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Gazette

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- Classroom notes on presenting mathematics in an elegant way
- Items relevant to mathematics education
- Letters on relevant topical issues
- Information on conferences, particularly those held in Australasia and the region
- Information on recent major mathematical achievements
- Reports on the business and activities of the Society
- Staff changes and visitors in mathematics departments
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Deadlines for submissions to 44(1), 44(2) and 44(3) of the *Gazette* are 1 February 2017, 1 April 2017 and 1 June 2017.

Volume 43 Number 5 2016

Editorial

Sid and I welcome you to the final issue of the *Gazette* for 2016.

How should university researchers engage better with government and industry? How should the impact of this engagement be assessed? These important issues are discussed in this issue by Geoff Prince in the AMSI column, Tim Marchant in his final President's column, and by Peter Forrester in the NCMS column.

In addition to these regular columns, we publish occasional reports from the Society's Divisions and Special Interest Groups. In this issue, Tim Garoni updates us on a busy year for ANZAMP.

David Wood writes about the Mathematical Research Institute MATRIX, explaining its structure, how to apply for programs, and listing those that are coming during the summer months. Further details of its programs into next year are given in the News section, along with mathematics conferences taking place around Australia, or of particular interest to Society members.

We publish reports on local conferences, forums and workshops, with another such report in this issue. Some of our local conferences award prizes for student talks. The Gazette is happy to celebrate these achievements by publishing extended abstracts of these prize-winning talks. One such appears here, by Adrianne Jenner, joint winner of the T.M. Cherry prize at ANZIAM 2016. Another technical note is written by Ashish Goyal, reporting on his Lift-Off Fellowship report.

The Australian Academy of Science has announced its annual honorific awards slightly earlier this year, so we are able to give the details in this issue. Our congratulations to Frank de Hoog and Joshua Ross, respective winners of the 2017 Hannan Medal and the 2017 Moran Medal. Congratulations also to expatriate mathematician Ruth Williams, who has just been awarded the 2016 John von Neumann Theory Prize by the Institute for Operations Research and Management Sciences.

At this time of year, we learn that many mathematicians from 14 universities have had success with their ARC applications. Details of these are given in the News section, along with local updates from departments around the nation. Our congratulations to all of them. One imagines that there must also have been a number of good applications which just missed out.

On a sad note, we record the recent passing of Wendy Robertson. We hope to have an obituary in a subsequent issue.

Dr David Widdup was the inaugural Executive Director of the Federation of Australian Science and Technological Societies (FASTS), now known as Science and Technology Australia (STA), which helped give the mathematical sciences a collaborative voice backed by a much broader scientific body. The critical role he

played in its success has not been well recognised; the article by Jan Thomas tells the story of his contribution.

Vital further information about the state of our profession is provided by the annual report by Peter Johnston on Higher degrees and honours bachelor degrees in mathematics and statistics completed in Australia in 2015.

Last but not least, four PhD students and early career mathematicians participated in the annual Heidelberg Laureate Forum in September; their report on the event is included here.

We hope you find this issue of the *Gazette* interesting.

David Yost, Centre for Informatics and Applied Optimisation, Faculty of Science and Technology, Federation University Australia, Ballarat, VIC 3353.
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David Yost is a graduate of the University of Melbourne, the Australian National University and the University of Edinburgh. He has lived in eight countries and ten cities, returning to Australia in 2003, where he has now completed thirteen years at Federation University Australia and its predecessor institution, the University of Ballarat, including a three-year period as Deputy Head of School. While most of his research is in functional analysis, he has lately been interested in convex geometry.

President's Column

Tim Marchant*

The Government has announced it will assess the engagement and impact of university research. In response to this, ACEMS/AMSI held a one-day workshop on measuring research engagement and impact in the mathematical sciences. Peter Taylor (UMel) chaired the event and the speakers were Leanne Harvey (ARC), Kerrie Mengersen (QUT), Geoff Prince (AMSI), Jacqui Ramagge (USyd) and myself. Each speaker brought a different perspective to the workshop with themes such as long lead times for impact in mathematics (Ramagge), mathematics a broad church requiring a broad range of metrics (Mengersen), engagement on our terms (Prince) and research engagement important but publications and rankings still the main game (Marchant).

One outcome of the meeting was the submission of a formal response to the ARC engagement and impact consultation paper. I encourage you to read our response and the speakers' presentations, which can found on the AMSI website. It's likely that the 2018 assessment will use both industry research income metrics and case studies at the 2-digit FOR code level. One of the issues is that industry research income is not highly relevant for Pure Mathematics, which as an enabling discipline, often measures its impact on other disciplines and over very long timescales. One positive for the mathematical sciences community however is the opportunities offered by the expanded AMSI Intern program, as the interaction of graduate research students with industry will be a key future performance indicator for us all.

The workshop and our consultation paper response has clarified a number of issues relating to research impact and engagement in the mathematical sciences and is a good example of how we can work together, in a co-operative and effective manner. The ARC will run a pilot assessment exercise in 2017, which we hope to participate in.

Citation rates and H-Indices, as measured by Scopus and Web of Science, are critical factors in many aspects of modern academic life. I have recently discovered that the Scopus database has a feedback facility for correcting papers and citations missing from their database. After reviewing and correcting my own profile, my Scopus citations rose 20%; quite a useful boost. If you have some spare time (it took me a few hours) I encourage you to review your own profiles. Also the Society has asked Scopus to include additional back issues of the Society journals in their database, as many are currently missing.

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This is my last President's column as my term ends during the December AustMS meeting. I have enjoyed the role over the last two years and offer my best wishes and support to Professor Kate Smith-Miles, the incoming AustMS President. One of the nicest aspects of the role is the working relationship you build with the Society's office holders. The Society's Secretary, Dr Peter Stacey and Treasurer, Dr Allen Howe, are two of the key contacts that I have worked with during my term as President. Both have an exceptional knowledge of the Society, its members, rules, processes and committees; are always extremely helpful and efficient; and are strongly committed to the success and future of the Society. I wish to thank both Peter and Algy for their support and wish them all the best for the future.

Tim Marchant received his Doctorate from Adelaide University in 1989. After graduation he joined Wollongong University where he is currently Dean of Research and Professor of Applied Mathematics. His research areas include nonlinear optics, nonlinear waves and combustion theory. Tim is a Fellow of the Australian Mathematical Society, a Member of the Endeavour Awards selection panel and on the editorial board of *Applied Mathematical Modelling*. His other interests include playing bridge and learning Mandarin.

Communications

Remembering David Widdup

Jan Thomas*

Dr David Widdup was the inaugural Executive Director of the Federation of Australian Science and Technological Societies (FASTS), now Science and Technology Australia (STA), and played a critical role in its success. For a number of reasons there has been little recognition of his contribution. In an attempt to address that I have worked with others to document his contribution to FASTS. See: http://scienceandtechnologyaustralia.org.au/wp-content/uploads/2011/06/DW 26july.pdf.

Photo: Australian Lesbian and Gay Archives

In searching for material for his contribution to FASTS, I was reminded again of his enormous contribution to the mathematical sciences. David's background was in mathematics and mathematics education and there is little doubt that, as FASTS Executive Director, it was an area where he spent a disproportionate amount of time. I commend the Appendix in the document referenced above. It is an address by David to the July 1989 AustMS meeting. Note in particular his comments on teacher supply (page 1) and concluding comments on the need for communication (page 3). With David's support and encouragement, the Australian Mathematical Sciences Council (AMSC) under the FASTS umbrella was formed shortly after. This gave the mathematical sciences a collaborative voice backed by a much broader scientific body.

In the early years of FASTS and AMSC, the mathematical sciences learnt how to have a political voice. For example, the first major forum organised by AMSC

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in 1991, with much behind the scenes help from David, had an impressive list of speakers. They included politicians and people from industry and it was the forerunner of the many held since by AMSC, the National Committee to reinforce the message of Reviews in 1996, 2006 and 2016 and the Australian Mathematical Sciences Institute (AMSI). While the AMSC was eventually wound up, by then AMSI was established and now provides robust advocacy for all areas of the discipline.

If David had not collaborated with Garth Gaudry and others to form the AMSC it is unlikely that I could have had the role I had with FASTS and AustMS. The paper I wrote in 2000 (https://www.austms.org.au/AustMath/lookfuture.pdf) had a huge influence on the decision by the Victorian government to fund AMSI and the subsequent support from Brendan Nelson that established the Summer School and the International Centre of Excellence for Education in Mathematics (ICE-EM). The impact of that paper was very much tied to the fact that it was published by FASTS and therefore seen as an issue for the broader science community, not just the mathematical community.

David's premature death was a tragedy. It would be compounded it we did not remember his contribution to what the mathematical sciences have today.

Postscript

In the period prior to, and after, David leaving FASTS many of us felt helpless to assist him through a difficult period in his life. There are many services now available that weren't then. Those messages that appear on our screens with numbers to call are for all of us to use, especially if we suspect someone is a suicide risk.

Jan Thomas OAM is a graduate of the University of Adelaide (Science Honours) and La Trobe (DipEd and BEd TESOL). She was a teachers and education consult for the Victorian Education Department before joining the Faculty of Education at what is now Victoria University. While there she become part-time Executive Officer for the AustMS and Vice-President of FASTS. As she prepared to retire, she joined with Professor Tony Guttmann to write the business plan for AMSI. When this was successful she became Executive Officer for AMSI. She eventually retired in March 2011 and is now a Senior Fellow at The University of Melbourne and has an office at AMSI.

John von Neumann Theory Prize for Ruth Williams

Ruth Williams, who has a long association with Australian mathematics, has been awarded the 2016 John von Neumann Theory Prize, jointly with Marty Reiman of Columbia University. It recognises seminal research contributions they have made, over the past several decades, to the theory and applications of 'stochastic networks/systems' and their 'heavy traffic approximations'. These profound contributions have led to further breakthroughs in stochastic operations research in general, and queueing theory in particular.

This award is made annually by INFORMS, the Institute for Operations Research and the Management Sciences, to a scholar (or scholars in the case of joint work) who has made fundamental, sustained contributions to theory in operations research and the management sciences. Previous winners include such distinguished names as George Dantzig, David Gale, Harold Kuhn, Albert Tucker, Michel Balinski, Martin Grötschel, Terry Rockafellar, Samuel Karlin, Lloyd Shapley, John Nash, Kenneth Arrow, Herbert Simon, Harry Markowitz and Robert Aumann. More details can be found at https://www.informs.org/Recognize-Excellence/INFORMS-Prizes-Awards/John-von-Neumann-Theory-Prize.

Ruth Williams is a Distinguished Professor in the Department of Mathematics at the University of California, San Diego. Ruth grew up in Bendigo and was dux of Bendigo High School before going on to complete her BSc(Hons) and MSc at the University of Melbourne. She completed her PhD at Stanford University under Kai Lai Chung. Over the years she has been awarded many honours for her research including election to the US National Academy of Sciences and DSc (*honoris causa*) from La Trobe University. At present Ruth is an Honorary Senior Fellow at La Trobe University, and a member of the advisory board of the research institute MATRIX. She presented an invited lecture at the 59th Annual Meeting of the Australian Mathematical Society in 2015.

Our congratulations to Ruth!

2017 Australian Academy of Science Awards

The Australian Academy of Science has very recently announced its 2017 Honorific awards for scientific excellence, including two mathematicians.

Our congratulations to Frank and Joshua.

2017 Hannan Medal

Dr Frank Robert de Hoog FTSE, CSIRO Data61

The prestigious Hannan Medal is a career honorific awards recognising life-long achievement in the advancement of any of the fields of statistical science, pure mathematics, applied mathematics and computational mathematics. It honours the contribution to time series analysis of the late Professor E.J. Hannan, FAA, Professor of Statistics at the Research School of Social Sciences of the Australian National University.

Dr de Hoog is recognised internationally as having made highly original and insightful contributions to the advancement of applied, computational and industrial mathematics, and has contributed substantially to the mathematics profession. The importance and significance of his theoretical and applied contributions, and their flow-on contributions to the advancement of science and to improving the efficiency of industrial processes, have been recognised by various awards.

The impact of his industrial research has been exceptional in terms of the speed of implementation by industry and the subsequent contributions to Australia's export economy.

2017 Moran Medal

Associate Professor Joshua Ross, School of Mathematical Sciences, The University of Adelaide

The Moran Medal recognises the contributions to science of the late P.A.P. Moran, FAA. Its purpose is to recognise outstanding research by scientists up to 10 years post-PhD in the calendar year of nomination, except in the case of significant interruptions to a research career, in one or more of the fields of applied probability, biometrics, mathematical genetics, psychometrics and statistics.

Dr Ross has made important and influential contributions to Applied Probability and Statistics, and through application to Conservation Biology and Public Health. His research has focused predominately on addressing problems arising in infectious disease epidemiology and conservation biology, though the methodological developments that he has provided to solve such problems are more widely applicable. These application topics are of great importance, and his contributions to these fields are significant.

Higher degrees and honours bachelor degrees in mathematics and statistics completed in Australia in 2015

Peter Johnston*

This report presents data relating to students who completed Honours or Higher Degrees in Mathematics during 2015. The data are part of an on-going project for the Australian Mathematical Society and should be read in conjunction with previous reports [1]–[16] covering the period 1993–2014.

This year represents the fifth occasion that data has been reported for two year coursework masters degrees with classifications (similar to existing Honours degrees). The University of Melbourne is the only university to offer such degrees in place of the traditional Honours degree, although some other universities are expected to follow this model. In the discussions that follow, these data have been merged together and will be referred to simply as "Honours", although the completions for the two degrees are presented in separate tables. As time goes on, and more universities offer coursework masters degrees of this type, the two data sets will be differentiated and displayed as separated entities (backdated to 2010).

Appendix 1 presents data for students completing Honours degrees in 2015, at all Universities in Australia. Within each institution, the data are broken down into male and female students and into the three traditional areas of Mathematics: Pure; Applied and Statistics. There is also the general category "Mathematics" for institutions that do not differentiate between the conventional areas. Finally, there is an "Other" category for newer areas of mathematics such as Financial Mathematics. Each category is further broken down into grades of Honours awarded. Appendix 2 presents the coursework masters degrees awarded by the University of Melbourne in 2015. Appendices 1 and 2 combined show that in 2015 there were 192 Honours completions in Australia, with 133 (69%) receiving First Class Honours (compared with 139 out of 186 (75%) in 2014 and 119 out of 173 (69%) in 2013). Over recent years the average fraction of First Class degrees awarded has been about 70%.

Figure 1 presents the total number of students completing Honours degrees in Mathematics, including two year Coursework Masters degrees (with classifications) over the period 1959–2015. It shows that in 2015 the number of Honours completions continues on an upward trend. The figure also shows the numbers of male and female students who completed Honours over the same time period. For last year, the number of male students has again increased over the previous years with 149 completions (141 in 2014 and 140 in 2013), while the number of female students decreased slightly to 43 (compared to 45 in 2014 and 33 in 2013).

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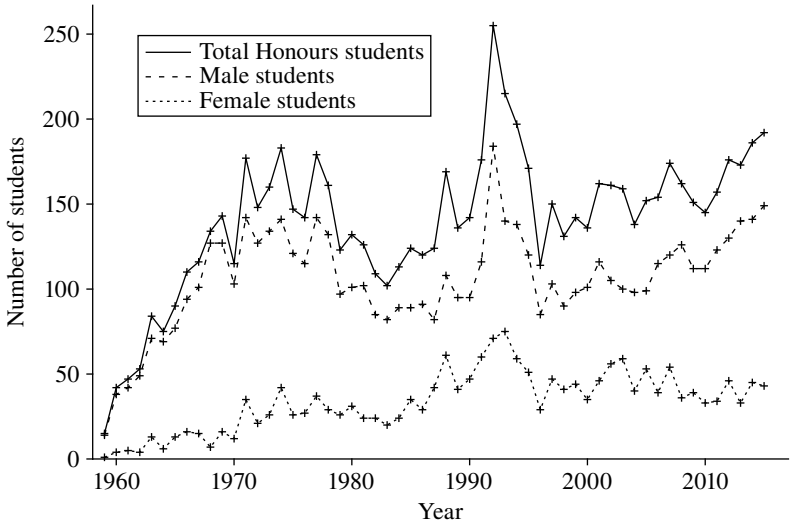

Figure 1. Number of Honours degrees, including two year Coursework Masters degrees (with classifications), completed in Mathematics and Statistics, 1959–2015.

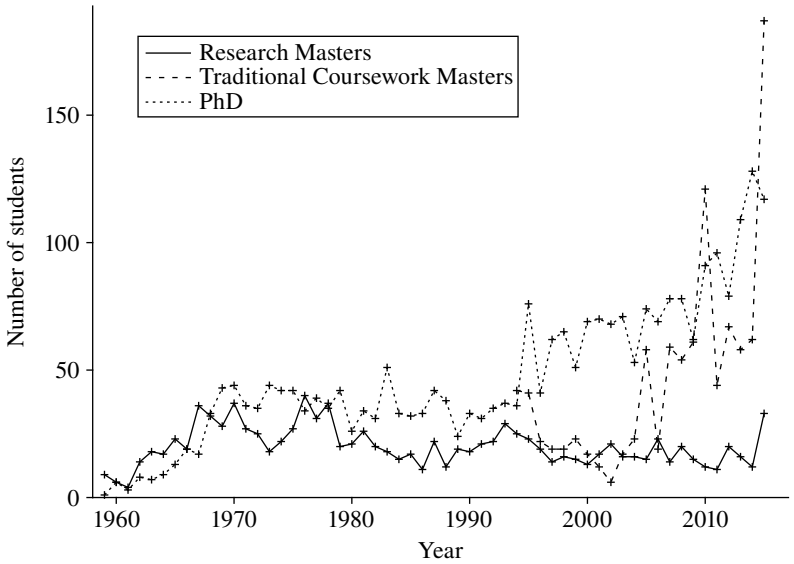

Figure 2. Number of research higher degrees completed in Mathematics and Statistics, 1959–2015.

Appendix 3 presents the data for Higher Degree completions in 2015. The data are broken down into traditional Coursework Masters, Research Masters and PhD degrees, with the latter two divided into the three typical areas of Mathematics. These data are also represented in Figure 2, as part of the overall Higher Degree data for the period 1959–2015. The figure shows that:

(i) There was a slight decrease in the number of PhD completions compared with 2014, but there is an overall increasing trend over the past 20 years. In 2015, there were 117 PhD completions (compared with 128 in 2014 and 109 in 2013), of which 74 were by male students and 43 by female students.

(ii) The number of Research Masters completions (33) increased dramatically, up from 12 in 2014.

(iii) There was a significant increase in coursework masters completions (187) in 2015, up from 62 in 2014 and 58 in 2013. This is even a significant increase over the previous peak number of completions (121 in 2010).

