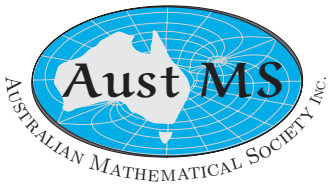
# The third

# Early Career Workshop

## of the Australian Mathematical Society

The Chifley Hotel, Wollongong, 24–25 September 2011



Research talks by:

**Vigleik Angeltveit** (Australian National University)
**Frances Kuo** (University of New South Wales)
**Aidan Sims** (University of Wollongong)

Advice talks by:

**Nalini Joshi** (University of Sydney)
**Mark Nelson** (University of Wollongong)
**Juliette Woods** (Australian Water Environments)

Organisers:

**Bronwyn Hajek** (University of South Australia)
**Natalie Thamwattana** (University of Wollongong)
**Stephan Tillmann** (University of Queensland)

Schedule of the third

# Early Career Workshop

of the Australian Mathematical Society

Saturday, 24 September 2011

| | | |
|---|---|---|
| 13:30 | Arrival | |
| 13:50 | Welcome | |
| 14:00 | **Vigleik Angeltveit** (ANU) | *Towards Algebraic K-theory of Thom Spectra* |
| 14:45 | Afternoon tea | |
| 15:15 | **Nalini Joshi** (Sydney) | *Mathematical Collaborations: how to kickstart and maintain dreams* |
| 15:45 | **Mark Nelson** (Wollongong) | *Developing Collaborative Research* |
| 16:15 | Q&A Session: Collaborations | |
| 18:00 | Pre-dinner drinks (Cash Bar) | |
| 19:00 | Dinner | |
| 20:30 | Discussion Session: Managing a career with a family (or other responsibilities) | |

Sunday, 25 September 2011

| | | |
|---|---|---|
| 09:00 | **Frances Kuo** (UNSW) | *Liberating the dimension* |
| 09:45 | **Juliette Woods** (AWE) | *The challenges and pleasures of working in industry* |
| 10:15 | Q&A Session: Networking in industry | |
| 10:45 | Morning tea | |
| 11:15 | **Aidan Sims** (Wollongong) | *Graph algebras: doing functional analysis with pictures* |
| 12:00 | Final Q&A Session | |
| 12:30 | Lunch | |

# Research Talks:

# Abstracts and Biographies of the Speakers

## Towards Algebraic K–theory of Thom Spectra

**Vigleik Angeltveit** (Australian National University)

The algebraic K–theory of a space $X$ is in some sense well understood. This understanding is based on the trace map to the topological cyclic homology of $X$, which is defined in terms of the topological Hochschild homology of $X$ as an $S^1$–equivariant spectrum.

If we want to understand the algebraic K-theory of Thom spectra, things become more complicated. I will explain some recent joint work with Blumberg, Gerhardt and Hill, where we construct a good $S^1$–equivariant model for the topological Hochschild homology of a Thom spectrum. I will also explain why getting from there to algebraic K-theory is not as straightforward as for spaces.

Vigleik Angeltveit received his Ph.D. from Massachusetts Institute of Technology in June 2006, working with Haynes Miller. From September 2006 to May 2011 he was a postdoc at the University of Chicago, the last two years on an MSRI fellowship. He joined the ANU in July 2011. Most of his work is in algebraic topology and algebraic K-theory, with a focus on using methods from stable homotopy theory to understand the algebraic K-theory of rings.

## Liberating the dimension

**Frances Kuo** (University of New South Wales)

High dimensional problems, that is, problems involving hundreds or thousands of variables, are becoming ever more important, with examples ranging from finance, health statistics and oil reservoir modeling to physics. Lattice rules are a family of quasi-Monte Carlo methods which are designed for approximating high dimensional integrals. In this talk I will tell the story of my fortunate involvement in the inception of the component-by-component construction of lattice rules, which was previously dismissed by some experts to be "doomed to failure." This involvement started during my PhD studies, and then continued with attempts of applying these methods to model applications. This experience was used to shape new theory, and in the latest collaborations, we apply these methods to the problem of groundwater flow through a porous material that is modeled as a random medium. In our exciting new theoretical development, we were able to completely tune the parameters in the theory to solve this infinite dimensional problem effectively and efficiently. Many new questions arise from this project, and our general approach could well adapt to the theoretical treatment of other applications.

