Turing Gateway to Mathematics

Annual Report 2017-2018

UNIVERSITY OF CAMBRIDGE

Isaac Newton Institute for Mathematical Sciences

Mission Statement

"The Turing Gateway to Mathematics (TGM) acts as a vehicle for knowledge exchange between the mathematical sciences and potential users of mathematics, including industry, government, business and other academic disciplines, both in the UK and internationally. It does this by facilitating interactions and activities such as programmes of work, research and training events, as well as bespoke projects. The TGM aims to widen access to mathematics generally, to shorten pathways to impacts for academic research, and to support education and training in areas where mathematical skills are needed".

What makes TGM different?

The Turing Gateway to Mathematics is a knowledge intermediary for the mathematical sciences. Supported by the Isaac Newton Institute for Mathematical Sciences and the University of Cambridge, the TGM reaches out to and engages with the users of mathematics – in industry, business, public sector and other scientific disciplines. With extensive access to multiple communities across the UK and globally, the TGM can respond in an agile and flexible manner. The TGM works as a delivery partner to facilitate the exchange, translation and dissemination of knowledge. Using effective communications and proven methodologies, the TGM develops and runs activities such as workshops and meetings, bringing people and organisations together in order to share knowledge and stimulate further research and collaboration.

Contents

Foreword

The Turing Gateway to Mathematics (TGM) is the impact initiative of the Isaac Newton Institute for Mathematical Sciences (INI) based at the University of Cambridge.

The TGM was established in 2013 and acts as a knowledge intermediary for the mathematical sciences in the UK. It aims to extend the reach and highlight the importance of mathematics to all potential users such as other academic disciplines, as well as those in business/industry and the public sector. User engagement is therefore a key focus, helping to understand the community and end-users in order to collaborate effectively.

The TGM delivers a range of activities, such as research scoping workshops and knowledge dissemination events across a number of different themes and sectors including biology and healthcare systems, environment and energy, financial risk, security sectors, Big Data and public policy.

As in previous years, a number of programmes of work were delivered during this report period, including collaborations with the *EPSRC Centre for Mathematical Imaging in Healthcare (CMIH)*, the *Cantab Capital Institute for the Mathematics of Information (CCIMI)* and Innovate UK's *Knowledge Transfer Network (KTN)*.

Following the successful inaugural Edwards Symposium, the TGM delivered a second workshop in September 2017, working with partners from across the University of Cambridge and the EPSRC Centre for Doctoral Training in Soft Matter and Functional Interfaces at Durham. *Challenges and Opportunities in Soft Matter* again highlighted the latest developments in soft matter science and celebrated the life and work of Sir Sam Edwards, who was a pivotal figure in the area. Funding from Unilever has ensured that the series can be delivered until 2020, with each year having a different scientific focus.

User engagement activities for the *EPSRC Centre for Mathematical Imaging in Healthcare* and the *Cantab Capital Institute for the Mathematics of Information* have continued. Engagement events for industry were delivered, which have brought those working on specific streams of research together with industrial stakeholders who have been able to apply this research to real world issues. Academic research was also promoted – highlighting the research taking place with associated challenges and exploring potential collaborative opportunities.

New Scientist Live is a festival of ideas and discovery, showcasing the biggest, best and most provocative science. In September 2017, as the lead partner, the TGM shared an exhibition space under the over-arching theme of "Mathematics in the Real World". This helped partners to engage with visitors by solving some fun mathematical problems and exploring the value of mathematics, particularly to children of school age. It was important to have a maths presence at this science show, to help promote maths outreach.

The TGM has maintained its delivery of Open for Business/knowledge exchange events that are linked to the Research Programmes being held at INI. These are specifically designed to bring together industrial, commercial and governmental organisations with mathematical scientists. They are usually run as part of a Research Programme week or as a stand-alone day and help to extend the reach of those academics who are at INI for an extended period of research activity.

