AMSI-FUNDED WORKSHOPS

JULY 2020 - JULY 2021

EVENT REPORT





* Australian Government Department of Education, Skills and Employment

AMSI-FUNDED WORKSHOPS

July 2020 – July 2021

Foreword	1
Committee Chair's Report	2
Workshops	3
Participation Breakdown	. 16
Committees	. 17

FOREWORD

AMSI supports collaborations between Australian and international researchers by funding mathematical and statistical events held by staff and students at AMSI Member Institutions. Joint workshop funding rounds are held twice yearly in partnership with the Australian Mathematical Society (AustMS). In this second year of restricted meetings during the pandemic, organisers and participants have adapted well to remote participation through online video communications. A particularly pleasing aspect was the high number of overseas online participants. AMSI provided flexible support to organisers under these special circumstances. While funding usually covers the travel and accommodation expenses of international keynote speakers, the model was adapted to support digital platforms, keynote recordings and post-event publication. Incentive research support payments were also offered to organisers of online events.

In the period of 1 July 2020 – 31 July 2021, AMSI sponsored 12 events. These workshops were diverse in focus with topics including oceanography, integrability and statistical ecology.

In 2020, AMSI was proud to enter into an additional partnership with MATRIX – a residential research institute for the mathematical sciences in Australia. The MATRIX-AMSI PhD Student Research Collaboration scheme supports Australian-based PhD students to organise symposia and engage in ongoing post-event collaboration. Six PhD research symposia were held in the reporting period.

AMSI previously partnered with the Sydney Mathematical Research Institute (SMRI) to bring international conference and workshop speakers to Australia. This scheme has been postponed until overseas researchers are again able to visit.

The AMSI workshop funding program aims to strengthen Australia's research capabilities by encouraging local and international collaboration. Each successful funding application must be proven to be of national benefit. Diversity is a core value of the program and organisers are required to actively encourage the participation of women and early-career researchers.

The program aligns with the project objectives of the Securing Australia's Mathematical Workforce: 2016–2021 agreement between AMSI and the Department of Education, Skills and Employment to:

- Strengthen research training and the work-readiness of advanced mathematical sciences graduates
- Promote university-industry collaborations that will encourage the private sector employment of mathematical sciences graduates
- Attract and improve the retention of senior undergraduate students in the mathematical sciences, with particular attention to women and Aboriginal and Torres Strait Islander students

COMMITTEE CHAIR'S REPORT

Since its inception 18 years ago, AMSI has provided important national benefits in research support along with its broad activities in education and industry outreach. The mathematical sciences in Australia are more productive and better appreciated because of this.

Even with a modest budget over the last financial year, AMSI has supported a pleasing variety of research topics. Five of the supported workshops have titles that relate directly to the areas of biomedical sciences and environmental mechanics. Five of the workshops



related directly to data analysis. Five related to the foundational disciplines of mathematical structures and mathematical physics. You can see that these categories are not mutually exclusive. As well as supporting local workshops, until this year of travel restrictions, AMSI has displayed its banner on regular international congresses when they occasionally operated in Australia.

The workshops that are summarised in this report, were highly successful in terms of scientific quality and in terms of the numbers and demographic spreads of delegates. I am grateful for the support of the government and of our member institutions, and for our volunteer conference organisers.

Since mid-2021 the Scientific Advisory Committee has been subsumed by a broader AMSI Research Committee, chaired by Professor Stephan Tillmann. The operation of the conference support scheme will continue in a similar way as before. Over many years the AMSI Scientific Advisory Committee (SAC) included top mathematical scientists from around the world, including a Fields Medallist and several members of national academies. We are grateful that they agreed to serve voluntarily because they, along with other members of the Research Committee understand the importance of stimulating mathematical and statistical research in Australia.

Philip Broadbridge

Scientific Advisory Committee Chair (until April 2021) Deputy Chair of Research Committee (from May 2021)

WORKSHOPS





Mathematics of Sea Ice and Ice Sheets

9–13 November 2020

Hosted by the University of Newcastle

The cryosphere is one of the critical components of the earth climate systems, and it has been the subject of significant transformation in recent years in response to climate change. There are several mathematical challenges to modelling this system, and the program aimed to bring together researchers who are experts in the mathematical modelling of ice sheets and sea ice, two related but separate parts of the cryosphere. This workshop bought together the leading researchers in this field, with 11 presentations on areas such as the practical issue of measuring waves and complex models of waves, sea ice and the atmosphere. The event attracted more than 80 registered participants and 40 presented talks. Although the advent of COVID-19 restrictions forced the organisers to switch from a face-to-face to an online format, the workshop was a great success and attracted speakers who may not have been able to attend otherwise.