Frances Kuo is from Taiwan, and immigrated to New Zealand after finishing high school. She completed both her Bachelor and PhD degrees at the University of Waikato, and subsequently moved to Australia to join the research group of Professor Ian Sloan at the University of New South Wales in 2003. Frances was awarded an UNSW VC's Postdoctorial Fellowship from 2004 to 2006, and an ARC QEII Fellowship from 2007 to 2011. She will take up a Senior Lectureship in Applied Mathematics in the School of Mathematics and Statistics from 2012. Frances has worked and published in the theory and application of high dimensional integration and approximation, quasi-Monte Carlo methods, lattice rules, information based complexity, parametric and stochastic partial differential equations, and is interested in applications in finance, statistics and porous media flow. She was the recipient of the 2003 Information-Based Complexity Young Researcher Award, and the 2011 ANZIAM J.H. Michell Medal. Frances is a proud mother of a gorgeous 2-year-old girl named Jenny.

## Graph algebras: doing functional analysis with pictures

**Aidan Sims** (University of Wollongong)

The study of $C^*$–algebras arose in the first half of the 20th century as part of the effort to understand the vaguaries of quantum physics. $C^*$–algebras are very abstract objects, and there are few classification or structure results to help us understand them, so tractable examples are crucial to the subject. Over the last 15 years, the theory of graph $C^*$–algebras has developed as an amazingly powerful tool for understanding deep abstract functional analytic objects using elementary pictures. In this talk I will describe the ideas behind some current research with Alexander Kumjian and David Pask which draws together ideas from combinatorics, algebraic topology, representation theory and functional analysis to provide a powerful new framework for describing and analysing very complex $C^*$–algebras using beautifully elementary pictures.

Aidan Sims was born in Armidale (NSW), and completed all of his schooling and his university studies in Newcastle, finishing his PhD in 2003. He held a post-doc there funded by the ARC Centre of Excellence for Complex Dynamic Systems and Control, before being awarded an ARC Australian Postdoctoral Fellowship in 2005. He moved down the coast to Wollongong to take up a permanent position in 2007. He has held continuous ARC funding since 2004: he has been awarded four ARC discovery grants and an ARC Future Fellowship entitled *Operator algebras as models for dynamics and geometry*, which currently supports his research. His research collaborations over the last ten years have included 23 collaborators worldwide. For all this, his two children, born in 2005 and 2008, already outsmart him on a regular basis.

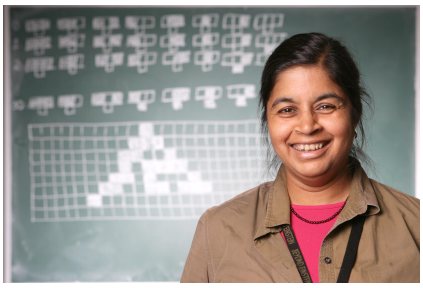
# Advice Talks:

# Abstracts and Biographies of the Speakers

## Mathematical Collaborations: how to kickstart and maintain dreams

**Nalini Joshi** (University of Sydney)

The word "collaborate" means to work together. It can also mean more indirect actions, such as to co-operate and develop common aims and ambitions. I will talk about both the direct and indirect aspects of mathematical collaborations and how I have initiated and maintained collaborations over long distances with international colleagues.



Nalini was awarded a PhD and MA from Princeton University in Applied Mathematics and a BSc (Hons) from the University of Sydney. She has held lecturing positions and fellowships at ANU, UNSW, and the University of Adelaide, as well as visiting positions at international institutions including Princeton, Kyoto, Manchester, Leeds and the Isaac Newton Institute of Mathematical Sciences at Cambridge University. In 2002, she came back to the University of Sydney to take up the Chair of Applied Mathematics. Nalini was President of the Australian Mathematical Society from December 2008 to September 2010, was elected to the Australian Academy of Science in 2008, and is currently chair of the National Committee for Mathematical Sciences.

## Developing Collaborative Research

**Mark Nelson** (University of Wollongong)

This presentation will cover a variety of issues, some of which may be connected to the title. Topics to be discussed may include (but are not limited to):

- Mathematical Societies—should you join them?
- Developing Collaborations—how to do it?
- Building Research Networks—how to do it?
- Polygamy

Perhaps the most important lesson an early career researcher can gain from this presentation is the need not to fall for flattery when someone asks you to give a presentation ("Mark, you have lots of collaborators. Do you want to give a presentation on this topic?").

Mark is an engineering mathematician from the University of Wollongong. His primary area of research is in the application of mathematical modelling to problems from biochemical, chemical and food engineering. He is currently working on mathematical models related to the spontaneous combustion of industrial compost heaps, the change in pH in the stomach following a meal, the effect of incomplete mixing upon biochemical processes, the biological treatment of wastewater and controlled drug release.

