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From the Director

I would like to extend a warm welcome to all participants in the 55th Annual Conference of the Australian Mathematical Society. I am pleased to see that we have been able to attract nearly 240 mathematicians and mathematical educators to this meeting, a good number for a conference in a non-capital city. We are especially pleased to welcome delegates from eleven different countries to the conference.

This year’s program features talks from a wide variety of areas of Mathematics and geographical locations. On behalf of the scientific committee I would like to thank all the plenary speakers for accepting the invitation to speak at the 55th Annual conference. With over 50 students registered, there will be plenty of competition for the B.H. Neuman prize for the best student talk. I wish them good luck, and hope that they find the conference mathematically stimulating.

Following on from previous years, this conference again includes an Early Career Workshop, an Education Afternoon for mathematics teachers and a Public Lecture – this year the Public Lecture will be given by Mick Roberts. His lecture: The mathematics of epidemics and pandemics is highly topical and is indicative of the wide reach of modern mathematics.

I am happy to announce that our program includes the second Hanna Neumann Lecture. This year the lecture will be given by Nalini Joshi, the first female professor at Sydney University, former president of the Australian Mathematical Society and Chair of the National Council for the Mathematical Sciences.

Finally I would like to thank all of the kind people who have helped to organise this conference: from members of the scientific committee, to session organisers, to all of the staff and students — both professional and academic — at the University of Wollongong who have been involved in various ways. Without your help and support, this meeting would not have been possible. I also wish to thank the Deputy Vice Chancellor (Research) Judy Raper and the Dean of Informatics, Phillip Ogunbona, for their financial support for this meeting. I also thank the Australian Mathematical Sciences Institute (AMSI) for sponsoring the Education Afternoon.

Specifically thanks, in no particular order. To John Banks at La Trobe University for designing a wonderful registration system. We are grateful for all the work you have put in to make this difficult task much more manageable. To Lisa Pyle, who had not realised when she started in February, how much work she had let herself in for. I am grateful for all her help in keeping the local organising committee on task. And to Aidan Sims and Jacqui Ramagge, who have contributed so much of their time to make this conference come about.

In hope that you all have a very agreeable conference, and that you enjoy your visit to the University of Wollongong and to the Illawarra.

David Pask
Conference Director
Conference Organisation

Local Organising Committee

David Pask – Conference Director  
Aidan Sims – Special Sessions and Timetables  
Jacqui Ramagge – Publicity  
Natalie Thamwattana – ECR and Women’s Events  
Bronwyn Hajek – ECR  
Ruibin Zhang – AustMS representative  
Caz Sandison – Teacher’s Afternoon  
Lisa Pyle – Coordinator

Scientific Committee

David Pask (University of Wollongong)  
Ruibin Zhang (University of Sydney)  
Ole Warnaar (University of Queensland)  
Yihong Du (University of New England)  
Gary Froyland (University of NSW)  
James Parkinson (University of Sydney)  
James Borger (Australian National University)  
Yvonne Stokes (University of Adelaide)  
Nora Ganter (University of Melbourne)

Organisers of Special Sessions

1. Algebra and Number Theory – James Parkinson, Anne Thomas  
3. Computational Mathematics – Bishnu Prasad Lamichhane  
4. Aspects of Applications in Mathematics – Barry Cox, Georg Gottwald  
5. Operator Algebras and Noncommutative Geometry – Nathan Brownlowe, Denis Potapov  
6. Optimisation – Natasha Boland, Andrew Eberhard  
7. Geometry and Topology – Finnur Larusson, Craig Westerland  
8. Topological Groups and Harmonic Analysis – George Willis  
10. Combinatorics – Alice Devillers  
11. Probability and Statistics – Mark Fielding  
12. General session – Aidan Sims  
13. Mathematical Physics – Gavin Brennen  
15. Education Afternoon – Jacqui Ramagge, Caz Sandison

This booklet was produced by Ben Maloney of the University of Wollongong in LaTeXusing templates kindly provided by John Banks of La Trobe University.
The conference organisers acknowledge the financial support given to them from

The Faculty of Informatics

AMSI

AustMS

CAMBRIDGE

University of Wollongong
Overview of the Academic Program

At this meeting there will be 7 plenary lectures, one public lecture, 183 contributed talks and 14 special sessions. The Education Afternoon on Tuesday 27th September features an addition two talks accessible to a general audience, and concludes with a panel discussion *Cave or Tunnel? Is there light ahead?*

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Plenary Lecturers
- Nalini Joshi (University of Sydney)
- Kenneth Paul Tod (University of Oxford)
- John Sader (University of Melbourne)
- Vigleik Angeltveit (Australian National University)
- George Willis (University of Newcastle)
- Hiroshi Matano (University of Tokyo)
- Mick Roberts (Massey University)

▷ Timetable of Plenary Lectures and Public Lecture – page 9

Public Lecture
- Mick Roberts (Massey University)

Special Sessions
- 1. Algebra and Number Theory – page 10
- 3. Computational Mathematics – page 14
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- 15. Education Afternoon – page 28

Education Afternoon
- Michael Giudici (University of Western Australia)
- Michael Barnsley (Australian National University)

Panel Discussion: *Cave or Tunnel? Is there light ahead?*

▷ Timetable for Education Afternoon – page 28
Social Program

▶ Sunday 25th September, 16:00-18:00
  Welcome Reception and Registration
  Novotel North Beach, 2-14 Cliff Road, North Wollongong
▶ Monday 26th September, 12:30-13:45
  Early Career Researchers Lunch
  SMART Building, 6.105
▶ Tuesday 27th September, 12:30-14:00
  Women’s Lunch
  Vice Chancellors Dining Room, McKinnon Building 67
▶ Wednesday 28th September, 18:30
  Conference Dinner
  Lagoon Restaurant, Stuart Park, North Wollongong

Annual General Meeting of the Society

▶ Wednesday 28th September 2011, 16:00-17:00
  Hope Theatre

Conference Information Desk

The information desk for the conference is located in the foyer of the Hope Theatre. This desk will be staffed each day of the conference during the morning.

Book and Software Display

Throughout the conference, Cambridge University Press will be displaying their wares in the foyer of Building 24.
Timetable of Events at a Glance

Except for the Welcome cocktails at the Novotel North Beach, North Wollongong and the conference dinner at the Lagoon Restaurant, Stuart Park, North Wollongong, all main conference events will take place at the main University of Wollongong campus.

Plenary lectures will be in the Hope Theatre and Special Sessions will take place in Building 24.

Plenary lectures and keynote talks should finish (including questions) at 55 minutes past their allotted start time, and contributed talks at 25 minutes past their allotted start time.

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<th>Saturday September 24</th>
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<tr>
<td>09:00 - 10:00</td>
<td>Plenary talk: George Willis</td>
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<td>10:00 - 11:00</td>
<td>ARC Presentation: Leanne Harvey</td>
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<td>Morning Tea</td>
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<td>Special Sessions</td>
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<td>15:30 - 16:00</td>
<td>NCMS talk: Nalini Joshi</td>
<td>Hope Theatre</td>
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<td>16:00 - 17:00</td>
<td>Annual General Meeting</td>
<td>Hope Theatre</td>
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<td>18:30</td>
<td>Conference Dinner</td>
<td>Lagoon Restaurant</td>
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### Thursday September 29

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<td>12:30 - 14:00</td>
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### Thursday September 29 and Friday September 30

ALTC-AustMS Professional Development Workshop 2011: Effective Teaching, Effective Learning in the Quantitative Disciplines
Plenary Lectures and Public Lecture

דל נלני ג’אשל (אוניברסיטת סידני)
"גאומטריה אסימטוטית או "אני לומד芝麻 to stop worrying and love exceptional Lie groups"

14:00 דל קנדיין פעלו תוד (אוניברסיטת אוקספורד)
"פסרוּס’ Weyl Curvature Hypothesis and his Conformal Cyclic Cosmology"

דל יואן יאדר (אוניברסיטת מובילנבורג)
"איך המתמטיקה יכולת לעזור למדידת תופעות לתוך סקאל, עיצוב משטחים ו.AddDays את זרם הסקאלות המפוארות"

14:00 דל ויגליק אנגלה טייט (אוניברסיטה האוסטרלית)
"aniem K-theory via the trace method"

18:30 דל מיק רוברטס (אוניברסיטת מאסי)
"확广大市民: The mathematics of epidemics and pandemics"

דל ג’ורג’ו ויליס (אוניברסיטת ניוהאוסקוויה)
"(EC) לפלס בלוק קומפקטים, לעניין קומפקטיים" 

14:00 דל היסיונוטו מטאני (אוניברסיטת טוקיו)
"Traveling waves in a sawtoothed cylinder and their homogenization limit"

דל מייקל רוברטס (אוניברסיטת מאסי)
"Mathematical models for the evolution and transmission of a virus"
Special Session 1: Algebra and Number Theory

Organisers  James Parkinson, Anne Thomas

Keynote Talk
▷ Mon 26 September 2011 – 21.104
15:00 Wadim Zudilin (The University of Newcastle)
   Ramanujan-style mathematics for Mahler measures

Contributed Talks
▷ Mon 26 September 2011 – 21.104
16:00 James Wan (University of Newcastle)
   Legendre Polynomials and Ramanujan-like series for 1/π
16:30 Justin Koonin (University of Sydney)
   Topology of eigenspace posets for unitary reflection groups
17:00 Joanne Hall (Royal Melbourne Institute of Technology)
   Structure of Hjelmslev planes over Galois rings.

▷ Tuesday 27 September 2011 – 21.104
10:30 Martin Bunder (University of Wollongong)
   Lucas Functions and Sums of Powers of Irrationals
11:00 Andrew Crisp (University of Sydney)
   An exotic Springer correspondence
11:30 Omar Ortiz (The University of Melbourne)
   Homogeneous Spaces of p-Compact Groups
12:00 Daniel Horadam (University of Newcastle)
   Fractal Groups and Automata
15:00 Ville Merila (University of Newcastle)
   Diophantine approximation of q-continued fractions
15:30 Sangeeta Jhanjee (Monash University)
   Various generalisations of minimax theorem using Clifford algebras
16:00 Alex Ghitza (The University of Melbourne)
   Lifting modular forms
16:30 Jie Du (University of New South Wales)
   Representations of Affine q-Schur Algebras
17:00 Wilson Ong (Australian National University)
   An Alternative Proof of Hesselholt’s Conjecture on Galois Cohomology of Witt Vectors of Algebraic Integers

▷ Wednesday 28 September 2011 – 21.104
11:30 James Parkinson (University of Sydney)
   A complete classification of commutative parabolic Hecke algebras
12:00 Michael Giudici (The University Of Western Australia)
   Generalised quadrangles with a group acting primitively on points and lines
12:30 Murray Elder (The University of Newcastle)
   New results about Baumslag-Solitar groups
Thursday 29 September 2011 – 21.104

10:30 Attila Egri-Nagy (University of Western Sydney)
Dependency Functions in Hierarchical (De)Compositions of Finite Transformation Semigroups

11:00 James East (University of Western Sydney)
Defining relations for idempotent generators in finite semigroups of mappings

11:30 Anthony Henderson (University of Sydney)
Small representations and the affine Grassmannian

12:00 Nora Ganter (The University of Melbourne)
Characters of categorical representations

12:30 Debargha Banerjee (Australian National University)
Endomorphism algebras of modular motives
Special Session 2: Calculus of Variations and Partial Differential Equations

Organisers  Ben Andrews, Yihong Du

Contributed Talks

▷ Mon 26 September 2011 – 21.103
15:00 Alan McIntosh (Australian National University)
   *Finite Speed of Propagation for First Order Systems and Second Order Operators*
15:30 Julie Clutterbuck (Australian National University)
   *Optimal bounds for the first Neumann eigenvalue on a manifold*
16:00 Paul Bryan (Australian National University)
   *Isoperimetric comparison techniques for Ricci flow on surfaces and curve shortening flow*
16:30 Menaka Lashitha Bandara (Australian National University)
   *The Kato square root problem on vector bundles of generalised bounded geometry*
17:00 Stephen Michael McCormick (Monash University)
   *Dain’s variational principle and its relation to an angular momentum-mass inequality in general relativity*

▷ Tuesday 27 September 2011 – 21.103
10:30 Parinya Sa Ngiamsunthorn (University of Sydney)
   *Persistence of bounded solutions of parabolic equations under domain perturbation*
11:00 David Hartley (Monash University)
   *Study of Mean Curvature Flow Equations using Functional Analysis*
11:30 Lin-Feng Mei (University of New England)
   *On a nonlocal equation modelling phytoplankton growth*
12:00 Sanjiban Santra (University of Sydney)
   *Asymptotic behavior of the least energy solution of a problem with competing powers*
15:00 Joseph Grotowski (The University of Queensland)
   *New Boundary Regularity Results for Elliptic Systems.*
15:30 Todd Oliynyk (Monash University)
   *There are no magnetically charged particle-like solutions of the Einstein-Yang-Mills equations for models with Abelian residual groups*
16:00 Frederic Rochon (Australian National University)
   *Asymptotics of complete Kahler metrics of finite volume on quasiprojective manifolds*
16:30 Nicholas Fewster-Young (University of New South Wales)
   *Existence of solutions to second order nonlinear singular boundary value problems.*

▷ Wednesday 28 September 2011 – 21.103
11:30 Xu-Jia Wang (Australian National University)
   *Regularity of elliptic and parabolic equation along a vector field*
12:00 Daniel Daners (University of Sydney)
   *An isoperimetric inequality related to a Bernoulli problem*
12:30 Florica Cirstea (University of Sydney)
   *On the classification of isolated singularities for nonlinear elliptic equations*
Thursday 29 September 2011 – 21.103

10:30 Yihong Du (University of New England)
   Propagation in a time-periodic nonlinear diffusion problem with free boundary

11:00 James McCoy (University of Wollongong)
   Fully nonlinear curvature flow with nonconvex initial data

11:30 Edward Norman Dancer (University of Sydney)
   Large interaction problems for non-linear P.D.E.
Special Session 3: Computational Mathematics

Organiser  Bishnu Prasad Lamichhane

Keynote Talk

- Tuesday 27 September 2011 – 24.G01
  11:30 Jonathan Borwein (The University of Newcastle)
  Mahler measures, short walks and log-sine integrals: A case study in hybrid computation

Contributed Talks

- Mon 26 September 2011 – 24.G01
  15:00 Bishnu Lamichhane (University of Newcastle)
  A Stabilized Mixed Finite Element Method for the Biharmonic Equation Based on Biorthogonal Systems
  15:30 Qinian Jin (Australian National University)
  Inexact Newton regularization methods
  16:00 Quoc Thong Le Gia (University of New South Wales)
  Solving parabolic equations on the unit sphere via Laplace transforms
  16:30 Sudi Mungkasi (Australian National University)
  Approximations of the Carrier-Greenspan periodic solution to the shallow water wave equations for flows on a sloping beach

- Tuesday 27 September 2011 – 24.G01
  10:30 Vivien Challis (University of Queensland)
  Implementing a topology optimisation algorithm on the GPU
  11:00 Stuart Hawkins (Macquarie University)
  A fully discrete Galerkin algorithm for high frequency exterior acoustic scattering in three dimensions
  15:00 Petrus H Potgieter (University of South Africa)
  On the fixed points of computable functions
  15:30 Paul Leopardi (Australian National University)
  Can compatible discretization, finite element methods, and discrete Clifford analysis be fruitfully combined?
Special Session 4: Aspects of Applications in Mathematics

Organisers  Barry Cox, Georg Gottwald

Contributed Talks

▷ Mon 26 September 2011 – 24.G02
15:00 Christopher Angstmann (University of New South Wales)
   Turing patterns and subcellular protein localisation
15:30 Andrew Francis (University of Western Sydney)
   The acquisition of genetic pathways in bacteria
16:00 Peter Kim (University of Sydney)
   Role of regulatory T cells in producing a robust immune response and maintaining immuno-dominance
16:30 Graeme Pettet (Queensland University of Technology)
   In silico investigation of clonal dynamics in the epidermis: simulating the Single Progenitor Cell model.
17:00 Martin Wechselberger (University of Sydney)
   Understanding Anomalous Delays in Models of Intracellular Calcium Dynamics

▷ Mon 26 September 2011 – 24.105
15:00 Tonghua Zhang (Swinburne University of Technology)
   Stability and bifurcation analysis of a mathematical model for gene expression
15:30 Alla Shymanska (Auckland University of Technology)
   Mathematical modelling of image converters and intensifiers
16:00 Philip Howes (University of Sydney)
   Painleve II Asymptotics
16:30 Samuel Butler (University of Sydney)
   Multidimensional Discrete Inverse Scattering
17:00 Robyn Stuart (University of New South Wales)
   Almost-invariant sets in open dynamical systems

▷ Tuesday 27 September 2011 – 24.G02
10:30 Jim Denier (University of Adelaide)
   Finite-time singularities in the boundary-layer equations: the fluid filled torus
11:30 Dimetre Triadis (La Trobe University)
   Infiltration in the Green-Ampt limit.
12:00 Joel Moitsheki (University of the Witwatersrand)
   Transient heat transfer in longitudinal fins of various profiles with temperature-dependent thermal conductivity and heat transfer coefficient
15:00 Bruce Henry (University of New South Wales)
   Fokker-Planck equations for anomalous subdiffusion in space-and-time-dependent force fields
15:30 Govind Menon (Brown University)
   How long does it take to compute the eigenvalues of a random matrix
16:00 Ben Goldys (University of New South Wales)
   Liouville theorem for some infinite-dimensional diffusions
5. Aspects of Applications in Mathematics

16:30 Tony Roberts (University of Adelaide)
   Stochastic self-similar solutions emerge from stochastic reaction-diffusion equation

▷ Wednesday 28 September 2011 – 24.G02
   11:30 Thien Tran-Duc (University of Wollongong)
      General Model for Molecular Interactions in a Benzene Dimer
   12:00 Ngamta Thamwattana (University of Wollongong)
      Modeling encapsulation of acetylene molecules into carbon nanotubes
   12:30 Barry Cox (University of Adelaide)
      Model for carbon nanocones

▷ Thursday 29 September 2011 – 24.G02
   10:30 Robert Marangell (University of Sydney)
      Stability and Instability in Kink-wave Solutions to the Sine-Gordon Equation
   11:00 Thi Dinh Tran (University of New South Wales)
      Complete integrability of mappings obtained from the discrete Korteweg-De Vries
      and a double copy of the discrete potential Korteweg-De Vries equations
   11:30 James Atkinson (University of Sydney)
      On exact solutions of integrable discrete equations
   12:00 Nalini Joshi (University of Sydney)
      The repellor and the limit set in complex dynamics of the Painlevé equations
Special Session 5: Operator Algebras and Noncommutative Geometry

Organisers  Nathan Brownlowe, Denis Potapov

Keynote Talk

▷ Tuesday 27 September 2011 – 24.101

10:30 Alexander Kumjian (University of Wollongong)
Cohomology of higher rank graphs

Contributed Talks

▷ Tuesday 27 September 2011 – 24.101

11:30 Nathan Brownlowe (University of Wollongong)
On some simple and purely infinite Exel-Larsen crossed product C*-algebras

12:00 Hui Li (University of Wollongong)
A new perspective on topological graph algebras

15:00 Ben Maloney (University of Wollongong)
Actions of Ore Semigroups on Higher Rank graphs

15:30 Michael Whittaker (University of Wollongong)
Spectral Triples for Hyperbolic Dynamical Systems

16:00 Adam Rennie (Australian National University)
Dimension in noncommutative geometry

16:30 Snigdhaan Mahanta (The University of Adelaide)
Twisted K-theory and bivariant Chern–Connes type character of some infinite dimensional spaces

▷ Thursday 29 September 2011 – 24.101

10:30 Aidan Sims (University of Wollongong)
Equivalence and amenability for Fell bundles

11:00 Valentin Deaconu (University of Nevada, Reno)
Entropy of shifts on topological graph C*-algebras

11:30 Samuel Webster (University of Wollongong)
k-coloured graphs and k-graphs.

12:00 Sooran Kang (University of Wollongong)
Co-universal C*-algebras associated with aperiodic k-graphs
Special Session 6: Optimisation

Organisers  Natashia Boland, Andrew Eberhard

Keynote Talk
▷ Tuesday 27 September 2011 – 24.102
  10:30 Matthias Ehrgott (The University of Auckland)
    Duality and Algorithms for Multiobjective Linear Programming

Contributed Talks
▷ Tuesday 27 September 2011 – 24.102
  11:30 Peter Malkin (BHP Billiton)
    Sherali-Adams Relaxations of Graph Isomorphism Polytopes
  12:00 Natashia Boland (The University of Newcastle)
    Lagrangian decomposition: a hierarchy of decompositions and computational trade-offs
  15:00 Andrew Craig Eberhard (Royal Melbourne Institute of Technology)
    Some Algorithms in Revealed Preference Theory
  15:30 Brailey Sims (University of Newcastle)
    Alternating projection type algorithms in the absence of convexity
  16:00 Faramroze Engineer (University of Newcastle)
    Turbo-charging the Feasibility Pump
  16:30 Francisco Javier Aragón Artacho (The University of Newcastle)
    Lipschitzian properties of Newton’s iteration

▷ Thursday 29 September 2011 – 24.102
  10:30 Boris Miller (Monash University)
    Optimization of connected controlled Markov chains
  11:00 Masoud Talebian (University of Newcastle)
    Dynamic Assortment and Pricing under Demand Learning
  11:30 Jerzy Filar (Flinders University)
    Identifying non-Hamiltonicity of cubic graphs by nested linear programming
  12:00 Christopher John Price (University of Canterbury)
    Recycling bases in the Halton sequence: an optimization view
Special Session 7: Geometry and Topology

Organisers  Finnur Larusson, Craig Westerland

Keynote Talk

- Mon 26 September 2011 – 24.G03
  15:00 Vigleik Angeltveit (Australian National University)
  Uniqueness of Morava $K$-theory.

