ABSTRACTS: INFOMM ANNUAL MEETING 2021

10.05-11.40: Student Presentations:

Breakout Room A - chair: Ellen Luckins

Harry Reynolds (Boston Scientific) : "Mathematical modelling of unsteady flows during ureteroscopy"
Ureteroscopy is a procedure used to treat kidney stones, which consists of passing a flexible tool known as an ureteroscope through the urinary system to access the kidney. Once accessed, a high-power laser is used to reduce the kidney stones to dust. Constant fluid irrigation washes the dust out of the urinary system, providing a clear view of the kidney interior via a camera at the tip of the scope. Traditionally this fluid irrigation is provided by a hanging saline bag, producing a constant flow. Instead, we consider fluid that is driven via an oscillatory pump, providing better fluid delivery control. This will introduce previously unseen oscillatory time-dependence to the flow. We explore how prevalent these oscillations are throughout the system, and how time-dependence can be harnessed to improve the procedure by decreasing dust wash-out times. Firstly, via finite element simulations, we consider time-dependent flow inside a 2D kidney cavity geometry. We solve for an oscillating inlet condition and explore how this can be varied to improve dust wash-out. Secondly, we present a model of fluid flow throughout the full ureteroscopy system. We explore how the fluid flux and pressure throughout the system depend on the upstream pump parameters.

Rahil Sachak-Patwa (Biosensors Beyond Borders): "Modelling and Forecasting the Symptom Dynamics of Influenza"
We formulate an ordinary differential equation mathematical model to describe the severity of symptoms experienced by a host infected with influenza. We fit this model to pooled human data of viral titer, innate immune response levels, and symptom scores, estimating the model parameters in the process. We then generate synthetic data relating to both healthy patients and a hypothetical population of comorbid patients and assess the forecasting accuracy of a two-variable model, the TS model, which describes the fraction of susceptible cells and the severity of symptoms. In particular, we investigate the TS model's ability to make real-time forecasts which can be updated daily, and whether or not it is possible to classify patients by fitting the TS model to data.

Meredith Ellis (Cellesce): "Predictive models of metabolite concentration for organoid expansion in the CXP1 bioreactor"
Organoids are three–dimensional multicellular tissue constructs that recapitulate the structure, heterogeneity, and function of their in vivo counterparts when cultured in vitro. Organoid production is a key technology in drug discovery and personalised medicine. However, producing organoids at scale in a reproducible manner is challenging. We are working with biotechnology company Cellesce, who develop bioprocessing systems for the expansion of organoids at scale. Their technology includes a bioreactor, which utilises the flow of culture media to enhance nutrient delivery to, and waste removal from, the organoids. Optimising bioreactor operating conditions requires spatiotemporal information about the media flow and metabolite concentrations within the bioreactor. Since collecting this data empirically is infeasible, we take a mathematical modelling approach.

In this talk, we will present a model to investigate how mass transport of glucose and lactate within the bioreactor depends on the inlet flow rate and the cell seeding density. We exploit extreme parameter ratios in the system to derive reduced–order models, which systematically account for the depth–averaged flow, nutrient consumption, and waste production, at a significantly reduced computational cost. We will explore the behaviour of the models analytically and numerically, and discuss how our quantitative insights can improve organoid viability by varying bioreactor operating conditions.

Ollie Bond (Tokamak Energy): "Mathematical modelling of flowing liquid metal inside a tokamak fusion reactor"

Tokamak Energy have built a nuclear fusion reactor called the ST-40, capable of reaching temperatures of 100 million degrees Celsius. This research project is focused on the behaviour of liquid metals (namely lithium) atop a component of ST-40 known as the divertor, which is where waste particle matter and heat is deposited. In particular, Tokamak Energy are interested in investigating what happens if the divertor is made up of a sequence of radial "trenches" based on the Liquid Metal-Infused Trenches (LiMIT) concept from the University of Illinois at Urbana-Champaign. Earlier in this research project we derived a two-dimensional model of thermoelectric magnetohydrodynamic (TEMHD) flow in a single trench at leading-order, incorporating the fluid velocity, temperature and magnetic field. In this talk we will present leading-order asymptotic and numerical solutions to the problem in the case where the wall is sufficiently thin so that some of the mixed boundary conditions can be approximated by Robin boundary conditions. We will also provide an overview of what the 3D version of the problem looks like in the case of slow variations across multiple trenches and along the trench, in a bid to obtain a problem which could be tackled using multiple-scales methods.

