The 9th BEAR PGR Conference

Friday 12th April, 2019

Programme

09:00 - 10:00	*Registration & coffee*
	Session I - chaired by Syeda Anam Hashmi
10:00 - 10:30	Dr Hassan Hemida - School of Engineering (Keynote Speaker)
10:30 - 10:45	George Parish - How Brain Oscillations Facilitate Human Perception and Memory
10:45 - 11:00	Tong Yin - Effects of regional and regulation policies on China's Provincial OFDI
11:00 - 11:20	*Coffee*
	Session II - chaired by Oliver Hall
11:20 - 11:35	Alexandra Thomas - Obtaining key stellar parameters with asteroseismology
11:35 - 11:50	Shen Huo - Flying Debris in Tornado Wind Field
11:50 - 12:05	Grigorios Papatzikas - BEAR resources in the front line to understand and target metabolism in cancer
12:10 - 13:10	*Lunch and posters*
	Session III - chaired by Alex Thomas
13:10 - 13:40	Mr Eliot Dixon - Tata Motors European Technical Centre (Keynote Speaker)
13:40 - 13:55	Bowen Liu - Testing the impact of environmental policy on air pollution: Evidence from Chinese cities
13:55 - 14:10	Nikolina Kovacev - Additive Manufacturing of Monolithic Catalyst for Automotive Applications
14:10 - 14:30	*Coffee*
	Session IV - chaired by Jade Siu
14:30 - 14:45	Muhammad Saqib Rabbani - A Compact Multi-Functional Sensor Design for Remote Health Monitoring
14:45 - 15:00	Ge Gao - Social Networks Centrality Measures on Investor Behaviour in P2PLending
15:00 - 15:30	Ms Zoe Osorio - IBM (Keynote Speaker)
15:30 - 16:00	Prizes and closing by Giulio Vita

Abstracts

How Brain Oscillations Facilitate Human Perception and Memory

George Parish [1,2]

[1] University of Birmingham, Department of Psychology, UK
[2] University of Kent, Department of Computer Science, UK

Background:

Neural oscillations have provided us with a language with which to understand the mechanisms within the brain. One review of these findings has argued that cortical oscillations regulate our attention and perception by providing shared up-states of neuronal activity. Here, neural desynchronisations are thought to signify the flow of information, which has been demonstrated in a previous computational model. As well as detecting 'when' you are thinking about something, new research has indicated that one can also detect 'what' you are thinking about. It is the purpose of the modelling project presented here to understand the processes behind this novel mind-reading capability, as well as to hypothesise about the utility of underlying nested frequencies in providing a hierarchical sampling-rate for temporal memory.

Methods:

We simulate a neural-network model to explore how the interactions between disparate, intrinsically oscillating brain regions provide temporal windows that regulate our perception and allow us to encode sequences of discrete events.

Results:

Through a complex and computationally demanding analysis of oscillatory phase, we show through our model that one can identify the encoding and subsequent re-instantiation of unique sequences.

Conclusions:

Here, we have created a neural-network model that defines a hierarchical architecture of perception and memory, theorising the roles that distinct brain oscillations might play in regulating our online experience and encoding memories. As such, we hope to provide a testable framework for future experiments in understanding how consciousness can emerge from a complex biological system.

Keywords: *neuroscience – oscillations – neural-networks*

Email correspondence: g.parish@bham.ac.uk

Effects of regional and regulation policies on China's Provincial OFDI

Tong Yin [1]

[1] University of Birmingham, Birmingham Business School, UK

Background:

Chinas Outward Foreign Direct Investment (OFDI) flows reached 183 billion USD in 2016 (UNCTAD). China became the second largest source of OFDI. It is very interesting to study why Chinas OFDI has been growing so fast in recent years boosted by several policies such as Open door policy and Go Global policies especially since China launched One Belt One Road policy in 2014.

Methods:

The literatures on the determinants of OFDI is extensive. However, a small part of it is able to use quantitative method to study the effect of policies. We think that it is very important to analyze the effect of policies. Firstly, China government played an important role in Chinas OFDI. Secondly, throughout Chinas economic reform in the past 40 years, policies were always important tools in China.

