Bulletin18

Michelmas 2020

OXFORD CENTRE FOR INDUSTRIAL & APPLIED MATHEMATICS
University of Oxford
Mathematical Institute, Andrew Wiles Building

Welcome PDRA's

Evangelia Antonopoulou

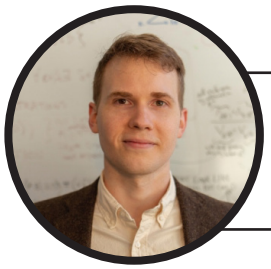
EVA is working on the development of new mathematical models for cell therapies for liver disease, where novel multi-scale and -physics mathematical models will be developed incorporating driving processes on different spatial and temporal scales. The results of this work will enable optimisation of the cell therapy to ensure the safe delivery and successful function of cells at the injury site and therefore facilitate successful clinical translation of next-generation cell therapies for liver disease.

Agnese Barbensi

AGNESE has been awarded the prestiguous Hooke Research Fellowship, after she passed her VIVA in May. Agnese is interested in the applications of low-dimensional topology and knot theory to biology. In particular, her research area involves topics such as DNA topology and entanglement of biopolymers.

Gillian Grindstaff

GILLIAN joins us as a PDRA in the Centre for Topological Data Analysis (TDA) after studying Mathematics at Pomona (undergraduate) and UT Austin (DPhil). Her research interests include geometric data analysis, phylogenetic moduli spaces and statistics, persistent homology, applications to geographical data.



Gregory Henselman-Petrusek

GREG joins the Centre for Topological Data Analysis (TDA) from Princeton. His research interests in computation (performant algorithms, combinatorial geometry, expressibility), homological algebra (exact, projective, and RE categories), and cognition (machine learning, brain image analysis, cognitive control). His teaching interests are in universal design and adaptive methods for attentional challenges

Renee Hoekzema

RENEE is a PDRA in the Centre for Topological Data Analyais (TDA)

Kris Kiradjiev

KRIS is now a PDRA modelling filtration of waste gas produced from factories. In particular, he aims to predict and optimise the operation of such filters. using mathematical techniques, such as asymptotic analysis and homogenisation, to develop models that are computationally cheap to solve but capture the underlying complex structure of the problem. His project is a collaboration with W. L. Gore and Associates, Inc. (famous for GORE-Tex), who design specific filters for sulphur dioxide.

Zachary Willmot

ZACH is using viscoelastic and stochastic modelling methods to study various aspects of the centriole division process.

New DPhils

SOPHIE ABRAHAMS research will focus on the lasers used in the treatment of kidney stones, in particular studying the energy transfers between the laser, stone and surrounding fluid. Sophie's supervisors are Profs. Sarah Waters and Derek Moulton

CHRISTOFFER ALEXANDERSON has just completed an integrated master's degree in biotechnology. His thesis focused on the mathematical modeling of cell metabolism, as well as its computational implementation. His DPhil, supervised by Prof. Alain Goriely will be centered on the modeling of the progression of brain diseases such as Alzheimer's and Parkinson's.

GEORGE BOOTH is a SABS DTC student at Linacre College funded by EPSRC working with Prof. Sarah Waters and Dr. Mohit Dalwadi. His work focuses on the design and optimisation of hollow fibre membrane bioreactors for applications in tissue engineering, with particular interest in modelling poroelastic fibres to characterise material deformation and changes in material properties under the action of fluid and mass transport. Prior to starting his DPhil, George completed his MEng in Chemical Engineering at Imperial College London.

DANIEL BOOTH is interested in fluid mechanics with biological/medical applications. his DPhil project is studying the process of producing microbubbles to be used in medical imaging such as tumour detection. He did his undergraduate degree here at Oxford.

GEORGIA BRENNAN. The clinical literature increasingly points to the failure of the brain to rid itself of toxic proteins with age as a driving factor for Alzheimer's disease. Georgias research supervised by Prof. Alain Goriely and Dr. Travis Thompson is advancing the understanding of the clearance of toxic proteins in Alzheimer's disease by developing, and analysing, the first mathematical network models that include specific modes of clearance.

PAVANJIT CHAGGAR s a SABS DTC student working with Prof. Alain Goriely**.** Pavan is a neuroscientist working on data analysis and modelling of brain atrophy in dementia.