<u>Breakout Room B – chair: Lingyi Yang</u>

Giancarlo Antonnuci (CCFE): "Parallel-in-time integration for chaotic systems"

For decades, researchers have been studying efficient numerical methods to solve differential equations, most of them optimised for one-core processors. However, we are about to reach the limit in the amount of processing power we can squeeze into a single processor. As a result, there is a need to develop low-complexity parallel algorithms capable of running efficiently in terms of computational time and electric power.

Parallelisation across time appears to be a promising way to provide more parallelism. In this talk, we are going to talk about how to use time-parallel algorithms to solve chaotic dynamical systems.

Zhen Shao (NAG): "Sketching techniques for large scale optimisations"

We first show that sparse random matrices (hashing ensembles with one or more non-zeros per column) have subspace embedding properties that are optimal in the sketching dimension. We then show the implications of this result for the efficient solution of least squares problems, in reducing the dimension of the observational or parameter spaces; and more generally, for random subspace variants of well-known nonconvex optimization algorithms. Global rates of convergence as well as some numerical experiments are presented.

Giuseppe Ughi (RE|5Q): "Mutual information based Neural Networks' Initialisation"

The ability to train randomly initialised deep neural networks is known to depend strongly on the variance of the weight matrices and biases as well as the choice of nonlinear activation. We complement the existing geometric analysis of this phenomenon with an information theoretic alternative. Lower bounds are derived for the mutual information between an input and hidden layer outputs. Using a mean field analysis we are able to provide analytic lower bounds as functions of network weight and bias variances as well as the choice of nonlinear activation.

Nicolas Boulle (Simula): "Data-driven discovery of physical laws with human understandable deep learning"

Scientific computing and machine learning have recently successfully converged on partial differential equation (PDE) discovery, PDE learning, and symbolic regression as promising means for applying machine learning to scientific investigations. These PDE learning techniques attempt to discover the coefficients of a PDE model or learn the operator that maps excitations to system responses. In this talk, we will introduce a novel data-driven and theoretically rigorous approach for learning Green's functions, and deriving mechanistic understanding, of unknown governing PDEs from observation data. First, physical system responses, under carefully selected excitations, are collected to train rational neural networks and learn Green's functions of hidden partial differential equations. Then, we analyze the learned Green's functions to reveal human-understandable properties and features, such as linear conservation laws, and symmetries, along with shock and singularity locations, boundary effects, and dominant modes. We illustrate this technique on several examples and capture a range of physics, including advection-diffusion, viscous shocks, and Stokes flow in a lid-driven cavity.

Breakout Room C – chair: Ambrose Yim

Yu Tian (Tesco): "Halo effect and demand transfer in retail"

Understanding the hidden relation existing between products is essential in economic and marketing research. It is common to see that, for example, customers buy hot dog buns after purchasing hot dogs on sales, or buy blueberries after finding that organic blueberries were unavailable. These are the situations where product relationships play their role, with important impact in e.g. pricing and marketing decisions. In this talk, we focus on two main types of product interactions, halo effect and demand transfer, and present a novel data-driven approach to extract the corresponding product relationships from easily accessible sales transaction data. Our methods are not based on time series analysis, as is usually done via the concept of price elasticity, but instead on the underlying network structure among products. The methods are validated through not only the existing product hierarchy, but also a large-scale flavour compound and recipe dataset.

John Fitzgerald (Elsevier): "A network analysis of the dynamics of international research"

Viewing complex systems as networks has been a fruitful pursuit for decades, in fields as diverse as neuroscience, economics, and sociology. Within this framework, the question of how to determine similar or strongly connecting groups of nodes in these networks has often been of particular interest. Such groups may reveal previously unlabelled higher-order structure in the network, corresponding to e.g. particular functional roles, or social groups, and allow a coarse-grained view of the system. Another key question is the importance of particular factors to the evolution of such networks, to better understand its process of development, and predict future states.

In this talk, we will focus on the application of network science techniques to the global system of research, using publication information from Elsevier's Scopus database. Specifically, we present our studies of the development of the co-authorship network at various levels of aggregation, discuss some questions about academia that network-based approaches can answer, and elaborate where existing models are lacking.