Results:

Our main contribution is that, to our knowledge, this is the first time that government policies are used in a quantitative analysis of Chinas OFDI. We use provincial data and quantitative method to analyze the effects of regional and regulation policies on Chinas provincial OFDI.

Conclusions:

We found that Chinas economy and OFDI-related polices had a joint effects on the total volume of OFDI. The volume of OFDI had a positive relationship with GDP per capita. Chinas OFDI-related policies would also release OFDI of provinces with relatively higher level of GDP per capita.

Keywords: *OFDI – China – Determinants*

Email correspondence: txy424@bham.ac.uk

Obtaining key stellar parameters with asteroseismology

Alexandra Thomas[1,2]

[1] University of Birmingham, School of Physics and Astronomy, UK
[2] Aarhus University, Stellar Astrophysics Centre, Denmark

Background:

In an era where we are searching for planets outside our solar system we need to learn as much as we can about the stars they orbit. Asteroseismology is the study of stars by observation of sound waves trapped within them causing them to naturally resonate like musical instruments. It provides us with a unique window on normally hidden interiors of the stars and an ability to paint an exquisite portrait of the properties and characteristics of the stars, and any planets they may host.

We take millions of observations of the stars in the sky and so we need a way to rapidly analyse our data using asteroseismology. I present a summary of our current techniques to extract properties of stars using various high-performance computing methods including numerical modelling, Bayesian inference and machine learning.

Methods:

The NASA Kepler mission observed the fluctuating light that came from around 170,000 stars in our galaxy. To obtain stellar properties the types of oscillation must be decrypted and then fitted with the closest matching model from a multi-dimensional grid of a theoretical models. To avoid the large computational timescales and numerous model simplifications necessary for our current techniques, we are developing a neural network which maps directly from observations to stellar properties. This is trained on old Kepler data and is preparation for the huge quantities of data we are about to receive from NASA's new satellite - TESS.

Results:

We are able to rapidly extract stellar properties with reasonable accuracy without the need of theoretical models. For some stars we can make more accurate predictions than via current methods.

Conclusions:

To improve on our results, we will need to build a Bayesian NN which considers all the possible uncertainties in the process. This tool will be incredibly useful for analysing the enormous quantity of data we are receiving from TESS and will need us to make use of the BlueBEAR service.

Keywords: *Stars – Big data – Machine Learning*

Email correspondence: axt367@student.bham.ac.uk

Flying Debris in Tornado Wind Field

Shen Huo [1]

[1] University of Birmingham, School of Engineering, UK

Background:

Tornadoes are some of the most horrifying natural disasters known to men and can cause tremendous damages to civil structures. Every year, damage due to tornadoes are estimated to cost $11.23 billion and much of the induced damage is caused flying debris. Despite the importance of this, surprisingly little work has been undertaken on flying debris in tornado wind fields.

Methods:

The aim of this research is to numerically simulate debris fight in tornado wind field in order study its flight behaviour and distribution of impact radius. A tornado-like vortex at the swirl ratio of 0.7 was generated using an open source CFD software, OpenFOAM.

Results:

The tornado at this current swirl ratio was found to be a single core type vortex with updraft flow around the core region. Debris that were picked up by the tornado near the range from 0.75 to 2 times the radius of the core have the largest variations in trajectory due to the updraft flows, while these flying debris is observed to impact at the location from 4 times the core radius to 10 times the core radius. The velocity of debris reaches maximum at the region between 1.8 to 3 times the core radius with the mean velocity at 0.65 times the maximum vortex tangential velocity.

Conclusions:

The work undertaken to date, shows that the flight behaviour of airborne debris predominately depends on the flow structure of the tornado, and can undergo drastic variation in trajectory and velocity.

Keywords: *Tornado – Debris Flight – Large-eddy Simulation*

Email correspondence: srh629@bham.ac.uk

BEAR resources in the front line to understand and target metabolism in cancer

Grigorios Papatzikas [1,2]

[1] University of Birmingham, Institute for Cancer and Genomics Sciences, UK
[2] Biology department, University of Barcelona, Spain

Background:

Rewiring metabolism is now considered a new hallmark of cancer. To further investigate this concept, systems biology utilizes omics technologies, to generate a vast amount of data by using next generation sequencing or NMR spectrometers. As the demand for such data increases, the demand for additional computational power to handle, store and analyse those data increases as well. Here, we are presenting a series of bioinformatics analyses using BEAR recourses to overcome this problem and understand metabolism.