For those who are interested in the finer details, the raw data are available directly from me. Simply send me an e-mail. I have an Excel spreadsheet containing the complete data for 2015 as well as spreadsheets containing cumulative data from 1959 for Honours, Research Masters and PhD degrees.

I would like to thank the many people who took the time and effort to collect this data and forward it to me. This year I received 34 out of a possible 38 responses to requests for data, which is a very good response rate. Finally, if having read this report, you would like to contribute missing data for 2015, I would be happy to add it to the spreadsheet.

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[16] Johnston, P. (2015). Higher degrees and honours bachelor degrees in mathematics and statistics completed in Australia in 2014. *Gaz. Aust Math. Soc.* **42,** 290–296.

Appendix 1. Number of Honours degrees completed in Mathematics And Statistics, 2015.

Uni.	Sex	Maths I	Maths IIA	Maths IIB	Maths III	Pure I	Pure IIA	Pure IIB	Pure III	Applied I	Applied IIA	Applied IIB	Applied III	Statistics I	Statistics IIA	Statistics IIB	Statistics III	Other I	Other IIA	Other IIB	Other III	Honours Total
ACU	M																					0
	F	1																				1
ADF	M									1												1
	F																					0
ANU	M	5																				5
	F	1																				1
BOU	M																					0
	F																					0
CDU																						0
																						0
CQU	M																					0
	F																					0
CSU	M																					0
	F																					0
CUT																						0
																						0
DKU	M									1												1
	F																					0
ECU	M																					0
	F																					0
FDU																						0
																						0
FUA	M													1								1
	F																					0
GFU	M									1	1											2
	F																					0
JCU	M																					0
	F																					0
LTU	M					3								1								4
	F					1								1								2
MDU	M																					0
	F										1											1
MNU	M					3	1			7				2	1							14
	F					2					1											3
MQU	M																					0
	F																					0
QUT	M	6																				6
	F																					0
RMT	M		1																			1
	F													1								1
SCU	M																					0
	F																					0
SUT	M																					0
	F																					0
UAD	M																					0
	F																					0

Appendix 1. (Continued.)

Uni.	Sex	Maths				Pure				Applied				Statistics				Other				Honours
		I	IIA	IIB	III	I	IIA	IIB	III	I	IIA	IIB	III	I	IIA	IIB	III	I	IIA	IIB	III	Total
UCB																						0
																						0
UNC	M	1				1																2
	F		1			1																2
UNE	M																					0
	F																					0
UNS	M					8	1			4	3			5	4			1	2			28
	F						2			1					1							4
UQL	M									2	2	1		4	1			4	1			15
	F					2													1			3
USA	M									2												2
	F									4												4
USN	M					7			1	6	2			5		1						22
	F					2		1		1				2			1					7
USQ	M													1								1
	F																					0
UTM	M						1			4	4											9
	F					1																1
UTS	M									1				1								2
	F									1				1					1			3
UWA	M					1								1	2			3				7
	F													1								1
UWG	M					3	2	1												1		7
	F									1								2				3
UWS	M	1																				1
	F		1																			1
VUT	M																					0
	F																					0
Totals		15	3	0	0	35	7	2	1	37	14	1	0	27	9	1	1	10	5	1	0	169

Appendix 2. Number of two year coursework masters degrees (with classifications) completed in Mathematics And Statistics, 2015

Uni.	Sex	Pure				Applied				Statistics				Other				Total
		I	IIA	IIB	III	I	IIA	IIB	III	I	IIA	IIB	III	I	IIA	IIB	III	
UMB	M	2	1	1		2	1	1	2	2	1		1	2		1	1	18
	F				1	1		1					2					5
Totals		2	1	1	1	3	1	2	2	2	1	0	3	2	0	1	1	23

Appendix 3. Number of research higher degrees completed in Mathematics And Statistics, 2015

Uni.	Sex	Coursework Masters	Research Masters Pure	Research Masters Applied	Research Masters Statistics	Research Masters Total	PhD Pure	PhD Applied	PhD Statistics	PhD Other	PhD Total
ACU	M					0					0
	F					0					0
ADF	M					0					0
	F					0		1			1
ANU	M	8		1	1	2	3	3			6
	F					0				1	1
BOU	M					0					0
	F					0					0
CDU						0					0
						0					0
CQU	M					0		1			1
	F					0					0
CSU	M					0					0
	F					0					0
CUT						0					0
						0					0
DKU	M					0		1			1
	F					0					0
ECU	M					0					0
	F					0					0
FDU						0					0
						0					0
FUA	M					0		4			4
	F					0		1			1
GFU	M					0					0
	F					0					0
JCU	M				1	1					0
	F					0		1			1
LTU	M	3				0				1	1
	F					0		1			1
MDU	M					0					0
	F					0		1			1
MNU	M			1		1		1			1
	F					0		1		2	3
MQU	M		4			4	3				3
	F					0		1			1
QUT	M	10		2	1	3		5	2		7
	F	4				0		6	2		8
RMT	M	85				0		3			3
	F	35				0		1		1	2
SCU	M					0					0
	F					0					0
SUT	M					0		2			2
	F					0		4			4
UAD	M			2		2	1	6	1		8
	F		1			1		1			1
UCB						0					0
						0					0

Appendix 3. (Continued)

Uni.	Sex	Coursework Masters	Research Masters Pure	Research Masters Applied	Research Masters Statistics	Research Masters Total	PhD Pure	PhD Applied	PhD Statistics	PhD Other	PhD Total
UMB	M		2			2		7	2		9
	F					0	1	1	1		3
UNC	M					0	3	5			8
	F					0					0
UNE	M					0					0
	F					0					0
UNS	M	6	1	2		3	1	1	1		3
	F	2				0	1				1
UQL	M	10	1	1		2			3	2	5
	F	9				0		2	2		4
USA	M					0			1		1
	F					0		1			1
USN	M		1	5	3	9	3				3
	F				1	1					0
USQ	M					0		1			1
	F					0		1			1
UTM	M					0					0
	F					0					0
UTS	M	3		1		1					0
	F	2		1		1				1	1
UWA	M					0	1		1		2
	F					0			1		1
UWG	M	6				0	1	3	1		5
	F	4				0		2	3		5
UWS	M					0					0
	F					0		1			1
VUT	M					0					0
	F					0					0
Totals		187	10	16	7	33	18	70	26	3	117

Mathematical Research Institute MATRIX

David Wood*

The Mathematical Research Institute MATRIX is a joint partnership between Monash University and The University of Melbourne, with the ARC Centre of Excellence for Mathematical and Statistical Frontiers (ACEMS) as an associate member. It hosts residential research programs in the mathematical sciences at its campus in Creswick, Victoria.

Upcoming MATRIX Research Programs

MATRIX is looking forward to a busy and exciting summer, with two major research programs coming up, one in topology and mathematical physics, and the other in number theory. Both research programs contain embedded AMSI/AustMS sponsored conferences.

- 28 November to 23 December 2016: *Interactions between topological recursion, modularity, quantum invariants and low-dimensional topology*
  Organisers: Motohico Mulase (University of California, Davis), Craig Hodgson (The University of Melbourne), Paul Norbury (The University of Melbourne), Norman Do (Monash University), Neil Hoffman (Oklahoma State University).
- 8–28 January 2017: *Hypergeometric motives and Calabi-Yau differential equations*
  Organisers: Ling Long (Louisiana State University), Masha Vlasenko (Institute of Mathematics of the Polish Academy of Sciences), Wadim Zudilin (University of Newcastle).

MATRIX Outreach

MATRIX is hosting the residential outreach event

- 23–27 November 2016: *Doing maths like a research mathematician*

for secondary school teachers as part of a larger outreach program sponsored by ACEMS. The aim of this event is to provide school teachers with the skills to run *Doing maths like a research mathematician*[1] events in the future.

These series of ACEMS sponsored workshops provide one important aspect of learning mathematics to secondary school students and teachers — namely, experiencing the immense satisfaction that comes from creating an idea and developing

*Deputy Director MATRIX, School of Mathematical Science, Monash University, Clayton VIC 3800. http://www.matrix-inst.org.au/

[1] http://acems.org.au/maths-like-a-mathematician-school-workshops/

it to a point where you know it is either always right, sometimes right or never right!

Applications to MATRIX

Throughout the year, MATRIX accepts expressions of interest (EoI) to organise a MATRIX program. An EoI may be up to one page in length and should indicate key research areas, possible participants and potential external funding sources, and may be emailed directly to MATRIX at any time. If accepted, MATRIX will invite a more developed formal program proposal. Guidelines for a program proposal submission are available on our website. Deadlines are in April and October each year.

MATRIX Minors

MATRIX Minor programs are self-funded visits to MATRIX to make use of the available office space and facilities at Creswick outside program times, for example to work intensively in a small group. Such visits are subject to the approval of MATRIX but can be arranged by sending an email request which briefly outlines the proposed research and timings.

Comments, suggestions and requests concerning MATRIX activities are always welcome. Please send these, as appropriate, to the Director, Jan de Gier (jdg@matrix-inst.org.au), Deputy Director, David Wood (davidw@matrix-inst.org.au) or the Chair of the Advisory Board, Tony Guttmann (guttmann@unimelb.edu.au).

David's research interests lie in discrete mathematics and theoretical computer science, especially structural graph theory, extremal graph theory, graph colouring, and combinatorial geometry. David holds an ARC Future Fellowship, is an Editor-in-Chief of The Electronic Journal of Combinatorics, is former President of the Combinatorial Mathematics Society of Australasia (CMSA), and is Deputy Director of MATRIX. He has worked at Monash University since 2012.

4th Heidelberg Laureate Forum report

Mark Bugden[1], Bao Ho[2], David Khoury[3] and Tian Sang[4]

The Heidelberg Laureate Forum (HLF) aims to inspire young researchers by simply placing them in close proximity to those at the very top of the field. Did it work?

Some of us were skeptical going into the conference. No doubt it was a good opportunity, but would it really "inspire", could it really change our outlook? Well, once at the HLF it was hard not to get caught up in the excitement — even when hearing about work outside our fields.

It is fair to say that the four of us felt like we did not know much about the Laureates before attending the conference. But we were all soon to learn just how impressive the Laureates' impacts on their fields have been (and really their impact on the world). It is no exaggeration. We had the chance to meet Vint Cerf who was pivotal in creating the Internet, and Ivan Sutherland who we can thank for computer graphics, the GUI interface, and for virtual reality. David asked these Turing award winners if they had any idea how important their work would be at the time they were doing it. Both of them shook their heads and said they just worked on what they thought was interesting or important at the time. The presence of these humble and impressive Laureates made us feel as though anything is possible.

Photo: ©Heidelberg Laureate Forum Foundation / Flemming – 2016

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Each day there were leisurely lunches, and incredible dinners. These social events were a key part of the HLF program, and were designed such that we usually found ourselves at a table with a Laureate. Tian reflected, "I shared very nice conversations with the Turing Award winner Raj Reddy on many connections between mathematics and computer science. I also had the opportunity to sit with Fields Medalist as well as Abel Prize winner Sir Michael Atiyah twice at the dinner table, and hear about many of his interesting ideas about mathematics and life in general. Apart from that, I also chatted with Nobel Prize winner Brian Schmidt from ANU during our Speyer City tour in Germany, and I found his project on women in science and mathematics is absolutely adorable."

A question we all had before the conference was would the Laureates' talks be comprehensible? We can now report, the answer is a resounding yes. The Laureates' talks were genuinely inspiring and informative. Bao shared that he was "especially motivated by Andrew Wiles' story of solving Fermat's Last Theorem, encouraging me to think again about a problem that I have almost given up." And Tian found "the talk by Sir Andrew Wiles on Fermat's Last Theorem was beautifully delivered, also the talk by Fields Medalist Vladimir Voevodsky has given me some ideas on one of the research problem I came across recently."

Mark best summarises our experience of the HLF, "The [final] dinner was held inside the Heidelberger Schloss, a castle overlooking the city of Heidelberg. I had the good fortune to be sitting at a table with Sir Michael Atiyah for dinner. Having dinner (and discussing complex geometry) with an actual knight, inside an actual castle, is an experience I won't soon forget."

Gromov–Witten Theory, Gauge Theory and Dualities

Kioloa Coastal Campus, Australian National University

9 – 16 January 2016

Bai-Ling Wang*

There has been mutually stimulating interaction between geometry and physics since the days of Euclid (300 BC), and more recently, of Newton, Maxwell and Einstein. In the past 30 years, even more exciting interactions between geometry and physics have emerged through the work of Donaldson in applying gauge theory to low dimensional topology, Witten's quantum field theory interpretations of Jones/Donaldson polynomials, Fukaya–Ono/Ruan–Tian's mathematical work on Gromov–Witten theory, and more recently through Kapustin–Witten's work on electric-magnetic duality and its relation to the geometric Langlands program. These introductory lecture series and the subsequent international conference brought together international leaders in these areas to foster communication and to initiate collaboration in Australia.

Organising Committee

- Associate Professor Bai-Ling Wang (Australian National University) (Chair)
- Professor Peter Bouwknegt (Australian National University)
- Dr Brett Parker (Australian National University)
- Associate Professor Paul Norbury (University of Melbourne)

Special presenters

- Bohui Chen (Sichuan University): Professor of Mathematics, expert in Yang–Mills theory and symplectic topology.
- Cheol-Hyun Cho (Seoul National University): Professor of Mathematics, expert in homological mirror symmetry and Fukaya category.

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- Huijun Fan (Beijing University): Professor of Mathematics, one of the founders of the Fan–Javis–Ruan–Witten theory.
- Bohan Fang (Beijing University): Associate Professor of Mathematics, expert in mirror symmetry for toric Calabi–Yau 3-folds.
- Kenji Fukaya (Simons Centre for Geometry and Physics, Stony Brook): Professor of Mathematics, ICM speaker and the main founder of the Fukaya Category in homological mirror symmetry.
- Andriy Haydys (University of Bielefeld): Professor of Mathematics, expert in higher dimensional gauge theory.
- Pedram Hekmati (IMPA, Rio de Janeiro): Assistant Professor of Mathematics, expert in moduli spaces, generalized geometry and mathematical physics
- Jianxun Hu (Zhongshan University): Professor of Mathematics, expert in Gromov–Witten theory.
- Hiroshi Iritani (Kyoto University): Associate Professor of Mathematics, expert in quantum cohomology and mirror symmetry.
- Bumsig Kim (KIAS, Seoul): Professor of Mathematics, ICM speaker and expert in algebraic geometry.
- Xiaobo Liu (Peking University): Professor of Mathematics, ICM speaker and expert in symplectic topology.
- Ziming Ma (National Taiwan University): Assistant Professor of Mathematics, expert in Calabi–Yau geometry and SYZ conjecture.
- Alina Marian (Northeastern University): Professor of Mathematics, expert in algebraic geometry.
- Daniel Mathews (Monash University): Lecturer of Mathematics, expert in contact Floer homology.
- Yong-Geun Oh (IBS, South Korea): Professor of Mathematics, ICM speaker and expert in Lagrangian Floer theory and mirror symmetry.
- Hiroshi Ohta (Nagoya University): Professor of Mathematics, expert in Lagrangian Floer theory and mirror symmetry.
- Kauro Ono (Kyoto University): Professor of Mathematics, ICM speaker and expert in Lagrangian Floer theory and mirror symmetry.
- Brett Parker (Australian National University): Lecturer of Mathematics, expert in tropical geometry and Gromov–Witten theory.
- Siye Wu (National Tsing-Hua University, Taiwan): Professor of Mathematics, expert in gauge theory, symplectic geometry and dualities.

Report

This workshop on 'Gromov-Witten Theory, Gauge Theory and Dualities' was the final event in the MSI 2015 special year on Geometry and Physics. The workshop began at ANU with three mini-courses. Kenji Fukaya, one of the world's most distinguished geometers, gave an exciting mini-course on his current work constructing a (4-3-2)-dimensional Yang-Mills field theory mixing Gauge Theory and the Fukaya category (involving holomorphic curves with boundaries on Lagrangian submanifolds). Constructing such a field theory relating Gauge Theory and the Fukaya category is an important open problem, and the subject of

the famous Atiyah–Floer conjecture. Kauro Ono gave introductory lectures on symplectic topology and applications of holomorphic curves, much based on his own research with Fukaya and others. Bohui Chen lectured on foundations of the analysis of holomorphic curves, the subject of his work with Bai-Ling Wang.

The topics of these three mini-courses were among the most important areas of current research in Gromov-Witten theory, gauge theory and dualities. With a solid background on each of topics these mini-course speakers brought us right to the frontier of current research. In particular, students were filled with excitement for further explorations.

After the mini-course, the conference moved to ANU's coastal campus at Kioloa. We were lucky to have a star-studded line-up of international speakers, including five ICM invited speakers. At the workshop, there were 19 excellent conference talks covering a wide range of topics from gauge theory, homological mirror symmetry, Gromov–Witten invariants, to contact topology. Our many international speakers felt inspired by the surroundings, and many made plans to return.

The conference concluded with a problem session where Kenji Fukaya and Hiroshi Iritani listed some of most important open problems in the areas of the conference. We plan to publish lecture notes from the mini-courses and conference contributions in the 'Proceedings of the CMA' series. We expect that this will become an important reference volume for researchers in this area.

Organisers' opinion of success

The conference at Kioloa was a resounding success. There were great talks and excellent international attendance. All participants enjoyed, and gained mathematically from, the conference. The three mini-courses held at ANU were also successful. The mini course talks were of excellent quality, and well attended; however, we would have been pleased if there had been more Australian students for these mini-courses.

As far as researchers in the field, the attendance met our expectations. We only had one unfortunate later cancellation (Professor Gang Tian), but we found a suitable replacement covering the gap in the range in conference topics. We had hoped for higher student participation from students outside of the ANU. Probably the beginning of January is too early in the season, and also there might have been competition from summer schools and summer vacation scholarships.

We would have preferred more female attendance. Of the several female leaders in the field that we had invited, we only managed to get one speaker, Alina Marian. To some extent, this situation reflects the gender imbalance in the field. Another qualified female mathematician working in this field in Australia, Joan Licata, was unable to attend due to being close to giving birth. Our measures to increase female participation were partially successful in that there was decent attendance by female students. Perhaps this will help equalise gender ratios in this field in the future.

Event feedback

All participants enjoyed both the introductory workshop and the international workshop. Students attending the mini-courses commented that the material they learnt covered a whole year of graduate courses. In particular, students appreciated the brilliant deliveries of three world-leading mathematicians. They felt even more excited once they noticed that the lecturers were also the creators of the material covered in the mini-courses.

For the international conference at Kioloa, those international participants were awed by the beautiful landscape of south coasts of NSW and those exotic animals around the ANU Kioloa Campus. Some of leading participants from China, Korea and Japan expressed strong wishes to have another conference in 2020 to report back on new progress.

