: Andrew Black

Template and Registration System: John Banks

Conference Website: maths.adelaide.edu.au/austms2018

Contents

Foreword

It is a pleasure and an honour to welcome the participants of the 62nd Annual Meeting of the Australian Mathematical Society to the University of Adelaide. I hope you will find the scientific program of the conference inspiring and that you will enjoy the associated events we have organised.

The program of the conference comprises 13 plenary lectures by internationally renowned mathematicians from four continents and all areas of mathematics. The plenary lectures will feature talks by Hanna Neumann Lecturer Hinke Osinga, Early Career Lecturer Renato Ghini Bettiol and ANZIAM Lecturer Steven Sherwood.

The conference is accompanied by several associated events, starting with the Early Career Workshop on the weekend before the conference. There will be a public lecture on the mathematical problems related to determining the precise shape of the earth. This public lecture will be given by Étienne Ghys, who recently gave a public lecture to Brazilian high school students at the ICM in Rio de Janeiro. The AustMS meeting will also feature an Education Afternoon aimed at high school teachers. Continuing a tradition that started at last year's conference, Lewis Mitchell has organised a debate on the question whether or not mathematics is better done by computers than by humans. I am very curious to see how both debating teams will argue their case.

In addition to the scientific program, there will be several social events, starting with the Women in Mathematical Sciences Dinner on the evening before the conference, a Welcome Reception and the Conference Dinner at the National Wine Centre of Australia. The latter brings me to a vital aspect of the conference program: the student talks and the Bernhard H. Neumann Prize. This year there will be 68 talks by students; the B. H. Neumann Prize Committee chaired by Masoud Kamgarpour will work tirelessly during the first three days of the conference to find the best talk and to award the prize at the conference dinner.

At the heart of the Annual Meeting are the special sessions. Here we will see a cross section of the beautiful and useful mathematics that is created in Australia. I would like to thank all the session organisers who put together the 18 special sessions, some of which have such a striking variety of talks that they almost exceed the limitations of a four day conference.

Finally, I want to thank everyone who helped to organise this conference, including some who are not mentioned explicitly as helpers on the next page. First of all I would like to thank the student volunteers who helped to pack the conference bags and staff the registration table. Further thanks go to the Society's outgoing and incoming Vice Presidents Annual Conferences Vladimir Gaitsgory and Vladimir Ejov and the Secretary Peter Stacey for providing me with initial directions, as well as to the members of the Program Committee for putting together an excellent list of plenary speakers. Special thanks goes John Banks, who never got tired of answering my questions about his fabulous *Register!* and adjusting it to the needs of this conference. I would also like to thank Yvonnes Stokes, the Chair of the WIMISG Executive Committee, who helped to organise the Women in Mathematics Dinner and was unfortunate enough to have her office just a few doors down from mine, so that I could spontaneously ask for her advice on important aspects of the conference. I also thank the local organising committee and the context of this foreword allows me to single out two of them, Guo Chuan Thiang and Hayden Tronnolone, who worked tirelessly to bring this conference booklet into a form that we could confidently put into the conference bags. Even with help from so many sides, this conference would not have been possible without the administrative support that was provided by the Faculty of Engineering, Computer and Mathematical Sciences, in particular the help of Madelaine Veltman who kept a close eye on the essential details of such a large event, including those which conference directors tend to forget or ignore.

I hope you all enjoy the conference as much as I enjoyed the challenge of organising it and I wish you a wonderful and memorable week in Adelaide.

Thomas Leistner
Conference Director

Conference Organisation

Program Committee

Ben Burton (University of Queensland)
Alan Carey (Australian National University)
Julie Clutterbuck (Monash University)
Alice Devillers (University of Western Australia)
Peter Forrester (University of Melbourne)
Gary Froyland (University of New South Wales)
Vladimir Gaitsgory (Macquarie University)
Thomas Leistner (University of Adelaide)
Giang Nguyen (University of Adelaide)
Jacqui Ramagge (University of Sydney)
Lesley Ward (University of South Australia)

Local Organising Committee at the University of Adelaide

Thomas Leistner – Director

Sanjeeva Balasuriya – Special Sessions
David Baraglia – Special Sessions
Andrew Black – Conference Poster and Booklet Cover Design
Judith Bunder – Women in Mathematical Sciences Dinner
Barry Cox – Treasurer
Peter Hochs – Secretary
Melissa Humphries – Women in Mathematical Sciences Dinner
Lewis Mitchell – Debate
Giang Nguyen – Sponsorship
David Roberts – Volunteers
Yvonne Stokes – Women in Mathematical Sciences Dinner
Guo Chuan Thiang – Booklet
Hayden Tronnolone – Booklet and Website
Raymond Vozzo – Education Afternoon

Allison Dinan – Administrative support
Sharyn Liersch – Administrative support
Madelaine Veltman – Administrative support

Registration System

John Banks (University of Melbourne)

Early Career Workshop

Luke Bennetts (University of Adelaide)
Michael Coons (University of Newcastle)
Madelaine Veltman (University of Adelaide, administrative support)

Conference Sponsors

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AustMS

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Conference Program

Overview of the Academic Program

The academic program comprises 248 talks, spread over 18 special sessions and including 13 plenary lectures and a public lecture. There are 68 talks presented by students and the names of student speakers are marked with a superscript "s". For a short overview of the conference program, please refer to page 119.

Plenary Lecturers

Renato Ghini Bettiol – *Early Career Lecturer* (City University of New York, USA)
Regina Burachik (University of South Australia, Australia)
Josef Dick (University of New South Wales, Australia)
Étienne Ghys (École normale supérieure de Lyon, France)
Manjunath Krishnapur (Indian Institute of Science, India)
Joan Licata (Australian National University, Australia)
Malwina Luczak (University of Melbourne, Australia)
Hinke Osinga – *Hanna Neumann Lecturer* (University of Auckland, New Zealand)
Nageswari Shanmugalingam (University of Cincinnati, USA)
Steven Sherwood – *ANZIAM Lecturer* (University of New South Wales, Australia)
Natalie Thamwattana (University of Newcastle, Australia)
Geordie Williamson (University of Sydney, Australia)

▷ Timetable of Plenary Lectures – page 27

Special Sessions

Education Afternoon

The Education Afternoon will consist of talks by mathematicians aimed at school teachers describing some interesting and cutting edge mathematical research and applications. The list of speakers and talks is given below. The session will also feature information about the ChooseMaths programme, which is run by the Australian Mathematical Sciences Institute and is aimed at encouraging young girls to continue their studies in mathematics.

- 15:00, Wednesday, 5th December
  Education Afternoon Tea and Education Afternoon
  Horace Lamb 422 (access via Hub Central)

  Étienne Ghys (École normale supérieure de Lyon)
  The mathematics of traffic jams

  Hinke Osinga (University of Auckland)
  Chaos and a pancake

  Lewis Mitchell (University of Adelaide)
  Using mathematics to study online social networks

Social Program

- 18:15 Monday, 3rd December
  Women in Mathematical Sciences Dinner
  The Playford, 120 North Tce, Adelaide
- 18:00 Tuesday, 4th December
  Welcome Reception
  Atrium of the Ingkarni Wardli Building
- 18:00 Wednesday, 5th December
  Public Lecture Reception
  Atrium of the Ingkarni Wardli Building
- 19:00 Wednesday, 5th December
  Public Lecture by Étienne Ghys: The shape of our planet Earth: a mathematical challenge!
  The Braggs Lecture Theatre
- 19:00 Thursday, 6th December
  Conference Dinner
  The National Wine Centre of Australia, Corner of Botanic & Hackney Roads Adelaide

Annual General Meeting of the Women in Mathematics Special Interest Group

- 17:00 Monday, 3rd December
  WIMSIG Annual General Meeting
  H6-03 Level 6 of the Hawke Building, City West Campus, University of South Australia, 55 North Tce, Adelaide

Annual General Meeting of the Australian Mathematical Society

- 14:00 Thursday, 6th December
  Annual General Meeting
  Horace Lamb Lecture Theatre

Lunch, Tea and Coffee

Throughout the conference, light lunches, tea and coffee will be served during the lunch breaks and the morning and afternoon teas in the Atrium of the Ingkarni Wardli Building (for times see the program).

Conference Information Desk

The information desk for the conference is located in the Ingkarni Wardli Atrium.

Publisher's Display

Cambridge University Press will have a stall in the Ingkarni Wardli Atrium presenting publications of the Australian Mathematical Society.

Wireless Network Access

Eduroam is available on campus. Those who do not have access to Eduroam through their home institution may use the network UofA Guest. The password is `biscuitchef`.

Security

The Security office is being temporarily relocated from the Kenneth Wills Building to Ground Floor of the Oliphant Building. The phone number is (08) 8313 5990.

Tue 4 December 2018

- □ *Registration – Ingkarni Wardli Atrium 08:00 – 09:00*
- □ *Opening Ceremony and Awards – The Braggs Lecture Theatre 09:00 – 10:30*
- □ *Morning Tea – Ingkarni Wardli Atrium 10:30 – 11:00*

■ Plenary Lecture – The Braggs Lecture Theatre

11:00 ► Geordie Williamson (The University of Sydney)
Semi-simplicity in representation theory

■ Plenary Lecture – The Braggs Lecture Theatre

12:00 ► Malwina Luczak (The University of Melbourne)
Near-criticality in mathematical models of epidemics

- □ *Lunch – Ingkarni Wardli Atrium 13:00 – 14:00*
- □ *Afternoon Tea – Ingkarni Wardli Atrium 15:00 – 15:30*

■ Plenary Lecture – The Braggs Lecture Theatre

17:00 ► Steven Sherwood (University of New South Wales)
Recent Advances in Climate Sensitivity

- □ *Welcome Reception – Ingkarni Wardli Atrium 18:00 – 20:00*

■ Afternoon Special Sessions

2. Algebra

Horace Lamb Lecture Theatre

14:00 Jeremy Sumner (University of Tasmania)
Markov association schemes (p. 58)

14:30 Alejandra Garrido (The University of Newcastle)
Hausdorff dimension and normal subgroups of free-like pro-p groups (p. 57)

15:30 Timothy Peter Bywaters[s] (The University of Sydney)
Spaces at infinity for hyperbolic totally disconnected locally compact groups (p. 56)

16:00 Carlisle King (The University of Western Australia)
Finite simple images of finitely presented groups (p. 58)

16:30 Stephan Tornier (The University of Newcastle)
Totally disconnected, locally compact groups from transcendental field extensions (p. 59)

3. Applied and Industrial Mathematics

Ligertwood 316

14:00 Andrei Ermakov[s] (University of Southern Queensland)
Mathematical problems of long wave transformation in a coastal zone with a variable bathymetry (p. 60)

14:30 Ajini Galapitage[s] (University of South Australia)
Optimal scheduling of trains using connected driver advice system (p. 60)

15:30 Mark Joseph McGuinness (Victoria University of Wellington)
MMM, microwaves measure moisture (p. 61)

16:00 Yvonne Stokes (The University of Adelaide)
A coupled flow and temperature model for fibre drawing (p. 62)

16:30 Sevvandi Priyanvada Kandanaarachchi (Monash University)
About outlier detection (p. 61)

4. Category Theory

Engineering and Mathematics EMG06

14:00 Yuki Maehara[s] (Macquarie University)
Inner horns for 2-quasi-categories (p. 64)

14:30 Michelle Strumila[s] (The University of Melbourne)
Infinity Cyclic Operads (p. 64)

15:30 Danny Stevenson (The University of Adelaide)
The right cancellation property of the class of inner anodyne maps (p. 64)

5. Computational Mathematics

Ligertwood 314 Flinders Room

14:30 Garry Newsam (The University of Adelaide)
A review of some approximation schemes used in FFTs on non-uniform grids (p. 67)

15:30 Robert Womersley (University of New South Wales)
Using spherical t-designs and ℓ_q minimization for recovery of sparse signals on the sphere (p. 68)

16:00 Yuguang Wang (University of New South Wales)
Sparse Isotropic Regularization for Spherical Harmonic Representations of Random Fields on the Sphere (p. 68)

16:30 Janosch Rieger (Monash University)
Integrating semilinear parabolic differential inclusions with one-sided Lipschitz nonlinearities (p. 67)

6. Differential Geometry

Barr Smith South 2051

14:00 Renato Ghini Bettiol (City University of New York)
Convex Algebraic Geometry of Curvature Operators (p. 69)

14:30 Romina Melisa Arroyo (University of Queensland)
The Alekseevskii conjecture: Overview and open questions (p. 69)

15:30 Ramiro Augusto Lafuente (The University of Queensland)
Homogeneous Einstein manifolds via a cohomogeneity-one approach (p. 70)

16:00 Owen Dearricott (The University of Melbourne)
Positive curvature in dimension 7 (p. 69)

16:30 Kelli Francis-Staite[s] (The University of Oxford)
Corners in C^∞-Algebraic Geometry (p. 70)

8. Functional Analysis, Operator Algebra, Non-commutative Geometry

Engineering South S111

14:00 Mathai Varghese (The University of Adelaide)
The magnetic spectral gap-labelling conjecture and some recent progess (p. 77)

15:30 Jessica Murphy[s] (The University of Sydney)
C-algebras associated to graphs of groups* (p. 77)

16:00 Becky Armstrong[s] (The University of Sydney)
A twisted tale of topological k-graph C-algebras* (p. 74)

16:30 Raveen Daminda de Silva[s] (University of New South Wales)
Maximum Generalised Roundness of Random Graphs (p. 75)

9. Geometric Analysis

Engineering and Mathematics EMG07

14:00 Miles Simon (Magdeburg University)
Some integral estimates for Ricci flow in four dimensions (p. 79)

14:30 Ahnaf Tajwar Tahabub[s] (The University of Adelaide)
Reduced SU(2) Seiberg-Witten Equations compared to SU(2) Ginzburg-Landau equations (p. 79)

15:30 Brett Parker (Monash University)
Regularity of the dbar equation in degenerating families (p. 79)

16:00 David Hartley (University of Wollongong)
On the Existence of Stable Unduloids of Dimension Eight (p. 78)

10. Geometry and Topology

Barr Smith South 2060

14:00 Brett Parker (Monash University)
Tropical geometry, the topological vertex, and Gromov-Witten invariants of Calabi-Yau 3-folds, (p. 81)

15:30 Benjamin Burton (University of Queensland)
Knot tabulation: a software odyssey (p. 80)

16:00 Anne Thomas (The University of Sydney)
Commensurability classification of certain right-angled Coxeter groups (p. 82)

16:30 Daniel Francis Mansfield (University of New South Wales)
Perpendicularity in Ancient Babylon (p. 81)

11. Harmonic Analysis

Ligertwood 111

14:30 Xuan Duong (Macquarie University)
BMO spaces associated to operators on non-doubling manifolds with ends (p. 83)

15:30 Neil Kristofer Dizon[s] (The University of Newcastle)
Optimisation in the Construction of Symmetric and Cardinal Wavelets on the Line (p. 83)

16:00 Hong Chuong Doan[s] (Macquarie University)
Maximal operators with generalised Gaussian bounds on non-doubling Riemannian manifolds with low dimension (p. 83)

16:30 Xing Cheng (Monash University)
Scattering of the nonlinear Klein-Gordon equations (p. 83)

12. Integrable Systems

Ligertwood 112

14:00 Nalini Joshi (The University of Sydney)
Hidden solutions of discrete systems (p. 85)

14:30 Remy Alexander Adderton[s] (The Australian National University)
A generalized Temperley-Lieb algebra in the chiral Potts model (p. 85)

15:30 Yibing Shen[s] (The University of Queensland)
Ground-state energies of the open and closed $p + ip$-pairing models from the Bethe Ansatz (p. 85)

16:00 Reinout Quispel (La Trobe University)
Finding rational integrals of rational discrete maps (p. 85)

16:30 Kenji Kajiwara (Kyushu University)
A new framework and extensions of log-aesthetic curves in industrial design by integrable geometry (p. 85)

13. Mathematical Biology

Ligertwood 216 Sarawak Room

15:30 Jeremy Sumner (University of Tasmania)
Predicating saturation in models of genome rearrangement in polynomial time (p. 88)

16:00 Yoong Kuan Goh[s] (University of Technology, Sydney)
Pattern Avoidance in Genomics (p. 87)

16:30 Maria Kleshnina[s] (The University of Queensland)
Learning advantages in evolutionary games (p. 87)

14. Mathematics Education

Horace Lamb 422 (via Hub Central)

14:00 David Hartley (University of Wollongong)
Student learning and feedback in higher education mathematics (p. 90)

14:30 Carolyn Kennett (Macquarie University)
Mathematics and Indigenous Culture (p. 90)

15:30 Margaret Marshman (University of the Sunshine Coast)
Making mathematics teachers: Beliefs about mathematics and mathematics teaching and learning held by academics who teach future teachers (p. 91)

16:00 Roland Dodd (Central Queensland University)
First year engineering mathematics diagnostic testing (p. 89)

16:30 William Guo (Central Queensland University)
You can teach old dogs new tricks if you know them well (p. 89)

15. Mathematical Physics

Engineering North N132

14:00 Anupam Chaudhuri[s] (Monash University)
One-point recursions of Harer-Zagier type (p. 93)

14:30 Arnaud Brothier (UNSW Sydney)
Constructions of 1+1-dimensional lattice-gauge theories and the Thompson group (p. 93)

15:30 Philip Broadbridge (La Trobe University)
The conditionally integrable diffusion equation with nonlinear diffusivity 1/u (p. 93)

16:00 Iwan Jensen (Flinders University)
Self-avoiding walks with restricted end-points (p. 94)

16:30 Anthony Mays (The University of Melbourne)
Determinantal polynomials, vortices and random matrices: an exercise in experimental mathematical physics (p. 94)

16. Number Theory

Ingkarni Wardli B17

14:00 Ole Warnaar (The University of Queensland)
On modular Nekrasov–Okounkov formulas (p. 96)

15:30 Florian Breuer (The University of Newcastle)
Heights and isogenies of Drinfeld modules (p. 95)

16:00 Matteo Bordignon^s (University of New South Wales Canberra)
Explicit bounds on exceptional zeroes of Dirichlet L-functions (p. 95)

16:30 Michaela Cully-Hugill^s (University of New South Wales Canberra)
Square-free numbers in short intervals (p. 95)

17. Optimisation

Engineering South S112

14:00 Marco Antonio López Cerdá (Alicante University)
A crash course on stability in linear optimization (p. 99)

15:30 Helmut Maurer (University of Mnster)
Multi-objective Optimal Control Problems in Biomedical Engineering (p. 99)

16:00 Sabine Pickenhain (Brandenburg Technical University Cottbus)
Optimal Control on Unbounded Intervals - Fourier-Laguerre Analysis of the Problem (p. 100)

16:30 Vladimir Gaitsgory (Macquarie University)
On continuity/discontinuity of the optimal value of a long-run average optimal control problem depending on a parameter (p. 98)

18. Probability Theory and Stochastic Processes

Ingkarni Wardli B18

14:00 Kais Hamza (Monash University)
Directed walk on a randomly oriented lattice (p. 103)

14:30 Kihun Nam (Monash University)
Correlated time-changed Lévy processes (p. 104)

15:30 Kostya Borovkov (The University of Melbourne)
The asymptotics of the large deviation probabilities in the multivariate boundary crossing problem (p. 102)

16:00 Andrea Collevecchio (Monash University)
Branching ruin number (p. 103)

16:30 Lachlan James Bridges^s (The University of Adelaide)
Markov-modulated random walk search strategies for animal foraging (p. 102)

19. Representation Theory

Barr Smith South 2052

14:00 Masoud Kamgarpour (University of Queensland)
Topology of representation stacks (p. 107)

14:30 Iva Halacheva (The University of Melbourne)
Puzzles for restricting Schubert classes to the symplectic Grassmannian (p. 107)

15:30 Alexander Ferdinand Kerschl^s (The University of Sydney)
Inner products on graded Specht modules (p. 107)

16:00 Marvin Krings^s (RWTH Aachen University)
The p-Part of the Order of an Almost Simple Group of Lie Type (p. 108)

16:30 Seamus Albion^s (The University of Queensland)
The Selberg integral and Macdonald polynomials (p. 106)

Wed 5 December 2018

□ *Award Talk – The Braggs Lecture Theatre 09:00 – 09:30*

■ Plenary Lecture – The Braggs Lecture Theatre

09:30 ► Natalie Thamwattana (The University of Newcastle)
A mathematical journey into nanoscience and nanotechnology

□ *Morning Tea – Ingkarni Wardli Atrium 10:30 – 11:00*

■ Plenary Lecture – The Braggs Lecture Theatre

11:00 ► Manjunath Krishnapur (Indian Institute of Science Bangalore)
Nodal sets of eigenfunctions of the Laplacian, with randomness

■ Plenary Lecture – The Braggs Lecture Theatre

12:00 ► Joan Licata (Australian National University)
Just Enough Twisting

□ *Lunch – Ingkarni Wardli Atrium 13:00 – 14:00*

□ *Debate – The Braggs Lecture Theatre 14:00 – 15:00*

□ *Afternoon Tea – Ingkarni Wardli Atrium 15:00 – 15:30*

□ *Education Afternoon Tea – Horace Lamb 422 (via Hub Central) 15:00 – 15:30*

□ *Education Afternoon – Horace Lamb 422 (via Hub Central) 15:30 – 18:00*

□ *Public Lecture Reception – Ingkarni Wardli Atrium 18:00 – 19:00*

□ *Public Lecture – The Braggs Lecture Theatre 19:00 – 20:00*
Étienne Ghys (École normale supérieure de Lyon)
The shape of our planet Earth: a mathematical challenge!

■ Afternoon Special Sessions

2. Algebra

Horace Lamb Lecture Theatre

15:30 James East (Western Sydney University)
Lattice paths and submonoids of $\mathbb{Z}^2$ (p. 56)

16:00 Yeeka Yau[s] (The University of Sydney)
Coxeter Systems for which the Brink-Howlett automaton is minimal (p. 59)

16:30 Alex Bishop[s] (University of Technology, Sydney)
Formal languages in group co-word problems (p. 56)

17:00 Ambily Ambattu Asokan (Cochin University of Science and Technology)
On von Neumann regularity of simple flat Leavitt path algebras (p. 56)

17:30 Faezeh Alizadeh[s] (Shahid Rajaee Teacher Training University)
Linear codes from matrices: answering a question of Glasby and Praeger (p. 56)

3. Applied and Industrial Mathematics

Ligertwood 316

15:30 Zlatko Jovanoski (University of New South Wales Canberra)
Population dynamics in a variable environment (p. 60)

16:30 Mark Nelson (University of Wollongong)
No Jab, no pay (p. 61)

17:00 Kieran Clancy (Flinders University)
Choosing investment frequency to minimise brokerage costs (p. 60)

17:30 William Erik Pettersson (University of Glasgow)
Large Scale Kidney Exchange Programme Models: Saving Lives with Integer Programming (p. 62)

4. Category Theory

Engineering and Mathematics EMG06

15:30 Marcy Robertson (The University of Melbourne)
A new class of coloured modular operads (p. 64)

16:00 David Gepner (The University of Melbourne)
Analytic monads and infinity operads (p. 64)

5. Computational Mathematics

Ligertwood 314 Flinders Room

15:30 Jerome Droniou (Monash University)
What the second Strang lemma and the Aubin-Nitsche trick should be (p. 66)

16:30 Markus Hegland (Australian National University)
Numerical linear algebra and the solution of systems of polynomial equations (p. 67)

17:00 Hanz Martin Cheng[s] (Monash University)
A combined GDM-ELLAM-MMOC (GEM) scheme for advection dominated PDEs (p. 66)

17:30 Alex Newcombe[s] (Flinders University)
QuickCross - a crossing minimisation heuristic based on vertex insertion (p. 67)

6. Differential Geometry

Barr Smith South 2051

15:30 Kumbu Dorji[s] (University of New England)
Three-dimensional Sasakian structures and point-extension of monopoles (p. 69)

16:00 Michael Eastwood (The University of Adelaide)
The exceptional aerobatics of flying saucers (p. 69)

16:30 Krzysztof Krakowski (Cardinal Stefan Wyszynski University in Warsaw)
Properties of some quasi-geodesics on Stiefel manifolds (p. 70)

17:00 David Baraglia (The University of Adelaide)
A gluing formula for families Seiberg-Witten invariants (p. 69)

17:30 Gerd Schmalz (University of New England)
A criterion for local embeddability of 3-dimensional CR-structures (p. 71)

7. Dynamical Systems and Ergodic Theory

Ligertwood 214 Piper Alderman Room

15:30 Michael Small (The University of Western Australia)
Characterising Chimeras by Constructing Networks (p. 73)

16:00 Renaud Leplaideur (Université de la Nouvelle Calédonie)
Recent results in Thermodynamic Formalism (p. 72)

16:30 Robert Marangell (The University of Sydney)
Travelling waves in a model for tumor invasion with the acid-mediation hypothesis (p. 72)

17:00 Timothy Roberts[s] (The University of Sydney)
Stable nonphysical waves in a model of tumour invasion (p. 72)

17:30 Fawwaz Batayneh[s] (University of Queensland)
Quasi-compactness and invariant measures for random dynamical systems of Jablonski maps (p. 72)

8. Functional Analysis, Operator Algebra, Non-commutative Geometry

Engineering South S111

15:30 Shaymaa Shawkat Kadhim Al-shakarchi[s] (University of New South Wales)
Isomorphisms of $AC(\sigma)$ spaces for linear graphs (p. 74)

16:00 David Leonard Brook[s] (The University of Adelaide)
Computations in Higher Twisted K-theory (p. 75)

16:30 Johnny Lim[s] (The University of Adelaide)
Pontryagin duality in higher Aharonov-Bohm effect (p. 76)

17:00 Nathan Brownlowe (The University of Sydney)
Can we reconstruct a directed graph from its Toeplitz algebra? (p. 75)

17:30 Elizabeth Bradford[s] (University of South Australia)
An application of recursive algorithm for inversion of linear operator pencils (p. 74)

9. Geometric Analysis

Engineering and Mathematics EMG07

15:30 Kwok-Kun Kwong (The University of Sydney)
Some sharp Lévy-Gromov type isoperimetric inequalities (p. 78)

16:00 Pedram Hekmati (The University of Auckland)
Higgs bundles and foliations (p. 78)

16:30 Romina Melisa Arroyo (University of Queensland)
The long-time behaviour of the pluriclosed flow on Lie groups (p. 78)

17:00 Yuhan Wu[s] (University of Wollongong)
Length-constrained curve diffusion (p. 79)

10. Geometry and Topology

Barr Smith South 2060

15:30 Dominic Tate[s] (The University of Sydney)
Compactification of the Space of Convex Projective Structures on Surfaces (p. 82)

16:00 Adam Wood[s] (The University of Melbourne)
Oriented geodesics in the three-sphere (p. 82)

16:30 Sophie Ham[s] (Monash University)
Triangulations of Solid Tori and Dehn Fillings (p. 80)

17:00 Vanessa Robins (Australian National University)
Tiling the Euclidean and Hyperbolic planes with ribbons (p. 81)

17:30 Chi-Kwong Fok (The University of Adelaide)
Twisted K-theory of compact Lie groups and extended Verlinde algebras (p. 80)

11. Harmonic Analysis

Ligertwood 111

15:30 Tran Vu Khanh (University of Wollongong)
Bergman and Bergman-Toeplitz operators on pseudoconvex domains (p. 84)

16:00 Anh Bui (Macquarie University)
Sharp weighted estimates for square functions associated to operators on homogeneous spaces (p. 83)

16:30 Geetika Verma (University of South Australia)
An inversion technique for linear operator pencils in Hilbert space (p. 84)

12. Integrable Systems

Ligertwood 112

15:30 Yang Shi (Flinders University)
Certain subgroups of the Coxeter groups and symmetry of discrete integrable equations (p. 85)

16:00 Paul Zinn-Justin (The University of Melbourne)
Schubert calculus and quantum integrable systems (p. 86)

16:30 Peter Forrester (The University of Melbourne)
Some exact Lyapunov exponents for random matrix products (p. 85)

15. Mathematical Physics

Engineering North N132

16:00 Nicholas Beaton (The University of Melbourne)
Knotting probabilities for polygons in lattice tubes (p. 93)

16:30 Jeongwhan Choi (Korea University)
Capillary-Gravity Surface over a Bump: Critical Surface Tension (p. 93)

17:00 Zongzheng Zhou (Monash University)
Two-point functions of random walk models on high-dimensional boxes (p. 94)

17:30 Timothy Garoni (Monash University)
A limit theorem for the coupling time of the stochastic Ising model (p. 94)

16. Number Theory

Ingkarni Wardli B17

15:30 Ayreena Bakhtawar[s] (La Trobe University)
On the growth of product of partial quotients (p. 95)

16:00 Philip Bos[s] (La Trobe University)
Hausdorff Measure and Dirichlet Non-Improvable Numbers (p. 95)

16:30 Thomas Morrill (UNSW Canberra)
Overpartitions (p. 96)

17:00 Timothy Trudgian (UNSW Canberra)
Zeroes of the zeta-function: mind the gap! (p. 96)

17:30 Marley Young[s] (University of New South Wales)
On multiplicative independence of rational function iterates (p. 96)

17. Optimisation

Engineering South S112

15:30 Alexander Kruger (Federation University Australia)
Characterizations of Hölder Error Bounds (p. 99)

16:00 Thi Hoa Bui[s] (Federation University Australia)
Generalized convexity (p. 97)

16:30 Cuong Nguyen Duy[s] (Federation University Australia)
Nonlinear parametric error bounds (p. 100)

17:00 Theo Bendit[s] (The University of Newcastle)
Doubleton Projections in Hilbert Spaces (p. 97)

17:30 David Kirszenblat[s] (The University of Melbourne)
A variational approach to the Dubins traveling salesman problem (p. 98)

18. Probability Theory and Stochastic Processes

Ingkarni Wardli B18

15:30 Ilze Ziedins (The University of Auckland)
Stochastic networks with selfish routing and information feedback (p. 105)

16:30 Oscar Peralta[s] (Technical University of Denmark)
A fluid flow model with RAP components (p. 104)

17:00 Liam Hodgkinson[s] (University of Queensland)
Central limit theorems for dynamic random graph models (p. 103)

17:30 Graham Brightwell (London School of Economics)
Long-term concentration of measure and the cut-off phenomenon (p. 102)

19. Representation Theory

Barr Smith South 2052

15:30 Edmund Xian Chen Heng[s] (Australian National University)
Braid group action on triangulated categories (p. 107)

16:00 Matthew James Spong[s] (The University of Melbourne)
Two models of equivariant elliptic cohomology (p. 108)

16:30 Saul Freedman[s] (The University of Western Australia)
p-groups related to exceptional Chevalley groups (p. 106)

17:00 Joel Gibson[s] (The University of Sydney)
The Product Monomial Crystal (p. 106)

17:30 Anthony Henderson (The University of Sydney)
Complementary symmetry for Slodowy varieties (p. 107)

Thu 6 December 2018

■ Morning Special Sessions

2. Algebra

Horace Lamb Lecture Theatre

09:00 Robert McDougall (University of the Sunshine Coast)
On Kurosh-Amitsur and base radical classes for a non-associative setting (p. 58)

09:30 Lauren Thornton[s] (University of the Sunshine Coast)
Some results differentiating Kurosh-Amitsur and base radical classes (p. 59)

10:00 Neeraj Kumar[s] (IIT Bombay)
Koszul and Cohen-Macaulay properties of residual intersections (p. 58)

3. Applied and Industrial Mathematics

Ligertwood 316

09:00 Benjamin Maldon[s] (The University of Newcastle)
Modelling Dye-Sensitized Solar Cells by Nonlinear Diffusion (p. 61)

09:30 Vanessa Robins (Australian National University)
Insights from the persistent homology analysis of porous and granular materials (p. 62)

10:00 Ilknur Tulunay (University of Technology, Sydney)
ST-metric estimation of factor weights (p. 63)

4. Category Theory

Engineering and Mathematics EMG06

09:00 Alexander Campbell (Macquarie University)
Bicategories vs Rezk's weak 2-categories (p. 64)

09:30 Dominic Weiller[s] (Australian National University)
Algebras in Braided Tensor categories and Embedded surfaces (p. 65)

10:00 Ivo De Los Santos Vekemans[s] (Australian National University)
The slice filtration and spectral sequence (p. 64)

5. Computational Mathematics

Ligertwood 314 Flinders Room

09:00 William McLean (University of New South Wales)
A second-order time stepping scheme for fractional diffusion problems (p. 67)

09:30 Hailong Guo (The University of Melbourne)
Recovery based finite element method for fourth-order PDEs (p. 66)

10:00 Quoc Thong Le Gia (University of New South Wales)
Stochastic Navier-Stokes equations on a thin spherical domain (p. 67)

6. Differential Geometry

Barr Smith South 2051

09:00 Keegan Flood[s] (The University of Auckland)
Scalar curvature and projective compactification (p. 69)

09:30 Daniel Snell[s] (The University of Auckland)
Distinguished curves in projective and conformal geometry (p. 71)

10:00 Anthony Shane Marshall[s] (Flinders University)
An Information Geometric Approach To Pulse-Doppler Sensor Optimisation (p. 70)

7. Dynamical Systems and Ergodic Theory

Ligertwood 214 Piper Alderman Room

09:00 Dave Smith (Yale-NUS College)
Dispersive quantisation (p. 73)

09:30 Peter Cudmore (The University of Melbourne)
'Systems all the way down': Managing Complexity with BondGraphTools (p. 72)

10:00 Cecilia Gonzalez-Tokman (The University of Queensland)
Lyapunov spectrum of Perron-Frobenius operator cocycles (p. 72)

8. Functional Analysis, Operator Algebra, Non-commutative Geometry

Engineering South S111

09:00 Michael Arthur Mampusti[s] (University of Wollongong)
Equilibrium in operator algebraic dynamical systems (p. 76)

09:30 Nicholas Seaton[s] (University of Wollongong)
A Dixmier-Douady Theory for Fell Algebras and their associated Brauer Group (p. 77)

10:00 Thomas Scheckter[s] (University of New South Wales)
A Noncommutative Generalisation of a Problem of Steinhaus (p. 77)

9. Geometric Analysis

Engineering and Mathematics EMG07

09:00 James McCoy (The University of Newcastle)
Closed ideal planar curves (p. 79)

09:30 Ramiro Augusto Lafuente (The University of Queensland)
Hermitian curvature flow on complex Lie groups (p. 78)

10:00 Yong Wei (Australian National University)
Volume preserving flow and geometric inequalities in hyperbolic space (p. 79)

10. Geometry and Topology

Barr Smith South 2060

09:00 Iva Halacheva (The University of Melbourne)
Virtual and welded tangles via operads (p. 80)

09:30 Boris Lishak (The University of Sydney)
Trisections and their complexity (p. 81)

10:00 David G Glynn (Flinders University)
Particles of the first generation (p. 80)

12. Integrable Systems

Ligertwood 112

10:00 Yury Stepanyants (University of Southern Queensland)
Helical solitons in vector modified Kortewegde Vries equations (p. 86)

13. Mathematical Biology

Ligertwood 216 Sarawak Room

09:00 Danya Rose (The University of Sydney)
Who cares? Or, when does paternal care arise in primates? (p. 87)

09:30 Anthony John Gallo[s] (The University of Adelaide)
Modelling Non-Uniform Growth in Cylindrical Yeast Colonies (p. 87)

10:00 Mike Chen (The University of Adelaide)
Multiscale modelling of fibre-reinforced hydrogels for tissue engineering (p. 87)

14. Mathematics Education

Horace Lamb 422 (via Hub Central)

09:00 Heather Lonsdale (Curtin University)
Choose-your-own assessment (p. 90)

09:30 Amie Albrecht (University of South Australia)
Learning to Communicate and Communicating to Learn (p. 89)

10:00 Simon James (Deakin University)
Benefits and challenges of peer-assessment for online subjects (p. 90)

16. Number Theory

Ingkarni Wardli B17

09:00 Nicole Sutherland (The University of Sydney)
The efficient computation of Splitting Fields using Galois groups (p. 96)

09:30 Mumtaz Hussain (La Trobe University)
Measure theoretic laws in Diophantine approximation (p. 96)

17. Optimisation

Engineering South S112

08:30 Ryan Loxton (Curtin University)
Minimizing Equipment Shutdowns in Oil and Gas Campaign Maintenance (p. 99)

09:00 Belinda Spratt (Queensland University of Technology)
Reducing post-surgery recovery bed occupancy through an analytical prediction model (p. 101)

09:30 William Erik Pettersson (University of Glasgow)
Multi-objective mixed integer programming: An exact algorithm (p. 100)

10:00 Guoyin Li (University of New South Wales)
Calculus of Kurdyka-Lojasiewicz exponent and its applications to sparse optimisation (p. 99)

18. Probability Theory and Stochastic Processes

Ingkarni Wardli B18

09:00 Volodymyr Vaskovych[s] (La Trobe University)
On asymptotic behavior of weighted functionals of long-range dependent random fields on spheres (p. 105)

09:30 Yi-Lung Chen[s] (University of New South Wales)
Sampling via Regenerative Chain Monte Carlo (p. 102)

10:00 Peter Taylor (The University of Melbourne)
Why is Kemeny's constant a constant? (p. 104)

19. Representation Theory

Barr Smith South 2052

08:30 Yusra Naqvi (The University of Sydney)
A product formula for certain coefficients of Macdonald polynomials (p. 108)