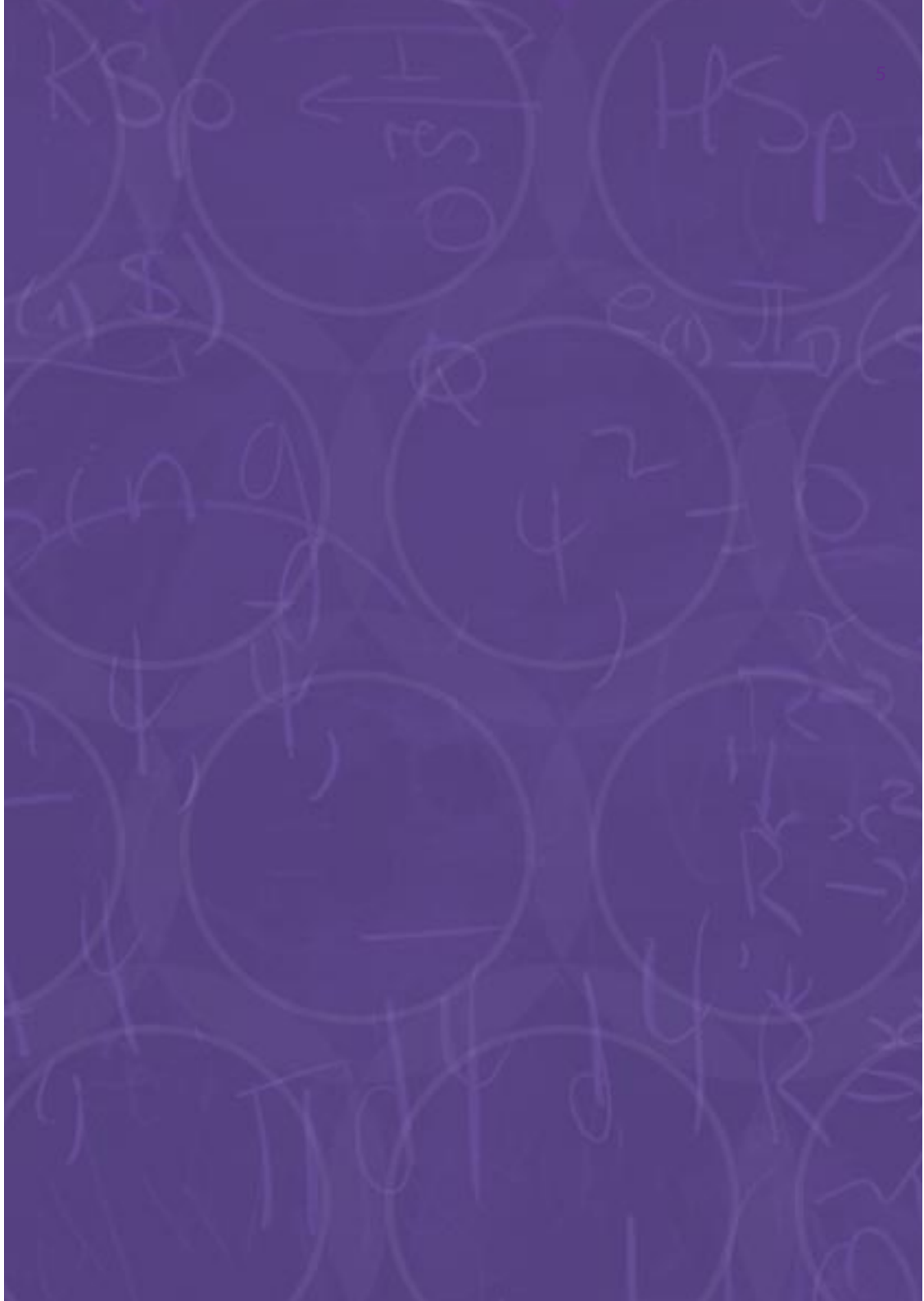
Foreword

The TGM continued to contribute to the review into Knowledge Exchange in the Mathematical Sciences, which published key recommendations in *The Era of Mathematics** at an official launch at the House of Lords in April 2018. This explored the critical role of mathematical sciences to the UK's increasingly innovative economy, highlighting their wide-ranging social and economic impact and making nine principal recommendations about how to ensure the UK becomes a world leader in mathematical science knowledge exchange. The review, which was led by Professor Philip Bond, aimed to address key questions around knowledge exchange in mathematics including incentives; mechanisms and enablers; and resourcing.

Through its engagement activity, the TGM has continued to extend its reach across different sectors. Delegates who attend TGM events are ensured greater opportunities for interaction between those in industry, the public sector and academia, often for individuals who have not worked together before. As in previous years, most activities have been delivered in partnership with other organisations, as detailed above, which has ensured further collaborative opportunities with new connections made across a breadth of sectors and subjects.

The increased scale of activity of the TGM is such that it needs to reinforce its identity as both an integral part of the Isaac Newton Institute and as a national facility for knowledge exchange for mathematical sciences in the UK. There is the additional need to avoid confusion with other organisations and it has therefore been decided to rebrand TGM as the Newton Gateway to Mathematics from January 2019.

**https://epsrc.ukri.org/newsevents/pubs/era-of-maths/*



Governance

The **TGM Advisory Board** has Members from industry and public bodies to help advise on strategic matters and on the overall development of the TGM. The Board meets twice a year in Cambridge.