Contributed Talks

- Mon 26 September 2011 – 24.G03
  16:00 Anne Thomas (University of Sydney)
  Finite and infinite generation of lattices on right-angled buildings
  16:30 Bryan Wang (Australian National University)
  Stringy product on orbifold $K$-theory

- Tuesday 27 September 2011 – 24.G03
  10:30 Henry Segerman (The University of Melbourne)
  Triangulations of hyperbolic 3-manifolds admitting strict angle structures
  11:00 Norman Do (The University of Melbourne)
  Counting lattice points in compactified moduli spaces of curves
  11:30 Tyson Ritter (University of Adelaide)
  Acyclic Embeddings of Open Riemann Surfaces into Elliptic Manifolds
  12:00 Tharatorn Supasiti (The University of Melbourne)
  On JSJ decomposition theorem for Haken 3-manifolds
  15:00 Snigdhayan Mahanta (The University of Adelaide)
  Assembly maps and the integral $K$-theoretic Novikov conjecture
  15:30 Elizabeth Stanhope (Lewis and Clark College/The University of Melbourne)
  Controlling orbifold topology via the Laplace spectrum
  16:00 Alexander Hanysz (University of Adelaide)
  Oka properties of some hypersurface complements
  16:30 Ali Sayed Elfard (University of Wollongong)
  On free paratopological groups

- Wednesday 28 September 2011 – 24.G03
  11:30 Facundo Memoli (University of Adelaide)
  Stability of Persistent Homology Invariants
  12:00 Volker Gebhardt (University of Western Sydney)
  Finite index subgroups of mapping class groups
  12:30 Craig Westerland (The University of Melbourne)
  Twisted Morava $K$-theory

- Thursday 29 September 2011 – 24.G03
  10:30 Michael Eastwood (Australian National University)
  Some remarks on linear elasticity
  11:00 Finnur Larusson (University of Adelaide)
  Deformations of Oka manifolds
11:30 Nora Ganter (The University of Melbourne)  
Topological $K$-theory
12:00 Laurentiu Paunescu (University of Sydney)  
A’Campo curvature bumps
Organiser  George Willis

Keynote Talk

▷ Tuesday 27 September 2011 – 24.204

10:30 Hung Le Pham (Victoria University of Wellington)
Multi-norms and amenability of groups

Contributed Talks

▷ Tuesday 27 September 2011 – 24.204

11:30 Michael Cowling (University of New South Wales)
The Fourier-Stieltjes algebra and group geometry
12:00 Andrew Morris (University of Newcastle)
Quaternic Wavelets

▷ Wednesday 28 September 2011 – 24.204

11:30 Xuan Duong (Macquarie University)
Boundedness of singular integrals and their commutators with BMO functions on Hardy spaces.
12:00 Jeffrey Hogan (University of Newcastle)
Higher-dimensional Clifford Fourier transforms
12:30 George Willis (The University of Newcastle)
Weighted convolution algebras on locally compact groups
Special Session 9: Financial Mathematics

Organisers  Fima Klebaner, Song Ping Zhu

Keynote Talk

▷ Tuesday 27 September 2011 – 24.105
10:30 Carl Chiarella (University of Technology, Sydney)
   Pricing Interest Rate Derivatives in a Multifactor HJM Model with Time Dependent Volatility

Contributed Talks

▷ Tuesday 27 September 2011 – 24.105
11:30 Song-Ping Zhu (University of Wollongong)
   Analytically pricing Parisian and Parasian options
12:00 Kais Hamza (Monash University)
   Martingales with given marginals
15:00 Guanghua Lian (Auckland University of Technology)
   Consistent Modeling of SPX and VIX Options: Efficient Evaluation Issues in Gatheral’s Three-factor Model
15:30 Ivan Guo (University of Sydney)
   Multi-Player Dynkin Games
16:00 Marianito Rodrigo (University of Wollongong)
   Calibration of Vasicek and CIR interest rate models via generating functions
16:30 Joanna Goard (University of Wollongong)
   Pricing of volatility derivatives using 3/2 stochastic models
Special Session 10: Combinatorics

Organiser  Alice Devillers

Keynote Talk

▷ Mon 26 September 2011 – 24.201
15:00 Dillon Mayhew (Victoria University of Wellington)
Recent research in matroid theory

Contributed Talks

▷ Mon 26 September 2011 – 24.201
16:00 Neil Gillespie (The University Of Western Australia)
Characterising a family of Neighbour Transitive Codes
16:30 Bao Ho (La Trobe University)
The Sprague-Grundy function for the real game Euclid

▷ Tuesday 27 September 2011 – 24.201
15:00 Cheryl Praeger (The University Of Western Australia)
Normal coverings of finite symmetric and alternating groups
15:30 Alice Devillers (The University Of Western Australia)
On quasiprimitive rank 3 permutation groups
16:00 Akos Seress (The University Of Western Australia)
Disconnected colors in generalized Gallai colorings

▷ Wednesday 28 September 2011 – 24.201
11:30 Jennifer Seberry (University of Wollongong)
Higher dimensional Hadamard matrices
12:00 Barbara Maenhaut (The University of Queensland)
Almost regular edge colourings of complete bipartite graphs
12:30 Richard P Brent (Australian National University)
Computing Bernoulli and Tangent numbers
Special Session 11: Probability and Statistics

Organiser  Mark Fielding

Contributed Talks

▷ Mon 26 September 2011 – 24.101

15:00 Andriy Olenko (La Trobe University)
   Abelian and Tauberian theorems for long memory random fields
15:30 Michael McCrae (AMSI)
   Statistical Based Arbitrage in Financial Markets using Cointegration
16:00 You-Gan Wang (University of Queensland)
   Gaussian Working Correlation Structure in Longitudinal Data Analysis
16:30 Shuangzhe Liu (AMSI)
   Influence diagnostics for INGARCH time series models

▷ Wednesday 28 September 2011 – 24.101

11:30 Mark James Fielding (University of Wollongong)
   Gaussian processes in Hybrid MCMC and Simulated Annealing for computationally
   expensive objective functions.
12:00 Scott Sisson (AMSI)
   Approximate Bayesian computation (ABC) and Bayes linear analysis: Towards
   high-dimensional ABC
12:30 John Ormerod (University of Sydney)
   Hybrid Variational Bayes
Organiser  Aidan Sims

Contributed Talks

▷ Tuesday 27 September 2011 – 24.204

15:00 Ian Doust (University of New South Wales)
   Metric trees of generalized roundness one

15:30 Stephen James Sanchez (University of New South Wales)
   p-negative type of finite metric spaces

16:00 Nicholas Bartlett (AMSI)
   Hall-Littlewood polynomials and generalisations of the Rogers–Ramanujan identities.

16:30 Vladimir Gaitsgory (University of South Australia)
   Singularly Perturbed Linear Programming Problems

▷ Thursday 29 September 2011 – 24.204

10:30 Raymond Booth (Flinders University)
   The Vanishing Art of Introductory Mathematics

11:00 Prabhu Manyem (Shanghai University)
   Nearly Identical Expressions in Existential Second Order Logic for Problems in P and NP

11:30 Rupert Gordon McCallum (University of New South Wales)
   A new large cardinal property
Special Session 13: Mathematical Physics

Organiser  Gavin Brennen

Contributed Talks

▷ Mon 26 September 2011 – 24.202
15:00 Ian Marquette (The University of Queensland)  
Polynomial algebras and superintegrability
15:30 Amir Moghaddam (The University of Queensland)  
Integrable Quantum Impurity Models
16:00 Andrew Birrell (University of Queensland)  
Integrability of BEC/BCS crossover Hamiltonians
16:30 Caley Finn (The University of Melbourne)  
Dynamics of the asymmetric exclusion process in the reverse bias regime
17:00 Jan De Gier (The University of Melbourne)  
Current fluctuations in the asymmetric exclusion process

▷ Tuesday 27 September 2011 – 24.202
10:30 Eduardo Cerutti Mattei (The University of Queensland)  
Integrable Heteroatomic Molecular Bose-Einstein Condensates
11:00 Frank De Silva (AMSI/University of Melbourne)  
The simplest correction to Hubbell’s law and its theoretical implications
11:30 Maria Tsarenko (The University of Melbourne)  
Random Tilings of Squares Triangles and Rhombi
12:00 Alex Lee (The University of Melbourne)  
Matrix models, lattice models and an $O(N)$-Potts correspondence

▷ Wednesday 28 September 2011 – 24.202
11:30 Timothy Garoni (Monash University)  
Loop models in three dimensions
12:00 Nicholas Beaton (MASCOS / University of Melbourne)  
A non-directed model of polymer adsorption
12:30 Anthony Mays (The University of Melbourne)  
A geometric triumvirate of random matrices

▷ Thursday 29 September 2011 – 24.202
10:30 Demosthenes Ellinas (Technical University of Crete)  
Quantum Master Equations from Operator Valued Measures: A Hopf Algebraic Approach
11:00 Peter Forrester (The University of Melbourne)  
A Fuchsian differential equation for Selberg correlation integrals
11:30 Andrea Bedini (MASCOS / University of Melbourne)  
From second-order to first-order in an infinite number of steps
12:00 Andrew Norton (Max Planck Institute for Gravitational Physics)  
The equation of motion of an extended charged particle
Special Session 14: Differential Geometry

Organiser  Michael Eastwood

Keynote Talk

▷ Mon 26 September 2011 – 24.203
  15:00 Rod Gover (AMSI)
  Families of conformal operators along a hypersurface and formal extension problems

Contributed Talks

▷ Mon 26 September 2011 – 24.203
  16:00 Matthew Randall (Australian National University)
  Local obstructions to 2-dimensional projective structures admitting skew-symmetric Ricci tensor
  16:30 Ana Hinic-Galic (La Trobe University)
  Totally geodesic subalgebras of N-graded filiform Lie algebras

▷ Tuesday 27 September 2011 – 24.203
  10:30 Arman Taghavi-Chabert (Masaryk University)
  Twistor geometry in six dimensions
  11:00 Thomas Leistner (University of Adelaide)
  Connected irreducible subgroups of O(2, n)
  11:30 Andreas Cap (University of Vienna)
  Infinitesimal automorphisms of parabolic geometries and dynamics
  12:00 Michael Fielding Barnsley (Australian National University)
  Fractal transformations associated with Bernoulli convolutions
  15:30 Vladimir Soucek (Charles University)
  Dunkl operators and a family of realizations of osp(1|2)
  16:00 Mathew Langford (Australian National University)
  Asymptotic Convexity of Hypersurfaces Moving by Curvature
  16:30 Naghmaa Tehseen (La Trobe University)
  Geometric approach to partial differential equations

▷ Wednesday 28 September 2011 – 24.203
  11:30 Katharina Neusser (Australian National University)
  On some generic distributions and their automorphism groups
  12:00 Dennis The (Australian National University)
  Rigidity of Schubert varieties in compact Hermitian symmetric spaces
  12:30 Katja Sagerschnig (Australian National University)
  (2, 3, 5)-distributions and associated conformal structures

▷ Thursday 29 September 2011 – 24.203
  11:30 Tohru Morimoto (Kinki University)
  Subriemannian curvatures
  12:00 Petr Somberg (Charles University)
  Howe duality for the symplectic Dirac operator
Organiser  Jacqui Ramagge, Caz Sanderson

▷ Tuesday 27 September 2011 – Hope Theatre
   15:00 Registration (Hope Theatre Foyer)

Invited Talks
15:30 Michael Giudici (University of Western Australia)
   Wallpaper, Crystals and Symmetry
16:00 Michael Barnsley (Australian National University)
   Fractals and Dynamics in Education
16:30 Panel Discussion: Cave or Tunnel? Is there light ahead? (Hope Theatre)
   Dean Jones (Head of Mathematics, Smiths High HS)
   Nalini Joshi (Chair of Australian Academy of Science, National Committee of
   Mathematical Sciences)
   Janine McIntosh (AMSI)
   Jacqui Ramagge (University of Wollongong)

Education Afternoon Reception  17:30 – 18:30

Public Lecture
18:30 Mick Roberts (Massey University)
   The mathematics of epidemics and pandemics
Conference Timetable
Mon 26 September 2011

- **Registration** – Hope Theatre  08:30 – 09:30
- **Welcome Ceremony** – Hope Theatre  09:30 – 11:00
- **Morning Tea** – Hope Theatre Foyer  11:00 – 11:30

**Plenary Lecture** – Hope Theatre
11:30 ► Nalini Joshi (University of Sydney)
*Geometric Asymptotics or “How I learnt to stop worrying and love exceptional Lie groups”*

- **Lunch**  12:30 – 13:45
- **AMSI Intern Programme Information** – Hope Theatre 13:45 – 14:00

**Plenary Lecture** – Hope Theatre
14:00 ► Kenneth Paul Tod (University of Oxford)
*Penrose’s Weyl Curvature Hypothesis and his Conformal Cyclic Cosmology*

**Afternoon Special Sessions**

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<tr>
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1. **Algebra and Number Theory**

24.104
15:00 Wadim Zudilin (The University of Newcastle)
*Ramanujan-style mathematics for Mahler measures*

16:00 James Wan (University of Newcastle)
*Legendre Polynomials and Ramanujan-like series for 1/π*

16:30 Justin Koonin (University of Sydney)
*Toplogy of eigenspace posets for unitary reflection groups*

17:00 Joanne Hall (Royal Melbourne Institute of Technology)
*Structure of Hjelmslev planes over Galois rings.*
2. Calculus of Variations and Partial Differential Equations

24.103
15:00 Alan McIntosh (Australian National University)
*Finite Speed of Propagation for First Order Systems and Second Order Operators*
15:30 Julie Clutterbuck (Australian National University)
*Optimal bounds for the first Neumann eigenvalue on a manifold*
16:00 Paul Bryan (Australian National University)
*Isoperimetric comparison techniques for Ricci flow on surfaces and curve shortening flow*
16:30 Menaka Lashitha Bandara (Australian National University)
*The Kato square root problem on vector bundles of generalised bounded geometry*
17:00 Stephen Michael McCormick (Monash University)
*Dain’s variational principle and its relation to an angular momentum-mass inequality in general relativity*

3. Computational Mathematics

24.G01
15:00 Bishnu Lamichhane (University of Newcastle)
*A Stabilized Mixed Finite Element Method for the Biharmonic Equation Based on Biorthogonal Systems*
15:30 Qinian Jin (Australian National University)
*Inexact Newton regularization methods*
16:00 Quoc Thong Le Gia (University of New South Wales)
*Solving parabolic equations on the unit sphere via Laplace transforms*
16:30 Sudi Mungkasi (Australian National University)
*Approximations of the Carrier-Greenspan periodic solution to the shallow water wave equations for flows on a sloping beach*

4. Aspects of Applications in Mathematics

24.G02
15:00 Christopher Angstmann (University of New South Wales)
*Turing patterns and subcellular protein localisation*
24.105
15:00 Tonghua Zhang (Swinburne University of Technology)
*Stability and bifurcation analysis of a mathematical model for gene expression*
24.G02
15:30 Andrew Francis (University of Western Sydney)
*The acquisition of genetic pathways in bacteria*
24.105
15:30 Alla Shymanska (Auckland University of Technology)
*Mathematical modelling of image converters and intensifiers*
24.G02
16:00 Peter Kim (University of Sydney)
*Role of regulatory T cells in producing a robust immune response and maintaining immunodominance*
24.105
16:00 Philip Howes (University of Sydney)
*Painleve II Asymptotics*
24.G02
16:30 Graeme Pettet (Queensland University of Technology)
*In silico investigation of clonal dynamics in the epidermis: simulating the Single Progenitor Cell model.*
24.105
16:30 Samuel Butler (University of Sydney)
Multidimensional Discrete Inverse Scattering

24.G02
17:00 Martin Wechselberger (University of Sydney)
Understanding Anomalous Delays in Models of Intracellular Calcium Dynamics

24.105
17:00 Robyn Stuart (University of New South Wales)
Almost-invariant sets in open dynamical systems

7. Geometry and Topology
24.G03
15:00 Vigleik Angeltveit (Australian National University)
Uniqueness of Morava K-theory.
16:00 Anne Thomas (University of Sydney)
Finite and infinite generation of lattices on right-angled buildings
16:30 Bryan Wang (Australian National University)
Stringy product on orbifold K-theory

10. Combinatorics
24.201
15:00 Dillon Mayhew (Victoria University of Wellington)
Recent research in matroid theory
16:00 Neil Gillespie (The University Of Western Australia)
Characterising a family of Neighbour Transitive Codes
16:30 Bao Ho (La Trobe University)
The Sprague-Grundy function for the real game Euclid

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15:30 Michaael McCrae (AMSI)
Statistical Based Arbitrage in Financial Markets using Cointegration
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Gaussian Working Correlation Structure in Longitudinal Data Analysis
16:30 Shuangzhe Liu (AMSI)
Influence diagnostics for INGARCH time series models

13. Mathematical Physics
24.202
15:00 Ian Marquette (The University of Queensland)
Polynomial algebras and superintegrability
15:30 Amir Moghaddam (The University of Queensland)
Integrable Quantum Impurity Models
16:00 Andrew Birrell (University of Queensland)
Integrability of BEC/BCS crossover Hamiltonians
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15:00 Rod Gover (AMSI)
   Families of conformal operators along a hypersurface and formal extension problems

16:00 Matthew Randall (Australian National University)
   Local obstructions to 2-dimensional projective structures admitting skew-symmetric Ricci tensor

16:30 Ana Hinic-Galic (La Trobe University)
   Totally geodesic subalgebras of $\mathbb{N}$-graded filiform Lie algebras
Tuesday 27 September 2011

- **Plenary Lecture – Hope Theatre**
  09:00 ▶ John Sader (The University of Melbourne)
  
  *How mathematics can help to measure atomic scale phenomena, design spacecraft and predict the flow of ornate water fountains*

- **Morning Tea – Hope Theatre Foyer  10:00 – 10:30**

- **Morning Special Sessions**

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1. **Algebra and Number Theory**
   24.104
   10:30 Martin Bunder (University of Wollongong)
   *Lucas Functions and Sums of Powers of Irrationals*
   11:00 Andrew Crisp (University of Sydney)
   *An exotic Springer correspondence*
   11:30 Omar Ortiz (The University of Melbourne)
   *Homogeneous Spaces of p-Compact Groups*
   12:00 Daniel Horadam (University of Newcastle)
   *Fractal Groups and Automata*

2. **Calculus of Variations and Partial Differential Equations**
   24.103
   10:30 Parinya Sa Ngiamsunthorn (University of Sydney)
   *Persistence of bounded solutions of parabolic equations under domain perturbation*
   11:00 David Hartley (Monash University)
   *Study of Mean Curvature Flow Equations using Functional Analysis*
   11:30 Lin-Feng Mei (University of New England)
   *On a nonlocal equation modelling phytoplankton growth*
   12:00 Sanjiban Santra (University of Sydney)
   *Asymptotic behavior of the least energy solution of a problem with competing powers*
3. Computational Mathematics

24.G01
10:30 Vivien Challis (University of Queensland)
   Implementing a topology optimisation algorithm on the GPU
11:00 Stuart Hawkins (Macquarie University)
   A fully discrete Galerkin algorithm for high frequency exterior acoustic scattering in three dimensions
11:30 Jonathan Borwein (The University of Newcastle)
   Measures, Walks and Integrals

4. Aspects of Applications in Mathematics

24.G02
10:30 Jim Denier (University of Adelaide)
   Finite-time singularities in the boundary-layer equations: the fluid filled torus
11:30 Dimetre Triadis (La Trobe University)
   Infiltration in the Green-Ampt limit.
12:00 Joel Moitsheki (University of the Witwatersrand)
   Transient heat transfer in longitudinal fins of various profiles with temperature-dependent thermal conductivity and heat transfer coefficient

5. Operator Algebras and Noncommutative Geometry

24.101
10:30 Alexander Kumjian (University of Wollongong)
   Cohomology of higher rank graphs
11:30 Nathan Brownlowe (University of Wollongong)
   On some simple and purely infinite Exel-Larsen crossed product $C^*$-algebras
12:00 Hui Li (University of Wollongong)
   A new perspective on topological graph algebras

6. Optimisation

24.102
10:30 Matthias Ehrgott (The University of Auckland)
   Duality and Algorithms for Multiobjective Linear Programming
11:30 Peter Malkin (BHP Billiton)
   Sherali-Adams Relaxations of Graph Isomorphism Polytopes
12:00 Natasha Boland (The University of Newcastle)
   Lagrangian decomposition: a hierarchy of decompositions and computational trade-offs

7. Geometry and Topology

24.G03
10:30 Henry Segerman (The University of Melbourne)
   Triangulations of hyperbolic 3-manifolds admitting strict angle structures
11:00 Norman Do (The University of Melbourne)
   Counting lattice points in compactified moduli spaces of curves
11:30 Tyson Ritter (University of Adelaide)
   Acyclic Embeddings of Open Riemann Surfaces into Elliptic Manifolds
12:00 Tharatorn Supasiti (The University of Melbourne)
   On JSJ decomposition theorem for Haken 3-manifolds
8. Topological Groups and Harmonic Analysis
24.204
10:30 Hung Le Pham (Victoria University of Wellington)  
*Multi-norms and amenability of groups*

11:30 Michael Cowling (University of New South Wales)  
*The Fourier-Stieltjes algebra and group geometry*

12:00 Andrew Morris (University of Newcastle)  
*Quaternionic Wavelets*

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10:30 Eduardo Cerutti Mattei (The University of Queensland)  
*Integrable Heteroatomic Molecular Bose-Einstein Condensates*

11:00 Frank De Silva (AMSI/University of Melbourne)  
*The simplest correction to Hubbell’s law and its theoretical implications*

11:30 Maria Tsarenko (The University of Melbourne)  
*Random Tilings of Squares Triangles and Rhombi*

12:00 Alex Lee (The University of Melbourne)  
*Matrix models, lattice models and an $O(N)$-Potts correspondence*

14. Differential Geometry
24.203
10:30 Arman Taghavi-Chabert (Masaryk University)  
*Twistor geometry in six dimensions*

11:00 Thomas Leistner (University of Adelaide)  
*Connected irreducible subgroups of $O(2,n)$*

11:30 Andreas Cap (University of Vienna)  
*Infinitesimal automorphisms of parabolic geometries and dynamics*

12:00 Michael Fielding Barnsley (Australian National University)  
*Fractal transformations associated with Bernoulli convolutions*

☐ *Lunch 12:30 – 14:00*

■ **Plenary Lecture – Hope Theatre**

14:00 Vigleik Angeltveit (Australian National University)  
*Algebraic K-theory via the trace method*
Afternoon Special Sessions

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1. Algebra and Number Theory

24.104
15:00 Ville Merila (University of Newcastle)
*Diophantine approximation of $q$-continued fractions*

15:30 Sangeeta Jhanjee (Monash University)
*Various generalisations of minimax theorem using Clifford algebras*

16:00 Alex Ghitza (The University of Melbourne)
*Lifting modular forms*

16:30 Jie Du (University of New South Wales)
*Representations of Affine $q$-Schur Algebras*

17:00 Wilson Ong (Australian National University)
*An Alternative Proof of Hesselholt’s Conjecture on Galois Cohomology of Witt Vectors of Algebraic Integers*

2. Calculus of Variations and Partial Differential Equations

24.103
15:00 Joseph Grotowski (The University of Queensland)
*New Boundary Regularity Results for Elliptic Systems.*

15:30 Todd Oliynyk (Monash University)
*There are no magnetically charged particle-like solutions of the Einstein-Yang-Mills equations for models with Abelian residual groups*

16:00 Frederic Rochon (Australian National University)
*Asymptotics of complete Kahler metrics of finite volume on quasiprojective manifolds*

16:30 Nicholas Fewster-Young (University of New South Wales)
*Existence of solutions to second order nonlinear singular boundary value problems.*

3. Computational Mathematics

24.G01
15:00 Petrus H Potgieter (University of South Africa)
*On the fixed points of computable functions*

15:30 Paul Leopardi (Australian National University)
*Can compatible discretization, finite element methods, and discrete Clifford analysis be fruitfully combined?*

4. Aspects of Applications in Mathematics

24.G02
15:00 Bruce Henry (University of New South Wales)
*Fokker-Planck equations for anomalous subdiffusion in space-and-time-dependent force fields*
15:30 Govind Menon (Brown University)  
*How long does it take to compute the eigenvalues of a random matrix*

16:00 Ben Goldys (University of New South Wales)  
*Liouville theorem for some infinite-dimensional diffusions*

16:30 Tony Roberts (University of Adelaide)  
*Stochastic self-similar solutions emerge from stochastic reaction-diffusion equation*

5. Operator Algebras and Noncommutative Geometry

24.101
15:00 Ben Maloney (University of Wollongong)  
*Actions of Ore Semigroups on Higher Rank graphs*

15:30 Michael Whittaker (University of Wollongong)  
*Spectral Triples for Hyperbolic Dynamical Systems*

16:00 Adam Rennie (Australian National University)  
*Dimension in noncommutative geometry*

16:30 Snigdhayan Mahanta (The University of Adelaide)  
*Twisted $K$-theory and bivariant Chern–Connes type character of some infinite dimensional spaces*

6. Optimisation

24.102
15:00 Andrew Craig Eberhard (Royal Melbourne Institute of Technology)  
*Some Algorithms in Revealed Preference Theory*

15:30 Brailey Sims (University of Newcastle)  
*Alternating projection type algorithms in the absence of convexity*

16:00 Faramroze Engineer (University of Newcastle)  
*Turbo-charging the Feasibility Pump*

16:30 Francisco Javier Aragón Artacho (The University of Newcastle)  
*Lipschitzian properties of Newton’s iteration*

7. Geometry and Topology

24.G03
15:00 Snigdhayan Mahanta (The University of Adelaide)  
*Assembly maps and the integral $K$-theoretic Novikov conjecture*

15:30 Elizabeth Stanhope (Lewis and Clark College/The University of Melbourne)  
*Controlling orbifold topology via the Laplace spectrum*

16:00 Alexander Hanysz (University of Adelaide)  
*Oka properties of some hypersurface complements*

16:30 Ali Sayed Elfard (University of Wollongong)  
*On free paratopological groups*

9. Financial Mathematics

24.105
15:00 Guanghua Lian (Auckland University of Technology)  
*Consistent Modeling of SPX and VIX Options: Efficient Evaluation Issues in Gatheral’s Three-factor Model*

15:30 Ivan Guo (University of Sydney)  
*Multi-Player Dynkin Games*

16:00 Marianito Rodrigo (University of Wollongong)  
*Calibration of Vasicek and CIR interest rate models via generating functions*

16:30 Joanna Goard (University of Wollongong)  
*Pricing of volatility derivatives using $3/2$ stochastic models*
10. Combinatorics

24.201
15:00 Cheryl Praeger (The University Of Western Australia)
Normal coverings of finite symmetric and alternating groups
15:30 Alice Devillers (The University Of Western Australia)
On quasiprimitive rank 3 permutation groups
16:00 Akos Seress (The University Of Western Australia)
Disconnected colors in generalized Gallai colorings

12. General session

24.204
15:00 Ian Doust (University of New South Wales)
Metric trees of generalized roundness one
15:30 Stephen James Sanchez (University of New South Wales)
p-negative type of finite metric spaces
16:00 Nicholas Bartlett (AMSI)
Hall-Littlewood polynomials and generalisations of the Rogers-Ramanujan identities.
16:30 Vladimir Gaitsgory (University of South Australia)
Singularly Perturbed Linear Programming Problems