09:00 Michael Ehrig (The University of Sydney)
Finite dimensional representations of orthosymplectic supergroups (p. 106)

09:30 Travis Scrimshaw (The University of Queensland)
Crystal structures for symmetric Grothendieck polynomials (p. 108)

10:00 Anna Romanov (The University of Sydney)
An orbit model for the spectra of nilpotent Gelfand pairs (p. 108)

□ *Morning Tea – Ingkarni Wardli Atrium 10:30 – 11:00*

■ Plenary Lecture – The Braggs Lecture Theatre

11:00 ► Hinke Osinga (The University of Auckland)
Robust chaos: a tale of blenders, their computation, and their destruction

■ Plenary Lecture – The Braggs Lecture Theatre

12:00 ► Renato Ghini Bettiol (City University of New York)
How to find non-trivial solutions out of trivial ones

□ *Lunch – Ingkarni Wardli Atrium 13:00 – 14:00*

□ *AGM – Horace Lamb Lecture Theatre 14:00 – 15:30*

□ *Afternoon Tea – Ingkarni Wardli Atrium 15:30 – 16:00*

■ Plenary Lecture – The Braggs Lecture Theatre

16:00 ► Regina Burachik (University of South Australia)
Maximal Monotonicity versus Convexity: A fruitful interplay

■ Plenary Lecture – The Braggs Lecture Theatre

17:00 ► Étienne Ghys (École normale supérieure de Lyon)
The topology of real analytic curves in the plane

□ *Conference Dinner – National Wine Centre of Australia 19:00 – 23:00*

Fri 7 December 2018

■ Morning Special Sessions

8. Functional Analysis, Operator Algebra, Non-commutative Geometry

Engineering South S111

09:00 Zahra Afsar (The University of Sydney)
Equilibrium states on Higher-rank Toeplitz noncommutative solenoids (p. 74)

09:30 Fei Han (National University of Singapore)
Modular invariants for proper actions (p. 76)

16. Number Theory

Ingkarni Wardli B17

09:00 Min Sha (Macquarie University)
Carmichael polynomials over finite fields (p. 96)

09:30 Anand Rajendra Deopurkar (Australian National University)
On the geometric Steinitz problem (p. 95)

18. Probability Theory and Stochastic Processes

Ingkarni Wardli B18

09:00 Angus Hamilton Lewis[s] (The University of Adelaide)
Algorithms for Markovian Regime Switching models for electricity prices (p. 103)

09:30 Andriy Olenko (La Trobe University)
Statistics and filter transforms of Gegenbauer-type processes (p. 104)

□ *Morning Tea – Ingkarni Wardli Atrium 10:00 – 10:30*

■ Plenary Lecture – The Braggs Lecture Theatre

10:30 ► Josef Dick (University of New South Wales)
Numerical methods for partial differential equations with random coefficients

■ Plenary Lecture – The Braggs Lecture Theatre

11:30 ► Nageswari Shanmugalingam (University of Cincinnati)
Analysis in non-smooth spaces using paths

□ *Lunch – Ingkarni Wardli Atrium 12:30 – 13:30*

□ *Afternoon Tea – Ingkarni Wardli Atrium 15:30 – 16:00*

■ Afternoon Special Sessions

2. Algebra

Horace Lamb Lecture Theatre

13:30 David Gepner (The University of Melbourne)
Algebraic K-theory, endomorphisms, and Witt vectors (p. 57)

14:30 George Willis (The University of Newcastle)
Solvable locally compact contraction groups are nilpotent (p. 59)

15:00 Stephen Glasby (The University of Western Australia)
Permutations with orders coprime to a given integer (p. 57)

16:00 Michael Giudici (The University of Western Australia)
Subgroups of classical groups that are transitive on subspaces (p. 57)

16:30 David Robertson (The University of Newcastle)
Locally compact piecewise full groups (p. 58)

17:00 Tim Stokes (University of Waikato)
What is a partial semigroup? (p. 58)

5. Computational Mathematics

Ligertwood 314 Flinders Room

13:30 Michael Haythorpe (Flinders University)
Using a crossing minimisation heuristic to solve some open problems (p. 66)

6. Differential Geometry

Barr Smith South 2051

13:30 Peter Vassiliou (Australian National University)
Symmetry and Geometric Control Theory (p. 71)

14:00 Michael Murray (The University of Adelaide)
Signs for Real and equivariant gerbes (p. 71)

14:30 Alessandro Ottazzi (University of New South Wales)
Nilpotent Lie groups and metric geometry (p. 71)

8. Functional Analysis, Operator Algebra, Non-commutative Geometry

Engineering South S111

13:30 Silvestru Sever Dragomir (Victoria University)
Inequalities in Hermitian unital Banach $*$-algebras (p. 76)

14:00 Ian Doust (University of New South Wales)
Asymptotic negative type properties of finite ultrametric spaces (p. 75)

14:30 Guo Chuan Thiang (The University of Adelaide)
Crystallographic T-duality and super Baum-Connes conjecture (p. 77)

15:00 Matthias Ludewig (The University of Adelaide)
The Chern character of differential graded algebras and an Index Theorem (p. 76)

16:00 Arnaud Brothier (UNSW Sydney)
Unitary representations of the Thompson group constructed with a category/functor method due to Jones (p. 75)

16:30 Faezeh Alizadeh[s] (Shahid Rajaee Teacher Training University)
Some results on Roman 2-domination in graphs (p. 74)

10. Geometry and Topology

Barr Smith South 2060

13:30 Matthias Ludewig (The University of Adelaide)
Supersymmetric path integrals: Integrating differential forms on the loop space (p. 81)

14:00 Chen Guanheng (The University of Adelaide)
Cobordism map on PFH induced by elementary Lefschetz fibration (p. 80)

14:30 Jian He (Monash University)
Counting Non-Crossing Partitions on Surfaces (p. 81)

14. Mathematics Education

Horace Lamb 422 (via Hub Central)

13:30 Greg Oates (University of Tasmania)
Conceptual Considerations in the Transition to University Mathematics: The Case for Limits as a Threshold Concept (p. 92)

14:00 Jelena Schmalz (University of New England)
Transition between school and university placement test and bridging course (p. 92)

14:30 Ross Moore (Macquarie University)
Authoring accessible 'Tagged PDF documents using LaTeX (p. 91)

15:00 Chi Mak (University of New South Wales)
Comparing the Quality of Learning Outcomes (p. 91)

16:00 Diane Donovan (The University of Queensland)
Educating On-line Software (p. 89)

16:30 Deborah Jackson (La Trobe University)
Reflections on a kaleidoscope of multi-faceted, cross-disciplinary mathematics support. Feeding the growing appetite (p. 90)

17. Optimisation

Engineering South S112

13:30 Phil Howlett (University of South Australia)
The two-train separation problem (p. 98)

14:00 Tansu Alpcan (The University of Melbourne)
Game Theory and Machine Learning for Complex Networked Systems (p. 97)

14:30 Andrew Craig Eberhard (Royal Melbourne Institute of Technology)
A fixed point operator in discrete optimisation (p. 97)

15:00 Janosch Rieger (Monash University)
Electrical impedance tomography for unknown domains (p. 100)

16:00 Minh N. Dao (The University of Newcastle)
Adaptive Douglas-Rachford splitting algorithm for the sum of two operators (p. 97)

16:30 Chayne Planiden (University of Wollongong)
A Derivative-free VU-algorithm for Convex Functions (p. 100)

17:00 Wilhelm Freire (Universidade Federal de Juiz de Fora)
The Interior Epigraph Directions Algorithm for Nonsmooth and Nonconvex Constrained Optimization and applications (p. 98)

17:30 Yalçin Kaya (University of South Australia)
Constraint Splitting and Projection Methods for Optimal Control (p. 98)

18. Probability Theory and Stochastic Processes

Ingkarni Wardli B18

13:30 Sarat Babu Moka (The University of Queensland)
Perfect Sampling for Gibbs Point Processes using Partial Rejection Sampling (p. 104)

14:00 Samuel Cohen (The University of Oxford)
Statistical Uncertainty in Decision Making (p. 102)

14:30 Hermanus Marinus Jansen (The University of Queensland)
The power of QED-like scaling for many-server queues in a random environment (p. 103)

19. Representation Theory

Barr Smith South 2052

13:30 Asilata Bapat (Australian National University)
Recollement of perverse sheaves on real hyperplane arrangements (p. 106)

14:00 Thomas Gobet (The University of Sydney)
A Soergel-like category for complex reflection groups of rank one (p. 107)

14:30 Valentin Buciumas (The University of Queensland)
Quantum polynomial functors (p. 106)

Plenary Lectures in The Braggs Lecture Theatre

▷ Tue 4 December 2018

11:00 ► Geordie Williamson (The University of Sydney)
Semi-simplicity in representation theory

12:00 ► Malwina Luczak (The University of Melbourne)
Near-criticality in mathematical models of epidemics

17:00 ► Steven Sherwood (University of New South Wales)
Recent Advances in Climate Sensitivity

▷ Wed 5 December 2018

09:30 ► Natalie Thamwattana (The University of Newcastle)
A mathematical journey into nanoscience and nanotechnology

11:00 ► Manjunath Krishnapur (Indian Institute of Science Bangalore)
Nodal sets of eigenfunctions of the Laplacian, with randomness

12:00 ► Joan Licata (Australian National University)
Just Enough Twisting

▷ Thu 6 December 2018

11:00 ► Hinke Osinga (The University of Auckland)
Robust chaos: a tale of blenders, their computation, and their destruction

12:00 ► Renato Ghini Bettiol (City University of New York)
How to find non-trivial solutions out of trivial ones

16:00 ► Regina Burachik (University of South Australia)
Maximal Monotonicity versus Convexity: A fruitful interplay

17:00 ► Étienne Ghys (École normale supérieure de Lyon)
The topology of real analytic curves in the plane

▷ Fri 7 December 2018

10:30 ► Josef Dick (University of New South Wales)
Numerical methods for partial differential equations with random coefficients

11:30 ► Nageswari Shanmugalingam (University of Cincinnati)
Analysis in non-smooth spaces using paths

Special Session 1: Algebra

Organisers Daniel Chan, Roozbeh Hazrat, Mircea Voineagu

Keynote Talks

▷ Fri 7 December 2018

13:30 David Gepner (The University of Melbourne)
Algebraic K-theory, endomorphisms, and Witt vectors (p. 57)

Contributed Talks

▷ Tue 4 December 2018

14:00 Jeremy Sumner (University of Tasmania)
Markov association schemes (p. 58)

14:30 Alejandra Garrido (The University of Newcastle)
Hausdorff dimension and normal subgroups of free-like pro-p groups (p. 57)

15:30 Timothy Peter Bywaters[s] (The University of Sydney)
Spaces at infinity for hyperbolic totally disconnected locally compact groups (p. 56)

16:00 Carlisle King (The University of Western Australia)
Finite simple images of finitely presented groups (p. 58)

16:30 Stephan Tornier (The University of Newcastle)
Totally disconnected, locally compact groups from transcendental field extensions (p. 59)

▷ Wed 5 December 2018

15:30 James East (Western Sydney University)
Lattice paths and submonoids of $\mathbb{Z}^2$ (p. 56)

16:00 Yeeka Yau[s] (The University of Sydney)
Coxeter Systems for which the Brink-Howlett automaton is minimal (p. 59)

16:30 Alex Bishop[s] (University of Technology, Sydney)
Formal languages in group co-word problems (p. 56)

17:00 Ambily Ambattu Asokan (Cochin University of Science and Technology)
On von Neumann regularity of simple flat Leavitt path algebras (p. 56)

17:30 Faezeh Alizadeh[s] (Shahid Rajaee Teacher Training University)
Linear codes from matrices: answering a question of Glasby and Praeger (p. 56)

▷ Thu 6 December 2018

09:00 Robert McDougall (University of the Sunshine Coast)
On Kurosh-Amitsur and base radical classes for a non-associative setting (p. 58)

09:30 Lauren Thornton[s] (University of the Sunshine Coast)
Some results differentiating Kurosh-Amitsur and base radical classes (p. 59)

10:00 Neeraj Kumar[s] (IIT Bombay)
Koszul and Cohen-Macaulay properties of residual intersections (p. 58)

▷ Fri 7 December 2018

14:30 George Willis (The University of Newcastle)
Solvable locally compact contraction groups are nilpotent (p. 59)

15:00 Stephen Glasby (The University of Western Australia)
Permutations with orders coprime to a given integer (p. 57)

16:00 Michael Giudici (The University of Western Australia)
Subgroups of classical groups that are transitive on subspaces (p. 57)

16:30 David Robertson (The University of Newcastle)
Locally compact piecewise full groups (p. 58)

17:00 Tim Stokes (University of Waikato)
What is a partial semigroup? (p. 58)

Special Session 2: Applied and Industrial Mathematics

Organisers Mark Nelson, Harvinder Sidhu

Keynote Talks

▷ Wed 5 December 2018

15:30 Zlatko Jovanoski (University of New South Wales Canberra)
Population dynamics in a variable environment (p. 60)

Contributed Talks

▷ Tue 4 December 2018

14:00 Andrei Ermakov[s] (University of Southern Queensland)
Mathematical problems of long wave transformation in a coastal zone with a variable bathymetry (p. 60)

14:30 Ajini Galapitage[s] (University of South Australia)
Optimal scheduling of trains using connected driver advice system (p. 60)

15:30 Mark Joseph McGuinness (Victoria University of Wellington)
MMM, microwaves measure moisture (p. 61)

16:00 Yvonne Stokes (The University of Adelaide)
A coupled flow and temperature model for fibre drawing (p. 62)

16:30 Sevvandi Priyanvada Kandanaarachchi (Monash University)
About outlier detection (p. 61)

▷ Wed 5 December 2018

16:30 Mark Nelson (University of Wollongong)
No Jab, no pay (p. 61)

17:00 Kieran Clancy (Flinders University)
Choosing investment frequency to minimise brokerage costs (p. 60)

17:30 William Erik Pettersson (University of Glasgow)
Large Scale Kidney Exchange Programme Models: Saving Lives with Integer Programming (p. 62)

▷ Thu 6 December 2018

09:00 Benjamin Maldon[s] (The University of Newcastle)
Modelling Dye-Sensitized Solar Cells by Nonlinear Diffusion (p. 61)

09:30 Vanessa Robins (Australian National University)
Insights from the persistent homology analysis of porous and granular materials (p. 62)

10:00 Ilknur Tulunay (University of Technology, Sydney)
ST-metric estimation of factor weights (p. 63)

Special Session 3: Category Theory

Organisers Alexander Campbell, David Roberts

Contributed Talks

▷ Tue 4 December 2018

14:00 Yuki Maehara[s] (Macquarie University)
Inner horns for 2-quasi-categories (p. 64)

14:30 Michelle Strumila[s] (The University of Melbourne)
Infinity Cyclic Operads (p. 64)

15:30 Danny Stevenson (The University of Adelaide)
The right cancellation property of the class of inner anodyne maps (p. 64)

▷ Wed 5 December 2018

15:30 Marcy Robertson (The University of Melbourne)
A new class of coloured modular operads (p. 64)

16:00 David Gepner (The University of Melbourne)
Analytic monads and infinity operads (p. 64)

▷ Thu 6 December 2018

09:00 Alexander Campbell (Macquarie University)
Bicategories vs Rezk's weak 2-categories (p. 64)

09:30 Dominic Weiller[s] (Australian National University)
Algebras in Braided Tensor categories and Embedded surfaces (p. 65)

10:00 Ivo De Los Santos Vekemans[s] (Australian National University)
The slice filtration and spectral sequence (p. 64)

Special Session 4: Computational Mathematics

Organisers Bishnu Lamichhane, Quoc Thong Le Gia

Keynote Talks

▷ Wed 5 December 2018

15:30 Jerome Droniou (Monash University)
What the second Strang lemma and the Aubin-Nitsche trick should be (p. 66)

Contributed Talks

▷ Tue 4 December 2018

14:30 Garry Newsam (The University of Adelaide)
A review of some approximation schemes used in FFTs on non-uniform grids (p. 67)

15:30 Robert Womersley (University of New South Wales)
Using spherical t-designs and ℓ_q minimization for recovery of sparse signals on the sphere (p. 68)

16:00 Yuguang Wang (University of New South Wales)
Sparse Isotropic Regularization for Spherical Harmonic Representations of Random Fields on the Sphere (p. 68)

16:30 Janosch Rieger (Monash University)
Integrating semilinear parabolic differential inclusions with one-sided Lipschitz nonlinearities (p. 67)

▷ Wed 5 December 2018

16:30 Markus Hegland (Australian National University)
Numerical linear algebra and the solution of systems of polynomial equations (p. 67)

17:00 Hanz Martin Cheng[s] (Monash University)
A combined GDM-ELLAM-MMOC (GEM) scheme for advection dominated PDEs (p. 66)

17:30 Alex Newcombe[s] (Flinders University)
QuickCross - a crossing minimisation heuristic based on vertex insertion (p. 67)

▷ Thu 6 December 2018

09:00 William McLean (University of New South Wales)
A second-order time stepping scheme for fractional diffusion problems (p. 67)

09:30 Hailong Guo (The University of Melbourne)
Recovery based finite element method for fourth-order PDEs (p. 66)

10:00 Quoc Thong Le Gia (University of New South Wales)
Stochastic Navier-Stokes equations on a thin spherical domain (p. 67)

▷ Fri 7 December 2018

13:30 Michael Haythorpe (Flinders University)
Using a crossing minimisation heuristic to solve some open problems (p. 66)

Special Session 5: Differential Geometry

Organisers Wolfgang Globke, Yuri Nikolayevsky

Contributed Talks

▷ Tue 4 December 2018

14:00 Renato Ghini Bettiol (City University of New York)
Convex Algebraic Geometry of Curvature Operators (p. 69)

14:30 Romina Melisa Arroyo (University of Queensland)
The Alekseevskii conjecture: Overview and open questions (p. 69)

15:30 Ramiro Augusto Lafuente (The University of Queensland)
Homogeneous Einstein manifolds via a cohomogeneity-one approach (p. 70)

16:00 Owen Dearricott (The University of Melbourne)
Positive curvature in dimension 7 (p. 69)

16:30 Kelli Francis-Staite[s] (The University of Oxford)
Corners in C^∞-Algebraic Geometry (p. 70)

▷ Wed 5 December 2018

15:30 Kumbu Dorji[s] (University of New England)
Three-dimensional Sasakian structures and point-extension of monopoles (p. 69)

16:00 Michael Eastwood (The University of Adelaide)
The exceptional aerobatics of flying saucers (p. 69)

16:30 Krzysztof Krakowski (Cardinal Stefan Wyszynski University in Warsaw)
Properties of some quasi-geodesics on Stiefel manifolds (p. 70)

17:00 David Baraglia (The University of Adelaide)
A gluing formula for families Seiberg-Witten invariants (p. 69)

17:30 Gerd Schmalz (University of New England)
A criterion for local embeddability of 3-dimensional CR-structures (p. 71)

▷ Thu 6 December 2018

09:00 Keegan Flood[s] (The University of Auckland)
Scalar curvature and projective compactification (p. 69)

09:30 Daniel Snell[s] (The University of Auckland)
Distinguished curves in projective and conformal geometry (p. 71)

10:00 Anthony Shane Marshall[s] (Flinders University)
An Information Geometric Approach To Pulse-Doppler Sensor Optimisation (p. 70)

▷ Fri 7 December 2018

13:30 Peter Vassiliou (Australian National University)
Symmetry and Geometric Control Theory (p. 71)

14:00 Michael Murray (The University of Adelaide)
Signs for Real and equivariant gerbes (p. 71)

14:30 Alessandro Ottazzi (University of New South Wales)
Nilpotent Lie groups and metric geometry (p. 71)

Special Session 6: Dynamical Systems and Ergodic Theory

Organisers Cecilia Gonzalez-Tokman, Robert Marangell

Contributed Talks

▷ Wed 5 December 2018

15:30 Michael Small (The University of Western Australia)
Characterising Chimeras by Constructing Networks (p. 73)

16:00 Renaud Leplaideur (Université de la Nouvelle Calédonie)
Recent results in Thermodynamic Formalism (p. 72)

16:30 Robert Marangell (The University of Sydney)
Travelling waves in a model for tumor invasion with the acid-mediation hypothesis (p. 72)

17:00 Timothy Roberts[s] (The University of Sydney)
Stable nonphysical waves in a model of tumour invasion (p. 72)

17:30 Fawwaz Batayneh[s] (University of Queensland)
Quasi-compactness and invariant measures for random dynamical systems of Jablonski maps (p. 72)

▷ Thu 6 December 2018

09:00 Dave Smith (Yale-NUS College)
Dispersive quantisation (p. 73)

09:30 Peter Cudmore (The University of Melbourne)
'Systems all the way down': Managing Complexity with BondGraphTools (p. 72)

10:00 Cecilia Gonzalez-Tokman (The University of Queensland)
Lyapunov spectrum of Perron-Frobenius operator cocycles (p. 72)

Special Session 7: Functional Analysis, Operator Algebra, Non-commutative Geometry

Organisers Zahra Afsar, Peter Hochs

Keynote Talks

▷ Tue 4 December 2018

14:00 Mathai Varghese (The University of Adelaide)
The magnetic spectral gap-labelling conjecture and some recent progess (p. 77)

Contributed Talks

▷ Tue 4 December 2018

15:30 Jessica Murphy[s] (The University of Sydney)
C-algebras associated to graphs of groups* (p. 77)

16:00 Becky Armstrong[s] (The University of Sydney)
A twisted tale of topological k-graph C-algebras* (p. 74)

16:30 Raveen Daminda de Silva[s] (University of New South Wales)
Maximum Generalised Roundness of Random Graphs (p. 75)

▷ Wed 5 December 2018

15:30 Shaymaa Shawkat Kadhim Al-shakarchi[s] (University of New South Wales)
Isomorphisms of $AC(\sigma)$ spaces for linear graphs (p. 74)

16:00 David Leonard Brook[s] (The University of Adelaide)
Computations in Higher Twisted K-theory (p. 75)

16:30 Johnny Lim[s] (The University of Adelaide)
Pontryagin duality in higher Aharonov-Bohm effect (p. 76)

17:00 Nathan Brownlowe (The University of Sydney)
Can we reconstruct a directed graph from its Toeplitz algebra? (p. 75)

17:30 Elizabeth Bradford[s] (University of South Australia)
An application of recursive algorithm for inversion of linear operator pencils (p. 74)

▷ Thu 6 December 2018

09:00 Michael Arthur Mampusti[s] (University of Wollongong)
Equilibrium in operator algebraic dynamical systems (p. 76)

09:30 Nicholas Seaton[s] (University of Wollongong)
A Dixmier-Douady Theory for Fell Algebras and their associated Brauer Group (p. 77)

10:00 Thomas Scheckter[s] (University of New South Wales)
A Noncommutative Generalisation of a Problem of Steinhaus (p. 77)

▷ Fri 7 December 2018

09:00 Zahra Afsar (The University of Sydney)
Equilibrium states on Higher-rank Toeplitz noncommutative solenoids (p. 74)

09:30 Fei Han (National University of Singapore)
Modular invariants for proper actions (p. 76)

13:30 Silvestru Sever Dragomir (Victoria University)
Inequalities in Hermitian unital Banach $*$-algebras (p. 76)

14:00 Ian Doust (University of New South Wales)
Asymptotic negative type properties of finite ultrametric spaces (p. 75)

14:30 Guo Chuan Thiang (The University of Adelaide)
Crystallographic T-duality and super Baum-Connes conjecture (p. 77)

15:00 Matthias Ludewig (The University of Adelaide)
The Chern character of differential graded algebras and an Index Theorem (p. 76)

16:00 Arnaud Brothier (UNSW Sydney)
Unitary representations of the Thompson group constructed with a category/functor method due to Jones (p. 75)

16:30 Faezeh Alizadeh[s] (Shahid Rajaee Teacher Training University)
Some results on Roman 2-domination in graphs (p. 74)

Special Session 8: Geometric Analysis

Organisers Guanheng Chen, Chi-Kwong Fok

Contributed Talks

▷ Tue 4 December 2018

14:00 Miles Simon (Magdeburg University)
Some integral estimates for Ricci flow in four dimensions (p. 79)

14:30 Ahnaf Tajwar Tahabub[s] (The University of Adelaide)
Reduced SU(2) Seiberg-Witten Equations compared to SU(2) Ginzburg-Landau equations (p. 79)

15:30 Brett Parker (Monash University)
Regularity of the dbar equation in degenerating families (p. 79)

16:00 David Hartley (University of Wollongong)
On the Existence of Stable Unduloids of Dimension Eight (p. 78)

▷ Wed 5 December 2018

15:30 Kwok-Kun Kwong (The University of Sydney)
Some sharp Lévy-Gromov type isoperimetric inequalities (p. 78)

16:00 Pedram Hekmati (The University of Auckland)
Higgs bundles and foliations (p. 78)

16:30 Romina Melisa Arroyo (University of Queensland)
The long-time behaviour of the pluriclosed flow on Lie groups (p. 78)

17:00 Yuhan Wu[s] (University of Wollongong)
Length-constrained curve diffusion (p. 79)

▷ Thu 6 December 2018

09:00 James McCoy (The University of Newcastle)
Closed ideal planar curves (p. 79)

09:30 Ramiro Augusto Lafuente (The University of Queensland)
Hermitian curvature flow on complex Lie groups (p. 78)

10:00 Yong Wei (Australian National University)
Volume preserving flow and geometric inequalities in hyperbolic space (p. 79)

Special Session 9: Geometry and Topology

Organisers Zsuzsanna Dancso, Jessica Purcell

Keynote Talks

▷ Tue 4 December 2018

14:00 Brett Parker (Monash University)
Tropical geometry, the topological vertex, and Gromov-Witten invariants of Calabi-Yau 3-folds, (p. 81)

Contributed Talks

▷ Tue 4 December 2018

15:30 Benjamin Burton (University of Queensland)
Knot tabulation: a software odyssey (p. 80)

16:00 Anne Thomas (The University of Sydney)
Commensurability classification of certain right-angled Coxeter groups (p. 82)

16:30 Daniel Francis Mansfield (University of New South Wales)
Perpendicularity in Ancient Babylon (p. 81)

▷ Wed 5 December 2018

15:30 Dominic Tate[s] (The University of Sydney)
Compactification of the Space of Convex Projective Structures on Surfaces (p. 82)

16:00 Adam Wood[s] (The University of Melbourne)
Oriented geodesics in the three-sphere (p. 82)

16:30 Sophie Ham[s] (Monash University)
Triangulations of Solid Tori and Dehn Fillings (p. 80)

17:00 Vanessa Robins (Australian National University)
Tiling the Euclidean and Hyperbolic planes with ribbons (p. 81)

17:30 Chi-Kwong Fok (The University of Adelaide)
Twisted K-theory of compact Lie groups and extended Verlinde algebras (p. 80)

▷ Thu 6 December 2018

09:00 Iva Halacheva (The University of Melbourne)
Virtual and welded tangles via operads (p. 80)

09:30 Boris Lishak (The University of Sydney)
Trisections and their complexity (p. 81)

10:00 David G Glynn (Flinders University)
Particles of the first generation (p. 80)

▷ Fri 7 December 2018

13:30 Matthias Ludewig (The University of Adelaide)
Supersymmetric path integrals: Integrating differential forms on the loop space (p. 81)

14:00 Chen Guanheng (The University of Adelaide)
Cobordism map on PFH induced by elementary Lefschetz fibration (p. 80)

14:30 Jian He (Monash University)
Counting Non-Crossing Partitions on Surfaces (p. 81)

Special Session 10: Harmonic Analysis

Organisers Anh Bui, Ji Li

Contributed Talks

▷ Tue 4 December 2018

14:30 Xuan Duong (Macquarie University)
BMO spaces associated to operators on non-doubling manifolds with ends (p. 83)

15:30 Neil Kristofer Dizon[s] (The University of Newcastle)
Optimisation in the Construction of Symmetric and Cardinal Wavelets on the Line (p. 83)

16:00 Hong Chuong Doan[s] (Macquarie University)
Maximal operators with generalised Gaussian bounds on non-doubling Riemannian manifolds with low dimension (p. 83)

16:30 Xing Cheng (Monash University)
Scattering of the nonlinear Klein-Gordon equations (p. 83)

▷ Wed 5 December 2018

15:30 Tran Vu Khanh (University of Wollongong)
Bergman and Bergman-Toeplitz operators on pseudoconvex domains (p. 84)

16:00 Anh Bui (Macquarie University)
Sharp weighted estimates for square functions associated to operators on homogeneous spaces (p. 83)

16:30 Geetika Verma (University of South Australia)
An inversion technique for linear operator pencils in Hilbert space (p. 84)

Special Session 11: Integrable Systems

Organisers Nalini Joshi, Milena Radnovic, Yang Shi

Contributed Talks

▷ Tue 4 December 2018

14:00 Nalini Joshi (The University of Sydney)
Hidden solutions of discrete systems (p. 85)

14:30 Remy Alexander Adderton[s] (The Australian National University)
A generalized Temperley-Lieb algebra in the chiral Potts model (p. 85)

15:30 Yibing Shen[s] (The University of Queensland)
Ground-state energies of the open and closed $p + ip$-pairing models from the Bethe Ansatz (p. 85)

16:00 Reinout Quispel (La Trobe University)
Finding rational integrals of rational discrete maps (p. 85)

16:30 Kenji Kajiwara (Kyushu University)
A new framework and extensions of log-aesthetic curves in industrial design by integrable geometry (p. 85)

▷ Wed 5 December 2018

15:30 Yang Shi (Flinders University)
Certain subgroups of the Coxeter groups and symmetry of discrete integrable equations (p. 85)

16:00 Paul Zinn-Justin (The University of Melbourne)
Schubert calculus and quantum integrable systems (p. 86)

16:30 Peter Forrester (The University of Melbourne)
Some exact Lyapunov exponents for random matrix products (p. 85)

▷ Thu 6 December 2018

10:00 Yury Stepanyants (University of Southern Queensland)
Helical solitons in vector modified Kortewegde Vries equations (p. 86)

Special Session 12: Mathematical Biology

Organisers Mike Chen, Peter Kim

Contributed Talks

▷ Tue 4 December 2018

15:30 Jeremy Sumner (University of Tasmania)
Predicating saturation in models of genome rearrangement in polynomial time (p. 88)

16:00 Yoong Kuan Goh[s] (University of Technology, Sydney)
Pattern Avoidance in Genomics (p. 87)

16:30 Maria Kleshnina[s] (The University of Queensland)
Learning advantages in evolutionary games (p. 87)

▷ Thu 6 December 2018

09:00 Danya Rose (The University of Sydney)
Who cares? Or, when does paternal care arise in primates? (p. 87)

09:30 Anthony John Gallo[s] (The University of Adelaide)
Modelling Non-Uniform Growth in Cylindrical Yeast Colonies (p. 87)

10:00 Mike Chen (The University of Adelaide)
Multiscale modelling of fibre-reinforced hydrogels for tissue engineering (p. 87)

Special Session 13: Mathematics Education

Organisers Amie Albrecht, Deborah King, Raymond Vozzo

Contributed Talks

▷ Tue 4 December 2018

- 14:00 David Hartley (University of Wollongong)
  Student learning and feedback in higher education mathematics (p. 90)
- 14:30 Carolyn Kennett (Macquarie University)
  Mathematics and Indigenous Culture (p. 90)
- 15:30 Margaret Marshman (University of the Sunshine Coast)
  Making mathematics teachers: Beliefs about mathematics and mathematics teaching and learning held by academics who teach future teachers (p. 91)
- 16:00 Roland Dodd (Central Queensland University)
  First year engineering mathematics diagnostic testing (p. 89)
- 16:30 William Guo (Central Queensland University)
  You can teach old dogs new tricks if you know them well (p. 89)

▷ Thu 6 December 2018

- 09:00 Heather Lonsdale (Curtin University)
  Choose-your-own assessment (p. 90)
- 09:30 Amie Albrecht (University of South Australia)
  Learning to Communicate and Communicating to Learn (p. 89)
- 10:00 Simon James (Deakin University)
  Benefits and challenges of peer-assessment for online subjects (p. 90)

▷ Fri 7 December 2018

- 13:30 Greg Oates (University of Tasmania)
  Conceptual Considerations in the Transition to University Mathematics: The Case for Limits as a Threshold Concept (p. 92)
- 14:00 Jelena Schmalz (University of New England)
  Transition between school and university placement test and bridging course (p. 92)
- 14:30 Ross Moore (Macquarie University)
  Authoring accessible 'Tagged PDF documents using LaTeX (p. 91)
- 15:00 Chi Mak (University of New South Wales)
  Comparing the Quality of Learning Outcomes (p. 91)
- 16:00 Diane Donovan (The University of Queensland)
  Educating On-line Software (p. 89)
- 16:30 Deborah Jackson (La Trobe University)
  Reflections on a kaleidoscope of multi-faceted, cross-disciplinary mathematics support. Feeding the growing appetite (p. 90)

Special Session 14: Mathematical Physics

Organisers Iwan Jensen, Thomas Quella

Contributed Talks

▷ Tue 4 December 2018

14:00 Anupam Chaudhuri[s] (Monash University)
One-point recursions of Harer-Zagier type (p. 93)

14:30 Arnaud Brothier (UNSW Sydney)
Constructions of 1+1-dimensional lattice-gauge theories and the Thompson group (p. 93)

15:30 Philip Broadbridge (La Trobe University)
The conditionally integrable diffusion equation with nonlinear diffusivity $1/u$ (p. 93)

16:00 Iwan Jensen (Flinders University)
Self-avoiding walks with restricted end-points (p. 94)

16:30 Anthony Mays (The University of Melbourne)
Determinantal polynomials, vortices and random matrices: an exercise in experimental mathematical physics (p. 94)

▷ Wed 5 December 2018

16:00 Nicholas Beaton (The University of Melbourne)
Knotting probabilities for polygons in lattice tubes (p. 93)

16:30 Jeongwhan Choi (Korea University)
Capillary-Gravity Surface over a Bump: Critical Surface Tension (p. 93)

17:00 Zongzheng Zhou (Monash University)
Two-point functions of random walk models on high-dimensional boxes (p. 94)

17:30 Timothy Garoni (Monash University)
A limit theorem for the coupling time of the stochastic Ising model (p. 94)

Special Session 15: Number Theory

Organisers Mumtaz Hussain, Min Sha

Keynote Talks

▷ Tue 4 December 2018

14:00 Ole Warnaar (The University of Queensland)
On modular Nekrasov–Okounkov formulas (p. 96)

Contributed Talks

▷ Tue 4 December 2018

15:30 Florian Breuer (The University of Newcastle)
Heights and isogenies of Drinfeld modules (p. 95)

16:00 Matteo Bordignon[s] (University of New South Wales Canberra)
Explicit bounds on exceptional zeroes of Dirichlet L-functions (p. 95)

16:30 Michaela Cully-Hugill[s] (University of New South Wales Canberra)
Square-free numbers in short intervals (p. 95)

▷ Wed 5 December 2018

15:30 Ayreena Bakhtawar[s] (La Trobe University)
On the growth of product of partial quotients (p. 95)

16:00 Philip Bos[s] (La Trobe University)
Hausdorff Measure and Dirichlet Non-Improvable Numbers (p. 95)

16:30 Thomas Morrill (UNSW Canberra)
Overpartitions (p. 96)

17:00 Timothy Trudgian (UNSW Canberra)
Zeroes of the zeta-function: mind the gap! (p. 96)

17:30 Marley Young[s] (University of New South Wales)
On multiplicative independence of rational function iterates (p. 96)

▷ Thu 6 December 2018

09:00 Nicole Sutherland (The University of Sydney)
The efficient computation of Splitting Fields using Galois groups (p. 96)

09:30 Mumtaz Hussain (La Trobe University)
Measure theoretic laws in Diophantine approximation (p. 96)

▷ Fri 7 December 2018

09:00 Min Sha (Macquarie University)
Carmichael polynomials over finite fields (p. 96)

09:30 Anand Rajendra Deopurkar (Australian National University)
On the geometric Steinitz problem (p. 95)

Special Session 16: Optimisation

Organisers Yalçin Kaya, Guoyin Li

Keynote Talks

▷ Tue 4 December 2018

14:00 Marco Antonio López Cerdá (Alicante University)
A crash course on stability in linear optimization (p. 99)

Contributed Talks

▷ Tue 4 December 2018

15:30 Helmut Maurer (University of Mnster)
Multi-objective Optimal Control Problems in Biomedical Engineering (p. 99)

16:00 Sabine Pickenhain (Brandenburg Technical University Cottbus)
Optimal Control on Unbounded Intervals - Fourier-Laguerre Analysis of the Problem (p. 100)

16:30 Vladimir Gaitsgory (Macquarie University)
On continuity/discontinuity of the optimal value of a long-run average optimal control problem depending on a parameter (p. 98)

▷ Wed 5 December 2018

15:30 Alexander Kruger (Federation University Australia)
Characterizations of Hölder Error Bounds (p. 99)

16:00 Thi Hoa Bui[s] (Federation University Australia)
Generalized convexity (p. 97)

16:30 Cuong Nguyen Duy[s] (Federation University Australia)
Nonlinear parametric error bounds (p. 100)

17:00 Theo Bendit[s] (The University of Newcastle)
Doubleton Projections in Hilbert Spaces (p. 97)