Membership (in 2017):

Name	Organisation
Matt Butchers	Knowledge Transfer Network
Alan Champneys	Representative of Programmes Committee
Nick Easton	BAE Systems Applied Intelligence
Dougal Goodman	The Foundation for Science & Technology
Peter Grindrod	University of Oxford
Graham Keniston-Cooper	Investor and Entrepreneur
Peter Landrock (Chair)	Cryptomathic
Natasa Milic-Frayling	University of Nottingham & Intact Digital Ltd.
Richard Pinch	Institute of Mathematics and its Applications
Sir Bernard Silverman	Freelance Research & Consultancy
Sian Thomas	Food Standards Agency

The **TGM Programmes Committee** provides input and guidance on specific scientific or research matters related to TGM activities. The Committee Members are all academics and operate largely in a virtual way and are responsive to ad-hoc questions and requests for guidance from the TGM. The Chair of the TGM Programmes Committee is invited to attend TGM Advisory Board meetings. Members of the Programmes Committee are invited to meet with the Advisory Board every 12 months to ensure they have opportunity to input more strategically to the range and nature of TGM activities.

Membership:

Name	Organisation
Peter Challenor	University of Exeter
Alan Champneys (Chair)	University of Bristol
Jacek Gondzio	University of Edinburgh
Des Higham	University of Strathclyde
Jane Hutton	University of Warwick
Arieh Iserles	University of Cambridge
Robert Leese	Smith Institute
Nigel Smart	University of Bristol
Adrian Weller	University of Cambridge

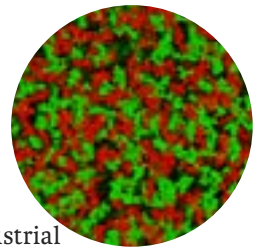
Staff and Management

The **TGM Manager** has overall responsibility for managing the TGM and for developing contacts with non-mathematical academics, with industry and business. This role is pivotal in identifying potential research opportunities of mutual benefit to mathematicians and industry.

The **Knowledge Exchange Coordinator** supports diversification of the TGM, coordinates events and marketing activity with industry and businesses, and leads some specific programmes of work, including user engagement on behalf of TGM Partners.

The **Events and Marketing Coordinator** provides administrative support to TGM events and marketing activities, as well as inputting to financial administration.

Activities from August 2017 - July 2018

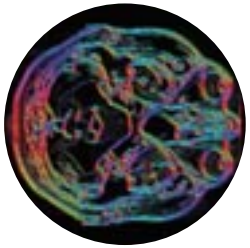


2nd Edwards Symposium - Challenges and Opportunities in Soft Matter

6 - 8 Sep 2017

This three day workshop followed a successful inaugural event in September 2016, and highlighted the latest developments in soft matter science with a particular (but not exclusive) emphasis on theoretical and mathematical models, and on how these models can inform industrial processes, materials, and design. It included opportunities for industrial participants to identify challenging questions that can stimulate future academic work and collaboration. Leading academic speakers conveyed their latest scientific work, in a forum intended to foster collaborative and interdisciplinary discussions across the industry/academia boundary.

The workshop was split into sessions discussing topics including New Functional Materials, Ionic Effects in Soft and Colloidal Materials, Soft Biomatter and Soft Matter under Flow. A number of challenges from industry were presented, as well as an “elevator pitch” session from early career researchers who gave overviews of their research, which was supplemented by posters displayed throughout the workshop. The event was delivered in partnership with the University of Cambridge, Unilever, Durham Soft Matter Centre, with additional financial support from the Royal Society of Chemistry.



IMA Conference on Inverse Problems – from Theory to Application

19 - 21 Sep 2017

This conference from the Institute of Mathematics and its Applications (IMA) brought together mathematicians and statisticians, working on theoretical and numerical aspects of inverse problems, and engineers, physicists and other scientists, working on challenging inverse problem applications. It was attended by industrial representatives, doctoral students, early career and established academics who worked in this field.

The topics that were covered included imaging regularisation theory, statistical inverse problems, sampling, data assimilation and inverse problem applications.

New Scientist Live

28 Sep – 1 Oct 2017

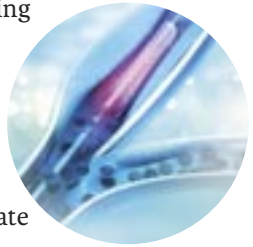
New Scientist Live is a festival of ideas and discovery, showcasing the biggest, best and most provocative science. In 2017, the TGM shared an exhibition space in partnership with INI, the Industrial Mathematics Knowledge Transfer Network (KTN), the Institute of Mathematics and its Applications (IMA), the International Centre for Mathematical Sciences (ICMS) and the Operational Research Society (ORS).