14. Differential Geometry

24.203
15:30 Vladimir Soucek (Charles University)
Dunkl operators and a family of realizations of $osp(1|2)$
16:00 Mathew Langford (Australian National University)
Asymptotic Convexity of Hypersurfaces Moving by Curvature
16:30 Naghmana Tehseen (La Trobe University)
Geometric approach to partial differential equations

15. Education Afternoon

Hope Theatre
15:30 Michael Giudici (University of Western Australia)
Wallpaper, Crystals and Symmetry
16:00 Michael Barnsley (Australian National University)
Fractals and Dynamics in Education
16:30 Panel discussion (Various)
Cave or Tunnel? Is there light ahead?
Plenary Lecture – Hope Theatre

09:00  George Willis (The University of Newcastle)
       Totally disconnected, locally compact groups

ARC Presentation – Leanne Harvey  10:00 – 11:00

Morning Tea – Hope Theatre Foyer  11:00 – 11:30

Morning Special Sessions

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1. Algebra and Number Theory

24.104
11:30 James Parkinson (University of Sydney)
A complete classification of commutative parabolic Hecke algebras

12:00 Michael Giudici (The University Of Western Australia)
Generalised quadrangles with a group acting primitively on points and lines

12:30 Murray Elder (The University of Newcastle)
New results about Baumslag-Solitar groups

2. Calculus of Variations and Partial Differential Equations

24.103
11:30 Xu-Jia Wang (Australian National University)
Regularity of elliptic and parabolic equation along a vector field

12:00 Daniel Daners (University of Sydney)
An isoperimetric inequality related to a Bernoulli problem

12:30 Florica Cirstea (University of Sydney)
On the classification of isolated singularities for nonlinear elliptic equations
4. Aspects of Applications in Mathematics
24.G02
11:30 Thien Tran-Duc (University of Wollongong)
   General Model for Molecular Interactions in a Benzene Dimer
12:00 Ngamta Thamwattana (University of Wollongong)
   Modeling encapsulation of acetylene molecules into carbon nanotubes
12:30 Barry Cox (University of Adelaide)
   Model for carbon nanocones

7. Geometry and Topology
24.G03
11:30 Facundo Memoli (University of Adelaide)
   Stability of Persistent Homology Invariants
12:00 Volker Gebhardt (University of Western Sydney)
   Finite index subgroups of mapping class groups
12:30 Craig Westerland (The University of Melbourne)
   Twisted Morava K-theory

8. Topological Groups and Harmonic Analysis
24.204
11:30 Xuan Duong (Macquarie University)
   Boundedness of singular integrals and their commutators with BMO functions on Hardy spaces.
12:00 Jeffrey Hogan (University of Newcastle)
   Higher-dimensional Clifford Fourier transforms

24.201
12:30 George Willis (The University of Newcastle)
   Weighted convolution algebras on locally compact groups

10. Combinatorics
24.201
11:30 Jennifer Seberry (University of Wollongong)
   Higher dimensional Hadamard matrices
12:00 Barbara Maenhaut (The University of Queensland)
   Almost regular edge colourings of complete bipartite graphs
12:30 Richard P Brent (Australian National University)
   Computing Bernoulli and Tangent numbers

11. Probability and Statistics
24.101
11:30 Mark James Fielding (University of Wollongong)
   Gaussian processes in Hybrid MCMC and Simulated Annealing for computationally expensive objective functions.
12:00 Scott Sisson (AMSI)
   Approximate Bayesian computation (ABC) and Bayes linear analysis: Towards high-dimensional ABC
12:30 John Ormerod (University of Sydney)
   Hybrid Variational Bayes
13. Mathematical Physics

24.202
11:30 Timothy Garoni (Monash University)
   Loop models in three dimensions
12:00 Nicholas Beaton (MASCOS / University of Melbourne)
   A non-directed model of polymer adsorption
12:30 Anthony Mays (The University of Melbourne)
   A geometric triumvirate of random matrices

14. Differential Geometry

24.203
11:30 Katharina Neusser (Australian National University)
   On some generic distributions and their automorphism groups
12:00 Dennis The (Australian National University)
   Rigidity of Schubert varieties in compact Hermitian symmetric spaces
12:30 Katja Sagerschnig (Australian National University)
   \((2,3,5)\)-distributions and associated conformal structures

\[ \square \text{Lunch 13:00 – 14:00} \]

- \[ \square \text{Plenary Lecture – Hope Theatre} \]
  14:00 Hiroshi Matano (University of Tokyo)
  Traveling waves in a sawtoothed cylinder and their homogenization limit

- \[ \square \text{Afternoon Tea – Hope Theatre foyer 15:00 – 15:30} \]
- \[ \square \text{NCMS: Nalini Joshi – Hope Theatre 15:30 – 16:00} \]
- \[ \square \text{AGM – Hope Theatre 16:00 – 17:00} \]
Thursday 29 September 2011

- Plenary Lecture – Hope Theatre
  09:00 ▶ Mick Roberts (Massey University)
  Mathematical models for the evolution and transmission of a virus

- Morning Tea – Hope Theatre Foyer 10:00 – 10:30

- Morning Special Sessions

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1. Algebra and Number Theory

24.104
10:30 Attila Egri-Nagy (University of Western Sydney)
Dependency Functions in Hierarchical (De)Compositions of Finite Transformation Semigroups
11:00 James East (University of Western Sydney)
Defining relations for idempotent generators in finite semigroups of mappings
11:30 Anthony Henderson (University of Sydney)
Small representations and the affine Grassmannian
12:00 Nora Ganter (The University of Melbourne)
Characters of categorical representations
12:30 Debargha Banerjee (Australian National University)
Endomorphism algebras of modular motives

2. Calculus of Variations and Partial Differential Equations

24.103
10:30 Yihong Du (University of New England)
Propagation in a time-periodic nonlinear diffusion problem with free boundary
11:00 James McCoy (University of Wollongong)
Fully nonlinear curvature flow with nonconvex initial data
11:30 Edward Norman Dancer (University of Sydney)
Large interaction problems for non-linear P.D.E.
4. Aspects of Applications in Mathematics

24.G02
10:30 Robert Marangell (University of Sydney)
"Stability and Instability in Kink-wave Solutions to the Sine-Gordon Equation"
11:00 Thi Dinh Tran (University of New South Wales)
"Complete integrability of mappings obtained from the discrete Korteweg-De Vries and a double copy of the discrete potential Korteweg-De Vries equations"
11:30 James Atkinson (University of Sydney)
"On exact solutions of integrable discrete equations"
12:00 Nalini Joshi (University of Sydney)
"The repellor and the limit set in complex dynamics of the Painlevé equations"

5. Operator Algebras and Noncommutative Geometry

24.101
10:30 Aidan Sims (University of Wollongong)
"Equivalence and amenability for Fell bundles"
11:00 Valentin Deaconu (University of Nevada, Reno)
"Entropy of shifts on topological graph C*-algebras"
11:30 Samuel Webster (University of Wollongong)
"k-coloured graphs and k-graphs."
12:00 Sooran Kang (University of Wollongong)
"Co-universal C*-algebras associated with aperiodic k-graphs"

6. Optimisation

24.102
10:30 Boris Miller (Monash University)
"Optimization of connected controlled Markov chains"
11:00 Masoud Talebian (University of Newcastle)
"Dynamic Assortment and Pricing under Demand Learning"
11:30 Jerzy Filar (Flinders University)
"Identifying non-Hamiltonicity of cubic graphs by nested linear programming"
12:00 Christopher John Price (University of Canterbury)
"Recycling bases in the Halton sequence: an optimization view"

7. Geometry and Topology

24.G03
10:30 Michael Eastwood (Australian National University)
"Some remarks on linear elasticity"
11:00 Finnur Larusson (University of Adelaide)
"Deformations of Oka manifolds"
11:30 Nora Ganter (The University of Melbourne)
"Topological K-theory"
12:00 Laurentiu Paunescu (University of Sydney)
"A’Campo curvature bumps"

12. General session

24.204
10:30 Raymond Booth (Flinders University)
"The Vanishing Art of Introductory Mathematics"
11:00 Prabhu Manyem (Shanghai University)
"Nearly Identical Expressions in Existential Second Order Logic for Problems in P and NP"
11:30 Rupert Gordon McCallum (University of New South Wales)
"A new large cardinal property"
13. Mathematical Physics

24.202
10:30 Demosthenes Ellinas (Technical University of Crete)
Quantum Master Equations from Operator Valued Measures: A Hopf Algebraic Approach
11:00 Peter Forrester (The University of Melbourne)
A Fuchsian differential equation for Selberg correlation integrals
11:30 Andrea Bedini (MASCOS / University of Melbourne)
From second-order to first-order in an infinite number of steps
12:00 Andrew Norton (Max Planck Institute for Gravitational Physics)
The equation of motion of an extended charged particle

14. Differential Geometry

24.203
11:30 Tohru Morimoto (Kinki University)
Subriemannian curvatures
12:00 Petr Somberg (Charles University)
Howe duality for the symplectic Dirac operator

Lunch 12:30 – 14:00
List of Registrants

As of 13 September 2011

Ms Natalie Aisbett
Dr Vigleik Angeltveit
Dr Christopher Angstmann
Dr Francisco Javier Aragón Artacho
Dr James Atkinson
Mr Alexander Badran
Ms Fran Baker
Mr Menaka Lashitha Bandara
Dr Debargha Banerjee
Mr Christopher Banks
Dr Ewan Barker
Prof Michael Fielding Barnsley
Mr Nicholas Bartlett
Prof Andrew Bassom
Mr Nicholas Beaton
Dr Andrea Bedini
Mr Andrew Birrell
Prof Natasha Boland
Dr Raymond Booth
Prof Jonathan Borwein
Prof Peter Bouwknegt
Prof Richard P Brent
Dr Nathan Brownlowe
Mr Paul Bryan
Prof Martin Bunder
Mr Samuel Butler
Prof Andreas Cap
Dr Vivien Challis
Prof Carl Chiarella
Mr Maurice Chiody
Ms Cath Chisholm
Dr Florica Cirstea
Dr Julie Chutterbuck
Mr Matthew Kevin Cooper
Prof Michael Cowling
Dr Barry Cox
Dr Mark Craddock
Mr Andrew Crisp
Prof Edward Norman Dancer
Dr Daniel Daners
Dr Pamela Joy Davy
Dr Jan De Gier
Mr Frank De Silva
Dr Valentin Deaconu
Dr Jim Denier
Mr Paul Denny
Dr Alice Devillers
Dr Norman Do
Prof Ian Doust

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Prof Yihong Du
Prof Xuan Duong
Dr David Easdown
Dr James East
Prof Michael Eastwood
Prof Andrew Craig Eberhard
Dr Maureen Edwards
Dr Attila Egri-Nagy
Prof Matthias Ehrgott
Dr Murray Elder
Mr Ali Sayed Elfard
Prof Demosthenes Ellinas
Dr Faramroze Engineer
Ms Mehri Esmaeili Darafshani
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Mr Bao Ho
Dr Jeffrey Hogan
Mr Daniel Horadam
Dr Algy Howe
Mr Philip Howes
Mr Daniel Jackson
Dr Simon James
Mrs Sangeeta Jhanjee
Dr Qinian Jin
Dr Stuart Johnson
Prof Nalini Joshi
Dr Sooran Kang

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Mr Sudi Mungkasi Australian National University
Prof Amnon Neeman Australian National University
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Dr Andrew Norton Max Planck Institute for Gravitational Physics
Dr Andriy Olenko La Trobe University
Dr Todd Oliynyk Monash University
Mr Wilson Ong Australian National University
Dr John Ormerod University of Sydney
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Dr Hung Le Pham
Dr Denis Potapov
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Dr Ngamta Thamwattana
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Mr Thien Tran-Duc
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Bond University
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University of Newcastle
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The University of Melbourne
La Trobe University
University of Wollongong
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University of Sydney
University of Sydney
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University of Wollongong
La Trobe University
The University of Melbourne
Mr James Wan  
Dr Bryan Wang  
Prof Xu-Jia Wang  
Prof You-Gan Wang  
Dr Samuel Webster  
Dr Martin Wechselberger  
Dr Craig Westerland  
Dr Michael Whittaker  
Prof George Willis  
Mr Shane Wilson  
Dr Leigh Wood  
Prof Ruibin Zhang  
Dr Tonghua Zhang  
Prof Song-Ping Zhu  
Dr Wadim Zudilin  

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0.1. Geometric Asymptotics or “How I learnt to stop worrying and love exceptional Lie groups”
Nalini Joshi (University of Sydney)
11:30 Mon 26 September 2011 – Hope Theatre
Nalini Joshi
At the heart of models of contemporary science are highly transcendental solutions of integrable systems whose mathematical description remains incomplete. They form the core of modern special function theory, which will shape the success and failure of scientific models for decades to come.
In this talk, I will explain what we know about these functions and describe a new mathematical theory that is expected to dramatically improve our understanding of these functions.

0.2. Penrose’s Weyl Curvature Hypothesis and his Conformal Cyclic Cosmology
Kenneth Paul Tod (University of Oxford)
14:00 Mon 26 September 2011 – Hope Theatre
Kenneth Paul Tod
Penrose’s Weyl Curvature Hypothesis, which dates from the late 70s, is a hypothesis, motivated by observation, about the nature of the Big Bang as a singularity of the space-time manifold. His Conformal Cyclic Cosmology is a remarkable suggestion, made a few years ago and still being explored, about the nature of the universe, in the light of the current consensus among cosmologists that there is a positive cosmological constant. I shall review both sets of ideas within the framework of general relativity, and emphasise how the second set solves a problem posed by the first.

0.3. How mathematics can help to measure atomic scale phenomena, design spacecraft and predict the flow of ornate water fountains
John Sader (The University of Melbourne)
09:00 Tuesday 27 September 2011 – Hope Theatre
John E. Sader
The art of applied mathematics lies in identifying the essential features of a “real-life” problem. This then leads to its abstraction to a mathematical formulation from which the underlying mechanisms and their consequences can be analysed. In this talk, I will give an overview of some of the applied mathematics my group is conducting in fields related to nanotechnology, classical fluid dynamics and space technology. I will endeavour to show that simple mathematical ideas can contribute to advances in modern technology and understanding of seemingly complex physical phenomena. Specifically, I will give an overview of work dealing with advancing the technological infrastructure of atomic scale measurements, understanding the design of hypersonic vehicles used for atmospheric entry of planetary probes, and explaining why ornate flows are generated by directing a jet (such as that emitted from a garden hose) onto a flat ceiling.

0.4. Algebraic K-theory via the trace method
Vigleik Angeltveit (Australian National University)
14:00 Tuesday 27 September 2011 – Hope Theatre
Vigleik Angeltveit
Algebraic K-theory is important in many different fields: algebraic geometry, number theory, geometric topology, and of course algebraic topology. The algebraic K-theory of a ring lives in stable homotopy theory and is extremely difficult to compute directly from the definition. But there is a comparison map to topological Hochschild homology, which is often easier to understand.
In my talk I will attempt to outline how one can use this comparison map to understand algebraic K-theory, and give some recent examples of instances where this approach has been successful. Parts of what I will be talking about is joint work with Teena Gerhardt and/or Lars Hesselholt.

0.5. PUBLIC LECTURE: The mathematics of epidemics and pandemics
Mick Roberts (Massey University)
18:30 Tuesday 27 September 2011 – Hope Theatre
Mick Roberts
This talk will describe how mathematical models may be used to explain the dynamics of infectious diseases, especially those caused by a virus. The measles vaccination schedule in New Zealand was redesigned in 2001 using a model, and there have been no further epidemics. Mosquito-borne viruses such as dengue are spreading into new regions due to climate change. Other viruses, like influenza and HIV, are difficult to bring under control, as they evolve rapidly to avoid the immune response. Mathematical models help us to understand epidemiology and guide public health interventions. I will explain how these models are constructed and analysed, using a minimum of mathematics.

0.6. Totally disconnected, locally compact groups
George Willis (The University of Newcastle)
09:00 Wednesday 28 September 2011 – Hope Theatre
George Willis
Locally compact groups appear in many branches of mathematics and their rich theory lends them their own intrinsic interest. It was shown by A.
Haar and A. Weil that locally compact groups are precisely those that support a translation-invariant measure, which has the further impact that they are also the class of groups to which methods of harmonic analysis naturally extend. Study of the structure of locally compact groups falls into two cases: connected groups, which appear as symmetries of smooth structures such as spheres for example; and totally disconnected groups, which appear as symmetries of discrete structures such as trees, as well as in number theoretic and algebraic contexts.

While the understanding of connected groups was essentially completed with the solution of Hilbert’s Fifth Problem in the 1950’s, the theory of totally disconnected groups is now at an exciting stage where enough has been discovered that the outlines of a full structure theory may dimly be seen but where many blank spaces remain. The lecture will survey recent advances in the understanding of totally disconnected, locally compact groups. These include: general tools that partially fill the role played by linear methods in the theory of Lie groups; applications of these methods in algebra and geometric group theory; and work on the classification of simple totally disconnected groups. Future directions for research and areas where discoveries remain to be made will be indicated.

0.7. Traveling waves in a sawtoothed cylinder and their homogenization limit
Hiroshi Matano (University of Tokyo)
14:00 Wednesday 28 September 2011 – Hope Theatre
Hiroshi Matano
My talk is concerned with a curvature-dependent motion of plane curves in a two-dimensional cylinder with spatially undulating boundary. The law of motion is given by

\[ V = \kappa + A, \]

where \( V \) is the normal velocity of the curve, \( \kappa \) is the curvature, and \( A \) is a positive constant. The boundary undulation is assumed to be recurrent. In other words, the boundary has many bumps that are aligned in a spatially recurrent manner. This includes periodic and quasi-periodic undulations as special cases.

We discuss how the average speed of the traveling wave depends on the geometry of the domain boundary. We will first give a necessary and sufficient condition for a traveling wave to exist. We then show that traveling waves have well-defined average speed if the undulation is uniquely ergodic. Next we present an example of traveling wave whose average speed is zero. Such a peculiar situation, which we call “virtual pinning”, can occur only in non-periodic environments.

We then consider the homogenization problem as the boundary undulation becomes finer and finer, and determine the homogenization limit of the average speed and the limit profile of the traveling waves. Quite surprisingly, this homogenized speed depends only on the maximal opening angles of the domain boundary and no other geometrical features are relevant.

We also estimate the rate of convergence of the traveling wave speed to its homogenization limit. It turns out that this convergence rate is precisely \( O(\sqrt{\varepsilon}) \) when the boundary undulation is periodic, while it is slower in the aperiodic case, where \( \varepsilon \) is a parameter that represents the typical scale of the boundary undulation. In a more general case where the boundary undulation is quasi-periodic with \( m \) independent frequencies, our preliminary analysis suggests that the convergence rate is \( O(\varepsilon^{2/(m+3)}) \), with some logarithmic corrections. This formula shows that the convergence becomes slower as \( m \) increases.

This is joint work with Bendong Lou and Ken-Ichi Nakamura.

0.8. Mathematical models for the evolution and transmission of a virus
Mick Roberts (Massey University)
09:00 Thursday 29 September 2011 – Hope Theatre
Mick Roberts
The influenza virus evolves through gradual mutation, causing antigenic drift. This enables the virus to compromise the effectiveness of the immune system. Less frequently, a reassortment leads to an antigenic shift, followed by a pandemic such as that of H1N1 (swine flu) in 2009. The HIV virus evolves within the host, forming ‘escape mutants’ that are not recognised by the immune system. Mathematical models may be used to describe and explain these processes, and to devise strategies for the control or elimination of the infection. In addition, models are now routinely used for predicting the public health requirements of epidemics of emerging infections.
1. Algebra and Number Theory

1.1. Endomorphism algebras of modular motives
Debargha Banerjee (Australian National University)
12:30 Thursday 29 September 2011 – 24.104
Debargha Banerjee / Eknath Ghate

We will show the endomorphism algebras of modular motives are related to a suitable lifts of the modular forms.

1.2. Lucas Functions and Sums of Powers of Irrationals
Martin Bunder (University of Wollongong)
10:30 Tuesday 27 September 2011 – 24.104
Martin Bunder

Lucas functions \( U_n(P, Q) \) satisfy:
\[
U_0(P, Q) = 0, U_1(P, Q) = 1, \\
U_{n+1}(P, Q) = PU_n - QU_{n-1}(P, Q).
\]
We show that for any positive integer \( m \), there are integers \( h, k, t_h, \ldots, t_k \) such that for all positive integers \( n \) and a range of values of integers \( P \) and \( Q \):
\[
mU_n(P, Q) = \sum_{i=1}^{k} t_i U_{n+i}(P, Q),
\]
where \( \sum_{i=1}^{k} t_i U_{n+i}(P, Q) < U_{n+s+1}(P, Q) \) for \( h \leq s < k \). Also \( m = \sum_{i=1}^{k} t_i c^i \), for \( c = 1/2(P = \pm \sqrt{P^2 - 4Q}) \). Several results in this paper can be generalised to Horadam functions.

1.3. An exotic Springer correspondence
Andrew Crisp (University of Sydney)
11:00 Tuesday 27 September 2011 – 24.104
Andrew Crisp

The Springer Correspondence is a deep result in algebraic geometry which establishes a connection between orbits of nilpotent elements in a Lie algebra and the irreducible representations of its associated Weyl group. An “exotic” bijective correspondence for type \( C \) is achieved by considering the action of the symplectic group on a different variety, the exotic nilpotent cone. I will present my work in describing an analogue for type \( F \), highlighting the octonionic origins of the exceptional Lie algebras and the interesting challenges involved in constructing and exploring this representation.

1.4. Representations of Affine \( q \)-Schur Algebras
Jie Du (University of New South Wales)
16:30 Tuesday 27 September 2011 – 24.104
Jie Du

We establish an isomorphism from the quantum loop algebra \( U_{C}(\widehat{gl}_{n}) \) with Drinfeld’s new presentation to the double Ringel–Hall algebra associated with a cyclic quiver \( \triangle(n) \) and an explicit homomorphism from the double Ringel–Hall algebra to an affine \( q \)-Schur algebra \( S_{\Delta}(n, r)_{C} \). We use them to link polynomial representations of \( U_{C}(\widehat{gl}_{n}) \) with representations of \( S_{\Delta}(n, r)_{C} \). Thus, using Chari-Pressley’s classification of finite dimensional representations of \( U_{C}(\widehat{gl}_{n}) \) and its generalization to irreducible polynomial representations of \( U_{C}(\widehat{gl}_{n}) \) by Frenkel and Mukhin, we are able to classify irreducible representations of \( S_{\Delta}(n, r)_{C} \) in terms of Drinfeld’s polynomials, when the parameter \( q \) is not a root of 1. On the other hand, using the classification of irreducible representations of the affine Hecke algebra \( H_{\Delta}(r)_{C} \) associated with an affine symmetric group by Zelevinsky and Rogawski, we obtain another classification of irreducible representations of \( S_{\Delta}(n, r)_{C} \) in terms of multi-segments. When \( n > r \), we identify the two classifications by an explicit map from multi-segments to Drinfeld’s polynomials.

This is joint work with Bangming Deng and Qiang Fu.

1.5. Defining relations for idempotent generators in finite semigroups of mappings
James East (University of Western Sydney)
11:00 Thursday 29 September 2011 – 24.104
James East

John Howie showed in 1966 that any non-bijective function from a finite set to itself can be obtained by composing a number of idempotent functions. In semigroup theoretic terms, this says that the singular part of a finite transformation semigroup is generated by its idempotents. I’ll present a set of defining relations for this singular subsemigroup with respect to the generating set consisting of all corank 1 idempotents. Along the way, I’ll also discuss some other extensions of Howie’s results in the context of partial transformation semigroups, Brauer monoids, partition monoids, semigroups of integer matrices, and semigroups of transformations of various kinds of spaces. If time permits, I’ll say something about the infinite case.

1.6. Dependency Functions in Hierarchical (De)Compositions of Finite Transformation Semigroups
Attila Egri-Nagy (University of Western Sydney)
10:30 Thursday 29 September 2011 – 24.104
Attila Egri-Nagy
Turning around the decompositions of finite transformation semigroups (Krohn-Rhodes Theory) we start from a fixed list of transformation semigroups

$$(X_1, S_1), \ldots, (X_n, S_n)$$

and build cascaded structures (substructures of the wreath product). Operations in the hierarchical structure are described as a tuple of functions $(d_1, \ldots, d_n)$ where a dependency function $d_i$ (of level $i$) is a function

$$d_i : X_1 \times \cdots \times X_{i-1} \to S_i \quad i \in \{1 \ldots n\}.$$ 

Algebraically these encode an action on trees and from an algorithmic viewpoint these functions and their combinatorial properties are the prime objects of study. Here we summarize the basic properties of dependency functions in hierarchical decompositions (real dependence, monomial generators, etc.) and outline the most important questions that are needed for dealing with decompositions. In general, we ask how and to what extent the local properties of the dependency functions determine the global properties of the composite structure.