The only local keynote speaker who was able to travel domestically to the workshop was Yury Stepanyants, a recognised expert in ocean waves who has made significant recent research on wave impact on the frozen ocean. The following international keynote speakers were able to participate remotely: Olga Sergienko from Princeton, Alison Kohout from New Zealand's National Institute of Water and Atmospheric Research, Ken Golden from the University of Utah, Chris Horvat from Brown University and Vernon Squire from the University of Otago. Sergienko is a glaciologist specialising in ice sheet modelling.

- 80 attendees (40 domestic, 15 female)
- 4 AMSI Member institutions represented
- 6 speakers (5 international, 2 female)
- 15 domestic postgraduates and ECRs

I found the workshop interesting and very well-organised.

Izolda Sturova (Russian Academy of Sciences)

Early-Career Workshop of the AustMS

7 December 2020

Online event preceding the 64th Annual Meeting of the AustMS hosted by the University of New England

The AustMS ECW 2020 was one of several satellite events surrounding the 64th AustMS Meeting (held online 8–11 December). Featuring speakers from industry and academia, this workshop provided early-career mathematicians with the chance to discuss career pathways, get advice from experienced mathematicians and (digitally) network with other early-career academics. The workshop was attended by 147 registered participants (140 ECRs and 7 speakers) and organisers Sophie Calabretto (Macquarie University) and Luke Bennetts (University of Adelaide). This compares with 57 in 2012, 64 in 2013, 73 in 2014, 77 in 2016, and 58 in 2018. The organisers believe that the number of participants was significantly higher than normal due to the online nature of the event, allowing people to attend with more flexibility. The number of participants online at any time fluctuated around the 60-65 mark.

The organisers invited seven speakers for the ECW: an early-career researcher, one `mathematics and statistics engagement' speaker, one `mathematics in the real world' / industry speaker, and four academic / career-advice speakers.

Gather.town proved an effective way of facilitating networking at this virtual event. Participants were encouraged to interact with their fellow ECRs before and after the workshop, and during the breaks in between sessions.

147	attendees	(132	domestic,	54 female)	
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- 25 AMSI Member institutions represented
- 7 speakers (2 international, 4 female)
- 141 domestic postgraduates and ECRs

MATRIX-AMSI PhD Student Symposium: 2020 Australasian Graduate Symposium in Combinatorics

16-18 December 2020

Online event hosted by MATRIX, Monash University, The University of Auckland and The University of Melbourne

The symposium provided a platform for graduate students in combinatorics to network and discuss advanced topics through a rotation of three participant sessions each day. The first session covered attendees' research in combinatorics and an open problem from the field. Next was a collaboration and networking session using the online platform Gather.town. Last was a tutorial session run by postdoctoral researchers in combinatorics. These sessions were popular and received unanimous favourable reviews. Both speakers did an excellent job in introducing useful tools from their research to a broader audience. Their talks were accessible, engaging, and helpful.

Overall, the feedback from the symposium was very positive. Most participants found the different sessions helpful and would be interested in participating in a similar event in the future if it were to occur. Several participants also noted that it was well organised. A substantial proportion of the participants were not based in Australia, and many of them were grateful that the online format allowed them to take part in the symposium. One suggestion for improvement was to put more emphasis in communicating that a goal of the symposium is to create new collaborations.

58 attendees (25 domestic, 15 female)2 speakers (1 female)

It was a great opportunity to participate in an international symposium from Sri Lanka. I'm an undergraduate, but I got so much knowledge about various areas of research and it was so helpful.

Anonymous (international participant)

MATRIX-AMSI PhD Student Symposium: Spatial and Temporal Statistics Symposium

17–19 February 2021

Online event hosted by MATRIX and The University of Wollongong

Held virtually over Zoom, the PhD Student Spatial and Temporal Statistics Symposium (STSS) took place over three days from 17 to 19 February 2021. The symposium highlighted work in spatial and spatio-temporal applications of statistics, covering topics from statistical theory, statistical methodology, and statistical computation to various spatial and temporal applications in health and environment sciences. The symposium attracted the interest of many postgraduate students, early career researchers and renowned researchers, both domestically and internationally.

The symposium had a focus on postgraduate students in spatial and temporal statistics, providing them a platform to showcase their research, the opportunity to learn from world-leading researchers in the field and network with academics, industry professionals and other students. The symposium was well received with overwhelmingly positive feedback from attendees. Participants found that the event introduced to them new ideas and knowledge helpful for their own future research. They also found the event to be a great platform to build connections with fellow researchers in the field of spatial and temporal statistics.