## The challenges and pleasures of working in industry

**Juliette Woods** (Australian Water Environments)

What are the challenges and pleasures of working in an industry where mathematicians are few and far between? On scientific multilingualism, "street fighting" mathematics, magical toolkits, and using one's powers for good.

Juliette Woods is Principal Groundwater Modeller at Australian Water Environments, an environmental consulting company that conducts research and engineering works for local councils, state and federal government, irrigators, developers and mining companies. She was awarded a PhD in Applied Mathematics with the University of Adelaide and CSIRO Land and Water. She was a research fellow at the Institute for Computational and Engineering Sciences at the University of Texas at Austin, then returned to Australia to work in consulting. She has specialised in salinity issues, particularly those affecting the River Murray.

| **Name** | **Affiliation** | **Email Address** | **Field of Research** |
|---|---|---|---|
| Francisco Artacho | Newcastle | fran.aragon@gmail.com | Optimisation, Variational Analysis |
| Menaka Bandara | ANU | lashputin@gmail.com | Harmonic and Geometric Analysis |
| Christopher Banks | Newcastle | Christopher.Banks@newcastle.edu.au | Totally disconnected groups |
| Nicholas Bartlett | AMSI | nicholas.bartlett@uqconnect.edu.au | q-series Identities and Symmetric Polynomials |
| Nicholas Beaton | Melbourne | nrbeaton@gmail.com | Combinatorics, Statistical mechanics |
| Andrea Bedini | Melbourne | abedini@ms.unimelb.edu.au | Statistical mechanics, polymer models |
| Andrew Birrell | Queensland | a.birrell@uq.edu.au | Quantum exactly solvable models and Bethe Ansatz solvable models |
| Andrew Crisp | Sydney | andrew.algebra@gmail.com | Representation theory of Lie algebras |
| Norman Do | Melbourne | normdo@gmail.com | Geometry & combinatorics of moduli spaces |
| Ali Elfard | Wollongong | a.elfard@yahoo.com | Topological Algebra |
| Faramroze Engineer | Newcastle | f.engineer@newcastle.edu.au | Operations Research |
| Caley Finn | Melbourne | c.finn3@student.unimelb.edu.au | Mathematical physics |
| Matthew Gibson | Sydney | contact.matt.gibson@gmail.com | Algebraic combinatorics, representation theory, applications to statistics |
| Neil Gillespie | UWA | gillen03@maths.uwa.edu.au | Algebraic combinatorics, coding theory |
| Ivan Guo | Sydney | ivanguo1986@gmail.com | Game Theory & Financial Mathematics |
| Joanne Hall | RMIT | joanne.hall@rmit.edu.au | Combinatorics, Coding theory |
| David Hartley | Monash | david.hartley@monash.edu | Geometric partial differential equations |

| **Name** | **Affiliation** | **Email Address** | **Field of Research** |
|---|---|---|---|
| Drew Heard | Melbourne | dheardie@gmail.com | Algebraic topology |
| Roslyn Hickson | ANU | Roslyn.Hickson@anu.edu.au | Infectious disease modelling, industrial maths |
| Ana Hinic Galic | LaTrobe | ahinicgalic@students.latrobe.edu.au | Differential Geometry |
| Bao Ho | LaTrobe | nbho@students.latrobe.edu.au | Combinatorics, game theory |
| Daniel Jackson | Monash | daniel.jackson@monash.edu | General relativity |
| Simon James | Deakin | sjames@deakin.edu.au | Aggregation functions, fuzzy sets |
| Sangeeta Jhanjee | Monash | sangeeta.jhanjee@monash.edu | Joint Spectral Theory using Clifford Algebras |
| Alex Lee | Melbourne | ajle@pgrad.unimelb.edu.au | Statistical mechanics |
| Paul Leopardi | ANU | paul.leopardi@anu.edu.au | Computational mathematics |
| Snigdhayan Mahanta | Adelaide | snigdhayan@gmail.com | Noncommutative geometry and topology; K-theory |
| Benjamin Maloney | Wollongong | bmaloney@uow.edu.au | Operator algebras |
| Robert Marangell | Sydney | robertmarangell@gmail.com | Dynamical systems, PDE, geometric and topological methods of stability analysis |
| Eduardo Mattei | Queensland | eduardo.mattei@ufrgs.br | Integrable Systems |
| Anthony Mays | Melbourne | a.mays@ms.unimelb.edu.au | Statistical physics, random matrix theory |
| Rupert McCallum | UNSW | rupertmccallum@yahoo.com | Topological Tits buildings, set theory |
| Stephen McCormick | Monash | stephen.mccormick@monash.edu | Geometric analysis, general relativity |
| Ville Merila | Newcastle | Ville.Merila@newcastle.edu.au | Transcendental number theory, Diophantine approximation |