1.7. New results about Baumslag-Solitar groups
Murray Elder (The University of Newcastle)
12:30 Wednesday 28 September 2011 – 24.104
Murray Elder
I will discuss some new results about this class of groups.

1.8. Characters of categorical representations
Nora Ganter (The University of Melbourne)
12:00 Thursday 29 September 2011 – 24.104
Nora Ganter, Mikhail Kapranov
Let $G$ be a finite group. The notion of representation of $G$ by functors on a category $V$ goes back to Grothendieck. More generally, one can consider representations of $G$ by 1-automorphisms of an object $V$ in a 2-category.

We introduce and study the character theory of such representations. The talk will give a short introduction to the subject and then dive into some applications.

1.9. Lifting modular forms
Alex Ghitza (The University of Melbourne)
16:00 Tuesday 27 September 2011 – 24.104
Alex Ghitza and Scott Mullane
We discuss applications of vanishing theorems for sheaf cohomology to the question of relating the spaces of modular forms (mod $p$) and spaces of modular forms in characteristic zero.

1.10. Generalised quadrangles with a group acting primitively on points and lines
Michael Giudici (The University Of Western Australia)
12:00 Wednesday 28 September 2011 – 24.104
Michael Giudici
Generalised polygons were introduced by Tits as a model for studying the simple groups of Lie type of rank 2. A generalised quadrangle is an incidence structure of points and lines such that the bipartite incidence graph has diameter 4 and girth 8. The classical examples are the low dimensional polar spaces associated with the classical groups $PSp(4,q)$, $PSU(4,q)$ and $PSU(5,q)$, and their duals. In this talk I will discuss recent work aimed at characterising the classical examples in terms of the action of their automorphism group on points and lines. This is joint work with John Bamberg, Joy Morris, Gordon Royle and Pablo Spiga.

1.11. Structure of Hjelmslev planes over Galois rings.
Joanne Hall (Royal Melbourne Institute of Technology)
17:00 Mon 26 September 2011 – 24.104
Joanne Hall, Asha Rao, Diane Donovan
Hjelmslev planes are a geometric structure with emerging applications in coding theory and quantum cryptography. Projective Hjelmslev planes are a generalisation of projective planes. Just as some projective planes can be constructed using a field, some Hjelmslev planes can be constructed using rings. We investigate the structure of a projective Hjelmslev plane over a Galois ring.

1.12. Small representations and the affine Grassmannian
Anthony Henderson (University of Sydney)
11:30 Thursday 29 September 2011 – 24.104
Pramod Achar and Anthony Henderson
Let $G$ be a simple algebraic group over the complex numbers. For any irreducible representation $V$ of $G$, the zero weight space $V^T$ of $V$ carries a representation of the finite Weyl group $W$. This is known to be particularly nice when $V$ is small, meaning that no weight of $V$ is twice a root of $G$. For example, when $G = PGL_n$ and $V$ is small, $V^T$ is an irreducible representation of $S_n$, and all irreducible representations of $S_n$ arise in this way. I will explain the geometric significance of smallness, and how the small part of the affine Grassmannian of the dual group $G^\vee$ (geometrizing representations of $G$) can be explicitly related to its nilpotent cone (geometrizing representations of $W$).
1.13. Fractal Groups and Automata
Daniel Horadam (University of Newcastle)
12:00 Tuesday 27 September 2011 – 24.104
Daniel Horadam
Fractal groups are a class of self-similar groups which act by automorphisms on a regular rooted tree. They play an important role in the structure theory of totally disconnected locally compact groups. In this talk I will present some examples and interesting properties of fractal groups, in particular those which are generated by finite automata, and discuss how they might be classified.

1.14. Various generalisations of minimax theorem using Clifford algebras
Sangeeta Jhanjee (Monash University)
15:30 Tuesday 27 September 2011 – 24.104
Sangeeta Jhanjee
The minimax principle or Courant-Fischer-Weyl minimax principle provides a variational characterisation of all eigenvalues. It is one of the most powerful tools in the investigation of the spectrum. In this talk, I would like to present various generalisations of minimax theorem using Clifford algebras.

1.15. Topology of eigenspace posets for unitary reflection groups
Justin Koonin (University of Sydney)
16:30 Mon 26 September 2011 – 24.104
Justin Koonin
The eigenspace theory of unitary reflection groups, initiated by Springer and Lehrer, suggests that there are analogues for reflection groups (in fact for all linear groups) of the Quillen complex of p-subgroups of a finite group. We investigate topological properties of these complexes, and the representations of reflection groups on their homology.

This talk will serve as an introduction to poset topology and its application to representation theory, and will also present new results which extend the well-known work of Orlik and Solomon on hyperplane arrangements.

1.16. Diophantine approximation of $q$-continued fractions
Ville Merila (University of Newcastle)
15:00 Tuesday 27 September 2011 – 24.104
Ville Merila
In his notes Ramanujan studied, among many other topics, certain continued fractions whose partial numerators and denominators are polynomials in parameter $q$, (usually $|q| < 1$). Many of these $q$-continued fractions have a rich structure for their connections to (number theoretic) functions such as (partial) theta function and partition function. In this talk we shall consider a wide class of $q$-continued fractions from the viewpoint of Diophantine approximation. Some special cases comprise for example Ramanujan, Ramanujan-Selberg, Eisenstein and Tasoev’s continued fractions with sharp irrationality measures.

1.17. An Alternative Proof of Hesselholt’s Conjecture on Galois Cohomology of Witt Vectors of Algebraic Integers
Wilson Ong (Australian National University)
17:00 Tuesday 27 September 2011 – 24.104
Wilson Ong
Let $K$ be a complete discrete valuation field of characteristic zero with residue field $k_K$ of characteristic $p > 0$. Let $L/K$ be a finite Galois extension with Galois group $G = \text{Gal}(L/K)$ and suppose that the induced extension of residue fields $k_L/k_K$ is separable. Let $W_n(\cdot)$ denote the ring of $p$-typical Witt vectors of length $n$. Hesselholt conjectured that the pro-abelian group $\{H^1(G, W_n(O_L))\}_{n \geq 1}$ is isomorphic to zero. Hogadi and Pisolkar have recently provided a somewhat lengthy proof of the conjecture. In this paper, we provide a considerably shorter proof of Hesselholt’s conjecture.

1.18. Homogeneous Spaces of $p$-Compact Groups
Omar Ortiz (The University of Melbourne)
11:30 Tuesday 27 September 2011 – 24.104
Omar Ortiz, Arun Ram, Craig Westerland
$p$-compact groups are the topological realization of complex reflection groups. In this talk we will focus in the object analogous to the flag variety in this setting and describe its cohomology using techniques from moment graph theory.

1.19. A complete classification of commutative parabolic Hecke algebras
James Parkinson (University of Sydney)
11:30 Wednesday 28 September 2011 – 24.104
James Parkinson
In this talk we describe a complete classification of commutative parabolic Hecke algebras (for Coxeter groups of arbitrary type, and arbitrary parabolic subgroups). In finite type, for example, these algebras arise as centraliser rings of induced permutation representations of finite groups of Lie type, and as such have a long and rich history. This is joint work with Peter Abramenko (Virginia) and Hendrik Van Maldeghem (Ghent).
1.20. Legendre Polynomials and Ramanujan-like series for $1/\pi$

James Wan (University of Newcastle)

16:00 Mon 26 September 2011 – 24.104

James Wan, Heng Huat Chan, Wadim Zudilin

In 1914, Ramanujan produced rational series for $1/\pi$ times a quadratic irrational; ever since such series have been a source of fascination. Inspired by the recent conjectures of Z. W. Sun and G. Almkvist, we present a recipe for producing very general series for $1/\pi$ in the spirit of Ramanujan.

In our resolution of the conjectures, we derive a new generating function for the rarefied Legendre polynomials, using some well-known results (such as Bailey’s identity) as well as a ‘forgotten’ result due to F. Brafman. Followed by significant amount of computer experimentation, and drawing from the theory of modular forms and hypergeometric series, we are able to prove rather unexpected links between the Legendre polynomials, Apery-like sequences, and $1/\pi$.

This talk is based on joint work with Heng Huat Chan and Wadim Zudilin.

1.21. Ramanujan-style mathematics for Mahler measures

Wadim Zudilin (The University of Newcastle)

15:00 Mon 26 September 2011 – 24.104

Wadim Zudilin

In my talk I will review some recent progress on evaluations of Mahler measures via hypergeometric series and Dirichlet $L$-series. I will provide more details for the case of the Mahler measure of $1 + x + 1/x + y + 1/y$, whose evaluation was observed by C. Deninger and conjectured by D. Boyd (1997). The main ingredients are relations between modular forms and hypergeometric series in the spirit of Ramanujan. The talk is based on joint work with Mat Rogers.
2. Calculus of Variations and Partial Differential Equations

2.1. The Kato square root problem on vector bundles of generalised bounded geometry
Menaka Lashitha Bandara (Australian National University)
16:30 Mon 26 September 2011 – 24.103
Lashi Bandara and Alan McIntosh
We consider complete Riemannian manifolds which are exponentially locally doubling and formulate a notion of generalised bounded geometry for vector bundles over such manifolds. We prove quadratic estimates for perturbations of Dirac type operators on such bundles, and hence obtain a Kato square root type estimate under an appropriate set of assumptions. Furthermore, we show that under uniform Ricci curvature bounds and uniform lower bounds on injectivity radius, a Kato square root estimate can be obtained for certain coercive operators over the bundle of finite rank tensors. Lastly, we show that this coercivity condition is automatically satisfied for scalar-valued functions.

2.2. Isoperimetric comparison techniques for Ricci flow on surfaces and curve shortening flow
Paul Bryan (Australian National University)
16:00 Mon 26 September 2011 – 24.103
Paul Bryan, Ben Andrews
I will describe a comparison technique for the isoperimetric profile of surfaces evolving by normalised Ricci flow and for the interior of closed curves evolving by normalised curve shortening flow. From this technique, we obtain explicit curvature bounds leading directly to convergence to a minimising (e.g. constant curvature) configuration.

2.3. On the classification of isolated singularities for nonlinear elliptic equations
Florica Cirstea (University of Sydney)
12:30 Wednesday 28 September 2011 – 24.103
Florica C. Cirstea
In this talk we discuss a broad class of nonlinear elliptic equations in a punctured domain and give a complete classification of the behaviour near an isolated singularity for all positive solutions. An important feature of our study lies in the incorporation of inverse square potentials and weighted nonlinearities, whose asymptotic behaviour is modeled by regularly varying functions. In particular, we find sharp conditions such that the singularity is removable for all non-negative solutions, thus resolving an open question of Vazquez and Veron (1985).

2.4. Optimal bounds for the first Neumann eigenvalue on a manifold
Julie Clutterbuck (Australian National University)
15:30 Mon 26 September 2011 – 24.103
Julie Clutterbuck (joint work with Ben Andrews)
We use gradient bounds to find a new proof of the optimal lower bound for the first Neumann eigenvalue on a manifold with bounds on the Ricci curvature.

2.5. Large interaction problems for non-linear P.D.E.
Edward Norman Dancer (University of Sydney)
11:30 Thursday 29 September 2011 – 24.103
Edward Norman Dancer
We discuss large interaction problems for certain systems of nonlinear elliptic and parabolic equations. These occur in both populations models in biology and nonlinear optics. We show that there is a limit problem when the interaction is large and the different nonlinearities in the two problems give the same limit problem. We also discuss the regularity of the limit problem and estimates for solutions which are uniform in the large parameter. This is joint work with my postdoc Kelei Wang and Zhiting Zhang (Chinese Academy of Sciences).

2.6. An isoperimetric inequality related to a Bernoulli problem
Daniel Daners (University of Sydney)
12:00 Wednesday 28 September 2011 – 24.103
Daniel Daners
Given a bounded domain \( \Omega \subset \mathbb{R}^N \) we look at the minimal parameter \( \Lambda(\Omega) \) for which a Bernoulli free boundary value problem for the \( p \)-Laplacian has a solution minimising an energy functional. We show that amongst all domains of equal volume \( \Lambda(\Omega) \) is minimal for the ball. Moreover, we show that the inequality is sharp with essentially only the ball minimising \( \Lambda(\Omega) \). This is joint work with Bernd Kawohl.

2.7. Propagation in a time-periodic nonlinear diffusion problem with free boundary
Yihong Du (University of New England)
10:30 Thursday 29 September 2011 – 24.103
Yihong Du
We consider the diffusive logistic equation with free boundary in time-periodic environment. Such a problem describes the spreading of a new or
2. Calculus of Variations and Partial Differential Equations

invasive species. We demonstrate a spreading-vanishing dichotomy and determine the asymptotic spreading speed when spreading occurs. This is joint work with Zongming Guo and Rui Peng.

Nicholas Fewster-Young (University of New South Wales)
16:30 Tuesday 27 September 2011 – 24.103
Nicholas Fewster-Young

This talk examines the existence of solutions to nonlinear singular boundary value problems. This area of differential equations has many applications in physical sciences, for example thermal explosions, electrohydrodynamics and radially symmetric nonlinear diffusion in the n-dimensional sphere. The results presented build on the work of P. Hartman and D. O’Regan, and improve on the current results. The method of proving these results relies on obtaining a priori bounds on all solutions to the problem and using O’Regan existence theorems to prove existence of solutions.

2.9. New Boundary Regularity Results for Elliptic Systems.
Joseph Grotowski (The University of Queensland)
15:00 Tuesday 27 September 2011 – 24.103
Joseph Grotowski

We consider quasilinear elliptic systems of divergence type, with inhomogeneity obeying the natural growth condition. We consider some recent results on partial regularity at the boundary under various boundary conditions.

2.10. Study of Mean Curvature Flow Equations using Functional Analysis
David Hartley (Monash University)
11:00 Tuesday 27 September 2011 – 24.103
David Hartley

Geometric evolution equations play an important role in the study of manifolds. One of the most famous evolution equations is where the surface moves at a speed proportional to the mean curvature. The resulting PDE is a heat equation and as such smooths the surface. For mean curvature flow equations one of the most important results is determining when a surface will converge to sphere. In this talk I discuss star-shaped surfaces moving via mean curvature flow equations by considering them as ODEs in an abstract Banach space.

2.11. Dain’s variational principle and its relation to an angular momentum-mass inequality in general relativity
Stephen Michael McCormick (Monash University)
17:00 Mon 26 September 2011 – 24.103
Stephen Michael McCormick

In 2008, Dain used a variational argument to prove that the extreme Kerr solution is a unique absolute minimum of the mass functional among a large class of vacuum, maximal, asymptotically flat, axisymmetric initial data for the Einstein equations with fixed angular momentum. In this talk I intend to provide an overview of Dain’s construction and how this variational argument was first used to prove that among all ‘momentarily stationary’, asymptotically flat, axisymmetric vacuum solutions; critical points of the mass coincide with stationary solutions. Furthermore, if an absolute minimum exists amongst maximal, asymptotically flat, axisymmetric vacuum solutions; then that solution is also ‘momentarily stationary’.

2.12. Fully nonlinear curvature flow with nonconvex initial data
James McCoy (University of Wollongong)
11:00 Thursday 29 September 2011 – 24.103
James McCoy

I will consider initial hypersurfaces which are not necessarily convex moving under second order fully nonlinear curvature flow. I’ll describe recent joint work with Ben Andrews and Mat Langford on non-collapsing of evolving hypersurfaces and some related results.

2.13. Finite Speed of Propagation for First Order Systems and Second Order Operators
Alan McIntosh (Australian National University)
15:00 Mon 26 September 2011 – 24.103
Alan McIntosh

For a self adjoint first order system D with bounded principal symbol, acting on a complete Riemannian manifold M, it is known that the group e^{itD} has finite speed of propagation. By this it is meant that if u has support in a compact set K, then e^{itD}u has support in K_{C|t|} = \{ y \in M; \dist(y,K) \leq C|t| \} for some constant C. I shall present a new proof of this result, at the same time showing that the result holds more generally, with the self-adjointness assumption weakened to the requirement that D generates a C_0 group satisfying \|e^{itD}\| \leq ce^{\kappa|t|} for some constants c and \kappa.

I also present implications of this result concerning Huygen’s principle for second order wave equations. This is recent joint research with Andrew Morris.
2.14. On a nonlocal equation modelling phytoplankton growth
Lin-Feng Mei (University of New England)
11:30 Tuesday 27 September 2011 – 24.103
Lin Feng Mei

We consider a nonlocal differential equation arising from phytoplankton dynamics. The existence, uniqueness, dynamic behaviour, as well as the limiting profiles as certain parameters are in extreme cases are investigated. This is based on a joint paper with Yihong Du.

2.15. There are no magnetically charged particle-like solutions of the Einstein-Yang-Mills equations for models with Abelian residual groups
Todd Oliynyk (Monash University)
15:30 Tuesday 27 September 2011 – 24.103
Todd Oliynyk

According to a conjecture from the 90s, globally regular, static, spherically symmetric (i.e. particle-like) solutions with nonzero total magnetic charge are not expected to exist in Einstein-Yang-Mills theory. In this talk, I will describe recent work done in collaboration with M. Fisher where we establish the validity of this conjecture under certain restrictions on the residual gauge group. Of particular interest is that our non-existence results apply to the most widely studied models with Abelian residual groups.

2.16. Asymptotics of complete Kahler metrics of finite volume on quasiprojective manifolds
Frederic Rochon (Australian National University)
16:00 Tuesday 27 September 2011 – 24.103
Frederic Rochon and Zhou Zhang

Let $X$ be a quasiprojective manifold given by the complement of a divisor $D$ with normal crossings in a smooth projective manifold $\overline{X}$. Using a natural compactification of $X$ by a manifold with corners $\overline{X}$, we describe the full asymptotic behavior at infinity of certain complete Kahler metrics of finite volume on $X$. When these metrics evolve according to the Ricci flow, we prove that such asymptotic behaviors persist at later time by showing the associated potential function is smooth up to the boundary on the compactification $\overline{X}$. However, when the divisor $D$ is smooth with $K_{\overline{X}} + [D] > 0$ and the Ricci flow converges to a Kahler-Einstein metric, we show that this Kahler-Einstein metric has a rather different asymptotic behavior at infinity, since its associated potential function is polyhomogeneous with in general some logarithmic terms occurring in its expansion at the boundary.

2.17. Persistence of bounded solutions of parabolic equations under domain perturbation
Parinya Sa Ngiamsunthorn (University of Sydney)
10:30 Tuesday 27 September 2011 – 24.103
Parinya Sa Ngiamsunthorn

We study the behaviour of bounded solutions (solutions that are defined for all time $t \in (-\infty, \infty)$ and are bounded in a suitable function space) of parabolic equations under perturbation of the underlying domain. We prove some convergence results for bounded solutions of linear parabolic equations in the $L^2$ and the $L^p$-settings. In addition, we study the persistence of a class of bounded solutions which decay to zero at $t \to \pm \infty$ of semilinear parabolic equations under domain perturbation.

2.18. Asymptotic behavior of the least energy solution of a problem with competing powers
Sanjiban Santra (University of Sydney)
12:00 Tuesday 27 September 2011 – 24.103
Sanjiban Santra

We consider the problem $\epsilon^2 \Delta u - u^q + u^p = 0$ in $\Omega$, $u > 0$ in $\Omega$, $u = 0$ on $\partial \Omega$. Here $\Omega$ is a smooth bounded domain in $\mathbb{R}^N$, $1 < q < p < \frac{N+2}{N-2}$ if $N \geq 3$ and $\epsilon$ is a small positive parameter. We study the asymptotic behavior of the least energy solution as $\epsilon$ goes to zero in the case $q \leq \frac{N}{N-2}$. We show that the limiting behavior is dominated by the singular solution $\Delta G - G^q = 0$ in $\Omega \setminus \{P\}$, $G = 0$ on $\partial \Omega$. The reduced energy is of nonlocal type.

2.19. Regularity of elliptic and parabolic equation along a vector field
Xu-Jia Wang (Australian National University)
11:30 Wednesday 28 September 2011 – 24.103
Xu-Jia Wang

By a perturbation argument we study the regularity of solutions in a given direction, assuming that the coefficients and inhomogeneous term are Holder continuous in the direction.
3. Computational Mathematics

3.1. Mahler measures, short walks and log-sine integrals: A case study in hybrid computation
Jonathan Borwein (The University of Newcastle)
11:30 Tuesday 27 September 2011 – 24.G01
Jonathan Borwein and Armin Straub

Abstract: The Mahler measure of a polynomial of several variables has been a subject of much study over the past thirty years. Very few closed forms are proven but many more are conjectured. We provide systematic evaluations of various higher and multiple Mahler measures using moments of random walks and values of log-sine integrals. We also explore related generating functions for the log-sine integrals and their generalizations.

This work, which is joint with Armin Straub, would be impossible without extensive symbolic and numeric computations. It also makes frequent use of the new NIST Handbook of Mathematical Functions.

My intention is to show off the interplay between numeric and symbolic computing while exploring the three topics in title.

3.2. Implementing a topology optimisation algorithm on the GPU
Vivien Challis (University of Queensland)
10:30 Tuesday 27 September 2011 – 24.G01
Vivien Challis

The release of NVIDIA’s CUDA architecture and language CUDA C puts the use of massively parallel Graphical Processing Units (GPUs) within the reach of the scientific programmer, placing large computational power at their finger tips for little cost. I’ll discuss my experiences rewriting our Fortran 90 topology optimisation algorithm using CUDA C. Our algorithm utilises both finite difference and finite element methods, which are well-suited to the GPU architecture. I’ll demonstrate the speed-ups attainable on consumer-grade GPUs compared to our traditional CPU implementation and highlight the lessons I’ve learned about scientific computing using GPUs.

3.3. A fully discrete Galerkin algorithm for high frequency exterior acoustic scattering in three dimensions
Stuart Hawkins (Macquarie University)
11:00 Tuesday 27 September 2011 – 24.G01
Stuart C. Hawkins and M. Ganesh

Surface integral equation reformulations of wave propagation models are the industrial standard to simulate scattering by three dimensional bodies. However, for high frequency scattering, standard discretization techniques for surface integral equations are inefficient for three dimensional exterior scattering simulations because they require a fixed number of unknowns per wavelength in each dimension, leading to very large CPU time and memory requirements.

In this talk we describe an efficient surface integral equation algorithm for simulating high frequency acoustic scattering by three dimensional convex obstacles. Using a powerful integration scheme for highly oscillatory integrals and globally supported high order basis functions, we demonstrate the high order accuracy and efficiency of our algorithm for scatterers with tens of thousands of wavelengths in diameter. Our algorithm requires only mild growth in the number of unknowns and CPU time as the wavenumber increases.

3.4. Inexact Newton regularization methods
Qinian Jin (Australian National University)
15:30 Mon 26 September 2011 – 24.G01
Qinian Jin

Inverse problems arise whenever one searches for unknown causes based on observation of their effects. Such problems are usually ill-posed in the sense that their solutions do not depend continuously on the data. In practical applications, one never has the exact data; instead only noisy data are available due to errors in the measurements. Thus, the development of stable methods for solving inverse problems is an important topic.

The inexact Newton regularization methods have been initiated by Hanke and then generalized by Rieder to solve nonlinear inverse problems in Hilbert spaces. Each of these methods consists of two components: an outer Newton iteration and an inner scheme providing increments by regularizing local linearized equations. An approximate solution is output by a discrepancy principle. Although numerical simulation indicates that they are quite efficient, it is a longstanding question that if these methods are order optimal. I will report our recent work and confirm that the methods indeed are order optimal.

In some situations, methods formulated in Hilbert space setting may not produce good results since they tend to smooth the solutions and thus destroy the special feature in the exact solution. By making use of the duality mappings and the Bregman distance we will formulate the inexact Newton regularization methods in Banach spaces and give the convergence analysis.
3.5. A Stabilized Mixed Finite Element Method for the Biharmonic Equation Based on Biorthogonal Systems
Bishnu Lamichhane (University of Newcastle)
15:00 Mon 26 September 2011 – 24.G01
Bishnu Lamichhane
We propose a stabilized finite element method for the approximation of the biharmonic equation with clamped boundary condition. The mixed formulation of the biharmonic equation is obtained by introducing the gradient of the solution and a Lagrange multiplier as new unknowns. Working with a pair of bases forming a biorthogonal system, we can easily eliminate the gradient of the solution and the Lagrange multiplier from the saddle point system leading to a positive definite formulation. Using a super-convergence property of a gradient recovery operator, we prove an optimal a priori estimate for the finite element discretization for a class of meshes.