Under the over-arching theme of "Mathematics in the Real World", the TGM and fellow exhibitors enjoyed an excellent opportunity for spreading awareness, sharing the opportunities that mathematics can provide for young people, and explaining the joys and challenges inherent within the subject in general. Over 30,000 visitors attended the show and dressed in bespoke t-shirts bearing d'Alembert's famous wave equation and the strapline "Maths Makes Waves", the TGM and partners spoke with a great many visitors over the 4 days.

The stand was rarely short of activity or interested crowds, who took away a wealth of literature, entered a six-part quiz and prize giveaway, and spent time constructing brightly coloured puzzle cubes. A number of the event's major speakers visited the stand, helping to further engage interested parents, teachers, students, children and other lovers of mathematics.

Developments in Healthcare Imaging – Connecting with Industry

18 Oct 2017

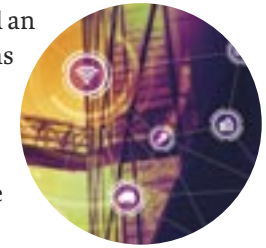


The EPSRC Centre for Mathematical Imaging in Healthcare (CMIH) held its second annual academic conference, delivered by the TGM. This one day conference brought together those academics working on advances in imaging technology with researchers who investigate new image analysis methods, to help address current challenges.

The event showcased the research being carried out at the Centre and presented an opportunity to hear in detail about some of the current projects, other industry challenges and explore new potential collaborations. It featured presentations from CMIH Industry Partners, including GlaxoSmithKline and Toshiba Medical Visualization Systems. A number of industry challenges and potential new partnerships were highlighted in an "elevator pitch" session.

CCIMI Connecting with Industry Workshop

22 Nov 2017

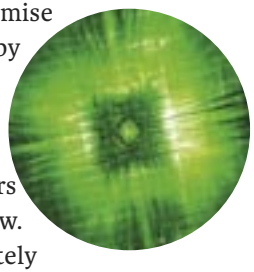


This industrial engagement day provided an update on the research and collaborations taking place at the Cantab Capital Institute for the Mathematics of Information (CCIMI). Associated industrial engagement talks explored the big questions in data science where mathematics is most suited to help provide answers.

This event included talks where academics highlighted their research related to data science, as well as talks from industry which discussed activity across a variety of sectors. Google DeepMind Technologies Limited spoke about challenges related to the power grid, Unilever highlighted the role of mathematics in their ice cream research and Tesco spoke about the use of data in their decision making. The event closed with a facilitated question and answers session that highlighted some of the key points from the day as well as additional challenges faced by those in attendance.

Algorithms and Software for Quantum Computers

14 - 15 March 2018



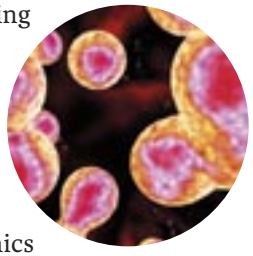
Next generation (Quantum) computers promise to speed up some mathematical processes by orders of magnitude, but new algorithms and software will need to be developed to exploit this power. Although general-purpose quantum computers are some years away, work should start on the software now. As quantum machines operate in a completely different way to conventional computers, code development requires entirely new thinking.

This workshop was delivered in collaboration with the Knowledge Transfer Network (KTN) and aimed to help address the need to build UK capacity in the development of quantum computer algorithms and software for industry. It brought together real-world problem owners (from telecoms, environment, finance, manufacturing and materials), with mathematicians, algorithm experts, and academic quantum computer hardware experts to explain what code developers need to know to create software.

Participants were spilt into break out groups, where they discussed the industry challenges that had been presented and explored how these might be tackled currently and then reflected on how quantum computation might be of benefit and how this might be implemented.

Developments in Healthcare Imaging – Connecting with Academia

2 May 2018



The EPSRC Centre for Mathematical Imaging in Healthcare (CMIH) held its second annual academic conference, which was delivered in partnership with the Liverpool Centre for Mathematical Sciences in Healthcare (LCMH).

This event brought together those academics working on advances in imaging technology with researchers who investigate new image analysis methods, to help address current challenges. It focused on the academic interactions taking place in the field of medical imaging and especially across the five EPSRC Centres for Mathematical Sciences in Healthcare.

The Programme featured talks that highlighted the role that deep learning can play alongside fundamental mathematical and statistical techniques used in medical imaging, including image analysis and modelling. There was a session for short “elevator pitches” where researchers presented snapshots of their work, which were further explored during a poster exhibition.