Registrants were from all around the world: 22 from Australia, 60 from other countries, and country data for the remaining 28 registrants was not collected.

110	attendees (22 domestic, 39 female)
10	speakers (2 international, 4 female)
82	postgraduates and ECRs

It was helpful to see all the different kinds of projects happening in our field, and great to meet peers from around the world doing similar work.

PhD student attendee

Practical Applications in Network Science

22–23 February 2021

Online event hosted by RMIT University and Victoria University

Attracting participants from a range of disciplines, this workshop was an insightful event to look into diverse applications of network science. The particular highlights of the workshop were the applications of network science in the study of proteins in biology, finding unusual patterns in social networks, the optimisation of transportation networks and the study of complex computer networks. The goals of the workshop were to showcase the wide spectrum of disciplines to which network science is applied, to foster cross disciplinary conversation and to provide collaborative platforms for researchers with different levels of expertise in network science.

Network science theory is a very important branch of mathematics that finds applications in several areas of Australia's science and research priorities like cybersecurity, food and health. This workshop aimed to bring together researchers from all areas of network science to strike up conversations and spark collaborations across diverse sectors to germinate new ideas and innovative approaches through conversation and networking. The workshop not only allowed researchers to build their knowledge and skills during the free training sessions, but also allowed the next generation of researchers to think in a multidisciplinary way about problems they care about. The use of the free open-source software R ensured sustainability of training skills and created learning and research opportunities for brand new entrants into fields using network science. The workshop provided participants with opportunities to further collaborate and advance their skills in reproducible research using R and open-source packages to conduct the research they care about.

78	attendees	(46 domestic, 40	female)
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- 12 AMSI Member institutions represented
- 7 speakers (1 international, 4 female)
- 42 postgraduates and ECRs

Events like this are extremely helpful in encouraging interdisciplinary awareness. I found that understanding key networking concepts has provided a new way of looking at old problems in my current research.

James Lever (University of Huddersfield)

MATRIX-AMSI PhD Student Symposium: (GT)² Graduate Talks in Geometry and Topology

2 March – 9 November 2021

Online event hosted by MATRIX

The Graduate Talks in Geometry and Topology symposium (GT)² is an online seminar series organised by and for graduate students. (GT)² has been running fortnightly since February 2021. Participants present their research to a diverse audience. The symposium gives them the opportunity to engage, network and share ideas with other students in geometry and topology. Each seminar features one or two student talks followed by informal social time when students can socialise and discuss mathematics.

(GT)² was originally proposed to run during Semester One 2021 (February–June). Such was the success of the series throughout this period that the organisers decided to continue into Semester Two. This success was measured by the regular attendance of a core subset of students, as well by the consistent attendance of Australian graduate students each fortnight. Fourteen talks were held in Semester One, and nine will have occurred by the end of Semester Two.

We have been able to engage with graduate students from most major universities, and foster a sense of belonging for graduates in geometry and topology. The opportunity to network and socialise with Australian graduate students across institutions has been invaluable.

PhD student symposium organisers

AMSI Workshop on Mathematical and Statistical Challenges in Modelling Cellular Systems in Biology

11 May 2021

Online event hosted by The University of Melbourne and the Australian National University

This whole-day event focused on the current mathematical and statistical challenges of modelling cellular systems. The workshop featured a line-up of nine exciting speakers, split across three sessions. The event brought together for the first time researchers interested in modelling whole cells, a 'grand challenge of 21st century science' and an emerging priority area of funding bodies in the USA, Europe and Asia.

By bringing Australian and international researchers together, this workshop identified a formidable group with complementary expertise and shared interests in this topic. This has already started to lay the foundations for the exploitation of future grant opportunities, and for industry engagement.

The highlight of the workshop was the development of a community of researchers with shared interests in modelling whole cellular systems. One of the two concrete outcomes emerging is the group of Australian and international scientists who are starting to develop plans to collaborate on a large grant application. This one-day AMSI workshop galvanised work around an ARC Centre of Excellence proposal for a Centre of Excellence in the Mathematical Analysis of Cellular Systems.

The second outcome is currently ongoing work on an overview and review paper of the state of the art in whole-cell modelling. Sadly, a significant void was left in the research community by the unexpected death of keynote speaker and valued collaborator Edmund Crampin in the week following this workshop.

113	attendees (63 domestic, 47 female)
5	AMSI Member institutions represented
9	speakers (3 international, 4 female)
48	domestic postgraduates and ECRs

Thanks for organising the workshop. It was very informative, the place to learn new ideas.