17:30 David Kirszenblat[s] (The University of Melbourne)
A variational approach to the Dubins traveling salesman problem (p. 98)

▷ Thu 6 December 2018

08:30 Ryan Loxton (Curtin University)
Minimizing Equipment Shutdowns in Oil and Gas Campaign Maintenance (p. 99)

09:00 Belinda Spratt (Queensland University of Technology)
Reducing post-surgery recovery bed occupancy through an analytical prediction model (p. 101)

09:30 William Erik Pettersson (University of Glasgow)
Multi-objective mixed integer programming: An exact algorithm (p. 100)

10:00 Guoyin Li (University of New South Wales)
Calculus of Kurdyka-Lojasiewicz exponent and its applications to sparse optimisation (p. 99)

▷ Fri 7 December 2018

13:30 Phil Howlett (University of South Australia)
The two-train separation problem (p. 98)

14:00 Tansu Alpcan (The University of Melbourne)
Game Theory and Machine Learning for Complex Networked Systems (p. 97)

14:30 Andrew Craig Eberhard (Royal Melbourne Institute of Technology)
A fixed point operator in discrete optimisation (p. 97)

15:00 Janosch Rieger (Monash University)
Electrical impedance tomography for unknown domains (p. 100)

16:00 Minh N. Dao (The University of Newcastle)
Adaptive Douglas-Rachford splitting algorithm for the sum of two operators (p. 97)

16:30 Chayne Planiden (University of Wollongong)
A Derivative-free VU-algorithm for Convex Functions (p. 100)

17:00 Wilhelm Freire (Universidade Federal de Juiz de Fora)
The Interior Epigraph Directions Algorithm for Nonsmooth and Nonconvex Constrained Optimization and applications (p. 98)

17:30 Yalcin Kaya (University of South Australia)
Constraint Splitting and Projection Methods for Optimal Control (p. 98)

Special Session 17: Probability Theory and Stochastic Processes

Organisers Andrea Collevecchio, Giang Nguyen, Thomas Taimre

Keynote Talks

▷ Wed 5 December 2018

15:30 Ilze Ziedins (The University of Auckland)
Stochastic networks with selfish routing and information feedback (p. 105)

Contributed Talks

▷ Tue 4 December 2018

14:00 Kais Hamza (Monash University)
Directed walk on a randomly oriented lattice (p. 103)

14:30 Kihun Nam (Monash University)
Correlated time-changed Lévy processes (p. 104)

15:30 Kostya Borovkov (The University of Melbourne)
The asymptotics of the large deviation probabilities in the multivariate boundary crossing problem (p. 102)

16:00 Andrea Collevecchio (Monash University)
Branching ruin number (p. 103)

16:30 Lachlan James Bridges[s] (The University of Adelaide)
Markov-modulated random walk search strategies for animal foraging (p. 102)

▷ Wed 5 December 2018

16:30 Oscar Peralta[s] (Technical University of Denmark)
A fluid flow model with RAP components (p. 104)

17:00 Liam Hodgkinson[s] (University of Queensland)
Central limit theorems for dynamic random graph models (p. 103)

17:30 Graham Brightwell (London School of Economics)
Long-term concentration of measure and the cut-off phenomenon (p. 102)

▷ Thu 6 December 2018

09:00 Volodymyr Vaskovych[s] (La Trobe University)
On asymptotic behavior of weighted functionals of long-range dependent random fields on spheres (p. 105)

09:30 Yi-Lung Chen[s] (University of New South Wales)
Sampling via Regenerative Chain Monte Carlo (p. 102)

10:00 Peter Taylor (The University of Melbourne)
Why is Kemeny's constant a constant? (p. 104)

▷ Fri 7 December 2018

09:00 Angus Hamilton Lewis[s] (The University of Adelaide)
Algorithms for Markovian Regime Switching (MRS) models for electricity prices (p. 103)

09:30 Andriy Olenko (La Trobe University)
Statistics and filter transforms of Gegenbauer-type processes (p. 104)

13:30 Sarat Babu Moka (The University of Queensland)
Perfect Sampling for Gibbs Point Processes using Partial Rejection Sampling (p. 104)

14:00 Samuel Cohen (The University of Oxford)
Statistical Uncertainty in Decision Making (p. 102)

14:30 Hermanus Marinus Jansen (The University of Queensland)
The power of QED-like scaling for many-server queues in a random environment (p. 103)

Special Session 18: Representation Theory

Organisers Yaping Yang, Gufang Zhao

Contributed Talks

▷ Tue 4 December 2018

14:00 Masoud Kamgarpour (University of Queensland)
Topology of representation stacks (p. 107)

14:30 Iva Halacheva (The University of Melbourne)
Puzzles for restricting Schubert classes to the symplectic Grassmannian (p. 107)

15:30 Alexander Ferdinand Kerschl[s] (The University of Sydney)
Inner products on graded Specht modules (p. 107)

16:00 Marvin Krings[s] (RWTH Aachen University)
The p-Part of the Order of an Almost Simple Group of Lie Type (p. 108)

16:30 Seamus Albion[s] (The University of Queensland)
The Selberg integral and Macdonald polynomials (p. 106)

▷ Wed 5 December 2018

15:30 Edmund Xian Chen Heng[s] (Australian National University)
Braid group action on triangulated categories (p. 107)

16:00 Matthew James Spong[s] (The University of Melbourne)
Two models of equivariant elliptic cohomology (p. 108)

16:30 Saul Freedman[s] (The University of Western Australia)
p-groups related to exceptional Chevalley groups (p. 106)

17:00 Joel Gibson[s] (The University of Sydney)
The Product Monomial Crystal (p. 106)

17:30 Anthony Henderson (The University of Sydney)
Complementary symmetry for Slodowy varieties (p. 107)

▷ Thu 6 December 2018

08:30 Yusra Naqvi (The University of Sydney)
A product formula for certain coefficients of Macdonald polynomials (p. 108)

09:00 Michael Ehrig (The University of Sydney)
Finite dimensional representations of orthosymplectic supergroups (p. 106)

09:30 Travis Scrimshaw (The University of Queensland)
Crystal structures for symmetric Grothendieck polynomials (p. 108)

10:00 Anna Romanov (The University of Sydney)
An orbit model for the spectra of nilpotent Gelfand pairs (p. 108)

▷ Fri 7 December 2018

13:30 Asilata Bapat (Australian National University)
Recollement of perverse sheaves on real hyperplane arrangements (p. 106)

14:00 Thomas Gobet (The University of Sydney)
A Soergel-like category for complex reflection groups of rank one (p. 107)

14:30 Valentin Buciumas (The University of Queensland)
Quantum polynomial functors (p. 106)

Abstracts

1. Plenary

1.1. How to find non-trivial solutions out of trivial ones

Renato Ghini Bettiol (City University of New York)

12:00 Thu 6 December 2018 – Braggs

A/Prof Renato Ghini Bettiol

Bifurcation Theory originates from problems in Applied Sciences and Engineering (such as the buckling of columns under compressive stress), and was developed by mathematicians into a powerful toolkit that uses the instability of solutions to certain problems to prove the existence of other solutions nearby. These "bifurcating" solutions are often less symmetric and harder to find directly, but can provide very interesting examples. In this talk, I will give a broad overview of topological bifurcation methods with plenty of examples, starting from Undergraduate Calculus, moving into Partial Differential Equations, and then finally some recent applications in Geometric Analysis.

1.2. Maximal Monotonicity versus Convexity: A fruitful interplay

Regina Burachik (University of South Australia)

16:00 Thu 6 December 2018 – Braggs

Regina Burachik

Perhaps the most important connection between maximal monotone operators and convex functions is the fact that the subdifferential of a convex function is maximal monotone (a result established by Rockafellar in 1970). This connection defines a map from the set of convex functions to the set of maximal monotone operators.

The focus of my talk is to describe maps traveling in the opposite direction. Namely, to a given maximal monotone operator T, we will associate a family of convex functions, denoted by $\mathcal{H}(T)$. For achieving this, I will recall a family of so-called "enlargements" of T (i.e., point-to-set maps whose graph contains the graph of T), denoted by $\mathcal{E}(T)$. The elements of $\mathcal{E}(T)$ enjoy better continuity properties than T itself, and it is, therefore, useful for defining approximations of inclusion problems involving T. As a recent application of the family $\mathcal{H}(T)$ of convex functions, I will define a newly introduced concept of distance between two point-to-set maps, one of them being maximal monotone. This distance is inspired by the now well-known concept of Bregman distance, which, in turn, is originally induced by a convex function. Hence, this new concept of distance provides a further example of the fruitful two-way interplay between maximal monotone operators and convex functions.

1.3. Numerical methods for partial differential equations with random coefficients

Josef Dick (University of New South Wales)

10:30 Fri 7 December 2018 – Braggs

Assoc Prof Josef Dick

Mathematical models often contain uncertainty in parameters and measurements. In this talk we focus on partial differential equations where some parameters are modeled by random variables. The main example comes for the diffusion equation where the diffusion parameters is modeled as a random field which randomly fluctuates around a given mean. We discuss recent progress on numerical methods in quantifying this uncertainty.

1.4. The topology of real analytic curves in the plane

Étienne Ghys (École normale supérieure de Lyon)

17:00 Thu 6 December 2018 – Braggs

Prof Étienne Ghys

In the neighborhood of a singular point, a real analytic curve in the plane consists of a finite number of branches. Each of these branches intersects a small circle around the singular point in two points. Therefore, the local topology is described by a chord diagram: an even number of points on a circle paired two by two. Not all chord diagrams come from a singular point. The main purpose of this talk is to give an complete description of those "analytic" chord diagrams. On our way, we shall meet some interesting concepts from computer science, graph theory and operads.

1.5. Nodal sets of eigenfunctions of the Laplacian, with randomness

Manjunath Krishnapur (Indian Institute of Science Bangalore)

11:00 Wed 5 December 2018 – Braggs

Prof Manjunath Krishnapur

There has been a long study of nodal sets (zero level sets) of eigenfunctions of the Laplacian on a Riemannian manifold. Some questions of interest are about the length (or appropriate dimensional Hausdorff measure) of the nodal set, the number of nodal domains, the topology of nodal domains, etc. Some of these questions are difficult and open to this day. Answers are sometimes easier and more precise when one adds some randomness into the problem. In this talk, we survey some recent results in two settings of randomness:

1) For random linear combinations of eigenfunctions of the Laplacian on the 2-dimensional torus, the total length of the nodal set is a random variable whose variance has interesting dependence on

the distribution of lattice points on circles. This is joint work with Igor Wigman and Par Kurlberg. We shall also mention extensions of this work, including central limit theorems for the nodal length by many other authors.

2) The sign of second eigenvector of the Laplacian of a weighted graph partitions the graph into two parts. In the simplest case of a line graph endowed with i.i.d. edge weights, we observed that if the edge-weights are supported away from 0, then the two parts are almost equal, but if the edge-weights can be close to zero, then the smaller of the lengths can be anywhere between 0 and 1/2. We explain this observation. This is joint work with Arvind Ayyer.

1.6. Just Enough Twisting

Joan Licata (Australian National University)

12:00 Wed 5 December 2018 – Braggs
Dr Joan Licata

Low-dimensional contact geometry is the study of twisting plane fields on 3-manifolds. We'll start by making this notion precise, and then discuss some of the consequences and questions that arise naturally from equipping topological objects with this extra geometric structure. The second half of the talk will focus on the surprising differences between plane fields that twist "just enough" and those that twist "too much" and examine the extent to which this twisting can be localized.

1.7. Near-criticality in mathematical models of epidemics

Malwina Luczak (The University of Melbourne)

12:00 Tue 4 December 2018 – Braggs
Prof Malwina Luczak

In an epidemic model, the basic reproduction number R_0 is a function of the parameters (such as infection rate) measuring disease infectivity. In a large population, if $R_0 > 1$, then the disease can spread and infect much of the population (supercritical epidemic); if $R_0 < 1$, then the disease will die out quickly (subcritical epidemic), with only few individuals infected.

For many epidemics, the dynamics are such that R_0 can cross the threshold from supercritical to subcritical (for instance, due to control measures such as vaccination) or from subcritical to supercritical (for instance, due to a virus mutation making it easier for it to infect hosts). Therefore, near-criticality can be thought of as a paradigm for disease emergence and eradication, and understanding near-critical phenomena is a key epidemiological challenge.

In this talk, we explore near-criticality in the context of some simple models of SIS (susceptible-infective-susceptible) epidemics in large homogeneous populations.

1.8. Robust chaos: a tale of blenders, their computation, and their destruction

Hinke Osinga (The University of Auckland)

11:00 Thu 6 December 2018 – Braggs
Prof Hinke Osinga

A blender is an intricate geometric structure of a three- or higher-dimensional diffeomorphism. Its characterising feature is that its invariant manifolds behave as geometric objects of a dimension that is larger than expected from the dimensions of the manifolds themselves. We introduce a family of three-dimensional Hnon-like maps and study how it gives rise to an explicit example of a blender. The map has two saddle fixed points. Their associated stable and unstable manifolds consist of points for which the sequence of images or pre-images converges to one of the saddle points; such points lie on curves or surfaces, depending on the number of stable eigenvalues of the Jacobian at the saddle points. We employ advanced numerical techniques to compute one-dimensional stable and unstable manifolds to very considerable arclengths. In this way, we not only present the first images of an actual blender but also obtain a convincing numerical test for the blender property. This allows us to present strong numerical evidence for the existence of the blender over a larger parameter range, as well as its disappearance and geometric properties beyond this range. We will also discuss the relevance of the blender property for chaotic attractors.

This is joint work with Stephanie Hittmeyer and Bernd Krauskopf (University of Auckland) and Katsutoshi Shinohara (Hitotsubashi University).

1.9. Analysis in non-smooth spaces using paths

Nageswari Shanmugalingam (University of Cincinnati)

11:30 Fri 7 December 2018 – Braggs
Prof Nageswari Shanmugalingam

Classical analysis on Riemannian manifolds assumes the vector space structure (tangent spaces), with each point in the manifold equipped with a vector space. Calculus on mappings on the manifold is done by restricting the function to curves in the manifold with a prescribed tangent at the base point in the manifold. In generally non-smooth metric spaces, where no tangent space structure, this approach can still be fruitful, leading to the notion of upper gradients first proposed by Heinonen and Koskela in the 1990s. The goal of this talk is to give a general overview of first order calculus on metric measure spaces developed in the past twenty years using this notion of upper gradients.

1.10. Recent Advances in Climate Sensitivity

Steven Sherwood (University of New South Wales)

17:00 Tue 4 December 2018 – Braggs
Prof Steven Sherwood

The "climate sensitivity" S is defined as the equilibrium warming of the Earth when subjected to a doubling of its atmosphere's carbon dioxide concentration. Estimates of this core parameter of Earth's climate have ranged from 1.5–4.5 °C since the first credible attempts to quantify it in the 1960s. The width and location of the pdf of S have large implications for future global warming, mitigation, and adaptation. We now have multiple lines of evidence that provide information on S, though no line of evidence can provide a precise estimate on its own. Past climate assessments, in particular those of the Intergovernmental Panel on Climate Change (IPCC), have provided confidence intervals on S based on expert judgment. In this talk I will discuss the first attempt by the climate community to quantify a posterior pdf of S using Bayesian methodology that takes into account the full range of evidence. The effort has raised a number of interesting issues around the meaning and interpretation of priors and model and error independence, but reveals the power and importance of Bayesian inference — and leads to an interesting result.

1.11. A mathematical journey into nanoscience and nanotechnology

Natalie Thamwattana (The University of Newcastle)

09:30 Wed 5 December 2018 – Braggs
Prof Natalie Thamwattana

Applying mathematics in nanoscience and nanotechnology forms a modern area of research where analytical and computational tools in mathematical sciences solve a wide range of problems in nanoscience and nanotechnology. Mathematical modelling generates important new insights into complex processes and reveals optimal parameters and situations that might otherwise be difficult or costly to obtain, especially through experimentation. This talk will focus on modelling the interactions between nanostructures and applications of these structures in energy, biology and medicine. Join me on a magical journey into the nanoscale where beautiful mathematics finds fascinating new applications.

1.12. Semi-simplicity in representation theory

Geordie Williamson (The University of Sydney)

11:00 Tue 4 December 2018 – Braggs
Prof Geordie Williamson

Representation theory is the study of linear symmetry. Since the first papers on the representation theory of finite groups by Frobenius at the end of the 19th century, the theory has grown to form a fundamental tool of modern pure mathematics, with applications ranging from the standard model in particle physics to the Langlands program in number theory. Some of the most important theorems in representation theory assert some form of semi-simplicity. Examples include Maschke's theorem on representations of finite groups over the complex numbers (proved in 1897), Weyl's theorem on representations of compact Lie groups (proved in 1930), and the Kazhdan-Lusztig conjecture (proved by Beilinson-Bernstein and Brylinski-Kashiwara in 1980). This talk will be an introduction to these ideas, with an emphasis on our attempts to uncover further layers of hidden semi-simplicity.

2. Algebra

2.1. Linear codes from matrices: answering a question of Glasby and Praeger

Faezeh Alizadeh[s] (Shahid Rajaee Teacher Training University)

17:30 Wed 5 December 2018 – Horace Lamb

Faezeh Alizadeh, Cheryl Praeger, Stephen Glasby

Let F be a field and let $F^{r\times s}$ denote the space of $r \times s$ matrices over F. Let K be an extension field of F. Given matrices A in $K^{r\times r}$ and B in $K^{s\times s}$ we call the subspace $C_F(A, B) := \{X \in F^{r\times s} | AX = XB\}$ an intertwining code. Let R, k and d be rate, dimension and minimum distance of $C_F(A, B)$, respectively. In the paper [1] the authors asked whether there is a sequence $C_1, C_2, \ldots$ of intertwining codes over a field F with parameters $[r_is_i, k_i, d_i]$ for which the quantity $R_id_i = \frac{k_id_i}{r_is_i}$ approach infinity. In this talk I will answer the question affirmatively. Finally, a sequence of intertwining codes with large minimum distance when the field is small was constructed.

2.2. On von Neumann regularity of simple flat Leavitt path algebras

Ambily Ambattu Asokan (Cochin University of Science and Technology)

17:00 Wed 5 December 2018 – Horace Lamb

Dr Ambily Ambattu Asokan

In this talk, we shall discuss an open question that whether the flatness of simple modules over a unital ring implies all modules are flat and thus the ring is von Neumann regular. This question was asked by Ramamurthi over 40 years ago. He called such rings SF-rings. We shall discuss the von Neumann regularity of SF Leavitt path algebras.

This is a joint work with Roozbeh Hazrat and Huanhuan Li.

2.3. Formal languages in group co-word problems

Alex Bishop[s] (University of Technology, Sydney)

16:30 Wed 5 December 2018 – Horace Lamb

Alex Bishop

The co-word problem for a group, asks if a given word does not represent the identity of the group. The interesting question is to classify classes of groups in terms of the complexity of their co-word problems; for example, a group has a co-word problem given by a regular language if and only if it is finite; or by a deterministic context-free language if and only if it is virtually free.

In this talk, we will discuss groups with co-word problems given by a more exotic class of formal language known as ET0L which has recently gained popularity within areas of group theory. This talk will conclude with some interesting related questions and some applications of ET0L in group theory.

2.4. Spaces at infinity for hyperbolic totally disconnected locally compact groups

Timothy Peter Bywaters[s] (The University of Sydney)

15:30 Tue 4 December 2018 – Horace Lamb

Mr Timothy Peter Bywaters

Totally disconnected locally compact (t.d.l.c.) groups which are generated by a compact set admit a transitive action on a locally finite graph with compact open vertex stabilisers. Such a graph is a generalisation of Cayely graph. Definitions such as hyperbolic groups and their Gromov boundary extend naturally to the non-discrete case.

T.d.l.c. groups also admit an action on a metric space known as the space of directions. This space is an analogue of the Tits boundary for a negatively curved group and is effective at detecting free abelian subgroups.

In my talk I will expand on both the Gromov boundary and space of directions for a hyperbolic t.d.l.c. group and state a theorem relating them.

2.5. Lattice paths and submonoids of $\mathbb{Z}^2$

James East (Western Sydney University)

15:30 Wed 5 December 2018 – Horace Lamb

Dr James East

The study of lattice paths is a cornerstone of enumerative combinatorics, and important applications exist in almost all areas of mathematics. The subject goes back at least to the likes of Fermat and Pascal in the 1600s, and leads to many famous number sequences and arrays, including Fibonacci, Catalan, Motzkin, Delannoy and Schröder numbers. The basic idea is to take some set $X \subseteq \mathbb{Z}^2$; see which points from $\mathbb{Z}^2$ you can get to by taking a "walk" from some designated origin using "steps" from X; and for each such point, calculate the total number of such walks (which might be infinite). Sometimes constraints are also imposed, so that the walks must stay within a specified region of the plane (e.g., the first quadrant).

In this talk I'll discuss some recent joint work with Nicholas Ham, in which we take a kind of meta-approach to such problems, classifying the step sets for which the solutions have various properties. It turns out that finiteness properties of solutions are closely related to the geometrical properties of the step set, algebraic properties of the monoid of endpoints, and combinatorial properties of certain bi-labelled digraphs. There is an intriguing divergence between the cases of finite and infinite step sets, and some constructions rely on highly non-trivial properties of real numbers.

2.6. Hausdorff dimension and normal subgroups of free-like pro-p groups

Alejandra Garrido (The University of Newcastle)

14:30 Tue 4 December 2018 – Horace Lamb
Dr Alejandra Garrido

Hausdorff dimension has become a standard tool to measure the size of fractals in real space. However, it can be defined on any metric space and therefore can be used to measure the size of subgroups of, say, pro-p groups (with respect to a chosen metric). This line of investigation was started 20 years ago by Barnea and Shalev, who showed that p-adic analytic groups do not have any "fractal" subgroups, and asked whether this characterises them among finitely generated pro-p groups.

I will explain what all of this means and report on joint work with Oihana Garaialde and Benjamin Klopsch in which, while trying to solve this problem, we ended up showing an analogue of a theorem of Schreier in the context of pro-p groups of positive rank gradient: any finitely generated infinite normal subgroup of a pro-p group of positive rank gradient is of finite index. I will also explain what "positive rank gradient" means, and why pro-p groups with such a property are "free-like".

2.7. Algebraic K-theory, endomorphisms, and Witt vectors

David Gepner (The University of Melbourne)

13:30 Fri 7 December 2018 – Horace Lamb
Dr David Gepner

Algebraic K-theory is a deep and difficult invariant of algebraic objects such as ring and varieties with numerous applications to number theory and geometry. We will begin with an introduction to algebraic K-theory and various related functors, such as Hochschild homology and cyclic homology. By a theorem of Almkvist, the endomorphism K-theory of a commutative ring is closely related to its ring of Witt vectors: more precisely, it contains the ring of rational Witt vectors (a dense subring of all Witt vectors) as a summand. In addition to the usual Witt vector operations, such as Frobenius and Verschiebung, we shall see that algebraic K-theory allows us to classify all suitably natural operations on the rational Witt vectors, answering a question originally posed by Almkvist in the 70s. Portions of this talk will report on joint work with Andrew Blumberg and Goncalo Tabuada.

2.8. Subgroups of classical groups that are transitive on subspaces

Michael Giudici (The University of Western Australia)

16:00 Fri 7 December 2018 – Horace Lamb
Prof Michael Giudici

Let V be an n-dimensional vector space over the finite field $\mathrm{GF}(q)$. There has been considerable interest in subgroups of $\Gamma\mathrm{L}_n(q)$ that are transitive on the set of all k-dimensional subspaces of V, for some k. For example, when $k=1$ the classification of all such subgroups enabled the classification of all finite 2-transitive groups of affine type. Suppose now that V admits a nondegenerate sesquilinear or quadratic form and let G be the semisimilarity group of the form, that is G is a unitary, symplectic or orthogonal group. By Witt's Lemma, G is transitive on the set $\mathcal{U}$ of k-dimensional subspaces of V of a given isometry type. Especially interesting are the cases where $\mathcal{U}$ is an orbit on totally singular, or nondegenerate subspaces. In this talk I will discuss recent work with Stephen Glasby and Cheryl Praeger that is looking to classify all subgroups H of G that are transitive on $\mathcal{U}$. Many interesting examples arise.

2.9. Permutations with orders coprime to a given integer

Stephen Glasby (The University of Western Australia)

15:00 Fri 7 December 2018 – Horace Lamb
Dr Stephen Glasby

Erdős and Turán, in 1967, showed that the proportion of permutations in the symmetric group $\mathrm{Sym}(n)$ of degree n with no cycle of length divisible by a fixed prime m is $\Gamma(1-\frac{1}{m})^{-1}\left(\frac{n}{m}\right)^{-\frac{1}{m}} + O(n^{-1-\frac{1}{m}})$. Let m be a positive square-free integer and let $\rho(m,n)$ be the proportion of permutations of $\mathrm{Sym}(n)$ whose order is coprime to m. We show that there exists a positive constant $C(m)$ such that

$$C(m)\left(\tfrac{n}{m}\right)^{\frac{\phi(m)}{m}-1} \leqslant \rho(n,m) \leqslant \left(\tfrac{n}{m}\right)^{\frac{\phi(m)}{m}-1} \quad \text{for all } n \geqslant m,$$

where ϕ is Euler's totient function.

The motivation for this problem arose from computational group theory, and I will mention some relevant classical results in statistical group theory to place our work in context. This is joint work with John Bamberg, Scott Harper, and Cheryl E. Praeger.

2.10. Finite simple images of finitely presented groups

Carlisle King (The University of Western Australia)

16:00 Tue 4 December 2018 – Horace Lamb
Dr Carlisle King

Given a finitely presented group Γ, one can ask which finite simple groups are images of Γ. There is a large literature on the study of finite images of various families of finitely presented groups arising geometrically, such as Fuchsian groups and hyperbolic groups. We will study a new result in this area concerning the free product $\Gamma = A * B$ of nontrivial finite groups A and B, proved using probabilistic methods.

2.11. Koszul and Cohen-Macaulay properties of residual intersections

Neeraj Kumar[s] (IIT Bombay)

10:00 Thu 6 December 2018 – Horace Lamb
Dr Neeraj Kumar

The notion of residual intersection was introduced by Artin and Nagata. In this talk, we shall see Koszul and Cohen-Macaulay properties of diagonal subalgebras of bigraded geometric residual intersections. Given a perfect ideal of height two in a polynomial ring, we show that all their powers have a linear resolution, and we shall discuss the Koszul, and Cohen-Macaulay property of the diagonal subalgebras of their Rees algebras. This is a joint work with H. Ananthnarayan and Vivek Mukundan.

2.12. On Kurosh-Amitsur and base radical classes for a non-associative setting

Robert McDougall (University of the Sunshine Coast)

09:00 Thu 6 December 2018 – Horace Lamb
Dr Robert McDougall

In this presentation we give a complete listing of the radical and semisimple classes for both Kurosh-Amitsur (KA) and base radical constructions in a universal class generated by a non-associative ring. We identify classes that are radical or semisimple under one construction but not the other.

2.13. Locally compact piecewise full groups

David Robertson (The University of Newcastle)

16:30 Fri 7 December 2018 – Horace Lamb
Mr David Robertson

A group G acting faithfully by homeomorphisms of the Cantor set is called *piecewise full* if any homeomorphism assembled piecewise from elements of G is itself an element of G. I will discuss when such a group admits a non-discrete locally compact second countable group topology and describe a number of examples. This is joint work with Alejandra Garrido and Colin Reid.

2.14. What is a partial semigroup?

Tim Stokes (University of Waikato)

17:00 Fri 7 December 2018 – Horace Lamb
Dr Tim Stokes

Free algebras make sense for any sufficiently well-behaved class of algebras of some fixed type. There is interest in extending the idea to partial algebras. For example, there is a useful notion of free category in which the free objects are built from directed graphs rather than sets. Categories are partial semigroups, and in thinking about how to extend the notion of freeness to partial semigroups in general, one must first decide what "partial semigroup" means. In this talk we explore various possible definitions and how they relate, giving examples. We then return to what the free objects look like: of course, this depends which definition one uses.

This is joint work with Professor Victoria Gould (York University, UK).

2.15. Markov association schemes

Jeremy Sumner (University of Tasmania)

14:00 Tue 4 December 2018 – Horace Lamb
Dr Jeremy Sumner

I will discuss what is a compelling example of the mathematics of phylogenetics leading to a novel algebraic structure. The motivation for this work comes from a simple model of aminoacyl-tRNA synthetase (aaRS) evolution devised by Julia Shore (UTAS) and Peter Wills (U Auckland). Starting with a proposed rooted tree describing the specialization of aaRS through evolution of the genetic code, their model produces a space of Markov rate matrices that form a commutative algebra under matrix multiplication. We refer to each of these as a 'tree-algebra'.

By their construction, one initially expects that the tree-algebras occur as an instance of association schemes. However this is not the case, and further study has revealed that both the tree-algebras and association schemes occur as a special case of a more general (and plausibly novel) algebraic structure which we have coined 'Markov association schemes'.

I will describe our first steps in attempting to characterize the Markov association schemes. In particular presenting two binary operations of 'sum' and 'product' on the class of the schemes.

2.16. Some results differentiating Kurosh-Amitsur and base radical classes

Lauren Thornton[s] (University of the Sunshine Coast)

09:30 Thu 6 December 2018 – Horace Lamb
Miss Lauren Thornton

It is known that Kurosh-Amitsur (KA) and base radical classes coincide in the universal class of associative rings but that not all KA radical classes are base radical in a more general setting. In this presentation we offer up some results which compare and contrast the two constructions to reveal a "hybrid" object that is both radical and semisimple but not necessarily both KA-radical and KA-semisimple.

2.17. Totally disconnected, locally compact groups from transcendental field extensions

Stephan Tornier (The University of Newcastle)

16:30 Tue 4 December 2018 – Horace Lamb
Dr Stephan Tornier

(Joint work with Timothy P. Bywaters) Let E over K be a field extension. Then the group of automorphisms of E which pointwise fix K is totally disconnected Hausdorff when equipped with the permutation topology. We study examples, aiming to establish criteria for this group to be locally compact, non-discrete and compactly generated.

2.18. Solvable locally compact contraction groups are nilpotent

George Willis (The University of Newcastle)

14:30 Fri 7 December 2018 – Horace Lamb
Prof George Willis

If G is a connected Lie group with an automorphism, α, such that $\alpha^n(x) \to 1$ as $n \to \infty$ for every $x \in G$, then G is nilpotent. This fact, which is well-known, may be proved by passing to the Lie algebra of G and using elementary linear algebra.

The corresponding statement does not hold in full generality when G is totally disconnected and locally compact, as examples built from non-abelian finite simple groups show. It does hold if G is solvable however. The argument falls into two cases, since G is the direct sum of closed subgroups

$$G = D \oplus T$$

with D divisible and T torsion. The divisible factor D may be shown, using work of Lazard, to be the direct sum of p-adic analytic groups and these may be shown to nilpotent by the same argument using the Lie algebra. The torsion case requires a more direct argument.

This is joint work with Helge Glöckner.

2.19. Coxeter Systems for which the Brink-Howlett automaton is minimal

Yeeka Yau[s] (The University of Sydney)

16:00 Wed 5 December 2018 – Horace Lamb
James Parkinson and Yee Yau

In their celebrated 1993 paper, Brink and Howlett proved that all finitely generated Coxeter groups are automatic. In particular, they constructed a finite state automaton recognising the language of reduced words in a Coxeter group. This automaton is not minimal in general, and recently Christophe Hohlweg, Philippe Nadeau and Nathan Williams stated a conjectural criteria for the minimality. In this talk we will explain these concepts, and prove the conjecture of Hohlweg, Nadeau, and Williams. This work is joint with James Parkinson.

3. Applied and Industrial Mathematics

3.1. Choosing investment frequency to minimise brokerage costs

Kieran Clancy (Flinders University)

17:00 Wed 5 December 2018 – Ligert 316

Dr Kieran Clancy

We consider a practical and seemingly simple problem in financial mathematics: Suppose that Joe sets aside $100 every week to invest in some shares. He predicts that the shares will have a rate of return of 8% per annum, while his bank interest is just 3% per annum. Joe would prefer to buy the shares immediately, but every time he buys a parcel of shares he has to pay a brokerage of $10, regardless of the amount purchased. Is it better for Joe to accumulate his savings for a number of weeks before purchasing the shares? If so, how long should Joe save up before buying each parcel? This problem is generalised and a solution is presented including a closed-form approximation using a Taylor series expansion. This talk is suitable for undergraduate audiences.

3.2. Mathematical problems of long wave transformation in a coastal zone with a variable bathymetry

Andrei Ermakov[s] (University of Southern Queensland)

14:00 Tue 4 December 2018 – Ligert 316

A.M. Ermakov, and Y.A. Stepanyants

We apply the rigorous mathematical methods to investigate surface wave transformation in a basin with a variable bathymetry. The development of rigorous mathematical methods for the description of wave transformation in the coastal zone represents an important and topical problem both from the academic and practical points of view, especially in the application of the protection of the Australian coastline from the hazardous impacts of oceanic waves. We consider long linear wave transformations in a coastal zone where water depth can vary arbitrarily smoothly. The derived system of differential equations that describes the changes of wave speed and free surface elevation are solved exactly for the different types of bottom profile. New analytical solutions in terms of special functions for wave transformation were obtained. The transformation coefficients were derived as the functions of wave frequency and the total depth drop for three typical models: piece-linear, piece-quadratic, and hyperbolic tangential depth profiles. For all these cases we have derived exactly solvable equations and obtained their solutions in terms of hypergeometric functions. The influence of the governing parameters on the type of wave transformation was analysed. We show that the results obtained are in agreement with the energy flux conservation and Lamb's formula in the limiting case of zero frequency.

3.3. Optimal scheduling of trains using connected driver advice system

Ajini Galapitage[s] (University of South Australia)

14:30 Tue 4 December 2018 – Ligert 316

Mrs Ajini Galapitage

On most railways, if a train is delayed then following train get to know about the delay when the driver saw a trackside signal. Then it will have to slow significantly, which causes delays to propagate back along the track. By using in-cab Driver Advice Systems connected to centralised scheduling systems, train delays can be detected as they happen, and new schedules can be calculated and issued to following trains so that additional delays are avoided.

The Scheduling and Control Group at the University of South Australia and Sydney-based Company TTG Transportation Technology have developed the Energymiser Driver Advice System that is used by train drivers to help them stay on time and reduce energy use.

On large congested rail networks with many trains, such as passenger networks in Sydney, or the coal network in the Hunter Valley, it is impossible to schedule the whole rail network at once in real time as the problem is too large. An alternative, more practical approach is to independently optimise small sections of the network, such as individual lines or junctions.

In this talk, I will present our methods to solve the junction scheduling problem and line scheduling problem with simulated examples in UK.

3.4. Population dynamics in a variable environment

Zlatko Jovanoski (University of New South Wales Canberra)

15:30 Wed 5 December 2018 – Ligert 316

Dr Zlatko Jovanoski

Many ecosystems are subject to external perturbations such as pollution, land clearing and sudden shocks to their environment. However, most current models used do not take the changing environment into consideration. In cases where the changes in the environment are taken into account this is usually done by specifying some time-dependent function for the carrying capacity that reflects the observed behaviour of the changing environment.

Recent models developed by our group directly couple the dynamics of one or two species with their environments. This is achieved by treating the carrying capacity, a proxy for the state of the environment, as a state variable in the governing equations of the model. Thereby, any changes to the environment can be naturally reflected in the survival, movement and competition of the species within the ecosystem.

Furthermore, a vast majority of models are deterministic and cannot adequately account for random external perturbation such as fires, drought, floods, contamination of water resources etc. By adding stochasticity (noise), it is possible to account for these anomalous impacts on population dynamics that deterministic models often ignore.

For this talk a simple ecosystem consisting of a single species and its variable environment is proposed. Specifically, a logistic population model that incorporates a stochastic carrying capacity is investigated. The carrying capacity is treated as a state variable and is described by a stochastic differential equation. The statistical properties of the carrying capacity and the population are analysed. The probability distribution of the mean-time to extinction, the expected time evolution of the population and its variance are computed using the Monte Carlo method.

3.5. About outlier detection

Sevvandi Priyanvada Kandanaarachchi (Monash University)

16:30 Tue 4 December 2018 – Ligert 316

Dr Sevvandi Priyanvada Kandanaarachchi

Does normalizing your data affect outlier detection? It is common practice to normalize data before using an outlier detection method. But which method should we use to normalize the data? Does it matter? The short answer is yes, it does. The choice of normalization method may increase or decrease the effectiveness of an outlier detection method on a given dataset.

In addition to normalization, what is the outlier detection method best suited for my problem? Given an outlier detection problem, a suitable outlier method is needed because the strengths and weaknesses of methods are different, rendering each method useful for a different set of problems. Therefore, choosing a suitable normalization method as well as an outlier detection method is important if one were to maximize performance. In this talk, we investigate this two-fold selection using meta-features of datasets and visualize the relative strengths and weaknesses of outlier methods using instance space analysis.

3.6. Modelling Dye-Sensitized Solar Cells by Nonlinear Diffusion

Benjamin Maldon[s] (The University of Newcastle)

09:00 Thu 6 December 2018 – Ligert 316

Mr Benjamin Maldon

Dye-Sensitized Solar Cells (DSSCs) maintain high research interest, owing to their potential as a viable solution to the renewable energy problem.