3.6. Solving parabolic equations on the unit sphere via Laplace transforms
Quoc Thong Le Gia (University of New South Wales)
16:00 Mon 26 September 2011 – 24.G01
Quoc Thong Le Gia and William McLean
We propose a method to construct numerical solutions of parabolic equations on the unit sphere. The time discretisation uses Laplace transforms and quadrature. The spatial approximation of the solution employs radial basis functions (RBFs) restricted to the sphere. The method allows us to construct high accuracy numerical solutions in parallel. In this work, we establish the $L_2$ error estimates for the cases of smooth and nonsmooth initial data. Some numerical experiments are also presented.

3.7. Can compatible discretization, finite element methods, and discrete Clifford analysis be fruitfully combined?
Paul Leopardi (Australian National University)
15:30 Tuesday 27 September 2011 – 24.G01
Paul Leopardi
This talk describes work in progress, towards the formulation, implementation and testing of compatible discretization of of differential equations, using a combination of Finite Element Exterior Calculus and discrete Geometric Calculus / Clifford analysis. Much work has been done in the two seemingly separate areas of the Finite Element Method and Geometric Calculus for over 42 years, and the first part of this talk briefly describes some of this work. The combination of the two methods could be called Finite Element Geometric Calculus (FEGC). The second part of the talk gives a tentative description of what FEGC might reasonably be expected to look like, if it were to be developed.

3.8. Approximations of the Carrier-Greenspan periodic solution to the shallow water wave equations for flows on a sloping beach
Sudi Mungkasi (Australian National University)
16:30 Mon 26 September 2011 – 24.G01
Sudi Mungkasi and Stephen Gwyn Roberts
The Carrier-Greenspan solutions to the shallow water wave equations for flows on a sloping beach are of two types, periodic and transient. This talk focuses only on periodic-type waves. We review an exact solution over the whole domain presented by Johns [Numerical integration of the shallow water equations over a sloping shelf, International Journal for Numerical Methods in Fluids, 2(3): 253–261, 1982] and its approximate solution (the Johns prescription) prescribed at the zero point of the spatial domain. A new simple formula for the shoreline velocity is presented. We also present new higher order approximations of the Carrier-Greenspan solution at the zero point of the spatial domain. Furthermore, we compare numerical solutions obtained using a finite volume method to simulate the periodic waves generated by the Johns prescription with those found using the same method to simulate the periodic waves generated by the Carrier-Greenspan exact prescription and with those found using the same method to simulate the periodic waves generated by the new approximations. We find that the Johns prescription may lead to a large error. In contrast, the new approximations presented in this talk produce a significantly smaller error. This talk is a presentation of our recently published work in the International Journal for Numerical Methods in Fluids (http://dx.doi.org/10.1002/fld.2607).

3.9. On the fixed points of computable functions
Petrus H Potgieter (University of South Africa)
15:00 Tuesday 27 September 2011 – 24.G01
Petrus H Potgieter
The Brouwer fixed-point theorem has been shown to be essentially non-constructive and non-computable. The counter-examples of Orevkov and Baigger imply that there is no procedure for finding the fixed point in general by providing an example of a computable function (in the sense of the Polish school of computable analysis) which does not fix any computable point. This talk takes a closer look at how non-computable points appear in the sets of fixed points of computable functions on the unit square.
4. Aspects of Applications in Mathematics

4.1. Turing patterns and subcellular protein localisation
Christopher Angstmann (University of New South Wales)
15:00 Mon 26 September 2011 – 24.G02
Christopher Angstmann

In his seminal 1952 paper Turing proposed a reaction-diffusion mechanism to explain morphogenesis. The same mechanism appears to be responsible for some aspects of subcellular protein localisation in bacteria and archaea. In particular the position of the septum in cell division is based on a Turing pattern. Spectral decomposition of the linearised form of a general set of reaction-diffusion equations allows us to predict the location of the septum without knowing the underlying proteins involved, or their dynamics. The location of the septum is then based only on the shape of the cell.

4.2. On exact solutions of integrable discrete equations
James Atkinson (University of Sydney)
11:30 Thursday 29 September 2011 – 24.G02
James Atkinson

Consider the famous multi-soliton solutions of the Korteweg de-Vries equation first written in explicit form by Hirota. Besides their physical significance, such solutions are now known to capture the mathematical heart of this integrable non-linear system. In fact all important features are preserved when not the solitons them-selves, but their characteristic feature of non-linear superposition principle becomes the central object. More general systems of this kind have been discovered and in fact now classification results exist within certain natural restricted classes of such objects. I will cover aspects of this story with a focus on recently discovered exact solutions and the important system discovered by V.E.Adler known as Q4.

4.3. Multidimensional Discrete Inverse Scattering
Samuel Butler (University of Sydney)
16:30 Mon 26 September 2011 – 24.105
Samuel Butler

A multidimensional inverse scattering transform for partial difference equations of two independent variables is presented. The equations considered possess a 3D consistency property, and give a variety of well-known partial integrable partial differential equations in various continuum limits, such as the KdV equation. The defining features of this IST are discussed, as are multidimensional solutions to this hierarchy of integrable lattice equations.

4.4. Model for carbon nanocones
Barry Cox (University of Adelaide)
12:30 Wednesday 28 September 2011 – 24.G02
B.J. Cox and J.M. Hill

Carbon nanocones may be considered a sheet of graphene with a section removed which is then joined to form a conical nanostructure. Closed nanocones may have one of five conical angles which are determined by the amount of the graphene sheet that is missing and this in turn determines the number of pentagonal rings required to close the apex of the cone. In previous studies of the structure of nanocones there has been great interest on the structure and morphology of the apex for various cone angles. However in the modelling presented here we concentrate on accounting for the curvature effects relevant along the wall of the nanocone, both close to and further away from the conical apex. We derive an analytical expression for the cone radius for any distance along the cone wall and also an integral expression for a correction to the conical height, which go some way towards accounting for the varying curvature of the cone wall. The predictions of this model are compared to molecular simulation results performed by the authors using LAMMPS.

4.5. Finite-time singularities in the boundary-layer equations: the fluid filled torus
Jim Denier (University of Adelaide)
10:30 Tuesday 27 September 2011 – 24.G02
Jim Denier

This talk will present results on a study of the flow within a fluid filled torus. Such a flow provides a paradigm for the study of unsteady boundary-layer separation, transition to turbulence in transient flows and the importance of decaying turbulence upon the dynamics of rotating flows. This talk will mainly focus upon the finite time singularities that arise in the boundary layer that is generated on the torus wall when the flow is spun up from rest (or alternatively spun down from a state of rigid body rotation). The effect of the singularity will be described, and if time permits the subsequent singularities of the flow will also be considered.

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4. Aspects of Applications in Mathematics

4.6. The acquisition of genetic pathways in bacteria
Andrew Francis (University of Western Sydney)
15:30 Mon 26 September 2011 – 24.G02
Andrew Francis

4.7. Liouville theorem for some infinite-dimensional diffusions
Ben Goldys (University of New South Wales)
16:00 Tuesday 27 September 2011 – 24.G02
Ben Goldys
We will show that the Liouville Theorem holds for generators of some stochastic partial differential equations. This result will be applied to the analysis of long-time behaviour of solutions.

4.8. Fokker-Planck equations for anomalous subdiffusion in space-and-time-dependent force fields
Bruce Henry (University of New South Wales)
15:00 Tuesday 27 September 2011 – 24.G02
C. Angstmann, B.I. Henry, T.A.M. Langlands, P. Straka
The Fokker-Planck equation models the evolution of the probability density function for diffusion in a force field. It unifies and generalizes Einstein’s theory of Brownian motion, Bachelier’s theory of random walks and Langevin’s theory of stochastic dynamics. Applications, which range across almost all areas of science, include the dispersal of pollutants in fluids and the pricing of derivatives in financial markets. A central aspect of the diffusion modelled by the Fokker-Planck equation is that the mean square displacement of diffusing entities scales linearly with time.

Over the past few decades sophisticated experiments and data collection in numerous biological, physical and financial systems have revealed anomalous subdiffusion in which the mean square displacement grows slower than linearly with time. A major theoretical challenge has been to obtain the appropriate revised Fokker-Planck equation for modelling such anomalous subdiffusion in a space-and-time-dependent force field.

We have derived Fokker-Planck equations for this purpose. Our derivations are based on the physically consistent theory of biased continuous time random walks, using mathematical tools from fractional calculus and stochastic calculus.

4.9. Painlevé II Asymptotics
Philip Howes (University of Sydney)
16:00 Mon 26 September 2011 – 24.105
P Howes
Some results of the asymptotics of the second continuous Painlevé equation are given. The results involve the explicit knowledge of Okamotos space of initial conditions (the regularisation of the vector field) for the equation.

4.10. The repellor and the limit set in complex dynamics of the Painlevé equations
Nalini Joshi (University of Sydney)
12:00 Thursday 29 September 2011 – 24.G02
Nalini Joshi
The asymptotic behaviours of the solutions of the Painlevé equations can be analysed in their space of initial values, which is a non-autonomous version of phase space. I show how to construct and understand their repellors and limit sets in this space.

4.11. Role of regulatory T cells in producing a robust immune response and maintaining immunodominance
Peter Kim (University of Sydney)
16:00 Mon 26 September 2011 – 24.G02
Peter Kim, Peter Lee, Doron Levy
Several theories exist concerning primary T cell responses, the most prevalent being that T cells follow developmental programs. We propose the alternative hypothesis that the response is governed by a feedback loop between conventional and adaptive regulatory T cells (iTregs). By developing a mathematical model, we show that the regulated response is robust to a variety of parameters and propose that T cell responses may be governed by emergent group dynamics rather than by autonomous programs.

We extend this model to show how T cell regulation may apply to immunodominance. Immunodominance refers to the phenomenon in which simultaneous T cell responses organize themselves into clear hierarchies. We extend our model of T cell regulation to consider multiple, concurrent T cell responses. Using our model, we show that iTreg-mediated regulation leads to a hierarchical expansion of T cell responses as observed in the phenomenon of immunodominance.

4.12. Stability and Instability in Kink-wave Solutions to the Sine-Gordon Equation
Robert Marangell (University of Sydney)
10:30 Thursday 29 September 2011 – 24.G02
R. Marangell and C. K. R. T. Jones
This talk investigates the spectrum of the linear operator coming from the sine-Gordon equation linearized about a traveling kink-wave solution. Using various geometric techniques as well as some elementary methods from ODE theory, it is shown that the point spectrum of such an operator is purely imaginary provided the wave speed c of the traveling wave is not ±1. Instabilities
must therefore be due to the presence of essential spectrum in the right half plane. By calculating the essential spectrum it is shown that the traveling wave is stable when the quantity \( c^2 - 1 \) is negative and unstable when \( c^2 - 1 \) is positive.

4.13. How long does it take to compute the eigenvalues of a random matrix
Govind Menon (Brown University)
15:30 Tuesday 27 September 2011 – 24.G02
Percy Deift, Govind Menon, Christian Pfra"ang

The symmetric eigenvalue algorithm is of fundamental importance in applied mathematics. We present the results of an extensive empirical study of three eigenvalue algorithms (QR, Toda, signum) on matrices chosen at random from a variety of ensembles. The main finding is a form of universality for the runtime distribution.

The methods of integrable systems make two appearances: (i) in the integrable structure of the algorithms; (ii) in the ‘integrable’ structure of random matrix theory.

No background in integrable systems, random matrix theory, or numerical analysis will be presumed (though of course it would help!)

4.14. Transient heat transfer in longitudinal fins of various profiles with temperature-dependent thermal conductivity and heat transfer coefficient
Joel Moitsheki (University of the Witwatersrand)
12:00 Tuesday 27 September 2011 – 24.G02
R.J. Moitsheki and C. Harley

Transient heat transfer through a longitudinal fin of various profiles is studied. The thermal conductivity and heat transfer coefficient are assumed to be temperature dependent. The resulting partial differential equation is highly nonlinear. Classical Lie point symmetry methods are employed and some reductions are performed. Since the governing boundary value problem is not invariant under any point symmetry, we therefore solve the original partial differential equation numerically. The effects of the realistic fin parameters such as the thermo-geometric fin parameter and the exponent of the heat transfer coefficient on the temperature distribution are studied.

4.15. In silico investigation of clonal dynamics in the epidermis: simulating the Single Progenitor Cell model.
Graeme Pettet (Queensland University of Technology)
16:30 Mon 26 September 2011 – 24.G02
Beth Addison-Smith and Graeme J. Pettet

Recent measurements of clone size in the basal layer of the murine inter-follicular epidermis have raised questions about long-held theoretical models of keratinocyte colony structure in the basal layer of the epidermis. These measurements led to the proposal of a novel theory of keratinocyte mitosis and differentiation in the epidermal basal layer. We have translated this theoretical model into cellular automata in an attempt to reproduce the measured clone-size dynamics. Our simulations raise a number of interesting questions about the theoretical model, and we propose a simple new model that addresses some of these concerns.

4.16. Stochastic self-similar solutions emerge from stochastic reaction-diffusion equation
Tony Roberts (University of Adelaide)
16:30 Tuesday 27 September 2011 – 24.G02
A. J. Roberts and Wei Wang

Similarity solutions have an important role in many applications—stochastic similarity should also be important. Here we explore a class of stochastic reaction, advection, diffusion PDEs. By transforming to log-time, Wayne’s transformation, algebraic decay of diffusion transforms to exponential attraction of the Gaussian similarity solution. A stochastic slow manifold model is then constructed for dynamics perturbed by small advection, reaction and stochastic forcing. The stochastic slow manifold evolution describes the emergent long time dynamics. This approach adapts to the case of dispersion in a stochastic shear flow—a case which is physically interesting as relevant to turbulent dispersion.

4.17. Mathematical modelling of image converters and intensifiers
Alla Shymanska (Auckland University of Technology)
15:30 Mon 26 September 2011 – 24.105

This work is devoted to numerical development of image converters and intensifiers which incorporate an inverting electron optical system (EOS) and a microchannel plate (MCP) as an amplifier. The use of MCP requires the image plane to be flat to match the channel plate, and the plate position should be coincide with the surface of the best focusing. Parameters of the system should be chosen to minimize a noise factor of the MCP which affects the visual acuity of an imaging device. Moreover, some image distortions, as a result of transferring the image from the photocathode to the screen by EOS, should be minimized. The numerical design of the system, which satisfies such requirements and provides high resolution, includes calculations of the electrostatic field in the device, trajectories of electrons emitted from a photocathode, and determination of the modulation-transfer-function (MTF) which gives...
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4.18. Almost-invariant sets in open dynamical systems
Robyn Stuart (University of New South Wales)
17:00 Mon 26 September 2011 – 24.105

Robyn Stuart
We explore the concept of metastability or almost-invariance in open dynamical systems. In such systems, the loss of mass through a “hole” occurs in the presence of metastability. We extend existing techniques for finding almost-invariant sets in closed systems to open systems by introducing a closing operation that has a small impact on the system’s metastability.

4.19. Modeling encapsulation of acetylene molecules into carbon nanotubes
Ngamta Thamwattana (University of Wollongong)
12:00 Wednesday 28 September 2011 – 24.G02
Ngamta Thamwattana
Polyacetylene is a well-known conductive polymer and when doped its conductivity can be altered by up to 12 orders of magnitude. However, due to entropy effects a polyacetylene chain usually suffers from distortions and interchain couplings which lead to unpredictable changes in its conducting property. Encapsulating a polyacetylene chain into a carbon nanotube can resolve these issues. Furthermore, since the carbon nanotube itself possesses excellent electrical conductivity, the combination of the carbon nanotube and polyacetylene may give rise to a new material with superior transport behavior. Here, we model mathematically the molecular interaction between an acetylene molecule and a carbon nanotube in order to determine conditions at which configurations of the acetylene molecule are accepted into the carbon nanotube as well as its equilibrium configurations inside various sizes of carbon nanotubes. For special cases of the acetylene molecule lying on the tube axis, standing vertically with its center on the tube axis and staying far inside the tube, explicit analytical expressions for the interaction energy are obtained.

4.20. Complete integrability of mappings obtained from the discrete Korteweg-De Vries and a double copy of the discrete potential Korteweg-De Vries equations
Thi Dinh Tran (University of New South Wales)
11:00 Thursday 29 September 2011 – 24.G02
Thi Dinh Tran
We study the complete integrability of mappings obtained as \((N, -1)\)-reductions of the discrete Korteweg-De Vries equation and a double copy of the discrete potential Korteweg-De Vries equation. We show that the mapping associated with the double copy of the pKdV equation is super integrable. The mapping corresponding to the KdV equation which can be derived from the previous mapping is completely integrable.

4.21. General Model for Molecular Interactions in a Benzene Dimer
Thien Tran-Duc (University of Wollongong)
11:30 Wednesday 28 September 2011 – 24.G02
Thien Tran-Duc, Ngamta Thamwattana, Barry J. Cox, James M. Hill

Modelling molecular interactions in a benzene dimer is a typical example of a class of problems involving aromatic molecules. Although many studies on the benzene dimer have been carried out both theoretically and experimentally and energetically favorable structures of a benzene dimer have been found, an investigation of all equilibrium structures of a benzene dimer has not so far been done. Here, we apply an approach in which the discrete atomic structure of a benzene molecule is replaced by two continuous rings of atoms, namely an inner carbon ring and an outer hydrogen ring with average constant atomic densities and the molecular interaction forces are calculated from the Lennard-Jones potential function. An analytical expression for the interaction energy is obtained which we use to determine all equilibrium structures of a benzene dimer as well as to determine those domains in which certain configurations are more favorable than others. Our results show that parallel, T-shaped, parallel displaced and tilted structures are all possible configurations of a benzene dimer and they exist at different regions of vertical and offset distances at different energy levels.

4.22. Infiltration in the Green-Ampt limit.
Dimetre Triadis (La Trobe University)
11:30 Tuesday 27 September 2011 – 24.G02
Dimetre Triadis

Behaviour for vertical infiltration as the diffusivity approaches a delta function has been the cause for debate and subject to some uncertainty. Recent
progress with an analytic nonlinear model has provided the exact infiltration coefficients for realistic soil behaviours with non-singular hydraulic functions, as well as their exact delta function diffusivity limits.

For a realistic soil, the well known Green-Ampt infiltration function is only obtained as an extreme limiting case where the diffusivity approaches a delta function much faster than the conductivity approaches a step function. Better agreement with experiment is obtained from a limiting delta-function diffusivity with a matching Gardner exponential hydraulic conductivity function. Several new soil models presented demonstrate that values of the second Philip infiltration coefficient differing from the Gardner model are possible for realistic limiting step function conductivities. The models also show that in the delta function diffusivity limit, the solution behaves as if the potential at the wet front were time-dependent, decreasing in magnitude from an initial value at the traditional Green-Ampt level.

4.23. Understanding Anomalous Delays in Models of Intracellular Calcium Dynamics
Martin Wechselberger (University of Sydney)
17:00 Mon 26 September 2011 – 24.G02
Emily Harvey, Vivien Kirk, Hinke Osinga, James Sneyd and Martin Wechselberger

In many cell types, oscillations in the concentration of free intracellular calcium ions are used to control a variety of cellular functions. It is thus important to understand the mechanisms underlying the generation and control of such patterns. We use geometric singular perturbation techniques to study the dynamics of representative calcium models. In particular, we show how recently developed canard theory for singularly perturbed systems with three or more slow variables applies to these calcium models. More precisely, the presence of a curve of folded singularities and corresponding canards can result in anomalous delays in the response of these models to a pulse of inositol (1,4,5)-trisphosphate (IP3) which is another important intracellular secondary messenger.

4.24. Stability and bifurcation analysis of a mathematical model for gene expression
Tonghua Zhang (Swinburne University of Technology)
15:00 Mon 26 September 2011 – 24.105
T. H. Zhang and Y. L. Song

Oscillation is a commonly encountered nonlinear phenomenon in biological problem, especially for processes with a time delay. It could result in unstable equilibrium or Hopf bifurcation. In this paper, we consider a mathematical model describing the process of gene expression. Using time delay as a parameter, we investigate the stability of the equilibrium. The critical value of the time delay is also found, which agrees well with the known result and the experimental data as well. At the critical value of the time delay, Hopf bifurcation and its bifurcation direction are studied, which are based on the normal form theory for delayed differential equation. The effect of the parameters, such as the Hill coefficient, reference concentration of protein and degradation rates on the bifurcation direction is also discussed.
5. Operator Algebras and Noncommutative Geometry

5.1. On some simple and purely infinite Exel-Larsen crossed product \( C^* \)-algebras
Nathan Brownlowe (University of Wollongong)
11:30 Tuesday 27 September 2011 – 24.101
Nathan Brownlowe, Astrid an Huef, Marcelo Laca, Iain Raeburn

We will look at some simple and purely infinite Exel-Larsen crossed product \( C^* \)-algebras associated to compact abelian groups.

5.2. Entropy of shifts on topological graph \( C^* \)-algebras
Valentin Deaconu (University of Nevada, Reno)
11:00 Thursday 29 September 2011 – 24.101
Valentin Deaconu

We give entropy estimates for two canonical noncommutative shifts \( \Phi : C^* (E) \to C^* (E) \) and \( \Psi : F_E \to F_E \) on the \( C^* \)-algebra and core algebra of some topological graphs, defined using a basis of the \( C^* \)-correspondence \( H(E) \). We compare their topological entropies as unital completely positive maps with the loop and block entropies that we associate directly to the topological graph. We show that the entropies of \( \Phi \mid_{F_E} \) and \( \Psi \) are different in general. We illustrate with some examples of topological graphs where the vertex and the edge spaces are unions of unit circles.

5.3. Co-universal \( C^* \)-algebras associated with aperiodic \( k \)-graphs
Sooran Kang (University of Wollongong)
12:00 Thursday 29 September 2011 – 24.101
Sooran Kang

For a row-finite \( k \)-graph \( \Lambda \), \( C^*_{\text{min}}(\Lambda) \) is called the co-universal \( C^* \)-algebra if given any \( C^* \)-algebra \( B \) generated by a Toeplitz-Cuntz-Krieger \( \Lambda \)-family in which all the vertex projections are nonzero, there is a canonical homomorphism from \( B \) onto \( C^*_{\text{min}}(\Lambda) \). The co-universal property naturally arises in the description of the gauge-invariant uniqueness property and it has been used to describe the ideal structure of certain \( C^* \)-algebras associated with topological graphs. In this talk, we describe how to construct the co-universal \( C^* \)-algebras associated with row-finite aperiodic \( k \)-graphs using the boundary path space. This is joint work with Aidan Sims of the University of Wollongong, Australia.

5.4. Cohomology of higher rank graphs
Alexander Kumjian (University of Wollongong/University of Nevada, Reno)
10:30 Tuesday 27 September 2011 – 24.101
Alexander Kumjian, David Pask and Aidan Sims

We introduce a homology theory and the corresponding cohomology theory of a higher rank graph (inspired by the cubical homology which appears in Massey’s text). We also define the \( C^* \)-algebra of a \( k \)-graph twisted by a two-cocycle which takes values in the circle and derive some basic properties. Interim report on joint work with David Pask and Aidan Sims.

5.5. A new perspective on topological graph algebras
Hui Li (University of Wollongong)
12:00 Tuesday 27 September 2011 – 24.101
Hui Li, David Pask and Aidan Sims

Katsura posed the notion of topological graphs which includes the directed graphs. He also defined a type of \( C^* \)-algebras \( O_X \) by taking the quotient of the Toeplitz algebras associated to the topological graphs. Specifically, when the topological graph is a directed graph, then the Cuntz-Pimsner algebra coincides with the \( C^* \)-algebra generated by the directed graph. In this talk, we are going to find a easy way to describe the Toeplitz representations and covariant Toeplitz representations without invoking the Hilbert modules material but only by writing down the algebraic relations between the functions.

5.6. Twisted K-theory and bivariant Chern–Connes type character of some infinite dimensional spaces
Snigdhayan Mahanta (The University of Adelaide)
16:30 Tuesday 27 September 2011 – 24.101
Snigdhayan Mahanta

I will outline the construction of a bivariant K-theory in a general operator algebraic framework following Cuntz for studying the twisted K-theory and K-homology of some infinite dimensional spaces like \( SU(\infty) \). I will also construct a bivariant Chern-Connes type character taking values in Puschnigg’s bivariant local cyclic homology. I will analyse the dual (twisted) K-homological univariant Chern-Connes type character in detail.

