Plenary speakers

Jean-Baptiste Cazier

Centre for Computational Biology, University of Birmingham

Jean-Baptiste Cazier is a Professor of Bioinformatics with interest across the broad spectrum of Computational and Mathematical modelling of natural phenomena. He has three main area of interest: Cancer Genetics, Population Genetics, Swarming and Metabonomics. His life-long goal is to integrate all his eclectic, and ever expending, fields of interest.

James "Ben" Brown

Laurence Berkeley National Labroratory, California

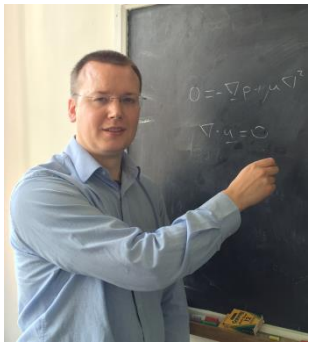
Ben Brown is a statistical biologist with diverse interests ranging from ecotoxicology to developmental biology. A common theme uniting his work is the study of gene regulation. His lab develops statistical machine learning tools to elucidate regulation in basal and ecologically adverse conditions.

Ben joined the Life Sciences Division in 2013 where he and his team are building a program focused on the development of tools for the integrative analysis of large, multi-scale biological datasets.

In 2015, he joined the UCB Statistics faculty as an adjunct professor to further his work on ensemble models. In the modENCODE Consortium, he led analysis for the fly transcription consortium (2011-2014).

David Smith

School of Mathematics, University of Birmingham



David J. Smith is Senior Lecturer in Applied Mathematics and Head of the Applied Mathematics research group.

Dave's main research areas are sperm motility biofluiddynamics, working alongside Centre for Human Reproductive Science, Birmingham Women's Hospital, and modelling the synthetic biology nanofiber M13 bacteriophage. Another central area of interest is the related problem of how cilia shape the development of the growing embryo.

Dave is an enthusiastic communicator of applied mathematics and biological modelling, and provides talks to young people on this subject, including recent school and college visits, and organises IMA West Midlands Branch talks at the University of Birmingham.

Ben Saunders

Team Leader - Materials & Process Modelling, Rolls-Royce plc

Ben Saunders graduated from University of Leeds with a Master degree in Automotive Engineering in 2004. Following a short stint at Ford Motor Company he joined Rolls-Royce plc in 2005 as a Finite Element Analysis Engineer, developing & validating heat transfer models for use in engine certification & component design. In 2011 Ben took on the role of managing the Materials & Process Modelling team within Design Systems Engineering, focussing on the development & validation of new & novel Material & Manufacturing Process simulation tools and deploying these capabilities across Rolls-Royce.

Nils Warnken

School of Metallurgy and Materials, University of Birmingham

Nils Warnken graduated from RWTH-Aachen University, Germany, in 2007 with a Dr.Ing. In Metallurgy and Materials Engineering. He is now a lecturer at the School of Metallurgy and Materials at the University of Birmingham. His research interest is the study and modelling of phase-transformation in metals and alloys, with a special interest in solidification related phenomena.

John Easton

Chief technology officer, IBM Systems and Technology Group

John Easton is an IBM Distinguished Engineer and the chief technology officer for IBM Systems and Technology Group in the UK and Ireland. He is known for his work helping commercial clients exploit large-scale distributed computational infrastructures. John currently leads a European team of IBM architects building the next generation of systems infrastructures to support business analytics workloads.