Rodrigo Leal-Cervantes (dunnhumby): "Stochastic Block Modelling of Spatial Networks with an Application to Retail Trips"

Community detection (CD), the problem of finding the meso-scale organisation of a network, has emerged as one of the most important tools in applied network science. Here, we focus on the case of spatial networks in which nodes are embedded in space and edges that connect distant nodes are unlikely to be present. So far, the CD methods that have been proposed for spatial networks are based on modularity maximisation with a suitably chosen null model that incorporates the effect of distance. However, the degree-corrected stochastic block-model (DC-SBM) would offer an improvement over modularity because is not limited to describing assortative structures, it generalises naturally to directed networks, and it can automatically find the number of blocks that best fit the data. In this work we propose a way to adapt the DC-SBM to deal with spatial networks. In a first step, we compare the network against a human mobility model and we construct what we call its spatial backbone, a signed binary network that contains the edges deemed statistically significant, which is then described in terms of a DC-SBM. We use our method to study several real-world datasets including a unique network of customers and stores that belongs to a large retailer chain in the UK.

11.55-12.45: Student Posters:

Poster Room A

Sophie Abrahams (Boston Scientific): "Modelling laser-induced bubbles in ureteroscopy for kidney stones"

'Ureteroscopy and laser lithotripsy' treatment of kidney stones involves passing a flexible scope containing a laser fibre, via the bladder and ureter, into the kidney. Within the kidney, laser pulses are used to fragment the stone into pieces small enough to pass through an outflow channel. The laser pulses also result in the vapourisation of liquid between the fibre and stone, producing a bubble. While in some cases, bubbles have undesirable effects – for example, causing retropulsion of the stone – it is possible to exploit bubbles to make the procedure more efficient. Here we report a model for the expansion of a single laser-induced vapour bubble in liquid as a function of the laser settings. The model employs the 'Rayleigh-Plesset' equation for bubble dynamics, coupled with three further equations: a convection-diffusion equation for the surrounding liquid temperature, with a source term for the input of laser energy; a conservation of energy equation at the vapour-liquid boundary; and the 'Clausius-Clapyron' equation relating the vapour temperature and pressure.

Georgia Brennan (Simula): "Clearance and Alzheimer's Disease: Mathematically Modelling a Mechanistic Link in the Brain's Protein Pandemic"

Mankind faces an aging crisis with Alzheimer's disease (AD) at the forefront. Clinical literature increasingly points to the connection between AD and the failure of the brain's ability to remove dangerous waste proteins with age. The research focus for this project is to develop an understanding of how clearance deficits can play a formative role in AD. We develop the first mathematical, data-driven, network model, coupling the clearance of toxic proteins and AD progression. Our groups' accessible research software enables clinical researchers to harness key mathematical insights for experimental research and treatment, producing simulations for the spread and dynamics of AD over 40 years in a matter of seconds. Key findings show that the characteristic propagation pathways of a toxic population can be significantly altered by fluctuations in regional clearance.

Poster Room B

James Harris (BP): "Combustion modelling relevant for predicting knock"

Knock can cause severe damage to spark-ignition engines. It is characterised by a knocking noise, which can be heard outside the engine, and high-frequency oscillations of the pressure within the cylinder. This is understood to be the result of a localised explosion in the unburned gas ahead of the spark-initiated flame. The compression of the gas between the deflagration and the cylinder walls is believed to be the cause of this explosion. We present a model for the combustion of a single species in a one-dimensional combustion chamber with closed ends. We model the behaviour using conservation of mass, momentum and energy, and assume the reaction rate has an Arrhenius temperature dependence. To gain insight into the important processes for knock, we take limits of some of the dimensionless parameters and solve the resulting simplified models.

Brady Metherall (Elkem): "A particle level model for a concept silicon reactor"

Traditional refining of silicon leads to carbon monoxide and carbon dioxide emissions into the atmosphere. An alternate process uses quartz particles coated in a thin layer of porous carbon as the raw material instead of lump quartz and carbon. This concept reactor operates at a lower temperature, and different chemical reactions occur, reducing the greenhouse gas emissions. As the quartz core is consumed, a void is formed between the quartz and the porous carbon layer. We develop a paradigm model for chemical and transfer processes within a single quartz-carbon pellet. We derive governing equations for the concentration of carbon monoxide and carbon, and conservation equations on the moving quartz interface. We non-dimensionalize our model and reduce to a dilute, distinguished limit. The resulting equations are then solved numerically. We show the time evolution of the concentrations, and how the quartz consumption is affected by varying the parameters of the model.