5.7. Actions of Ore Semigroups on Higher Rank graphs
Ben Maloney (University of Wollongong)
15:00 Tuesday 27 September 2011 – 24.101
Ben Maloney
An elegant theorem of Kumjian and Pask says that if a group $G$ acts freely on a directed graph $E$, then the associated crossed product $C^*(E) \rtimes G$ of the graph algebra is stably isomorphic to the graph algebra $C^*(G \setminus E)$ of the quotient graph. Their theorem has been extended in several directions: to actions of groups on higher-rank graphs, by Kumjian and Pask, and Pask, Quigg and Raeburn, and to actions of Ore semigroups on directed graphs, by Pask, Raeburn and Yeend (PRY). We wish to consider actions of Ore semigroups on higher-rank graphs.

Our main theorem directly extends that of PRY to higher-rank graphs, with some interesting new features. First of these is our more efficient use of Laca’s dilation theory for endomorphic actions: by exploiting his uniqueness theorem, we have been able to avoid the complicated direct-limit constructions used in PRY. Second, we have found an explicit isomorphism, which led us to revisit the case of group actions. A third feature of general interest is our direct approach to crossed products of the $C^*$-algebras of skew-product graphs, which is based on the treatment of skew products of directed graphs in Kaliszewski, Quigg and Raeburn.

5.8. Dimension in noncommutative geometry
Adam Rennie (Australian National University)
16:00 Tuesday 27 September 2011 – 24.101
A. Rennie, R. Senior

I will discuss the role that dimension plays in determining when a ‘space’, classical or noncommutative, is geometric.

5.9. Equivalence and amenability for Fell bundles
Aidan Sims (University of Wollongong)
10:30 Thursday 29 September 2011 – 24.101
Aidan Sims and Dana P. Williams

I will report on current joint work with Dana Williams of Dartmouth College. I will first outline an elegant proof that the Muhly-Williams imprimitivity bimodule $X$ for the full $C^*$-algebras of equivalent groupoids is an off-diagonal corner of the full $C^*$-algebra of a linking bundle, and that the quotient map to the reduced algebra of the linking bundle carries $X$ to an imprimitivity bimodule for the reduced $C^*$-algebras. I will then discuss how to use this result to see that if $B$ is a Fell bundle over a groupoid $G$ such that the orbit space of $G$ is a $T_0$ topological space and the restriction of $B$ to each isotropy group is metrically amenable in the sense that its full and reduced $C^*$-algebras coincide, then the full and reduced $C^*$-algebras of $B$ coincide also.

5.10. $k$-coloured graphs and $k$-graphs.
Samuel Webster (University of Wollongong)
11:30 Thursday 29 September 2011 – 24.101
Robert Hazlewood, Iain Raeburn, Aidan Sims and Samuel B.G. Webster

We provide a concrete description of the relationship between $k$-coloured graphs and $k$-graphs, and prove some results about the topology of the path space, and simplicity of the associated $C^*$-algebra.

5.11. Spectral Triples for Hyperbolic Dynamical Systems
Michael Whittaker (University of Wollongong)
15:30 Tuesday 27 September 2011 – 24.101
Michael Whittaker

In this talk I will define spectral triples on hyperbolic dynamical systems known as Smale spaces. The summability of one of these spectral triples is shown to recover the topological entropy of the Smale space itself. I will give an introduction to Smale Spaces and their associated $C^*$-algebras. I plan to concentrate on a specific example and no background in dynamics is necessary. Spectral triples will be introduced along with some accompanying definitions and examples. Finally, a type of metric on equivalence classes of a Smale space is defined, which gives rise to spectral triples.
6. Optimisation

6.1. Lipschitzian properties of Newton’s iteration
Francisco Javier Aragón Artacho (The University of Newcastle)
16:30 Tuesday 27 September 2011 – 24.102
F. J. Aragón Artacho, A. L. Dontchev, M. Gaydu, M. H. Geoffroy, and V. M. Veliov

For a version of Newton’s method applied to a generalized equation with a parameter, we extend the paradigm of the Lyusternik-Graves theorem to the framework of a mapping acting from the pair “parameter-starting point” to the set of corresponding convergent Newton’s sequences. Under ample parameterization, the Lipschitz-like (or Aubin) property of the mapping associated with convergent Newton’s sequences becomes equivalent to the metric regularity of the mapping associated with the generalized equation.

6.2. Lagrangian decomposition: a hierarchy of decompositions and computational trade-offs
Natashia Boland (The University of Newcastle)
12:00 Tuesday 27 September 2011 – 24.102
Natashia Boland and Olivia Smith

Lagrangian relaxation and Lagrangian duality are powerful tools in solving mixed integer programming problems, both in terms of finding high-quality feasible solutions and finding good dual bounds for proving optimality of solutions. However, these tools are predicated on a decomposition of the problem which splits the constraints into two sets. Many applications, such as constrained shortest path problems arising in methods for crew and vehicle scheduling, do not lend themselves to this decomposition structure. An approach known as Lagrangian decomposition offers an alternative, exploiting natural partitions of the constraints into multiple sets. This approach has attractive theoretical properties, but has not been as widely explored in the literature as standard Lagrangian relaxation, perhaps because it tends to produce a dual space of very high dimension. Here we show that it is possible to construct a hierarchy of alternative Lagrangian decompositions which trade off the dimension of the dual space (and hence computational difficulty of computing a dual bound) against the quality of the bound obtained. We illustrate these ideas using constrained shortest path problems with multiple side constraints.

6.3. Some Algorithms in Revealed Preference Theory
Andrew Craig Eberhard (Royal Melbourne Institute of Technology)
15:00 Tuesday 27 September 2011 – 24.102
Andrew Craig Eberhard (other authors D. Ralph, L. Stojkov and J-P Crouzeix)

When dealing with consumer demand in economic modeling, researchers often solve the optimization problem which maximises utility for a given budget constraint. Commonly used utilities are Cobb–Douglas and CES functions. In practice, we do not have access to the utility but only have access to a finite selection of demand data that assigns a consumers choice of a commodity bundle to a given price. This data is sometimes contradictory and often not of high quality. The problem of fitting a utility function to this finite data set which yields the same preference structure was first solved by Afriat and recently there have been proposed other approaches by authors such as Crouzeix. We discuss some numerical algorithms and techniques to perform these approximations and how one can accommodate deviations from the standard model of consistent consumer preference. A fast heuristic that has promise of providing a technique for large data sets is discussed. Some philosophical issues arise as to what model errors might mean and how to accommodate them and interpret them. We also summarise some recent observation regarding the ideal case studies in economic text books.

6.4. Duality and Algorithms for Multiobjective Linear Programming
Matthias Ehrgott (The University of Auckland)
10:30 Tuesday 27 September 2011 – 24.102
Matthias Ehrgott

Multiobjective linear programming (MOLP) concerns the optimization of several conflicting objective functions over a polyhedral feasible set. Solving an MOLP means finding efficient solutions and corresponding non-dominated objective function vectors, which do not allow the simultaneous improvement of all objectives. Extensions of the simplex algorithm for MOLP that work in (possibly high dimensional) variable space have been investigated since the 1960s. However, since the number of efficient extreme points of the feasible set can be very large, these algorithms tend to be very slow. In this talk we consider instead methods which directly work in the (lower dimensional) objective space. We
will first review an improved version of an algorithm by Benson that constructs the nondominated set by polyhedral outer approximation. We then cover geometric duality, a recently proposed duality theory for MOLP which avoids a duality gap and where the dual problem is also an MOLP. We then derive a dual variant of Benson’s algorithm that solves the dual problem by outer approximation. Finally, we show that the dual algorithm can be interpreted as an inner polyhedral approximation method for the primal MOLP.

6.5. Turbo-charging the Feasibility Pump
Faramroze Engineer (University of Newcastle)
16:00 Tuesday 27 September 2011 – 24.102
Natasha L. Boland, Andrew C. Eberhard, Faramroze G. Engineer, Matteo Fischetti, and Martin W.P. Savelsbergh

The Feasibility Pump (FP) has proved to be an effective method for finding feasible solutions to Mixed-Integer Programming (MIP) problems. FP iterates between a rounding procedure and a projection procedure that together provide a sequence of points alternating between LP-relaxation feasible but fractional solutions, and integer but LP infeasible solutions. The process attempts to minimise the distance between consecutive iterates, producing an integer feasible solution when closing the distance between them. Recent advances using constraint propagation demonstrate that enhancements to the rounding procedure aimed at improving LP feasibility of the integer points can markedly improve the quality of feasible solutions found. Here we explore an alternative idea that generates many integer points at each FP iteration. We investigate the benefits of replacing the rounding procedure with a more sophisticated line search that efficiently explores a much larger neighbourhood of integer points close to an FP iterate. An extensive computational study on 1000+ benchmark instances demonstrates the effectiveness of the proposed approach.

6.6. Identifying non-Hamiltonicity of cubic graphs by nested linear programming
Jerzy Filar (Flinders University)
11:30 Thursday 29 September 2011 – 24.102
Jerzy Filar, Michael Haythorpe and Seguei Rossomakhine

Given a cubi graph, we construct a nested sequence of polyhedral sets containing a, possibly empty, kernel set H. The latter has the properties that (i) it is defined by polynomially many constraints and variables and, (ii) it contains the convex hull of all Hamiltonian cycles of the graph. Thus if H is empty, the underlying graph is non-Hamiltonian. The validity of the converse statement is an open problem. However, in tests of hundreds of problems no counterexample has been encountered to date.

6.7. Sherali-Adams Relaxations of Graph Isomorphism Polytopes
Peter Malkin (BHP Billiton)
11:30 Tuesday 27 September 2011 – 24.102
Peter N. Malkin

There has been significant interest recently in understanding lift-and-project techniques for constructing hierarchies of linear programming relaxations for combinatorial problems. Such lift-and-project procedures have been proposed by Lovasz and Schrijver (1991), Lasserre (2001), Sherali-Adams (1990), among many others. Many combinatorial problems have been investigated using these methods. We present the Sherali-Adams lift and project hierarchy applied to a graph isomorphism polytope whose integer points encode the isomorphisms between two graphs. We establish that Omega(n) iterations are needed in the worst case before converging to the convex hull of integer points. Moreover, we show that the Sherali-Adams relaxations characterize a new vertex classification algorithm for graph isomorphism, which generalizes the classic vertex classification algorithm and generalizes the work of Tinhofer on polyhedral methods for graph isomorphism testing. This generalized vertex classification algorithm is also strongly related to the well-known Weisfeiler-Lehman algorithm, which surprisingly can be characterized in terms of the Sherali-Adams relaxations of a semi-algebraic set.

6.8. Optimization of connected controlled Markov chains
Boris Miller (Monash University)
10:30 Thursday 29 September 2011 – 24.102
Boris Miller

The article considers the optimal stochastic control approach to the analysis of connected controlled Markov chains (CCMC). Models of controllable Markov chains (CMC) are appropriate to the analysis of control of flows in the Internet, to the large dams management and many others areas. The principal difficulty of the application of CMC is the problem of the models high dimension particularly for CCMC. But nowadays this problem is less important due to the development of multiprocessor supercomputers that make the numerical solution of the optimal control problems for CCMC more achievable. Models of CCMC arise in queuing systems with many service lines where some idle lines may be used to avoid the
congestion if the principal lines have been subjected the huge workload. We suggest the tensor form of the representation for such CCMC and give the dynamic programming equation in corresponding tensor form. Numerical approach to the solution of the access and service rate control has been proposed.

6.9. Recycling bases in the Halton sequence: an optimization view
Christopher John Price (University of Canterbury)
12:00 Thursday 29 September 2011 – 24.102
CJ Price

A modification of the Halton sequence of quasi-random points is given which allows for the same base to be used for more than one dimension. The main advantage of this is that the asymptotic uniformity property of Halton sequences becomes relevant after fewer points than for the original Halton sequence. A new quality measure using minimal spanning trees is given, and its connections with global optimization shown. The modified sequence maintains the property that different points differ in each element, which is important in global optimization for avoiding the projection deficiency.

6.10. Alternating projection type algorithms in the absence of convexity
Brailey Sims (University of Newcastle)
15:30 Tuesday 27 September 2011 – 24.102
Brailey Sims

6.11. Dynamic Assortment and Pricing under Demand Learning
Masoud Talebian (University of Newcastle)
11:00 Thursday 29 September 2011 – 24.102
Natashia Boland, Martin Savelsbergh, Masoud Talebian

Retailers, from fashion stores to grocery stores, face the common challenge of deciding what range of products to offer (assortment planning) and at what prices (pricing management). New trends in business, like mass customization, and entry into emerging markets, put retailers in situations where the size of the market, an important component of demand, is not exactly known in advance. In this research, we develop a mathematical model to make assortment and pricing decisions in situations where the size of the market is unknown. It incorporates on-line learning using Bayesian updates to establish market size and dynamic programming. Solutions to the model provide managerial insights, which can increase a retailer’s efficiency and profitability and can enable better service.
7. Geometry and Topology

7.1. Uniqueness of Morava K-theory.
Vigleik Angeltveit (Australian National University)
15:00 Mon 26 September 2011 – 24.G03
Vigleik Angeltveit

Classical obstruction theory seemingly produces uncountably many A-infinity structures on the Morava K-theory spectrum K(n). We show that these A-infinity structures are all equivalent, using a Bousfield-Kan spectral sequence converging to the homotopy groups of the moduli space of A-infinity ring spectra equivalent to K(n). This spectral sequence has infinitely many differentials, and to show that all the relevant classes die we study the connective Morava K-theory spectrum k(n) and use the theory of Postnikov towers and S-algebra k-invariants developed by Dupger and Shipley.

7.2. Counting lattice points in compactified moduli spaces of curves
Norman Do (The University of Melbourne)
11:00 Tuesday 27 September 2011 – 24.G03
Norman Do and Paul Norbury

How many ways are there to obtain a genus g surface by gluing together the edges of an g given polygons? For geometric reasons, it is natural to generalise this problem to the case of stable surfaces. We show that such an augmented enumeration yields lattice point polynomials which can be recursively computed. Their top degree coefficients are intersection numbers on compactified moduli spaces of curves while their constant terms are Euler characteristics of compactified moduli spaces of curves. On the other hand, the geometric meaning of the intermediate coefficients remains a complete mystery. In this talk, we will define the lattice point polynomials, present some of their properties, and indicate possible connections to topics such as Gromov-Witten theory and topological recursion.

7.3. Some remarks on linear elasticity
Michael Eastwood (Australian National University)
10:30 Thursday 29 September 2011 – 24.G03
Michael Eastwood

I shall present the equations for linearised elasticity in three dimensions and explain some links with Riemannian and projective geometry.

7.4. On free paratopological groups
Ali Sayed Elfard (University of Wollongong)
16:30 Tuesday 27 September 2011 – 24.G03
Ali Sayed Elfard and Peter Nickolas

Let FP(X) be the free paratopological group on a T1 space X and let i2 be the map of (X ⊕ X−1 ⊕ {e})2 to the subspace FP2(X) of FP(X), where FP2(X) is the set of all words of reduced length not exceeding 2, X has its original topology and X−1 has the discrete topology. In this talk, we describe a base of neighborhoods at the identity e in FP2(X) and give conditions on X under which the map i2 is a quotient. In addition, we give examples of topological spaces for which i2 is a quotient.

References

7.5. Topological K-theory
Nora Ganter (The University of Melbourne)
11:30 Thursday 29 September 2011 – 24.G03
Nora Ganter

This is an expository talk, introducing one of my favorite tools in algebraic topology. Rather than focussing on how exactly K-theory is defined, the talk aims to give a feel for the enormous success K-theory enjoyed soon after its introduction in the late 50’s.

7.6. Finite index subgroups of mapping class groups
Volker Gebhardt (University of Western Sydney)
12:00 Wednesday 28 September 2011 – 24.G03
Jon Berrick, Volker Gebhardt, Luis Paris

The interaction between mapping class groups and finite groups has long been a topic of interest. The famous Hurwitz bound of 1893 states that a closed Riemann surface of genus g has an upper bound of 84(g − 1) for the order of its finite subgroups, and Kerckhoff showed that the order of finite cyclic subgroups is bounded above by 4g + 2.

The subject of finite index subgroups of mapping class groups was brought into focus by Grossman’s discovery that the mapping class group M_{g,n} of an oriented surface Σ_{g,n} of genus g with n boundary components is residually finite, and thus well-endowed with subgroups of finite index. This prompts the “dual” question: What is the minimum index mi(M_{g,n}) of a proper subgroup of finite index in M_{g,n}?
Results to date have suggested that, like the maximum finite order question, the minimum index question should have an answer that is linear in \( g \). The best previously published bound due to Paris is \( \text{mi}(\mathcal{M}_{g,n}) > 4g + 4 \) for \( g \geq 3 \). This inequality is used by Aramayona and Souto to prove that, if \( g \geq 6 \) and \( g' \leq 2g - 1 \), then any nontrivial homomorphism \( \mathcal{M}_{g,n} \to \mathcal{M}_{g',n'} \) is induced by an embedding. It is also an important ingredient in the proof of Zimmermann that, for \( g = 3 \) and \( 4 \), the minimal nontrivial quotient of \( \mathcal{M}_{g,0} \) is \( \text{Sp}_{2g}(\mathbb{F}_2) \).

I will report on recent work with Jon Berrick and Luis Paris, in which we showed an exact exponential bound for \( \text{mi}(\mathcal{M}_{g,n}) \). Specifically, we proved that \( \mathcal{M}_{g,n} \) contains a unique subgroup of index \( 2^{n-1}(2^g - 1) \) up to conjugation, a unique subgroup of index \( 2^{n-1}(2^g + 1) \) up to conjugation, and the other proper subgroups of \( \mathcal{M}_{g,n} \) are of index greater than \( 2^{n-1}(2^g + 1) \). In particular, the minimum index for a proper subgroup of \( \mathcal{M}_{g,n} \) is \( 2^{n-1}(2^g - 1) \).

7.7. Oka properties of some hypersurface complements

Alexander Hanysz (University of Adelaide)
16:00 Tuesday 27 September 2011 – 24.G03
Alexander Hanysz

Oka manifolds can be viewed as the “opposite” of Kobayashi hyperbolic manifolds. Kobayashi conjectured that the complement of a generic algebraic hypersurface of sufficiently high degree is hyperbolic. Therefore it is natural to ask whether the complement is Oka for the case of low degree or non-algebraic hypersurfaces. We provide a complete answer to this question for complements of hyperplane arrangements, and some results for graphs of meromorphic functions.

7.8. Deformations of Oka manifolds

Finnur Larusson (University of Adelaide)
11:00 Thursday 29 September 2011 – 24.G03
Finnur Larusson

The class of Oka manifolds has emerged from the modern theory of the Oka principle, initiated in 1989 in a seminal paper of Gromov. They were first formally defined by Forstneric in 2009 in the wake of his result that some dozen possible definitions are all equivalent. The Oka property can be seen as an answer to the question: what should it mean for a complex manifold to be “anti-hyperbolic”? One of the many open problems in Oka theory is to clarify the place of Oka manifolds in the classification theory of compact complex manifolds, surfaces in particular. To address this problem, we need to understand how the Oka property behaves with respect to deformations of compact complex manifolds. In the talk, we will present the first results in this direction.

7.9. Assembly maps and the integral K-theoretic Novikov conjecture

Snigdhayan Mahanta (The University of Adelaide)
15:00 Tuesday 27 September 2011 – 24.G03
Snigdhayan Mahanta

For a countable discrete and torsion free group \( G \), the \( K \)-theoretic integral Novikov conjecture with coefficients in a ring \( R \) says that a certain assembly map

\[ H_*(BG; K_R) \to K_*(R[G]) \]

is (split) injective, where \( K_R \) denotes the non-connective algebraic \( K \)-theory spectrum of \( R \). I will show that if such a group is a subgroup of a general linear group over any field or a subgroup of any almost connected Lie group, then it satisfies the integral \( K \)-theoretic Novikov conjecture with coefficients in the \( C^* \)-algebra of compact operators and the algebra of Schatten class operators. The talk will be based on the preprint http://arxiv.org/abs/1107.2191

7.10. Stability of Persistent Homology Invariants

Facundo Memoli (University of Adelaide)
11:30 Wednesday 28 September 2011 – 24.G03
Facundo Memoli

We will describe some results regarding the Gromov-Hausdorff stability of Persistent Homology invariants arising from Vietoris-Rips simplicial constructions. These results have applications in the context of matching shapes and in data analysis.

7.11. A’Campo curvature bumps

Laurentiu Paunescu (University of Sydney)
12:00 Thursday 29 September 2011 – 24.G03
Laurentiu Paunescu

In this (joint with T.C. Kuo and S. Koike) work we will define and describe the distribution of the A’Campo curvature bumps associated to an analytic function in two variables (real or complex).

7.12. Acyclic Embeddings of Open Riemann Surfaces into Elliptic Manifolds

Tyson Ritter (University of Adelaide)
11:30 Tuesday 27 September 2011 – 24.G03
Tyson Ritter

In complex geometry a manifold is Stein if there are, in a certain sense, ‘many’ holomorphic maps from the manifold into \( \mathbb{C}^n \). While this has long been well-understood, a fruitful definition of the dual notion has until recently been elusive. In Oka theory, a manifold is \( \text{Oka} \) if it satisfies a series of several equivalent definitions, each stating in
some way that the manifold has ‘many’ holomorphic maps into it from \( \mathbb{C}^n \). Related to this is the geometric condition of ellipticity due to Gromov, who effectively showed that it implies a complex manifold is Oka.

We present recent contributions to three open questions involving elliptic and Oka manifolds. We show that affine quotients of \( \mathbb{C}^n \) are elliptic, and combine this with an example of Margulis to construct new elliptic manifolds with free fundamental group and vanishing higher homotopy. It then follows that every open Riemann surface properly acyclically embeds into an elliptic manifold. This extends a previous result for open Riemann surfaces with abelian fundamental group, and gives a partial answer to a question of Lárusson.

7.13. Triangulations of hyperbolic 3-manifolds admitting strict angle structures

Henry Segerman (The University of Melbourne)
10:30 Tuesday 27 September 2011 – 24.G03
Craig D. Hodgson, J. Hyam Rubinstein and Henry Segerman

It is conjectured that every hyperbolic 3-manifold with torus boundary components has a decomposition into positive volume ideal hyperbolic tetrahedra (a “geometric” triangulation of the manifold). Under a mild homology assumption on the manifold we construct topological ideal triangulations which admit a strict angle structure, which is a necessary condition for the triangulation to be geometric. In particular, every knot or link complement in the 3-sphere has such a triangulation.

7.14. Controlling orbifold topology via the Laplace spectrum

Elizabeth Stanhope (Lewis and Clark College/The University of Melbourne)
15:30 Tuesday 27 September 2011 – 24.G03
Emily Proctor, Liz Stanhope

We will discuss the degree to which the Laplace spectrum of a Riemannian orbifold determines the topology of that orbifold. We will report on progress in showing that isospectral sets of Riemannian orbifolds, sharing a lower curvature bound, contain only finitely many topologically distinct orbifolds.

7.15. On JSJ decomposition theorem for Haken 3-manifolds

Tharatorn Supasiti (The University of Melbourne)
12:00 Tuesday 27 September 2011 – 24.G03
Tharatorn Supasiti

The Torus Theorem states that if a compact, orientable, irreducible 3-manifold admits a singular essential torus, then it either admits an embedded one or it is a small Siefert fibred space. It is one in a series of beautiful results that explore the interplay between algebra and topology. The first published proof was given by Feustel in 1976. It relies heavily on the JSJ theory that was developed by Jaco and Shalen, and independently by Johannson. So, in a way, both theories should be viewed together. Here, the existence of a singular essential torus allows us to explicitly construct the characteristics submanifold \( K \) from which the desired embedded essential torus is contained in its boundary or \( K \) is the whole manifold itself. We will give a short proof that uses Aitchison and Rubinstein’s short hierarchy.

7.16. Finite and infinite generation of lattices on right-angled buildings

Anne Thomas (University of Sydney)
16:00 Mon 26 September 2011 – 24.G03
Anne Thomas and Kevin Wortman

Examples of right-angled buildings include trees, products of trees, and buildings whose apartments are hyperbolic planes tessellated by right-angled polygons. A lattice on such a building is a group acting with finite stabilisers so that a certain series converges. We discuss the basic question of whether lattices on right-angled buildings are finitely generated. This is joint work with Kevin Wortman.

7.17. Stringy product on orbifold K-theory

Bryan Wang (Australian National University)
16:30 Mon 26 September 2011 – 24.G03
Bryan Wang

Motivated by orbifold string theory models in physics, Chen and Ruan discovered a new product called the stringy product on the cohomology for the inertia orbifold of an almost complex orbifold. This cohomology with the stringy product is now called the Chen-Ruan cohomology, as a classical limit of orbifold quantum cohomology theory. Later, various versions of stringy product on orbifold K-theory of the inertia orbifold were proposed. In recent joint work with Jianxun Hu, we define a stringy product on the orbifold K-theory for the orbifold itself and show that a modified de-localized Chern character to the Chen-Ruan cohomology is an isomorphism over the complex coefficient. As an application, we find a new product on the equivariant K-theory of a finite group with the conjugation product, which is different to the well-known Pontryajin (or fusion) product.