Student presentations

Fadhel Al-Mousawi

Performance Evaluation of Multi-bed Silica gel Adsorption System for Cooling and Power Generation (Fadhel Al-Mousawi, Raya Al-Dadah, Saad Mahmoud)

Global power demand has increased significantly over the last few decades and the need for sustainable sources has become an urgent aim. Low grade heat sources such as solar energy, geothermal energy and waste heat can be alternative sources. Silica gel/water adsorption for cooling and power could be a promising low-grade heat utilization system because of its ability to use low grade heat below 358 K. In this study, the basic adsorption cooling cycle has been modified by adding an expander between the hot bed and the condenser to generate electricity as well as cooling. A MATLAB Simulink program for multi bed Silica gel water adsorption system for cooling and power has been developed to investigate the effect of using different number of beds on the overall cycle performance. Results show that it is possible to produce power and cooling at the same time without affecting the cooling output. Results show that for 3 and 4 bed adsorption system can produce average cooling and power of almost 2.65 kW and 0.27 kW and 3.43 kW and 0.36 kW respectively compare to 1.63 kW cooling and 0.17 kW using 2 bed adsorption system. In addition, the COP and the total cycle efficiency have been investigated at different operating conditions.

Jim Barrett

CARMA models for stochastic variability

Stochastic variability is one of the most important concepts in experimental physics. There are almost no experiments where measurement errors don't matter, and there are many interesting physical systems that are so complicated that our observations of them can look like a stochastic mess. In my talk I present a method for making sense of stochastic variability using continuous, autoregressive moving average (CARMA) models, which allow us to efficiently pin down the intrinsic timescales in a stochastic process. I'll also show how I've used CARMA models, Bayesian inference and a whole bunch of computing power to investigate planets around distant stars, stellar winds and the orbit of a neutron star.

Kristian Brock

A Design for Phase II Clinical Trials with Efficacy and Toxicity Outcomes and Predictive Variables

PePs2 is a phase II clinical trial of Pembrolizumab in non-small cell lung cancer patients. The primary objective is to learn if treatment is associated with sufficient efficacy and acceptably-low toxicity to be given to performance status 2 patients. Patient-specific factors will likely affect whether patients achieve a good outcome. Two predictive variables of note are the expression level of the PD-L1 protein; and whether the patient has been treated before.

Existing phase II trial methodologies simultaneously scrutinise efficacy and toxicity but do not admit predictive variables. Can we create a design that uses predictive data to selectively approve the treatment only where it works?

We developed a novel Bayesian methodology called BeBoP that analyses binary efficacy and toxicity outcomes. Importantly, BeBoP admits explanatory variables so we could control for the fact that patients have different PD-L1 expression levels. Using a broad simulation study, we demonstrated that BeBoP performs well across a wide range of scenarios. BeBoP let us avoid the unappealing prospect of running separate trials for good and poor prognosis patients.

Bayesian statistics fuses prior beliefs with observed data and involves calculus. The update integral in our example is five-dimensional and costly to evaluate. Each iteration evaluated eight such integrals. We studied 16 scenarios and performed 10,000 replicates, so 1.28m integrals were evaluated. If each took 1s, this would require 15 days of processing. We completed the simulations in less than a day thanks to the massive opportunity for parallel processing in BEAR.

Muhammad Subkhi Sadullah

Ternary Lattice Boltzmann simulation for Modelling Lubricant Impregnated Surfaces

Lubricant Impregnated Surfaces (LIS) are porous surfaces infused with lubricant (e.g. oil). Compared to superhydrophobic surfaces, LIS have been demonstrated to have superior range of liquid repellency as well as better robustness. Given such advantages, LIS have many promising applications varying from foods and beverages packaging to energy harvesting systems. Investigating such system empirically is demanding as it is subject to surface texturing, surface energy manipulation, and the availability of the lubricant. To complement experiments, a powerful numerical approach is therefore needed. In this contribution we present a ternary free energy lattice-Boltzmann model suitable for simulating such system. The distinctive feature of this free energy model is that we are able to predict analytically and capture the relevant physical parameters such as contact angles, liquid-liquid and solid-liquid interfacial tensions. To verify the consistency of this free energy model, we first performed wetting simulation of two immiscible liquids on a solid surface and confirmed its agreement with the so called Girifalco-Good relations. The model is then exploited to map possible wetting states in LIS system as predicted by simple thermodynamic argument. We then discuss how the wetting behaviour of water droplets on LIS may depend on the initial condition and their wetting states.