MARKUS FERDINAND DABLANDER enters his second year as part of the EPSRC InFoMM CDT. His research focuses on graph-based machine learning methods in computational drug-discovery. Before this he studied his MRes in Modelling Biological Complexity at University College London. His undergraduate was in Mathematics at University of Vienna.. Markus's supervisor is Prof. Renaud Lambiotte.

SIMON FINNEY will be studying the viability of using hydrogel coated cells to treat liver disease non-invasively. This will involve modelling how the hydrogel affects the cell's behaviour mechanically and biologically. He is interested in modelling problems which use a continuous framework and have 'real-world' applications. Simon's supervisors are Profs Sarah Waters, Andreas Muench, and Dr. Matt Hennessey.

All new DPhils have been added to the OCIAM-internal Mailing list where we post details of seminars and socials.

JAMES HARRIS research project, supervised by Prof. Colin Please, is a collaboration with BP,model the combustion process within an internal combustion engine, to explore how the octane number of a blended fuel depends on its composition.

ERIK HÖRMANN is a first year DPhil student in Applied Mathematics, coming from a Physics background and heading towards network science. Before joining OCIAM he studied Statistical Physics and Applied Mathematics at La Sapienza, University of Rome. He would like to tackle problems in network science with methods derived from Statistical Mechanics. Erik is supervised by Prof. Renaud Lambiotte

BRADY METHERALL will be developing mathematical models for the thermodynamics, chemistry, and transport of materials in silicon furnaces to try to reduce the carbon footprint of silicon processes. Brady's supervisors are Prof's Breward, Oliver and Please.

WESLEY RIDGEWAY joins us from the University of Saskatchewan, Department of Physics and Engineering Physics. Wesley interested in using techniques from asymptotic analysis and perturbation theory to analyse ODE and PDE models that arise in biology, physics, and industry. In some of my previous research, the analysis has centred around characterizing bifurcations in PDE and ODE systems. I also enjoy numerical analysis as a way of verifying asymptotic theory.

JOE ROBERTS is a part of the EPSRC InFoMM CDT. His research is on modelling the carding of recycled carbon fibre using a continuum approach, supervised by Peter Howell.

BARNUM SWANNELL completed his undergraduate degree in mathematics at Cambridge University, specialising in fluid mechanics and being particularly interested in applications to biology. He then joined the SABS:R3 CDT, undertaking two short rotation projects in the maths institute. For his DPhil project, he shall be working with collaborators at Roche to developing mathematical models of microfluidic organ on a chip systems relevant to drug discovery. Barnum's supervisors are Pro Sarah Waters and Jim Oliver.

TILLY WOODS I'm interested in applications of fluid dynamics and mathematical modelling to geoscience. In particular, her DPhil, supervised by Prof. Ian Hewitt, will focus on modelling aspects of ice sheets and glaciers. My undergraduate degree was also at Oxford, where I completed the MMath.

OCIAM Faculty Research interests

CHRIS BREWARD

Fluid mechanics, surfactants, modelling biological and industrial systems

JON CHAPMAN

Modelling, asymptotics, and differential equations for fluid and solid mechanics

PAUL DELLAR

Lattice Boltzmann methods, complex fluids, magnetohydrodynamics, kinetic theory, atmosphere/ocean fluid dynamics, scientific computing, algorithms for quantum systems

MOHIT DALWADI

Uses mathematical modelling to investigate a wide range of physical phenomena with biological and industrial applications such as carbon recycling, chemical decontamination, membrane filtration, synthetic biology, and quorum sensing. One unifying aspect of this work is the substantial application and development of multiscale (asymptotic) techniques such as homogenization to fluid flow and mass transport problems with moving boundaries.

RADEK ERBAN

Molecular dynamics, biophysics, collective behaviour, numerical methods, stochastic processes, differential equations, biochemistry, mathematical biology, dynamical systems, swarm robotics.

ANDREW FOWLER

Environmental, geophysical and medical problems, dynamical systems

ALAIN GORIELY

Mechanics of biological growth; the modelling of the brain; the theoretical foundations of mechanics; the dynamics of curves, knots, and rods; the modelling of cancer; the development of new photovoltaic devices; the modeling of lithium-ion batteries and, more generally the study and development of mathematical methods for applied sciences.