7.18. Twisted Morava K-theory

Craig Westerland (The University of Melbourne)
12:30 Wednesday 28 September 2011 – 24.G03
Hisham Sati and Craig Westerland
We develop an analogue of twisted K-theory for Morava’s extraordinary K-theories (analogues of K-theory of vector bundles at higher chromatic levels). We show that $K(n)$ may be twisted by an $(n+2)$-dimensional cohomology class; the $n=1$ case recovers a localization of twisted K-theory, and the $n=2$ case is a restriction of the twisted elliptic cohomology of Ando-Blumberg-Gepner. These theories are equipped with means of computation: Atiyah-Hirzebruch spectral sequences, and a Khorami-type theorem.
8. Topological Groups and Harmonic Analysis

8.1. The Fourier-Stieltjes algebra and group geometry
Michael Cowling (University of New South Wales)
11:30 Tuesday 27 September 2011 – 24.204
Michael Cowling and Michael Leinert

The Fourier algebra $A(G)$ is the algebra (under pointwise operations) of matrix coefficients of the regular representation of a (locally compact) group $G$. It is an open question whether the algebra $A(G)$ determines the group $G$. We answer this question for connected Lie groups. The solution uses two facts: an isomorphism from $A(G_1)$ to $A(G_2)$ determines a homeomorphism between the groups, and this mapping sends cosets (or objects that are nearly cosets) to other objects of the same kind.

8.2. Boundedness of singular integrals and their commutators with BMO functions on Hardy spaces.
Xuan Duong (Macquarie University)
11:30 Wednesday 28 September 2011 – 24.204
The Anh Bui and Xuan Thinh Duong

Let $L$ be a non-negative self-adjoint operator on $L^2(X)$ where $X$ is a doubling space. In this talk, we will establish sufficient conditions for a singular integral $T$ to be bounded from certain Hardy spaces $H^p_L$ (Hardy spaces associated to the operator $L$) to Lebesgue spaces $L^p$, $0 < p \leq 1$, and for the commutator of $T$ and a BMO function to be weak-type bounded on Hardy space $H^1_L$. Our results are applicable to the following cases: (i) $T$ is the Riesz transform or a square function associated with the Laplace-Beltrami operator on a doubling Riemannian manifold, (ii) $T$ is the Riesz transform associated with the magnetic Schrödinger operator on an Euclidean space, and (iii) $T = g(L)$ is the spectral multiplier of $L$.

8.3. Higher-dimensional Clifford Fourier transforms
Jeffrey Hogan (University of Newcastle)
12:00 Wednesday 28 September 2011 – 24.204
Jeffrey Hogan

The Clifford Fourier transform was introduced by Brackx, De Schepper and Sommen in 2005 as the exponential of a Cliffordised Hermite operator. Brackx and De Schepper computed a closed form for the kernel of the operator in dimension $d=2$. In this talk we describe closed forms for the Clifford Fourier kernel and its fractionalisation in all even dimensions and discuss the problem of computing the kernel in odd dimensions. We also give results on the covariance properties of these operators. This is joint work with Mark Craddock (University of Technology Sydney)

8.4. Quaternionic Waves
Andrew Morris (University of Newcastle)
12:00 Tuesday 27 September 2011 – 24.204
Andrew Morris

Quaternionic-valued functions have been used as a model for colour images and Fourier-type transforms of such signals have been studied using various Fourier kernels. We develop some basic wavelet theory for quaternionic signals using the Fourier kernel which arises from the Clifford-Hermite functions. We present an analog of the convolution theorem and investigate quadrature mirror filters. Requirements for the solutions to dilation equations and the construction of a quaternionic scaling function and multiwavelet analysis structure are presented. We further discuss design conditions which are required for a wavelet basis to be constructed with desired regularity.

8.5. Multi-norms and amenability of groups
Hung Le Pham (Victoria University of Wellington)
10:30 Tuesday 27 September 2011 – 24.204
H. G. Dales, M. Daws, H. Pham, P. Ramsden

In this talk, I will first discuss the theory of multi-norms which was introduced recently by Dales and Polyakov. This theory will then be used to prove some new characterizations of amenability for locally compact groups. These include a combinatorial condition similar to, but formally weaker than, Folner’s condition, and also answer the question of when the module $L^p(G)$ is injective.

8.6. Weighted convolution algebras on locally compact groups
George Willis (The University of Newcastle)
12:30 Wednesday 28 September 2011 – 24.201
George Willis

A weighted convolution algebra over a locally compact group $G$ is the space $L^1(G) := \left\{ \phi \in L^1_{loc}(G) : \|\phi\|_w = \int_G |\phi(x)|w(x) \, dx < \infty \right\}$, where $w$ is a submultiplicative weight, that is, a positive real-valued function satisfying $w(xy) \leq w(x)w(y)$ for every $x, y \in G$. Such weighted convolution algebras were first studied by Beurling over abelian groups in relation to the problem of spectral synthesis, and are now an important class of Banach algebras.

Submultiplicative weights and weighted convolution algebras are generally not difficult to find. This talk describes a specific weighted convolution algebra on a totally disconnected, locally compact
group, $G$, that is defined in terms of the intrinsic structure of $G$. How well Banach algebraic properties of $L^1_w(G)$ capture the group structure of $G$ will be discussed.
9. Financial Mathematics

9.1. Pricing Interest Rate Derivatives in a Multifactor HJM Model with Time Dependent Volatility
Carl Chiarella (University of Technology, Sydney)
10:30 Tuesday 27 September 2011 – 24.105
Ingo Beyna, Carl Chiarella, Boda Kang

We investigate the partial differential equation (PDE) for pricing interest derivatives in the multifactor Cheyette Model, that involves time-dependent volatility functions with a special structure. The high dimensional parabolic PDE that results is solved numerically via a modified sparse grid approach, that turns out to be accurate and efficient. In addition we study the corresponding Monte Carlo simulation, which is fast since the distribution of the state variables can be calculated explicitly. The results obtained from both methodologies are compared to the analytical solution existing for bonds and caplets.

9.2. Joanna Goard
Joanna Goard (University of Wollongong)
16:30 Tuesday 27 September 2011 – 24.105
Joanna Goard

Analytic solutions are found for prices of variance and volatility swaps and VIX options under empirically-validated stochastic volatility models for the dynamics of the underlying assets.

9.3. Multi-Player Dynkin Games
Ivan Guo (University of Sydney)
15:30 Tuesday 27 September 2011 – 24.105
Ivan Guo

A single period multi-player Dynkin game is constructed where each player can either exit the game for a fixed payoff or stay and split the remaining payoff with the other non-exiting players. The emphasis is put on the rivalrous nature of the payoffs, meaning that the sum of all payoffs is fixed, but the exact allocation is based on the players’ decisions. Both pure and mixed strategy cases are considered, and an equilibrium containing maximin and minimax strategies is constructed. Furthermore the value at which equilibria are attained is shown to be unique. This work forms the basis on which multi-player financial game options can be constructed.

9.4. Martingales with given marginals
Kais Hamza (Monash University)
12:00 Tuesday 27 September 2011 – 24.105
Kais Hamza, Fima Klebaner & Jie Yen Fan

While it is well known that stochastic processes are not uniquely defined by their one-dimensional marginals, the question of how to construct martingales with given marginals has recently become the focus of a substantial body of work. In this talk we will review some of the constructions found in the literature.

Joint work with Fima Klebaner and Jie Yen Fan

9.5. Consistent Modeling of SPX and VIX Options: Efficient Evaluation Issues in Gatheral’s Three-factor Model
Guanghua Lian (Auckland University of Technology)
15:00 Tuesday 27 September 2011 – 24.105
Guang-Hua Lian, Robert J. Elliott

It is an important issue to consistently price options written on S&P500 and VIX indices. Gatheral (2007, 2008) proposed a three-factor stochastic volatility model to achieve this goal. However, the non-affine structure of the model leads to the analytical intractability that closed-form pricing formula may not exist for S&P500 options, nor for VIX options. Monte Carlo simulation method adopted in Gatheral is rather inefficient in terms of calculation and model calibration. This study proposes two analytical asymptotic formulae to efficiently price S&P500 options and VIX options, respectively, based on Gatheral’s three-factor stochastic volatility model. By applying singular perturbation techniques, our formulae are obtained by solving a set of partial differential equation systems. We then rigorously justified the convergence of the asymptotic formulae. We lastly present some numerical examples to demonstrate that our asymptotic formulae can achieve high efficiency and accuracy for a large class of options with relative short tenor.

9.6. Calibration of Vasicek and CIR interest rate models via generating functions
Marianito Rodrigo (University of Wollongong)
16:00 Tuesday 27 September 2011 – 24.105
Marianito Rodrigo

We propose a new method to calibrate the Vasicek and CIR interest rate models from bond prices. We define an appropriate generating function and derive recursive relations between the derivatives of the generating function and the bond prices. The parameters of the Vasicek and CIR models are then obtained by solving a system of linearly independent equations arising from the recursive relations. We include numerical results that show the method’s accuracy when bond prices generated from the exact formulas are used. This is
joint work with R. Mamon of the University of Western Ontario.

9.7. Analytically pricing Parisian and Parasian options
Song-Ping Zhu (University of Wollongong)
11:30 Tuesday 27 September 2011 – 24.105
Song-Ping Zhu and Wen-Ting Chen
In this talk, we shall present two analytic solutions for the valuation of European-style Parisian and Parasian options under the Black-Scholes framework. A key feature of our solution procedure is the reduction of a three-dimensional problem to a two-dimensional problem through a coordinate transform that has elegantly “absorbed” the directional derivative associated with the “barrier time” into the time derivative and thus resulted in two coupled, but simplified PDE (partial differential equation) systems. For Parisian options, the coupled PDE systems are then analytically solved by applying the Laplace transform technique in conjunction with the construction of “moving window”, which are introduced to evaluate the option prices backwards, slide by slide, until the value of the option at a given time and trigger value is found for a given underlying price. On the other hand, due to the non-resetting mechanism of the Parasian option, the coupled PDE systems of this type of options are much more complicated than those of their Parisian counterparts, and the “moving window” technique fails in this case. Alternatively, the double Laplace transform technique is then applied to solve for the option prices in the Laplace space. Of course, our success of obtaining closed-form analytical solution in this case hinges on overcoming the difficulty of analytically performing Laplace inversions.
10. Combinatorics

10.1. Computing Bernoulli and Tangent numbers

Richard P Brent (Australian National University)
12:30 Wednesday 28 September 2011 – 24.201

Richard P Brent and David Harvey
Some algorithms for computing Bernoulli and Tangent numbers are described. In particular, we give a new asymptotically fast algorithm to compute the first $n$ Bernoulli or Tangent numbers in time $O(S \log(n) \log(\log(n)))$, where $S$ is the space required to store the output, and hence $S$ is a lower bound on the time complexity. We also give a very simple in-place algorithm for computing the first $n$ Tangent numbers using $O(n^2)$ integer operations. Although this is not asymptotically fast, it is extremely simple and convenient for moderate values of $n$, say up to 1000.

10.2. On quasiprimitive rank 3 permutation groups

Alice Devillers (The University Of Western Australia)
15:30 Tuesday 27 September 2011 – 24.201

Alice Devillers, Michael Giudici, Cai Heng Li, Geoffrey Pearce and Cheryl Praeger

While studying quotients of locally $s$-distance transitive groups, we encountered the following question: which multipartite complete graphs $\Gamma = K_{n|m}$ ($n \geq 3$) and automorphism group $G$ of $\Gamma$ are such that $G$ acts distance-transitively on $\Gamma$ and the only quotients of $\Gamma$ by nontrivial normal subgroups of $G$ are trivial. That implies that $G$ is rank 3 on the set of vertices of $\Gamma$ and quasiprimitive. This led us to look for a classification of rank 3 group actions which are quasiprimitive but not primitive.

Our classification is achieved by first showing that $G$ must be almost simple and then by classifying imprimitive almost simple permutation groups which induce a 2-transitive action on a block system and for which a block stabiliser acts 2-transitively on the block. Some of the cases involve a detailed study of classical matrix groups over finite fields.

There are two infinite families and a finite number of individual imprimitive examples. All examples but one involve projective linear groups. When combined with earlier work of Bannai, Kantor, Liebler, Liebeck and Saxl, this yields a classification of all quasiprimitive rank 3 permutation groups.

This work will be published in the Journal of the London Mathematical Society.

10.3. Characterising a family of Neighbour Transitive Codes

Neil Gillespie (The University Of Western Australia)
16:00 Mon 26 September 2011 – 24.201

Neil Gillespie

We consider codes to be subsets of ordered $m$-tuples from a fixed alphabet $Q$ of size $q$, and as such we interpret codes as subsets of vertices of the Hamming graph. An automorphism of the Hamming graph, $\Gamma$, is a permutation of the vertex set that preserves adjacency. It is known that $Aut(\Gamma)$ is isomorphic to the wreath product $S_q \wr S_m$, and that the base group, $B$, of $Aut(\Gamma)$ is isomorphic to $S^n_m$.

When transmitting a code, $C$, a single error occurs if a single entry in a codeword is changed, and so, in the Hamming graph errors are adjacent vertices to codewords. We define a neighbour of a codeword to be an adjacent vertex of that codeword that is not itself a codeword, and we let $C_1$ denote the set of neighbours of $C$. We say a code $C$ is neighbour transitive if there exists an automorphism group $X \leq Aut(\Gamma)$ such that $C$ and $C_1$ are both $X$-orbits.

If $C$ is an $X$-neighbour transitive code with minimum distance $\delta \geq 3$, we can show that $X$ has a 2-transitive action on $Q$, and so, following Burnside’s classical result, is either of almost simple or affine type. If the action is of almost simple type we say the code is alphabet almost simple neighbour transitive. In this talk we construct some interesting examples of almost simple neighbour transitive codes. Using these examples we also characterise alphabet almost simple $X$-neighbour transitive codes with $\delta \geq 3$ and $X \cap B \neq 1$.

10.4. The Sprague-Grundy function for the real game Euclid

Bao Ho (La Trobe University)
16:30 Mon 26 September 2011 – 24.201

Nhan Bao Ho

The game Euclid, introduced and named by Cole and Davie, is played with a pair of nonnegative integers. The two players move alternatively, each subtracting a positive integer multiple of one of the integers from the other integer without making the result negative. The player who reduces one of the integers to zero wins. Unfortunately, the name Euclid has also been used for a subtle variation of this game due to Grossman in which the game stops when the two entries are equal. For that game, Straffin showed that the losing positions $(a, b)$ with $a < b$ are precisely the same as those for Cole and Davie’s game. Nevertheless,
11. Combinatorics

the Sprague-Grundy functions are not the same for the two games. We give an explicit formula for the Sprague-Grundy function for the original game of Euclid and we explain how the Sprague-Grundy functions of the two games are related.

10.5. Almost regular edge colourings of complete bipartite graphs
Barbara Maenhaut (The University of Queensland)
12:00 Wednesday 28 September 2011 – 24.201
Barbara Maenhaut
A graph $G$ is almost regular on $S \subseteq V(G)$ if the degrees of any two vertices of $S$ differ by at most 1. An edge-colouring of the complete bipartite graph $K_{m,n}$ is almost regular on $S \subseteq V(K_{m,n})$ if the spanning subgraph induced by each colour is almost regular on $S$. In this talk I will illustrate the proof of the following lemma in which an edge-colouring of a complete bipartite graph is transformed into an almost regular edge-colouring of that complete bipartite graph.

**Lemma** Let the vertex set of $K_{m,n}$ be comprised of the partite sets $A$ and $B$ where $|A| = m$ and $|B| = n$. Let $\gamma$ be an edge colouring of $K_{m,n}$ and let $S \subseteq V(K_{m,n})$ such that either $S \subseteq A$ or $S \subseteq B$. Then there exists an edge colouring $\gamma'$ of $K_{m,n}$ such that the following conditions hold:

- For each colour $c$, the number of edges of colour $c$ is the same for $\gamma$ and $\gamma'$.
- For each $x \in V(K_{m,n}) \setminus S$ and each colour $c$, the number of edges of colour $c$ incident with $x$ is the same for $\gamma$ and $\gamma'$.
- For $x, y \in V(K_{m,n}) \setminus S$, the colour of the edge $xy$ is the same for $\gamma$ and $\gamma'$.
- The edge colouring $\gamma'$ is almost regular on $S$.

Applications of this lemma to prove classical results and new results will be presented.

10.6. Recent research in matroid theory
Dillon Mayhew (Victoria University of Wellington)
15:00 Mon 26 September 2011 – 24.201
Dillon Mayhew
A matroid is a geometrical structure that abstracts the notion of linear dependence. There has been a great deal of recent activity in matroid research, and many old conjectures are now within striking distance.

This talk will give a brief (and incomplete) overview of recent matroid research, concentrating on two contrasting types of results: exact and qualitative. No knowledge of matroid theory will be assumed.

10.7. Normal coverings of finite symmetric and alternating groups
Cheryl Praeger (The University of Western Australia)
15:00 Tuesday 27 September 2011 – 24.201
Cheryl Praeger
A covering of a finite group $G$ is a set of proper subgroups whose union is $G$. The covering is normal if it is closed under conjugation by $G$. The object is to minimise the number of conjugacy classes of subgroups involved in a normal covering. Part of our motivation comes from a number theoretic application to do with factorisation of integer polynomials - and we study the alternating and symmetric groups as these are the most common Galois groups. We prove that the minimum number of conjugacy classes required for a normal covering of $A_n$ or $S_n$ lies between $a\phi(n)$ and $bn$ for certain constants $a, b$, where $\phi(n)$ is the Euler phi-function, and we show that the number depends on the arithmetical complexity of $n$. Moreover we get very tight bounds in the case where $n$ is divisible by at most two primes. This is joint work with Daniela Bubboloni [Firenze].

10.8. Higher dimensional Hadamard matrices
Jennifer Seberry (University of Wollongong)
11:30 Wednesday 28 September 2011 – 24.201
Jennifer Seberry and Tianbing Xia
The Hadamard Conjecture is now over 100 years old and still unproven. The conjecture is that a $2 \times 2$ Hadamard matrix exists for order 1, 2 and $4t$ ($t$ a non-negative integer). We review results on the status of the conjecture and construct Hadamard matrices in higher dimensions which have applications in spectroscopy, security, error-correction, signal processing, acoustics and ...

10.9. Disconnected colors in generalized Gallai colorings
Akos Seress (The University of Western Australia)
16:00 Tuesday 27 September 2011 – 24.201
S. Fujita, A. Gyarfas, C. Magnant, A. Seress
Gallai-colorings of complete graphs - edge colorings such that no triangle is colored with three distinct colors - occur in various contexts such as the theory of partially ordered sets (in Gallai’s original paper), information theory and the theory of perfect graphs. A basic property of Gallai-colorings with at least three colors is that at least one of the color classes must span a disconnected graph. We are interested here in whether this or a similar property remains true if we consider colorings that do not contain a multicolored copy of a fixed graph $F$. 
11. Probability and Statistics

11.1. Gaussian processes in Hybrid MCMC and Simulated Annealing for computationally expensive objective functions.
Mark James Fielding (University of Wollongong)
11:30 Wednesday 28 September 2011 – 24.101
Mark Fielding, David Nott, S.-Yui. Liong

Hybrid MCMC is considered in Statistical models where evaluating a probability function is computationally expensive, relying on output from a numerically intensive computer model. We develop efficient methods to minimise the number of function evaluations in MCMC by replacing the target distribution with a Gaussian process approximation. The approximation is used in generating better proposals and the true target is used in their acceptance/rejection.

Extensions are made to the method of Rasmussen (2003): Parallel tempering with Rasmussen’s scheme, incorporating the true target at all temperatures; Parallel tempering with full replacement by the approximation at all temperatures; And parallel tempering retaining the true target only at the lowest temperature. Hybrid MCMC with the Gaussian process approximation is also considered for efficient Simulated Annealing with a computationally expensive objective function.

11.2. Influence diagnostics for INGARCH time series models
Shuangzhe Liu (AMSI)
16:30 Mon 26 September 2011 – 24.101
F. Zhu, S. Liu and P. Xu

In this talk, we consider some INGARCH models to study time series of count data. We review the maximum likelihood estimation method and present gradient vectors, Hessian matrices and other related results. Based on such results, we use case-weights, data and other perturbation schemes to make local influence analysis for some of the models. We include illustrated real data examples.

11.3. Statistical Based Arbitrage in Financial Markets using Cointegration
Michael McCrae (AMSI)
15:30 Mon 26 September 2011 – 24.101
M. McCrae, Lin, Y-X, Gulati, C.

This talk reviews the derivation, nature and properties of cointegration - a statistical technique for deriving any stationary relationships among eligible I(1) series - especially among financial data series. It reviews the application of cointegration techniques in the financial and derivatives markets through a strategy known as pairs trading, and reviews significant modern developments of this technique and its applications.

11.4. Abelian and Tauberian theorems for long memory random fields
Andriy Olenko (La Trobe University)
15:00 Mon 26 September 2011 – 24.101
A.Olenko

In many cases mathematical models for spatial phenomena or images are obtained as particular examples of random fields. Models of this type are often satisfactorily characterized by their correlation or spectral functions.

Unfortunately well-known results by Pitman and Bingham can not be used to derive asymptotic results for long-memory random fields. Asymptotics for the correlation function $B_n(r)$, when $r \to \infty$ and the isotropic spectral function $\Phi(\lambda)$, when $\lambda \to 0$ have been studied. New Abelian and Tauberian theorems for some classes of extended regularly varying functions will be discussed. Various illustrative examples will be given.

11.5. Hybrid Variational Bayes
John Ormerod (University of Sydney)
12:30 Wednesday 28 September 2011 – 24.101
John Ormerod

Variational Bayesian methods offer computationally efficient approaches for fitting many Bayesian models. Unfortunately there are models where the quality of these approximations can be quite poor. In this talk a hybrid Variational Bayes/Gibbs Sampling method will be presented which exploits the close connection between the two methods. The resulting method is useful in several contexts where trading off accuracy for computational speed may be beneficial. Examples illustrating the approach may include normal mixture models, missing data models and bridge regression methods, time permitting.

11.6. Approximate Bayesian computation (ABC) and Bayes linear analysis: Towards high-dimensional ABC
Scott Sisson (AMSI)
12:00 Wednesday 28 September 2011 – 24.101
S. A. Sisson, D. J. Nott and Y. Fan

Bayes linear analysis and approximate Bayesian computation (ABC) are techniques commonly
used in the Bayesian analysis of complex models. In this talk we connect these ideas by demonstrating that regression-adjustment ABC algorithms produce samples for which first and second order moment summaries approximate adjusted expectation and variance for a Bayes linear analysis. This gives regression-adjustment methods a useful interpretation and role in exploratory analysis in high-dimensional problems. As a result, we propose a new method for combining high-dimensional, regression-adjustment ABC with conventional sampler-based approaches (such as MCMC), thereby providing an improved estimate of the joint posterior in high dimensional analyses. We illustrate this method with several examples, with a focus on predictive inference and model checking.

11.7. Gaussian Working Correlation Structure in Longitudinal Data Analysis
You-Gan Wang (University of Queensland)
16:00 Mon 26 September 2011 – 24.101

You-Gan Wang and Vincent Carey

We investigate methods for data-based selection of working covariance models in the analysis of correlated data with generalized estimating equations. Two selection criteria are studied: Gaussian pseudolikelihood, and a geodesic distance based on discrepancy between model-sensitive and model-robust regression parameter covariance estimators. The Gaussian pseudolikelihood is found to be reasonably sensitive for several response distributions and non-canonical mean-variance relations for longitudinal data. Assessment of adequacy of both correlation and variance models for longitudinal data should be routine in applications, and open source software supporting this practice is described. Examples are provided using data from two medical studies.
12. General session

Nicholas Bartlett (AMSI)
16:00 Tuesday 27 September 2011 – 24.204
Nicholas Bartlett
The Hall–Littlewood polynomials are a family of symmetric functions which play an important role in representation theory and algebraic combinatorics. In this talk we will examine their importance in understanding recent work generalising Macdonald’s eta-function identities and the famous Rogers–Ramanujan identities. We will also describe a new, explicit formula for these polynomials, leading to a generalisation of the $C_n$ Rogers–Selberg identity.

12.2. The Vanishing Art of Introductory Mathematics
Raymond Booth (Flinders University)
10:30 Thursday 29 September 2011 – 24.204
RS Booth / ZA Melzak
This (as yet unpublished) book, authored by Professor Z A Melzak, retired from the University of British Columbia, puts much of undergraduate mathematics in its proper historical perspective. As such much of its material is essential knowledge for all who teach at first or second year University level.