Methods:

We have used CaStLes, to analyse transcriptomic and metabolomics data in different types of haematological cancers. Gene expression analysis highlighted the important role of metabolic rewiring both in lymphomas and leukemias. Next, advance gene set enrichment analysis explored the complexity of metabolic pathways in those cancers. Going beyond gene expression results, we applied Genome-Scale Metabolic Modelling to predict potential drug targets for new therapeutic strategies.

Results:

Gene expression analysis and metabolic modelling reveal differential reliance on oxidative phosphorylation and cholesterol biosynthesis in Chronic Lymphocytic Leukemia. In contrast, Non- Hodgkin lymphomas demonstrate asparagine metabolism as a metabolic vulnerability.

Conclusions:

Overall, our findings indicate the potential of targeting metabolism in CLL.

Keywords: *metabolism – –*

Email correspondence: g.papatzikas@bham.ac.uk

Testing the impact of environmental policy on air pollution: Evidence from Chinese cities

Bowen Liu[1]

[1] University of Birmingham, Department of Economics, UK

Background:

The Chinese central government implemented a series of Environmental Protection Inspection programs between 2016 and 2017 that included sending central inspectors to local provinces and cities to investigate pressing environmental pollution problems, and to urge local government and party officials to exert more effort for environmental protection actions. Using the officially published Air Quality Index (AQI) and its components (e.g. $PM_{2.5}$, PM_{10}, SO_2, NO_2, CO and O_3-8h), our research empirically examine whether the inspection policy is effective in improving air quality in targeted cities.

Methods:

Based on the natural experiment design, we focus on the trial inspection (January 2016) in Hebei province, by employing daily meteorological condition data and air pollution concentration data for 334 Chinese cities from 2013 to 2017, and compare air quality in Hebei with Non-Hebei cities before, during and after the inspection. We also divide Hebei cities into 8 criticized and 3 un-criticized cities (according to the official report published by the MEP) to see whether air quality within Hebei cities respond to the inspection differently.

Results:

We found a slight decrease of AQI in the 6 months before inspectors station in Hebei, a fairly large drop during the one month inspection, and finally the largest effect on AQI improvement in the 5.5 months after inspection left Hebei. The findings are robust through various sensitivity and placebo tests.

Conclusions:

Our results suggests that in developing countries like China, the great administrative power and radical policy implementations can actually work to improve air quality levels.

Keywords: *Air pollution – Environmental regulation – China*

Email correspondence: bxl720@student.bham.ac.uk

Additive Manufacturing of Monolithic Catalyst for Automotive Applications

Nikolina Kovacev[1]

[1] University of Birmingham, School of Engineering, UK

Background:

Further improvements of the efficiency of the engine and the exhaust-after treatment system are necessary to reach the mandatory CO_2 emission levels and enhance the fuel economy. Low flow-through resistance and high surface area are crucial for the successful application of monoliths. Additive manufacturing enables the fabrication of intricate and innovative designs of the monoliths to replace the traditional flow through design. One of the most promising techniques to achieve lower exhaust gas emissions and improve the fuel economy is exhaust gas reforming. Exhaust gas reformer uses the heat, CO_2 and oxygen to convert the primary fuel to reformate which is then fed to the engine and the after-treatment system.

Methods:

The study is focused on the application of a novel and compact monolith catalyst for fuel reforming, hydrogen generation and simultaneous exhaust gas after-treatment. Monolith substrates with complex internal geometry are investigated both experimentally and computationally. Numerical model for obtaining pressure drop values is developed involving various monolith designs. The current design criteria includes pressure drop and surface area. The optimized design is manufactured on industrial ceramic 3D printer (Admaflex 130) which uses digital light processing (DLP) resin 3D printing technology.