Poster Room C

Markus Dablander (Lhasa): "Using siamese neural networks in computational drug discovery"

We present a novel siamese deep learning model for the computational prediction of activity cliffs in chemical space. Activity cliffs are pairs of compounds that are structurally similar but exhibit an unexpectedly high potency difference against a given biological target. Activity cliffs thus reveal small structural compound transformations with large biological impact. To predict activity cliffs, we propose a siamese neural architecture that is naturally suited for the extraction of features from pairs of input entities. Our method is the first activity-cliff prediction technique that can be seamlessly integrated with either modern graph neural networks or classical molecular fingerprints. It is trained in a synergistic dual-task framework to predict whether a compound pair forms an activity cliff and which of both compounds is the more active one. We experimentally test the ability of our technique to predict activity cliffs in a data set of coagulation factor Xa inhibitors; our method achieves strong predictive performance and manages to substantially outcompete a variety of baseline models.

Deqing Jiang (Alan Turing Institute): "Approximating value functions with single-layer neural networks"

Solving high-dimensional PDEs is important for understanding the role played by related mathematical finance models in pricing financial instruments and risk management. Compared to conventional numerical schemes, methods derived from deep-learning, for instance, Deep Galerkin Method (DGM), could go beyond the 'curse of dimensionality' and achieve convincing fitting results. In our project, we analyse a training algorithm where a single-layer neural network approximates the solution of a linear differential equation. Then we apply mean-field analysis to try to answer why this process could lead to a suboptimal or optimal approximator and capture some of the characteristics of a local minima.

Poster Room D

Anna Berryman (BEIS): "Modelling the labour market: Can we predict occupation transitions?"

We present a data-driven, network-based model to model the labour markets during a demand shock. The network used connects occupations that workers have transitioned between in the past, and captures the complex structure of relationships between occupations within the labour market. We develop these networks in both space and time to compare occupational mobility across the United States and through economic upturns and downturns. We also extend the agent-based model developed at INET to include multiple applications, on-the-job search, and wage dynamics. With the occupational mobility network and extended model, we hope to be able to infer an ease of transition network for which we expect links between occupations to be constant in time, allowing us to use this network and the model to predict future occupational mobility.

Constantin Puiu (NAG): "Speeding up Second Order Optimization Methods"

Second order methods take much fewer iterations to converge than first order methods, but each iteration is much more expensive .We propose a framework that can be applied to any second order method to improve its CPU time by reducing the iteration cost, while also trying to preserve the progress. The idea can be used with different algorithms, however, we focus on Gauss-Newton for nonlinear least-squares and Newton (for generic objectives). We show numerically that applying our most basic framework to any algorithm results in a cost per unit progress between (approximately) 50% and 100% of the cost of the original method. Furthermore, applying a more sophisticated variant of the framework can result in a speedup of ten times. We show theoretically that all the desired convergence properties are maintained.

Poster Room E

Joe Roberts (Gen 2 Carbon): "Modelling the carding of recycled carbon fibre"

The many potential applications and properties of carbon fibre mean that the demand for it has increased in recent years. This means that the amount of carbon fibre waste is increasing. This waste can be recovered and turned into non-woven materials for use in industry. One step in this process is the carding of carbon fibres using carding machines, which are also used in the textile industry. Carding machines consist of a set of toothed rollers of different sizes, moving in different directions and at different velocities, with the aim of producing a web of aligned fibres. In this study, a continuum model is derived for carbon fibres moving through a carding machine, considering different regions of the machine. We examine properties such as the density and order of fibres through the machine, and look at the role of the teeth in the combing of the fibres. The aim of this work is to make the process of producing a web of aligned fibres more efficient by examining the properties of the machine.

15.00-16.35: Student Presentations:

Breakout Room A – chair: Rahil Sachak-Patwa

Ellen Luckins (Elkem): "Chemical reaction and counter-current flow systems in the metallurgy industry"

Industrial-scale production of silicon involves reducing quartz rock (composed of silicon dioxide) with carbon in a submerged arc furnace. The chemical reactions in the furnace are highly endothermic; the heat required is provided both by radiation onto the surface of the raw materials, and by a flow of hot gas through the porous material bed. Although heat and mass transfer in the furnace depend on the chemical reactions, the interaction of these processes is not well understood. Motivated by this industrial problem, in this talk we present a model for the counter-current heat and mass transfer between gases and a porous material bed in the presence of an endothermic, temperature-dependent chemical reaction. Using the method of matched asymptotic expansions, we investigate various distinguished limits for different rates of heat transfer between the phases, assuming throughout that the effective Péclet number in the solid material is large. Through our analysis, we identify the parameter regimes most applicable to the production of silicon, and employ our asymptotic solutions to provide new insights into the mechanisms underpinning the dynamics within a silicon furnace. We also link to similar behaviours observed in other metallurgical applications, including rotary kilns and calciners.