12.3. Metric trees of generalized roundness one
Ian Doust (University of New South Wales)
15:00 Tuesday 27 September 2011 – 24.204
Elena Caffarelli, Ian Doust and Anthony Weston
Every finite metric tree has generalized roundness strictly greater than one. On the other hand, some countable metric trees have generalized roundness precisely one. The purpose of this paper is to identify some large classes of countable metric trees that have generalized roundness precisely one. The purpose of this paper is to identify some large classes of countable metric trees that have generalized roundness precisely one. At the outset we consider spherically symmetric trees endowed with the usual combinatorial metric (SSTs). Using a simple geometric argument we show how to determine decent upper bounds on the generalized roundness of finite SSTs that depend only on the downward degree sequence of the tree in question. By considering limits it follows that if the downward degree sequence $(d_0, d_1, d_2, \ldots)$ of a SST $(T, \rho)$ satisfies $|\{j | d_j > 1\}| = \aleph_0$, then $(T, \rho)$ has generalized roundness one. Included among the trees that satisfy this condition are all complete $n$-ary trees of depth $\infty$ ($n \geq 2$), all $k$-regular trees ($k \geq 3$) and inductive limits of Cantor trees. The remainder of the paper deals with two classes of countable metric trees of generalized roundness one whose members are not, in general, spherically symmetric. The first such class of trees are merely required to spread out at a sufficient rate (with a restriction on the number of leaves) and the second such class of trees resemble infinite combs.

12.4. Singularly Perturbed Linear Programming Problems
Vladimir Gaitsgory (University of South Australia)
16:30 Tuesday 27 September 2011 – 24.204
Vladimir Gaitsgory
Some optimization problems are characterized by the fact that their optimal values may change abruptly with small changes of data (due to an abrupt change of feasible domains). One of the way of investigating these phenomena is to study families of problems depending on a parameter in such a way that the optimal values obtained with small positive values of the parameter are significantly different from those obtained with the zero value of the parameter (that is, the dependences of the optimal values on the parameter are discontinuous at zero). Such families of optimisation problems are called singularly perturbed (SP). In our presentation, we will deal with SP linear programming problems, and our main focus will be on the construction of the “true limit” problems, the solution of which can be used for construction of near optimal solutions of the SP problems with small but nonzero values of the parameter.

12.5. Nearly Identical Expressions in Existential Second Order Logic for Problems in P and NP
Prabhu Manyem (Shanghai University)
11:00 Thursday 29 September 2011 – 24.204
Prabhu Manyem
We consider a problem in finite model theory. We show that a decision problem known to be in the computational complexity class P (Maximum Matching) and another one only known to be in NP (Maximum Independent Set) have almost identical expressions in existential second order logic. More precisely, the difference is only in the first order part of the expression, which can be computed directly from the input structure. The input domain is assumed to have a linear order. Thus as far as the second order predicates (the unknowns) are concerned, the expressions are identical; they are universal Horn formulae.
12.6. A new large cardinal property
Rupert Gordon McCallum (University of New South Wales)
11:30 Thursday 29 September 2011 – 24.204
Rupert McCallum

Reflection principles with a second-order parameter yield the large cardinals known as “indescribable cardinals”. If one tries to generalise this in a natural way so as to include parameters of third order or higher, one obtains an inconsistency. Tait in his essay “Constructing Cardinals from Below” proposed that this problem could be avoided by placing restrictions on the formulas to be reflected. However, some of the reflection principles he proposed have been proved inconsistent by Peter Koellner in “On Reflection Principles”. We introduce a new large-cardinal property which is consistent relative to an $\omega$-Erdős cardinal which yields a consistency proof for restricted versions of these reflection principles.

12.7. p-negative type of finite metric spaces
Stephen James Sanchez (University of New South Wales)
15:30 Tuesday 27 September 2011 – 24.204
Stephen Sanchez

The notions of negative type and generalized roundness have been used extensively in metric geometry to investigate various questions of embeddability. An early example is Schoenberg’s classical result that a metric space is isometric to a subset of a Euclidean space if and only if it has 2-negative type. While the supremal $p$-negative type of certain metric spaces such as $L_p(\mu)$ and $C[0,1]$ has been known for some time, calculating the supremal $p$-negative type of a given finite metric spaces has remained difficult.

In this talk I will show how by combining results of Li and Weston and Wolf, one may calculate the supremal $p$-negative type of a given finite metric space. The result is then applied to calculate the supremal $p$-negative types of the complete bipartite graphs and to prove a gap in the spectrum of possible supremal $p$-negative type values for path metric graphs.

The talk should be accessible to everyone.
13. Mathematical Physics

13.1. A non-directed model of polymer adsorption
Nicholas Beaton (MASCOS / University of Melbourne)
12:00 Wednesday 28 September 2011 – 24.202
Nicholas Beaton
Self-avoiding walks have long been considered as an idealised model of polymers, and can be used to study phenomena like polymer collapse and adsorption. Thus far the only models which have been solved exactly, such as Dyck paths and partially directed walks, have a directedness constraint. I’ll introduce a new model which is not restricted in this way.

13.2. From second-order to first-order in an infinite number of steps
Andrea Bedini (MASCOS / University of Melbourne)
11:30 Thursday 29 September 2011 – 24.202
Andrea Bedini
Self-avoiding trails are a model of polymer collapse alternative to self-avoiding walks (SAWs) where the paths may revisit sites but not bonds. While it’s established that trails in the swollen (high-temperature) phase are in the same universality class as SAWs, their properties at collapse are not yet fully understood. We present numerical evidence that trails on the simple cubic lattice have, in a larger parameter space, both a first-order and a second-order line of phase transitions with the two lines meeting at a multi-critical point of peculiar scaling properties.

13.3. Integrability of BEC/BCS crossover Hamiltonians
Andrew Birrell (University of Queensland)
16:00 Mon 26 September 2011 – 24.202
Andrew Birrell, Jon Links and Phil Isaac
In the last several decades a prolific field of research has flourished, dedicated to constructing and analysing exactly solvable quantum models. The understanding of quantum integrability that made such analysis tractable finds its origin in the melding of the Quantum Inverse Scattering Method and Bethe Ansatz techniques. This approach can be complicated and difficult to implement. In some instances an ability to extend the exact solutions to the most general Hamiltonians to which they are applicable is outside the scope of such techniques. In this talk, I will demonstrate an alternative method, inspired by an old approach by Richardson in the 1960s, that enables such a determination. In particular we will derive the integrability conditions for a general family of BEC/BCS crossover Hamiltonians and determine the manifolds in the coupling parameter space for which they can be solved exactly.

13.4. Current fluctuations in the asymmetric exclusion process
Jan De Gier (The University of Melbourne)
17:00 Mon 26 September 2011 – 24.202
Jan De Gier
I will discuss the current statistics of the one-dimensional asymmetric exclusion process with particle injection and extraction at two boundaries. In the limit of infinite system size, I will present an exact expression for the current large deviation function.

13.5. The simplest correction to Hubbell’s law and its theoretical implications
Frank De Silva (AMSI/University of Melbourne)
11:00 Tuesday 27 September 2011 – 24.202
Frank De Silva
This paper introduces a simple change to the Hubbell’s equation on distance to red shift. It is shown that the prediction of the equation is compatible with data, obtained from distance measurements, which are independent of red shift. Having shown its compatibility with these observations, the paper then introduces the theoretical basis for the equation. The theoretical basis relies on a single assumption that in the expansion of the universe, the ratio \( \frac{d(\text{space})}{d(\text{time})} = \text{Constant} = \text{speed of light} \). It is shown that the equations of special relativity follow directly from this 1 assumption.

Demosthenes Ellinas (Technical University of Crete)
10:30 Thursday 29 September 2011 – 24.202
Demosthenes Ellinas
Hopf algebras of functions and operators are utilized to develop a mathematical construction scheme for building generalized diffusion equations, algebraic Markov chains and quantum master equations, by means of algebraic random walks\[1-3\]. The main construction treats exemplary cases of elementary Hopf algebras, such as circle, line, plane, sphere, finite groups and anyonic algebras\[4-8\]. It studies pairs of covariance \[9\], formed by a translation operator and its associated operator valued measures, such as, OVMs related to Wigner distribution functions
13. Mathematical Physics

[10], positive OVM (POVMs) related to position/momentum distributions of canonical quantum systems, and analogous POVMs related to distributions associated to spin quantum systems. The construction utilizes (completely) positive trace preserving maps (CPTP) of (density) matrices [11]. The appropriately defined (weak) asymptotic limit of the action of such maps, it is shown to lead to quantum master equations of Lindblad type[12]. Particular quantum master equations describing information loss due to dephasing, are derived and investigated as show cases of open quantum systems [13].


13.7. Dynamics of the asymmetric exclusion process in the reverse bias regime
Caley Finn (The University of Melbourne)
16:30 Mon 26 September 2011 – 24.202
Jan de Gier, Caley Finn, Mark Sorrell
The asymmetric simple exclusion process (ASEP) is a model describing the diffusion of hard-core particles along a one-dimensional chain. With open boundaries, the ASEP is a non-equilibrium system with late time behaviour described by a unique stationary distribution. The relaxation rate to this distribution can be found by solving the Bethe ansatz equations for the system. Earlier work found the asymptotic behaviour of the relaxation rate in the forward bias regime. We extend these results to the reverse bias regime and describe how fine structure in the Bethe ansatz solutions changes the asymptotic behaviour.

13.8. A Fuchsian differential equation for Selberg correlation integrals
Peter Forrester (The University of Melbourne)
11:00 Thursday 29 September 2011 – 24.202
Peter Forrester
Certain Selberg correlation integrals are given in terms of a basis of solutions of a particular Fuchsian matrix differential equation. The explicit form of the connection matrix from the Frobenius type power series to this basis is calculated. This allows us to determine the leading asymptotic form of negative moments of the characteristic polynomial, which relates to an effect known as singularity dominated strong fluctuations.

13.9. Loop models in three dimensions
Timothy Garoni (Monash University)
11:30 Wednesday 28 September 2011 – 24.202
Timothy Garoni, Youjin Deng, Qingsquan Liu
Loop models in two dimensions have been an active field of study over recent decades, and many exact results have been found. In three dimensions, however, very few results are known. In this talk I’ll describe the results of a systematic Monte Carlo study of the O(n) loop model on a three-dimensional 3-regular lattice, for real non-negative n.

13.10. Matrix models, lattice models and an O(N)-Potts correspondence
Alex Lee (The University of Melbourne)
12:00 Tuesday 27 September 2011 – 24.202
Alex Lee
Matrix models can be used to describe statistical mechanical models on surfaces of arbitrary Euler characteristic. Recently, Eynard and Orantin developed a theory to solve such models and this has since been used to solve the Ising and O(N) on random surfaces. In this talk I will give a basic introduction to matrix models and outline an approach to solving the Potts matrix model using a known correspondence with the O(N) matrix model.

13.11. Polynomial algebras and superintegrability
Ian Marquette (The University of Queensland)
15:00 Mon 26 September 2011 – 24.202
Ian Marquette
We will present recent results concerning polynomial algebras in context of quantum superintegrable systems. We will discuss superintegrable quantum systems involving the fourth and fifth Painlevé transcendents and the generalized MICZ-Kepler system.
13.12. Integrable Heteroatomic Molecular Bose-Einstein Condensates
Eduardo Cerutti Mattei (The University of Queensland)
10:30 Tuesday 27 September 2011 – 24.202
Eduardo Cerutti Mattei
We study an exactly solvable model for heteroatomic molecular Bose-Einstein condensates. We start by revisiting the integrability of the model through the Yang-Baxter algebra. Using a classical analysis we determine the phase space fixed points of the system. It is found that bifurcations of the fixed points naturally separate the coupling parameter space in different regions. Remarkably, two distinct scenarios emerge, depending if the number of atoms of different species is equal or not. This result suggests the ground-state properties of the model exhibit an unusual sensitivity on the atomic imbalance. We then confirm this finding by a quantum analysis using different approaches, such as the energy gap, the fidelity, the entanglement and the behavior of the ground-state solutions of the Bethe ansatz equations.

13.13. A geometric triumvirate of random matrices
Anthony Mays (The University of Melbourne)
12:30 Wednesday 28 September 2011 – 24.202
Anthony Mays
A random matrix is, broadly speaking, a matrix with entries randomly chosen from some distribution. In the non-random case eigenvalues can occur anywhere in the complex plane, but, remarkably, random elements imply predictable behaviour, albeit in a probabilistic sense. Correlation functions are one measure of a probabilistic characterisation and we discuss a 5-part scheme, based upon orthogonal polynomials, to calculate the eigenvalue correlation functions. We apply this scheme to three ensembles of random matrices, each of which can be identified with one of the surfaces of constant Gaussian curvature: the plane, the sphere and the anti- or pseudo-sphere. We will be using real random matrices, which possess the added complication of having a finite probability of real eigenvalues.

Amir Moghaddam (The University of Queensland)
15:30 Mon 26 September 2011 – 24.202
Amir Moghaddam, Dr Jon Links and A/Prof. Yao-Zhong Zhang
We present a new integrable model describing the interaction of two spin-half impurities in an isotropic Heisenberg chain. Periodic boundary conditions are imposed on the system. The Hamiltonian of the new model is obtained based on the Quantum Inverse Scattering Method and diagonalised via the algebraic Bethe ansatz.

13.15. The equation of motion of an extended charged particle
Andrew Norton (Max Planck Institute for Gravitational Physics)
12:00 Thursday 29 September 2011 – 24.202
Andrew H Norton
If a charged particle is modelled as having an extended charge distribution with finite self-energy, then Maxwell field theory can be used to calculate its equation of motion. In this way, one can derive a self-consistent electrodynamics for the extended particle. Conventional wisdom would have it that this self-consistent electrodynamics should not differ significantly from Maxwell-Lorentz electrodynamics. That is, that the equation of motion for the extended charged particle would differ from the Lorentz force equation only by small radiative corrections and small model-dependent structure terms. However, a fully relativistic calculation for one such particle shows that this conventional wisdom is false. The extended particle we consider is a uniformly charged sphere. The self-consistent electrodynamics for this simple particle turns out to be far more interesting than can be described by any variant of Maxwell-Lorentz theory. It also appears to be a better physical description. For example, the spin angular momentum and magnetic moment of the electron can both be modelled within this electrodynamics, and a purely classical explanation can be given for the failure of Maxwell-Lorentz electrodynamics at the Compton wavelength scale. These results follow directly from Maxwell field theory, so need to be somehow reconciled with quantum theory.

13.16. Random Tilings of Squares Triangles and Rhombi
Maria Tsarenko (The University of Melbourne)
11:30 Tuesday 27 September 2011 – 24.202
Jan de Gier, Bernard Nienhuis, Maria Tsarenko
In this talk, we introduce an integrable square-triangle-rhombus random tiling model. This model is an extension of the square-triangle tiling by the addition of a rhombus. The model is solvable by the algebraic Bethe Ansatz and the entropy can be computed in a two-parameter subspace. Square-triangle-rhombus random tilings are generalisations of rhombus tilings, or non-intersecting lattice paths. Recently it has also been related to the so called puzzles which compute Littlewood-Richardson coefficients.
14. Differential Geometry

14.1. Fractal transformations associated with Bernoulli convolutions
Michael Fielding Barnsley (Australian National University)
12:00 Tuesday 27 September 2011 – 24.203
Michael Barnsley

We consider the family of dynamical systems $T = T(a, b, \rho) : [0, 1] \to [0, 1]$ where $1 \leq a + b$, $0 < a, b, \rho < 1$, $T(x) = x/a$, $0 \leq x \leq \rho$, $T(x) = x/b + (1 - 1/b)$ and $\rho < x \leq 1$.

Under what conditions on $(a, b, \rho)$ are two such systems topologically conjugate? I will outline the rich theory of this subject. The material in this talk is derived from collaboration with B. Harding, K. Igudesman, J. Keesling, N. Mihalache, A. Samuels, N. Singreva and A. Vince.

14.2. Infinitesimal automorphisms of parabolic geometries and dynamics
Andreas Cap (University of Vienna)
11:30 Tuesday 27 September 2011 – 24.203
Andreas Cap

14.3. Families of conformal operators along a hypersurface and formal extension problems
Rod Gover (AMSI)
15:00 Mon 26 September 2011 – 24.203
Rod Gover

The problem of constructing conformally invariant differential operators along a hypersurface has been looked at by a number of authors in connection with the study of Polyakov type formulae, conformal Dirichlet-Neumann problems, the asymptotics of Poincare-Einstein manifolds, Q-curvature and the AdS/CFT correspondence of Physics. I will discuss recent progress and its connection to the asymptotics of a class of conformal boundary problems. This is joint work with Larry Peterson and Andrew Waldron.

14.4. Totally geodesic subalgebras of $N$-graded filiform Lie algebras
Ana Hinic-Galic (La Trobe University)
16:30 Mon 26 September 2011 – 24.203
Grant Cairns, Ana Hinic-Galic, Yury Nikolayevsky

A metric Lie algebra $g$ is a Lie algebra equipped with an inner product. A subalgebra $h$ of a metric Lie algebra $g$ is said to be totally geodesic if a Lie subgroup corresponding to $h$ is a totally geodesic submanifold relative to the left-invariant Riemannian metric on the simply connected Lie group associated to $g$ defined by the inner product.

We will start with a brief overview of results on totally geodesic subalgebras of metric nilpotent (and in particular, filiform) Lie algebras. We will then give a complete characterisation of the maximal dimension of totally geodesic subalgebras of $N$-graded metric filiform Lie algebras (the question is motivated by an earlier result of Kerr and Payne).

14.5. Asymptotic Convexity of Hypersurfaces Moving by Curvature
Mathew Langford (Australian National University)
16:00 Tuesday 27 September 2011 – 24.203
Mathew Langford

We study a simple method for obtaining a theorem of Huisken and Sinestrari, which demonstrates that compact, mean convex, hypersurface solutions of the mean curvature flow become (weakly) convex at singular points and see how the proof might apply to other flows by functions of the principal curvatures. The Huisken-Sinestrari result was crucial in classifying singular behaviour of the mean curvature flow.

14.6. Connected irreducible subgroups of $O(2,n)$
Thomas Leistner (University of Adelaide)
11:00 Tuesday 27 September 2011 – 24.203
Thomas Leistner

The fact that any representation of a compact Lie group admits a positive definite invariant scalar product implies that there is an abundance of irreducible subgroups of $O(n)$. For indefinite scalar products the situation is quite different. For example, for any $n$, the Lorentz group $O(1,n)$ has no irreducible subgroups apart from its connected component. We will show how this and a similar classification result for irreducible, connected subgroups of $O(2,n)$ follows from the Karpelevich-Mostov theorem. As an application we obtain a classification of irreducible conformal holonomy groups of conformal Lorentzian manifolds (This is based on joint work with Antonio J. Di Scala, Politecnico di Torino, and with Jesse Alt, University of the Witwatersrand)

14.7. Subriemannian curvatures
Tohru Morimoto (Kinki University)
11:30 Thursday 29 September 2011 – 24.203
Tohru Morimoto

For each subriemannian manifold of constant subriemannian symbol we construct a Cartan connection canonically associated with this structure, which thereby enables us to define the curvatures of the subriemannian manifold.
14.8. On some generic distributions and their automorphism groups
Katharina Neusser (Australian National University)
11:30 Wednesday 28 September 2011 – 24.203
Katharina Neusser

There is an interesting class of vector distributions, which can be equivalently described as certain types of parabolic geometries. Having introduced these types of distributions, we will show how one can deduce just from the existence of their equivalence to certain parabolic geometries strong restrictions on the possible dimensions of their automorphism groups. This talk is based on a joint work with Andreas Cap.

14.9. Local obstructions to 2-dimensional projective structures admitting skew-symmetric Ricci tensor
Matthew Randall (Australian National University)
16:00 Mon 26 September 2011 – 24.203
Matthew Randall

A projective surface is a 2-dimensional manifold equipped with a projective structure i.e. a class of torsion-free affine connections that have the same geodesics as unparameterised curves. Given any projective surface we can ask whether it admits a torsion-free affine connection (in its projective class) that has skew-symmetric Ricci tensor. This is equivalent to solving a particular semi-linear overdetermined partial differential equation. It turns out that there are local obstructions to solving the PDE in two dimensions. These obstructions are constructed out of local invariants of the projective structure.

14.10. (2, 3, 5)-distributions and associated conformal structures
Katja Sagerschnig (Australian National University)
12:30 Wednesday 28 September 2011 – 24.203
Katja Sagerschnig

A (2, 3, 5)-distribution is a maximally non-integrable rank 2 subbundle in the tangent bundle of a 5-dimensional manifold. Based on fundamental work of Elie Cartan, Pawel Nurowski showed how to construct a conformal class of pseudo-Riemannian metrics of signature (2,3) that is naturally associated with such a distribution. This talk will be concerned with the application of parabolic geometry methods to the study of Nurowski’s conformal structures. I will discuss joint work with Andreas Cap and with Matthias Hammerl.

14.11. Howe duality for the symplectic Dirac operator
Petr Somberg (Charles University)
12:00 Thursday 29 September 2011 – 24.203
Petr Somberg

We find the Fisher decomposition for the space of polynomials valued in Segal-Shale-Weil representation. As a consequence, this allows to determine symplectic monogenics, i.e. the space of polynomial solutions of symplectic Dirac(-Kostant) operator.

14.12. Dunkl operators and a family of realizations of \(osp(1|2)\)
Vladimir Soucek (Charles University)
15:30 Tuesday 27 September 2011 – 24.203
Vladimir Soucek

A family of radial deformations of the realization of the Lie superalgebra \(osp(1|2)\) in the theory of Dunkl operators is obtained. This leads to a Dirac operator depending on 3 parameters. Several function theoretical aspects of this operator are studied, such as the associated measure, the related Laguerre polynomials and the related Fourier transform. For special values of the parameters, it is possible to construct the kernel of the Fourier transform explicitly, as well as the related intertwining operator.

14.13. Twistor geometry in six dimensions
Arman Taghavi-Chabert (Masaryk University)
10:30 Tuesday 27 September 2011 – 24.203
Arman Taghavi-Chabert

We describe twistor geometry in six dimensions, including the Penrose transform for zero-rest-mass fields, in the language of spinors.

Naghmana Tehseen (La Trobe University)
16:30 Tuesday 27 September 2011 – 24.203
Naghmana Tehseen

The geometric study of differential equations aims to describe the local and global structure of the solutions as integral submanifolds of an equation manifold. The study of partial differential equations (PDEs) leads to the concept of Vessiot distributions, which provides the convenient formal framework to investigate PDEs on an appropriate jet bundle. In this talk I will give a brief exposition of Vessiot distributions of PDEs and then go on to describe some recent work.
14.15. Rigidity of Schubert varieties in compact Hermitian symmetric spaces

Dennis The (Australian National University)
12:00 Wednesday 28 September 2011 – 24.203

Dennis The

Compact Hermitian symmetric spaces (CHSS) are a distinguished class of homogeneous varieties that play a central role in algebraic and differential geometry. Their topology is well understood: in particular, the homology of any CHSS $G/P$ admits a nice basis in terms of Schubert varieties. Most Schubert varieties are singular, and a natural question is that of smoothability: Given a Schubert variety $X[w]$ in a CHSS, does its homology class admit a smooth representative? More generally, “how many” different representatives exist? If the only representatives are $G$-translates of $X[w]$, then $X[w]$ is said to be Schur rigid. Using a differential geometric approach, substantial progress on the rigidity problem was made by Maria Walters, Robert Bryant, and Jaehyun Hong in the cases that $X[w]$ is smooth or the CHSS is a Grassmannian. I will discuss work with Colleen Robles (Texas A&M) to study the rigidity of Schubert varieties in arbitrary CHSS using tools from exterior differential systems, Lie algebra cohomology, and representation theory.
15. Education Afternoon

15.1. Wallpaper, Crystals and Symmetry.
Michael Giudici (University of Western Australia)
15:30 Tuesday 27 September 2011 – Hope Theatre
Michael Giudici

Next time you are struggling to choose wallpaper and are faced with what seems like a myriad of different patterns, you will be relieved to know that a little mathematics proves that there are essentially only 17 patterns to choose from. I will discuss how group theory (the mathematical abstraction of symmetry) can be used to make this assertion. The same ideas are also used in crystallography to analyse the different possible structures of crystals.

15.2. Fractals and Dynamics in Education
Michael Barnsley (Flinders University)
10:30 Thursday 29 September 2011 – Hope Theatre
RS Booth / ZA Melzak

I will present some accessible ideas, new to me and of pedagogical value, concerning fractal geometry and dynamical systems. I will include a demonstration of the Fractal Camera.
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