Milad Ghomlaghi (Monash University)

MATRIX-AMSI PhD Student Symposium: Dynamical Systems in Triangulated Categories and Surfaces (DiTS)

7 June – 2 July 2021

Online event hosted by MATRIX and the Australian National University

Motivated by the notion of entropy for continuous morphisms in a topological dynamical system, one can similarly define the notion of categorical entropy for endofunctors in triangulated categories. Computing entropy of a given endofunctor can be quite complicated, even in topology; many papers introduced different methods of computing entropies for specific morphisms. In many recent works, it was shown that various topological notions have well-defined analogies in homological algebra. Guided by these analogies, researchers hope to develop methods to compute categorical entropy by emulating methods developed in topology. This symposium gathered students from these two seemingly different fields to learn the ideas from topology and translate them into ideas in homological algebra.

The four-week symposium focused on the necessary background on triangulated categories and stability conditions in the first week, followed by two weeks of specialised talks and finally, a week on interesting topics chosen by attendees. Interactive workshops were held at the end of each week, allowing attendees to further discuss concepts introduced in the talks and ask specific questions on that week's topic.

- 23 attendees (12 domestic, 2 female)
- 6 speakers (3 international, 1 female)
- 18 domestic postgraduates and ECRs

MATRIX-AMSI PhD Student Symposium: Categories and Companions Symposium

8–12 June 2021

Online event hosted by MATRIX, Kyushu University, Macquarie University and the University of Sydney

Categories and Companions Symposium 2021 (CaCS2021) was an event for research students (honours/masters/PhD) in category theory and related disciplines from around the world to meet each other and share their work.

Each day featured a 50-minute talk by an invited speaker and a series of 20-minute contributed talks by research students, split across two sessions—the first aimed at Australasian and American time zones and the second at Australasian, African and European time zones. There were 35 contributed talks from research students, and 5 invited talks from established mathematicians.

Attendees had the opportunity to meet and talk to each other in smaller groups at various times throughout the symposium. Discussions stemming from talks and breakout room sessions were often continued over the workshop Discord server.

The symposium also featured a 90-minute Q&A session in which students could submit general questions related to category theory in advance (via the Slido platform) or ask questions live during the event. The session involved a discussion between the participants and was attended by over 25 people.



The MATRX-AMSI PhD Student Symposia program provided us with a unique opportunity to organise an academic event on a global scale whilst still PhD students. Further, we have gained an international network. Indeed, one of us has begun collaborating with a participant after meeting for the first time through the symposium.

PhD Student symposium organisers

PDE Models in Mathematical Biology

24 June 2021

Online event hosted by Queensland University of Technology and the University of South Australia

PDE Models in Mathematical Biology was an online forum featuring leaders in the Australian mathematical biology community, specifically those researchers who use partial differential equations in mathematical biology.

The fully online free half-day event included four national and international keynote speakers from the mathematical biology community with plenty of opportunity for discussion with the speakers. The event was also used to promote the potential for follow-up collaboration face-to-face locally in each city and in online discussion between different universities.

Invited speakers were Associate Professor Bronwyn Hajek (University of South Australia), Professor Michael Plank (University of Canterbury, New Zealand), Associate Professor Jennifer Flegg (University of Melbourne) and Professor Scott McCue (Queensland University of Technology).

213	attendees (72 domestic, 64 female)	
15	AMSI Member institutions represented	
4	speakers (1 international, 3 female)	
73	domestic postgraduates and ECRs	

Thanks for organising the workshop. It was great to see something more in-depth than a conference talk. The speakers were really good.

Peter Johnston (Griffith University)

MATRIX-AMSI PhD Student Symposium: Data-Driven Modelling in Mathematical Biology

28 June – 9 July 2021

Online event hosted by MATRIX and Queensland University of Technology

Mathematical biology is a diverse, cross-disciplinary area of research at the interface of applied mathematics, statistics, biophysics and experimental science. Cross-collaboration between experts in these fields is quickly becoming requisite for impactful research. This online symposium fostered new collaborations and skill development across each of these fields through talks, lectorials in model calibration, and most importantly, data-driven collaborative projects. These elements brought together experts in deterministic and stochastic modelling, theoretical analysis (for example, travelling wave analysis), experimental science, model calibration, and statistics. The symposium concluded with participants presenting results from their group projects.