Mathematical modelling of oncolytic virotherapy: The effects of a PEG-modified adenovirus conjugated with herceptin

Adrianne Jenner*, Adelle C.F. Coster** and Peter Kim* ***

Oncolytic virotherapy is an experimental cancer treatment which uses genetically engineered viruses to specifically target and kill cancer cells. One limitation of this treatment is that free virus particles are rapidly cleared by the immune system, preventing the virus from arriving at the tumour site. To improve virus survival and delivery, virus particles may be coated with polyethylene glycol (PEG) which is known to increase plasma retention. PEG-modification however, is also known to decrease viral infectivity. To overcome this, the virus may be conjugated with herceptin. Herceptin is a monoclonal antibody which recognises and binds to a protein over-expressed on 20%–30% of breast cancer cells. Experimental studies in Kim *et al.* [2] look at the effects of treating tumour cells with a PEG-modified virus conjugated with herceptin. In the study presented here, a mathematical model is derived to describe the interaction between an oncolytic virus, tumour cells and the immune system.

Oncolytic viruses have the ability to infect tumour cells, replicate, then burst out of the infected tumour cell, killing it and creating new viruses to infect nearby tumour cells. Once a virus enters the body, the immune system activates cells that can kill the invading virus particles. As oncolytic viruses only replicate within tumour cells, this local infection coordinates the immune response to the tumour site. Once there, the killer immune cells are assumed to not only cause apoptosis in virus infected cells, but also tumour cells. It is believed that infection of a tumour cell by a virus triggers the production of antiviral factors, [3]. These antiviral factors induce an antiviral state in neighbouring tumour cells which is assumed to reduce their susceptibility to infection, [1]. A diagram which represents these interactions is shown in Figure 1.

The mathematical model of this system is comprised of seven ordinary differential equations (ODEs). The model was optimised to the experimental data from [2] to obtain parameter estimates. A least-squares non-linear fitting algorithm was used

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Adrianne Jenner jointly won the T.M. Cherry Prize for the best student talk at the ANZIAM 2016 Conference in Canberra. This is an extended abstract of that talk.

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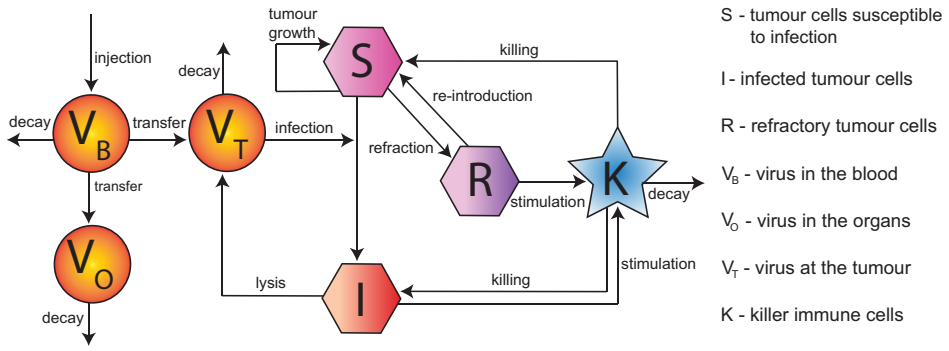
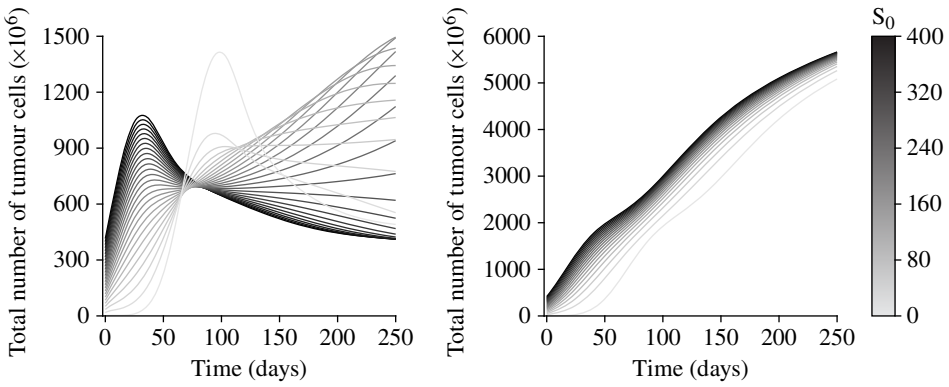


Figure 1. Compartmental diagram of the interaction between an intravenously injected oncolytic virus, tumour cells and the immune system.

to obtain estimates for all parameters. With these, the model provides a platform from which predictions can be made about the response of cancer growth to other modes and combinations of treatments. For example, when perturbations were made of the initial tumour volume prior to treatment, a counter-intuitive outcome of the treatment was observed, Figure 2.

From Figure 2(a) we see that the initial tumour volume can have an extensive effect on the overall treatment outcome. Those tumours starting with a typical (mid range) initial tumour volume tend to grow over time and do not respond to the treatment as well as those with a very small initial tumour or a very large initial tumour size. This illustrates that there is a window of tumour growth within which it would be be disadvantageous to start treatment. The model predicts



(a) Model with immune system (b) Model with no immune system

Figure 2. Predicted total tumour volume as a function of time, obtained using the model with parameter estimates obtained through optimisation to the experimental data of [2]. Figure (a) is obtained using the full model and Figure (b) is obtained by removing the immune system from the model. Different initial tumour sizes are shown.

that treatment should be postponed until the tumour leaves this intermediate size range.

One aim of this study was to determine whether or not the inclusion of an immune response was necessary to embody the observed experimental behaviour. A comparison was made between the predicted tumour volume of the complete model and that from the model with the killer immune cells removed, see Figure 2(b). It was found that the effect of the initial tumour size was negligible on the overall outcome as all tumour volumes tended to the same limiting volume in the absence of killer immune cells. Extremely different outcomes can be obtained depending on the behaviour of the subject's immune system, supporting the inclusion of the immune system into the model.

It is envisioned that refinements of the model could be used to tailor treatment regimes to optimise individual patient outcomes. If it was possible to quantify all the different possible outcomes of this treatment based on the possible stimulation and killing rates of a subject's immune system, then we could predict, depending on their initial tumour size, how likely a particular treatment was to succeed. It is widely known that every subject reacts to treatment differently and we could use this to our advantage to optimise the treatment regime.

We have shown that without the inclusion of the immune system in this interaction we would be missing some very interesting dynamics. This indicates that the immune system is a critical non-negligible part of the interaction between an oncolytic virus and a tumour. With this knowledge, viruses used to treat cancer may be better understood and the treatment of cancer be made more effective.

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Lift-Off Fellowship report: Mathematical modelling of hepatitis B and hepatitis D viruses

Ashish Goyal*

Host Institution: UNSW Australia
Host Supervisor: Professor John M. Murray
Dates of Fellowship: 11 July 2016 to 29 August 2016

Introduction

The major cause of liver cancer around the globe is hepatitis B virus (HBV). With 400 million chronic carriers, it causes almost one million deaths every year. Almost 5 to 10% of these chronic HBV carries are also infected with hepatitis D virus (HDV). HDV is one of the only two known human viruses that require a helper virus (HBV). In conjunction with HBV, it increases adult morbidity and mortality by 5 to 10 times. Morbidity and mortality of HDV depends on whether an individual is infected by both viruses at the same time (coinfection) or whether chronic HBV infection precedes HDV infection (superinfection). Superinfection results in double the mortality in cirrhosis patients and triple the rates of hepatocellular carcinoma (HCC) compared to coinfection. There is no established effective treatment or vaccination against HDV making it a significant worldwide health issue.

One of the primary objectives of this research was to propose the hypothesis that cell-to-cell transmission exists in HBV. A secondary objective was to recognize the hindrance caused by HDV in eliminating HBV in the population. Another objective was to determine a better estimate of HDV half-life and investigate interactions between HDV, HBV and the host system. In addition, I aimed to start a joint research project with Dr Harel Dahari and his team at Loyola University, Chicago.

Major achievements

1. The possibility of the existence of cell-to-cell transmission in the spread of hepatitis B virus was proposed and investigated for the first time using computational modelling. This project has been recently published in [1].
2. The impact of ignoring HDV presence in the population on socio-economic outcomes of policies aimed at eliminating HBV prevalence was studied and this study; this study has been recently published in [2].
3. During the period of the fellowship, a new collaboration with Dr Harel Dahari from Loyola University was established. We are currently investigating

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the phenomenon of HCV cure after a short term of direct acting antiviral agents related drugs.

4. I have additionally initiated a project aimed at explaining the correlated dynamics of HBsAg and HDV RNA levels in HBV/HDV coinfected patients. The model has been developed and initial testing of the model to the real world data has been performed successfully.

Future

The research during this fellowship helped improve our understanding of hepatitis viruses and may lead to the development of a successful vaccine and/or therapy. The models proposed are novel and generic in nature that can be employed for the investigation of other viruses. This probably will be a profit to the scientific community as our research can be employed as a building tool in fields such as mathematical biology, epidemiology and public health policymaking. This fellowship will definitely improve my career opportunities in the future.

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Dr Ashish Goyal currently holds a postdoc position under the mentorship of Dr Ruy M. Ribeiro and Dr Alan S. Perelson at Los Alamos National Laboratory, USA. He recently graduated from UNSW Australia with a doctorate in Mathematics under the supervision of Professor John M. Murray. His research interests span the fields of biology and epidemiology of infectious diseases, in particular, hepatitis viruses. His current work investigates the spatial and viral dynamics of hepatitis viruses using mathematical, computational and statistical modelling techniques.

Book Reviews

Math Bytes

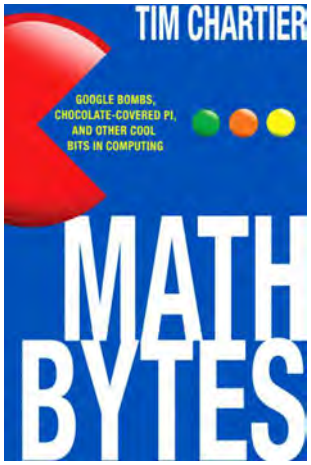
Tim Chartier
Princeton University Press, 2014, ISBN 978-0-69116-060-3

Preliminary remarks

This is possibly the first book I've ever read which could truly be described as a 'gem'. It is a gem in terms of its presentation, its humour, its colourfulness, and its brevity. I have rarely come across a book which crams so many ideas so well into so few pages, and it is full of delights.

The author's aim is to explore the areas where mathematics and computing meet — areas getting larger all the time. I thought of myself as an expert in this area, but even in this short book I found new topics.

A bit more detail



There are 14 chapters, each one about 10 pages long, and handsomely produced in full colour. And there are wonderful examples from popular culture, with a picture of the singer Beyoncé being turned into a Sierpinski triangle, and a maze made in the shape of Bart Simpson. As well as a stylized picture of Barack Obama (used in his 2008 campaign), how to add up random faces to obtain a picture of George Clooney, and how to maximize your score in Angry Birds.

This is designed as a popular text, and so the amount of formal mathematics is relatively small. But the mathematical *ideas* are immense.

The enjoyment of the book would be enhanced by a modicum of computer programming, and if you have some expertise in any programming language, be it high-level like Mathematica or Maple, or low-level like C, you can spend hours programming some of the material (I certainly have). It's a pity that there isn't an accompanying website with programs to download, although the author does obligingly supply a few apps on his personal webpage. One is for approximating a picture by an array of coloured M&Ms. This is the sort of thing a computer is good for: if you tried to use *real* M&Ms you'd end up eating them on the way[1].

[1] You will recognize the voice of experience here.

I had fun with his fractal island, which can be produced with a simple algorithm. Here is how the algorithm is given in the book:

> Start with a square with vertices at $(0,0)$, $(16,0)$, $(16,16)$ and $(0,16)$.
> Now, follow these steps:
> 1. For each line segment (of which there are currently 4) compute the midpoint (x_m, y_m).
> 2. Roll a die, and if you roll
>   - 1-3, let $dx = 2$
>   - 4-6, let $dx = 4$
> 3. Roll the die again, and if you roll
>   - 1-3, keep the dx above
>   - 4-6, change dx to $(-dx)$.
> 4. Repeat steps 2 and 3 to find dy.
> 5. Your new midpoint will be $(x_m + dx, y_m + dy)$.

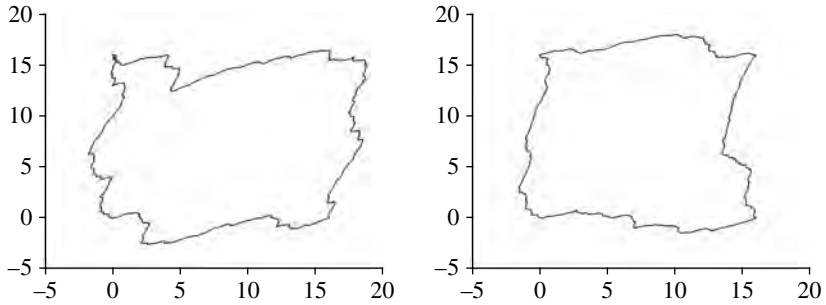
The author intimates by example, without stating it exactly, that at every further step the values of dx and dy are halved. He also recommends that at stage k using as dx and dy a value r chosen randomly to satisfy

$$-\left(\frac{1}{2}\right)^k\left(\frac{7}{10}\right) \le r \le \left(\frac{1}{2}\right)^k\left(\frac{7}{10}\right).$$

This is the sort of thing that's great fun to program. And having written your program, you can explore parameters, like the 7/10 value in the above equation for r, or even the fraction by which the differences dx and dy are adjusted each stage.

Although this might seem a pointless amusement, randomness is a vital element in design. In his 1999 *Digital Typography*, Donald Knuth points out that building a little randomness into a font design gives the resulting shape a little more 'character', and makes it seem a little less clinical.

Just for fun, here are two island shapes I generated, both starting with a square:



We've all seen those remarkable computer-generated scenes with trees, rocks, and all manner of other natural phenomena, but all created using some randomness.

Chapter 9, 'Distorting Reality' starts with a discussion of the 'vanishing leprechaun' whereby a card with 15 leprechauns, cut up and re-assembled in a different order,

has now only 14 leprechauns. (If you want to see this effect without buying or borrowing the book, check out http://britton.disted.camosun.bc.ca/jblep1.htm). This is an old puzzle, and various versions stretch back hundreds of years. If you've never seen it before, the illusion is striking. Chartier shows simply and neatly, with useful diagrams, how the illusion works, and how you can make your own. Then he shows how some simple operations can affect the appearance of an image, and shows some polar warping of Marilyn Monroe, as well as transformations of the colours of an image.

Two other chapters of note: Chapter 11, 'March MATHness' looks at the prediction of winners in the American basketball knockout tournament, which takes off in March. With 64 teams, and 63 to be knocked out, there are

$$2^{63} = 9\,223\,372\,036\,854\,775\,808$$

possible different predictions. This chapter contains a little matrix algebra to demonstrate how to build on 'team strengths', and asks whether it's possible to do better than 63 random guesses. Chapter 12, 'Ranking a Googol of Bits' looks at Google's PageRank algorithm, both informally, and with slightly more depth, again involving matrices and including a quick mention of eigenvectors. This chapter concludes with 'Google Bombs', showing the faces of President George W. Bush, and film-maker Michael Moore.

Conclusions

At only 129 pages (excluding bibliography and index) this book really has something for everybody. I can heartily recommend it to three classes of readers:

1. Mathematics educators, always on the lookout for 'real world' applications to discuss with their students,
2. Students, looking at ways in which mathematics is, and can be, used outside the classroom,
3. Everybody else.

It's a great little book.

Acknowledgments

I am indebted to discussions with Mr Victor Fagundes, at the time a year 10 student from Melbourne Boys High School, who spent a week with me on a work experience, and who read through the book with me and whose insights and perspectives helped me greatly.

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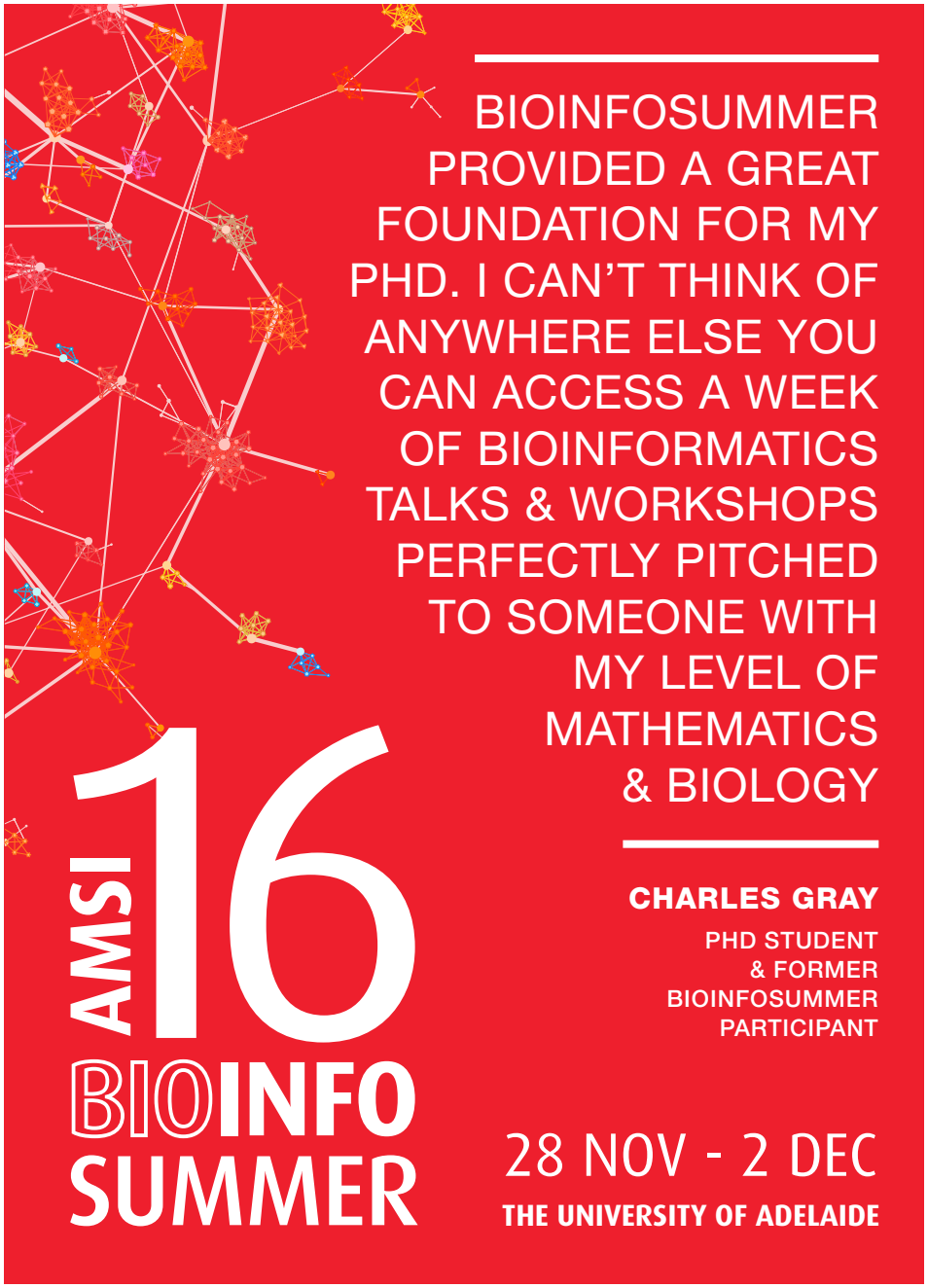

BIOINFOSUMMER PROVIDED A GREAT FOUNDATION FOR MY PHD. I CAN'T THINK OF ANYWHERE ELSE YOU CAN ACCESS A WEEK OF BIOINFORMATICS TALKS & WORKSHOPS PERFECTLY PITCHED TO SOMEONE WITH MY LEVEL OF MATHEMATICS & BIOLOGY
CHARLES GRAY
PHD STUDENT & FORMER BIOINFOSUMMER PARTICIPANT
AMSI 16
BIOINFO SUMMER
28 NOV - 2 DEC
THE UNIVERSITY OF ADELAIDE
AMSI
AUSTRALIAN MATHEMATICAL SCIENCES INSTITUTE
THE UNIVERSITY of ADELAIDE
Australian Government
Department of Education and Training
ABACBS
EMBL Australia
bhpbilliton Foundation
REGISTER AMSI.ORG.AU/BIS
AMSI RESEARCH

Peter Forrester*

Recently the Chief Scientist's office produced a draft document relating to Australian infrastructure needs in Science and Technology. This involves to some extent projecting into the future, and prioritizing areas that will give the greatest national return. From the viewpoint of the mathematical sciences, an area of growing national importance that should be better supported in an academic-business-government network is cyber security. If this has not been obvious for some time, the high profile malware attack on the Australian Bureau of Metereology computer network, and the crippling of the census night website, bring this dramatically to the attention of the public.