While ample nanomaterials have been suggested to improve their efficiency, mathematical modelling and analysis remains noticeably sparse. The dominant model in this area remains the electron diffusion equation, which has been extended to include time-dependence and nonlinear characteristics since its introduction 24 years ago.

In this talk, we analyse this diffusion equation by Lie Symmetry and Homotopy methods and compare results to standard finite difference numerical solutions to obtain the characteristic traits of a DSSC.

3.7. MMM, microwaves measure moisture

Mark Joseph McGuinness (Victoria University of Wellington)

15:30 Tue 4 December 2018 – Ligert 316

Prof Mark Joseph McGuinness

Measure the moisture content of bauxite in real time on a conveyor belt as it is offloaded from a ship - this is the challenge that alumina company Rusal Aughinish brought to a European Study Group with Industry, held during one week in June 2017 at the Univeristy of Limerick in Ireland. Rusal were using a newly installed microwave analyser, and they sought our judgement on the reliability of the moisture measurements produced by the analyser. If you come to this talk, you will hear how we tackled the data and information provided, and what we learned about the physics of microwaves propagating through a field of polarisers. Come, and be amazed at the twist and turns of our negotiations of the path to enlightenment.

3.8. No Jab, no pay

Mark Nelson (University of Wollongong)

16:30 Wed 5 December 2018 – Ligert 316

Assoc Prof Mark Nelson

Before vaccination campaigns in the 1960s and 1970s disease such as diphtheria, tetanus, and whooping cough were responsible for killing thousands of children in Australia. Wide-spread vaccination programs have almost eliminated the death of children from these disease in Australia.

Opponents to vaccination have existed for as long as vaccination itself. The anti-vaccination movement received a major boost in 1998 with the publication of a, now discredited, study in the Lancet which claimed that the mumps, measles and rubella (MMR) vaccine was related to autism. The publication of this study has lead to an increase in the number of opponents to vaccination.

What is the possible effect of the anti-vaccination movement upon the spread of contagious disease?

To answer this question we combine the standard SIR model with vaccination for the spread of a contagious disease with a, slightly modified, SIR model for the spread of the anti-vaccination contagion. This leads to a system of nine differential equations. We use this model to investigate how the spread of the anti-vaccination contagion within a town increases the number of infections of an infectious disease (assumed to be measles) over a twenty-year time frame.

This is joint work with Matthew Giffard, a second-year undergraduate student at the University of Wollongong.

3.9. Large Scale Kidney Exchange Programme Models: Saving Lives with Integer Programming

William Erik Pettersson (University of Glasgow)

17:30 Wed 5 December 2018 – Ligert 316
Dr William Erik Pettersson

For people with end stage kidney disease, the best possible outcome is a transplant from a living donor. However, finding someone willing to share a kidney is not easy, and is made harder if the donor also has to be medically compatible. A kidney exchange programme facilitates the donation of kidneys amongst a group of donors and patients, which helps to alleviate this medical requirement. A pool involving these donor-patient pairs can be modelled as a graph, with arcs representing compatible donations. The exact goal of such a model depends on various ethical, legal and logistical considerations, but a common theme is the finding of a largest cardinality cycle packing in this graph. Integer programming is a common technique in such programmes, and many different models have been investigated in the literature. We examine a number of these models in the context of transnational kidney exchange programmes, scaling the instance sizes upwards to account for larger pool sizes. In this context we discuss various options and parameters for modelling which improve the efficiency of these algorithms at larger scales, as well as experimental data presenting how these options impact upon existing models.

3.10. Insights from the persistent homology analysis of porous and granular materials

Vanessa Robins (Australian National University)

09:30 Thu 6 December 2018 – Ligert 316
Dr Vanessa Robins

Persistent homology is an algebraic topological tool developed for data analysis that measures changes in topology of a filtration: a growing sequence of spaces indexed by a single real parameter. It produces invariants called the barcodes or persistence diagrams that are sets of intervals recording the birth and death parameter values of each homology class in the filtration. When the filtration parameter is a length-scale, persistence diagrams provide a comprehensive description of geometric structure over the given parameter range.

The physical properties of porous and granular materials critically depend on the topological and geometric details of the material micro-structure. For example, the way water flows through sandstone depends on the connectivity and diameters of its pores, and the balance of forces in a grain silo on the contacts between individual grains. These materials are therefore a natural application area for persistent homology.

My work with the x-ray micro-CT group at ANU has produced topologically valid and efficient algorithms for studying and quantifying the intricate structure of complex porous materials. Our code package, diamorse, for computing skeletons, partitions, and persistence diagrams from 2D and 3D images is available on GitHub. The code contains several optimisations that allow it to process images with up to 2000^3 voxels on a high-end desktop PC. This software is enabling us to explore the connections between topology, geometry and physical properties of sandstone rock cores and granular packings. We have shown that persistence diagrams display a clear signal of crystallisation in bead packings, the degree of consolidation in sandstones, percolating length scales in porous media, and the trapping of non-wetting phase in two-phase fluid flow experiments.

3.11. A coupled flow and temperature model for fibre drawing

Yvonne Stokes (The University of Adelaide)

16:00 Tue 4 December 2018 – Ligert 316
Prof Yvonne Stokes

In the drawing of optical fibres viscosity is strongly temperature dependent. Surprisingly, where other parameters are assumed to be constant and only the final fibre geometry obtained from the initial preform geometry is important, a flow model is all that is required. If, however, there is a desire to know the geometry along the neck-down length from preform to fibre, then a temperature model must be coupled to the flow model; likewise, if parameters apart from the viscosity (e.g. surface tension) are temperature dependent.

In this talk we outline the derivation of an efficient asymptotic model for the drawing of fibres with arbitrary cross-sectional geometry. ODEs describe the change in area of the cross-section and the temperature from preform to fibre. In general, these are coupled with a 2D transverse-flow problem describing the evolution of the geometry in the cross-section due to surface tension and pressure. The accuracy of the model is demonstrated by comparison with experiments and finite-element simulations.

3.12. ST-metric estimation of factor weights

Ilknur Tulunay (University of Technology, Sydney)
10:00 Thu 6 December 2018 – Ligert 316
Dr Ilknur Tulunay

Consider discrete plane curves on (0, 1] x (0, 1]. ST-metric can be thought as distances between the discrete curves. It is defined as a square root of the symmetrized relative entropy of two n-point sets on (0, 1] and their averages. This idea has been introduced and applied to the performance measures of portfolios by Tulunay (2017). Factor analysis of major indexes are examined by Ang et al (2018) where the objective function of the optimization problem is set as tracking error (tracking differences times the standard deviation over some period). We purpose ST-metric optimization to find the factor exposures (weights) for a given index (or stock). Empirical evidence shows that ST-metric method gives better estimation of the factor exposures (weights).

4. Category Theory

4.1. Bicategories vs Rezk's weak 2-categories

Alexander Campbell (Macquarie University)

09:00 Thu 6 December 2018 – Eng Math G06

Dr Alexander Campbell

For each $n \geq 0$, Rezk defined a model structure on the category of simplicial presheaves over Joyal's category Θ_n whose fibrant objects are a model for weak n-categories. In this talk, I will show that this model is equivalent in the cases $n = 0, 1, 2$ to the classical notions of set, category, and bicategory, in the sense that they form Quillen equivalent model categories. This is partly joint work with Edoardo Lanari.

4.2. Analytic monads and infinity operads

David Gepner (The University of Melbourne)

16:00 Wed 5 December 2018 – Eng Math G06

Dr David Gepner

We develop an infinity-categorical version of the classical theory of polynomial and analytic functors, initial algebras, and free monads. Using this machinery, we provide a new model for infinity-operads as analytic monads. We justify this definition by proving that the infinity-category of analytic monads is equivalent to that of dendroidal Segal spaces, which are known to be equivalent to the other existing models for infinity-operads.

4.3. Inner horns for 2-quasi-categories

Yuki Maehara[s] (Macquarie University)

14:00 Tue 4 December 2018 – Eng Math G06

Mr Yuki Maehara

2-*quasi-categories* are a model for $(\infty, 2)$-categories, defined as the fibrant Θ_2-sets with respect to a model structure due to Ara. Since this model structure is constructed using Cisinski's machinery, the 2-quasi-categories and the fibrations between them can be characterised by the right lifting property with respect to a certain set of maps that admits an explicit description. However, this set is not very easy to work with from the combinatorial viewpoint. In this talk, I will give an alternative characterisation of (fibrations between) 2-quasi-categories using a much more convenient set, namely the inner horn inclusions and equivalence extensions introduced by Oury in his PhD thesis.

4.4. A new class of coloured modular operads

Marcy Robertson (The University of Melbourne)

15:30 Wed 5 December 2018 – Eng Math G06

Dr Marcy Robertson

Modular operads, defined by Getzler-Kapronov in the 90s, originally came up as a way to encode the combinatorics of the Feynman transform. The coloured version, also called compact symmetric multicategories, can be thought of as a generalisation of a category in which arrows are replaced with undirected spans which allow for "feedback." It has been unclear (at least to the speaker) what exactly these coloured modular operads are supposed to be. In this talk we give a partial answer arising from the study of certain combinatorial objects that arise in virtual and welded knot theory.

4.5. The right cancellation property of the class of inner anodyne maps

Danny Stevenson (The University of Adelaide)

15:30 Tue 4 December 2018 – Eng Math G06

Dr Danny Stevenson

Some proofs in quasi-category theory can be simplified by exploiting the fact that certain classes of simplicial maps satisfy what is sometimes called the right cancellation property. It is well-known that the class of left and right anodyne maps satisfy this property. It is less well-known that the class of inner anodyne maps also satisfies this property. I will discuss both the proof of this fact and some applications.

4.6. Infinity Cyclic Operads

Michelle Strumila[s] (The University of Melbourne)

14:30 Tue 4 December 2018 – Eng Math G06

Miss Michelle Strumila

Dendroidal sets are a useful way of modelling infinity operads. We have defined a dendroidal set based on the mapping class groups of surfaces. We then go on to show that it is not an infinity operad, but a strict operad, via a theorem about dendroidal groupoids.

4.7. The slice filtration and spectral sequence

Ivo De Los Santos Vekemans[s] (Australian National University)

10:00 Thu 6 December 2018 – Eng Math G06

Mr Ivo De Los Santos Vekemans

A Postnikov tower from classical algebraic topology is built via localisation functors from a filtered sequence of localising subcategories $\tau_{\geq n}$ each generated by spheres S^k for $k \geq n$. Similarly, in the equivariant setting slice towers are built via localising functors from the slice filtration of localising subcategories generated by suitable representation spheres. In this talk I will introduce the slice tower, show how it gives an interesting spectral sequence (by contrast, the spectral sequence of a Postnikov tower is stable on the first page) and detail such a calculation.

4.8. Algebras in Braided Tensor categories and Embedded surfaces

Dominic Weiller[s] (Australian National University)

09:30 Thu 6 December 2018 – Eng Math G06
Mr Dominic Weiller

Given a monoidal category, the algebra objects, their bimodules and bimodule intertwiners form a bicategory. If we start with a braided tensor category (BTC), the braiding produces a monoidal product of algebras making the category of algebras, bimodules and intertwiners into a tricategory with a single 0-morphism (also called a monoidal bicategory). Using the theory of surface diagrams for Gray categories with duals, one expects to produce an 'extended TQFT of embedded surfaces' given a special Frobenius algebra in a BTC.

We will consider a non-extended version and see how to obtain invariants of embedded surfaces up to isotopy by drawing 'fine enough' trivalent graphs on a surface and choosing a special Frobenius algebra. Interesting examples must come from non-symmetrically braided categories as algebras in symmetric tensor categories give boring invariants. For example, picking the E_6 algebra in A_{11} (a non-symmetric BTC) we can distinguish the unlinked union of two tori from two concentrically nested tori.

5. Computational Mathematics

5.1. A combined GDM-ELLAM-MMOC (GEM) scheme for advection dominated PDEs

Hanz Martin Cheng[s] (Monash University)

17:00 Wed 5 December 2018 – Ligert 314

Hanz Martin Cheng, Jerome Droniou, Kim-Ngan Le

We propose a combination of the Eulerian Lagrangian Localised Adjoint Method (ELLAM) and the Modified Method of Characteristics (MMOC) for time-dependent advection-dominated PDEs. The combined scheme, so-called GEM scheme, takes advantages of both ELLAM scheme (mass conservation) and MMOC scheme (easier computations), while at the same time avoids their disadvantages (respectively, harder tracking around the injection regions, and loss of mass). We present a precise analysis of mass conservation properties for these three schemes and numerical results illustrating the advantages of the GEM scheme. A convergence result of the MMOC scheme, motivated by our previous work on the convergence of ELLAM schemes, is provided, which can be extended to obtain the convergence of GEM scheme.

5.2. What the second Strang lemma and the Aubin-Nitsche trick should be

Jerome Droniou (Monash University)

15:30 Wed 5 December 2018 – Ligert 314

Assoc Prof Jerome Droniou

The second Strang lemma is widely considered, in the finite element community, as the key to establish error estimates for linear problems written in variational/weak form. It has however limitations that prevent its application to important methods, such as Finite Volume methods, discontinuous Galerkin, Virtual Element Methods, Hybrid High Order schemes, etc. Some of these methods are written in "fully discrete form": (some of) their unknowns are not functions on the physical domain of interest.

In this talk, I will present a 'third Strang lemma' that is applicable to any scheme, including those in fully discrete form. The idea is to estimate, in a discrete energy norm ("H^1-like", for 2nd order elliptic equations), the difference between the solution to the scheme and an interpolant of the continuous solution. This third Strang lemma is simpler to prove and use than the second Strang lemma, and defines a natural notion of consistency that satisfies the Lax principle: 'stability + consistency implies convergence'.

I will also discuss improved estimates in a weaker ("L^2-like") norm, by presenting an Aubin-Nitsche trick adapted to schemes in fully discrete form. I will show that the terms to estimate when using this Aubin-Nitsche trick are extremely similar to the ones already estimated when applying the third Strang lemma.

I will conclude by showing how these generic results yield new estimates for Finite Volume methods (and, time permitting, for discontinuous Galerkin).

5.3. Recovery based finite element method for fourth-order PDEs

Hailong Guo (The University of Melbourne)

09:30 Thu 6 December 2018 – Ligert 314

Dr Hailong Guo

In this talk, a recovery based finite element method for biharmonic equations is constructed and analyzed. In our construction, the popular post-processing gradient recovery operators are used to calculate approximately the second order partial derivatives of a continuous linear finite element function which do not exist in traditional meaning. The proposed scheme is straightforward and simple. More importantly, it is shown that the numerical solution of the proposed method converges to the exact one with optimal orders both under L^2 and discrete H^2 norms, while the recovered numerical gradient converges to the exact one with superconvergence order. Some novel properties of gradient recovery operators are discovered in the analysis of our method. In several numerical experiments, our theoretical findings are verified and a comparison of the proposed method with the nonconforming Morley element and C^0 interior penalty method is given.

5.4. Using a crossing minimisation heuristic to solve some open problems

Michael Haythorpe (Flinders University)

13:30 Fri 7 December 2018 – Ligert 314

Dr Michael Haythorpe

My colleagues and I were recently successful in developing QuickCross, a robust and highly efficient heuristic for minimising crossings. In this talk, I will discuss how we have been able to use QuickCross to attack some problems in crossing minimisation, including determining the crossing numbers of some infinite families of graphs, and answering (in both the positive and the negative) some open conjectures about minimal graphs with certain crossing numbers. I will also discuss our recently completed comprehensive survey of graphs with known crossing numbers, the first of its kind in this highly active area of research.

5.5. Numerical linear algebra and the solution of systems of polynomial equations

Markus Hegland (Australian National University)

16:30 Wed 5 December 2018 – Ligert 314
Prof Markus Hegland

In my talk I will give a short review of numerical methods for the solution of systems of polynomial equations. I will in particular focus on the role of sparse linear matrix factorisation.

5.6. Stochastic Navier-Stokes equations on a thin spherical domain

Quoc Thong Le Gia (University of New South Wales)

10:00 Thu 6 December 2018 – Ligert 314
Dr Quoc Thong Le Gia

We consider the incompressible stochastic Navier-Stokes equations on a thin spherical domain along with free boundary conditions under a random forcing. We show that the martingale solution of these equations converge to the martingale solution of the stochastic Navier-Stokes equation on a sphere as the thickness converges to zero. This is a joint work with Gaurav Dhariwal (Vienna, Austria) and Zdzislaw Brzezniak (York, UK).

5.7. A second-order time stepping scheme for fractional diffusion problems

William McLean (University of New South Wales)

09:00 Thu 6 December 2018 – Ligert 314
Assoc Prof William McLean

I will describe recent work with Jiwei Zhang (Beijing Computational Science Research Center) and Hong-lin Liao (Nanjing University of Aeronautics and Astronautics) on the stability and convergence of the Alikhanov scheme for a fractional diffusion equation. We employ variable time steps to resolve the initial singularity in the solution. Our analysis relies on a novel Gronwall inequality which in turn requires us to prove a delicate monotonicity property of the Alikhanov weights.

5.8. QuickCross - a crossing minimisation heuristic based on vertex insertion

Alex Newcombe[s] (Flinders University)

17:30 Wed 5 December 2018 – Ligert 314
Mr Alex Newcombe

The crossing number of a graph is the minimum number of edge crossings in any drawing of the graph into the plane. Computing the crossing number is NP-hard and thus heuristic methods for minimising crossings are currently of interest. This talk will introduce a heuristic method for minimising crossings which is based upon repeatedly solving the so-called vertex insertion problem. This is in contrast to the current state-of-the-art crossing minimisation heuristic, the Planarization Method, which is based primarily on edge insertion techniques. We show that our approach is similarly effective in terms of solution quality and execution time, and is often superior for dense instances. In particular, we discuss a highly efficient implementation of our heuristic, which we call QuickCross, and which is available for use. Several design aspects of the implementation are also discussed.

5.9. A review of some approximation schemes used in FFTs on non-uniform grids

Garry Newsam (The University of Adelaide)

14:30 Tue 4 December 2018 – Ligert 314
Dr Garry Newsam

One of the two main constructions that enable fast computation of the discrete Fourier transform on non-uniform grids approximates the associated matrix F as

$$F \approx \sum_{p=1}^{P} D_p F_N E_p.$$

Here F_N is the standard $N \times N$ FFT matrix, D_p, E_p are diagonal matrices, and $P = O(|\log \epsilon|)$ where ϵ is the desired approximation accuracy. The entries of the diagonal matrices are the vectors $\mathbf{u}_p, \mathbf{v}_p$ in a rank-P approximation UV^T to a matrix $\hat{F}$ derived from F that has the form

$$\hat{F}_{m,n} = e^{2\pi i x_m y_n} \qquad x_m,\, y_n \in [-1/2, 1/2], \quad 1 \leq m, n \leq N.$$

Originally the rank-P approximations were constructed via a standard Taylor series expansion of the exponential about the origin; more recently, Ruiz-Antolin and Townsend [*SIAM J. Sci. Comput.,* **40**(1), pp. A529-A547, 2018] have constructed more efficient and numerically stable approximations based on expanding the exponential kernel as a bivariate series of Chebychev polynomials. The talk will compare these two schemes with alternative schemes based on expanding the exponential kernel in a Fourier-Bessel series and as a sum of prolate spheroidal wave functions, and benchmark all against the optimal rank-P approximations obtainable from the singular value decomposition of $\hat{F}$.

5.10. Integrating semilinear parabolic differential inclusions with one-sided Lipschitz nonlinearities

Janosch Rieger (Monash University)

16:30 Tue 4 December 2018 – Ligert 314
Prof Dr Wolf-Juergen Beyn, Prof Dr Etienne Emmrich, Dr Janosch Rieger

Semilinear parabolic differential inclusions with Lipschitz nonlinearities and their numerical approximations have been studied extensively in the literature. The established techniques for proving existence results and error estimates are based on projections that reduce the differential inclusion to a differential equation and rely on the Lipschitz property. To obtain similar results for non-Lipschitzian nonlinearities, we extend techniques for relaxed one-sided Lipschitz differential inclusions in finite-dimensional spaces to parabolic inclusions in the setting of Gelfand triples.

5.11. Sparse Isotropic Regularization for Spherical Harmonic Representations of Random Fields on the Sphere

Yuguang Wang (University of New South Wales)

16:00 Tue 4 December 2018 – Ligert 314

Quoc T. Le Gia, Ian Sloan, Rob Womersley and Yu Guang Wang

I will talk about sparse isotropic regularization for a random field on the unit sphere $\mathbb{S}^2$ in $\mathbb{R}^3$, where the field is expanded in terms of a spherical harmonic basis. A key feature is that the norm used in the regularization term, a hybrid of the ℓ_1 and ℓ_2-norms, is chosen so that the regularization preserves isotropy, in the sense that if the observed random field is strongly isotropic then so too is the regularized field. The Pareto efficient frontier is used to display the trade-off between the sparsity-inducing norm and the data discrepancy term, in order to help in the choice of a suitable regularization parameter. A numerical example using Cosmic Microwave Background (CMB) data is considered in detail. In particular, the numerical results explore the trade-off between regularization and discrepancy, and show that substantial sparsity can be achieved along with small L_2 error.

5.12. Using spherical t-designs and ℓ_q minimization for recovery of sparse signals on the sphere

Robert Womersley (University of New South Wales)

15:30 Tue 4 December 2018 – Ligert 314

Xiaojun Chen and Robert Womersley

This paper considers the recovery of sparse signals on the sphere from their low order, potentially noisy, Fourier-Laplace coefficients. The approach uses spherical t-designs (sets of points on the sphere for which equal weight cubature is exact for all spherical polynomials of degree at most t) to formulate a constrained $\ell_q(0 < q \leq 1)$ minimization model. We show that well-conditioned spherical t-designs and ℓ_q minimization have effective properties for recovery of sparse signals on the sphere. A key role is played by the separation of the underlying point set on which the discrete signal resides. Numerical examples and a discussion of super-resolution are provided.

6. Differential Geometry

6.1. The Alekseevskii conjecture: Overview and open questions

Romina Melisa Arroyo (University of Queensland)

14:30 Tue 4 December 2018 – BS Sth 2051

Dr Romina Melisa Arroyo

One of the most important open problems on Einstein homogeneous manifolds is the *Alekseevskii conjecture*. This conjecture says that any connected homogeneous Einstein space of negative scalar curvature is diffeomorphic to a Euclidean space.

In this talk we aim to discuss recent advances towards the above mentioned conjecture, share our contributions and describe some open problems.

This talk is based in a joint work with Ramiro Lafuente (The University of Queensland).

6.2. A gluing formula for families Seiberg-Witten invariants

David Baraglia (The University of Adelaide)

17:00 Wed 5 December 2018 – BS Sth 2051

Dr David Baraglia

The families Seiberg-Witten (SW) invariant is a generalisation of the ordinary SW invariant to families of smooth 4-manifolds. We use a gluing construction to study the SW equations on a family of connected sums. The result is a formula which allows the computation of certain families SW invariants in terms of ordinary SW invariants. Amongst the applications of this result is an obstruction to the existence of positive scalar curvature metrics invariant under a given group of diffeomorphisms. This talk is based on joint work with Hokuto Konno and Mathai Varghese.

6.3. Convex Algebraic Geometry of Curvature Operators

Renato Ghini Bettiol (City University of New York)

14:00 Tue 4 December 2018 – BS Sth 2051

Prof Renato Ghini Bettiol

In this talk, I will discuss a few properties of the set of algebraic curvature operators of n-dimensional spaces satisfying a sectional curvature bound, under the light of the emerging field of Convex Algebraic Geometry. This is a report on joint work (in progress) with M. Kummer and R. Mendes.

6.4. Positive curvature in dimension 7

Owen Dearricott (The University of Melbourne)

16:00 Tue 4 December 2018 – BS Sth 2051

Dr Owen Dearricott

In this talk I outline a construction for putting positive sectional curvature on a series of 7-manifolds discussed as viable candidates to carry positively curved metrics with co-dimension one principal orbits discussed by Grove, Wilking and Ziller in JDG in 2008 by appropriately modifying a naturally occurring 3-Sasakian metric. This builds on previous work where I considered isolated examples of this sort where the base Bianchi IX self-dual Einstein orbifold metric had an algebraic closed form.

6.5. Three-dimensional Sasakian structures and point-extension of monopoles

Kumbu Dorji[s] (University of New England)

15:30 Wed 5 December 2018 – BS Sth 2051

Mr Kumbu Dorji

Let M be a compact, oriented, Riemannian three-manifold, admitting a geodesible Killing vector field along which the Ricci curvature tensor is everywhere positive, and is constant outside a compact subset K of M. Let E be a smooth complex vector bundle, defined initially over $M \setminus \{P\}$, with connection ∇ and endomorphism φ satisfying the monopole equation on $M \setminus \{P\}$. In this talk we show that M admits a local Sasakian structure outside K. Moreover, assuming that all prescribed singularities of the monopole field are contained in K, we use this structure together with methods of complex analysis to provide sufficient conditions for smooth extension of the monopole across P.

6.6. The exceptional aerobatics of flying saucers

Michael Eastwood (The University of Adelaide)

16:00 Wed 5 December 2018 – BS Sth 2051

Prof Michael Eastwood

The motion of a flying saucer is restricted by the three-dimensional geometry of the space in which it moves. In this way, various Lie algebras arise from thin air. I shall discuss the geometry of the particular thin air needed so that Engel's 1893 construction of the exceptional Lie algebra G2 emerges. This is joint work with Pawel Nurowski.

6.7. Scalar curvature and projective compactification

Keegan Flood[s] (The University of Auckland)

09:00 Thu 6 December 2018 – BS Sth 2051

Mr Keegan Flood

In this talk we will use projective tractor calculus to study the geometry of solutions to the PDE governing the metrizability of projective manifolds. As a consequence we will see that under suitable assumptions on the (generalized) scalar curvature the "boundary at infinity" of a projectively compact pseudo-Riemannian metric inherits a well-behaved geometric structure from that of the interior. We will examine the non-vanishing scalar curvature case which yields a conformal structure on boundary, then the scalar-flat case which yields a projective structure on the boundary.

6.8. Corners in C^∞-Algebraic Geometry

Kelli Francis-Staite[s] (The University of Oxford)

16:30 Tue 4 December 2018 – BS Sth 2051

Miss Kelli Francis-Staite

The moduli spaces of J-holomorphic curves in a symplectic manifold can be used to define invariants of the manifold, such as the Gromov-Witten invariants. The geometric structure on these moduli spaces used to define these invariants has several different models. These models include the Kuranishi spaces of Fukaya-Oh-Ohta-Ono, and the polyfolds approach of Hoefer. There is now interest in using derived differential geometry to describe these moduli spaces, such as in the work of Joyce; the suggested geometric structure is a 'd-orbifold with corners'.

To define such spaces, the theory of C^∞-algebraic geometry has been extended to include manifolds with corners. This talk will present foundational work in this area. Specifically, we will consider C^∞-schemes, a category that contains smooth manifolds but also their fibre products, and how to generalise this to manifolds with corners. This is joint work with Joyce. If time, we will consider how to recover the corners structure from these 'C^∞-schemes with corners'.

6.9. Properties of some quasi-geodesics on Stiefel manifolds

Krzysztof Krakowski (Cardinal Stefan Wyszynski University in Warsaw)

16:30 Wed 5 December 2018 – BS Sth 2051

Dr Krzysztof Krakowski

We consider a class of curves of constant curvature on Stiefel manifolds called quasi-geodesics. They find their applications in computer vision and pattern recognition, where they serve as interpolating curves. I will review geometric properties of quasi-geodesics on Stiefel manifolds and their connection with solutions of a sub-Riemannian optimal control problem on a Lie group that acts on the manifold.

6.10. Homogeneous Einstein manifolds via a cohomogeneity-one approach

Ramiro Augusto Lafuente (The University of Queensland)

15:30 Tue 4 December 2018 – BS Sth 2051

Dr Ramiro Augusto Lafuente

We establish new non-existence results on non-compact homogeneous Einstein manifolds. The key idea of the proof is to consider non-transitive group actions on these spaces (more precisely, actions with cohomogeneity one), and to find geometric monotone quantities for the ODE that results from writing the Einstein equation in such a setting. As a first application, we show that homogeneous Einstein metrics on Euclidean spaces are Einstein solvmanifolds. In addition, non-existence of left-invariant Einstein metrics on the Lie group $\mathsf{Sl}(2,\mathbb{R})^k$ also follows, and this is the first time that the Alekseevskii conjecture has been verified for a non-compact semisimple Lie group (in higher dimensions). This is joint work with C. Böhm.

6.11. An Information Geometric Approach To Pulse-Doppler Sensor Optimisation

Anthony Shane Marshall[s] (Flinders University)

10:00 Thu 6 December 2018 – BS Sth 2051

Mr Anthony Shane Marshall

Information Geometry seeks to apply the methods of Differential Geometry to the field of probability theory. The information geometric approach to the optimisation of radar systems provides an interesting avenue for novel research, in an area where much practical and experimental knowledge already exists. Investigating a Pulse-Doppler sensor system by this method involves describing a collection of sensors and a target, where any infinitesimal variation in the configuration of the sensors produces a new information space, a point in the "Configuration Manifold". The family of all configuration metrics is then viewed as a sub-manifold of the manifold of all Riemannian metrics for the corresponding state space. This is the set of all states of the target, viewed as a Riemannian manifold via the information gain at a point in the space. Given some specific choice of sensor configuration, the determination of a geodesic path through the "information space" is then possible.An interesting feature of this geodesic path is that by parametrising the geodesic by arc length, an optimal "speed limit" for traversing the curve is obtained. The existence of this speed limit is somewhat surprising, as it emerges naturally despite the fact that no equations of motion are included in the calculation. The system described above has, so far, only been investigated for the 2D case with fixed sensor locations and with the assumption that the sensors and target "know" everything about each other. Systems of greater complexity are yet to be examined. Further applications under investigation in this research include the sonar employed by bats in their navigation and hunting. Bats have been extensively studied and it is well known that they modify their sonar "chirp" as they hunt. The initial results of examining bat sonar reveals that the bats may be optimising information gain as they reconfigure the parameters of their sonar system.

6.12. Signs for Real and equivariant gerbes

Michael Murray (The University of Adelaide)

14:00 Fri 7 December 2018 – BS Sth 2051
Prof Michael Murray

I will discuss how Real and equivariant gerbes on a manifold with involution give rise to signs over the fixed points of the involution. In particular I'll discuss the question of whether every possible choice of signs on the fixed points can arise from a Real or equivariant gerbe. These ideas have application to twisted K-theory although I probably won't have time to discuss that.

6.13. Nilpotent Lie groups and metric geometry

Alessandro Ottazzi (University of New South Wales)

14:30 Fri 7 December 2018 – BS Sth 2051
Dr Alessandro Ottazzi

In this seminar I will consider some links between Lie theory and metric geometry. For example, if two nilpotent Lie groups are isometric (with respect to some left-invariant distances) then they are isomorphic (Kivioja, Le Donne 2017). However, if the two groups are only bi-Lipschitz equivalent (globally), then it is not known whether they are isomorphic. In fact, it is an important open problem in geometric group theory to establish whether quasi-isometric nilpotent Lie groups are isomorphic. In the seminar I will discuss some results that are related to this questions, obtained in different collaborations.

6.14. A criterion for local embeddability of 3-dimensional CR-structures

Gerd Schmalz (University of New England)

17:30 Wed 5 December 2018 – BS Sth 2051
Prof Gerd Schmalz

We introduce a CR-invariant class of Lorentzian metrics on a circle bundle over a 3-dimensional CR-structure, which we call FRT-metrics. These metrics generalise the Fefferman metric, allowing for more control of the Ricci curvature, but are more special than the shearfree Lorentzian metrics introduced by Robinson and Trautman. Our main result is a criterion for embaddability of 3-dimensional CR-structures in terms of the Ricci curvature of the FRT-metrics in the spirit of the results by Lewandowski et al. and Hill et al. This is joint work with Masoud Ganji.

6.15. Distinguished curves in projective and conformal geometry

Daniel Snell[s] (The University of Auckland)

09:30 Thu 6 December 2018 – BS Sth 2051
Mr Daniel Snell

Distinguished curves play an important role in the study of many geometries and are of interest for a wide range of applications. Projective and conformal geometry are two examples of parabolic geometries and thus possess natural notions of distinguished curves.
We will present a characterization of distinguished curves in these settings phrased in the language of tractor calculus, a framework well suited to the study of parabolic geometries. We will also see how this characterization may be used to produce conserved quantities along such curves.
This is joint work with A. Rod Gover (University of Auckland) and Arman Taghavi-Chabert (American University of Beirut).

6.16. Symmetry and Geometric Control Theory

Peter Vassiliou (Australian National University)

13:30 Fri 7 December 2018 – BS Sth 2051
Dr Peter Vassiliou

An open question in geometric control theory is that of explicit integrability. This is the problem of characterizing those smooth nonlinear control systems whose states and control inputs can be parametrized by finite expressions of arbitrary functions and their derivatives. The control theoretic notions of "differential flatness" and "dynamic feedback linearization" constitute the current state of the art in this area. In this talk I will describe recent work that exploits an auspicious class of Lie group symmetries for this problem. The problem of constructing the required parametrization is shown to be intimately associated to the geometric properties of a certain principal connection.

7. Dynamical Systems and Ergodic Theory

7.1. Quasi-compactness and invariant measures for random dynamical systems of Jablonski maps

Fawwaz Batayneh[s] (University of Queensland)

17:30 Wed 5 December 2018 – Ligert 214
Mr Fawwaz Batayneh

We define admissible random Jablonski maps and show some results regarding the quasi-compactness property and existence of absolutely continuous invariant measures and physical measures. Illustrative example will also be provided.

7.2. 'Systems all the way down': Managing Complexity with BondGraphTools

Peter Cudmore (The University of Melbourne)

09:30 Thu 6 December 2018 – Ligert 214
Dr Peter Cudmore

Many problems in biology, ecology and engineering involve predicting and controlling complex systems, loosely defined as interconnected system-of-systems. Such systems can exhibit a variety of interesting non-equilibrium features such as emergence, phase transitions and other multi-scale phenomenon which result from mutual interactions between subsystems.

Constructing and analysing models of complex systems is often a non-trivial task due to the high dimensionality, heterogeneity and nonlinearity of the system in question. Mathematicians and scientists alike need tools, computational tools in particular, to manage the complexity of their dynamical systems models.

In this talk we introduce '`BondGraphTools`' a systems modelling framework, and discuss how to model and simulate complex physical systems without making the models unwieldy, breaking the laws of physics, or doing any of the tedious stuff by hand.

7.3. Lyapunov spectrum of Perron-Frobenius operator cocycles

Cecilia Gonzalez-Tokman (The University of Queensland)

10:00 Thu 6 December 2018 – Ligert 214
Dr Cecilia Gonzalez-Tokman

The Lyapunov spectrum of Perron-Frobenius cocycles contains relevant information about dynamical properties of random (non-autonomous) dynamical systems. Here, we describe the Lyapunov spectrum for a family of expanding maps of the circle, and discuss natural perturbations which, in some parameter regimes, induce collapse (instability) of this spectrum. This is joint work with Anthony Quas.

7.4. Recent results in Thermodynamic Formalism

Renaud Leplaideur (Université de la Nouvelle Calédonie)

16:00 Wed 5 December 2018 – Ligert 214
Mr Renaud Leplaideur

The goal of Dynamical System is to describe orbits of the action. Due to chaos, it is usually impossible to describe all the trajectories. The Ergodic Theorem allows to only describe *almost all orbits*. This "*almost all*" makes reference to an invariant (probability) measure. The Thermodynamic Formalism is then a way to singularize one of these measures, called *equilibrium state*. In this talk, one shall present new developments in Thermodynamic Formalism.

Introduced in the 70s , mainly by Sinai, Ruelle and Bowen, the theory holds for uniformly hyperbolic dynamical systems. Up to now, there is still no general theory for the non-uniformly hyperbolic systems. We shall present some recent results for the case of Partially Hyperbolic Attractors with singularities (as the Lorenz Attractor).

Thermodynamic Formalism was clearly inspired by Statistical Mechanics. However, despite the vocabulary is the same, the notions and the settings are sometimes different. We shall present here some recent result on the problem of *Phase Transition*.

If time is sufficient, we will also talk about Ergodic Optimization or equivalently, the question of ground states at temperature zero.

7.5. Travelling waves in a model for tumor invasion with the acid-mediation hypothesis

Robert Marangell (The University of Sydney)

16:30 Wed 5 December 2018 – Ligert 214
Dr Robert Marangell

In this talk, I will discuss how Geometric Singular Perturbation Theory (GSPT) can be used to show the existence of travelling wave solutions in a Gatenby-Gawlinski model. In particular, I will show how GSPT can be used to show the existence of a slow travelling wave with an interstitial gap. Such a gap has been observed experimentally, and we provide a mathematical framework for its existence in terms of a dynamic transcritical bifurcation.