Overall, the symposium ran smoothly and accomplished the goals to foster an interest among participants in connecting mathematical models and experimental data. The two-day format worked well, with successful and insightful talks and lectorials given on the first day of the workshop. Participants noted they enjoyed the breadth of material covered: each speaker delivered an exposition on the application of mathematics in different areas. Those who participated in the group projects seemed to learn new skills, expand their networks, and make great progress on challenging projects in a relatively short period of time.

- 49 attendees (12 female)
- 7 AMSI Member institutions represented
- 40 speakers (35 international, 8 female)

The Mathematics of Conformal Field Theory II

5-9 July 2021 (postponed from July 2020 due to COVID-19 impacts)

Online event hosted by the Australian National University

This event was a major component of the 2021 Special Year of Mathematical Physics at MSI, ANU. It featured universally acknowledged leaders as well as dynamic future leaders. The recent drive in theoretical physics to unify gravity with the other fundamental forces has led to an explosion of activity at the interface between mathematics and physics, and conformal field theory has proven to be a particularly active and exciting example of this interaction. While conformal field theory was initially developed for physical purposes, it has also inspired breakthroughs in diverse mathematical fields such as number theory, combinatorics, differential and algebraic geometry, sporadic finite groups, quantum groups, knot theory, and more. This conference engaged the various mathematics and mathematical physics communities who study CFT to discuss recent breakthroughs and develop new directions for future research. On the mathematical side, subjects included vertex algebras, conformal nets, subfactors, and higher categories, while on the physical side topics included gauged quantum field theories, topological defects/interfaces and statistical lattice models.

The event was originally planned in a hybrid format, with domestic attendees invited to join in person in Canberra in addition to the option for online participation, but was forced to move to an entirely online format. There were 18 excellent one-hour talks given by highprofile researchers, six of them internationals. There were also six contributed talks from HDR students and early-career researchers. Participants represented 22 countries and nine Australian universities. Participants celebrated the recent 60th birthday of Professor Peter Bouwknegt at the beginning of the conference with a day of talks centred around the themes of Professor Bouwknegt's distinguished research career.

- 96 attendees (41 domestic, 15 female)
- 9 AMSI Member institutions represented
- 18 speakers (6 international, 4 female)
- 16 domestic postgraduates and ECRs

I found this workshop on conformal field theory to be very insightful. It brought together many experts from different subfields and presented many cutting-edge results on the topics, which I found very enlightening and learned a lot [sic].

Bin Gui (Tsinghua University)

PARTICIPATION BREAKDOWN



'It was helpful to see all the different kinds of projects happening in our field, and great to meet peers from around the world doing similar work.'

AMSI-MATRIX PhD Symposium student attendee



149 speakers

43 female speakers 93 international speakers

'Great choice of talks.'

AMSI-MATRIX PhD Symposium student attendee

COMMITTEES

Scientific Advisory Committee (until April 2021)

- Professor Philip Broadbridge (Chair) Emeritus Professor, La Trobe University
- **Professor Lesley Ward** University of South Australia
- Professor Darren Crowdy Imperial College London
- Professor Ezra Getzler
 Northwestern University
- **Professor Mary Myerscough** The University of Sydney
- Professor Terence Tao
 UCLA
- **Professor Andrew Barbour** The University of Melbourne

Research Committee (from May 2021)

- **Professor Stephan Tillmann (Chair)** The University of Sydney
- Professor Phil Broadbridge (Deputy Chair) La Trobe University
- Professor Tim Marchant (AMSI Director, ex officio) Australian Mathematical Sciences Institute
- Angela Coughlin (AMSI Research & Higher Education Program Manager, ex officio) Australian Mathematical Sciences Institute
- Professor Stephen Davis (ACE Network Standing Committee Chair, ex officio) RMIT University
- Associate Professor John Bamberg The University of Western Australia

- Professor Ole Warnaar University of Queensland
- Professor Elizabeth Mansfield Emeritus Professor, University of Kent
- Professor Tim Marchant (AMSI Director, ex officio) Australian Mathematical Sciences Institute
- Angela Coughlin (AMSI Research & Higher Education Program Manager, ex officio) Australian Mathematical Sciences Institute
- Francesca Hoban Ryan (Secretary) Australian Mathematical Sciences Institute
- Professor Linda Cummings New Jersey Institute of Technology
- Professor Yasuhide Fukumoto Kyushu University
- Dr Ezra Getzler
 Northwestern University
- Dr Ramiro Lafuente The University of Queensland
- **Professor Mary Myerscough** The University of Sydney
- **Professor Aidan Sims** The University of Wollongong
- **Professor Scott Sisson** The University of New South Wales
- Professor Terry Tao UCLA; Clay Mathematics Institute
- **Professor Lesley Ward** University of South Australia

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