A model of how relevant parties may be better networked can perhaps be found in the UK's Heilbronn Institute. This is a partnership between UK Government Communications Headquarters, and the University of Bristol. Each member of the Institute spends half their time pursuing research directed by the Government Communications Headquarters, and the other half doing personal academic research. In the Decadal Plan for the Mathematical Sciences, Item 5 of Chapter 3, Australian strengths in the mathematical sciences, states that 'Australian mathematical scientists build collaborations with each other, across industries and with other disciplines.' Generous government support to industry internships for PhD students is clearly a facilitator of this strength. On the other hand, there is nothing similar to the Heilbronn Institute at present in Australia. If there was to be, a number of mathematical scientists otherwise conducting research in a purely academic environment would have an opportunity to use their skills for important government needs. It may well be that the culture so created would feed down to the teaching of mathematics in the undergraduate program.

Peter Forrester received his Doctorate from the Australian National University in 1985, and held a postdoctoral position at Stony Brook before joining La Trobe University as a lecturer in 1987. In 1994 he was awarded a senior research fellowship by the ARC, which he took up at The University of Melbourne. Peter's research interests are broadly in the area of mathematical physics, and more particularly in random matrix theory and related topics in statistical mechanics. This research and its applications motivated the writing of a large monograph *Log-gases and Random Matrices* (PUP, Princeton) which took place over a fifteen-year period. His research has been recognised by the award of the Medal of the Australian Mathematical Society in 1993, and election to the Australian Academy of Science in 2004, in addition to several ARC personal fellowships. He was AustMS President from 2012 to 2014.

*Chair, National Committee for Mathematical Sciences, Department of Mathematics and Statistics, The University of Melbourne, Parkville 3010, VIC.
Email: p.forrester@ms.unimelb.edu.au

2016 AMSI-SSA LECTURER

JEFFREY ROSENTHAL

Professor of Statistics, University of Toronto

TOURING ACROSS AUSTRALIA
28 NOVEMBER–16 DECEMBER 2016

SPECIALIST LECTURES

THE MATHEMATICS OF MARKOV CHAIN MONTE CARLO

11.30–12.30PM MON 28 NOV
QUEENSLAND UNIVERSITY OF TECHNOLOGY

2–3PM TUES 29 NOV
MACQUARIE UNIVERSITY

11.30–12.30PM WED 30 NOV
UNIVERSITY OF TECHNOLOGY SYDNEY

2.30–3.30PM THURS 1 DEC
UNIVERSITY OF WOLLONGONG

11.30–12.30PM THURS 15 DEC
LA TROBE UNIVERSITY

PUBLIC LECTURES

FROM LOTTERIES TO POLLS TO MONTE CARLO

6–7PM MON 28 NOV
THE UNIVERSITY OF QUEENSLAND &
QUEENSLAND UNIVERSITY OF TECHNOLOGY

6–7PM WED 30 NOV
THE UNIVERSITY OF NEW SOUTH WALES

6–7PM WED 13 DEC
UNIVERSITY OF ADELAIDE & SSA

6–7PM THURS 15 DEC
AUSTRALIAN MATHEMATICAL SCIENCES INSTITUTE

RESEARCH.AMSI.ORG.AU/AMSI-LECTURER

AMSI AUSTRALIAN MATHEMATICAL SCIENCES INSTITUTE

SSAI Statistical Society of Australia Inc.

AMSI RESEARCH

AMSI News

Geoff Prince*

NCRIS ignores mathematics!

Australia is undertaking a review of the National Collaborative Research Infrastructure Strategy (NCRIS) following government commitment to its funding over the next decade: see https://www.education.gov.au/national-collaborative-research-infrastructure-strategy-ncris. Mathematics and statistics are notable only by their almost complete absence from the process to date! Why is maths a blind spot for NCRIS and why does it matter?

In my view there is an underlying complacency about mathematics in NCRIS — a sense that, while mathematics is an underpinning capability of Australian science, engineering and technology, those domain experts can look after the maths themselves. The recent AMSI/Geoscience Australia Computational Science Workshop provided any number of real world counterexamples with a large number of agency scientists turning up to share their maths and stats challenges with us.

On the basis of these observations AMSI made a submission to the NCRIS Review, which you can see here: http://amsi.org.au/2016/09/14/amsi-response-national-infrastructure-roadmap-capabilities-issues-paper/.

The thrust of our submission is that the collaborative and flexible engagement of expert end users and mathematical scientists must be supported by NCRIS in order for Australia to maintain the currency of its strategic data and computational sciences base. We went on to outline what such an NCRIS facility would look like. Here are some excerpts.

The capability gap

> Mathematicians are problem solvers. And the best solutions are the ones that create new and portable mathematics. This creativity is what distinguishes the mathematical scientist from the mathematically literate engineer or scientist. Breakthrough innovations flow from this new mathematics: tomography and bioinformatics are striking examples of successful collaborations. Our innovation system ignores this collaborative capability at its peril.
>
> Australia's big capability gap is the 'at scale' flexible engagement of mathematical sciences researchers with our innovation system in the age of data and computation. Reliance on the mathematical and statistical capacity of end users in the Science and Research Priority areas and in Australian businesses is inadequate to the task of dealing with the major mathematical challenges of disruptive technologies.

*Australian Mathematical Sciences Institute, Building 161, c/- The University of Melbourne, VIC 3010, Australia. Email: director@amsi.org.au

The government has made industry-research collaboration a cornerstone of NISA. Collaborations in data analysis, simulation and computation are integral to the effectiveness of NCRIS. What we propose is an innovative infrastructure platform which will bring these collaborations to scale in a responsive and flexible way. It will provide a mechanism for rapid adoption of mathematical innovation developing here and internationally. Without it we will continue with patchy uptake of offshore developments and not at the leading edge needed for our own national priorities.

Some Australian mathematical scientists do of course engage with end users by various means: for example, the ARC ACEMS, CEED and earlier MASCOS and CMA Centres of Excellence, the Mathematics and Statistics Industry Study Group, past CSIRO mathematical sciences divisions, ARC Linkage projects and the AMSI Intern PhD program. However, these programs fall far short of servicing demand, and they can only mobilise a part of the mathematical research community and an even smaller part of the end user world. Engagement on the scale envisaged in NISA will need an additional, new platform. Australia is a long way behind northern hemisphere nations in this respect. Bioinformatics in Australia is a notable exception and a great example of what can be achieved.

The concept: the capability can be elaborated by considering how to service it

A flexible and responsive resource centre staffed by expert support personnel servicing a diverse range of mathematical engagement with sophisticated end users from universities, agencies and the private sector.

The Centre will also broker new collaborations and assist them to set up their legal and financial frameworks.

The staff will be mathematicians, statisticians, optimisers, computational scientists and interns along with administrative and business personnel. The expert staff will be sourced from both the public and private sectors.

The staff will be mobile and deliver both on site and remote services to collaborations. Secondary nodes may develop.

The Centre will be co-located with a major university mathematical sciences school with a full spectrum of research interests.

Projects will be of varying size but the imperative is to deliver proof of concept on time scales not otherwise achievable by the collaboration partners.

The Centre will be linked to centres overseas and create a channel for the rapid adoption of international innovation.

It will use other NCRIS facilities as required.

The Centre will be part of AMSI and consequently hard-wired to the discipline and its networks.

What it isn't

It is not a commercialisation facility. It will not compete with CSIRO's Data 61, Biarri or any of the universities whose business it is to commercialise research outcomes. It will, however, provide an articulation to commercialisation services when that's appropriate.

It is not a consultancy. It will service and broker research collaborations but it will not supply solutions direct to corporate or agency clients. It may refer such work to commercial providers. It has a broader range of capabilities than a specialist consultancy and the staff will work under the scientific direction of the collaborators.

It is not a virtual facility nor a residential facility.

It is not a Centre of Excellence (CoE). Nor is it intended to compete with or usurp the roles of CoEs. It will give mathematical scientists across the entire research system the opportunity to have their collaborations supported. It will make referrals to mathematical sciences CoEs and other expert groupings.

Who will use it

Non-mathematical clients (geoscientists, fintech specialists, machine learners, digital security people, defence optimisers, climate modellers and architects, etc.) will use it as a matching service for mathematical collaborators, theoretical and applied, and then use the resources to tie the knot. New and existing cross and multidisciplinary partnerships involving mathematical scientists will seek its resources to realise research outcomes efficiently.

Government agencies, large corporates, SMEs, start-ups, government departments will all use it.

What it will achieve

It will increase the responsiveness of the mathematical sciences to the needs of an innovation system increasingly dependent on mathematical resources.

It will radically increase the scale of research-industry and research-agency collaborations.

It will create a resource environment where research collaborations can take place efficiently.

It will bring mathematical quality and integrity to bear on the mathematical and statistical dimension of the work of agencies and companies.

It will enhance the interactions between the mathematical sciences and other domains so important for the vibrancy of our discipline and our partner domains.

It will bring specialists from the world's best practice sites to Australia.

Current NCRIS examples

http://www.bioplatforms.com/what-we-do/

http://www.bioplatforms.com/bioinformatics-capabilities/

http://nci.org.au/about-nci/our-role/

In the past our discipline has sought a dedicated mathematical sciences research institute from NCRIS. This approach has put us where we are today, thoroughly ignored by the NCRIS planners. We have to establish the need for mathematical sciences capability beyond our discipline and we have to convince them that we must be part of that delivery. I believe that we will achieve some credibility through this current submission if nothing else.

The following people took part in this exercise although AMSI takes responsibility for its final submission: Markus Hegland, Andrew Eberhard, Joe Grotowski, Tim Marchant, Peter Taylor, Jan de Gier, David Wood; thanks also to Tony Guttmann, Tony Dooley, Phil Hall, Adelle Howse, Mark Lawrence and Shaun Gregory. The Melbourne/Monash MATRIX Institute made a separate submission. AMSI endorsed MATRIX in its contribution.

I was a Monash undergraduate and took out a La Trobe PhD in 1981 in geometric mechanics and Lie groups. This was followed by a postdoc at the Institute for Advanced Study in Dublin. I've enjoyed teaching at RMIT, UNE and La Trobe. My research interests lie mainly in differential equations, differential geometry and the calculus of variations. I'm a proud Fellow of the Society, currently a Council and Steering Committee Member. I became AMSI director in September 2009.

AMSI

AMSI RESEARCH SUMMER OF MATHS 16-17

RESEARCH.AMSI.ORG.AU

AMSI 16 BIOINFO summer

28 NOV - 2 DEC

THE UNIVERSITY OF ADELAIDE

AMSI 17 SUMMER SCHOOL

9 JAN - 3 FEB 17

THE UNIVERSITY OF SYDNEY

mathsfest AUSTRALIA2016

ADVANCES IN ERGODIC THEORY HYPERBOLIC DYNAMICS & STATISTICAL LAWS

28 NOV – 2 DEC

CANBERRA

mathsfest AUSTRALIA2016

60TH ANNUAL MEETING OF THE AUSTRALIAN MATHEMATICAL SOCIETY

5 – 8 DECEMBER

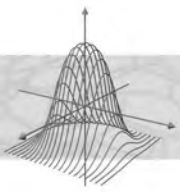
CANBERRA

mathsfest AUSTRALIA2016

NONLINEAR & GEOMETRIC PARTIAL DIFFERENTIAL EQUATIONS

9 – 13 DECEMBER

CANBERRA



ANZAMP News

Tim Garoni*

It has been a busy and productive year for the Australian mathematical physics community. The following sample of upcoming/recent meetings advertised on the ANZAMP website gives a sense of the level of activity:

- *Integrable Systems 2016* (University of Sydney),
- *String Geometries and Dualities (Australia-Brazil meeting)* (IMPA, Rio de Janeiro),
- *Topological Matter, Strings, K-theory and related areas* (University of Adelaide),
- *New Trends in Low Dimensional Physics: Quantum Integrability and Applications* (Chinese Academy of Sciences Beijing, China),
- *Boundary Degrees of Freedom and Thermodynamics of Integrable Models* (International Institute of Physics, Natal, Brazil),
- *SUSY (Supersymmetry and Unification of Fundamental Interactions) 2016* (University of Melbourne),
- *Interactions between topological recursion, modularity, quantum invariants and low-dimensional topology* (MATRIX, Creswick).

The highlight of the ANZAMP calendar is its Annual Meeting. The list of plenary speakers at previous ANZAMP meetings illustrates both the breadth of topics covered, and the calibre of the speakers. Our last Annual Meeting, held in December 2015, boasted a record number of attendees, and the plenary speakers covered topics in combinatorics, statistical mechanics, quantum field theory, geometry, integrable systems and special functions.

The next ANZAMP Meeting will be held from 1 to 3 February, 2017, and ANZAMP is proud to announce the following confirmed keynote speakers:

- Luis Fernando Alday (University of Oxford)
- Bernd Krauskopf (University of Auckland)
- Eric Ragoucy (LAPTh - CRNS)
- Tomohiro Sasamoto (Tokyo Institute of Technology)
- Susan Scott (Australian National University)

The 2017 ANZAMP Meeting is being organized by the School of Mathematics and Statistics at the University of New South Wales. It will be held in Kiama, on the New South Wales South Coast. Kiama is a popular holiday destination about two hours drive south of Sydney. Both the location and the impressive line-up of international speakers promises to make the 2017 ANZAMP Meeting a wonderful

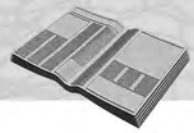
*Chair, ANZAMP. Email: tim.garoni@monash.edu

event. ANZAMP would like to sincerely thank the Program Committee for its tireless efforts in organising such an impressive list of speakers.

Student participation is a key focus of ANZAMP meetings. Both student membership of ANZAMP, and student registration at our Annual Meeting is free of charge. In addition, ANZAMP awards the A.J. Guttmann Prize for the most outstanding talk by a student or recent graduate presented at each ANZAMP Annual Meeting.

A very welcome development internationally was the recent award of the 2016 Nobel Prize in Physics to David Thouless, Duncan Haldane and Michael Kosterlitz for *theoretical discoveries of topological phase transitions and topological phases of matter*. This topic is one that has long been close to the hearts of many members of the Australian mathematical physics community, and is actively worked on by many current ANZAMP members. ANZAMP warmly congratulates the winners.

Tim Garoni received his Doctorate from the University of Melbourne in 2003, and then held postdoctoral positions at the University of Minnesota, New York University, and the University of Melbourne. Tim joined Monash University in 2011, where he is currently an Associate Professor in the School of Mathematical Sciences. Tim's research interests are chiefly in the application of Markov-chain Monte Carlo methods to problems in statistical mechanics, especially to the study of phase transitions. This involves developing, and rigorously analyzing, Monte Carlo algorithms for studying discrete/combinatorial models in equilibrium statistical mechanics.



News

General News

University of Melbourne Centre of Excellence

The School of Mathematics and Statistics is pleased to announce that it is now part of another successful ARC Centre of Excellence at the University, based in the School of Chemistry. It will be known as the ARC Centre of Excellence in Exciton Science http://www.arc.gov.au/centres-excellence-2017-summary.

Congratulations to John Sader for his involvement as a Chief Investigator on this proposal and to Paul Mulvaney from Chemistry as Centre Director on this successful Centre.

RMIT University, Public Lecture

Professor Edwin Galea, of the University of Greenwich (London, UK), gave a public lecture 'Safety in Numbers' in the frame of a workshop on Fire Emergency Management on 22 November.

Completed PhDs

Curtin University

- Dr Zahra Hassan A Al Helal, *Optimal control of diabetes*, supervisor: Volker Rehbock.

Macquarie University

- Dr Alexander Campbell, *A higher categorical approach to Giraud's non-abelian cohomology*, supervisor: Ross Street.

RMIT University

- Dr Johannes Kotzerke, *BioTwist: overcoming severe distortions in ridge-based biometrics for successful identification*, supervisors: Kathy Horadam, Stephen Davis and Arathi Arakala. Double-badged award with The University of Twente, Netherlands.
- Dr Fahad Musallam Alharbi, *Helical flow of yield stress fluids*, supervisors: John Shepherd and Andrew Stacey.

University of Adelaide

- Dr David Wilke, *Pressure and flow within the umbilical vessels*, supervisors: Jim Denier, Trent Mattner, Yee Khong and Yvonne Stokes.

- Dr David Bowman, *Holomorphic flexibility properties of spaces of elliptic functions*, supervisors: Finnur Larusson and Nicholas Buchdahl.
- Dr David Arnold, *Thin-film flows in helical channels*, supervisors: Yvonne Stokes and Edward Green.
- Dr Kale Davies, *On the derivation and application of closure approximations of cellular automata models*, supervisors: Nigel Bean, Ben Binder and Josh Ross.