IAN GRIFFITHS

Hydrodynamics with application to physicochemical applications, Filtration, Water purification, Glass manufacture, Slow viscous flow, Surfactant systems, Asymptotic analysis.

PETE GRINDROD

1. The theory and applications of dynamically evolving networks, including nonlinear node-based dynamics and fully coupled network dynamics. Modelling of behaviour within evolving peer-to-peer communication and social networks. Applications of mathematics to social media, digital media and marketing, analysis extreme opinions with counter terrorism, and generally the digital economy.
2. Analysis of cognitive and conscious phenomena within human brains, including modelling and very large-scale simulation of information processing within the human cortex, reverse engineering, and drawing implications for novel computing paradigms.
3. Probabilistic forecasting for very spiky time-series, with applications to forecasting of domestic and small business energy consumption
4. Inference and forecasting problems for the retail, consumer goods, and telecommunications sectors. Behaviour-based risk measures and targetted-marketing applicationsModels for counter terrorism and real time recognition of anomalies within vast communications data sets.
5. Strategy for innovation and leadership within commercial and public data scientific activities; technology research and innovation; knowledge exchange; and open innovation.

HEATHER HARRINGTON

Algebraic systems biology, topological data analysis, complexity science

MATT HENNESSEY

Pattern formation in soft poroelastic materials such as hydrogels. My work combines fluid mechanics, solid mechanics, and thermodynamics, along with asymptotic analysis and numerical simulations, to understand the rich variety of instabilities that can occur in these materials and how they can be used in emerging technologies.

IAN HEWITT

Mathematical models applied to geoscience, though I work on some other applications too. I'm particularly focussed on modelling ice sheets and how they interact with the climate. My research is problem-driven, which means it involves quite a lot of different areas, including fluid mechanics (predominantly low Reynolds number, some non-Newtonian), solid mechanics (elasticity and plasticity), thermodynamics, phase change, porous media flow, amongst other things. Mathematically, most of my work involves differential equations, tackled using (simple) numerics and asymptotic methods. I'm interested in topics such as free- and moving-boundary problems, homogenisation theory, complex variable methods.

PETER HOWELL

Modelling, asymptotics and differential equations for fluid and solid mechanics

SAM HOWISON

Mathematical finance, fluid mechanics, superconductivity, industrial problems

RENAUD LAMBIOTTE

The dynamics and the structure of large-scale networks. Inspired by empirical datasets mostly from social networks and neuroimaging, I study models of spreading processes on networks, which I then use to uncover significant patterns in interacting systems. Mathematically, my work combines ideas from graph theory, dynamical systems, stochastic systems and statistical physics. My most prominent contributions are in community detection, the problem of clustering densely connected nodes, and in temporal networks, where the network itself is a dynamical entity with nodes and edges appearing and disappearing over time.

IRENE MOROZ

Geophysical fluids, wavelets, dynamical systems, time series, data assimilation, plankton modelling

DEREK MOULTONI

Is interested in developing mathematical models of natural physical systems, in particular differential equation models based on continuum fluid and solid mechanics. His previous and ongoing work has covered a wide variety of topics, with particular focus on biological problems, including the morphogenesis of seashells, plant growth in response to environmental cues, procedures for kidney stone removal, and elastic mechanisms for generating rapid motion such as the launching of a chameleon's tongue in prey capture.

ANDREAS MUENCH

Methods and areas: singular perturbation methods and multiscale methods, phase-field models, scientific computing, free boundary problems, conservation laws and shocks; Application fields: Suspension, polymer liquids, hydrogels, interfaces.