7.6. Stable nonphysical waves in a model of tumour invasion

Timothy Roberts[s] (The University of Sydney)

17:00 Wed 5 December 2018 – Ligert 214
Mr Timothy Roberts

Travelling wave solutions to partial differential equations appear in myriad applications, from biology to ecology and physics. However, establishing the stability of such waves can be difficult. Motivated by the dynamical systems theory for ordinary differential equations (ODEs), a natural first step in this process is to determine the spectral stability of the solution via the spectrum of the linearised operator. In this talk we apply this process to a biological model for cancer invasion driven by haptotaxis developed by Perumpanani et al (1999) and further studied by Harley et al (2014) which admits a family of travelling shock solutions. This family of solutions can be naturally divided into four classes of waves, based on the underlying geometry of the corresponding steady state solutions in phase space; three of these classes are physically reasonable, while the last is not. In doing so we reach a surprising conclusion: there exists a family of nonphysical travelling wave solutions which are spectrally stable.

7.7. Characterising Chimeras by Constructing Networks

Michael Small (The University of Western Australia)
15:30 Wed 5 December 2018 – Ligert 214
Prof Michael Small

We describe a new multi-channel time series analysis technique which represents a dynamical system as a network ($\mathcal{G}$). Each scalar variable from a multichannel time series is encoded as an ordinal word, these words are then concatenated to provide a unique label for a node of $\mathcal{G}$. Nodes are linked if corresponding words occur in temporal succession. The structural complexity of this graph can be shown to characterise the degree of synchrony or coherence of the individual time series channels. In the case of dynamical behaviour on system of low-dimensional systems connected via a connectivity or coupling network (which we denote $\mathcal{C}$ to distinguish it from $\mathcal{G}$), each node can be thought of as emitting a scalar time series which we use to construct words and the concatenation of these words across all nodes of $\mathcal{C}$ creates a unique label for a node of $\mathcal{G}$. As chimeras emerge and grow, the structural complexity of $\mathcal{G}$ is shown to decrease. Using this construction we are then able to ask how $\mathcal{C}$ and $\mathcal{G}$ are related.

With Debora Correa and David M. Walker (Department of Mathematics and Statistics, University of Western Australia).

7.8. Dispersive quantisation

Dave Smith (Yale-NUS College)
09:00 Thu 6 December 2018 – Ligert 214
Dave Smith, Natalie Sheils, Peter Olver, Beatrice Pelloni

We consider the linear Schrödinger equation with homogeneous linear boundary conditions. We prove that in the case of pseudoperiodic boundary conditions the solution of the initial-boundary value problem at specific times is a linear combination of a certain number of copies of the initial datum while at other times the solution appears to be fractal. Further, we present the solution for general homogenous linear boundary conditions in terms of eigenvalues which can be found numerically.

8. Functional Analysis, Operator Algebra, Non-commutative Geometry

8.1. Equilibrium states on Higher-rank Toeplitz noncommutative solenoids

Zahra Afsar (The University of Sydney)
09:00 Fri 7 December 2018 – Eng Sth 111
Dr Zahra Afsar

We consider a family of higher-dimensional noncommutative tori, which are twisted analogues of the algebras of continuous functions on ordinary tori, and their Toeplitz extensions. Just as solenoids are inverse limits of tori, our Toeplitz noncommutative solenoids are direct limits of the Toeplitz extensions of noncommutative tori. We consider natural dynamics on these Toeplitz algebras, and compute the equilibrium states for these dynamics. We find a large simplex of equilibrium states at each positive inverse temperature, parametrised by the probability measures on an (ordinary) solenoid. This is a joint work with Astrid an Huef, Iain Raeburn and Aidan Sims.

8.2. Isomorphisms of $AC(\sigma)$ spaces for linear graphs

Shaymaa Shawkat Kadhim Al-shakarchi[s] (University of New South Wales)
15:30 Wed 5 December 2018 – Eng Sth 111
Mrs Shaymaa Shawkat Kadhim Al-shakarchi

A theorem of Gelfand and Kolmogorov in 1939 asserts that, the compact spaces X and Y are homeomorphic if and only if the algebras of continuous functions C(X) and C(Y) are isomorphic as algebras. In 2005, the algebras of absolutely continuous functions $AC(\sigma)$ was defined by Doust and Ashton on a compact subset σ of the complex plane, and they studied whether there was a similar link for these algebras between the properties of the domain σ and the Banach algebra properties of the function space. In one direction Doust and Leinert (2015) showed that if $AC(\sigma_1)$ is algebra isomorphic to $AC(\sigma_2)$ then σ_1 and σ_2 must be homeomorphic, so the interest now is in examining the converse implication.

In general the answer is no. We have examples of infinite families of homeomorphic spaces $\{\sigma_n\}$ for which the corresponding $AC(\sigma_n)$ spaces are mutually nonisomorphic.

On the other hand, if one only considers sets σ lying in restricted families, then one can obtain positive results. Doust and Leinert showed that if the sets σ_1 and σ_2 are polygonal compact subsets of the plane then $AC(\sigma_1)$ is algebra isomorphic to $AC(\sigma_2)$. It is conjectured that this result also holds if σ_1 and σ_2 are finite unions of closed line segments. Examination of this case leads to an interesting question in geometric graph theory which I will discuss.

8.3. Some results on Roman 2-domination in graphs

Faezeh Alizadeh[s] (Shahid Rajaee Teacher Training University)
16:30 Fri 7 December 2018 – Eng Sth 111
Faezeh Alizadeh, Hamid Reza Maimani, Leila Parsaei Majd, Mina Rajabi Parsa

For a graph $G = (V, E)$ of order n, a Roman $\{2\}$-dominating function $f : V \to \{0, 1, 2\}$ has the property that for every vertex $v \in V$ with $f(v) = 0$, either v is adjacent to a vertex assigned 2 under f, or v is adjacent to least two vertices assigned 1 under f. In this paper, we classify all graphs with Roman $\{2\}$-domination number belonging to the set $\{2, 3, 4, n-2, n-1, n\}$. Furthermore, we obtain some results about Roman $\{2\}$-domination number of some graph operations.

8.4. A twisted tale of topological k-graph C*-algebras

Becky Armstrong[s] (The University of Sydney)
16:00 Tue 4 December 2018 – Eng Sth 111
Becky Armstrong

Directed graph C^*-algebras are a popular tool for investigating various classes of C^*-algebras, and have provided a fruitful source of examples. These C^*-algebras have been generalised in many ways, including to k-graph C^*-algebras, topological graph C^*-algebras, and, more generally, to topological k-graph C^*-algebras; and to twisted k-graph C^*-algebras, which involve cohomological data in their construction. Recently, Nathan Brownlowe and I initiated the study of twisted topological k-graph C^*-algebras using C^*-algebras associated to product systems. For my PhD project I have been examining an approach using twisted groupoid C^*-algebras. In this talk, I will discuss twisted C^*-algebras associated to topological k-graphs, and I will present some examples. (This is joint work with my PhD supervisors, Nathan Brownlowe and Aidan Sims.)

8.5. An application of recursive algorithm for inversion of linear operator pencils

Elizabeth Bradford[s] (University of South Australia)
17:30 Wed 5 December 2018 – Eng Sth 111
Ms Elizabeth Bradford

There are numerous examples of systems that can be represented by linear equations. In many cases the system coefficient is an operator that depends on an unknown parameter. We are interested in what happens to the solution when we change this parameter. If the coefficient is a linear operator pencil which depends on a single complex parameter and the resolvent is analytic on a deleted neighbourhood of the origin, the resolvent can be calculated by different procedures. We calculate the resolvent matrix using different recursive procedures. In this talk I will show how these methods are used to solve a pseudo-real problem consisting of an infinite set of differential equations.

8.6. Computations in Higher Twisted K-theory

David Leonard Brook[s] (The University of Adelaide)

16:00 Wed 5 December 2018 – Eng Sth 111

Mr David Leonard Brook

Higher twisted K-theory is a highly contemporary area of research developed by Ulrich Pennig and Marius Dadarlat in 2016 as a generalisation of the topological K-theory and twisted K-theory of the 20th century. Its construction involves replacing the compact operators used in twisted K-theory with a special class of algebra known as "strongly self-absorbing C*-algebras", which were introduced by Toms and Winter in 2005. In this talk, I will summarise key definitions and results of topological and operator algebraic K-theory in order to present a concise introduction to twisted and higher twisted K-theory, and explain why this newly defined construction is expected to yield meaningful results. In particular, I will present a computation of the higher twisted K-theory of odd-dimensional spheres and outline the direction of my future research.

8.7. Unitary representations of the Thompson group constructed with a category/functor method due to Jones

Arnaud Brothier (UNSW Sydney)

16:00 Fri 7 December 2018 – Eng Sth 111

Dr Arnaud Brothier

The Thompson group is the group of homeomorphisms of $[0, 1]$ that are piecewise linear with slopes a power of 2 and breakpoints a dyadic rational. It is one of the most studied discrete group which still remains very mysterious. Motivating in constructing conformal field theories Jones recently discovered a very general process that produces a unitary representation of the Thompson group from very few data such as an isometry between Hilbert spaces or a planar algebra together with a certain element. We will present this construction and provide concrete examples. This is a joint work with Jones.

8.8. Can we reconstruct a directed graph from its Toeplitz algebra?

Nathan Brownlowe (The University of Sydney)

17:00 Wed 5 December 2018 – Eng Sth 111

Dr Nathan Brownlowe

Can we reconstruct a directed graph from its Toeplitz algebra? Do we need more data than just its Toeplitz algebra? In this talk I will answer these questions. This is joint work with Marcelo Laca, Dave Robertson, and Aidan Sims.

8.9. Maximum Generalised Roundness of Random Graphs

Raveen Daminda de Silva[s] (University of New South Wales)

16:30 Tue 4 December 2018 – Eng Sth 111

Mr Raveen Daminda de Silva

Given a metric space, we can define its maximum generalised roundness, a non-negative real number which determines properties including embeddings into L^p spaces. We investigate the distribution of the maximum generalised roundness of large random graphs, endowed with the path length metric, presenting experimental data and discussing the limiting behaviour.

8.10. Asymptotic negative type properties of finite ultrametric spaces

Ian Doust (University of New South Wales)

14:00 Fri 7 December 2018 – Eng Sth 111

Ian Doust, Stephen Sánchez and Anthony Weston

Negative type inequalities arise in the study of embedding properties of metric spaces. For example a famous result of Schoenberg states that a finite metric space (X, d) may be isometrically embedded in a Hilbert space if and only if it is of 2-negative type, that is if

$$\sum_{i,j=1}^{n} d(z_i, z_j)^2 \eta_i \eta_j \leq 0$$

whenever $z_1, \ldots, z_n \in X$ and $\eta_1 + \cdots + \eta_n = 0$. Unfortunately, even for small metric spaces negative type inequalities often reduce to intractable combinatorial problems. For some specific classes of finite metric space however, the last decade has seen progress on obtaining sharper, more quantitative versions of these inequalities involving the so-called p-negative type gap. (This is roughly a measure of how negative the left-hand side above needs to be.)

Ultrametric spaces arise in many different areas of mathematics. Finite ultrametric spaces have p-negative type for all p. In this talk we shall discuss the very special properties of the p-negative type gap for these spaces.

8.11. Inequalities in Hermitian unital Banach $*$-algebras

Silvestru Sever Dragomir (Victoria University)

13:30 Fri 7 December 2018 – Eng Sth 111

Prof Silvestru Sever Dragomir

In this presentation we introduce the quadratic weighted geometric mean for invertible elements x, y in a Hermitian unital Banach $*$-algebra and real number n. We show that it can be represented in terms of the usual geometric mean and provide various inequalities for this mean under various assumptions for the elements involved. For related work on inequalities in Hermitian unital Banach $*$-algebras, see https://rgmia.org/v19.php, Articles: 161-162, 165, 171-175 and 177-178.

8.12. Modular invariants for proper actions

Fei Han (National University of Singapore)

09:30 Fri 7 December 2018 – Eng Sth 111

Assoc Prof Fei Han

Witten genus and elliptic genera are modular topological invariants for manifolds, which are closely related to representation of loop groups and the hypothetical index theory on free loop space as well as the elliptic cohomology theory in algebraic topology. They find applications in problems of positive curvature and continuous group action on manifolds. In this talk, we will briefly introduce these invariants and present our joint work with Varghese Mathai on generalizing them to open manifolds with proper actions of open groups.

8.13. Pontryagin duality in higher Aharonov-Bohm effect

Johnny Lim[s] (The University of Adelaide)

16:30 Wed 5 December 2018 – Eng Sth 111

Mr Johnny Lim

Pontryagin duality in cohomology depicts the close relation between the ordinary integral homology and its character group the circle-valued cohomology theory. In particular, there is a non-degenerate pairing map between them that provides a way for 'phase' computation. One of the famous examples being the Aharonov-Bohm effect in quantum mechanics, which is the manifestation of Pontryagin duality in cohomology in degree 1. The extension of this notion to a generalised cohomology theory, such as K-theory, then plays a role in higher Aharonov-Bohm effect in Type II String theory. Moreover, an analytic Pontryagin duality pairing in K-theory can be formulated explicitly and in fact it encodes much more data than that of in cohomology. In this talk, I will explain this notion in more detail and discuss the Pontryagin duality pairing between even K-homology K_0 and circle-valued K^0 theory.

8.14. The Chern character of differential graded algebras and an Index Theorem

Matthias Ludewig (The University of Adelaide)

15:00 Fri 7 December 2018 – Eng Sth 111

Dr Matthias Ludewig

We define a Fredholm module over a differential graded algebra A to be parity preserving linear map $c : A \to L(H)$ for some graded $\mathbb{Z}_2$-graded Hilbert space H, together with an odd self-adjoint operator Q on $L(H)$ satisfying certain algebraic and analytic conditions. In particular, for applications, it is too strong to require c to be a representation, and also $[Q, c(a)] = c(da)$ need not always hold. However, it turns out that one can still construct a cocyle $\mathrm{Ch}(Q, c)$ of such a Fredholm module, which is a generalization of the famous cocycle of Jaffe, Lesniewski and Osterwalder to the graded case; we call this the Bismut-Getzler Chern character, since in case A is given by the differential forms on an even dimensional spin manifold, with c the Clifford multiplication and Q the Dirac operator, this cocycle turns out to be related to a loop space path integral considered by Bismut and Getzler. In the case of an ungraded algebra, the pairing of the JLO-cocycle with Connes' Chern character of a projection in A turns out to be given by an index; this is the non-commutative index theorem by Getzler and Szenes. We show that in our graded situation, there is a similar theorem, which involves the pairing our cocycle with the Bismut-Chern character of a projection, the latter being constructed in a special case by Getzler, Jones and Petrack, who were motivated by Bismut's loop space considerations. Our results complete an essential part of the Getzler-Jones-Petrack programme of infinite dimensional localization in the loop space. This is joint work with Batu Gneysu.

8.15. Equilibrium in operator algebraic dynamical systems

Michael Arthur Mampusti[s] (University of Wollongong)

09:00 Thu 6 December 2018 – Eng Sth 111

Mr Michael Arthur Mampusti

In this talk, an operator algebraic dynamical system is a C*-algebra with an action of a locally compact group. When the locally compact group is the real line, we consider the action as a time evolution of the C*-algebra, and an equilibrium state as a state which is invariant under the action. We consider Kubo-Martin-Schwinger (KMS) states for operator algebraic dynamical systems, which are, in particular, equilibrium states.

In 2008, Ionescu and Watatani associated a Cuntz-Pimsner algebra to a Mauldin-Williams graph. The Cuntz-Pimsner algebra is a C*-algebra which comes with a canonical action of the circle. Lifting this action to the real line, we obtain a operator algebraic dynamical system. We discuss the KMS states of this operator algebraic dynamical system, and the information that these states recover about the Mauldin-Williams graph.

8.16. C*-algebras associated to graphs of groups

Jessica Murphy[s] (The University of Sydney)

15:30 Tue 4 December 2018 – Eng Sth 111
Ms Jessica Murphy

Graph of groups arise naturally as the quotient objects of groups acting on trees, and play a fundamental role in Bass-Serre theory. A C^*-algebra theory for graphs of groups has recently been introduced, and as part of their analysis, it is shown that there is a natural C^*-subalgebra isomorphic to a directed graph C^*-algebra built from paths in the graph of groups. In this talk I will discuss the relationship between graph of groups C^*-algebras and these C^*-subalgebras corresponding to directed graphs. (This is a joint work with my supervisor, Nathan Brownlowe)

8.17. A Noncommutative Generalisation of a Problem of Steinhaus

Thomas Scheckter[s] (University of New South Wales)

10:00 Thu 6 December 2018 – Eng Sth 111
Mr Thomas Scheckter

Responding to work of Révész on a problem of Steinhaus, Komlós showed that every integrable sequence of random variables contains a subsequence which “satisfies the strong law of large numbers”, such that the sequence of Cesàro averages converges almost everywhere. We solve an open problem of Randrianantoanina by extending this result to arbitrary semifinite von Neumann algebras. In this talk we discuss the history of the problem, what it means to study almost everywhere convergence in the noncommutative setting, the technical obstructions of the noncommutative setting, and several related results.

8.18. A Dixmier-Douady Theory for Fell Algebras and their associated Brauer Group

Nicholas Seaton[s] (University of Wollongong)

09:30 Thu 6 December 2018 – Eng Sth 111
Mr Nicholas Seaton

In 1963, J. Dixmier and A. Douady classified continuous trace C^*-algebras with spectrum T up to Morita equivalence by classes in the 2nd Cech cohomology group. They also associated a Brauer group to the spectrum of these C^*-algebras. In 2011, A. An Huef, A. Kumjian and A. Sims generalised this to classify Fell algebras, however they did not construct a Brauer group. In this talk, we will discuss their Dixmier-Douady theory and describe an approach to find the Brauer group for Fell algebras over their spectrum.

8.19. Crystallographic T-duality and super Baum-Connes conjecture

Guo Chuan Thiang (The University of Adelaide)

14:30 Fri 7 December 2018 – Eng Sth 111
Dr Guo Chuan Thiang

A relatively unexplored direction for the Baum–Connes conjecture is for super-groups. The simplest example is glide reflection, generating the integer group but with the even-odd grading: the graded K-theory of the group algebra is isomorphic to the twisted K-homology of the classifying space, and both already have 2-torsion. This is one example in a whole zoo of crystallographic T-dualities, discovered recently with my collaborator K. Gomi, which had been anticipated from string theory and the physics of topological matter.

8.20. The magnetic spectral gap-labelling conjecture and some recent progess

Mathai Varghese (The University of Adelaide)

14:00 Tue 4 December 2018 – Eng Sth 111
Prof Mathai Varghese

Given a constant magnetic field on Euclidean space $\mathbb{R}^p$ determined by a skew-symmetric $(p \times p)$ matrix Θ, and a $\mathbb{Z}^p$-invariant probability measure μ on the disorder set Σ which is by hypothesis a Cantor set, where the action is assumed to be minimal, the corresponding Integrated Density of States of any self-adjoint operator affiliated to the twisted crossed product algebra $C(\Sigma) \rtimes_\sigma \mathbb{Z}^p$, where σ is the multiplier on $\mathbb{Z}^p$ associated to Θ, takes on values on spectral gaps in the magnetic gap-labelling group. The magnetic frequency group is defined as an explicit countable subgroup of $\mathbb{R}$ involving Pfaffians of Θ and its sub-matrices. We conjecture that the magnetic gap labelling group is a subgroup of the magnetic frequency group. We give evidence for the validity of our conjecture in 2D, 3D, the Jordan block diagonal case and the periodic case in all dimensions, as well as for all principal solenoidal tori.

9. Geometric Analysis

9.1. The long-time behaviour of the pluriclosed flow on Lie groups

Romina Melisa Arroyo (University of Queensland)

16:30 Wed 5 December 2018 – Eng Math G07

Dr Romina Melisa Arroyo

The *pluriclosed flow* is a geometric flow that evolves pluriclosed Hermitian structures (i.e. Hermitian structures for which its 2-fundamental form satisfies $\partial\bar{\partial}\omega = 0$) in a given complex manifold. The aim of this talk is to discuss the asymptotic behaviour of the pluriclosed flow in the case of left-invariant structures on Lie groups. More precisely, invariant structures on 2-step nilmanifolds and almost abelian solvmanifolds. We will analyze the flow and explain how a suitable normalization converges to *pluriclosed solitons*, which are self-similar solutions to the flow. Moreover, we will show that some of those limits are shrinking solitons, which is an unexpected feature in the solvable case. We will also exhibit the first example of a homogeneous manifold on which a geometric flow has some solutions with finite extinction time and some that exist for all positive times.

This is a joint work with Ramiro Lafuente (The University of Queensland).

9.2. On the Existence of Stable Unduloids of Dimension Eight

David Hartley (University of Wollongong)

16:00 Tue 4 December 2018 – Eng Math G07

Dr David Hartley

The stability of constant mean curvature hypersurfaces is an important topic in mathematics and influences problems such as the dynamics of the volume preserving mean curvature flow. We consider the case where the hypersurfaces have free boundary contained in parallel planes, this results in the periodic Delaunay hypersurfaces. They include spheres (which are always stable), cylinders (which are stable at large radii), and nodoids (which are unstable). The final case of unduloids is more complex. All unduloids of dimension two through seven are unstable, but there exists stable unduloids of dimension nine and greater. In this talk, we will consider the missing case of whether there exists stable unduloids of dimension eight. We will also work towards finding a criterion to determine if a specific unduloid is stable or unstable.

9.3. Higgs bundles and foliations

Pedram Hekmati (The University of Auckland)

16:00 Wed 5 December 2018 – Eng Math G07

Dr Pedram Hekmati

The existence of Hermitian-Einstein metrics on holomorphic bundles is intimately tied to the notion of stability. In this talk I will explain how this correspondence works in the setting of holomorphic bundles on foliated manifolds and if time allows, its extension to transverse Higgs bundles.

9.4. Some sharp Lévy-Gromov type isoperimetric inequalities

Kwok-Kun Kwong (The University of Sydney)

15:30 Wed 5 December 2018 – Eng Math G07

Dr Kwok-Kun Kwong

The Lévy-Gromov isoperimetric inequality states that under a positive Ricci curvature lower bound, the area-to-volume ratio of a domain is not smaller than that of a certain ball in the comparison space. In this talk, I will present my recent work on a new sharp Lévy-Gromov type isoperimetric inequality which involves the cut distance. There are two remarkable features of the result. One is that we allow the Ricci curvature lower bound to be arbitrary. The second one, which is more surprising, is that we obtain a lower bound for the volume instead of an upper bound (of course the bound cannot depend only on the boundary area, but also on its cut distance). This is in contrast with the classical isoperimetric inequality, the Lévy-Gromov isoperimetric inequality and the Bishop-Gromov volume comparison theorem, all of which provide an upper bound of the volume of a domain either in terms of its boundary area, or in terms of the volume of its counterpart in the comparison space. If time allows, I will also discuss another isoperimetric inequality which involves the extrinsic radius of a domain.

9.5. Hermitian curvature flow on complex Lie groups

Ramiro Augusto Lafuente (The University of Queensland)

09:30 Thu 6 December 2018 – Eng Math G07

Dr Ramiro Augusto Lafuente

In this talk we will report on recent progress on the study of the Hermitian curvature flow of left-invariant metrics on complex unimodular Lie groups. After reducing the evolution to the Ricci flow-type equation $\partial_t g_t = -\mathrm{Ric}^{1,1}(g_t)$, we show that the solution g_t always exist for all positive times, and that the renormalization $(1+t)^{-1}g_t$ converges in Cheeger-Gromov sense as $t \to \infty$ to a non-flat, left-invariant, self-similar solution (soliton). This is joint work with M. Pujia and L. Vezzoni.

9.6. Closed ideal planar curves

James McCoy (The University of Newcastle)

09:00 Thu 6 December 2018 – Eng Math G07
Assoc Prof James McCoy

We use a gradient flow to deform closed planar curves to curves with least variation of geodesic curvature in the L^2 sense. Given a smooth initial curve we show that the solution to the flow exists for all time and converges smoothly to a multiply-covered circle, provided the length of the evolving curve remains bounded under the flow. Curves in any homotopy class with initially small length cubed times the energy do enjoy a uniform length bound under the flow. This is joint work with Ben Andrews, Glen Wheeler and Valentina Wheeler.

9.7. Regularity of the dbar equation in degenerating families

Brett Parker (Monash University)

15:30 Tue 4 December 2018 – Eng Math G07
Dr Brett Parker

Pseudo-holomorphic curves satisfy a nonlinear PDE called the dbar equation. As the dbar operator is elliptic, standard regularity results apply to the dbar equation from a fixed domain, or a smooth family of domains. I will explain what happens in a degenerating family of domains. This result is important for analysing the moduli space of pseudo-holomorphic curves because curves in this moduli space can degenerate, forming nodes and bubbles.

9.8. Some integral estimates for Ricci flow in four dimensions

Miles Simon (Magdeburg University)

14:00 Tue 4 December 2018 – Eng Math G07
Prof Miles Simon

We present some integral estimates which hold for any solution to Ricci flow on a closed four dimensional manifold. Under the extra assumption that the scalar curvature is bounded, we show that at any potential finite singular time, the manifold can at most degenerate to a C^0 Riemannian orbifold. We show that the flow can then be continued through this singularity, using the orbifold Ricci flow.

9.9. Reduced SU(2) Seiberg-Witten Equations compared to SU(2) Ginzburg-Landau equations

Ahnaf Tajwar Tahabub[s] (The University of Adelaide)

14:30 Tue 4 December 2018 – Eng Math G07
Mr Ahnaf Tajwar Tahabub

To sidestep the computational difficulty of the Yang-Mills invariants for 4-manifolds, Nathan Seiberg and Edward Witten developed two abelian non-linear partial differential equations (called Seiberg-Witten Equations) that essentially provide the same information but under mild assumptions. However, the abelian nature of the U(1) twisted spin group used for these SW equations make them far easier to study. Remarkably, Witten showed that the dimension reduction (to two dimensions) gives precisely the Ginzburg-Landau equations for super-conductors. This relationship combined with that determined by Taubes with Pseudo-holomorphic curves provides better insight into the theory of super-conductors. In this talk I shall briefly construct the non-abelian SW equations for an orientable compact 4-manifold and specialise to the case for SU(2) twisted spin group. This will lead into the dimensional reduction of these equations and an outline of how these equations compare to the non-abelian SU(2) Ginzburg-Landau theory in analogy to Witten's result.

9.10. Volume preserving flow and geometric inequalities in hyperbolic space

Yong Wei (Australian National University)

10:00 Thu 6 December 2018 – Eng Math G07
Dr Yong Wei

In this talk I will describe some recent work (joint with Ben Andrews (ANU) and Xuzhong Chen (Hunan)) on the application of volume preserving flow for hypersurfaces to prove geometric inequalities in hyperbolic space. I will first discuss some earlier results which give relations between quermassintegrals for horospherically convex hypersurfaces. Then I will discuss two generalisations: First, we extend these inequalities under the weaker condition of positive intrinsic curvature; and second, we prove some sharper family of inequalities which hold for horospherically convex hypersurfaces.

9.11. Length-constrained curve diffusion

Yuhan Wu[s] (University of Wollongong)

17:00 Wed 5 December 2018 – Eng Math G07
Ms Yuhan Wu

We show that initial closed curves suitably close to a circle flow under the length-constrained curve to round circles in infinite time. We provide an estimate on the total length of time for which such curves are not strictly convex. We further show that there are no closed translating solutions to the flow and that the only closed rotators are circles.

10. Geometry and Topology

10.1. Knot tabulation: a software odyssey

Benjamin Burton (University of Queensland)

15:30 Tue 4 December 2018 – BS Sth 2060

Benjamin Burton

The tabulation of all prime knots up to a certain number of crossings was one of the founding problems of knot theory in the 1800s, and continues to be of interest today. Here we take a tour through the many and varied software challenges required to tabulate all 350 million prime knots up to 19 crossings. Sights along the way include combinatorial, algebraic and geometric computations, along with a mix of theoretical algorithm design and practical algorithm engineering.

10.2. Twisted K-theory of compact Lie groups and extended Verlinde algebras

Chi-Kwong Fok (The University of Adelaide)

17:30 Wed 5 December 2018 – BS Sth 2060

Dr Chi-Kwong Fok

In a series of recent papers, Freed, Hopkins and Teleman put forth a deep result which identifies the twisted K-theory of a compact Lie group G with the representation theory of its loop group LG. Under suitable conditions, both objects can be enhanced to the Verlinde algebra, which appears in mathematical physics as the Frobenius algebra of a certain topological quantum field theory, and in algebraic geometry as the algebra encoding information of moduli spaces of G-bundles over Riemann surfaces. Verlinde algebras for G with nice connectedness properties have been well-known. However, explicit descriptions of such for disconnected G are lacking. In this talk, I will explain the various aspects of the Freed-Hopkins-Teleman Theorem and present partial results on an extension of the Verlinde algebra with disconnected G, with a view towards its relation to a generalisation of moduli spaces called twisted moduli spaces. The talk is based on work in progress joint with David Baraglia and Varghese Mathai.

10.3. Particles of the first generation

David G Glynn (Flinders University)

10:00 Thu 6 December 2018 – BS Sth 2060

Dr David G Glynn

Journey starts benignly with "Theorems of points and planes in three-dimensional projective space" (2010), tunnels through "A rabbit hole between geometry and topology" (2013), and roller-coasts into physics "Cosmology = Topology/Geometry: mathematical evidence for the holographic principle" (2016). Buzzing particles swarm over a calm sea of quarks. Everything in triplicate.

10.4. Cobordism map on PFH induced by elementary Lefschetz fibration

Chen Guanheng (The University of Adelaide)

14:00 Fri 7 December 2018 – BS Sth 2060

Dr Chen Guanheng

Periodic Floer homology (PFH) is a three dimension analogy of Taubes' Gromov invariant for mapping torus. Y-J. Lee and C.H.Taubes show that it is equivalent to Seiberg Witten cohomology. One naturally expects that this equivalence extends to TQFT level. Motivated by this conjecture, we show that the cobordism map on PFH induced by elementary Lefschetz fibration is well defined, in addition, we give an explicit computation for it.

10.5. Virtual and welded tangles via operads

Iva Halacheva (The University of Melbourne)

09:00 Thu 6 December 2018 – BS Sth 2060

Ms Iva Halacheva

Usual tangles in 3-space were described by Jones using planar algebras, which one can think of as algebras over the operad of planar tangles. Bar-Natan and Dancso introduced the concept of circuit algebras, for which the planarity condition is dropped, to describe virtual tangles, i.e. tangles in thickened surfaces. We relate circuit algebras to modular operads, introduced by Getzler and Kapranov and used to study surface gluing in topology, with interesting implications for both sides.

10.6. Triangulations of Solid Tori and Dehn Fillings

Sophie Ham[s] (Monash University)

16:30 Wed 5 December 2018 – BS Sth 2060

Ms Sophie Ham

It remains an open conjecture that every knot complement has a geometric triangulation. This conjecture has been proved for a class of knots known as 2-bridge knots. However, it is not known for many additional classes of knots. In this talk, we present the main ideas for a proof of this conjecture for a large class of knots called highly twisted knots. The method involves first using the explicit geometry of fully augmented links from which highly twisted knots are constructed to determine triangulations of the initial manifolds, then applying results by Gue'ritaud and Schleimer on changes in triangulations under Dehn filling to fully augmented links [Gue'ritaud and Schleimer, Geom. Topol, 2010]. This should prove that highly twisted knots have a geometric triangulation. Gue'ritaud and Schleimer found canonical triangulations of Dehn fillings of links that satisfied certain genericity assumptions. However, these assumptions do not hold for many examples arising in practice.

We generalise their results to extend to broader classes of links, including many examples of fully augmented links.

10.7. Counting Non-Crossing Partitions on Surfaces

Jian He (Monash University)

14:30 Fri 7 December 2018 – BS Sth 2060
Dr Jian He

Given a surface with boundary and a number of points on its boundary components, a non-crossing partition is a way to join those points up into several non-intersecting polygons. The special case, where only bigons are allowed, corresponds to the enumeration of arc diagram on the surface. The count of arc diagram is known, and it has a rich structure. In particular it has polynomial behaviour in the number of points on each boundary component, and the leading coefficients of the polynomial are the intersection numbers on the moduli space of curves of the topological type of the given surface. We will show that the general count of non-crossing partitions follows a similar topological recursion and exhibits all the interesting behaviours of the arc diagram count.

This is joint work with Norman Do and Daniel Mathews.

10.8. Trisections and their complexity

Boris Lishak (The University of Sydney)

09:30 Thu 6 December 2018 – BS Sth 2060
Dr Boris Lishak

A trisection is a way to represent a smooth 4-manifold as a gluing of three 1-handlebodies - an analogue of Heegaard splittings in dimension 4. The intersection of the handlebodies is a 2-dimensional closed surface. We will discuss how the genera of the surface and of the handlebodies depends on the fundamental group of the manifold.

10.9. Supersymmetric path integrals: Integrating differential forms on the loop space

Matthias Ludewig (The University of Adelaide)

13:30 Fri 7 December 2018 – BS Sth 2060
Dr Matthias Ludewig

We construct an integral map for differential forms on the loop space of Riemannian spin manifolds. For example, Bismut-Chern character forms are integrable with respect to this map, with their integrals given by indices of Dirac operators. Moreover, the map satisfies a localization principle, which provides a rigorous background for path integral proofs of the Atiyah-Singer Index theorem by Alvarez-Gaum, Atiyah, Witten, Bismut and others. This is joint work with Florian Hanisch.

10.10. Perpendicularity in Ancient Babylon

Daniel Francis Mansfield (University of New South Wales)

16:30 Tue 4 December 2018 – BS Sth 2060
Dr Daniel Francis Mansfield

This talk is about the origins of perpendicularity and an ancient form of proto-trigonometry from Mesopotamia which is almost 4000 years old. The talk is based on my 2017 article on Plimpton 322 and an upcoming article about another long lost tablet which shows how this ancient proto-trigonometry was used.

10.11. Tropical geometry, the topological vertex, and Gromov-Witten invariants of Calabi-Yau 3-folds,

Brett Parker (Monash University)

14:00 Tue 4 December 2018 – BS Sth 2060
Dr Brett Parker

Complex manifolds with normal crossing divisors, and normal crossing degenerations, have a natural large scale with a tropical, or piecewise integral-affine structure. Moreover, on this large scale, holomorphic curves correspond to piecewise-linear tropical curves. I will draw some pictures, and explain some beautiful aspects of this tropical correspondence in the Calabi-Yao 3-fold setting, related to the Strominger–Yau–Zaslow approach to mirror symmetry: In this case, the large scale is a 3-dimensional integral affine manifold with singularities along a 1-dimensional graph. The vertices of this singular graph come in two types: positive and negative, and the relative Gromov–Witten invariants around the positive vertices contain the topological vertex of Aganagic, Klemm, Marino and Vafa.

10.12. Tiling the Euclidean and Hyperbolic planes with ribbons

Vanessa Robins (Australian National University)

17:00 Wed 5 December 2018 – BS Sth 2060
Dr Vanessa Robins

Patterns built from repeating motifs appear in all cultures and have long been studied in art, mathematics, engineering and science. Most mathematical work has focussed on patterns in the Euclidean plane (the book “Tilings and Patterns” by Grünbaum and Shephard contains a comprehensive survey of the field up to the mid 1980s) but the importance of hyperbolic geometry as a model for natural forms is increasingly recognised. An example that inspires this work is the discovery that co-polymer molecules consisting of three mutually immiscible arms can self-assemble into structures modelled by stripes on the gyroid triply periodic minimal surface. The gyroid surface has genus three in its smallest side-preserving translational unit cell, and therefore has the hyperbolic plane as its simply-connected covering space. Its 3d space-group symmetries induce a non-euclidean crystallographic group generated by hyperbolic isometries that are known explicitly. Stripe patterns on the gyroid lift via the covering map to tilings of the hyperbolic plane by infinitely long strips, or ribbons.

The defining property of a ribbon tile is the existence of a translation isometry that maps a given tile back onto itself as well as preserving the tiling pattern of the whole space. I will describe how to classify and enumerate crystallographic ribbon tilings of the hyperbolic plane by viewing them as decorations of 2-orbifolds.

10.13. Compactification of the Space of Convex Projective Structures on Surfaces

Dominic Tate[s] (The University of Sydney)

15:30 Wed 5 December 2018 – BS Sth 2060

Mr Dominic Tate

In 1984 Morgan and Shalen describe a means of compactifying the Teichmuller space of hyperbolic structures on surfaces which realises a boundary point of the Teichmuller space by an action on an R-tree. It is known that in the setting of higher Teichmuller theory, where the group of hyperbolic isometries, PSL(2,R) is replaced by PSL(n,R), the action described by Morgan and Shalen on R-trees is generalised to an action on Euclidean buildings of rank n-1. In the case of PSL(3,R), Parreau (2015) provided a geometric description of actions which represent some of the points on the boundary of the higher Teichmuller space, which possess the additional quality that the length spectrum of the PSL(3, R) action on a rank 2 building continuously extends the length spectrum of the holonomy groups of convex projective structures on the interior of the space of convex projective structures. I generalise Parreau's construction to all rational points on the boundary of the higher Teichmuller space.

10.14. Commensurability classification of certain right-angled Coxeter groups

Anne Thomas (The University of Sydney)

16:00 Tue 4 December 2018 – BS Sth 2060

Pallavi Dani, Emily Stark and Anne Thomas

Two abstract groups are commensurable if they have isomorphic finite index subgroups. We give the commensurability classification for certain families of right-angled Coxeter groups. A key step is proving that these Coxeter groups are virtually fundamental groups of geometric amalgams of surfaces. We then use covering-theoretic arguments and Euler characteristic to establish our classification.