University of Melbourne

- Dr Ling Ding, *Regression clustering using Gibbs sampler and optimal cluster number estimation*, supervisor: Guoqi Qian.
- Dr Hamid Mokhtar, *A few families of Cayley graphs and their efficiency as communication networks*, supervisor: Sanming Zhou.
- Dr Elena Tartaglia, *Rational and logarithmic minimal models and their generalisations*, supervisor: Paul Pearce.

University of New South Wales

- Dr Jieyi He, *Detecting and modelling serial dependence in non-Gaussian and non-linear time series*, supervisor: William Dunsmuir.
- Dr Isaac Donnely, *Diffusion: continuum, networks and limits*, supervisors: Bruce Henry and Chris Angstmann.

University of Sydney

- Dr John Mitry, *A geometric singular perturbation approach to neural excitability*, supervisor: Martin Wechselberger.
- Dr Michael Barwick, *Morse classification of low order jet spaces*, supervisor: Laurentiu Paunescu.

Awards and other achievements

Australian National University

- Dr Zsuzsanna Dancso has been awarded an ARC Early Career grant worth $360,000 to study Homological methods in combinatorics, algebra and geometry. This project aims to solve problems in graph theory, lattice theory and geometry using algebraic techniques. The techniques and language provided by this algebraic approach will be used to gain fresh insight into classical problems, prove stronger theorems and uncover connections between different areas. This project intends to integrate Australia's strength in homological algebra and category theory with applications in various different fields of mathematics. This is expected to provide tools for further investigation of applications in other fields, including computer science and combinatorial optimisation.
- Associate Professor Uri Onn has been awarded an ARC Future Fellowship worth $776,000 to study Representations of arithmetic groups and their

associated zeta functions. This project aims to investigate deep connections between number theory and group theory by studying linear actions of arithmetic groups. Arithmetic groups are used in geometry, dynamics, number theory and other areas of pure mathematics. This project will study their representations from two perspectives. First, it will establish properties of the associated zeta functions to resolve open problems about the asymptotic behaviour of the dimensions of the irreducible representations. Second, it will explore the evolution of representations across families of groups under new induction and restriction functors, in analogy with creation and annihilation operators in physics. The project will enhance Australia's capacity in representation theory and group theory, the mathematics that underline symmetry in nature.

- Dr Timothy Trudgian has been awarded an ARC Future Fellowship worth $652,000 to study Explicit methods in number theory: Computation, theory and application. This project aims to use explicit estimates to unify three problems in number theory: primitive roots, Diophantine quintuples, and linear independence of zeroes of the Riemann zeta-function. It will use computational and analytic number theory to reduce the quintuples problem to a soluble level. Pursuing relations between the zeta zeroes will overhaul many current results. This project will apply its findings about primitive roots to signal processing, cryptography and cybersecurity.
- Professor Murray Batchelor has been awarded an ARC Discovery grant worth $362,000 to study Mathematical structure of the quantum Rabi model. This project aims to find the mathematical structure behind the quantum Rabi model, the simplest model describing the interaction between quantum light and matter. The Rabi model is the connecting link in the essential interplay between mathematics, physics, and technological applications. Solving the mathematical structure behind it is expected to form the basis for solving related and equally important models. Such models describe a qubit, the building block of quantum information technologies, and so could realise quantum algorithms and quantum computations.
- Professor Xu-Jia Wang, Professor Neil Trudinger and Dr Jiakun Liu have been awarded an ARC Discovery grant worth $538,500 to study Variational theory for fully nonlinear elliptic equations. This project aims to develop new methods and techniques to solve challenging mathematical problems in fully nonlinear partial differential equations arising in important applications. The project will develop methods and techniques to study these equations' regularity and variational properties. This project is expected to establish comprehensive theories and enhance and promote Australian participation and leadership in this area of mathematics.

Macquarie University

- Dr Richard Garner has been awarded an ARC Future Fellowship worth $805,054 to study Enriched categories: Applications in geometry and logic. The project aims to apply enriched categories to fields including algebraic

and differential geometry and theoretical computer science. Enriched categories, introduced in Australia in the 1960s, underlie major mathematical results such as Grothendieck's revolutionary work in algebraic geometry. Emerging scientific areas like higher differential geometry and homotopy type theory urgently need the formalism of enriched categories to be made applicable to them. Success in this could rapidly develop these areas and solidify Australia's position as a leading international force in mathematics.

Monash University

- Dr Norm Do was honoured at the 2016 Australian Government Department of Education and Training Citations for Outstanding Contributions to Student Learning. Norm received a citation 'For exceptional commitment and contributions that inspire students at all levels to pursue mathematics and to appreciate its nature, beauty and power' (https://www.monash.edu/news/internal/the-insider/22-sep-2016/recognition-for-teaching-innovation).
- Dr Kengo Deguchi has been awarded an ARC EArly Career grant worth $360,000 to study mathematical descriptions of magneto-hydrodynamic turbulence. The project aims to better predict magneto-hydrodynamic turbulence than existing empirical models. Turbulence in high-speed flows of electrically conductive fluid sustains magnetic fields in various engineering, geophysical, and astrophysical flows. However, investigations into magneto-hydrodynamic flows have been limited to slow flows, and the application of the results to the actual problems hindered. This project aims to improve magneto-hydrodynamic flow control in future energy-generating technology, using theoretical and numerical tools that are mathematically consistent with the high-speed limit of the governing equations. More efficient electric generators could improve Australia's future energy supply with fewer emissions of global warming gases.
- Dr Pu Gao has been awarded an ARC EArly Career grant worth $306,759 to study 'Probabilistic combinatorics: properties of large networks'. This project aims to analyse important real-world network properties such as robustness and reliability, investigate the performance of network algorithms such as message propagation, and solve fundamental problems in probabilistic combinatorics. Random graphs are indispensable for modelling and analysing the growing Internet and many social networks, due to their large size and random nature. The intended outcome is improved understanding of properties of real networks, including robustness and message propagation performance. It should provide better knowledge of the evolutionary behaviour of large growing networks, relevant to a world that is influenced greatly by the Internet.
- Dr Anita Liebenau has been awarded an ARC EArly Career grant worth $324,499 to study 'Advances in graph Ramsey theory'. This project aims to solve significant questions at the forefront of graph Ramsey theory, which provides the theoretical background for understanding networks that are omnipresent in the modern world. Major progress is anticipated on the

recently introduced concept of Ramsey equivalence, including the development of deep new tools that combine probabilistic methods, extremal graph theory and graph decomposition techniques. The project will use these new tools to solve old questions on the structure of minimal Ramsey graphs, thus fostering the international competitiveness of Australian research and enhancing Australia's reputation as a knowledge nation.

- Dr Daniel Horsley has been awarded an ARC Future Fellowship worth $766,000 to study 'Edge decomposition of dense graphs, including the Nash–Williams conjecture'. Edge decomposition of graphs is important for graph theory, combinatorial design theory and finite geometry, and also has strong applications to digital communication and information technologies. It is anticipated that the project will result in methods for edge decomposition of dense graphs, the solution of famous open problems, and a deeper, more cohesive understanding of edge decomposition.
- Associate Professor Jessica Purcell has been awarded an ARC Future Fellowship worth $933,054 to study 'Interactions of geometry and knot theory'. This project aims to use recent breakthroughs in hyperbolic geometry and Kleinian groups to relate geometry to knots which are mathematical objects arising in microbiology, chemistry, physics, and mathematics. Knots are often studied via the space around them known as the knot complement. Knot complements decompose into geometric pieces, and the most common geometry is hyperbolic, which completely determines a knot. However, how to obtain information on the hyperbolic geometry of a knot from a classical description is unknown. This project will obtain information by uncovering results that would enable classification of even extremely complicated knots, and could affect mathematics and other fields.
- Dr Jerome Droniou, Professor Dr Robert Eymard and Dr Gianmarco Manzini have been awarded an ARC Discovery grant worth $359,500 to study 'Discrete functional analysis: bridging pure and numerical mathematics'. This project aims to create the first numerical analysis tools to design robust, mathematically proven algorithms for engineering problems in underground flows. These equations are essential to accurately model and understand phenomena such as oil extraction, carbon sequestration and groundwater contamination. The project will provide powerful mathematical tools to improve the reliability of numerical simulations for such challenges and significantly improve the reliability of the predictions under assumptions that are compatible with field applications.
- Associate Professor Zihua Guo, Dr Ji Li, Professor Carlos Kenig and Professor Kenji Nakanishi have been awarded an ARC Discovery grant worth $350,000 to study 'Harmonic analysis and dispersive partial differential equations'. Harmonic analysis is used to study these equations; in which a system's local behaviour is used to analyse global properties, using techniques such as the Fourier transform. The project will investigate central problems in the area, revealing deep connections between analysis and geometry, and apply these to study the solutions' long-term behaviour to non-linear equations. Expected outcomes include theoretical results and

practical techniques to solve non-linear dispersive equations, which arise in quantum and fluid mechanics.

- Associate Professor Todd Oliynyk has been awarded an ARC Discovery grant worth $276,000 to study 'Gravitating relativistic material bodies: a mathematical analysis'. This project aims to establish the local-in-time existence and geometric uniqueness of solutions to the Einstein-Elastic equations representing systems of gravitating relativistic material bodies, and to understand the long-time behaviour of these solutions. In spite of their importance to astrophysics, almost nothing is known about the mathematical properties of solutions to the equations of motion governing gravitating systems of relativistic material bodies. This project would provide mathematical tools for the study of gravitating relativistic material bodies and provide guidance on developing stable numerical schemes for simulations that are essential for comparing theory with experiment. This would significantly improve current understanding of the behaviour of matter and gravitational fields near the matter-vacuum boundary of bodies and help understanding of the physics of these boundaries.
- Professor German Valencia, Professor Dianne Cook, Associate Professor Csaba Balazs, Professor Andreas Buja and Associate Professor Marzia Rosati have been awarded an ARC Discovery grant worth $394,000 to study 'Visualisation of multidimensional physics data'. This project aims to link multi-parameter models used in physics to explore experimental data, and statistical tools for multivariate analysis and visualisation. It addresses an important gap in the understanding of phenomenological physics analyses containing many simultaneously important parameters. This is expected to improve the understanding of results in multi-parameter models.

Queensland University of Technology

- Professor Matthew Simpson, Associate Professor Ruth Baker and Associate Professor Michael Plank have been awarded an ARC Discovery grant worth $392,000 to study 'Mathematical models of cell migration in three-dimensional living tissues'. This project aims to develop mathematical models of cell migration in crowded, living tissues. Existing models rely solely on stochastic simulations, and therefore provide no general mathematical insight into how properties of the crowding environment (obstacle shape, size, density) affect the migration of cells through that environment. This project will produce mathematical analysis, mathematical calculations and exact analytical tools that quantify how the crowding environment in three-dimensional living tissues affects the migration of cells within these tissues. Long term effects will be the translation of this new mathematical knowledge into decision support tools for researchers from the life sciences.

RMIT University

- Associate Professor Clifford Da Costa, received a citation from the Office of Learning and Teaching for developing engaging learning environments for

statistics students, with a non-mathematical background, that promotes self-directed learning and an appreciation of statistics in their lives.

- Professor Xinghuo Yu, Dr Mahdi Jalili, Professor Lewi Stone and Professor Jinhu Lu have been awarded an ARC Discovery grant worth $301,500 to study 'Engineering evolving complex network systems through structure intervention'. Complex network systems with evolving components are ubiquitous in nature and society. The science of biological networks, the Internet and large-scale power networks demand tools to understand and influence their evolving dynamics. This project could result in a breakthrough theory in network science and technology to augment biological systems and power grids. Expected benefits include cost-effective augmentation of power networks injected with renewable energy sources, and advancing basic biology research.

University of Adelaide

- Dr Guo Chuan Thiang has been awarded an ARC EArly Career grant worth $357,000 to study 'T-duality and K-theory: unity of condensed matter and string theory'. This project aims to uncover deep mathematical structures which underlie recent discoveries at the forefront of string theory and condensed matter physics, using K-theory and T-duality as guiding themes. Inspired by string theory, T-duality techniques and geometric Fourier–Mukai transforms will be developed to study topological phases of matter. Similarly, topological materials motivate the detailed study of real twisted K-theory and T-duality, which are then applicable to orientifold string theories. Anticipated outcomes include a deeper understanding of the theory of topological materials and its connection to string theory, and well-motivated mathematics widely applicable to the physical sciences. This understanding paves the way for novel technological applications.
- Associate Professor Yvonne Stokes has been awarded an ARC Future Fellowship worth $904,000 to study 'Mathematics as the key to modern glass and polymer fibre technology'. This project aims to develop fully coupled flow and energy models to determine the preform structure and fibre-drawing parameters needed to fabricate a desired microstructured optical fibre by stretching of the preform to a fibre. It will focus on polymer to develop a non-Newtonian flow model, which can handle the subset of Newtonian glass fibre drawing. It will develop fast, powerful three-dimensional predictive tools to solve the models and experimentally validate solutions. This work will direct future design of microstructured optical fibres to empower next-generation optical-fibre technologies. Expected outcomes are fibre designs for telecommunications, medicine, biotechnology, sensing and imaging.
- Professor Peng Shi, Associate Professor Cheng-Chew Lim and Professor Ligang Wu have been awarded an ARC Discovery grant worth $286,000 to study 'Fuzzy modelling and design of complex networked systems'. This project aims to develop analysis and synthesis approaches for non-linear networked control systems, including modelling, stability analysis and design problems. The non-linear effects and analysis of networked control

systems have received considerable attention because of the universal existence of nonlinearities in practice. Network-based non-linear systems are widely used but face problems from non-linearities and networks. This project will establish a software-based nonlinear networked control system platform to test the presented algorithms and strengthen the scenarios in applications. This project is expected to increase Australian excellence in cyber-security and advanced manufacturing.

- Professor Mathai Varghese and Dr David Baraglia have been awarded an ARC Discovery grant worth $335,000 to study 'Parametrised gauge theory and positive scalar curvature'. This project aims to study innovative extensions of Seiberg–Witten gauge theory with new applications to the topology of metrics of positive scalar curvature on four-dimensional manifolds. Since Atiyah–Bott, Donaldson, Hitchin, and Seiberg–Witten's work on various equations in gauge theory, profound applications have changed the geometry and topology of low dimensional manifolds. Parametrised index theory has obtained deep results on the topology of metrics of positive scalar curvature in higher dimensions, but these methods do not work in the case of the fourth dimension. This project will develop (parametrised) Seiberg–Witten gauge theory as a new approach to the study of the topology of metrics of positive scalar curvature in four dimensions. Expected outcomes include new invariants related to positive scalar curvature in four dimensions.

University of Melbourne

- Associate Professor Deb King received a 'Citation for Outstanding Contributions to Student Learning' in 'The Australian Awards for University Teaching' (http://www.senatorbirmingham.com.au/Latest-News/ID/3203/Academics-lauded-for-innovative-teaching).
- Associate Professor Enrico Valdinoci has been listed as a 'Thomson Reuters Highly Cited Researcher'.
- Stephen Leslie received the 2016 Woodward Medal for Science and Technology. The medal is awarded annually to a member of staff of the University of Melbourne for research published in the previous five years that has made a significant contribution to knowledge. Stephen's award was for 'The fine-scale genetic structure of the British population', which appeared in *Nature*, volume 519, pp. 309–314, 2015.
- Dr Nicholas Beaton has been awarded an ARC EArly Career grant worth $322,054 to study 'Statistical mechanics and the topology of polymer systems'. This project aims to study the behaviour of systems of long polymers in solution, and the effects of temperature, solvent and other environmental properties. Polymer models capture important physical properties of real-world molecules like DNA. This project will study the topology of polymer chains in tightly confined spaces. Knots and links hinder important biological processes like DNA replication, and this project will research how entanglement forms and how the biological mechanisms are used to manage it. The project is expected to have both important biological consequences

and to enhance Australia's position as a centre for research in statistical mechanics.

- Dr Sophie Zaloumis has been awarded an ARC EArly Career grant worth $345,491 to study 'Mathematical and statistical modelling of antimalarial drug action'. This project aims to develop a mathematical model to optimise global antimalarial treatment policy. Malaria-causing parasites are resistant to the most potent antimalarial drug available. If left unaddressed, a catastrophic rise in global malaria incidence and mortality could occur. Changes to global antimalarial treatment policy increasingly rely on mathematical models, but they do not encompass recent breakthroughs in antimalarial drug action and the immune response. This project's model is expected to improve antimalarial drug dosing regimens and control the spread of antimalarial drug resistance.
- Dr Mark Holmes has been awarded an ARC Future Fellowship worth $776,000 to study 'Phase transitions in stochastic systems'. This project aims to understand models of physical and biological phenomena in the presence of uncertainty/randomness. Such models often exhibit phase transitions if a variable defining the model is modified. For example, a population explosion can occur if the average number of offspring per individual is larger than one, while macroscopic defects can occur in a material if the density of microscopic defects is larger than some threshold. This research could lead to strategies for directing physical and biological systems towards preferred states or phases, and better prediction of adverse events such as fracturing of Antarctic sea ice.
- Professor Edmund Crampin, Dr Vijay Rajagopal, Professor Dr Hywel Roderick and Professor Christian Soeller have been awarded an ARC Discovery grant worth $316,000 to study 'How calcium makes the heart grow'. This project aims to develop a mathematical model of calcium signalling in heart cells. Our hearts grow to adapt to long-term changes, such as during development and in pregnancy or heart disease. Biochemical reactions involving calcium control the growth of heart cells, which also use calcium signalling to trigger contraction with each beat. How calcium controls the heartbeat and regulates cell growth is unknown. This project will develop a new mathematical model of calcium signalling in heart cells to understand important cellular adaption processes. This knowledge will lead to the ability to independently control cellular pathways mediated by calcium, opening new avenues in biotechnology and biomedicine.
- Professor Aurore Delaigle has been awarded an ARC Discovery grant worth $339,000 to study 'Statistical challenges involving indirect data'. This project aims to develop statistical methodology for solving contemporary problems involving indirectly observed data whose complexity is exacerbated by factors such as incompleteness or episodic availability. Modern statistics find it difficult to analyse complex data which contain important information only in an indirect way, such as data measured with noise or aggregated data. This project considers both finite dimensional data and functional data. The expected methodology will be able to solve frontier problems, where only sophisticated methods can access information. This

is expected to benefit brain studies, economics, infectious disease, nutrition and public health.