Matthew Shirley (Elkem): "Heat exchange between the gases and solid in a silicon furnace"

In a silicon furnace, gases are produced near the bottom as a by-product of the silicon creating chemical reactions that occur at very high temperatures. These hot gases then flow upwards through the incoming raw materials and transfer heat to them, both through diffusive heat transfer and through exothermic channel reactions between the gas and the solid. Controlling the flow of gas is therefore important to maximising the energy transferred to the solid, which will increase the furnaces efficiency.

The tops of channels through the solid raw material are sometimes observed to have formed in industrial furnaces and it is believed the gases preferentially flow through these channels. In this talk, we will present a model we have developed for the multi-phase gas flow through one of these channels coupled to the surrounding solid temperature, including the effect of multiple chemical reactions. Using our model, we will predict how the gas and solid temperatures change with depth and at what height different chemical reactions will occur.

Thomas Babb (BP): "Permeability Reduction by Fines Migration During Low Salinity Water Flooding"

A common method to increase recovery of oil during the process of extraction from a reservoir is to inject low salinity water into the reservoir. This weakens ionic bonds between the oil and the rock, allowing the oil to flow more easily, increasing recovery. This process can also weaken ionic bonds between the rock and small clay particles, called fines, which can be released into the flow. These fines are strained by small connections in the rock, causing blockages. These blockages lower the permeability of the rock and reduce the oil recovered. The aim of this research is to develop a mathematical model for the release, transport, and straining of fines during low salinity water funding and its effect on permeability. In this talk we will present a continuous, "Darcy" style model, how it is derived from the homogenisation of a discrete network model, and the properties of its solutions.

Arkady Wey (Gore): "A network model for filtration"

Filters are used in industry to separate impurities and harmful particulates from solution, with applications ranging from high-volume industrial emissions abatement to the processing of blood samples. WL Gore & Associates, Inc. supply businesses with particle filtration products. These are constructed from fibres, the gaps between which form a complex network of pores, within which particles can become trapped as the filtration process progresses. However, as the pores capture contaminants, they shrink and become blocked. The filters gradually clog, preventing further particle removal. Clogging greatly increases downtime and running costs of filtration processes, leading to decreased overall productivity. It also often leads to filter disposal, to the detriment of the environment.

In this talk, we will present a network model that predicts contaminant removal and pore clogging. The model comprises coupled differential equations for the particle concentration and pore volume on the network, constrained by algebraic equations that account for the conservation of mass across each pore. Using numerical simulations, we will explore and explain parameter effects on the efficiency and running-time of the filter.

Breakout Room B – chair: Zhen Shao

Victor Wang (CME): "Estimating neural SDE constrained by a polytope"

Modelling joint dynamics of liquid vanilla options is crucial for arbitrage-free pricing of illiquid derivatives and managing risks of option trade books. We have developed new methods to help machine learning build economically reasonable models for options markets. By embedding no-arbitrage restrictions within a neural network, more trustworthy and realistic models can be built, allowing for better risk management in the banking system.

Christoph Hoeppke ([company redacted]): "Accelerated solution of optimal control problems using deep reinforcement learning"

Direct collection is one of the main approaches used today to solve optimal control problems. As non-liner problem solvers are a key component of direct collocation solvers, their performance is directly linked to their initial solution, hence high accuracy initialization methods are required. This is especially important in industries such as Formula One, where high quality lap simulations are essential to vehicle design. Recently, we have seen the successful application of deep reinforcement learning algorithms to several optimal control tasks. Such algorithms provide an efficient method for fast initialization near globally optimal solutions. In this talk, we will present the use of proximal policy optimization methods to generate initial solutions and accelerate collocation algorithms in lap simulation applications.