JIM OLIVER

The application of asymptotic methods to free and moving boundary problems in industry, engineering and biology

COLIN PLEASE

Fluid mechanics, electrochemistry, continuum models

DOMINIC VELLA

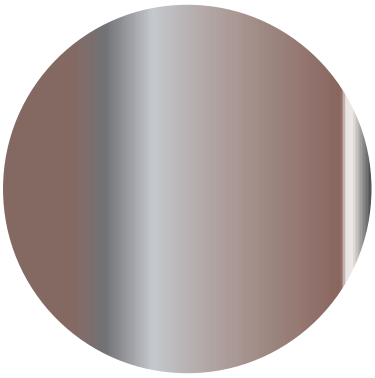
Surface tension, thin elastic objects, flow in porous media

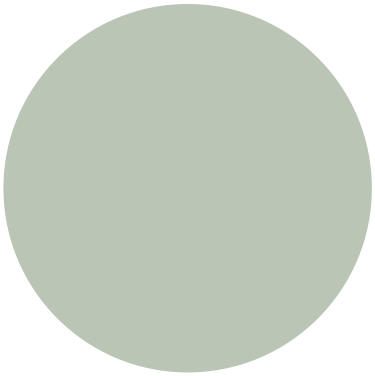
SARAH WATERS

Mathematical medicine and biology, biological fluid mechanics, biomechanics, tissue engineering and regenerative medicine

OCIAM-relevant seminars, talks and colloqiua are listed here.

Events





OCIAM Seminars

15 Oct Pierre Haas
University of Oxford
22 Oct Howard Stone
Princeton
29 Oct Andrea Bertozzi
University of California, LA
12 Nov Helen Wilson
University College London
26 Nov Dan Anderson
George Mason University

Although the format is now virtual, we are keeping the same timeslot: Thursdays during term-time from 4-5pm. The medium will be Zoom and the link is:
https://zoom.us/j/91676355626

Titles and abstracts can be found on the **website**.

Computational Finance
Seminars

15 Oct Jan Obloj
University of Oxford
22 Oct Leandro Sanchez Betancourt
University of Oxford
5 Nov Sergey Nadtochiy
Illinois Institute of Technology
12 Nov Samuel Drapeau
Shanghai Jiao Tong University

Talks take place on Thursdays at 4pm. Titles and abstracts can be found on the **website.**

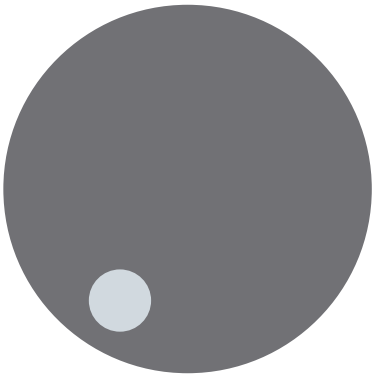
Math Bio & Ecology
Seminars

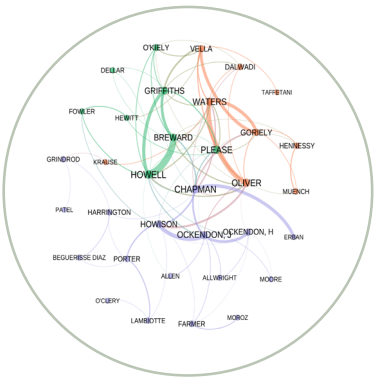
16 Oct Hye-Won Kangn
University of Maryland
23 Oct Sarah Teichmann
Wellcome Genome Campus
30 Oct Amber Smith
Pediatrics, Uni of Tennessee
6 Nov TBC

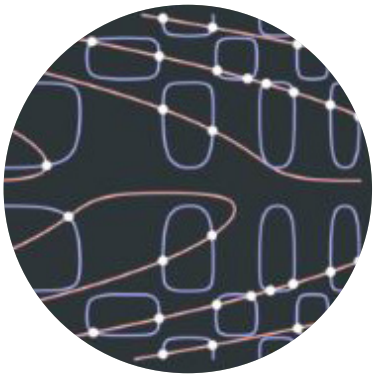
13 Nov Heather Harrington
University of Oxford
20 Nov Aleksandr Sahakyan
Weatherall Institute for Molecular Medicine
27 Nov Richard Smith
John Innes Centre, Norwich
4 Dec Austine Kong
Nuffield Dep. of Population Health

Talks take place on Fridays at 2pm. Titles and abstracts can be found on the **website.**

If you would like your event listed please get in touch.