- Professor Peter Forrester and Associate Professor Paul Norbury have been awarded an ARC Discovery grant worth $318,000 to study 'Random matrix products, loop equations and integrability'. This project aims to research integrable structures inherent in random matrix products and loop equations. These are topics in random matrix theory, which is well known for its diverse appearances in mathematics and its applications. Integrable structures provide random matrix theory with quantitative predictions for use in these applications; link seemingly distinct theories; and are a unifying theme of fundamental and lasting importance. This project will strengthen international collaborations, provide research training, and make the footprint of Australian mathematical science more visible.
- Professor Christian Haesemeyer has been awarded an ARC Discovery grant worth $345,000 to study 'Algebraic invariants of singularities'. This project aims to study the local and global behaviour of singularities that algebraic equations can describe via difficult algebraic invariants constructed from (algebraic) functions on the geometric object. A geometric object has a singularity at a point where its tangent directions do not behave the way they should. Examples include black holes, the vertex of a cone or a road intersection. This project is expected to contribute to fundamental research goals in pure mathematics, and increase the international competitiveness of Australian mathematics research.
- Associate Professor James McCaw, Associate Professor Julie Simpson, Associate Professor Jane Heffernan and Dr Federico Frascoli have been awarded an ARC Discovery grant worth $335,000 to study 'Mathematical and statistical methods for modelling in vivo pathogen dynamics'. This project aims to develop mathematical models and Bayesian statistical methods that better capture how natural defence responses and drugs help control infection. When viruses (e.g. influenza) or parasites (e.g. malaria) invade the human body, they begin to replicate. To date, only simple mathematical models have been developed to capture these processes, and these models are not well formulated. This project will improve biomathematics and biostatistical algorithms for pathogen dynamics and is ultimately expected to benefit public health and clinical research aimed at alleviating the effect of infectious diseases on human health.
- Professor Dr Enrico Valdinoci and Dr Serena Dipierro have been awarded an ARC Discovery grant worth $286,000 to study 'Non-local equations at work'. Non-local fractional equations arise naturally in many fields of pure and applied mathematics. This project will consider symmetry and rigidity results; problems from atom dislocation theory; nonlocal minimal surfaces; symbolic dynamics for nonlocal equations; and free boundary problems. This project aims to obtain substantial progress in this field, both from the point of view of the mathematical theory and in view of concrete applications. This project should contribute to the development of the mathematical theory and give insight for concrete applications in physics and biology.

University of New England

- Dr Maolin Zhou has been awarded an ARC EArly Career grant worth $330,324 to study 'Nonlinear free boundary problems: propagation and regularity'. This project aims to understand the propagation profile and regularity of two important classes of free boundary problems. Nonlinear free boundary problems arise from many applied fields, and pose great challenges to the theory of nonlinear partial differential equations, as the underlying domain of the solution to such problems has to be solved together with the solution itself. This research is expected to enhance the existing theory of partial differential equations, and extend its applications to new situations such as flow through porous media and spreading of invasive species.
- Associate Professor Shusen Yan, Professor Edward Dancer, Professor Yihong Du and Professor Chang-Shou Lin have been awarded an ARC Discovery grant worth $345,000 to study 'Non-linear partial differential equations: bubbles, layers and stability'. This project aims to investigate nonlinear elliptic partial differential equations in well-established models in applied sciences. The treatment of them challenges the existing mathematical theory. This project will enrich and expand the mathematical theory in semi-linear elliptic equations to understand the equations under investigation.

University of New South Wales

- The Canada based Institute for Combinatorics and its Applications (ICA) recently announced that Catherine Greenhill has been awarded the Hall medal. This medal is a worldwide award for outstanding work by mid-career researchers in combinatorics.
- Dr Michael Feischl has been awarded an ARC EArly Career grant worth $313,964 to study 'Optimal adaptivity for uncertainty quantification'. This project aims to use an adaptive mesh refinement algorithm to improve the ratio of approximation accuracy versus computational time. Partial differential equations with random coefficients are crucial in simulating groundwater flow, structural stability and composite materials, but their numerical approximation is difficult and time consuming. Advances in adaptive mesh refinement theory allow full analysis and mathematical understanding of the convergence behaviour of the proposed algorithm. The project intends to develop a theory of adaptive algorithms and freely available software for their reliable (and mathematically underpinned) simulation which could solve problems beyond the capabilities of even the most powerful computers.
- Dr David Harvey has been awarded an ARC Future Fellowship worth $805,054 to study 'Counting points on algebraic surfaces'. This project aims to develop algorithms for calculating the number of solutions to polynomial equations and to compute zeta functions of certain types of algebraic varieties. Existing algorithms cannot solve these problems. The new

algorithms will enable researchers in number theory to test and refine conjectures on generalisations of many famous problems, such as the Sato–Tate conjecture, the Lang–Trotter conjecture and the Birch–Swinnerton–Dyer conjecture. The project will also have a flow-on effect in other areas of mathematics and computer science where zeta functions play a central role, including cryptography, coding theory and mathematical physics.

- Professor Michael Cowling has been awarded an ARC Discovery grant worth $286,000 to study 'Homogeneous metric spaces'. This project aims to develop a framework to model real-world phenomena simultaneously to illustrate their similarities and differences. It will apply techniques developed to deal with one type of homogeneous metric space to another type and improve the understanding of the unifying features of these model spaces. This will enable the transfer of techniques from one area to another, increasing the ease and efficiency with which they may be used.
- Dr Pinhas Grossman, Professor David Evans and Professor Masaki Izumi have been awarded an ARC Discovery grant worth $318,143 to study 'Quadratic fusion categories: a frontier in subfactor theory'. Fusion categories are mathematical structures that generalise the symmetries of finite groups; this project aims to investigate their quantum symmetries. These structures arise as invariants of subfactors in operator algebras and in mathematical models of conformal field theory. The quadratic fusion categories encompass most known subfactors that do not come from finite or quantum groups and form a vast frontier about which little is known. By uncovering the symmetries of the quadratic fusion categories, the project will advance subfactor theory and provide new models for conformal field theory. Progress in these fields will have applications to the emerging technology of quantum computing.
- Professor Igor Shparlinski has been awarded an ARC Discovery grant worth $345,000 to study additive combinatorics, arithmetic algebraic geometry, and apply them to the theory of finite fields. Additive combinatorics and algebraic geometry are mostly developed over the complex numbers and other fields of characteristic zero. This project will bring the power of these different, discrete and continuous areas to finite fields, opening new perspectives for progress on several major problems, inaccessible by other methods. The project will advance and affect the development of number theory research in Australia and methodologies useful in mathematics and computer science, including cryptography.
- Professor Fedor Sukochev, Dr Denis Potapov and Professor Alan Carey have been awarded an ARC Discovery grant worth $388,000 to study 'New methods in spectral geometry'. This project aims to use methods from mathematical scattering theory to resolve problems in the spectral analysis and index theory of differential operators. Both areas underpin the theoretical understanding of physical materials at micro length scales where quantum phenomena dominate. The project will develop new mathematical results in spectral analysis and geometry, and apply its results to theoretical models of quantum phenomena whose spectral properties are at

the limit of the range of mathematical techniques. Solving these problems is expected to influence non-commutative analysis.

- Associate Professor Mark Tanaka and Associate Professor Ruiting Lan have been awarded an ARC Discovery grant worth $286,000 to study 'Microbial natural history and molecular evolution'. This project aims to develop mathematical and computational models of microbial evolution that capture dynamics at both within-host and between-host scales, combined with processes of mutation. Integration of these elements with computational statistical methods will produce a framework that will enable inference from genome sequencing data. The mathematical models will be applied to bacterial genomic data to investigate how natural selection acts on experimental and natural populations of microorganisms. The mathematical models and statistical approaches developed here are intended to be applicable to infectious disease of both humans and domesticated animals, and could influence public health policies.

University of Newcastle

- Dr Amir Salehipour (School of Mathematical and Physical Sciences) together with Miss Leila M. Naeni (School of Built Environment, UTS, and School of Electrical Engineering and Computer Science, UON) won the prestigious 2016 Project Management Achievement Award — Research Category, awarded by Australian Institute of Project Management, for conducting outstanding research in the context of enhancing the well-known earned value technique with advanced mathematics and statistics tools in order to overcome several limitations of the earned value, particularly, when determining acceptable levels of deviations from the baseline plan. The study, which was published in *Journal of Construction Engineering and Management*, concluded that implementing the developed tools together with the traditional tools noticeably improves the project controlling scheme (http://ascelibrary.org/doi/10.1061/%28ASCE%29CO.1943-7862.0001078).
- Dr Amir Salehipour has been awarded an ARC EArly Career grant worth $360,000 to study 'Exact and hybrid algorithms for the Aircraft Landing Problem'. This project aims to develop algorithms with superior guaranteed performance. Aircraft Landing Problems (ALP) are an important class of decision problems. Optimal solution of an ALP is applicable in transportation and health care delivery, benefitting systems experiencing long delays. This project aims to address several of the Australian Government's Science and Research Priorities, focusing on food supply chains, effective operation and resource allocation in transport, and better models of health care delivery and services.
- Dr Yuen Yong has been awarded an ARC Discovery grant worth $296,000 to study 'Microcantilevers for multifrequency atomic force microscopy'. This project aims to design a microcantilever with high-performing sensors more sensitive and with better noise performance than the typical optical system used in commercial Atomic Force Microscopes (AFMs). The AFM, a nanotechnology instrument, uses a microcantilever (with an extremely

shape probe) to interrogate a sample surface. It has made important discoveries in nanotechnology, life sciences, nanomachining, material science and data storage systems. Despite its success, the technique's spatial resolution and quantitative measurements are limited. This project could lead to breakthrough technologies such as atomic force spectroscopy to study elastic modulus of nanostructures, and establish Australia's prominence in this emerging field.

University of Queensland

- Dr Hien Nguyen has been awarded an ARC EArly Career grant worth $360,000 to study 'Feasible algorithms for big inference'. This project aims to develop algorithms for computationally-intensive statistical tools to analyse Big Data. Big Data is ubiquitous in science, engineering, industry and finance, but needs special machine learning to conduct correct inferential analysis. Computational bottlenecks make many tried-and-true tools of statistical inference inadequate. This project will develop tools including false discovery rate control, heteroscedastic and robust regression and mixture models, via Big Data-appropriate optimisation and composite-likelihood estimation. It will make open, well-documented, and accessible software available for the scalable and distributable analysis of Big Data. The expected outcome is a suite of scalable algorithms to analyse Big Data.
- Professor Geoffrey McLachlan and Associate Professor Shu-Kay Angus Ng have been awarded an ARC Discovery grant worth $335,000 to study 'Expanding the role of mixture models in statistical analyses of big data'. This project aims to develop theoretical procedures to scale inference and learning algorithms to analyse big data sets. It will develop analytic tools and algorithms to analyse big data sets which classical methods of inference cannot analyse directly due to the data's complexity or size. This will accelerate the progress of scientific discovery and innovation, leading, for example, to new fields of inquiry; to an increase in understanding from studies on human and social processes and interactions; and to the promotion of economic growth and improved health and quality of life. Such applications should lead to breakthrough discoveries and innovation in science, engineering, medicine, commerce, education and national security.
- Professor S. Ole Warnaar and Professor Eric Rains have been awarded an ARC Discovery grant worth $357,000 to study 'Symmetric functions and Hodge polynomials'. This project aims to explain a connection between two seemingly disparate mathematical notions: mixed Hodge polynomials of certain varieties, naturally arising in algebraic geometry, and Macdonald polynomials from the theory of symmetric functions. This project will resolve this connection using symmetric function theory, algebraic combinatorics and representation theory. This project could enhance Australia's international reputation in algebraic combinatorics, combinatorial representation theory and algebraic geometry.

University of Sydney

- Andrew Crisp received a Vice-Chancellor's Award for Outstanding Teaching.
- Dr Kevin Coulembier has been awarded an ARC EArly Career grant worth $360,000 to study Quasi-hereditary categories in Lie theory'. This project aims to use diagram algebras and categorical representation theory to study fundamental open problems in the representation theory of Lie algebras and their generalisations. The concept of symmetry is omnipresent in science and culture. Its mathematical study leads to the notion of groups, algebras and their representation theory. Representation theory is applicable in many active research areas, including subatomic particle physics and quantum computing. Solutions to these problems could lead to better understanding of several categories of representations of Lie algebras, and create new research tools.
- Professor Anthony Henderson and Associate Professor Pramod Achar have been awarded an ARC Discovery grant worth $345,000 to study 'Modular character sheaves'. This project aims to complete the fundamental mathematical theory of modular group representations, the algebraic description of symmetry over finite number systems. Group representation theory can be applied to any linear problem involving symmetry. However, the modular case, where the characteristic of the underlying field is a prime number, is less understood than real or complex scalars, and this lack of understanding blocks potential applications. This project will use geometric methods to answer questions about modular representations of the finite groups of Lie type, the most important class of finite groups. This project could make modular representation theory essential for computations, enabling faster solutions to problems of linear algebra and allowing future applications in such areas as data transmission technology.
- Professor Jacqui Ramagge, Dr Nathan Brownlowe, Professor Iain Raeburn and Professor Marcelo Laca have been awarded an ARC Discovery grant worth $286,000 to study 'From actions to operator algebras and their equilibrium states'. This project aims to construct C^*-algebras from various types of actions and analyse their equilibrium states. Operator algebras are widely used in mathematics and to describe physical systems. They are technically challenging to work with and impossible to fully classify, making detailed analysis of large classes of examples important research in the area. This project will construct C^*-algebras from various actions; analyse their equilibrium states; and consider actions of semigroups and groupoids. The project expects to produce significant mathematical outcomes, and the findings will be important beyond academia, expand Australia's knowledge base and foster Australian competitiveness.
- Associate Professor Qiying Wang, Professor Shiqing Ling and Professor Weidong Liu have been awarded an ARC Discovery grant worth $288,471 to study 'Non-linear cointegrating regression with endogeneity'. This project aims to develop the asymptotic theory of estimation and statistical inference in models concerned with non-linear co-integrating regression with endogeneity and long memory. It will tackle a number of long-standing

technical problems related to non-linear covariance functionals and non-linear transformation of nonstationary time series. It is intended to provide technical tools for practitioners to study the long-run relationship of economic variables, and could apply to a range of statistical, empirical finance and economic models, enhancing national leadership in these areas.

- Professor Jean Yang, Associate Professor Samuel Mueller, Dr John Ormerod, Dr Pengyi Yang and Professor Graham Mann have been awarded an ARC Discovery grant worth $354,500 to study 'Prognosis based network-type feature extraction for complex biological data'. This project aims to develop statistical tools that integrate high-throughput molecular data with biological knowledge to make discoveries in complex diseases. This project uses machine learning methods, statistical models and proteomic platforms to identify relationships among clinico-pathologic and molecular measurements. It will produce tools and insights that are intended to accelerate the process of biologically and clinically significant discoveries in biomedical research. This project will help Australian researchers in statistics and users of statistics (from fields as diverse as biology, ecology, medicine, finance, agriculture and the social sciences) to make better predictions that are easier to understand.
- Professor Ruibin Zhang has been awarded an ARC Discovery grant worth $416,500 to study 'Geometric themes in the theory of Lie supergroups and their quantisations'. This project aims to develop mathematics on the geometry of super spaces and the algebra of super transformations, which are the cornerstones of the mathematical foundation of supersymmetry. The Large Hadron Collider at the European Organization for Nuclear Research is investigating supersymmetry as a possible symmetry of fundamental physics. Its empirical verification would confirm the existence of new constituents of matter, and reveal deep structures of space-time beyond the framework of Einstein's general relativity. Results of the project are expected to be directly applicable to high energy physics.

University of Western Australia

- Dr Luke Morgan received the UWA Vice-Chancellor's Early Career Investigator award.
- Professor Michael Small received the UWA Vice-Chancellor's Senior Research Award.
- Professor Timothy Sercombe, Associate Professor Anthony Roberts, Professor Xiaozhi Hu, Dr Vivien Challis and Professor Joseph Grotowski have been awarded an ARC Discovery grant worth $347,000 to study 'Predicting strength of porous materials'. This project aims to develop a predictive theory of strength for unflawed, low-ductile porous materials — an unsolved problem in computational solid mechanics. Three-dimensional printing of lightweight, porous materials is used in industry, medicine and science. The project will develop the theory and conduct experiments on porous metallic and polymeric samples made using additive manufacturing, which

require understanding and optimisation of the building of fine scale features. Understanding strength should improve design of stronger materials, by using and extending the capabilities of three-dimensional printing. These advances will further provide a much-needed basis for a fundamental understanding of fracture in other porous materials important to society such as concrete, rocks, porous ceramics and bone implants.

University of Wollongong

- Noel Cressie was awarded the 2016 Barnett Prize by the Royal Statistical Society, London, for excellence in environmental statistics.
- Dr Alexandra Burden has been awarded an ARC EArly Career grant worth $360,000 to study 'Statistical tools for assessing effects of environmental change'. This project aims to develop statistical tools for improving prediction of environmental exceedances, such as atmospheric carbon dioxide sources and sinks. Predicting extreme environmental conditions or events is crucial for effective environmental decision-making and management. The project will develop the tools using statistical inference based on a statistical model that combines predictions from related scientific models. In the case of carbon dioxide, improving prediction reliability by reducing bias and uncertainty whilst accounting for model-based dependence is an important step toward mitigating carbon dioxide sources and protecting carbon dioxide sinks. This capability is crucial for adaptive planning and a resilient society.
- Associate Professor Ngamta Thamwattana and Professor James Hill have been awarded an ARC Discovery grant worth $248,499 to study 'Optimal electromaterial structures for energy applications'. This project aims to develop new mathematical and modelling approaches to determine optimal configurations and parameters for material structures created from three-dimensional printing of combined metals and electromaterials. Electromaterials are needed for sustainable energy, but solving coupled-systems of highly nonlinear governing equations is needed for optimal control of spatial arrangement and composition in nano and micro-structural domains. Dealing with this mathematical complexity is critical to developing high efficiency energy generation and gas storage systems. This is expected to enhance transport mechanisms within electrochemical devices and create opportunities for industry to use electrofunctional materials.
- Professor Song-Ping Zhu, Professor Robert Elliott and Dr Ivan Guo have been awarded an ARC Discovery grant worth $369,000 to study 'Liquidity in financial markets'. This project aims to develop a theory which models the effect of liquidity on option prices under different market conditions. Economic or financial crises are inevitable and affect economics. During or after a major financial crisis, market liquidity usually becomes risky and needs to be studied. Through both empirical and theoretical explorations, this project will quantify and measure liquidity risk and its effect

on the options markets. It will develop a framework to help market regulators manage illiquidity, enhance the efficiency of option trading in illiquid markets and help in the detection of market manipulation.

Appointments, departures and promotions

Australian National University

- Dr Han Xiaolong departed on 19 September 2016.

Curtin University

New staff:

- Dr Fabrizio Padula, Research Assistant for Lorenzo Ntogramatzidis. He comes from the University of Brescia, Italy. Dates: 1 March 2016 to 31 August 2018.
- Dr Min Zhang, Research Assistant for Professor Jie Sun. She comes from Tianjin University. Dates: 1 August 2016 to 31 July 2017,

Staff Promotions:

- Dr Lorenzo Ntogramatzidis has been promoted to Associate Professor.
- Dr Heather Lonsdale has been promoted to Senior Lecturer.