10.15. Oriented geodesics in the three-sphere

Adam Wood[s] (The University of Melbourne)

16:00 Wed 5 December 2018 – BS Sth 2060

Mr Adam Wood

In 1989 Werner Fenchel gave a classification of oriented lines and their common perpendiculars in hyperbolic space with an application to the construction and description of right angled hexagons. In this talk we discuss these notions in the spherical setting.

11. Harmonic Analysis

11.1. Sharp weighted estimates for square functions associated to operators on homogeneous spaces

Anh Bui (Macquarie University)

16:00 Wed 5 December 2018 – Ligert 111

Dr Anh Bui

Let X be a metric spaces with a doubling measure and let L be a linear operator in $L^2(X)$ whose heat kernels satisfy the Gaussian upper bound. This paper proves sharp L^p_w norm inequalities for square functions associated to L including the vertical square functions, the Lusin area integral square functions and the Littlewood-Paley g-functions. It is worth noticing that we do not assume any regularity condition on the heat kernel.

11.2. Scattering of the nonlinear Klein-Gordon equations

Xing Cheng (Monash University)

16:30 Tue 4 December 2018 – Ligert 111

Dr Xing Cheng

In this talk, we will show the scattering of the mass-critical nonlinear Klein-Gordon equations. To prove the scattering, we rely on the bilinear restriction estimate to give the profile decomposition. We also need to use the solution of the mass-critical nonlinear Schrodinger equation to approximate the nonlinear profile in the large scale case. Then we can prove the scattering by using the concentration-compactness/rigidity method.

11.3. Optimisation in the Construction of Symmetric and Cardinal Wavelets on the Line

Neil Kristofer Dizon[s] (The University of Newcastle)

15:30 Tue 4 December 2018 – Ligert 111

Neil Dizon, Jeffrey Hogan, Joseph Lakey

Ingrid Daubechies' construction of compactly supported smooth orthogonal wavelets on the line having multiresolution structure, coupled with other desirable properties, relied heavily on techniques of complex analysis, many of which are unavailable in the higher-dimensional setting. Alternatively, Franklin, Hogan, and Tam developed techniques which have been successful in producing Daubechies' wavelets, among others, from uniform samples of the so-called quadrature filters associated with the multiresolution structure. In this talk, we present an alternative construction of compactly supported smooth orthogonal wavelets by considering samples of the scaling functions and associated wavelets as variables. This allows for the construction of scaling functions and wavelets with optimal cardinality and symmetry properties.

11.4. Maximal operators with generalised Gaussian bounds on non-doubling Riemannian manifolds with low dimension

Hong Chuong Doan[s] (Macquarie University)

16:00 Tue 4 December 2018 – Ligert 111

Mr Hong Chuong Doan

Let L be a non-negative self-adjoint operator on $L^2(\mathcal{R}^1\sharp\mathcal{R}^2)$. In this talk, we will investigate the boundedness of the maximal operator associated with the heat semi-group $\mathcal{M}_\Delta f(x) := \sup_{t>0}|e^{-t\Delta}f(x)|$ where Δ is the Laplace-Beltrami operator acting on the non-doubling manifold with two ends $\mathcal{R}^1\sharp\mathcal{R}^2$. By using the subordination formula, we obtain the weak type $(1,1)$ and L^p $(1 < p \leq \infty)$ boundedness of the maximal operator $T_k f(x) := \sup_{z\in S^0_\mu}|(z\sqrt{L})^k e^{-z\sqrt{L}}f(x)|$ where k is a non-negative integer and $S^0_\mu := \{z \in \mathbb{C} : |\arg z| < \mu\}$ with $0 < \mu < \dfrac{\pi}{4}$.

11.5. BMO spaces associated to operators on non-doubling manifolds with ends

Xuan Duong (Macquarie University)

14:30 Tue 4 December 2018 – Ligert 111

Prof Xuan Duong

Consider a non-doubling manifold with ends $M = \mathfrak{R}^n\sharp\,\mathbb{R}^m$ where $\mathfrak{R}^n = \mathbb{R}^n \times \mathbb{S}^{m-n}$ for $m > n \geq 3$. We say that an operator L has a generalised Poisson kernel if $\sqrt{L}$ generates a semigroup $e^{-t\sqrt{L}}$ whose kernel $p_t(x,y)$ has an upper bound similar to the kernel of $e^{-t\sqrt{\Delta}}$ where Δ is the Laplace-Beltrami operator on M. An example for operators with generalised Gaussian bounds is the Schrödinger operator $L = \Delta + V$ where V is an arbitrary non-negative locally integrable potential. Our aim is to introduce the BMO space associated to an operator with generalised Poisson bounds which serves as an appropriate setting for certain singular integrals with rough kernels to be bounded from $L^\infty(M)$ into this new BMO space. We can also show that the John-Nirenberg inequality holds and we give an interpolation theorem for a holomorphic family of operators which interpolates between $L^q(M)$ and the new BMO space. As an application, we show that the holomorphic functional calculus $m(\sqrt{L})$ is bounded from $L^\infty(M)$ into the new BMO, and bounded on $L^p(M)$ for $1 < p < \infty$.

11.6. Bergman and Bergman-Toeplitz operators on pseudoconvex domains

Tran Vu Khanh (University of Wollongong)

15:30 Wed 5 December 2018 – Ligert 111

Dr Tran Vu Khanh

In this talk, we discuss about regularity properties of Bergman and Bergman-Toeplitz operators on some classes of pseudoconvex domains in $\mathbb{C}^n$.

11.7. An inversion technique for linear operator pencils in Hilbert space

Geetika Verma (University of South Australia)

16:30 Wed 5 December 2018 – Ligert 111

Dr Geetika Verma

We explain an inversion technique to find the generalised resolvent of a linear operator pencil in Hilbert space that is singular at the origin. We outline a recursive procedure that reduces the original resolvent problem to a sequence of equivalent resolvent problems on smaller spaces by using an increasing sequence of orthogonal projections to progressively extract the singular terms in the Laurent series expansion of the resolvent. The extraction terminates after a finite number of steps if the reduced resolvent becomes nonsingular at the origin in which case the original resolvent has a finite order pole at the origin. If the process continues ad infinitum we appeal to Zorn's lemma to justify the existence of an upper bound on the sequence of orthogonal projections. Thus we determine the singular component of the Laurent series and show that the original resolvent has an isolated essential singularity at the origin. We illustrate our remarks by considering the inversion of a linear operator pencil defined by taking the Laplace transform of an infinite system of ordinary differential equations.

12. Integrable Systems

12.1. A generalized Temperley-Lieb algebra in the chiral Potts model

Remy Alexander Adderton[s] (The Australian National University)

14:30 Tue 4 December 2018 – Ligert 112

Mr Remy Alexander Adderton

The Temperley-Lieb algebra (TLA) plays a central role in the integrability of some key models in statistical mechanics. In this talk I will describe a new TLA generalization for the N-state chiral Potts model given by N-1 coupled Temperley-Lieb algebras. This is analogous to the well known relation between the quantum Potts chain and the Temperley-Lieb algebra. I will also discuss some representations of the coupled Temperley-Lieb algebra in the one- and two-boundary cases.

12.2. Some exact Lyapunov exponents for random matrix products

Peter Forrester (The University of Melbourne)

16:30 Wed 5 December 2018 – Ligert 112

Prof Peter Forrester

It was nominated by Kingman that "Pride of place among the unsolved problems of subadditive ergodic theory must go to the calculation of the Lyapunov exponent". In this talk I'll survey some known results where the Lyapunov exponent – and sometimes spectrum – for random matrix products can be calculated exactly, and I'll present some new examples too.

12.3. Hidden solutions of discrete systems

Nalini Joshi (The University of Sydney)

14:00 Tue 4 December 2018 – Ligert 112

Prof Nalini Joshi

Hidden solutions are well known in irregular singular limits of differential equations. These solutions are not able to be identified uniquely through conventional analysis, because free parameters identifying the solution lie hidden beyond all orders of a divergent asymptotic expansion. In previous studies, we identified such solutions of discrete Painlevé equations, known as q-PI, d-PI, and d-PII, in the limits where their independent variable goes to infinity. In this talk, we extend the investigation to further solutions and to new types of equations.

Through such analysis, we determine regions of the complex plane in which the asymptotic behaviour is described by a power series expression, and find that the behaviour of these asymptotic solutions shares a number of features with the tronquée and tri-tronquée solutions of corresponding differential Painlevé equation.

12.4. A new framework and extensions of log-aesthetic curves in industrial design by integrable geometry

Kenji Kajiwara (Kyushu University)

16:30 Tue 4 December 2018 – Ligert 112

Kenji Kajiwara, Jun-ichi Inoguchi, Kenjiro T. Miura and Wolfgang Schief

In this talk we discuss a new framework of the log-aesthetic curves (LAC) in industrial design based on the similarity geometry, where LAC is understood as a similarity geometric analogue of the Euler's elasticae. We discuss two basic characterizations of LAC: (i) the rigid motion of integrable deformation of plane curves (ii) variational principle. Then we discuss some new outcomes based on this formulation, namely (i) integrable discretization of LAC (ii) space curve extension of LAC.

12.5. Finding rational integrals of rational discrete maps

Reinout Quispel (La Trobe University)

16:00 Tue 4 December 2018 – Ligert 112

Prof Reinout Quispel

We present a novel method for finding rational first and second integrals of rational maps/ordinary difference equations.

12.6. Ground-state energies of the open and closed $p + ip$-pairing models from the Bethe Ansatz

Yibing Shen[s] (The University of Queensland)

15:30 Tue 4 December 2018 – Ligert 112

Yibing Shen, Phillip S. Isaac, Jon Links

We first study the $p+ip$ Hamiltonian isolated from its environment (closed model) through the Bethe Ansatz solution and consider the case of a large particle number. A continuum limit approximation is applied to compute the ground-state energy. We discuss the evolution of the solution curve, and the limitations of this approach. We then consider an alternative approach that transforms the Bethe Ansatz equations to an equivalent form in terms of the real-valued conserved operator eigenvalues. This approach also generalizes to accommodate interaction with the environment (open model).

12.7. Certain subgroups of the Coxeter groups and symmetry of discrete integrable equations

Yang Shi (Flinders University)

15:30 Wed 5 December 2018 – Ligert 112

Ms Yang Shi

We explore some unique properties of the Coxeter groups in the context of discrete integrable systems. In particular, we look at the applications of the

Normalizer theory of parabolic subgroups in the studies of discrete Painlevé equations.

12.8. Helical solitons in vector modified Korteweg–de Vries equations

Yury Stepanyants (University of Southern Queensland)

10:00 Thu 6 December 2018 – Ligert 112
Prof Yury Stepanyants

We study existence and structure of helical solitons in the vector modified Korteweg–de Vries (mKdV) equations, one of which is completely integrable by Inverse Scattering Method, whereas another one is nonintegrable. The latter one describes nonlinear waves in various physical systems, including plasma and chains of particles connected by elastic springs. By using the dynamical system methods such as the blow-up near singular points and the construction of invariant manifolds, we construct helical solitons by the efficient shooting method. The helical solitons arise as the result of co-dimension one bifurcation and exist along a curve in the velocity-frequency parameter plane. Examples of helical solitons are constructed numerically for the non-integrable equation and compared with exact solutions in the integrable vector mKdV equation. The stability of helical solitons with respect to small perturbations is confirmed by direct numerical simulations. Examples of interactions of helical solitons with each other and with plane solitons will be presented for both integrable and non-integrable equations

12.9. Schubert calculus and quantum integrable systems

Paul Zinn-Justin (The University of Melbourne)

16:00 Wed 5 December 2018 – Ligert 112
Assoc Prof Paul Zinn-Justin

We shall discuss the recent breakthrough in solving the 19th century problem of Schubert calculus using quantum integrability. This is joint work with A. Knutson.

13. Mathematical Biology

13.1. Multiscale modelling of fibre-reinforced hydrogels for tissue engineering

Mike Chen (The University of Adelaide)

10:00 Thu 6 December 2018 – Ligert 216

Dr Mike Chen

Tissue engineering aims to grow artificial tissues in vitro to replace those in the body that have been damaged through age, trauma or disease. A recent approach to engineer artificial cartilage involves seeding cells within a scaffold consisting of an interconnected three dimensional printed lattice of polymer fibres combined with a cast or printed hydrogel, and subjecting the construct (cell-seeded scaffold) to an applied load in a bioreactor. A key question is to understand how the applied load is distributed throughout the construct to the mechanosensitive cells.

To address this, we employ homogenisation theory to derive macroscale governing equations for the effective material properties of the composite, where we treat the fibres as a linear elastic material and the hydrogel as a poroelastic material and exploit the disparate length scales (small inter-fibre spacing compared with construct dimensions). This description reflects the orthotropic nature of the composite. To validate the model, solutions from finite element simulations of the macroscale, homogenised equations are compared to experimental data describing the unconfined compression of fibre-reinforced hydrogels.

13.2. Modelling Non-Uniform Growth in Cylindrical Yeast Colonies

Anthony John Gallo[s] (The University of Adelaide)

09:30 Thu 6 December 2018 – Ligert 216

Mr Anthony John Gallo

Laboratory experiments have shown that yeast can grow vertically upwards from an agar plate to form a cylindrical colony. However, the nature in which nutrients diffuse through the colony and how this affects cell proliferation within the colony is not fully understood. In general, the nutrient distribution will be non-constant and hence there will be spatially dependent cell proliferation. In this talk, we present an agent-based discrete model to simulate non-uniform growth using a probability distribution to model the non-constant nutrient gradient and biased cell proliferation. Analytic expressions are derived to approximate the (average) trajectories of the initial cells in the colony, and this provides a way to analyse the non-uniform growth within the colony.

13.3. Pattern Avoidance in Genomics

Yoong Kuan Goh[s] (University of Technology, Sydney)

16:00 Tue 4 December 2018 – Ligert 216

Mr Yoong Kuan Goh

One part of genomics research is gene rearrangements. There is a tantalising connection between this field and the field of pattern avoidance within combinatorics. In this talk, I will describe the connection between these two fields and the possibility in applying some outcomes of pattern avoidance research to solve the problems in gene rearrangements.

13.4. Learning advantages in evolutionary games

Maria Kleshnina[s] (The University of Queensland)

16:30 Tue 4 December 2018 – Ligert 216

Miss Maria Kleshnina

The idea of incompetence as a learning or adaptation function was introduced in the context of evolutionary games as a fixed parameter. However, live organisms usually perform different nonlinear adaptation functions such as a power law or exponential fitness growth. Here, we examine how the functional form of the learning process may affect the social competition between different behavioral types. Further, we extend our results for the evolutionary games where fluctuations in the environment affect the behavioral adaptation of competing species and demonstrate importance of the starting level of incompetence for survival. Hence, we define a new concept of learning advantages that becomes crucial when environments are constantly changing and requiring rapid adaptation from species. This may lead to the evolutionarily weak phase when even evolutionary stable populations become vulnerable to invasions.

13.5. Who cares? Or, when does paternal care arise in primates?

Danya Rose (The University of Sydney)

09:00 Thu 6 December 2018 – Ligert 216

Dr Danya Rose

Paternal care is a rare trait among primates, with males of most species preferring a competitive approach to gaining paternities and spending little time interacting with or protecting their own young. Males who care for their young risk foregoing opportunities to compete with other males for extra paternities. Affecting the costs and rewards of either strategy are biological issues such as lactational amenorrhea, pregnancy duration, and life history, which we include in a new model of the interplay between care and competition. We explore this model in an effort to characterise some conditions under which paternal care might arise.

13.6. Predicating saturation in models of genome rearrangement in polynomial time

Jeremy Sumner (University of Tasmania)

15:30 Tue 4 December 2018 – Ligert 216

Dr Jeremy Sumner

Genome rearrangement models provide an evolutionary comparison of genomes with identifiably similar content, such as genes or other large scale genomic units. These models focus on differences in structure, such as the order that these units appear in the genome, and describe molecular evolution via rearrangements. For certain domains of life, such as bacteria, where evolution is complicated and often dominated by “horizontal” transmission of genetic material (via lateral gene transfer events), this somewhat coarse-grained approach is eminently sensible.

However, genome rearrangements are mathematically combinatorial in nature and the calculation of evolutionary distance with respect to a general rearrangement model is inherently of factorial complexity. Various heuristics have been used to address this issue; however many of these demand quite stringent, unrealistic conditions on the allowed rearrangements.

We are exploring an approach which applies representation theory to calculate evolutionary distance between circular genomes as a maximum likelihood estimate (MLE) of time elapsed. This approach opens the door to numeric approaches where approximate solutions and/or partial results may be obtained in polynomial time. In particular, some pairs of genomes do not have an MLE distance as the relative arrangement of their genomes is at stochastic saturation with respect to the model under consideration. We are able to predict this situation using a (quadratic time) eigenvalue evaluation.

14. Mathematics Education

14.1. 'Learning to Communicate' and 'Communicating to Learn'

Amie Albrecht (University of South Australia)

09:30 Thu 6 December 2018 – HL 422

Dr Amie Albrecht

Mathematics is a language of its own, and students need to learn to communicate effectively through both the written and spoken word. Conversely, communication is also an important part of learning mathematics. By articulating and justifying their mathematical ideas, and listening to and making sense of the ideas of others, students develop and refine their conceptual understanding. Yet few tertiary mathematics courses provide students with explicit opportunities, encouragement and support in developing effective communication skills.

In this talk I will discuss assessment and classroom strategies designed to elicit exploratory thinking, encourage revision, and support growth in oral presentation and mathematical writing skills. This approach has been developed over five years in 'Developing Mathematical Thinking', a course designed for pre-service maths teachers at the University of South Australia.

The major assessment item in this course requires students to communicate the results of an in-depth investigation of a self-selected topic via a written report and an oral presentation. I will describe a structure that supports each student in choosing a topic, writing a draft report, providing peer critique, revising work in response to feedback, and preparing a high-quality final report.

Student competence and confidence with oral communication is progressively developed through weekly mini-talks which gradually increase in length, and audience familiarity and size. Each week focuses on different skills such as delivery, body language, organisation, and visual aids. Guided peer feedback and self-reflection help students continually improve.

Focusing on both 'learning to communicate' and 'communicating to learn' by having students talk about their evolving mathematical ideas while also learning to communicate mathematically has turned out to be a powerful strategy to propel their mathematical development.

14.2. First year engineering mathematics diagnostic testing

Roland Dodd (Central Queensland University)

16:00 Tue 4 December 2018 – HL 422

Dr Roland Dodd, Antony Dekkers

The mathematics capability of students, entering the Central Queensland University (CQU) engineering program, has a very large variation. Many engineering mathematics students commence their undergraduate studies with significant mathematics deficiencies in their fundamental mathematics skills.

Every year at CQU an engineering mathematics skills analysis is offered to incoming first year students, consistently revealing problems in foundation mathematics concepts and principles. This paper discusses a comparison and analysis of these engineering mathematics diagnostic test results since introduction in 2016. Outcomes for further use and integration in the CQU engineering program are presented.

14.3. Educating On-line Software

Diane Donovan (The University of Queensland)

16:00 Fri 7 December 2018 – HL 422

Prof Diane Donovan

In this talk I will reflect on the principles of a "good" learning environment for mathematics and the challenge of using technology to enhance this process.

The primary aim of this talk will be to promote discussion on how to personalize technology driven learning environments. So how we can foster real-time interactions both between the students and with the demonstrator. Are we providing platforms which allow for individuality in learning but also in thinking? Can we efficiently provide direct communication between students experienced academics?

I will propose and discuss some approaches which I have trialed in recent years.

14.4. You can teach old dogs new tricks if you know them well

William Guo (Central Queensland University)

16:30 Tue 4 December 2018 – HL 422

Prof William Guo

After finishing the final examination of an advanced mathematics unit at Central Queensland University (CQU), a distance student in her mid-30s wrote to me "... I know it can be a little bit difficult to teach this old dog new tricks, but with perseverance I think I just might have learnt a couple of things." She is among the one-third of students who are 35 years or up in a typical unit at CQU, one of many regional universities in Australia. By the definition of 'adult learner' or 'mature student' as a person who is 25 years or up and is involved in forms of learning, the percentage of mature students would be close to 50 percent in many mathematics units at CQU. These mature students, particularly those 35 years or up, are typically returning adults who pursue higher education with more life experience, work commitments and/or family responsibilities at CQU.

As reported in literature, mature students tend to be self-initiated, self-directed, self-determined, and self-planned. The traditional pedagogical methods based on the premise of transmission of knowledge and skills from the teacher to the adolescent students may not meet the needs of mature students. My experience in teaching mature students, particularly those 35 years or up enrolled in my introductory, intermediate, and advanced mathematics classes since 2013 at CQU, shares above commonalities possessed by mature students. However, my experience also indicates that any alternative overall delivery approach tailored to incorporate such commonalities is insufficient to guide most mature students going through these mathematics units with confidence. An approach of 'a baseline for all' plus 'an adaptive addition to individual' has been much more appropriate to the mature students, particularly those 35 years or up enrolled in my mathematics classes. This talk will present some cases of teaching mathematics units for mature students from 35 to over 80 years using this approach in the past a few years at CQU.

14.5. Student learning and feedback in higher education mathematics

David Hartley (University of Wollongong)

14:00 Tue 4 December 2018 – HL 422

Dr David Hartley

In this talk I will give a brief review of literature on feedback, highlighting its importance in the student learning process. There is a lack of theory that is specific to higher education mathematics and I discuss why the more general theories may not be as relevant to this context. I will then go through some reflections on how I have seen students use feedback during my last 21 months as a learning developer providing student support.

14.6. Reflections on a kaleidoscope of multi-faceted, cross-disciplinary mathematics support. Feeding the growing appetite

Deborah Jackson (La Trobe University)

16:30 Fri 7 December 2018 – HL 422

Dr Deborah Jackson

Quality mathematics support is now an essential ingredient of student success in many and varied disciplines. Such support needs to capture the interest and enthusiasm of the students and answer the requests for sound mathematics support by lecturers and coordinators, in a wide range of subjects or disciplines. To be successful, mathematics support should also be enriching, interesting, colourful, relevant and interactive, as well as flexible and multi-faceted. It should not only answer specific questions, but encourage deep learning, and give students confidence in translating discipline problems into mathematical ones, and vice versa. Catering for multi-campus and online remote learning adds more dimensions and dilemmas that need to be addressed. We discuss the multi-faceted mathematics support provided by La Trobe University's Maths Skills Program and Maths Hub, which have encapsulated a whole range of support to multi-disciplines to appease a growing appetite.

14.7. Benefits and challenges of peer-assessment for online subjects

Simon James (Deakin University)

10:00 Thu 6 December 2018 – HL 422

Dr Simon James

The use of peer-assessment has the potential to provide students with an engaging experience, allowing them to become aware of multiple approaches to meeting assignment requirements, and to think critically on assignment objectives. For some tasks, peer assessment could also help alleviate workload issues for academics and provide students with valuable feedback. This presentation reflects on the experiences of implementing peer-assessment for a mathematical coding project in a unit designed for pre-service teachers.

14.8. Mathematics and Indigenous Culture

Carolyn Kennett (Macquarie University)

14:30 Tue 4 December 2018 – HL 422

Carolyn Kennett, Madeleine Dawson, Ruby Foster

In this talk, I will talk about the National Indigenous Science Education Program and present some work done by two students working with me on a mathematics outreach project as part of the program.

14.9. Choose-your-own assessment

Heather Lonsdale (Curtin University)

09:00 Thu 6 December 2018 – HL 422

Dr Heather Lonsdale

Assessing a diverse range of learning outcomes, for a diverse range of learners, is always a challenge. In mathematics students are often used to a more traditional form of test-based assessment, but this does not always allow them to demonstrate their full range of capabilities.

I will talk about some of my work on alternative assessment options, but in particular about the choices that students have been able to make as to how they undertake these. For oral assessment of problem-solving, which can seem daunting to students unaccustomed to it, students were given the choice of the frequency and the format of these assessments — including whether to be assessed as a group or individually. For a mathematical modelling unit, students were given the option of completing an application-based modelling project in place of test-based assessment. For a range of units, the final exam was set as optional if students were able to demonstrate the learning outcomes in other ways during the semester.

In this practice-based talk, I will present these experiences and my reflections, and hope to prompt discussion about the ways we assess and the choices we give students in demonstrating their learning.

14.10. Comparing the Quality of Learning Outcomes

Chi Mak (University of New South Wales)

15:00 Fri 7 December 2018 – HL 422

Dr Chi Mak

The School of Mathematics and Statistics of the University of New South Wales (UNSW) has used online formative assessments as supplements to tutorials in various first year Mathematics courses since 2008. From 2015, the pattern of face-to-face tutorial progressively changed and reduced from two per week to one. The other tutorial has been replaced by an *online tutorial* which composes of videos, other materials and online formative assessments. The purpose of the formative assessments is to provide problems with guidance for students to apply what they learnt from the videos etc. Immediate feedback is provided to facilitate learning.

In general, surveys show that students are satisfied with the new tutorial and online assessment arrangements. To evaluate the change of quality of learning Mathematics, Freislich and Bowen-James conducted a specific research into one of the courses. A few questions were identified from the written final exam in the year 2015 (prior to the change) and similar questions in the year 2016 (after the change). The questions were marked again using a new marking scheme based on the SOLO taxonomy [Biggs and Collis, *Evaluating the quality of learning: The SOLO taxonomy*, New York: Academic Press]. They marked a random sample of scripts and have some interesting findings.

In another course, the assessment pattern was changed so that 50% of the final assessment mark is contributed from the online assessment on the skills to be mastered in this course. The Mathematics writing skills is assessed through a written assignment and the final written exam. It is intended that a similar method of Freislich and Bowen-James noted above will be used to compare the quality of learning outcomes between the old and new assessment patterns.

14.11. Making mathematics teachers: Beliefs about mathematics and mathematics teaching and learning held by academics who teach future teachers

Margaret Marshman (University of the Sunshine Coast)

15:30 Tue 4 December 2018 – HL 422

Dr Margaret Marshman, Prof Merrilyn Goos (University of Limerick)

Secondary mathematics pre-service teachers are a significant cohort of students within university mathematics classes. Often these students experience mathematics teaching and learning differently across their initial teacher education. I will present the results of a survey of Australian mathematicians and mathematics educators who teach secondary mathematics pre-service teachers, documenting their beliefs about mathematics, its teaching, and its learning. The findings are presented using descriptive statistics, t-tests and analysis of interview data with a small subset. In general, participants had a Problem-solving view of mathematics and those with a background in education tended to have more agreement with a Problem-solving approach to teaching.

14.12. Authoring accessible 'Tagged PDF' documents using LaTeX

Ross Moore (Macquarie University)

14:30 Fri 7 December 2018 – HL 422

Dr Ross Moore

Several ISO standards have emerged for what should be contained in PDF documents, to support applications such as 'archivability' (PDF/A) and 'accessibility' (PDF/UA). These involve the concept of 'tagging', both of content and structure, so that smart reader/browser-like software can adjust the view presented to a human reader, perhaps afflicted with some physical disability. In this talk we will look at a range of documents which are fully conformant with these modern standards, mostly containing at least some mathematical content, created directly in LaTeX. The examples are available on the author's website: `http://web.science.mq.edu.au/~ross/TaggedPDF/`.

The desirability of producing documents this way will discussed, along with aspects of how much extra work is required of the author. Also on the above website is a 'five-year plan' proposal how to modify the production of LaTeX-based scientific publications to adopt such methods. This will involve cooperation between academic publishers and a TUG working group. The proposal PDF is itself produced to be fully accessible, complying with both PDF/UA-1 and PDF/A-2a standards; get it at `http://web.science.mq.edu.au/~ross/TaggedPDF/PDF-standards-v2.pdf`.

14.13. Conceptual Considerations in the Transition to University Mathematics: The Case for Limits as a Threshold Concept

Greg Oates (University of Tasmania)

13:30 Fri 7 December 2018 – HL 422

Dr Greg Oates; Dr Robyn Reaburn (UTAS); Dr Kumudini Dharmasada (UTAS); Dr Michael Brideson (UTAS)

Threshold concepts remain relatively unexplored in mathematics, despite suggestions that the troublesome nature of such concepts pose a critical barrier to student understanding of mathematics. Many studies have identified student difficulties with limits, and their findings point to a strong likelihood that limits do indeed constitute a threshold concept in mathematics. This paper describes the initial results in a study that sought to investigate students' understanding of limits and differentiation from the prospective of Threshold Concepts. While the findings to date do not provide conclusive evidence for limits as a threshold concept, they do reinforce the troublesome nature of the limit concept, and suggest some important implications for the teaching of limits consistent with previous studies. In particular, the findings suggest we need to be more explicit in the attention we pay to potential changes in the language and the way we conceptualise limits and asymptotes as students transition from school to university.

14.14. Transition between school and university — placement test and bridging course

Jelena Schmalz (University of New England)

14:00 Fri 7 December 2018 – HL 422

Dr Jelena Schmalz

UNE introduced a new structure for first-year Maths units in 2016. The Bridging Course and the Placement Test were developed and introduced as a part of this new structure. The purpose of the placement test is to help students determine which Mathematics units they should enrol. This maximises students' chances of success and satisfaction throughout their degree. The Bridging Course is a free course open to anyone enrolled at UNE that aims to help build up knowledge and fill gaps in mathematical skills to prepare students for studying first year mathematics units at UNE, and is also helpful to any students in schools or disciplines which require quantitative skills. This Bridging Course allows to start any time, and work at ones own pace. In the talk we introduce the Placements test and the Bridging Course, and discuss the impact of these innovations.

15. Mathematical Physics

15.1. Knotting probabilities for polygons in lattice tubes

Nicholas Beaton (The University of Melbourne)

16:00 Wed 5 December 2018 – Eng Nth 132

Dr Nicholas Beaton

Self-avoiding polygons are the standard statistical mechanical model for ring polymers in dilute solution. In three dimensions polygons can be knotted, and it is a celebrated result of Sumners and Whittington that sufficiently long polygons are knotted with high probability. However, self-avoiding polygons in 3D are not solvable, and in this context "sufficiently long" is very long — perhaps on the order of 10^5.

I will discuss a variant of this model, namely polygons restricted to semi-infinite tubes of the cubic lattice. This is a simple model of ring polymers in nanochannels, and is solvable, being characterised by a finite transfer matrix. It is thus possible to exactly compute growth rates and critical exponents, and (when the matrix is not too big) develop a static Monte Carlo method that allows the sampling of polygons directly from a chosen Boltzmann distribution. In this way knotting probabilities can be accurately estimated.

This is joint work with Chris Soteros and Jeremy Eng.

15.2. The conditionally integrable diffusion equation with nonlinear diffusivity 1/u

Philip Broadbridge (La Trobe University)

15:30 Tue 4 December 2018 – Eng Nth 132

Prof Philip Broadbridge

The nonlinear diffusion equation in one time and two space dimensions,

$$\frac{\partial u}{\partial t} = \nabla \cdot \left[\frac{1}{u} \nabla u \right],$$

is known to have an infinite dimensional Lie point symmetry group, including a free pair of conjugate harmonic functions. Each choice of complex analytic function f(z) will lead to a symmetry reduction to a non-integrable PDE in one time and one space dimension. There is some advantage in finding a direct mapping from a chosen function f(z) to an infinite dimensional class of explicit solutions of the nonlinear diffusion equation. That class is given here. The solutions satisfy constant-flux boundary conditions on any contour. The increasing solutions have initial condition $u = 0$ and the decreasing positive solutions are extinguished in finite time. With diffusivity $D = 1/u$, the solutions apply to diffusion of an electron gas. With $D = 1/(c - u)$, they apply to fluid flow in porous media.

15.3. Constructions of $1 + 1$-dimensional lattice-gauge theories and the Thompson group

Arnaud Brothier (UNSW Sydney)

14:30 Tue 4 December 2018 – Eng Nth 132

Dr Arnaud Brothier

I will present work in progress joint with Alexander Stottmeister. Bringing together ideas developed by Vaughan Jones between subfactor theory and conformal field theory, and from lattice-gauge theory, we construct $1 + 1$-dimensional multi-scale models that are connected to representations of the Thompson group or its rotation subgroup. The construction is operator-algebraic and works for any compact group with a certain family of measures on its unitary dual. Formally we consider a net of C*-algebras equipped with states indexed by binary trees. The limit gives us a von Neumann algebra together with a state. When the group is abelian we can give a very precise description of this limit. I will present this construction with two main examples based on the group U(1) and its associated family of Gibbs states coming from the Kogut-Susskind Hamiltonian.

15.4. One-point recursions of Harer-Zagier type

Anupam Chaudhuri[s] (Monash University)

14:00 Tue 4 December 2018 – Eng Nth 132

Mr Anupam Chaudhuri

Harer and Zagier computed the virtual Euler characteristics of moduli spaces of smooth curves via the enumeration of ribbon graphs with one face. They found a recursion for this enumeration, which we refer to as a one-point recursion. In this talk, we explore other enumerative problems that satisfy analogous one-point recursions with the aim of uncovering a common theme between these problems. In particular, we will show that monotone Hurwitz numbers satisfy a one-point recursion.

15.5. Capillary-Gravity Surface over a Bump: Critical Surface Tension

Jeongwhan Choi (Korea University)

16:30 Wed 5 December 2018 – Eng Nth 132

Jeongwhan Choi, S.I. Whang, J.S. Kim, S.H. Yun

We concern forced surface waves on an incompressible, inviscid fluid in a two dimensional channel with a small bump on a horizontal rigid flat bottom and nonzero surface tension on the free surface. It has been known that a nondimensional wave speed, called Foude number, is near 1 and a nondimensional surface tension, called Bond number, is near 1/3, the KdV theory fails and a time dependent fifth order KdV equation, called Kawahara equation, can be derived to model the wave motion on the free surface. In this study, a time dependent Kawahara equation with a forcing is studied both theoretically and numerically. Existence theorem and various numerical results are presented.

15.6. A limit theorem for the coupling time of the stochastic Ising model

Timothy Garoni (Monash University)

17:30 Wed 5 December 2018 – Eng Nth 132
Assoc Prof Timothy Garoni

The coupling time of the stochastic Ising model is the random time required for processes started in the all-plus and all-minus states to coalesce, when coupled in the natural way. We show that, for any natural d, and sufficiently high temperature, the (appropriately standardised) coupling time of the stochastic Ising model on d-dimensional tori tends weakly to a Gumbel distribution. This is joint work with Tim Hyndman, Zongzheng Zhou and Andrea Collevecchio.

15.7. Self-avoiding walks with restricted end-points

Iwan Jensen (Flinders University)

16:00 Tue 4 December 2018 – Eng Nth 132
Dr Iwan Jensen

Any SAW has a minimal bounding rectangle, which is the unique rectangle such that the SAW does not extend beyond the rectangle and the SAW touches all the borders of the rectangle. We study SAWs with prescribed end-points within the minimal bounding rectangle. Among these models are the well-known ordinary unrestricted SAW, SAWs with one or both end-points attached to a surface, and SAWs confined to a wedge. Spanning walks arise naturally in the study of so-called bridges while yet another model is related to the problem of SAWs crossing a square. We determine the critical exponents γ from series analysis and for the new models we conjecture the exact value.

15.8. Determinantal polynomials, vortices and random matrices: an exercise in experimental mathematical physics

Anthony Mays (The University of Melbourne)

16:30 Tue 4 December 2018 – Eng Nth 132
Dr Anthony Mays

Inspired by the interpretation of eigenvalues of random matrices as a gas of interacting particles we develop a toy model of vortex or particle dynamics using determinantal polynomials of random matrices. By introducing quaternionic structures we generate vortex/anti-vortex systems, and from studying the phase surface of the associated wavefunction, we identify topological rules governing the creation and annihilation of the vortices. We also discuss an interpretation of annihilation events in terms of quaternionic states. This exploratory project is very much in the vein of experimental mathematics, and so contains many avenues for further investigation.

15.9. Two-point functions of random walk models on high-dimensional boxes

Zongzheng Zhou (Monash University)

17:00 Wed 5 December 2018 – Eng Nth 132
Dr Zongzheng Zhou

The self-avoiding walk (SAW) on $\mathbb{Z}^d$ is known to display the same large-scale behaviour as simple random walk (SRW) when d is large. In particular, the SAW and SRW Green's functions are known to display the same asymptotics when $d \geq 5$. On finite boxes, however, where SAWs must have finite length, this SAW-SRW correspondence breaks down. To recover such a correspondence, we introduce a random-length random walk (RLRW), and rigorously derive its Green's function. By combining these general RLRW results with the asymptotic walk-length distribution of the SAW on the complete graph, we obtain an explicit conjecture for the SAW Green's function on high-dimensional tori, both at criticality and within a broad family of scaling windows. Using a random walk representation of the Ising model, due to Aizenman, these conjectures extend naturally to the Ising model, where they then shed light on a number of questions under current debate by computational/theoretical physicists. Finally, we will also discuss the case of free boundary conditions, where the RLRW model again clarifies a number of actively debated questions.