Huining Yang (BP): "Bargaining under uncertainty"

Bargaining is an essential part of many human activities. Of particular interest is the case in which two parties, the buyer and the seller, enter into negotiation rounds before a deadline, exchanging a sequence of offers in order to agree on the price or value of a project. We will discuss the problem of finding optimal strategies for each player in the negotiation. One of the key factors in bargaining is finding strategies which take into account the uncertainties due to both internal and external sources that are inherent in the problem. Another important factor in bargaining is the effect of a finite deadline. In this talk, we develop a two-player linear-quadratic game model for bargaining, which takes into account the above factors. We then apply natural policy gradient methods, which are a type of popular reinforcement learning approach, to find the Nash equilibrium strategies for each player in the setting of known and unknown parameters.

Ambrose Yim (Elsevier): "Estimating Indices of Critical points Without Second Derivatives"

Can we reconstruct the topography of a surface from finite point samples? In this talk, we discuss how the number of descending directions of a surface's saddle point (called the index) can be recovered using methods in topological data analysis. While the index can be inferred using second derivatives, second derivatives are often difficult to compute or unavailable in real world contexts. To address this problem, we develop a computational pipeline for estimating the index of saddle points without computing derivatives. Using techniques in topological data analysis, our framework uses a sufficiently dense point sample near the saddle point to infer its index. We show that the density required to infer the index is bounded by the curvature of the surface.

Breakout Room C – chair: Giuseppe Ughi

James Morrill (Iterex Therapeutics): "Causality in Neural controlled differential equations"

Neural controlled differential equations (Neural CDEs) are a continuous-time extension of recurrent neural networks (RNNs). They are considered SOTA for modelling functions on irregular time series, outperforming other ODE benchmarks (ODE-RNN, GRU-ODE-Bayes) in offline prediction tasks. However, current implementations are not suitable to be used in online prediction tasks, severely restricting the domains of applicability of this powerful modelling framework. We identify such limitations with previous implementations and show how said limitations may be addressed, most notably to allow for online predictions. We benchmark our online Neural CDE model on three continuous monitoring tasks from the MIMIC-IV ICU database, demonstrating improved performance on two of the three tasks against state-of-the-art (SOTA) non-ODE benchmarks, and improved performance on all tasks against our ODE benchmark.

Joel Dyer (Improbable): "Likelihood-free inference for implicit time series models"

Simulation models frequently have intractable likelihood functions, making classical likelihood-based statistical inference challenging. A popular likelihood-free approach to obtaining parameter posteriors for simulators is approximate Bayesian computation, where the pertinence of parameters is measured by comparing simulator output and observed data. Appropriate measures of closeness between observed and simulated data are often difficult to construct, in particular for time series data, which can be complex and high-dimensional. Existing approaches typically involve manually constructing summary statistics, which requires substantial domain expertise and experimentation, or rely on unrealistic assumptions such as independent, identically distributed data. Furthermore, little attention has been paid to more complex time series scenarios, such as multivariate and irregularly sampled time series.

In this talk, we will introduce the use of path signatures as a natural candidate feature set for constructing distances between time series data in a semi-automated fashion. We will present experiments that suggest that such an approach can generate more accurate approximate Bayesian posteriors than existing techniques for time series models.

Alexandru Puiu (Macquarie): "A simulation framework for power markets"

Network constraints play a key role in the price finding mechanism for European Power Markets, but historical data is very sparse and usually insufficient for many quantitative applications. In this talk, we will present our reconstruction of the constraints data, known as the Power Transmission Distribution Factors (PTDFs) and Remaining Available Margins (RAMs), by first recovering the underlying time dependent signals known as the Generation Shift Keys (GSKs) and Phase Angles (PAs), and the electricity grid characteristics, via a mathematical optimisation problem. This is solved by exploiting marginal convexity in certain subspaces via alternating minimisation. The GSKs and PAs are then mapped to the PTDFs and RAMs using the grid structure. We will show that our reconstruction achieves good in-sample and out-of-sample relative errors for the PTDFs and RAMs, and we will further compare the performance of our model to the naive mean value inputting, and demonstrate that our reconstructed GSKs and PAs recover specific structures.

Lingyi Yang (NATS): "Probabilistic approaches for optimising arrival management in air traffic control"

We rely on air traffic controllers to ensure our journeys on commercial flights are safe and punctual. Runway availability is a limiting factor at Heathrow and therefore a queuing system is used. The key question is whether we can plan movement of aircraft further afield to eliminate these queues. In this talk we discuss some probabilistic methods we have applied to this problem, taking ideas and inspiration from reinforcement learning, optimal transport, and game theory.