Flinders University

- Jerzy Filar is leaving to take up a position at the University of Queensland.

Monash University

New staff (Lecturers):

- Dr Tiangang Cui
- Dr Kengo Deguchi
- Dr Janosch Rieger

New staff (Postdoctoral Fellows):

- Dr Shuhao Sun
- Dr Eric Zhou
- Dr Binh Nguyen
- Sr Sarah Jabbari

RMIT University

- Professor Kathy Horadam FAustMS FICA has been awarded the title of Emeritus Professor of RMIT University. She retired from the University on 1 September 2016 after 31 years service with RMIT, with earlier appointments held over nine years at the University of Melbourne, Monash University and Murdoch University.

Swinburne University

- Dr Birgit Loch has been promoted to Professor.

- Dr Birgit Loch has resigned to accept a Chair in teaching and learning at La Trobe University.
- Manmohan Singh will be retiring at the end of November.
- Joe Sampson will be retiring at the end of December.

University of Adelaide

- Dr Ben Binder has been promoted to Associate Professor.
- Dr Pedram Hekmati, who was at Adelaide from 2010 to 2015 and then at Instituto Nacional de Matemática Pura e Aplicada (IMPA) in Brazil, has been appointed to a continuing Senior Lectureship at the University of Auckland.
- Professor John Rice has been appointed to an Adjunct Professorship. John is Executive Director of the Australian Council of Deans of Science.

University of Melbourne

New staff:

- Dr Jing Fu (Research Fellow)
- Dr Jason Polak (Research Fellow)
- Dr Thomas Wong (Research Fellow)
- Dr Serena Dipierro (Lecturer)
- Associate Professor Enrico Valdinoci (Associate Professor)

University of Queensland

- Jerzy Filar, currently at Flinders University, will commence on 1 December 2016 as Director of CARM, the Centre for Applications in Natural Resource Mathematics. Jerzy is a broadly trained applied mathematician with research interests spanning a wide spectrum of both theoretical and applied topics in Operations Research, Optimisation, Game Theory, Applied Probability and Environmental Modelling. He spent the first 13 years of his academic career in the US, which included appointments at the University of Minnesota, The Johns Hopkins University and the University of Maryland and long-term consulting for the Environmental Protection Agency in Washington, DC. He returned to Australia in 1992 where he first worked at the University of South Australia and later at Flinders. He is the editor-in-chief of Springer's Environmental Modelling and Assessment. Jerzy is also a Fellow of the Australian Mathematical Society. He has supervised, or co-supervised, to completion 22 PhD students who are working in various universities, industries and research institutions in Australia, USA, UK, China, Morocco and France. As a hobby he dabbles in writing science.
- Sam Kault has joined UQ as a lecturer, teaching a second-year course in Calculus and Linear algebra. Sam completed his PhD in 2013 in mathematical physics (Parafermions and Bosonization), and was supervised by Associate Professor Yao-Zhong Zhang. Currently Sam is fairly teaching-focused, but his main research interest is Conformal Field Theory.

- Dr Dietmar Oelz has been appointed as Lecturer in Applied Mathematics. He comes from the Courant Institute of Mathematical Sciences at New York University where he was a research associate in Mathematical Biology. His PhD studies at the University of Vienna in Austria included extended research stays in Buenos Aires and in Paris. Later on, Dietmar took positions at the University of Vienna, the Austrian Academy of Sciences and at UC Davis. In 2013 he won an Erwin Schroedinger Fellowship of the Austrian Science Fund. Dietmar's background is in Mathematical Modeling and Simulation as well as in Partial Differential Equations. His research interests are in Mathematical and Computational Cell Biology focusing on topics such as cell movement, cell shape and intra-cellular transport.
- Sergio Galindo-Torres has recently being appointed to a joint position as a lecturer in Applied Mathematics and a Research Scientist at the School of Civil Engineering at the University of Queensland. He is also the recipient of an Advance Queensland Fellowship for his research on numerical methods applied to industry. His career combines three disciplines: He has a BSc degree and PhD in computational physics; his research has focused mainly on the creation of novel algorithms applied particularly to Civil and Environmental Engineering, and recently he has achieved his longstanding dream of securing an academic position at UQ,s School of Mathematics where he teaches partial differential equations. Connecting these three areas is the incredible power of mathematics, which he believes can be used to gain insight and predict the evolution of any physical process. Currently, he supervises/co-supervises 11 PhD students (one graduated). Additionally, he has contributed in securing, both individually and as part of a research team, more than $2M in research funding from different sources, including the Australian Research Council, Queensland Government, and the private sector.
- Yu Mei has commenced as a PostDoctoral Fellow with Min Chun Hong, after completing undergraduate studies in Mathematics at Northwest University in China from 2007 to 2011, followed by an MPhil(2011–2013) and a PhD (2013-2016) in Mathematics at the Chinese University of Hong Kong. Main research interests lie in nonlinear partial differential equations from fluid dynamics including Navier–Stokes equations, Euler equations and Liquid Crystal systems, but also include free boundary and asymptotic limits problems in fluid mechanics, in particular surface waves and boundary layer theory.
- Wen-Hsi Yang is a Postdoctoral Fellow working in the Centre for Application in Natural Resource Mathematics (CARM) since June 2016. His research is in statistical analysis, modelling and theory for spatial, temporal and spatio-temporal data. Currently he is working with people in the Department of Agricultural and Fisheries of the Queensland Government and also with Professor Kaye Basford.
- Kaleb Leemaqz is a Post Doctoral Fellow working with Professor Geoff McLachlan, specifically on optimizing computationally intensive statistical algorithms.

University of Technology Sydney

This year has seen or will see the departure of six staff members, including three former Heads of School and four staff with a combined century of service:

- Ed Lidums (Lecturer) retired in March 2016.
- Tim Langtry (Associate Professor and former Head of School) retired in July 2016.
- Beverley Moore (Senior Lecturer and former Head of School) retired in July 2016.
- Davy Wong (Lecturer) retired in July 2016.
- Steve Bush (Senior Lecturer) left for a position as Senior Statistician at the Commonwealth Bank in September 2016.
- Debbie Street (Professor of Statistics and former Head of School) is set to leave the Maths group at UTS for a research chair at the university's Centre for Health Economics Research and Evaluation (CHERE).
- Layna Groen (Senior Lecturer) retired in July 2016.

University of Western Australia

- Professor Snezhana Abarzhi joined in early September as Professor of Applied Mathematics.

University of Wollongong

- Dr Andrew Zammit Mangion has been appointed as a continuing Senior Lecturer in statistics.

New Books

University of Queensland and University of the Sunshine Coast

Makar, K., Dole, S., Visnovska, J., Goos, M., Bennison, A. and Fry, K. (eds) (2016). *Research in Mathematics Education in Australasia 2012–2015*. Springer, Singapore. ISBN 978-981-10-1417-8, ISBN 978-981-10-1419-2 (eBook).

Conferences and Courses

Conferences and courses are listed in order of the first day.

W-Algebras

Dates: Monday 28 November 2016 to Friday 2 December 2016
Venue: University of Melbourne
Web: https://sites.google.com/site/ausreptheory/workshop2016

For further details, please see the website or *Gazette* 43(3) p. 213.

BioInfoSummer 2016

Dates: 28 November to 2 December 2016
Venue: The University of Adelaide
Web: http://http://bis.amsi.org.au/

The full program for the AMSI BioInfoSummer 2016 is now available on our website, and features an exciting range of planned activities. This year's event includes lectures from international guest speakers, academic researchers, and industry professionals, specialised workshops including computer and wet labs, a poster session, programming competition, public lecture, Women in STEM networking event and a COMBINE careers panel session.

This year's event is hosted by the University of Adelaide from 28 November to 2 December and will feature the following speakers (plus many more):

- Associate Professor Orly Alter, The University of Utah
- Dr Simon Anders, Institute for Molecular Medicine Finland
- Dr Thomas Conway, IBM Research Australia
- Dr Melissa Davis, The University of Melbourne
- Associate Professor Mingyao Li, University of Pennsylvania
- Professor Terry Speed, The Walter and Eliza Hall Institute of Medical Research
- Associate Professor Xia Yang, University of California, Los Angeles

Featured speaker

Dr Mingyao Li, Statistical issues in single-cell RNA sequencing analysis

Dr Mingyao Li obtained her PhD in Biostatistics from the University of Michigan in 2005. Her main research area is statistical genetics and genomics, bioinformatics, and computational biology, which is applicable to cardiometabolic diseases (such as coronary artery disease, heart failure) and eye diseases (including age-related macular degeneration). Recently, Dr Li has expanded her interests from traditional statistical genetics to statistical genomics and bioinformatics, and single-cell transcriptomics.

Talk abstract: http://bis.amsi.org.au/mingyao-li-2016/

For further details, please see the website or contact us at bioinfosummer@amsi.org.au.

MATRIX: Interactions between topological recursion, modularity, quantum invariants and low-dimensional topology

Dates: 28 November to 23 December 2016
Venue: University of Melbourne, Water Street, Creswick, Victoria
Web: http://www.matrix-inst.org.au/events/interactions-between-topological-recursion-modularity-quantum-invariants-and-low-dimensional-topology/

Associated events:

- Quantum Invariants and Low-dimensional Topology
  14–17 December 2016
- Topological Recursion and Modularity
  19–23 December 2016

For further details, please see the website or *Gazette* 43(1) p. 69.

Maths Fest Australia 2016

Dates: 28 November to 16 December 2016
Venue: Canberra
Web: http://maths.anu.edu.au/events/austms-meeting-2016

Incorporating

- Advances in Ergodic Theory, Hyperbolic Dynamics, and Statistical Laws
  Dates: 28 November to 2 December 2016
- 60th Annual Meeting of the Australian Mathematical Society
  Dates: 5–8 December 2016
  Venue: The Australian National University
- Nonlinear and Geometric Partial Differential Equations
  Dates: 9–13 December 2016

Registration for all three events is now open at the website.

Further details and links for these three events are listed here in chronological order.

Advances in Ergodic Theory, Hyperbolic Dynamics & Statistical Laws

Dates: 28 November to 2 December 2016
Venue: ANU, Canberra
Web: http://mathsfest.amsi.org.au/advances-ergodic-theory-hyperbolic-dynamics-statistical-laws/

A component of Maths Fest Australia 2016. For further details, please see the website or *Gazette* 43(2) p. 148.

Tools and Mathematics: Instruments for Learning

Dates: 29 November to 1 December 2016
Venue: Lecture theatre ELI 122, University of Newcastle Sydney Campus, 55 Elizabeth Street in the Sydney CBD
Web: https://carma.newcastle.edu.au/meetings/tools/

This workshop will now include a remote panel chaired by Dame Celia Hoyles and Dr Elena Prieto, 4–6pm Wednesday 30 November. Panel title: 'Changing the way people think, move and feel mathematically: the contribution of digital technologies'.

Panel members:

- Celia Hoyles

- Elena Prieto
- Paul Drijvers
- Richard Noss
- Ulrich Kortenkamp

The meeting celebrates the publication of *Tools and Mathematics: Instruments for Learning* by the late Professor Jonathan Borwein with coauthors Professor John Monaghan and Professor Luc Trouche
(http://www.springer.com/in/book/9783319023953).

Plenary speakers:

- John Monaghan
- Luc Trouche
- Michael Assis
- Michael Barnsley
- Naomi Borwein
- Also by video, Uri Wilensky

Registration:
https://www.eventbrite.com.au/e/tools-and-mathematics-instruments-for-learning-tickets-27424446257

Further information on the book, abstract submission, and confirmed invited speakers is available on the conference website. Please pass this call for abstracts on to colleagues in your networks who may be interested.

Organisers: Judy-anne Osborn and Naomi Borwein.

Workshop on Integrable Systems 2016

Dates: 1–2 December 2016
Venue: University of Sydney
Web: http://wp.maths.usyd.edu.au/igs/workshops/integrable-systems-2016/

For further details, please see the website or *Gazette* 43(3) p. 215.

Early Career Researchers Workshop

Dates: 3–4 December
Venue: Australian Academy of Science, Canberra
Web: https://carma.newcastle.edu.au/mcoons/ECW2016.html

This year, the Early Career Researchers Workshop will be precede the AustMS meeting in Canberra. The theme of this year's ECW will be 'Addresing your audience'. See the website for more information.

Workshop on Data Assimilation

Dates: 5–9 December 2016
Venue: Bureau of Meteorology Head Office, Melbourne
Website: http://www.bom.gov.au/research/workshop/2016/index.html

For further details, please see the website or *Gazette* 43(4) p. 261, or contact Ms V. Jemmeson (v.jemmeson@bom.gov.au.

23rd Australian Statistical Conference 2016 in conjunction with 14th Australasian Data Mining Conference (AusDM) and 9th Australian Conference on Teaching Statistics (OZCOTS)

Dates: 5–9 December 2016
Venue: Hotel Realm, Canberra
Website: www.asc2016.com.au

For further details, please see the website or *Gazette* 43(1) p. 69.

60th Annual Meeting of the Australian Mathematical Society

Dates: 5–8 December 2016
Venue: Canberra
Web: http://maths.anu.edu.au/events/austms-meeting-2016

Part of Maths Fest Australia 2016. For further details, please see the website.

Nonlinear & Geometric Partial Differential Equations

Dates: 9–13 December
Venue: ANU, Canberra
Web: http://research.amsi.org.au/maths-fest-australia-2016/

Part of Maths Fest Australia 2016. For further details, please see the website or *Gazette* 43(2) p. 149.

Australasian Conference on Combinatorial Mathematics and Combinatorial Computing (40ACCMCC)

Dates: 12–16 December 2016
Venue: University House, The University of Newcastle city campus
Web: https://40accmcc.newcastle.edu.au/

The 40th ACCMCC will follow a similar format to previous conferences in this annual series, which is overseen by the Combinatorial Mathematics Society of Australasia (CMSA) and began in 1972. You can now register for the conference at Eventbrite.

We will have a special session to honour the late Professor Mirka Miller.

Just after the conference, on 16 and 17 of December, we will have a workshop on Applied Probability, Combinatorics and Optimisation at the same venue; see next item.

Invited speakers:

- Nathan Clisby (University of Melbourne)
- Amy Glen (Murdoch University)
- Bojan Mohar (Simon Fraser University)
- Florian Pfender (University of Colorado Denver)

- Dana Randall (Georgia Institute of Technology)
- Bruce Reed (National Institute of Informatics, Tokyo, Japan)
- Benny Sudakov (ETH Zurich)
- Geoff Whittle (University of Wellington)

Chaired by Judy-anne Osborn and Thomas Kalinowski.

String Geometries and Dualities: Australia-Brazil meeting

Dates: 12–16 December 2016
Venue: IMPA, Rio de Janeiro
Web: www.impa.br/opencms/en/eventos

Organizing Committee:

- Henrique Bursztyn (IMPA)
- Reimundo Heluani (IMPA)
- Pedram Hekmati (IMPA)
- Peter Bouwknegt (Australian National University)
- Mathai Varghese (University of Adelaide)

Over the last three decades, string theory has had a profound impact in pure mathematics. The aim of this interdisciplinary conference is to bring together experts to discuss recent developments and investigate new problems and applications in mathematical areas connected to string theory, including generalized geometry, vertex algebras, topological T-duality and related topics. In addition we hope to foster links between Australian and Brazilian researchers, and those with close connections to either party.

Applied Probability, Combinatorics and Optimisation (APCO)

Dates: 16-17 December 2016
Venue: University House, The University of Newcastle city campus
Web: https://carma.newcastle.edu.au/apco/

The first workshop on Applied Probability, Combinatorics and Optimisation will be held at the University of Newcastle, right after ACCMCC. There are three confirmed invited speakers:

- Jerzy Filar: Currently Strategic Professor of Mathematics, Flinders University, Australia (From 1 December 2016: Director of the Centre for Applications in Natural Resource Mathematics (CARM), The University of Queensland, Australia)
- Dana Randall: Director of Algorithms and Randomness Center, Georgia Institute of Technology, USA
- Nick Wormald: Australian Laureate Fellow, Monash University, Australia

There will be a limited number of contributed talks at this workshop. If you are interested to deliver your research outcome in these areas at this workshop, please submit your abstract by email to ali.eshragh@newcastle.edu.au.

Attendance of the APCO workshop is free, but requires registration through the ACCMCC registration page.

APCO Organising Committee:

- Ali Eshragh (The University of Newcastle)
- Thomas Kalinowski (The University of Newcastle)
- Catherine Greenhill (The University of New South Wales)

Differential geometry, Lie theory and Low-dimensional Topology

Dates: 19–21 December 2016
Venue: La Trobe University
Web: http://www.gygeom.com/

For further details, please see the webpage, or *Gazette* 43(3) p. 216.

MATRIX: Hypergeometric motives and Calabi-Yau differential equations

Dates: 8–28 January 2017
Venue: University of Melbourne, Water Street, Creswick, Victoria
Web: http://www.matrix-inst.org.au/events/hypergeometric-motives-and-calabi-yau-differential-equations/

Participation is by invitation only. For further details, please see the website.

AMSI Summer School 2017

Dates: 9 January to 3 February 2017
Venue: The University of Sydney
Web: http://ss.amsi.org.au/

Registration is still open, until 4 December. The AMSI Summer School is a four-week residential school in the mathematical sciences and cognate disciplines. Eight exciting subjects are offered, given by eminent lectures from around Australia, to give you the opportunity to study areas and take credit* for a subject that may not be available at your home university. The school is primarily for honours and postgraduate students in the mathematical sciences and cognate disciplines, but other students are welcome to apply.

For further details, please see the website.

ANZAMP 5th annual meeting

Dates: 1–3 February 2017
Venue: Kiama, NSW
Web: www.anzamp.austms.org.au/meetings/current/

Registration is now open. The meeting will take place in the popular seaside holiday town of Kiama on the New South Wales South Coast.

The program committee is pleased to announce the full line up of keynote speakers:

- Luis Fernando Alday (Oxford)

- Bernd Krauskopf (Auckland)
- Eric Ragoucy (LAPTh - CRNS)
- Tomohiro Sasamoto (Tokyo Institute of Technology)
- Susan Scott (Australian National University)

The meeting has a tradition of encouraging contributed talks in a wide range of topics in mathematical physics and especially talks from ANZAMP student members who are eligible to compete for the A J Guttmann student talk prize.

ANZAMP is a division of the AustMS so AustMS members and members of societies with reciprocity agreements (e.g. NZMS) can easily join ANZAMP.

For further information, including transport and accommodation information, see the conference website, or contact anzamp.meeting@gmail.com.