The Mathematics of Machine Learning – A Research Conference of the Cantab Capital Institute for the Mathematics of Information

24 May 2018

The Cantab Capital Institute for the Mathematics of Information (CCIMI) held its second annual academic conference, which focused on the academic interactions taking place related to the mathematics of machine learning. It brought together academics working to advance data science and provided an update on the research and collaborations taking place at CCIMI.

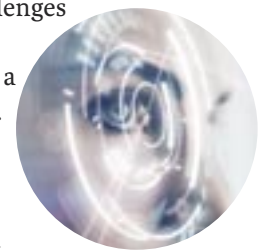
The event explored complexity theory, signal processing, partial differential equations, and deep neural networks and included presentations from academics based at the Centre as well as partners in industry including Facebook and Cantab Capital Partners LLP.

Knowledge Exchange Activities for INI Research Programmes

The Isaac Newton Institute sponsors Knowledge Exchange activity, referred to as 'Open for Business' (OfB) knowledge exchange events, as a part of its continuing objective of bringing academic researchers involved with its research programmes into contact with industrial, commercial and government organisations and individuals.

These activities, which are delivered by the TGM, provide opportunities for cross-fertilisation between the activities of users from industry and the public sector, and the research focus of the Institute. OfB events are structured to enable the formation of new public-private partnerships, collaborative research and to assist in identifying the common challenges that have greatest potential for research, knowledge exchange, public policy and commercial impact.

Thirteen OfB events were hosted during the reporting year, including three satellite events which took place in partnership with Schlumberger during the Imaging and Vision Research Programme and two that were held at the British Antarctic Survey, as part of the Sea Ice Phenomena Programme.

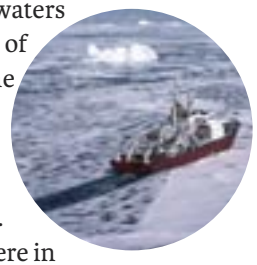


Computational Challenges in Image Processing

5 September 2017

This afternoon event highlighted the challenges and potential novel solutions for computational image processing, which is a dynamic and fast moving field of research. Talks and discussion emphasised possible new mathematical models which are needed to address the ever growing challenges in applications and technology, generating new demands that cannot be met by existing mathematical concepts and algorithms.

This event formed part of the Variational Methods and Effective Algorithms for Imaging and Vision Research Programme and was specifically designed to bring together industrial, commercial and government organisations with the mathematical scientists taking part in the INI Programme.



Mathematics of Sea Ice Phenomena

18 Sep 2017, Satellite Workshop

Sea ice forms by freezing of ocean surface waters and provides a partial barrier to exchanges of heat, moisture and momentum between the atmosphere and ocean. Sea ice formation releases dense brine and sea ice melting produces a fresh surface layer, so that it affects buoyancy-driven ocean circulation. Sea ice is an important part of the cryosphere in the Southern Ocean; both in its own right, and as it affects atmosphere-ocean exchanges and feedbacks, and global oceanic circulation.

The British Antarctic Survey (BAS) invited participants of the INI Programme on Mathematics of Sea Ice Phenomena to attend a day of talks, posters and discussions on topics relevant to sea ice in the Southern Ocean. Particular topics that were covered were diagnosis of, and the causes and mechanisms driving trends and variability of sea ice; ranging from the deep past using ice core proxies, the current satellite era and climate model projections of sea ice in the future.

Knowledge Exchange Activities for INI Research Programmes

Future Developments in Climate Sea Ice Modelling

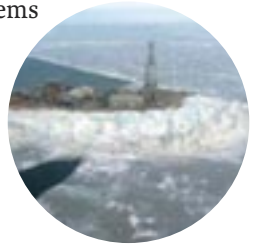
25 Sep 2017

This event specifically addressed climate model representation of sea ice and the fundamental and applied issues in mathematical modelling of sea ice. It sought to identify future priorities for climate sea ice model development and took place as part of the Mathematics of Sea Ice Phenomena Research Programme.

Observations, theory and numerical modelling strongly indicate a substantial alteration of the Earth's climate with global average warming in the coming decades. Our understanding of current and future climate is substantially derived from climate models. This workshop enabled the presentation and discussion of different views and modelling approaches, as well as issues relevant to adequate simulation of sea ice from the perspective of the mathematical modeller.

Sea Ice – Structure Interaction

13 Nov 2017, Satellite Workshop



Current knowledge of sea ice mechanics stems largely from measurements performed in a multi-year ice setting, rather than the first-year sea-ice dominated Arctic of recent years. Even less information is available regarding sea ice mechanics in the Antarctic.

