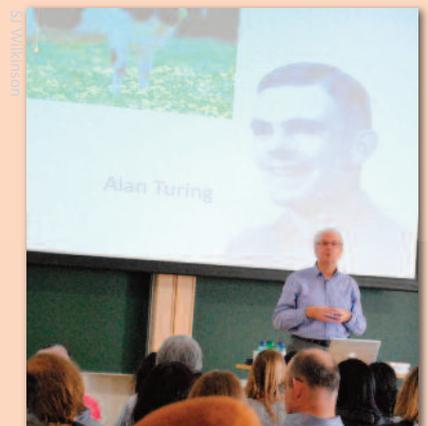


# Mathematical Patterns in Animal Markings

*Tigers have stripes, leopards have spots, and some cows have large irregular patches. How do these patterns in animal markings arise?*

This was one of the questions considered by Professor Ian Stewart from the University of Warwick during his talk at INI on 22 March. Speaking to a packed seminar room, Ian explained that about 60 years ago, Alan Turing showed his colleagues a drawing with irregular black-and-white patches, asking them whether they agreed that it looked like a cow. In 1952 Turing published a paper suggesting a chemical process to create animal markings, and a mathematical equation describing that process. These 'Turing equations' lead to patterns that are remarkably similar to those found on many animals, including complex stripes on fish and intricate patterns on seashells. The talk was part of the Cambridge Science Festival.

If you missed the talk, it is available to download at [sms.cam.ac.uk/media/1685333](http://sms.cam.ac.uk/media/1685333)



## Simons Foundation supports INI with new Fellowship scheme

The Institute is delighted to announce new funding from the Simons Foundation. Beginning in March 2015, INI will receive \$150k per annum for four years to provide 35 Fellowships for visiting scholars. These Fellowships will be available to researchers in any branch of the mathematical sciences and will support visits to INI and participation in a wide range of scientific programmes.

The Simons Foundation is a private foundation based in New York City, and was incorporated in 1994 by Jim and Marilyn Simons. The Simons Foundation's mission is to advance the frontiers of research in mathematics and the basic sciences by sponsoring a range of programmes that aim to promote a deeper understanding of our world.

### In this issue...

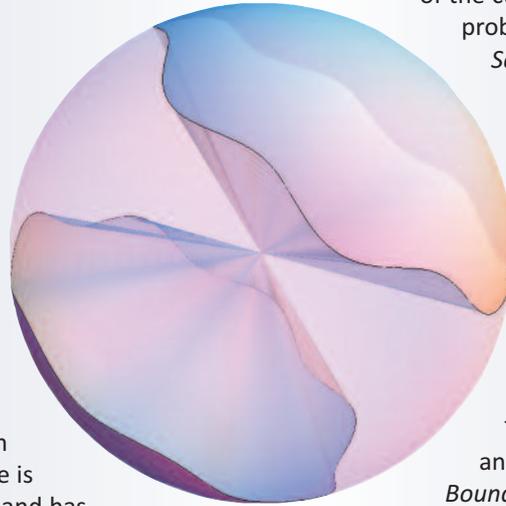
- Current programmes
- Social anthropology at INI
- Donation of sculptures
- Honorary Fellowship news
- New administrative database project underway
- INI staff get creative!

# Current and recent scientific programmes

## Free Boundary Problems and Related Topics (Jan–Jul 2014)

Free boundary problems are considered to be one of the most important directions in the mainstream of the analysis of partial differential equations (PDEs), with an abundance of applications across the sciences and real world problems. In the last two decades, various new ideas, techniques, and methods have been developed and new important, challenging problems in physics, engineering, industry, finance, biology, and other areas have arisen. The area has a long tradition of international collaboration in the form of congresses, workshops and scientific programmes, dating from the late 1970's. This current programme is an important event in the field in 2014 and has attracted many leading mathematical scientists.

The programme began in January with a well attended *Introductory School* where some of the leading experts in the



field gave presentations on basic topics, as well as some of the current directions and challenging problems. In addition, there have been two *Satellite Meetings*: one in Oxford during February and one in Warwick during March. These meetings have allowed for a large body of updated information to be disseminated to scientists across the UK. The workshops have also facilitated many new contacts and collaborations with researchers in related fields, a very valuable asset in our interdisciplinary work.

The final part of the programme includes an *International Conference on Free Boundary Problems: Theory and Applications* which will bring together mathematical scientists with interests in the theory, numerics and applications of free boundary problems and discuss recent significant advances and current trends/directions in the field.