16. Number Theory

16.1. On the growth of product of partial quotients

Ayreena Bakhtawar[s] (La Trobe University)

15:30 Wed 5 December 2018 – IW B17

Miss Ayreena Bakhtawar

The metrical theory of continued fractions is one of the major subjects in the study of continued fractions. From Dirichlet's (1842) and Legender's (1808) results we conclude that to find a good rational approximation to an irrational number we only need to focus on its convergents. Let $[a_1(x), a_2(x), \ldots]$ be the continued fraction expansion of a real number $x \in [0, 1)$. In this talk, we focus on the growth rate of $a_n(x)a_{n+1}(x)$ which is tightly connected with the Dirichlet improvable numbers. More precisely, we determine the Hausdorff dimension of the set

$$F(\phi) = \{x \in [0,1) : a_{n+1}(x)a_n(x) \geq \phi(n) \text{ for infinitely many } n \in \mathbb{N} \text{ and } a_{n+1}(x) < \phi(n) \text{ for all sufficiently large } n \in \mathbb{N}\}$$

where $\phi : \mathbb{N} \to \mathbb{R}^+$ is an arbitrary positive function. This in return contribute to the metrical theory of continued fractions This is a joint work with Philip Bos.

16.2. Explicit bounds on exceptional zeroes of Dirichlet L-functions

Matteo Bordignon[s] (University of New South Wales Canberra)

16:00 Tue 4 December 2018 – IW B17

Mr Matteo Bordignon

We aim to improve the upper bound for the exceptional zeroes of Dirichlet L-functions. This is done improving on explicit estimate for $L'(\sigma, \chi)$ for σ close to unity.

16.3. Hausdorff Measure and Dirichlet Non-Improvable Numbers

Philip Bos[s] (La Trobe University)

16:00 Wed 5 December 2018 – IW B17

Mr Philip Bos

Let $\Psi : [1, \infty) \to \mathbb{R}_+$ be a non-decreasing function, $a_n(x)$ the n'th partial quotient of x and $q_n(x)$ the denominator of the n'th convergent. The set of Ψ-Dirichlet non-improvable numbers

$$G(\Psi) := \Big\{x \in [0,1) : a_n(x)a_{n+1}(x) > \Psi\big(q_n(x)\big) \text{ for infinitely many } n \in \mathbb{N}\Big\},$$

is related with the classical set of $1/q^2\Psi(q)$-approximable numbers $\mathcal{K}(\Psi)$ in the sense that $\mathcal{K}(3\Psi) \subset G(\Psi)$. Both of these sets enjoy the same s-dimensional Hausdorff measure criterion for $s \in (0, 1)$. We prove that the set $G(\Psi) \setminus \mathcal{K}(3\Psi)$ is uncountable by proving that its Hausdorff dimension is the same as that for the sets $\mathcal{K}(\Psi)$ and $G(\Psi)$. This gives an affirmative answer to a question raised by Hussain-Kleinbock-Wadleigh-Wang (2017).

This is a joint work with Ayreena Bakhtawar and Mumtaz Hussain.

In my talk, I will set the scene and sketch the proof.

16.4. Heights and isogenies of Drinfeld modules

Florian Breuer (The University of Newcastle)

15:30 Tue 4 December 2018 – IW B17

Prof Florian Breuer

It is known that if two elliptic curves defined over a number field are linked by an isogeny of degree d, then the difference of their Faltings heights is bounded by $\frac{1}{2}\log d$. A similar result also holds for the Weil heights of their j-invariants.

In this talk, I will present analogous results for Drinfeld modules. In particular, one can associate several different heights to a Drinfeld module, and the key lies in comparing these heights. This is joint work with Fabien Pazuki.

16.5. Square-free numbers in short intervals

Michaela Cully-Hugill[s] (University of New South Wales Canberra)

16:30 Tue 4 December 2018 – IW B17

Ms Michaela Cully-Hugill

The smallest theoretical interval length containing at least one square-free number was given by Filaseta and Trifonov in 1992, which applied for all significantly large numbers. The explicit version of their proof will be presented, as well as the resulting explicit interval length that can be used for specific ranges. An outline of the classical result will also be given, as well as how it can be used in conjunction with Filaseta and Trifonov's result to give an explicit result for the range of all positive integers not covered by computation.

16.6. On the geometric Steinitz problem

Anand Rajendra Deopurkar (Australian National University)

09:30 Fri 7 December 2018 – IW B17

Dr Anand Rajendra Deopurkar

Let L/K be a finite extension of number fields. Associated to this extension is the discriminant ideal D in the ring of integers of K. The Steinitz invariant is a refinement of the discriminant; it is a square root of D in the ideal class group. An open problem in number theory is to characterise ideal classes that can arise as Steinitz invariants. I will describe a complete solution to the geometric analogue of this problem, obtained jointly with Anand Patel, using the geometry of vector bundles on algebraic curves.

16.7. Measure theoretic laws in Diophantine approximation

Mumtaz Hussain (La Trobe University)
09:30 Thu 6 December 2018 – IW B17
Dr Mumtaz Hussain

In this talk, I will briefly discuss some new measure theoretic methods and techniques which helps in determining the size of limsup sets in Diophantine approximation.

16.8. Overpartitions

Thomas Morrill (UNSW Canberra)
16:30 Wed 5 December 2018 – IW B17
Dr Thomas Morrill

We give a brief introduction to these combinatoric objects and their connections to automorphic forms, and present upcoming work in overparition generating series.

16.9. Carmichael polynomials over finite fields

Min Sha (Macquarie University)
09:00 Fri 7 December 2018 – IW B17
Dr Min Sha

Motivated by Carmichael numbers, we introduce Carmichael polynomials over finite fields, establish Korselt's criterion for them, and estimate the number of such polynomials of fixed degree. (This is joint work with Sunghan Bae and Su Hu.)

16.10. The efficient computation of Splitting Fields using Galois groups

Nicole Sutherland (The University of Sydney)
09:00 Thu 6 December 2018 – IW B17
Dr Nicole Sutherland

We consider the efficient computation of splitting fields of polynomials over arithmetic fields using the Galois group algorithm of Fieker and Klüners. I will report on recent work for polynomials over global function fields and considerations which are unique to prime characteristic. One particular splitting field allows a polynomial to be solved by radicals, an original motivator of Galois groups, and I will also describe the extra computation necessary to gain a splitting field in this form and the considerations here which are unique to prime characteristic.

16.11. Zeroes of the zeta-function: mind the gap!

Timothy Trudgian (UNSW Canberra)
17:00 Wed 5 December 2018 – IW B17
Dr Timothy Trudgian

Several open problems (with wine/cash prizes for their resolution) will be presented on gaps between zeroes of the Riemann zeta-function. I shall outline the history of the problem as well as some ongoing work joint with Caroline Turnage-Butterbaugh at Carleton College, MN, USA.

16.12. On modular Nekrasov–Okounkov formulas

Ole Warnaar (The University of Queensland)
14:00 Tue 4 December 2018 – IW B17
Prof Ole Warnaar

The Nekrasov–Okounkov formula is a far-reaching generalisation of Euler's classical product formula for the generating function of integer partitions. In this talk I will discuss several modular analogues of the Nekrasov–Okounkov formula based on Littlewood's decomposition (a two-dimensional analogue of Euclidean division) and variations thereof. If time permits I will discuss connections with the Hilbert scheme of points in the plane.

16.13. On multiplicative independence of rational function iterates

Marley Young[s] (University of New South Wales)
17:30 Wed 5 December 2018 – IW B17
Mr Marley Young

We give lower bounds for the degree of multiplicative combinations of iterates of rational functions (with certain exceptions) over a general field, establishing the multiplicative independence of said iterates. This leads to a generalisation of Gao's method for constructing elements in the finite field $\mathbb{F}_{q^n}$ whose orders are larger than any polynomial in n when n becomes large.

17. Optimisation

17.1. Game Theory and Machine Learning for Complex Networked Systems

Tansu Alpcan (The University of Melbourne)

14:00 Fri 7 December 2018 – Eng Sth 112
Assoc Prof Tansu Alpcan

There is a growing need to manage the efficiency and security of complex networked systems, which are no longer operated by a single agent, but require the coordination of many agents who manage different parts of the network. Game theory provides an excellent analytical framework to model such multi-agent problems. However, modern data and computation-intensive systems challenge traditional game and system-theoretic formulations, which suffer from scalability issues when there are large numbers of agents and complex, non-convex system representations. An emerging grand challenge is to better understand how system disciplines (communication/control/signal processing) and game theory will benefit from data and algorithm-oriented methods of machine learning. Similarly, machine learning methods need a counterpart of the formalism that underpin system disciplines and game theory. This talk will discuss these challenges within an optimisation context and using specific examples.

17.2. Doubleton Projections in Hilbert Spaces

Theo Bendit[s] (The University of Newcastle)

17:00 Wed 5 December 2018 – Eng Sth 112
Mr Theo Bendit

We present a simple, non-constructive, sufficient condition for a normed-closed subset C of a real Hilbert Space to admit a point that projects onto precisely two points of C. We examine some consequences, limitations, and possible generalisations of this result, making reference to its relevance to the study of Chebyshev sets.

17.3. Generalized convexity

Thi Hoa Bui[s] (Federation University Australia)

16:00 Wed 5 December 2018 – Eng Sth 112
Ms Thi Hoa Bui

Some important generalised convexity properties like quasiconvexity, explicit quasiconvexity and psedoconvexity are not stable when the function is perturbed by a linear functional with sufficiently small norm. In this talk, we will consider a class of generalised convex functions so-called robustly quasiconvex function that some expected optimisation properties remain stable under a small linear perturbation. We will recall some known results for continuously differentiable functions, and discuss on how to deal with non-smooth functions using the mean of Frchet subdifferentials.

Besides, some other important of generalized convexity properties are introduced for further discussion.

17.4. Adaptive Douglas-Rachford splitting algorithm for the sum of two operators

Minh N. Dao (The University of Newcastle)

16:00 Fri 7 December 2018 – Eng Sth 112
Dr Minh N. Dao

The Douglas-Rachford algorithm is a classical and powerful splitting method for minimizing the sum of two convex functions and, more generally, finding a zero of the sum of two maximally monotone operators. Although this algorithm has been well understood when the involved operators are monotone or strongly monotone, the convergence theory for weakly monotone settings is far from being complete. In this work, we propose an adaptive Douglas-Rachford splitting algorithm for the sum of two operators, one of which is strongly monotone while the other one is weakly monotone. With appropriately chosen parameters, the algorithm converges globally to a fixed point from which we derive a solution of the problem. When one operator is Lipschitz continuous, we prove global linear convergence which sharpens recent known results.

17.5. A fixed point operator in discrete optimisation

Andrew Craig Eberhard (Royal Melbourne Institute of Technology)

14:30 Fri 7 December 2018 – Eng Sth 112
Prof Andrew Eberhard

I will discuss some duality structures that have appeared in discrete optimisation in conjunction with studies of discrete proximal point algorithm, augmented Lagrangian duality, some supporting theory for the “Feasibility Pump” and more recently with regard to Stochastic Integer programming. A common theme appears involving a fixed point operator associated with the local minima of a regularised dual function. This enables the one to describe some MIP heuristics in terms of a related continuous optimisation problem, enabling the use of ideas from continuous optimisation.

17.6. The Interior Epigraph Directions Algorithm for Nonsmooth and Nonconvex Constrained Optimization and applications

Wilhelm Freire (Universidade Federal de Juiz de Fora)

17:00 Fri 7 December 2018 – Eng Sth 112
Prof Wilhelm Freire

We present an algorithm that uses a generalized Lagrangian duality for solving nonsmooth and nonconvex constrained optimization problems. The method considers the dual problem induced by a general augmented Lagrangian to generate a sequence of points (dual variables) in the interior of the epigraph of the dual function. The method is a modification of the deflected subgradient method. In the inner iteration of the algorithm, we find a primal minimizer of the Lagrangian, which in turn is used to update the dual variables in the outer iteration. We describe new strategies for minimizing the Lagrangian and solve some academic and applied problems.

17.7. On continuity/discontinuity of the optimal value of a long-run average optimal control problem depending on a parameter

Vladimir Gaitsgory (Macquarie University)

16:30 Tue 4 December 2018 – Eng Sth 112
Prof Vladimir Gaitsgory

We will discuss conditions, under which the optimal value of a long run average optimal control problem is continuous/discontinuous with respect to a perturbation parameter. A distinctive feature of our approach is that the perturbation analysis of the optimal control problem is carried out on the basis of the perturbation analysis of the infinite-dimensional linear programming problem that is equivalent to the former. The presentation will be based on results obtained in collaboration with V. S. Borkar, M. Mammadov and L. Manic

17.8. The two-train separation problem

Phil Howlett (University of South Australia)

13:30 Fri 7 December 2018 – Eng Sth 112
Prof Phil Howlett

When a train travels from one station to the next on level track the strategy that minimizes energy consumption for a given journey time is maximum acceleration, speedhold at the optimal driving speed, coast and maximum brake. If two trains travel along the same track in the same direction then the usual safety constraint is that the trains must be separated by two signals at all times. If both trains follow the optimal single train strategy then the safety constraint may be violated. What is the optimal strategy for each train when a safe separation constraint is imposed?

17.9. Constraint Splitting and Projection Methods for Optimal Control

Yalçin Kaya (University of South Australia)

17:30 Fri 7 December 2018 – Eng Sth 112
Heinz H. Bauschke, Regina S. Burachik and C. Yalçin Kaya

We consider the minimum-energy control of a car, which is modelled as a point mass sliding on the frictionless ground in a fixed direction, and so it can be mathematically described as the double integrator. The control variable, representing the acceleration or the deceleration, is constrained by simple bounds from above and below. Despite the simplicity of the problem, it is not possible to find an analytical solution to it because of the constrained control variable. To find a numerical solution to this problem we apply three different projection-type methods: (i) Dykstra's algorithm, (ii) the Douglas–Rachford (DR) method and (iii) the Aragón Artacho–Campoy (AAC) algorithm. To our knowledge, these kinds of (projection) methods have not previously been applied to continuous-time optimal control problems, which are infinite-dimensional optimization problems. The problem we study in this article is posed in infinite-dimensional Hilbert spaces. Behaviour of the DR and AAC algorithms are explored via numerical experiments with respect to their parameters. An error analysis is also carried out numerically for a particular instance of the problem for each of the algorithms.

17.10. A variational approach to the Dubins traveling salesman problem

David Kirszenblat[s] (The University of Melbourne)

17:30 Wed 5 December 2018 – Eng Sth 112
Mr David Kirszenblat

In this talk, we will propose a new method for solving the Dubins traveling salesman problem, which asks for a shortest curvature-constrained path visiting an unordered set of locations in the plane. The problem is similar to the classical Euclidean traveling salesman problem, which asks for a shortest tour through a number of cities. The difference is that there is a curvature constraint that accounts for the minimum turning radius of a vehicle such as an unmanned aerial vehicle. As a result, the problem contains elements of both continuous and discrete geometric optimisation. Many heuristic approaches to the problem involve a discretization of the configuration space, which can lead to a suboptimal solution. We propose a very different approach, which draws inspiration from a mechanical model consisting of a string, pulleys and weights. Applying the calculus of variations, we derive optimality conditions to be satisfied by a locally shortest path. We then combine a gradient descent method with a branch and bound approach for finding a globally shortest path.

17.11. Characterizations of Hölder Error Bounds

Alexander Kruger (Federation University Australia)
15:30 Wed 5 December 2018 – Eng Sth 112
Assoc Prof Alexander Kruger

We continue the study of necessary and sufficient subdifferential conditions for Hölder error bounds, particularly merging the conventional approach with the new advancements proposed recently in Yao, Zheng (2016). We formulate a general lemma collecting the main arguments used in the proofs of the subdifferential sufficient error bound conditions and demonstrate that both linear and Hölder type conditions, conventional and the new advancements, can be obtained as direct consequences of this lemma. Some new estimates for the modulus of Hölder error bounds will be presented.

17.12. A crash course on stability in linear optimization

Marco Antonio López Cerdá (Alicante University)
14:00 Tue 4 December 2018 – Eng Sth 112
Prof Marco Antonio López Cerdá

The talk is intended to provide a kind of biased survey of our more representative results on stability for the linear optimization problem. Qualitative and quantitative approaches are both considered, and some infinite dimensional extensions of the main results are also presented. The material of this talk deals with the lower/upper semicontinuity of the feasible/optimal set mappings, different types of ill-posedness, distance to ill-posedness, Lipschitz properties of these mappings under different types of perturbations, and estimates of the associated Lipschitz bounds.

17.13. Calculus of Kurdyka-Lojasiewicz exponent and its applications to sparse optimisation

Guoyin Li (University of New South Wales)
10:00 Thu 6 December 2018 – Eng Sth 112
Dr Guoyin Li and Dr. Tingkei Pong

Nowadays, optimisation involving data of huge sizes is ubiquitous. Sparse optimisation has emerged as a challenging frontier of modern optimisation because it effectively computes an optimal solution with desired low complexity structure so that a resulting solution can be efficiently stored, implemented and utilised, and is robust to the data inexactness. Among many available methods, first-order methods and their acceleration counterpart are popular methods due to its simplicity and efficiency.

In this talk, we study the Kurdyka-Lojasiewicz (KL) exponent, an important quantity for analysing the convergence rate of first-order methods. Specifically, we show that many convex or nonconvex optimisation models that arise in applications such as sparse recovery have objectives whose KL exponent is 1/2: this indicates that various first-order methods are locally linearly convergent when applied to these models. Our results cover the sparse logistic regression problem and the least squares problem with SCAD or MCP regularization. We achieve this by relating the KL inequality with an error bound concept due to Luo and Tseng (1992), and developing calculus rules for the KL exponent.

17.14. Minimizing Equipment Shutdowns in Oil and Gas Campaign Maintenance

Ryan Loxton (Curtin University)
08:30 Thu 6 December 2018 – Eng Sth 112
Ryan Loxton, Zeinab Seif, Elham Mardaneh

This talk considers the problem of scheduling periodic maintenance tasks in oil and gas plants. The maintenance requirements are defined by a set of maintenance items, which are essentially lists of activities that may require costly equipment shutdowns and isolations to complete. The aim is to minimize shutdowns by synchronizing maintenance items with similar shutdown requirements into short-term maintenance operations called campaigns. Real process plants can involve tens of thousands of maintenance items and thus manually scheduling the campaigns is extremely tedious. We describe a mixed-integer linear programming model for optimally allocating maintenance items to campaigns so that total shutdown cost is minimized. The model incorporates constraints on maintenance deadlines, campaign times, maintenance item suppression and labour hours per campaign. The model has been tested on realistic scenarios for Karratha Gas Plant in Western Australia, which is the main processing plant for the massive North West Shelf oil and gas project.

17.15. Multi-objective Optimal Control Problems in Biomedical Engineering

Helmut Maurer (University of Mnster)
15:30 Tue 4 December 2018 – Eng Sth 112
Yalçin Kaya, Helmut Maurer

In recent years, optimal control theory has been successfully applied to various dynamic models in biomedical engineering. The choice of a single objective functional is a critical issue, since in most cases we have to deal with competing objectives. We consider dynamic systems that may also contain time delays in state and control variables. When two or more objectives are given, we compute the efficient set (Pareto front) using a Tschebycheff type approach. From a practical point of view, it is often compulsory to choose a solution with an additional objective in mind. We sketch a method to carry out the optimization over the efficient set. The multi-objective approach is illustrated on a combination therapy of cancer and a model of optimal vaccination and treatment in an epidemiological SEIR model. The same techniques can be applied to the optimal control of a time-delayed HIV model.

17.16. Nonlinear parametric error bounds

Cuong Nguyen Duy[s] (Federation University Australia)

16:30 Wed 5 December 2018 – Eng Sth 112
Mr Nguyen Duy Cuong

Error bounds play an important role in sensitivity analysis and convergence analysis of computational algorithms. In some cases, it is useful to study general nonlinear error bounds when the conventional linear error bounds do not hold. In this talk, we discuss a nonlinear parametric error bound model for lower semicontinuous functions in metric or Banach/Asplund spaces and provide some basic tools to study this property. As applications, we will show that nonlinear parametric error bounds can be used to establish necessary and/or sufficient conditions for nonlinear (graph) regularity properties of set-valued mappings as well as nonlinear transversality properties of collections of sets.

17.17. Multi-objective mixed integer programming: An exact algorithm

William Erik Pettersson (University of Glasgow)

09:30 Thu 6 December 2018 – Eng Sth 112
Dr William Erik Pettersson

Many heuristic methods have been used to find non-dominated objective vectors to a multi-objective mixed integer program (MOMIP), but no generic exact algorithms yet exist. The first exact algorithm for the bi-objective case was only given in 2016. We present here an exact MOMIP algorithm that generalises to an arbitrary number of objective functions, the first such algorithm. Working with an arbitrary number of objective functions, say k, is particularly difficult as the set of non-dominated objective vectors consists of not necessarily convex polytopes of arbitrary dimension (up to k). Our new algorithm consists of three phases: (1) a collection phase, in which the algorithm finds all polytopes which contain some part of the solution, (2) a convexity phase, which takes all such polytopes and creates a set of non-intersecting convex polytopes which cover the same set, and (3) a dominance phase, which then compares such polytopes to determine where (in the objective space) some polytopes may be either partially or totally dominated.

These three phases are presented so as to encourage further work to improve the performance of the algorithm, and a Python implementation currently in use for computational experiments will soon be made available for use by other researchers.

17.18. Optimal Control on Unbounded Intervals - Fourier-Laguerre Analysis of the Problem

Sabine Pickenhain (Brandenburg Technical University Cottbus)

16:00 Tue 4 December 2018 – Eng Sth 112
Prof Sabine Pickenhain

We consider a class of infinite horizon variational and control problems arising from economics, quantum mechanics and stabilization. Herein we assume that the objective is of regulator type. The problem setting implies uniformly and non-uniformly weighted Sobolev spaces as the state spaces. For this class of problems we use a duality concept of convex analysis to find sufficient optimality conditions. We develop a Fourier-Laguerre method to solve the dual problem in an Hilbert space setting.

17.19. A Derivative-free VU-algorithm for Convex Functions

Chayne Planiden (University of Wollongong)

16:30 Fri 7 December 2018 – Eng Sth 112
Dr Chayne Planiden

The VU-algorithm is a two-step proximal bundle method that minimizes nonsmooth functions in a superlinearly convergent manner. It takes advantage of the fact that the space can be separated into a V-space, on which the objective function is nonsmooth, and the orthogonal U-space, on which the function behaves smoothly. The proximal bundle method is used to take a minimizing step parallel to the V-space, then a quasi-Newton step can be taken parallel to the U-space, thus speeding up convergence.

This work is our effort to create a derivative-free version of the VU-algorithm. Both the U-step and the V-step rely on availability of gradients and Hessians; we replace them with suitable approximations via the simplex gradient and the minimum Frobenius norm. A novel tilt-correct step is introduced, in order to deal with the first-order error in the proximal step. Convergence is proved and numerical results are presented.

17.20. Electrical impedance tomography for unknown domains

Janosch Rieger (Monash University)

15:00 Fri 7 December 2018 – Eng Sth 112
Dr Janosch Rieger, Prof Dr Bastian Harrach

Electrical impedance tomography is a noninvasive imaging technique, which recovers the internal structure of an object from the impact of externally applied electrical currents on its electrical potential. As this problem is strongly ill-posed, we do not attempt to solve it in its original form, but we compute the convex source support introduced by Kusiak and Sylvester, which is a convex set carrying useful information on the existence and the approximate location of inhomogeneities in the imaged body.

In a first attempt, we computed the convex source support from a single measurement under the assumption that the exact shape of the imaged body is known and that the electrical potential can be measured on the entire boundary of the body. In this talk, I will present a local version of this approach, in which we drop these assumptions almost entirely, which is an important step towards real-world applicability of the method. As before, we compute the convex source support as the solution of a shape optimisation problem, which we project onto a suitable space of convex polytopes.

17.21. Reducing post-surgery recovery bed occupancy through an analytical prediction model

Belinda Spratt (Queensland University of Technology)

09:00 Thu 6 December 2018 – Eng Sth 112

Dr Belinda Spratt, Prof Erhan Kozan

Operations Research approaches to surgical scheduling are becoming increasingly popular in both theory and practice. Often these models neglect stochasticity in order to reduce the computational complexity of the problem. In this talk, historical data is used to examine the occupancy of post-surgery recovery spaces as a function of the initial surgical case sequence. We show that the number of patients in the recovery space is well modelled by a Poisson binomial random variable. A mixed integer nonlinear programming model for the surgical case sequencing problem is presented that reduces the maximum expected occupancy in post-surgery recovery spaces. Given the complexity of the problem, Simulated Annealing is used to produce good solutions in short amounts of computational time. Computational experiments are performed to compare the methodology here to a full year of historical data. The solution techniques presented are able to reduce maximum expected recovery occupancy by 18% on average. This reduction alleviates a large amount of stress on staff in the post-surgery recovery spaces and improves the quality of care provided to patients.

18. Probability Theory and Stochastic Processes

18.1. The asymptotics of the large deviation probabilities in the multivariate boundary crossing problem

Kostya Borovkov (The University of Melbourne)

15:30 Tue 4 December 2018 – IW B18

Prof Kostya Borovkov

For a multivariate random walk with i.i.d. jumps satisfying the Cramér moment condition and having mean vector with at least one negative component, we derive the exact asymptotics of the probability of ever hitting the positive orthant that is being translated to infinity along a fixed vector with positive components. This setup is motivated by a multivariate ruin problem. Our approach combines advanced large deviation techniques developed by A. Borovkov and A. Mogulskii with new auxiliary constructions, which enable us to extend their results on hitting remote sets with smooth boundaries to the case of boundaries with a "corner" at the "most probable hitting point". We also discuss how our results can be extended to the case of more general target sets and to continuous time Lévy processes. [Joint work with Y. Pan.]

18.2. Markov-modulated random walk search strategies for animal foraging

Lachlan James Bridges[s] (The University of Adelaide)

16:30 Tue 4 December 2018 – IW B18

Mr Lachlan James Bridges

Due to natural selection, it is hypothesised that a foraging animal should utilise a search strategy that is close to the theoretical optimal strategy. Thus, determining the theoretical optimal search strategy for a foraging animal is of practical use in the fields of ecology and conservation biology. Early animal foraging models found that a Lévy walk optimised the search efficiency, and empirical evidence for Lévy walk strategies was found for a number of different animal species. However, more recent results have found that various intermittent search strategies can outperform a standard Lévy walk. We will generalise these intermittent strategies in one dimension using Markov-modulated random walks.

18.3. Long-term concentration of measure and the cut-off phenomenon

Graham Brightwell (London School of Economics)

17:30 Wed 5 December 2018 – IW B18

Prof Graham Brightwell

We present concentration of measure inequalities for Markov chains possessing a contractive coupling. We also illustrate the use of our inequalities to show that certain chains exhibit the cut-off phenomenon: the total variation distance between the distributon of the chain at time t and the stationary distribution drops from 1 to 0 over a short time interval. (Joint work with Andrew Barbour and Malwina Luczak.)

18.4. Sampling via Regenerative Chain Monte Carlo

Yi-Lung Chen[s] (University of New South Wales)

09:30 Thu 6 December 2018 – IW B18

Mx Yi-Lung Chen

MCMC techniques are popular solutions to approximate quantities that are difficult to compute exactly. Unfortunately, despite its wide use across various fields, most Markov chain samplers lack theoretically justified methods to analyze their output. That is to say, most MCMC samplers lack a) a consistent variance estimator for a given ergodic average; and b) an estimator for the total variation distance between the distribution of a draw from the Markov chain sampler and its target distribution.

In this study, we take a Gibbs sampler for the posterior distribution of the Bayesian Lasso as an example, and demonstrate how one can systematically address a) and b) by exploiting the underlying regenerative structure of the simulation output. Roughly speaking, regenerative structure are the times when a stochastic process (in this case a Markov chain) scholastically 'restarts' itself. Intuitively, if a Markov chain frequently 'restarts' itself, it should have a fast convergence hence, one may examine the convergence of a Markov chain sampler by identifying these events. Note that however a drawback of the proposed methodology is that it primarily applies to models, which while intractable, exhibit a lot of structure and permit analytical approximations.

18.5. Statistical Uncertainty in Decision Making

Samuel Cohen (The University of Oxford)

14:00 Fri 7 December 2018 – IW B18

Assoc Prof Samuel Cohen

Much work in mathematical finance has revolved around how to incorporate an understanding of 'Knightian' uncertainty in valuations. Largely, this has been done with little attention to statistics. In this talk we shall consider how uncertainty in estimation can be explicitly and consistently incorporated in valuation of decisions, using the theory of nonlinear expectations.

18.6. Branching ruin number

Andrea Collevecchio (Monash University)

16:00 Tue 4 December 2018 – IW B18
Dr Andrea Collevecchio

The branching-ruin number of a tree, which describes its asymptotic growth and geometry, can be seen as a polynomial version of the branching number. This quantity was defined by Collevecchio, Kious and Sidoravicius (2018) in order to understand the phase transitions of the once-reinforced random walk (ORRW) on trees. Strikingly, this number was proved to be equal to the critical parameter of the ORRW on trees. In this talk, we present new results on the link between the branching-ruin number and the criticality of random processes on trees. First, we study random walks on random conductances on trees, when the conductances have an heavy tail at zero, parametrized by some $p > 1$, where $1/p$ is the exponent of the tail. We prove a phase transition recurrence/transience with respect to p and identify the critical parameter to be equal to the branching-ruin number of the tree. Second, we study a multi-excited random walk on trees where each vertex has M cookies and each cookie has an infinite strength towards the root. Here again, we prove a phase transition recurrence/transience and identify the critical number of cookies to be equal to the branching-ruin number of the tree, minus 1. This result extends a conjecture of Volkov (2003). Besides, we study a generalized version of this process and generalize results of Basdevant and Singh (2009). Based on joint work with Cong Bang Huynh and Daniel Kious

18.7. Directed walk on a randomly oriented lattice

Kais Hamza (Monash University)

14:00 Tue 4 December 2018 – IW B18
Assoc Prof Kais Hamza

Consider a randomly-oriented Manhattan lattice, where every line in $\mathbb{Z}^2$ is assigned, once and for all, a random direction by flipping independent fair coins. At each step, the particle moves to the nearest site along the diagonal in the direction of the line orientations at the current site. We prove that the walk thus defined localizes on two vertices at all large times, almost surely. We also provide estimates for the tail of the length of paths. In particular, we show that the probability of the path to be larger than n decays sub-exponentially in n.

Joint work with Andrea Collevecchio and Laurent Tournier.

18.8. Central limit theorems for dynamic random graph models

Liam Hodgkinson[s] (University of Queensland)

17:00 Wed 5 December 2018 – IW B18
Mr Liam Hodgkinson

Perhaps the most common representation of a complex network is that of a random graph of large size. There is a significant body of work devoted to analysing large dense random graphs, usually through their homomorphism densities, that is, the proportion of appearances of a chosen shape (triangles, for example). Unfortunately, there has been less success in analysing dynamic (time-evolving) random graph models. In this talk, I will consider a class of discrete-time Markov dynamic random graph models evolving as inhomogeneous random graphs with edge probabilities depending on the previous state. Under suitable assumptions, I will show how one can prove central limit theorems for their homomorphism densities.

18.9. The power of QED-like scaling for many-server queues in a random environment

Hermanus Marinus Jansen (The University of Queensland)

14:30 Fri 7 December 2018 – IW B18
Mr Hermanus Marinus Jansen

We consider a many-server queue whose parameters are modulated by an independent right-continuous stochastic process (called the background process). This means that the arrival rate and the server speed both depend on the state of the background process. We are interested in diffusion limits for this type of queue and especially in the influence of the background process on the limit. We show that a diffusion limit exists under quite general scaling conditions. Both the scaling and the limit depend on the second order behaviour of the background process in this case. However, generalising the QED or Halfin-Whitt scaling to modulated queues, we see that in this special case neither the scaling nor the diffusion limit depends on the second order behaviour of the background process. This suggest that a nave QED-like scaling is actually a good way to deal with a random environment, in that the system becomes insensitive for fluctuations of the background process.

18.10. Algorithms for Markovian Regime Switching (MRS) models for electricity prices

Angus Hamilton Lewis[s] (The University of Adelaide)

09:00 Fri 7 December 2018 – IW B18
Mr Angus Hamilton Lewis

A popular model for electricity prices is the independent-regime MRS model whereby multiple independent AR(1) processes are interweaved by a Markov Chain. These models can be viewed as an extension of Hidden Markov models (HMMs) or regime-switching time series. We can think of these models as multiple independent AR(1) processes evolving, but at each time we only observe one of them, and which process is observed is determined by a (hidden) Markov chain. In this talk, we extend the classical forward-backward algorithm for HMMs to this model, which allows us to evaluate the likelihood, implement the EM algorithm and find the MLEs for these models. These results are presented in the context of electricity price modelling.

18.11. Perfect Sampling for Gibbs Point Processes using Partial Rejection Sampling

Sarat Babu Moka (The University of Queensland)

13:30 Fri 7 December 2018 – IW B18

Dr Sarat Babu Moka

We present a perfect sampling algorithm for Gibbs point processes, based on the partial rejection sampling of Guo et al. (2017). We focus on pairwise interaction processes and penetrable spheres mixed models; examples include hard-core, Strauss and area-interaction processes. Given that the interaction range of the target process is r, the proposed algorithm has $O(\log(1/r))$ running time complexity for generating a perfect sample, provided that the density of the points is not too high.

18.12. Correlated time-changed Lévy processes

Kihun Nam (Monash University)

14:30 Tue 4 December 2018 – IW B18

Dr. Hasan Fallahgoul and Dr Kihun Nam

Time-changed Lévy processes, which consist of a Lévy process that runs on a stochastic time, can effectively capture main empirical regularities of asset returns such as jumps, stochastic volatility, and leverage. However, neither their transitional density nor characteristic function is available in closed-form when the Lévy process and time-change are not independent. For a given solution to a linear parabolic partial differential equation, we derive a closed-form expression for the transitional density, moment generating function, and characteristic function of the time-changed Lévy processes, when the Lévy and time-change process are correlated. Our approach can be applied to virtually all models in the option pricing literature. This is a joint work with Dr. Hasan Fallahgoul.

18.13. Statistics and filter transforms of Gegenbauer-type processes

Andriy Olenko (La Trobe University)

09:30 Fri 7 December 2018 – IW B18

Dr Andriy Olenko

General filter transforms of stochastic processes are studied. As a particular case these transformations include wavelet transformations. They are applied to Gegenbauer-type seasonal long-memory processes with spectral singularities outside the origin. Estimates for the singularity location and long-memory parameters are proposed. Their almost surely convergence to the true values of parameters is proved. Solutions of the estimation equations are studied and adjusted statistics are proposes. Numerical results are presented to confirm the theoretical findings.

The talk is based on joint results with H. Alomari (La Trobe University, Australia), A. Ayache and M. Fradon (University of Lille, France).

18.14. A fluid flow model with RAP components

Oscar Peralta[s] (Technical University of Denmark)

16:30 Wed 5 December 2018 – IW B18

N. Bean, G. Nguyen, B. F. Nielsen, and O. Peralta

The class of matrix-exponential distributions (ME) constitutes an algebraic generalisation of the class of phase-type distributions (PH). Similarly, the Rational arrival process (RAP) generalises the Markovian arrival process (MAP) in an algebraic sense, however, their probabilistic constructions are considerably different. For the MAP, the driving process is a Markov jump process with finite state space, while it is a piecewise deterministic Markov process (PDMP) for the RAP. This approach has been further studied in the literature to define a class of quasi-birth and death processes (QBD) with RAP components, an algebraic generalisation of the QBD. In this talk we provide a generalisation of the fluid flow model in a similar direction. More specifically, we construct a Markov additive process with an underlying PDMP whose characteristics are similar to the one associated to the RAP, which we call Fluid RAP (FRAP). We analyse some first passage probabilities of the FRAP, which are shown to be algebraic extensions of classic results for the fluid flow model. We conclude by discussing the similarities and differences between the techniques that were needed to study the FRAP and the ones commonly used for fluid flow models in the literature.

18.15. Why is Kemeny's constant a constant?

Peter Taylor (The University of Melbourne)

10:00 Thu 6 December 2018 – IW B18

Peter Taylor, with Dario Bini, Jeff Hunter, Guy Latouche and Beatrice Meini

In their 1960 book on finite Markov chains, Kemeny and Snell established that a certain sum is invariant. The value of this sum has become known as *Kemeny's constant*. Various proofs for the invariance have been given over time, some more technical than others. We shall first give a simple algebraic proof and then follow it up with a probabilistic proof that gives physical insight into what is going on. The result extends without a hitch to continuous-time Markov chains on a finite state space.

For Markov chains with denumerably infinite state space, the constant may be infinite and even if it is finite, there is no guarantee that the physical argument will hold. We shall show that the physical interpretation does go through for the special case of a birth-and-death process with a finite value of Kemeny's constant.

18.16. On asymptotic behavior of weighted functionals of long-range dependent random fields on spheres

Volodymyr Vaskovych[s] (La Trobe University)

09:00 Thu 6 December 2018 – IW B18

Mr Volodymyr Vaskovych

We study long-range dependent random fields defined on the sphere. The asymptotic behavior of the least-squares estimator in the regression model with the error given by such fields is investigated. The least-squares estimator in this model is a weighted functional of random fields with long-range dependence. It is known that in this scenario the limits can be non-Gaussian. We obtain the limiting distribution and the rate of convergence for these functionals. The results were obtained under rather general assumptions on the spectral densities of the random fields. Some simulation studies are presented to support theoretical findings. This is a joint work with V. Anh (QUT), and A. Olenko (La Trobe University).