The British Antarctic Survey (BAS) invited participants of the INI Programme on Mathematics of Sea Ice Phenomena and industrial partners to attend a day of talks and discussions on topics relevant to sea ice interaction with structures, such as ships and fixed platforms. Particular topics covered included an overview of sea ice changes in the Arctic and Antarctic, advances in technology for ice mechanics, remote sensing for ship routing, and ice forces on ship and structures. It was delivered in partnership with BAS and the EU project ICE-ARC.

Form and Deformation in Art, Toys and Games

1 December 2017

New mathematical approaches, such as shape analysis and computational anatomy, can be applied to growth and form in a variety of complex living and inanimate systems. Mathematical tools have the capacity to revolutionise a whole range of interdisciplinary problems, from image analysis to medical diagnosis, from study of paintings to mechanical toys and games.

This day workshop took place as part of the INI Programme on Growth Form and Self-organisation and brought together industrial and academic experts from a diverse set of backgrounds including mathematics, physics, and biology, with those looking at animation, art, image processing, computer vision and visual art. The talks were wide ranging and included reflections on the role of growth and form; a talk about the digital restoration of manuscripts and paintings; as well as mathematical approaches to toys; and board games as a model of mathematics.

Knowledge Exchange Activities for INI Research Programmes

Mathematics of Imaging and Vision

6 December 2017

Mathematical imaging, image processing and computer vision are fundamental for gaining information across numerous areas. The rapid development of new imaging hardware, the advance in medical imaging, the advent of multi-sensor data fusion and multimodal imaging, as well as the advances in computer vision have stimulated research leading to highly sophisticated and rigorous mathematical models and theories.

This event, which was part of the INI Programme on Variational Methods and Effective Algorithms for Imaging and Vision, explored the challenges as well as the new horizons in theory, models, techniques and applications of mathematical imaging and vision. A wide variety of talks were given, including one that explored seismic imaging, another on motion fields and animation, followed by a talk on digital features classification of Roman pottery.

Variational Methods and Effective Algorithms for Imaging and Vision Research Programme

Sep – Dec 2017, Satellite Workshops

Three highly successful satellite workshops were run as part of this INI Programme and in partnership with Schlumberger. Because variational methods play a crucial role at all stages of their research and operation, Schlumberger partnered with INI and the TGM to bring academics and industrial researchers together under this series of workshops to explore the potential of emerging methods in large-scale optimisation, optimal transport and machine learning for the oil and gas industry.

These took place on:

- 28 September 2017 - Large-Scale Optimisation Algorithms and Applications
- 27 October 2017 - Application of Optimal Transport
- 7 December 2017 - Machine Learning for Acquisition Systems

Taming Uncertainty in Mathematical Models used in the Private and Public Sectors

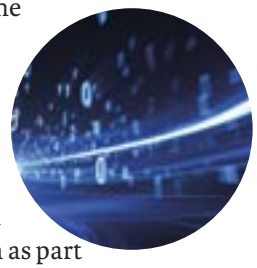
1 February 2018

This was run as part of the INI Programme on Uncertainty Quantification for Complex Systems: Theory and Methodologies and concentrated on how to handle uncertainty arising from the use of mathematical models. The event took place towards the start of the INI Programme, so provided the opportunity for Programme participants to engage with delegates from industry and the public sector, and also to reflect on some of the key outputs from the Programme so far.

The introductory talks highlighted the key issues raised from the Programme and summarised the outputs from an earlier workshop on key Uncertainty Quantification methodologies. Three end-user sessions were given by the engineering, financial and healthcare sectors, where speakers described how uncertainty is managed at present in their organisations and the challenges they face.

Big Data and the Role of Statistical Scalability

28 February 2018



Because interest in Big Data is so intense, the field is developing very rapidly. This event facilitated the dissemination of state-of-the-art statistical research and highlighted a number of key future research directions. It was part of the INI Programme on Statistical Scalability and sought to extend the reach of the research being undertaken as part of the Programme.

The academic talks illustrated the latest advances in statistical scalability research and were followed by three end-user sessions which featured speakers from the health, energy and communications sectors. Speakers described the challenges of managing Big Data scaling in their organisations and academic participants were able to engage with stakeholders from a variety of sectors and identify any opportunities for collaborative working.

Knowledge Exchange Activities for INI Research Programmes

Uncertainty Quantification for Complex Systems – Development in Theory & Methodologies

15 June 2018

The workshop was part of the INI Programme on Uncertainty Quantification for Complex Systems: Theory and Methodologies and took place towards the end of the Programme. It focused on disseminating the key research outputs and highlighted some potential outcomes that could be taken forward.

