

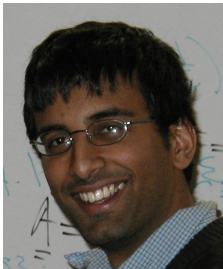
2009 Australian Mathematical Society Early Career Researchers Workshop

Abstracts and Biographies of Speakers

Are integers like polynomials?

Akshay Venkatesh (Stanford University)

The arithmetic of integers behaves like the arithmetic of polynomials over a finite field. This analogy (applied judiciously) works well in a remarkable range of examples; I will discuss this analogy and some ways it has influenced my work.



Akshay grew up in Perth; in high school, he became the only Australian to win medals in both the International Physics Olympiad and the International Mathematics Olympiad. He did his undergraduate study at the University of Western Australia, then got his PhD from Princeton University in 2002 (at the age of 20), with a thesis entitled *Limiting forms of the trace formula*. After a postdoctoral position at MIT, he held a Clay Research Fellowship at the Courant Institute in New York, and has been a Professor at Stanford University since last

September. In 2008 he was awarded the prestigious SASTRA Ramanujan Prize for research in number theory.

Three combinatorial dual identities and their proximity to something useful

Thomas Britz (University of New South Wales)

In the introduction to mathematical articles or mathematical seminars these days, one often finds some defensive arguments that try to persuade the audience that the mathematical results presented are of value for solving real-world problems. A few generations ago, mathematicians of the English tradition in particular, proudly announced

that their mathematical results were ‘pure’ and without any sullyng real-world applications.

Both points of view are quite reasonable within their particular cultural contexts. However, I would claim that, apart from mathematical modelling and other branches of mathematics that exist solely for real-world applications, the distinctions between ‘pure’ and ‘applied’ mathematics is entirely artificial.

To back up this claim, I will in this talk present three nice dual identities from combinatorics: Greene’s Theorem on posets, the MacWilliams identity, and a new and intriguing identity concerning graphs. Each of these results could well be considered to be quite abstract and thus ‘pure’. However, I will show how the abstract theory behind these results lies closer to real-world applicability than one might first imagine.



Thomas is from Denmark, and got his PhD from the University of Aarhus in 2003. After postdoctoral positions in Canada and Denmark, he came to the University of New South Wales in 2006 and currently holds an Australian Postdoctoral Fellowship to investigate ‘Chromatic polynomials, random graphs, and error-correcting codes’. He has experience in industrial and commercial consultancy, including with Qantas. In addition to his publications in graph theory and matroid theory, he is possibly the only combinatorialist to have published in the *Journal of Electroanalytical Chemistry* (a collaboration with his father).

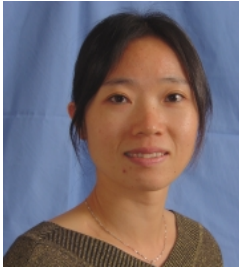
New methods for global optimization problems

Zhiyou Wu (University of Ballarat)

Global optimization has found many applications in science, industry and commerce. It is aimed at finding the best solution to optimization problems which may have various local optima. The traditional optimization methods are designed primarily for searching for local optimal solutions, and often fail in dealing with global optimization problems. One of the main reasons for their failure is that they can easily be entrapped in local optima. Moreover, these techniques cannot generate and use the global information needed to find global optima for a problem with various local ones.

Due to the importance of global optimization, a significant number of global optimization methods have been developed in the past three decades. However, the existing methods lack verifiable global optimality conditions, which are used for determining whether a solution is a global one. In this talk, we will introduce some verifiable global optimality conditions and efficient numerical methods to solve certain classes of global

optimization problems.



Zhiyou is from China, and did her undergraduate study at Chongqing Normal University, where she subsequently lectured for ten years. She then returned to postgraduate study, getting her PhD from Shanghai University in 2003. After postdoctoral positions in China and Singapore, she came to Australia in 2004, working at the University of New South Wales for a year before moving to Ballarat. She currently holds an Australian Postdoctoral Fellowship to investigate ‘Filled function methods for global optimization and their applications’, and has recently returned from a one-year Humboldt Fellowship in Germany.

How to make the most of your PhD

Kerry Landman (University of Melbourne)

I will discuss how to make the most of the opportunities presented during your PhD studies, to help you build your knowledge and skills and maximise your choices after you graduate.



Kerry got her PhD from the University of Melbourne, and returned there after six years in the USA, during which she worked at MIT, the Environmental Protection Agency, and Southern Methodist University. Her research interests are in mathematical modelling of a wide range of industrial, environmental, biological, and medical phenomena: these include cell invasion in developmental biology and tissue engineering, shape changes of red blood cells, indoor pollution by radon gas, heat loss in houses, consolidation and filtration of minerals waste, cooking of wheat grains for breakfast cereal manufacture and the design of windscreen wipers. From 1993 to 1997, Kerry was the Director of the Mathematics-in-Industry Study Group.

A mathematician’s survival guide

Jan de Gier (University of Melbourne)

I will highlight some choices facing postgraduate and early career mathematicians aspiring to an academic career, drawing from personal experience and using examples from Steven Krantz’s book with the same title.



Jan is from the Netherlands, and got his PhD from the University of Amsterdam. He came to Australia in 1999, and currently holds a QEII Research Fellowship at the University of Melbourne, investigating solvable lattice models. From the pure mathematical point of view, these provide unexpected links between combinatorics and statistical mechanics on the one hand, and symmetric polynomials, algebraic geometry and representation theory on the other; they can also be used to model real-world phenomena such as superconductivity, quasicrystals, and traffic flow. From 2004 to 2006, Jan was the editor of the Gazette of the Australian Mathematical Society.

What you can expect from industry, and what industry expects from you

Elliot Tonkes (Energy Edge Pty Ltd)

The culture, expectations and objectives of industry can be very different from the academic environment. In this session, I will convey some of my observations and experiences of the expectations of industry workplaces compared with the academic arena. Energy Edge has had considerable interaction with government and the private sector, and there is a range of cultures which we have observed. My professional observations are based through employment or consulting to government sectors, the finance industry and engineering environments.

What you can expect from industry:

- What level of remuneration and responsibility is there?
- What sort of career progression is typical?
- What degree of pressure is there to perform?
- How much use is the academic education in day-to-day work?
- What freedom is available to research and publish?

What industry expects from you:

- What knowledge base and skill set is presumed from a higher degree graduate?
- How much innovation and research is expected from an employee?
- What level of flexibility in hours and in specialization is expected?
- What sort of upskilling and subject-domain training is expected?



Elliot has degrees in mechanical engineering and science, and a PhD in mathematics from the University of Queensland. His research interests cover partial differential equations, dynamic programming and applications as diverse as energy markets and sports science. His previous jobs have included working as an engineer in the energy sector, as a contract programmer, and as an academic in IT and mathematics departments at Bond University and the University of Queensland.

He is currently the Director of Risk and Analytics at Energy Edge Pty Ltd, which offers trading and financial risk management services in commodity markets including water, carbon and electricity.