| **Name** | **Affiliation** | **Email Address** | **Field of Research** |
|---|---|---|---|
| Amir Moghaddam | Queensland | amir.moghaddam@uqconnect.edu.au | Mathematical Physics |
| Omar Ortiz | Melbourne | o.omarenrique@student.unimelb.edu.au | Algebra, representation theory, algebraic topology |
| Matthew Randall | ANU | matthew.randall@anu.edu.au | Differential geometry |
| Tyson Ritter | Adelaide | tyson.ritter@alumni.adelaide.edu.au | Complex Analytic Geometry |
| Parinya Ngiamsunthorn | Sydney | pasa4391@uni.sydney.edu.au | Nonlinear Analysis |
| David Shellard | ANU | shellard.david@gmail.com | Partial Differential Equations |
| Robyn Stuart | UNSW | r.stuart@unsw.edu.au | Ergodic theory, dynamical systems |
| Tharatorn Supasiti | Melbourne | t.supasiti@student.unimelb.edu.au | Combinatorial topology and geometric group theory |
| Masoud Talebian | Newcastle | Masoud.Talebian@newcastle.edu.au | Operations Research |
| Thi Dinh Tran | UNSW | dinhtran82@yahoo.com | Discrete integrable systems |
| Thien Tran-Duc | Wollongong | ttd689@uowmail.edu.au | Mathematical modelling in nanotechnology |
| Dimetre Triadis | LaTrobe | D.Triadis@latrobe.edu.au | Mathematical hydrology, geometric methods for differential equations, asymptotic analysis |
| Maria Tsarenko | Melbourne | m.tsarenko@ms.unimelb.edu.au | Mathematical Physics (Integrable Lattice Models) |
| Samuel Webster | Wollongong | swebster@uow.edu.au | Operator Algebra, graph algebras |

# Event Feedback Form for the **Early Career Workshop 2011**

Thank you for participating in the Workshop.

To assist us in improving future Workshops, we would be grateful if you would take a couple of minutes to provide some feedback.

Please tick as appropriate: ☐ Postgraduate student ☐ Post-PhD

How did you find out about this event? (please tick all that apply)

☐ AustMS Gazette
☐ AustMS mailing list
☐ PhD supervisor
☐ Head of Department/Postgraduate Director
☐ Fellow students/colleagues or departmental news
☐ Other

What funding sources enabled you to attend? (please tick all that apply)

☐ Own research grant / travel account
☐ Supervisor's research grant / travel account
☐ Departmental travel funds
☐ AustMS funding for Annual Meeting
☐ Other external sources of funding
☐ Self-funded

Please circle a number on the 1-5 scale below.

| **Research talks** | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
|---|---|---|---|---|---|
| **(Angeltveit, Kuo, Sims)** | | | | | |
| The mathematics presented was interesting | 1 | 2 | 3 | 4 | 5 |
| The talks were understandable to a wide audience | 1 | 2 | 3 | 4 | 5 |
| Adequate opportunities for questions and discussion | 1 | 2 | 3 | 4 | 5 |
| Overall, I benefited from the research talks | 1 | 2 | 3 | 4 | 5 |
| **Advice sessions** | | | | | |
| **(Joshi, Nelson, Woods)** | | | | | |
| The information presented was useful for my career | 1 | 2 | 3 | 4 | 5 |
| There was a good range of topics | 1 | 2 | 3 | 4 | 5 |
| The information was covered in sufficient depth | 1 | 2 | 3 | 4 | 5 |
| Adequate opportunities for questions and discussion | 1 | 2 | 3 | 4 | 5 |
| Overall, I benefited from the advice talks | 1 | 2 | 3 | 4 | 5 |

PTO

**Comments:**

Was there anything you thought was particularly interesting?

Are there any topics (particularly for the advice sessions) that you would like to see covered in future Early Career Workshops?

How do you think the Workshop could be improved?

How do you think other postgrads and postdocs could be encouraged to attend future Workshops?

Any other comments?

If you have any thoughts or suggestions in the coming weeks, or any requests from friends who could not attend this year, please feel free to contact Natalie Thamwattana or Stephan Tillmann.