[1]V. Anh, A. Olenko, V. Vaskovych, On LSE in regression model for long-range dependent random fields on spheres, submitted.

18.17. Stochastic networks with selfish routing and information feedback

Ilze Ziedins (The University of Auckland)

15:30 Wed 5 December 2018 – IW B18

Assoc Prof Ilze Ziedins

There are many networks where individuals choose which route to take to minimize their own delay (selfish routing), and in some cases may even choose not to enter the network at all (balking or reneging). We will compare and contrast behaviour in two different kinds of network — parallel queues, and linear networks with feedback. In the former, individuals choose which queue to enter, and probabilistic and state-dependent routing can give very different behaviours. In the latter, feedback operates to deter users from entering the system as delays increase. The linear system also has a rate control on entries to the system, and the interaction between this and the state-dependent arrival rate are of particular interest. Both models are idealized versions of traffic models — the parallel queues model private vs. public transport routes, the linear network models a motorway with ramp metering.

19. Representation Theory

19.1. The Selberg integral and Macdonald polynomials

Seamus Albion[s] (The University of Queensland)

16:30 Tue 4 December 2018 – BS Sth 2052

Mr Seamus Albion

In 1944, Atle Selberg discovered a remarkable generalisation of Euler's beta integral. Now known as the Selberg integral, it has since played an important role in analytic number theory, random matrix theory, and conformal field theory. In their recent proof of the AGT conjecture for $SU(2)$, Alba, Fateev, Litvinov, and Tarnopolsky (2011) required a Selberg integral over a pair of Jack polynomials. In this talk we will discuss how to obtain the integral of Alba et al. using Macdonald polynomial theory as well as some further generalisations for $SU(n)$.

19.2. Recollement of perverse sheaves on real hyperplane arrangements

Asilata Bapat (Australian National University)

13:30 Fri 7 December 2018 – BS Sth 2052

Dr Asilata Bapat

A hyperplane arrangement gives a stratification on a vector space, whose topology is encoded in an associated abelian category of perverse sheaves. The interplay between the perverse sheaves and their restrictions to the open and closed strata is known as recollement. The category of perverse sheaves associated to a hyperplane arrangement has an alternate algebraic description due to Kapranov and Schechtman. In this talk, I will describe recollement in terms of this algebraic interpretation. I will also briefly discuss the special case of finite Coxeter arrangements, building on work by Martin Weissman.

19.3. Quantum polynomial functors

Valentin Buciumas (The University of Queensland)

14:30 Fri 7 December 2018 – BS Sth 2052

Dr Valentin Buciumas

The classical polynomial functors of Friedlander and Suslin give a useful interpretation of the polynomial representation theory of the general linear group. I will present a quantum generalization of the category of polynomial functors and explain what is needed to generalize two properties of polynomial functors: stability and composition. Time permitting, I will talk about a quantum 'type BCD' generalization of polynomial functors. This is joint work with Hankyung Ko.

19.4. Finite dimensional representations of orthosymplectic supergroups

Michael Ehrig (The University of Sydney)

09:00 Thu 6 December 2018 – BS Sth 2052

Dr Michael Ehrig

In the talk I want to review how to obtain a description of the category of finite dimensional representations for the orthosymplectic supergroup via a graded version of the Deligne category and associated Brauer algebra. This is joint with Catharina Stroppel.

19.5. p-groups related to exceptional Chevalley groups

Saul Freedman[s] (The University of Western Australia)

16:30 Wed 5 December 2018 – BS Sth 2052

Mr Saul D. Freedman

It is well-known that given any finite group, we can use standard representation theory to represent the group on some finite vector space, i.e., on some elementary abelian p-group. In 1978, Bryant and Kovács proved an analogue of this fact for p-groups that are not elementary abelian. Namely, if H is a subgroup of the general linear group $\mathrm{GL}(d,p)$, with $d > 1$, then there exists a p-group P such that $\mathrm{Aut}(P)$ induces H on the Frattini quotient of P. However, it is not known in general when we can choose P to be small, in terms of its exponent-p class, exponent, nilpotency class and order. In this talk, we consider the representation theory of the (finite) simply connected versions of the exceptional Chevalley groups, and their overgroups in corresponding general linear groups, in order to construct small related p-groups.

19.6. The Product Monomial Crystal

Joel Gibson[s] (The University of Sydney)

17:00 Wed 5 December 2018 – BS Sth 2052

Joel Gibson

The product monomial crystal is the non-generic case of Nakajima's tensor product crystals for a semisimple Lie algebra. In this talk I present a Demazure-type character formula for these crystals. In type A, this character formula shows that the product monomial crystal corresponds to the generalised Schur module, a family of GL_n modules which generalise irreducibles and skew-Schur modules.

19.7. A Soergel-like category for complex reflection groups of rank one

Thomas Gobet (The University of Sydney)

14:00 Fri 7 December 2018 – BS Sth 2052
Dr Thomas Gobet

We introduce analogues of Soergel bimodules for complex reflection groups of rank one. We describe the indecomposable objects in the category and give a presentation by generators and relations of its split Grothendieck ring. This ring turns out to be an extension of the Hecke algebra of the reflection group, and is generically semisimple (when defined over the complex numbers).

This is joint work with Anne-Laure Thiel.

19.8. Puzzles for restricting Schubert classes to the symplectic Grassmannian

Iva Halacheva (The University of Melbourne)

14:30 Tue 4 December 2018 – BS Sth 2052
Ms Iva Halacheva

The Grassmannian Gr(k,V) of k-planes in a symplectic vector space V contains the subscheme SpGr(k,V) of k-planes which are self-orthogonal. Using the pullback along the inclusion map, a natural question is to consider how the image of a Schubert class of Gr(k,V) expands into Schubert classes of SpGr(k,V). Coskun gave an algorithm for positively computing this in cohomology. We use puzzles and techniques from integrable systems to generalize this result to equivariant cohomology and K-theory.

19.9. Complementary symmetry for Slodowy varieties

Anthony Henderson (The University of Sydney)

17:30 Wed 5 December 2018 – BS Sth 2052
Prof Anthony Henderson

Let λ and μ be two partitions with the first dominating the second. Various quantities $f(\lambda,\mu)$ attached to such a pair obey a rule of 'complementary symmetry': if λ^c and μ^c denote the partitions obtained by taking the diagrams complementary to those of λ and μ in a fixed rectangle and rotating them 180 degrees, then $f(\lambda^c,\mu^c) = f(\lambda,\mu)$. For example, this holds for the Kostka number $K_{\lambda,\mu}$. I will discuss a geometric result along these lines, stating that Slodowy varieties for the general linear group obey this complementary symmetry, which has recently been generalized to other classical groups by Yiqiang Li.

19.10. Braid group action on triangulated categories

Edmund Xian Chen Heng[s] (Australian National University)

15:30 Wed 5 December 2018 – BS Sth 2052
Mr Edmund Xian Chen Heng

It is known that braid groups act on the curves of punctured disk and through this, Thurston gave a classification theory of braid groups by looking at the dynamics of this action. By a paper written by Khovanov and Seidel, these curves on the punctured disk can be viewed as objects in the homotopy category of bounded chain complexes of projective modules over the zig-zag algebra. Furthermore, the braid group acts on it just as how it acts on curves. In this talk I will describe the recipe to relate the geometrical objects (curves) to the algebraic objects (complexes) and how this gives us an action on a triangulated category.

19.11. Topology of representation stacks

Masoud Kamgarpour (University of Queensland)

14:00 Tue 4 December 2018 – BS Sth 2052
Dr Masoud Kamgarpour

I will talk about computing how to compute the Euler characteristic of the stack of finite dimensional representations of the fundamental group of Riemann surface. This is joint work with David Baraglia.

19.12. Inner products on graded Specht modules

Alexander Ferdinand Kerschl[s] (The University of Sydney)

15:30 Tue 4 December 2018 – BS Sth 2052
Mr Alexander Ferdinand Kerschl

A cellular basis of an algebra gives a natural way of constructing "cell modules" for the algebra, that come equipped with an associative inner product. Quotiening out by the radical of the inner products on the cell modules gives a complete set of pairwise non-isomorphic simple modules for the algebra. Webster introduced a diagrammatic algebra, the diagramatic Cherednik algebra, that contains the much studied quiver Hecke algebra of type A as a sub-algebra. Building on Webster's work, Bowman constructed several graded cellular bases for the quiver Hecke algebras using the diagrams that depend on a loading θ. We use Webster's diagram calculus and the theory of cellular algebras to compute inner products of particular basis elements in corresponding cell modules, the graded Specht modules. As an application we classify the simple modules for the quiver Hecke algebras in terms of the loading. We also obtain results on graded dimensions of the simple modules of these algebras.

19.13. The p-Part of the Order of an Almost Simple Group of Lie Type

Marvin Krings[s] (RWTH Aachen University)

16:00 Tue 4 December 2018 – BS Sth 2052
S.P. Glasby, Marvin Krings, Alice C. Niemeyer

Primitive permutation groups are fundamental building blocks in the sense that every finite permutation group can be built from the primitive ones. Apart from the alternating group A_n and the symmetric group S_n of degree n, the primitive subgroups G of S_n are small. For example, in 1980 Praeger and Saxl showed that $|G| \leq 4^n$, which is much smaller than $\frac{n!}{2}$. Since this time, powerful results such as the O'Nan-Scott Theorem, which classifies the primitive permutation groups, and the Classification of the Finite Simple Groups, have become available.

We will bound the p-part $|G|_p$ of $|G|$ for some prime p. This is the largest p-power $p^{\nu_p(G)}$ that divides $|G|$. The bound $|G| \leq 4^n$ implies $\nu_p(G) \leq n \log_p(4)$. We prove the stronger bound $\nu_p(G) \leq \frac{2\sqrt{n}}{(p-1)} + 1$ (with five exceptions). For several cases, we even obtain a bound that is logarithmic in n.

Our proof uses the O'Nan-Scott theorem to reduce to simple groups. The hardest case, and the one I will discuss, is when the simple group is of Lie type.

19.14. A product formula for certain coefficients of Macdonald polynomials

Yusra Naqvi (The University of Sydney)

08:30 Thu 6 December 2018 – BS Sth 2052

Dr Yusra Naqvi

Macdonald polynomials generalise several classical families of symmetric polynomials, including Schur polynomials, Jack polynomials and Hall-Littlewood polynomials. In 1989, Richard Stanley conjectured that certain coefficients obtained when a product of Jack polynomials is expanded in the Jack basis can be expressed as a product of weighted hooks of Young diagrams. In this talk, I will outline a proof of a special case of this conjecture and its extension to the case of Macdonald polynomials.

19.15. An orbit model for the spectra of nilpotent Gelfand pairs

Anna Romanov (The University of Sydney)

10:00 Thu 6 December 2018 – BS Sth 2052

Dr Anna Romanov

Let N be a connected and simply connected nilpotent Lie group, and let K be a subgroup of the automorphism group of N. We say that the pair (K,N) is a nilpotent Gelfand pair if the set of integrable K-invariant functions on N forms an abelian algebra under convolution. In 2008, Benson and Racliff established a one-to-one correspondence between the set of bounded K-spherical functions for such a Gelfand pair and a set of K-orbits in the dual of the Lie algebra of N. The sets on either side of this bijection can be given the structure of topological spaces, and Benson and Ratcliff conjectured that this set-theoretic correspondence is actually topological. In this talk, we will describe Benson-Racliff's construction and provide a proof of their conjecture for a certain class of nilpotent Gelfand pairs, establishing a geometric model for the spectrum of such pairs. This is joint work with H. Friedlander, W. Grodzicki, W. Johnson, G. Ratcliff, B. Strasser, and B. Wessel.

19.16. Crystal structures for symmetric Grothendieck polynomials

Travis Scrimshaw (The University of Queensland)

09:30 Thu 6 December 2018 – BS Sth 2052

Dr Travis Scrimshaw

Kashiwara's theory of crystal bases allows one to study the representation theory of (Drinfel'd-Jimbo) quantum groups using combinatorics. It has a received significant attention since its inception in the 1990s and has been connected to numerous fields of mathematics. One particular example of crystals is to semistandard Young tableaux for type A_n irreducible representations, which has given a representation theoretic explanation of many now classical combinatorial constructions.

Another well-studied object is the Grassmannian, the set of k-dimensional subspaces in n-dimensional space. Here, the Schubert classes in the cohomology are given by certain Schur functions, which are the characters of the type A_n irreducible representations. For the K-theory of the Grassmannian, the Schubert classes correspond to symmetric Grothendieck polynomials. In terms of combinatorics, they are known to be a sum over set-valued tableaux and decompose positively (up to a sign based on the degree) in terms of Schur functions.

In this talk, we will show that set-valued tableaux have a type A_n crystal structure, which recovers the Schur function decomposition. We will also discuss a potential K-theoretic extension of crystals. This is joint work with Cara Monical and Oliver Pechenik.

19.17. Two models of equivariant elliptic cohomology

Matthew James Spong[s] (The University of Melbourne)

16:00 Wed 5 December 2018 – BS Sth 2052

Mx Matthew James Spong

In 1994, Grojnowski gave a construction of an equivariant elliptic cohomology theory associated to an elliptic curve over the complex numbers. This has seen useful applications in both algebraic topology and geometric representation theory, however the construction is somewhat ad hoc and there has been significant interest in the question of its geometric interpretation.

We show that there are two global models for Grojnowski's theory, which shed light on its geometric meaning. One model is constructed as the loop group-equivariant K-theory of a free loop space. This is a slight modification of a construction which was given by Kitchloo in 2014, and our main contribution here is to determine its precise relationship with Grojnowski's theory. The second model is constructed as the Borel-equivariant cohomology of a double free loop space. This is equivariant for the action of the gauge group of the trivial principal bundle on an orientable genus 1 surface. This largely follows a proposal of Rezk from 2016.

20. Public Lecture

20.1. The shape of our planet Earth: a mathematical challenge!

Étienne Ghys (École normale supérieure de Lyon)

19:00 Wed 5 December 2018 – Braggs
Prof Étienne Ghys

Our planet Earth is rotating. The centrifugal force produces some equatorial bulge so that the Earth is not exactly spherical. The mathematical question of the determination of the shape of a rotating body has been central in the development of mathematics for several centuries. Newton was the first to get an estimate of the flattening of the Earth by a purely theoretical reasoning, "without having to get out of his home", as Voltaire wrote. I will discuss historical developments, like for instance the surprising discovery by Poincaré of rotating bodies having the shape of a pear! This topic is indeed a wonderful example of the interaction between pure and applied science. Even though the question has been studied by the greatest mathematicians since 350 years and many discoveries have been made, many important questions still remain open.

List of Registrants

Current as of Sun 2 Dec 2018

Mr Remy Alexander Adderton[s]	The Australian National University
Dr Zahra Afsar	The University of Sydney
Mrs Shaymaa Shawkat Kadhim Al-shakarchi[s]	University of New South Wales
Mr Seamus Albion[s]	The University of Queensland
Dr Amie Albrecht	University of South Australia
Mrs Faezeh Alizadeh[s]	Shahid Rajaee Teacher Training University
Assoc Prof Tansu Alpcan	The University of Melbourne
Dr Ambily Ambattu Asokan	Cochin University of Science and Technology
Miss Becky Armstrong[s]	The University of Sydney
Dr Romina Melisa Arroyo	University of Queensland
Miss Ayreena Bakhtawar[s]	La Trobe University
Dr John Banks	The University of Melbourne
Dr Asilata Bapat	Australian National University
Dr David Baraglia	The University of Adelaide
Mr Fawwaz Batayneh[s]	University of Queensland
Dr Nicholas Beaton	The University of Melbourne
Mx Kimberly Becker[s]	The University of Adelaide
Mr Theo Bendit[s]	The University of Newcastle
Prof Renato Ghini Bettiol	City University of New York
Mr Alex Bishop[s]	University of Technology, Sydney
Mr Matteo Bordignon[s]	University of New South Wales Canberra
Prof Kostya Borovkov	The University of Melbourne
Mr Philip Bos[s]	La Trobe University
Assoc Prof Murk Bottema	Flinders University
Ms Elizabeth Bradford[s]	University of South Australia
Prof Florian Breuer	The University of Newcastle
Mr Lachlan James Bridges[s]	The University of Adelaide
Prof Graham Brightwell	London School of Economics
Prof Philip Broadbridge	La Trobe University
Mr David Leonard Brook[s]	The University of Adelaide
Dr Arnaud Brothier	UNSW Sydney
Dr Nathan Brownlowe	The University of Sydney
Dr Valentin Buciumas	The University of Queensland
Dr Anh Bui	Macquarie University
Ms Thi Hoa Bui[s]	Federation University Australia
Dr Judith Bunder	The University of Adelaide
Assoc Prof Regina Burachik	University of South Australia
Prof Benjamin Burton	University of Queensland
Dr David Butler	The University of Adelaide
Mr Timothy Peter Bywaters[s]	The University of Sydney
Dr Grant Cairns	La Trobe University
Miss Bethany Caldwell[s]	University of South Australia
Dr Alexander Campbell	Macquarie University
Prof Pietro Cerone	La Trobe University
Mr Anupam Chaudhuri[s]	Monash University
Dr Mike Chen	The University of Adelaide
Mx Yi-Lung Chen[s]	University of New South Wales
Mr Hanz Martin Cheng[s]	Monash University
Dr Xing Cheng	Monash University

Prof Jeongwhan Choi	Korea University
Dr Renu Choudhary	Auckland University of Technology
Dr Kieran Clancy	Flinders University
Dr Julie Clutterbuck	Monash University
Assoc Prof Samuel Cohen	The University of Oxford
Dr Andrea Collevecchio	Monash University
Dr Julia Collins	Australian Mathematical Sciences Institute
Mr Don Coutts	Canberra Institute of Technology
Dr Peter Cudmore	The University of Melbourne
Ms Michaela Cully-Hugill[s]	University of New South Wales Canberra
Mr Zhou Dai[s]	University of South Australia
Dr Zsuzsanna Dancso	The University of Sydney
Dr Minh N. Dao	The University of Newcastle
Prof Jan De Gier	The University of Melbourne
Mr Raveen Daminda de Silva[s]	University of New South Wales
Dr Owen Dearricott	The University of Melbourne
Dr Anand Rajendra Deopurkar	Australian National University
Assoc Prof Josef Dick	University of New South Wales
Mr Neil Kristofer Dizon[s]	The University of Newcastle
Mr Hong Chuong Doan[s]	Macquarie University
Dr Roland Dodd	Central Queensland University
Prof Diane Donovan	The University of Queensland
Mr Kumbu Dorji[s]	University of New England
Dr Ian Doust	University of New South Wales
Prof Silvestru Sever Dragomir	Victoria University
Assoc Prof Jerome Droniou	Monash University
Prof Xuan Duong	Macquarie University
Dr James East	Western Sydney University
Prof Michael Eastwood	The University of Adelaide
Prof Andrew Craig Eberhard	Royal Melbourne Institute of Technology
Dr Michael Ehrig	The University of Sydney
Mr Andrei Ermakov[s]	University of Southern Queensland
Mr Nicholas Fewster-Young	University of South Australia
Prof Jerzy Filar	The University of Queensland
Mr Keegan Flood[s]	The University of Auckland
Dr Chi-Kwong Fok	The University of Adelaide
Prof Peter Forrester	The University of Melbourne
Miss Kelli Francis-Staite[s]	The University of Oxford
Mr Saul Freedman[s]	The University of Western Australia
Prof Wilhelm Freire	Universidade Federal de Juiz de Fora
Prof Vladimir Gaitsgory	Macquarie University
Mrs Ajini Galapitage[s]	University of South Australia
Mr Anthony John Gallo[s]	The University of Adelaide
Assoc Prof Timothy Garoni	Monash University
Dr Alejandra Garrido	The University of Newcastle
Dr David Gepner	The University of Melbourne
Prof Étienne Ghys	École Normale supérieure de Lyon
Mr Joel Gibson[s]	The University of Sydney
Prof Michael Giudici	The University of Western Australia
Dr Stephen Glasby	The University of Western Australia
Dr Wolfgang Globke	University of Vienna
Dr David G Glynn	Flinders University
Dr Thomas Gobet	The University of Sydney
Mr Yoong Kuan Goh[s]	University of Technology, Sydney
Dr Cecilia Gonzalez-Tokman	The University of Queensland
Prof Joseph Grotowski	The University of Queensland
Dr Xing Gu	AMSI/University of Melbourne
Dr Chen Guanheng	The University of Adelaide
Dr Hailong Guo	The University of Melbourne

Prof William Guo	Central Queensland University
Ms Iva Halacheva	The University of Melbourne
Mr Michael Alexander Hallam[s]	The University of Adelaide
Ms Sophie Ham[s]	Monash University
Assoc Prof Kais Hamza	Monash University
Assoc Prof Fei Han	National University of Singapore
Dr David Hartley	University of Wollongong
Dr Michael Haythorpe	Flinders University
Prof Roozbeh Hazrat	Western Sydney University
Dr Jian He	Monash University
Prof Markus Hegland	Australian National University
Dr Pedram Hekmati	The University of Auckland
Prof Anthony Henderson	The University of Sydney
Mr Edmund Xian Chen Heng[s]	Australian National University
Dr Peter Hochs	The University of Adelaide
Mr Liam Hodgkinson[s]	University of Queensland
Dr Algy Howe	Australian National University
Prof Phil Howlett	University of South Australia
Dr Melissa Humphries	The University of Adelaide
Dr Mumtaz Hussain	La Trobe University
Dr Deborah Jackson	La Trobe University
Miss Sarah James[s]	The University of Adelaide
Dr Simon James	Deakin University
Mr Hermanus Marinus Jansen	The University of Queensland
Dr Iwan Jensen	Flinders University
Mr Daniel John[s]	The University of Adelaide
Prof Nalini Joshi	The University of Sydney
Dr Zlatko Jovanoski	University of New South Wales Canberra
Prof Kenji Kajiwara	Kyushu University
Dr Masoud Kamgarpour	University of Queensland
Dr Sevvandi Priyanvada Kandanaarachchi	Monash University
Dr Yalçin Kaya	University of South Australia
Ms Carolyn Kennett	Macquarie University
Mr Alexander Ferdinand Kerschl[s]	The University of Sydney
Dr Tran Vu Khanh	University of Wollongong
Dr Carlisle King	The University of Western Australia
Assoc Prof Deborah King	The University of Melbourne
Mr David Kirszenblat[s]	The University of Melbourne
Miss Maria Kleshnina[s]	The University of Queensland
Dr Krzysztof Krakowski	Cardinal Stefan Wyszynski University in Warsaw
Assoc Prof Jonathan Kress	University of New South Wales
Mr Marvin Krings[s]	RWTH Aachen University
Prof Manjunath Krishnapur	Indian Institute of Science Bangalore
Assoc Prof Alexander Kruger	Federation University Australia
Dr Neeraj Kumar[s]	IIT Bombay
Dr Kwok-Kun Kwong	The University of Sydney
Dr Ramiro Augusto Lafuente	The University of Queensland
Prof Marco Antonio López Cerdá	Alicante University
Dr Quoc Thong Le Gia	University of New South Wales
Dr Thomas Leistner	The University of Adelaide
Mr Renaud Leplaideur	Université de la Nouvelle Calédonie
Mr Angus Hamilton Lewis[s]	The University of Adelaide
Assoc Prof Guoyin Li	University of New South Wales
Dr Joan Licata	Australian National University
Mr Johnny Lim[s]	The University of Adelaide
Dr Boris Lishak	The University of Sydney
Mr Dennis Liu[s]	The University of Adelaide
Miss Xuemei Liu[s]	University of South Australia
Dr Heather Lonsdale	Curtin University

Prof John Loxton	Western Sydney University
Prof Ryan Loxton	Curtin University
Prof Malwina Luczak	The University of Melbourne
Dr Matthias Ludewig	The University of Adelaide
Mr Yuki Maehara[s]	Macquarie University
Dr Chi Mak	University of New South Wales
Mr Benjamin Maldon[s]	The University of Newcastle
Mr Michael Arthur Mampusti[s]	University of Wollongong
Dr Daniel Francis Mansfield	University of New South Wales
Dr Robert Marangell	The University of Sydney
Mr Anthony Shane Marshall[s]	Flinders University
Dr Margaret Marshman	University of the Sunshine Coast
Prof Helmut Maurer	University of Mnster
Dr Anthony Mays	The University of Melbourne
Assoc Prof James McCoy	The University of Newcastle
Dr Robert McDougall	University of the Sunshine Coast
Prof Mark Joseph McGuinness	Victoria University of Wellington
Assoc Prof William McLean	University of New South Wales
Dr Peter McNamara	The University of Melbourne
Mr Samuel Mills[s]	The University of Adelaide
Ms Stephanie Mills[s]	University of South Australia
Dr Lewis Mitchell	The University of Adelaide
Dr Sarat Babu Moka	The University of Queensland
Mr Benjamin Moore[s]	The University of Adelaide
Dr Ross Moore	Macquarie University
Dr Luke Morgan	The University of Western Australia
Dr Thomas Morrill	UNSW Canberra
Prof Sid Morris	Federation University Australia
Miss Jessica Murphy[s]	The University of Sydney
Prof Michael Murray	The University of Adelaide
Dr Kihun Nam	Monash University
Dr Yusra Naqvi	The University of Sydney
Assoc Prof Mark Nelson	University of Wollongong
Mr Alex Newcombe[s]	Flinders University
Dr Garry Newsam	The University of Adelaide
Dr Giang Nguyen	The University of Adelaide
Ms Trang Nguyen[s]	University of South Australia
Mr Cuong Nguyen Duy[s]	Federation University Australia
Dr Yuri Nikolayevsky	La Trobe University
Dr Greg Oates	University of Tasmania
Dr Andriy Olenko	La Trobe University
Prof Hinke Osinga	The University of Auckland
Dr Alessandro Ottazzi	University of New South Wales
Dr Brett Parker	Monash University
Mr Thomas Pedersen[s]	University of Wollongong
Mr Oscar Peralta[s]	Technical University of Denmark
Dr William Erik Pettersson	University of Glasgow
Prof Sabine Pickenhain	Brandenburg Technical University Cottbus
Dr Chayne Planiden	University of Wollongong
Assoc Prof Jessica Purcell	Monash University
Dr Thomas Quella	The University of Melbourne
Prof Reinout Quispel	La Trobe University
Prof Chris Radford	Memorial University
Dr Nawin Raj	University of Southern Queensland
Mx Jacqui Ramagge	The University of Sydney
Dr Colin David Reid	The University of Newcastle
Dr Janosch Rieger	Monash University
Dr David Roberts	The University of Adelaide
Mr Timothy Roberts[s]	The University of Sydney

Dr David Robertson	The University of Newcastle
Dr Marcy Robertson	The University of Melbourne
Dr Vanessa Robins	Australian National University
Dr Anna Romanov	The University of Sydney
Dr Danya Rose	The University of Sydney
Dr Joshua Ross	The University of Adelaide
Mr Matthew James Ryan[s]	The University of Adelaide
Mr Thomas Scheckter[s]	University of New South Wales
Prof Gerd Schmalz	University of New England
Dr Jelena Schmalz	University of New England
Dr Travis Scrimshaw	The University of Queensland
Mr Nicholas Seaton[s]	University of Wollongong
Dr Min Sha	Macquarie University
Prof Nageswari Shanmugalingam	University of Cincinnati
Mr Yibing Shen[s]	The University of Queensland
Prof Steven Sherwood	University of New South Wales
Ms Yang Shi	Flinders University
Prof Harvinder Sidhu	University of New South Wales
Dr Leesa Sidhu	University of New South Wales Canberra
Prof Miles Simon	Magdeburg University
Prof Michael Small	The University of Western Australia
Dr Dave Smith	Yale-NUS College
Prof Kate Smith-Miles	The University of Melbourne
Mr Daniel Snell[s]	The University of Auckland
Mx Matthew James Spong[s]	The University of Melbourne
Dr Belinda Spratt	Queensland University of Technology
Miss Haripriya Sridharan[s]	The University of Adelaide
Dr Peter Stacey	La Trobe University
Prof Yury Stepanyants	University of Southern Queensland
Dr Danny Stevenson	The University of Adelaide
Dr Tim Stokes	University of Waikato
Prof Yvonne Stokes	The University of Adelaide
Miss Michelle Strumila[s]	The University of Melbourne
Dr Jeremy Sumner	University of Tasmania
Dr Nicole Sutherland	The University of Sydney
Mr Ahnaf Tajwar Tahabub[s]	The University of Adelaide
Dr Thomas Taimre	University of Queensland
Mr Dominic Tate[s]	The University of Sydney
Prof Peter Taylor	The University of Melbourne
Prof Natalie Thamwattana	The University of Newcastle
Dr Guo Chuan Thiang	The University of Adelaide
Dr Anne Thomas	The University of Sydney
Dr Bevan Thompson	The University of Queensland
Miss Lauren Thornton[s]	University of the Sunshine Coast
Dr Stephan Tornier	The University of Newcastle
Dr Timothy Trudgian	UNSW Canberra
Dr Ilknur Tulunay	University of Technology, Sydney
Prof Mathai Varghese	The University of Adelaide
Mr Volodymyr Vaskovych[s]	La Trobe University
Dr Peter Vassiliou	Australian National University
Mr Ivo De Los Santos Vekemans[s]	Australian National University
Dr Geetika Verma	University of South Australia
Dr Mircea Voineagu	University of New South Wales
Dr Raymond Vozzo	The University of Adelaide
Dr Yuguang Wang	University of New South Wales
Prof Ian Wanless	Monash University
Prof Ole Warnaar	The University of Queensland
Dr Yong Wei	Australian National University
Mr Dominic Weiller[s]	Australian National University

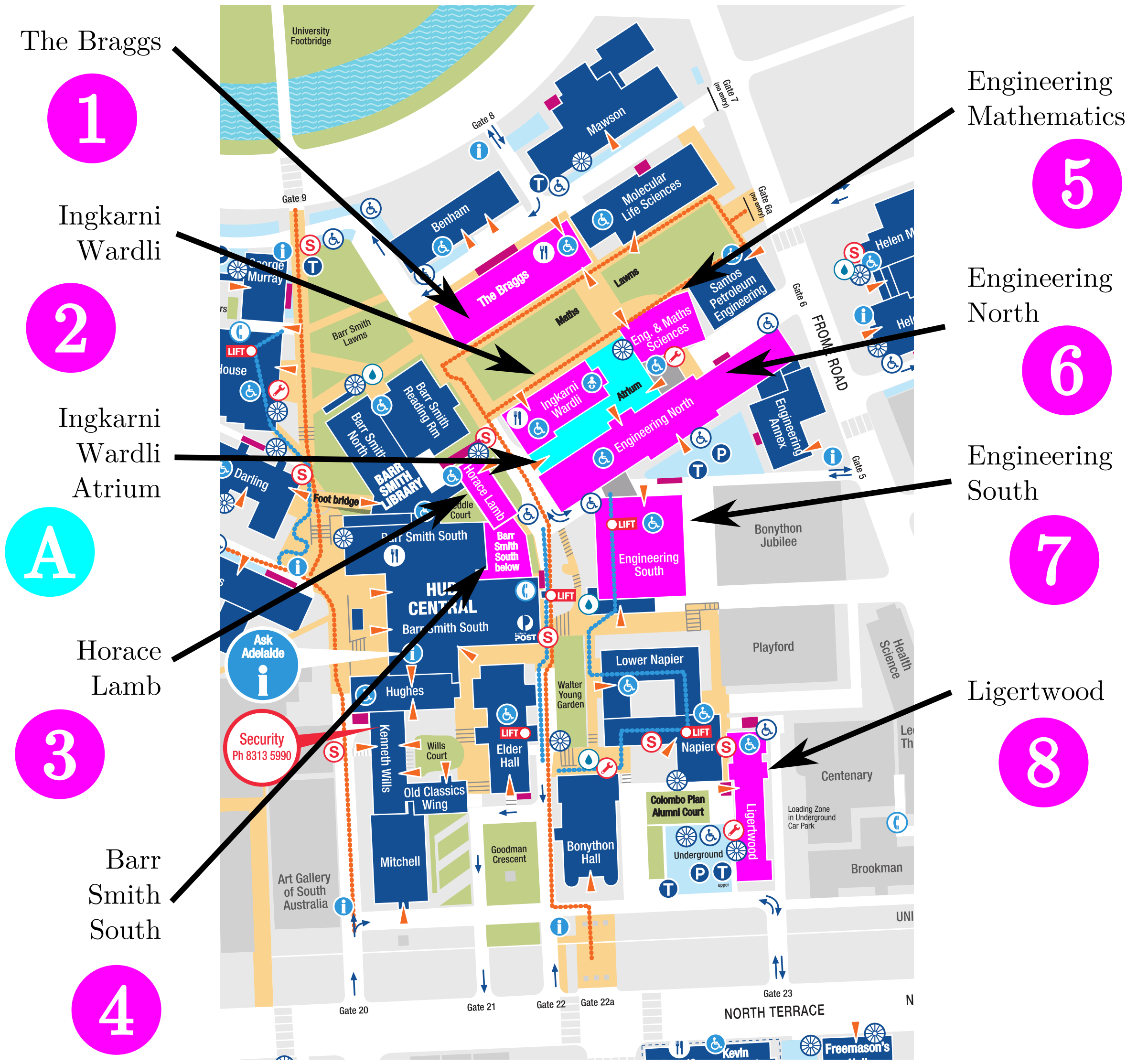
Miss Kym Erin Wilkins[s]	The University of Adelaide
Prof Geordie Williamson	The University of Sydney
Prof George Willis	The University of Newcastle
Dr Robert Womersley	University of New South Wales
Mr Adam Wood[s]	The University of Melbourne
Ms Yuhan Wu[s]	University of Wollongong
Dr Yaping Yang	The University of Melbourne
Mr Yeeka Yau[s]	The University of Sydney
Mr Sungha Yoon[s]	Korea University
Mr Marley Young[s]	University of New South Wales
Dr Gufang Zhao	The University of Melbourne
Dr Zongzheng Zhou	Monash University
Assoc Prof Ilze Ziedins	The University of Auckland
Assoc Prof Paul Zinn-Justin	The University of Melbourne

Index of Speakers

Conference Timetable Summary

	Monday	Tuesday	Wednesday	Thursday	Friday
8:00		Registration			
8:30				Optimisation & RepTheo session	
9:00		Opening Ceremony and Awards	Award Lecture	Special sessions *(3 talks)*	Special sessions *(2 talks)*
9:30			Plenary Lecture *Natalie Thamwattana*		
10:00					Morning Tea
10:30		Morning Tea	Morning Tea	Morning Tea	Plenary Lecture *Josef Dick*
11:00		Plenary Lecture *Geordie Williamson*	Plenary Lecture *Manjunath Krishnapur*	Hanna Neumann Lecture *Hinke Osinga*	
11:30					Plenary Lecture *Nageswari Shanmugalingam*
12:00		Plenary Lecture *Malwina Luczak*	Plenary Lecture *Joan Licata*	Early Career Lecture *Renato Bettiol*	
12:30					Lunch
13:00		Lunch	Lunch	Lunch	
13:30					Special sessions *(4 talks)*
14:00		Special sessions *(2 talks)*	Debate	AustMS AGM *(in Horace Lamb Lecture Theatre)*	
15:00		Afternoon Tea	Afternoon Tea / EA Tea		
15:30		Special sessions *(3 talks)*	Special sessions *(5 talks)* / Education Afternoon	Afternoon Tea	Afternoon Tea
16:00				Plenary Lecture *Regina Burachik*	Special sessions *(4 talks)*
17:00	WIMSIG General Meeting	ANZIAM Lecture *Steven Sherwood*		Plenary Lecture *Étienne Ghys*	
18:00		Welcome Reception	Public Lecture Reception		
18:30	Women in Mathematical Sciences Dinner *The Playford*				
19:00			Public Lecture *Étienne Ghys*	Conference Dinner *National Wine Center*	
20:00					

The opening ceremony, all plenary lectures, the public lecture and the debate take place in the Braggs Lecture theatre. Teas, coffees and lunches are served in the Atrium of the Ingkarni Wardli building, where also the Welcome Reception and the Public Lecture Reception will be held.



Session	Building	Room
Algebra	3	Horace Lamb Lecture Theatre 1022
Applied and Industrial Mathematics	8	Ligertwood 316
Category Theory	5	Engineering Mathematics EMG06
Computational Mathematics	8	Ligertwood 314 (Flinders Room)
Differential Geometry	4	Barr Smith South 2051
Dynamical Systems and Ergodic Theory	8	Ligertwood 214 (Piper Alderman Room)
Functional Analysis	7	Engineering South S111
Geometric Analysis	5	Engineering Mathematics EMG07
Geometry and Topology	4	Barr Smith South 2060
Harmonic Analysis	8	Ligertwood 111
Integrable Systems	8	Ligertwood 112
Mathematical Biology	8	Ligertwood 216 (Sarawak Room)
Mathematical Physics	6	Engineering North N132
Mathematical Education	3	Horace Lamb 422
Number Theory	2	Ingkarni Wardli B17
Optimisation	7	Engineering South S112
Probability Theory and Stochastic Processes	2	Ingkarni Wardli B18
Representation Theory	4	Barr Smith South 2052
Annual General Meeting	3	Horace Lamb Lecture Theatre 1022
Plenaries	1	The Braggs G60
Lunch, tea and social events	A	Ingkarni Wardli Atrium