## Advanced Monte Carlo Methods for Complex Inference Problems (Apr–May 2014)

In recent years there has been an explosion of complex datasets in areas as diverse as Bioinformatics, Ecology, Epidemiology, Finance and Population genetics. In a wide variety of these applications, the stochastic models devised to realistically represent the data generating processes are very high dimensional and the only computationally feasible and accurate way to perform statistical inference is with Monte Carlo.

The focus of this programme is on recent innovations in the field of Monte Carlo methods for inference in complex and intractable statistical problems. This brings together researchers from a broad base, for the first time since 2009, to promote discussion and development of this important and rapidly advancing cross-disciplinary area. This programme has a workshop in the first week which will serve as a catalyst for the remaining 3 weeks of intensive research.

## Mathematical, Statistical and Computational Aspects of the New Science of Metagenomics (Mar–Apr 2014)



Metagenomics is the study of the genomes of communities of microorganisms. Such microbiomes are to be found within, around and upon plants, fungi and animals, on the land and in the sea, in both moderate and extreme environments. Higher organisms depend on microbiomes for their nutrition and defence. DNA can be sampled from microbiomes to study their composition, function and interaction with higher organisms.

This one-month programme was designed to bring together researchers from different disciplines who have an interest in, or who might in future benefit from, the new science of metagenomics. These fields include computer science, bioinformatics, statistics, mathematics, genomics, medicine, ecology, and soil science.

The first week of the programme comprised a workshop on: community profiling and comparative metagenomics; metagenomic sequence assembly; ecological modelling; microbial transcriptomics, proteomics and metabolomics; and bioinformatic tools and statistical methods for metagenomics. Ensuing discussions distilled new strands of metagenomic research, forging new multidisciplinary collaborations to take them forwards. An *Open for Business* event towards the end of the programme revealed a fascinating variety of industrial applications of metagenomic science.

Further details on all programmes can be found at [www.newton.ac.uk/programmes](http://www.newton.ac.uk/programmes)

## Honorary Fellowships

Honorary Fellowships have been awarded to two outstanding individuals who have made sustained contributions to the work of INI.

**Sir David Wallace**, Master of Churchill College, was awarded an Honorary Fellowship in recognition of his leadership of the Institute during his Directorship from 2006–2011 and also for his continued support of Institute activities through the Development Board.

**Professor Peter Landshoff's** Fellowship comes in recognition of exceptional service to INI in particular for taking a leading role in the creation of INI in 1992, serving two terms as Chair of the Management Committee and for long-standing support of INI and its activities.

## New admin system

INI is famous for the level of service its staff provide to visiting academics, enabling them to channel all their energies into their research. With over 1000 participants attending programmes and workshops each year (some staying for just a week and others staying for periods of up to 6 months, and often accompanied by their families), there is a huge administrative cost associated with achieving this level of service.

INI is therefore in the process of developing ISAAC, a new database that takes advantage of modern technologies. Via ISAAC's web interface, programme organisers, participants and other stakeholders will be able to efficiently exchange information with INI staff.

Organisers will be able to automatically generate customisable invitations to INI programmes and workshops and participants will be able to accept or decline request visit dates, and accommodation needs as well as being able to upload titles, abstracts, slides for seminars and preprints for publication amongst other things.

Central to the specification of ISAAC is the requirement to balance the automation of processes (thereby reducing or eliminating the need for staff to re-enter data) with a flexibility that enables INI to retain its "personal touch": the 80:20 approach.

## How do mathematicians collaborate with each other?



Deputy Director Christie Marr (l) discusses the project with Ursula Martin

INI is central to a new study that looks in detail at how mathematicians work together and the role of technology in supporting collaborative research. INI was selected for this study due to its unique role in the international mathematical ecosystem that brings together mathematicians and other scientists from around the world.

The project lead is Professor Ursula Martin CBE of the University of Oxford, who is a research mathematician and computer scientist. The project is part of a broader research programme led by Ursula, and supported by an EPSRC Senior Fellowship, with a number of

partners in academia and industry, with goals of understanding the roles of people and computers in the advance of mathematics, and investigating new technologies to accelerate progress.

Team member Lorenzo Lane has observed and interviewed participants on the *Mathematical, Statistical and Computational Aspects of the New Science of Metagenomics* programme and looked at how participants work with others, face-to-face and at a distance, to understand how and why collaboration takes place, and what technology, if any, is currently used to support collaboration in mathematical research and the deployment of mathematics. Participants on the programme commented that the very act of being observed by Lorenzo had such a positive impact on the science.