ANZIAM 2017

Dates: 5–9 February 2017
Venue: Adelaide Hills Convention Centre, Hahndorf, SA
Web: www.maths.adelaide.edu.au/anziam2017

Registration is now open at the conference website, where you can find further details, including accommodation. Please note the following deadlines:

- Early-bird registration closes: 16 December 2016
- Abstract submission closes: 12 January 2017

You are strongly advised to book your accommodation by the early-bird deadline. The majority of the available accommodation in Hahndorf is being held for ANZIAM 2017 at special rates until this date, after which it will be released for booking by the general public. Hahndorf is a South Australian tourist destination and there is, in general, high demand for the accommodation throughout the year, including at the time of the conference. If you cannot secure accommodation in Hahndorf you will need to obtain accommodation in Adelaide or elsewhere and commute by public transport or car. Please follow the instructions given on the accommodation webpage in order to receive the special conference prices.

The Mathematical Biology Special Interest Group is holding a one-day workshop on the Friday following ANZIAM, 10 February, while the MISG 2017 will be held in the next week 13–17 February. See under 'Associated Events' on the ANZIAM 2017 website.

Remembrance Day

Dedicated to the memory of Professor Jonathan Michael Borwein

Date: 10 February 2017
Venue: Institut Henri Poincaré, Paris
Web: https://carma.newcastle.edu.au/meetings/remembranceday/

The Society's Steering Committee has agreed to sponsor the meeting and encourages members to attend.

Speakers

- David H. Bailey (Lawrence Berkeley National Laboratory)
- Patrick Combettes (North Carolina State University)
- Ivar Ekeland (University Paris-Dauphine)
- Martin Grötschel (Berlin-Brandenburgische Akademie der Wissenschaften)
- Adrian S. Lewis (Cornell University)
- Luc Trouche (Ecole Normale Supérieure, Lyon)
- Qiji Jim Zhu (Western Michigan University)
- Matthew K. Tam (University of Gttingen and CARMA)
- F.J. Aragón Artacho (University of Alicante and CARMA)
- Alexander Ioffe (Technion)

Please contact Professor Michel Théra (michel.thera@unilim.fr) if you have any questions.

HDA2017, 7th Workshop on High-Dimensional Approximation

Dates: 13–17 February 2017
Venue: UNSW
Web: http://www.hda2017.unsw.edu.au

For further details, please see the website or *Gazette* 43(3) pp. 217–218.

Mathematics in Industry Study Group 2017

Dates: 13–17 February 2017
Venue: University of South Australia
Web: http://mathsinindustry.com/2017/misg-2017/

Registration (free) is now open for MISG 2017, one of the world's longest running mathematics think-tanks. As usual, we expect four to six exciting industry projects for participants to work on; details will be progressively added to the website. The workshop is an ideal opportunity to make contact and forge partnerships with Australian and New Zealand industries, and to collaborate with other mathematicians, scientists and engineers.

We are looking for industry problems to tackle at MISG 2017. Please contact the MISG Director, A/Prof Peter Pudney (Peter.Pudney@unisa.edu.au), if you have a problem you would like us to look at, if you have industry contacts that may be interested, or if you have any questions about MISG.

Applied Probability @ the Rock

Dates: 17–21 April 2017
Venue: Ayers Rock Resort
Web: http://www.maths.adelaide.edu.au/APatR/

For further details, please see the website or *Gazette* 43(3) p. 218.

MATRIX: Integrability in Low-Dimensional Quantum Systems

Dates: 11–23 June 2017
Venue: University of Melbourne, Water Street, Creswick, Victoria
Web: http://www.matrix-inst.org.au/events/computational-inverse-problems/

Registration is by invitation only. For further details, please see the website.

MATRIX: Integrability in Low-Dimensional Quantum Systems

Dates: 26 June to 21 July 2017
Venue: University of Melbourne, Water Street, Creswick, Victoria
Web: http://www.matrix-inst.org.au/events/integrability-in-low-dimensional-quantum-systems/

Registration is by invitation only. For further details, please see the website.

Harmonic Analysis and PDE

Dates: 17–21 July 2017
Venue: Macquarie University
Web: http://research.amsi.org.au/events/event/harmonic-analysis-pde/

Harmonic Analysis and Partial Differential Equations (PDEs) have important roles in fundamental and applied mathematical research with extensive applications to other research fields such as complex analysis, mathematical modelling, signal processing, medical imaging.

This workshop, organised on the occasion of Professor Xuan Duong turning 60 in 2017, will bring the leading experts from all over the world, including USA, Europe, China, Japan, to Australia to be together with Australian experts as well as early career researchers and PhD students. The reports to be presented will be the most recent significant developments and future directions of Harmonic Analysis and PDEs. The workshop will also provide time and ample opportunities for discussions, research collaborations for the participants, and foster potential collaborations in the future.

28th International Workshop on Combinatorial Algorithms

Dates: 17–21 July 2017
Venue: Newcastle
Web: https://carma.newcastle.edu.au/meetings/iwoca/

This is a very special IWOCA, dedicated to the memory of Professor Mirka Miller. For further details, please see the website.

12th International Conference on Fixed Point Theory and its Applications

Dates: 24–28 July 2017
Venue: Harbourview Function Centre, Newcastle
Web: https://carma.newcastle.edu.au/meetings/icfpta/

Dedicated to the memory of Jonathan M. Borwein in recognition of his prodigious contributions to nonlinear analysis.

Celebrating William (Art) Kirk's 80th birthday and the 70th birthday of Brailey Sims.

The purpose of ICFPTA 2017 is to bring together leading experts and researchers in fixed point theory and to assess new developments, ideas and methods in this important and dynamic field. A special emphasis will be put on applications in related areas, as well as other sciences, such as the natural sciences, medicine, economics and engineering.

The conference will continue the tradition of the previous fixed point theory meetings which were held in Marseille (1989), Halifax (1991), Seville (1995), Kazimierz Dolny (1997), Haifa (2001), Valencia (2003), Guanajuato (2005), Chiang Mai (2007), Changhua (2009), Cluj-Napoca (2012) and Istanbul (2015).

MATRIX: Elliptic Partial Differential Equations of Second Order: celebrating 40 years of Gilbarg and Trudinger's book

Dates: 16–28 October 2017
Venue: University of Melbourne, Water Street, Creswick, Victoria
Web: http://www.matrix-inst.org.au/events/elliptic-differential-equations-of-second-order/

Registration is by invitation only. For further details, please see the website.

MATRIX: Combinatorics, Statistical Mechanics, and Conformal Field Theory

Dates: 29 October to 18 November 2017
Venue: University of Melbourne, Water Street, Creswick, Victoria
Web: http://www.matrix-inst.org.au/events/combinatorics-statistical-mechanics-and-conformal-field-theory/

Registration is by invitation only. For further details, please see the website.

Mathematics of Risk

Date: 20 November to 8 December 2017
Venue: University of Melbourne, Water Street, Creswick, Victoria
Web: http://www.matrix-inst.org.au/events/mathematics-of-risk/

Registration is by invitation only. For further details, please see the website.

Incorporating workshop on mathematical modelling of risk and contiguous topics.

Date: 27 November to 1 December 2017
Venue: as above.

Tutte Centenary Retreat

Dates: 26 November to 2 December 2017
Venue: University of Melbourne, Water Street, Creswick, Victoria
Web: http://www.matrix-inst.org.au/events/tutte-centenary-retreat/

Registration is by invitation only. For further details, please see the website.

AustMS 2017: 61st Annual Meeting

Dates: 11–14 December 2017
Venue: Macquarie University

Further details to come.

Geometric R-matrices

Dates: 17–22 December 2017
Venue: University of Melbourne, Water Street, Creswick, Victoria
Web: http://www.matrix-inst.org.au/events/geometric-r-matrices/

Registration is by invitation only. For further details, please see the website.

Non-equilibrium Systems and Special Functions

Dates: 7 January to 2 February 2018
Venue: University of Melbourne, Water Street, Creswick, Victoria
Web: http://www.matrix-inst.org.au/events/non-equilibrium-systems-and-special-functions/

Registration is by invitation only. For further details, please see the website.

Vale

Wendy Robertson

With regret we inform members of the death on Friday 19 November of Dr Wendy Robertson, formerly of the University of Western Australia.

Wendy and her husband Alex Robertson jointly authored the influential book *Topological Vector Spaces* in 1964 (republished in 1973, and translated into both German and Russian).

Cheryl Praeger writes

> Lady Jefferies from Girton College Cambridge, where Wendy did her undergraduate studies and her PhD, told me she regarded Wendy as 'her best student'.
> Wendy was always very supportive of younger members of staff. She came to Perth from Glasgow in 1973 when her husband Alex accepted the position of Foundation Professor of Mathematics at Murdoch University. Wendy was appointed then to a senior lectureship at UWA.

Visiting mathematicians

Visitors are listed in alphabetical order and details of each visitor are presented in the following format: name of visitor; home institution; dates of visit; principal field of interest; principal host institution; contact for enquiries.

Prof Tomoyuki Arakawa; Research Institute of the Mathematical Sciences, Japan; 22 November to 4 December 2016; UOM; Arun Ram

Prof Harry Braden; University of Edinburgh; 29 November to 3 December 2016; applied; USN; Nalini Joshi

Dr Brenton Clarke; Murdoch University; 20 August to 31 December 2016; UWA; Berwin Turlach

Ms Giulia dal Verme; Università degli Studi di Milano-Bicocca, Milano, Italy; 15 September to 14 December 2016; pure; USN; Jacqui Ramagge

Dr Geoffrey Decrouez; Higher School of Economics, Russia; 4 November to 19 December 2016; UOM; Peter Taylor

Prof Reinier Díaz Millán; Federal Institute of Goias, Goiania, Brazil; 1 January 2016 to 31 December 2016; optimization, variational inequality problem, inclusion problem, splitting methods; USA; Regina Burachik

Asen Dontchev; Mathematical Reviews; 10–22 January 2017; optimisation; FDU; Alex Kruger

Dr Caley Finn; Université Savoie Mont Blanc, France; 28 November to 16 December 2016; UOM; Jan De Gier

Prof Edwin Galea; University of Greenwich (UK); 23 November to 3 December 2016; computational emergency engineering; RMIT; Marc Demange

Dr Richard Garner; Macquarie; 23 January to 3 February 2017; pure; USN; Anthony Henderson

Ms Carina Geldhauser; Weierstrass, Institute for Applied Analysis and Stochastics, Berlin; 2 November to 3 December 2016; UOM; Enrico Valdinoci

Dr Zhao Hua Gong; Shandong Institute of Business and Technology; January 2016 to January 2017; optimal control and its applications; CUT; Ph: 92663534

Dr Paul Griffiths; Oxford Brookes University; 3–25 January 2017; pure; USN; Sharon Stephen

Dr Jeremie Guilhot; 10–22 December 2016; pure; USN; James Parkinson

Mr Cheng Hu; Shandong University; 1 June to 31 December 2016; statistics; USN; Qiying Wang

Dr Hsin-Cheng Huang; Academia Sinica, Taiwan; 28 November to 2 December 2016; spatial and environmental statistics; UOW; Noel Cressie

Prof Gerhard Huisken; 16–22 December 2016; pure; USN; Zhou Zhang

Dr Ingrid Irmer; Florida State University; 10 October to 31 December 2016; UOM; Craig Hodgson

Prof Monique Jeanblanc; Universite d'Evry; 23 November to 20 December 2016; financial maths; USN; Marek Rutkowski

Prof Bertrand Jouve; CNRS (France); 10 November to 6 December; graph theory and complex networks; RMIT; Marc Demange

Dr Shashank Kanade; University of Alberta, Canada; 20 November to 3 December 2016; UOM; David Ridout

Dr Napsu Karmitsa; Turku University, Finland; 2 January to 24 December 2016; optimisation; FDU; Adil Bagirov

Dr DE Zhou Kong; Shandong Agricultural University; February 2016 to February 2017; CUT; applied differential equations contact; Ph: 92663534

Prof Tony Krzesinski; University of Stellenbosch, South Africa; 18 November to 21 December 2016; UOM; Peter Taylor

A/Prof Nicole Lemire; University of Western Ontario; 30 January to 16 April 2017; pure; USN; Gus Lehrer

A/Prof Jingjian Li; Guangxi University P.R. China; January 2016 to January 2017; UWA; Cai Heng Li

Professor Chong Yang Liu; Shandong Institute of Business and Technology; January 2016 to January 2017; CUT; optimal control and its applications; Ph: 92663534

Dr Yong Liu; Wuhan University of Science and Technology; June 2016 to June 2017; CUT; applied finance and economics; Ph: 92663534

Dr Xia Liu; Henan Normal University, China; 1 September 2016 to 31 August 2017; SUT; applied mathematics, dynamical systems; Tonghua Zhang

A/Professor De Xiang Ma; North China Electric Power University; March 2016 to March 2017; CUT; applied differential equations; Ph: 92663534

Prof Jose Mazon; University of Valencia; 2–22 December 2016; pure; USN; Daniel Hauer

Dr Jin Song Meng; University of Electronic Science and Technology China; January 2016 to January 2017; CUT; optimal control and its applications; Ph: 92663534

Dr Anne Moreau; University of Poitiers, France; 19 November to 4 December 2016; UOM; Arun Ram

A/Prof Shahar Nevo; Bar-Ilan University; 28 November 2016 to 4 January 2017; applied; USN; Milena Radnovic

Dr Peter O'Sullivan; University of Sydney; 2 July to 31 December 2016; ANU; Peter Bouwknegt

Prof Dmitry Pelinovsky; McMasters University; 1 January to 30 June 2018; applied; USN; Nalini Josh

Prof Dana Randall; Algorithms and Randomness Center, Georgia Institute of Technology; 11–18 December 2016; UNC; Ali Eshragh, Thomas Kalinowski, Sogol Mohammadian and Catherine Greenhill

Mr James Reoch; Adelaide; 3 August 2015 to 31 December 2017; applied; USN; Peter Sehoon Kim

Mr Gerben Scheepmaker; TU Delft; 3–20 January 2017; energy-efficient train control; USA; Amie Albrecht

Mr Yu Shen; Tongji University; 1 December 2016 to 30 April 2017; stats; USN; Qiying Wang

A/Prof Scott Sisson; UNSW; 9 January to 3 February 2017; stats; USN; Anthony Henderson

Mr Moritz Thon; 3 September to 25 November 2016; applied; USN; Mary Myerscough

Prof Walter Tholen; York University, Toronto, Canada; 29 November to 11 December 2016; category theory; MQU; Ross Street

Prof Dom Verity; Macquarie; 9–20 January 2017; pure; USN; Anthony Henderson
Mr Søren Vilsen; University of Aalborg, Denmark; 1 August to 31 December 2016; UMB; David Balding
A/Prof Begoña Vitoriano; Complutense University, Madrid, Spain; 21 November to 20 December 2016; disaster management; RMIT; GEO-SAFE project, Marc Demange
Ms Jun Wang; University of Science and Technology of China; 1 October 2015 to 1 March 2017; ANU; Ben Andrews
Ms Pei Wang; Central South University, China; July 2016 to June 2018; CUT; stochastic optimisation; Ph: 92663534
Ms Wei Wang; Hunan University of Technology; April 2016 to February 2017; CUT; stochastic optimal control and optimization; Ph: 92663534
Dr Simon Wood; 20 August 2016 to 31 December 2017; ANU; Peter Bouwknegt
Dr Jeroen Wouters; 25 February 2015 to 24 February 2017; applied; USN; Georg Gottwald
Dr Ying Xu; Hefei University of Technology; 1 September 2015 to 31 August 2017; pure; USN; Ruibin Zhang
Dr Oded Yacobi; University of Sydney; 22 November to 4 December 2016; UOM; Arun Ram
Prof Yasuhito Yamada; Kobe University; 27 November to 3 December 2016; applied; USN; Nalini Joshi
A/Prof Hengyun Yang; Shanghai Maritime University; 16 January 2016 to 15 January 2017; pure; USN; Ruibin Zhang
A/Professor Yanyan Yin; Jiangnan University, Wuxi, China; March to Dec 2016; CUT; control and optimization of stochastic systems with actuator saturation; Ph: 92663534
Dr Jin Long Yuan; Dalian University of Technology; January 2016 to January 2017; CUT; optimal control and its application to bio-processes; Ph: 92663534
Dr Seif Zeinabolsadat; Eram University, Iran; January 2016 to January 2017; CUT; optimisation; Ph: 92663534
Dr Hong-Bing Zeng; Hunan University of Technology; March 2016 to February 2017; CUT; sampled-data synchronization control for chaotic neural networks under actuator saturation; Ph: 92663534
Prof Da-jun Zhang; Shanghai University; 28 November to 4 December 2016; applied; USN; Nalini Josh
Mr Yang Zhang; University of Science and Technology, China; 1 October 2015 to 30 September 2017; pure; USN; Ruibin Zhang
Prof Jiandong Zhao; Ludong University, China; 1 June to 30 November 2016; differential equations and mathematical biology; SUT; Tonghua Zhang
Hui Zhou; Peking University, PRC; September 2015 to March 2017; UWA; Cheryl Praeger, Alice Devillers and Michael Giudici

The Society's Annual General Meeting

The Society's 60th Annual General Meeting will be held at 1.15 pm on Wednesday 7 December at the Manning Clark Centre, Australian National University. Lunch will be provided in the foyer from 12.45. It is hoped that the new time of day, with lunch provided, will encourage more members to attend. Visit the conference website (http://maths.anu.edu.au/events/austms-meeting-2016) to see the agenda and papers for the meeting.

Peter Stacey
AustMS Secretary
Email: P.Stacey@latrobe.edu.au

Peter Stacey joined La Trobe as a lecturer in 1975 and retired as an associate professor at the end of 2008. Retirement has enabled him to spend more time with his family while continuing with some research and some work on secondary school education. He took over as secretary of the Society at the start of 2010.

The Australian Mathematical Society

President:	Professor Tim Marchant, FAustMS	Dean of Research University of Wollongong NSW 2522, Australia. tim_marchant@uow.edu.au
Secretary:	Dr P. Stacey	Department of Mathematics and Statistics La Trobe University Bundoora, VIC 3086, Australia. P.Stacey@latrobe.edu.au
Treasurer:	Dr A. Howe	Department of Mathematics Australian National University Acton, ACT 0200, Australia. algy.howe@maths.anu.edu.au
Business Manager:	Ms May Truong	Department of Mathematics Australian National University Acton, ACT 0200, Australia. office@austms.org.au

Membership and Correspondence

Applications for membership, notices of change of address or title or position, members' subscriptions, correspondence related to accounts, correspondence about the distribution of the Society's publications, and orders for back numbers, should be sent to the Treasurer. All other correspondence should be sent to the Secretary. Membership rates and other details can be found at the Society web site: www.austms.org.au.

Local Correspondents

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