A short introductory talk provided an overview of the Uncertainty Quantification Programme, which was followed by a number of academic talks that reviewed progress made over the duration of the Programme, in relation to some of the key research themes. These included Surrogate Modelling, Multi-level and Multi-fidelity Methods, Dimension Reduction Strategies, Inverse Problems and Design. Two end-user talks were given by the environmental and energy infrastructure sectors.

Statistical Scalability for Streaming Data

21 June 2018

Challenges in streaming data arise in numerous fields – consumer products, financial transactions, computer network traffic, transport and communications networks and energy systems are just some of them. As with statistical scaling generally, this requires an integrated approach. The problems faced can often be generic and so have relevance to numerous other sectors and end-user applications. Additionally, real applications of streaming data involve specialist streaming infrastructure, hardware and software.

This event harnessed expertise from the research that was undertaken as part of the INI Statistical Scalability Research Programme. It highlighted experience, expertise and challenges from a number of key stakeholders from areas including exploration, geology, energy, the environment and communications.

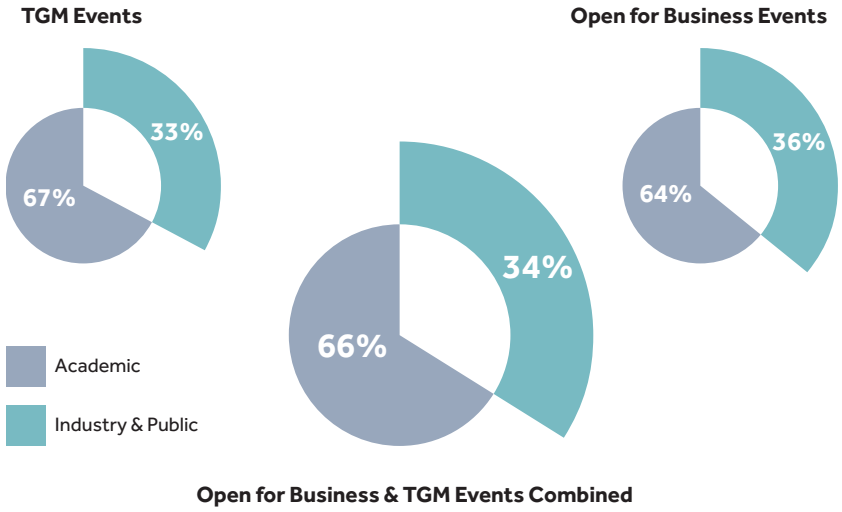
Participation

The TGM remains successful in facilitating links between industry, academia and the public sector, ensuring participation from a significant number of researchers in disciplines other than the mathematical sciences.

The TGM has continued to engage across a wide range of sectors, with 1054 delegates attending the 19 events that the TGM coordinated between August 2017 and July 2018. The diversity of sectors has expanded and includes aerospace, analytics, biotechnology, communication, data science, defence, energy, engineering, environment, finance, healthcare, information technology, security, space, technology and transport.

A number of Open for Business satellite events took place related to the Mathematics of Sea Ice Phenomena and Variational Methods and Effective Algorithms for Imaging and Vision Programmes. Although industrial partners were invited, these were primarily aimed at the academic participants of the two Programmes, so this has altered the participation rates, as compared to previous years.

Attendance at TGM delivered events, divided by affiliation



Accounts for August 2017 to July 2018

	Actual 2017 - 2018 £,000	Actual 2016 - 2017 £,000
Income		
University of Cambridge Funding [1]	55	55
"Open for Business" Events Income [2]	20	-
TGM Events Income [3]	41	20
Corporate Partnership Scheme	46	20
Isaac Newton Institute[4]	63	-
Registration Fees [5]	-	38
Total Income	**225**	**133**
Expenditure		
Staff Costs	145	138
"Open for Business" Events Expenditure	32	-
TGM Events Expenditure	47	48
Overheads & Administration	9	5
Total Expenditure	**233**	**191**
Total Surplus /(Deficit)	**(8)**	**(59)**

Note 1
University of Cambridge Higher Education Innovation funding

Note 2

OFB Income - sponsorship	10,485
OFB Income - registration fees	9,336
	19,821

Note 3

Event Income - sponsorship	31,041
Event Income - registration fees	9,929
	40,970

Note 4
INI contribution to staff costs

Note 5
Registration fees are now shown above, see notes 2 and 3

Grants & Funding

The TGM is an integral component of the Isaac Newton Institute and therefore support is provided by INI to enable TGM to continue to develop its current service to the community.