Phase 2 will take place in the second half of 2014, and will consist of the design, deployment and evaluation of possible technological interventions that may assist with collaborative working.

## Artwork makes a splash!

INI has added two new dynamic sculptures to its collection of mathematical artwork thanks to Onno Bokhove, a participant on the *Mathematics for the Fluid Earth* programme in 2013.

These attractive sculptures were conceived and created by Wout Zweers, Valerie Zwart and Onno Bokhove and were kindly donated to the Institute by the Stichting Free Flow Foundation.

To create the sculptures, a film was made of splashes in a wave channel at the University of Twente, and the individual stills were examined. Outlines from a chosen set of stills were then traced by hand before being modelled into three-dimensional pieces. In addition to these steel sculptures, models in foam, wood and perspex were also made as part of the project. It is hoped that this work will inspire future research in the areas of mathematics and fluid dynamics, as well as innovations in art and design.

The sculptures can be viewed during office hours in the INI library.



## Staff in the Spotlight



**Alex Poole**

### What is your job and how long have you worked at the Institute?

I'm the Business Systems Developer and I have worked at INI since November 2013; I'm here until August on a fixed term contract.

### What does your job involve?

A lot goes on behind the scenes here at the Institute to make sure everyone's visit goes as smoothly as possible. Be it accommodation, offices or lecture theatres, every resource at the Institute must be booked in advance to ensure there are no clashes. Traditionally this happened through a combination of manual and

IT-based systems that have been adapted over 20 years. My job is to create a brand new IT system to free colleagues from mundane tasks and allow them to focus on offering the world-class Customer Service for which the Institute is renowned.

### What do you enjoy most about your job?

I love the combination of consultancy and technical requirements that my job entails. In a world where programmers are increasingly commoditised, this is becoming rare. I have to tease out from colleagues how they do their job, and turn that into a specification for an IT system, which of course I also have to build. I'm constantly getting to the bottom of processes and finding the balance between requirements and constraints, and that makes every day an interesting challenge. The abundance of biscuits and fresh thick black coffee is also rather pleasant.

### What have been the highlights of your job so far?

My colleagues. I'm deeply grateful to be working with so many intelligent yet unassuming people. Fun people too! This hasn't always been the case in other jobs I've done in the past.

### Do you have any hobbies?

Playing music was my first love and I still play keyboards most weekends in local ska, reggae and soul bands. I've been sober at too many weddings...

### What is your favourite book?

I devoured *The Time Traveller's Wife* by Audrey Niffenegger in not many sessions, and it gave my manly tear ducts a proper workout. There are dozens though.

### What is your greatest luxury in life?

Peace and quiet. I have two young boys. A good steak tartare with a decent claret would come a very close second though.

### Who would be your ideal dinner party guests?

Brendan Eich - the inventor of javascript who's been in the news recently. I'd love to hear him have a stab at reconciling his conservative religious and libertarian viewpoints. George Orwell - I'd like to ask him how it feels to be so prescient. Possibly George Osborne, for the opposite reason, but best I steer clear of politics! Miles Davis and Bob Marley - just because I wish I had had the opportunity to hear them.

## Upcoming events

**20 May 2014: 13:00–14:00**

As part of INI Correspondent's Day, INI is hosting a talk by **Professor John Barrow** entitled *Maths is Everywhere*. The event is not open to the public but those that are interested can watch the talk live at [www.newton.ac.uk/webseminars/live1/](http://www.newton.ac.uk/webseminars/live1/)

**27 May 2014: 16:00–17:00**

**Rothschild Seminar:** The Rothschild Distinguished Visiting Fellow for the programme *Free Boundary Problems and Related Topics*, **Professor Luis Caffarelli**, will give a lecture entitled *What makes a Surface "Optimal"?* which will be suitable for a general scientific audience. All are welcome to attend.

## INI staff get creative!

On 4 March INI staff took part in an away day at Barrington Hall near Cambridge. The day involved a number of team building activities including painting a group masterpiece. The staff were split into 4 teams and each team had to recreate a section of a painting by Picasso. Each section was divided into 4 canvases (making 16 sections in total) and the teams had to earn the paint to complete the task by correctly completing a variety of quizzes and tests. The staff all enjoyed the day and the resulting 'masterpiece' will be displayed in the Institute.