Stefanie Gillmeier

An overview of our currently used tornado-like vortex models (Stefanie Gillmeier, Hassan Hemida and Mark Sterling)

The structure of a full-scale tornado is highly complex, showing a three-dimensional flow field, instabilities, singularities and non-linear effects. Whether a vortex model can represent the complexity of a real tornado depends on the similarity of the model solution to the full-scale case. However, data sets of full-scale tornadic events are very limited and for that reason tornado-like vortices are modelled numerically and experimentally to provide a statistical representative validation data set for different vortex models. At the School of Civil Engineering ANSYS CFX commercial code is used as a simulation tool to study tornado-like vortices. The design consists of two chambers, a convection chamber and a convergence chamber. Angular momentum is imposed by guide vanes around the convergence chamber. Different vortex structures can be produced by changing the guide vane angle. Experimental simulation in a similar shaped tornado-like vortex simulator are conducted and used to validate the numerical model. Current interest of research is to use those numerical and experimental simulations to analyze the effect of scaling on wind loads on structures exposed to tornado-like flow fields. This conference contribution provides an overview about what can and will be done regarding tornado research at the University of Birmingham throughout the next years.

Andrew Endmondson

Discovering new family trees of biblical manuscripts Department of Theology and Religion

Until the arrival of the printing press, all documents had to be copied by hand – and the copyists made mistakes every time. These changes in the text are analogous to genetic mutations in species' DNA. Therefore the tools used in the field of phylogenetics to study the evolution of species can also be used to study the evolution of texts of a given work. The International Greek New Testament Project transcribed 1,659 manuscripts of chapter 18 of the Gospel of John into electronic form, which were then collated using specialist software. I encoded this data into a matrix (with over 650,000 pieces of information) suitable for input to the phylogenetic software "MrBayes". MrBayes is a powerful open source application that runs the Metropolis-Coupled Markov Chain Monte Carlo (MC3) algorithm to perform Bayesian inference for phylogenetic and evolutionary models. It is MPI-capable, and therefore highly suitable for making use of BlueBEAR's parallel processing. The resulting phylogenetic tree for John 18 contains many interesting features. For example, one sub-tree corresponds to the famous "Ferrar Group" of New Testament manuscripts. Here the group membership identified by MrBayes agrees with the conclusions of recent more traditional research – even though all the known criteria for group membership are found elsewhere.

Austin Tomlinson

Accelerating the Vortex Lattice with CUDA.

When simulating the melting of a superconducting vortex lattice, computational optimisations are crucial for achieving reasonable run times. The vortex lattice consists of two-dimensional magnetic flux tubes in a regular array. We are interested in how these lattices “melt” into “vortex liquids”. This field is particularly prone numerical artefacts that are consequences of the system having very long transient behaviour and sensitivity to the size of the system. Typically, we gain excellent speed-ups of the required code by parallelizing our molecular dynamics engine. By modifying our serial code using Intel® Cilk™ Plus, we achieve optimal performance on BlueBEAR’s standard nodes. When scaling up our problem to larger numbers of vortices, we search for new ways to accelerate our code. CUDA is a C/C++ extension developed by NVidia to enable developers to program their graphics cards. The GPUs on BlueBEAR’s GPU service offer Tesla K20 cards with over 2000 cores that we can simulate the vortex lattice on. We are one of few adopters of this service and are innovating new ways to simulate vortex physics. GPU acceleration is more involved than CPU parallelization; there is a hierarchy of slow global memory to a fast local cache. Memory management is key to achieving optimal run times, as is careful control of thread distribution. We will discuss how we have implemented CUDA in the context of the vortex lattice, quantify the efficiency of GPU acceleration for this problem, and how it relates to the BlueBEAR setup.