Data Science
Seminars

16 Oct Bastian Rieck
ETH Zurich

Talks take place on Fridays at 12pm. There will be seminars this term, please keep a look out on the **website.**

Networks
Seminars

13 Oct Renaud Lambiotte
University of Oxford
20 Oct Leto Peel
Maastricht University
27 Oct Anatol Wegner
University College London
10 Nov Michail Gnacik
University of Portsmouth

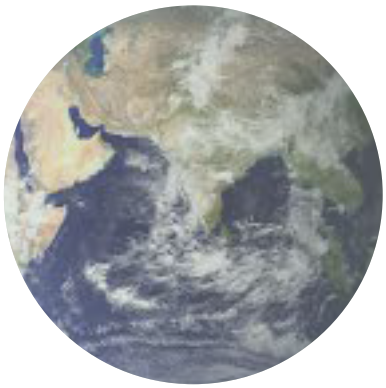
Talks take place on Tuesdays at 2pm. Titles and abstracts can be found on the **website.**

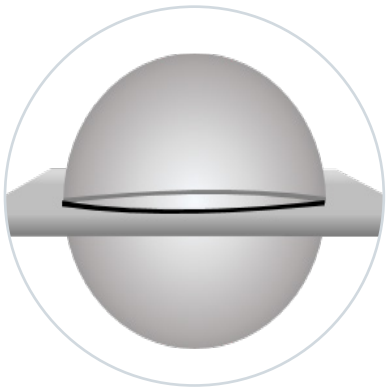
Computational Math & Applications
Seminars

15 Oct Jim Bremer
UC Davis
22 Oct Victoria Howle
Texas Tech University
29 Oct Kirikk Serkh
University of Toronto
5 Nov Maxim Olshanskii
University of Houston
12 Nov Francesca Rapetti
University of Nice Sophia-Antipolis
19 Nov Chris Rackauckas
MIT
26 Nov Nilima Nigam
Simon Fraser University
3 Dec Haim Avron
Tel Aviv University

Talks take place on Thursdays at 2pm. Titles and abstracts can be found on the **website.**

Events





Mathematical Geoscience
Seminar

23 Oct **Colin Meyer**
Dartmouth
6 Nov **TBC**
20 Nov **Chloe Michaut**
École Normale Supérieure de Lyon
4 Dec **Celine Guervilly**
Newcastle University
29 Jan Sam Pegler
University of Leeds

Talks take place on Fridays at 2pm. Abstracts can be found on the **website.**

Applied Topology
Seminar

23 Oct **Oliver Gäfvert**
KTH Stockholm
6 Nov **Michelle Feng**
UCLA
20 Nov **Michał Lipinski**
Jagiellonian University
4 Dec **Fabio Strazzeri**
Institut de Robòtica i Informàtica Industrial

Oxford Mathematics
Public Lecture

28 Oct **David Sumpter**
Professor of Applied Mathematics at the University of Uppsala, Sweden.

How Learning Ten Equations Can Improve Your Life

Is there a secret formula for becoming rich? Or for happiness? Or for becoming popular? Or for self-confidence and good judgement? David Sumpter answer these questions with an emphatic 'Yes!' All YOU need are The Ten Equations.

In this lecture David will reveal three of these: the confidence equation that helps gamblers know when they have a winning strategy; the influencer equation that shapes our social interactions; and the learning equation that YouTube used to get us addicted to their videos.

5.00pm-6.30pm
Watch online **various links here.**

The Oxford Mathematics Public Lectures are generously supported by XTX Markets.

Moving on

OCIAM is 21 Academic Faculty,
7 Emeritus Professors,
7 Hooke Research Fellows,
3 Affiliate Researchers,
15 Post-docs,
1 Departmental Lecturer,
1 Research Support,
53 DPhil Students,
9 OCIAM Research Fellows,
210 Alumni...and hundreds of friends all over the world.

HAMZA ALAWIYE has left the building as Dr. Alawiye! He is now a Heilbronn Research Fellow at University of Bristol. Congratulations Hamza.

ALEXANDER BRADLEY has finished his DPhil and has now started a post-doc at the British Antarctic Survey in Cambridge. Though we're not sure where he is physically.

CHRISTIAN GOODBRAKE is braving air travel to TU Austin. As a post-doc there he will be donig computational cardiovascular modelling. He will also be making up for three years without Mexican food.

MATTEO TAFFETANI takes a new permanent role as Lecturer in the Department of Engineering Mathematics at University of Bristol. Congratulations Matteo.

cover image from OCIAM Learns seminar series 2020©