The University of Cambridge has contributed to the funding of the TGM through the Higher Education Innovation Funding scheme, which has partially covered administrative costs but not expenses for specific TGM activities. The latter are funded through partnerships with stakeholders including from industry and the public sector, philanthropy and participant registration fees.

Partnership

The TGM aims to widen access to mathematics and continues to build relationships with organisations from industry and the public sector, who seek deeper engagement with the mathematical sciences community. Companies and organisations can partner with the TGM either by working on specific projects or programmes of work, or via one-off or annual donations to help underwrite direct costs and support underrepresented groups and early stage researchers. Through the Partnership Scheme, an organisation can gain targeted contact with experts from mathematics and across the multiple disciplines it underpins, benefit from enhanced opportunities of access to, and development of, ground-breaking research and meet with other relevant stakeholders. This is an effective way to increase an interaction with other communities, such as Government, business, industry and technology, and presents opportunities for networking, knowledge exchange and collaboration.

Organisations can also be specifically associated with a Thematic Programme of Work, which are designed to stimulate mathematical science knowledge exchange. These aim to involve relevant stakeholder communities, and activities include workshops, consultations and projects.

Engaging with Users of Mathematics

TGM activities have expanded, with continued emphasis on partnership and collaboration with other organisations, which is a more effective way of engaging with a wider group of stakeholders, helping to reduce duplication.

Since 2016, the TGM has been the user engagement partner for two initiatives to help enhance end-user engagement and interaction. These are the Cantab Capital Institute for the Mathematics of Information (CCIMI) and the EPSRC Centre for Mathematical Imaging in Healthcare (CMIH). As part of these collaborations, the TGM develops programmes of work, disseminates information and develops strategic relationships, to ensure effective translation of science to the user. This is helping partners to understand and gain consensus on the challenges that need to be overcome and facilitate other interdisciplinary collaborations to enrich the existing communities.

The TGM continues in the delivery of the Edwards Symposium Series working with the Edwards Centre for Soft Matter at Cambridge, the Durham Centre for Soft Matter and supported by Unilever. The Series is both a tribute to the life and work of Professor Sir Sam Edwards FRS, one of the great scientific minds of the 20th Century, and a recognition of the fast evolving and diverse nature of soft matter science.

Since early 2018, the TGM has been working on the development and delivery of a programme of work “Evidence Based Decisions for UK Landscapes" for the Natural Environment Research Council (NERC) and the Department for Environment, Food & Rural Affairs (Defra). This demonstrates the ability of the TGM to work closely and in partnership with funders and Government to effectively deliver mathematical sciences knowledge exchange and create impact.

Initially a two-day research scoping workshop was held in Cambridge, bringing together a diverse range of researchers and stakeholders from multiple disciplines to investigate new mathematical and statistical modelling techniques which can enable better evidence-based decisions to be made around UK landscapes. This workshop forms the first part of a range of activities, which has a focus on terrestrial land use (rural and urban), coastal and freshwater. As an integral part of NERC’s future strategy, this programme of work will potentially include a funding call and a one month Isaac Newton Institute Research Programme to be held in July 2019.

The TGM has also collaborated with other organisations including the Knowledge Transfer Network (KTN) and the Institute of Mathematics and its Applications (IMA) to deliver events over the reporting year and welcomes approaches from other bodies who want to explore potential collaborations.

Future Development

The TGM aims to respond in a speedy and focused way to new ideas and approaches, but recognises the need for a targeted and continuous approach to the delivery of longer term knowledge exchange activities in the mathematical sciences. The series of Thematic Knowledge Exchange Programmes are designed to stimulate and support research activities and include workshops, consultations and project meetings. These include Mathematics for Financial Services, Mathematics for Biology and Healthcare Systems, Mathematics for the Space and Security Sectors, Mathematics for the Environment and Energy, and Mathematics of Big Data.

The TGM will be rebranded as the Newton Gateway to Mathematics from January 2019.

Activity from September - December 2018

With its aspiration of playing a key national role in mathematical sciences knowledge exchange, the TGM has developed the following activities in collaboration with stakeholders, funders and other academic partners.

3rd Edwards Symposium - New Horizons in Soft Matter
(5 -7 September 2018)

Evidence Based Decisions for UK Landscapes
(16 – 18 September 2018)

Developments in Healthcare Imaging - Connecting with Industry
(17 October 2018)

Novel Computational Paradigms
(30 – 31 October 2018)

Artificial Intelligence and Machine Learning in Clinical Imaging Research: Progress and Promise
(6 November 2018)

Cantab Capital Institute for the Mathematics of Information – Connecting with Industry
(14 November 2018)

Understanding Multi-Modal Data for Social and Human Behaviour
(27 November 2018)