Results:

The optimum monolith design is obtained from the numerical simulation results and manufactured by additive manufacturing. The initial simulations show, as expected, that the pressure drop values are slightly higher than for the traditional flow through monoliths because of intricate design of lattice structures.

Conclusions:

In this study, a novel compact monolith catalyst for automotive applications is optimized according to pressure drop and surface area values and manufactured by additive manufacturing technology. The experimental validation of the numerical model with high temperature pressure test will follow. Further development of the numerical model will include study of heat transfer and incorporation of mass transfer and coating of the optimized monolith with the catalytic active phases and subsequently testing the reforming catalyst in the actual exhaust system for fuel reforming and exhaust after-treatment.

Keywords: *monolith – catalyst – fuel reforming*

Email correspondence: nxk889@student.bham.ac.uk

A Compact Multi-Functional Sensor Design for Remote Health Monitoring

Muhammad Saqib Rabbani [1]

[1] University of Birmingham, Department of Electronic, Electrical and System Engineering, UK

Background:

Wireless sensing of vital signs i.e. respiration heartbeat rate, body temperature, blood pressure, blood glucose level and Oxygen absorption in the blood, is anticipated to be a more convenient way to check the vitality signs of a person, when compared to the traditional invasive or contact based vital sign monitoring devices such as ECG, Oximeter, etc. In recent years, remote vital sign monitoring has been proposed for applications in areas such as regular and special health care, emergency services, security and defense sectors. However, the precision and consistency of results gained using a remote wireless health monitoring system need to be addressed rigorously for its application to real world scenarios, especially in the case where a patient undergoes random movements. Recently, we initiated a comprehensive study to develop such a multi-functional sensor for remote wireless health monitoring applications.

Methods:

In a Doppler radar based health monitoring sensor, the amplitude and frequency of chest vibrations due to respiration and heartbeat are detected. However, the amplitude of the chest vibration due to a heartbeat is extremely small ($\sim$0.2mm) and hence an accurate detection of heartbeat with the Doppler radar operating at the conventional lower microwave frequency band such as 2.4 GHz, 5.7 GHz and 10GHz has been challenging. Therefore, millimetre-wave frequencies (30-300 GHz) are recommended to improve heartrate detection due to the enhanced sensitivity afforded by the shortened wavelength.

Results:

Initially, we employed Doppler radar techniques using higher electromagnetic frequencies at around 60GHz for respiration rate and heartbeat detection of a person sitting in a fixed position at up to 2m distance. The 60GHz wireless system showed high detection sensitivity especially for incredibly small heartbeat vibrations in the chest. Most recently, we employed beam steering antennas for vital signs detection when the person is free to move within about 20 degrees angular range of the fixed sensor position at up to 3m radial distance.

Conclusions:

In the next stage, will be investigating the detection possibilities of other vital signs such as body temperature, blood pressure, blood glucose level and Oxygen absorption in the blood though non-contact wireless systems. These vital signs may be detected by studying the electrical properties of the involved body materials and their interaction with the propagated electromagnetic waves at various frequencies.

Keywords: *non-contact vital sign monitoring – wireless sensor for health monitoring – Doppler radar*

Email correspondence: m.s.rabbani@bham.ac.uk

Social Networks Centrality Measures on Investor Behaviour in P2PLending

Ge Gao [1]

[1] University of Birmingham, Department of Economics, UK

Background:

Considered as a flourishing finance platform, there are still plenty of unprofessional investors in P2P Lending market. Previous researchers provided evidence of herding behavior among P2P lenders. Since the similarity exists between social media and P2P lending platform, we consider employing social network centrality measure to investigate the herding behavior in P2P lending.

Methods:

We apply a social networks model on loan data from Renrendai.com. Firstly, we build a one-to-one combination between every lender in every loan, recording the bid information. Secondly, we calculate betweenness and degree centrality of these lenders. Thirdly, we build a social network with nodes and edges. Nodes represent the lenders, edges lengths reflect the betweenness, nodes sizes are combined with degree centrality.

Results:

Our analysis results in a high-centralized network. Generally, every lender would invest in 9.6 loans on average. The average degree-centrality is 183.9, however, there are 7 investors have over 2000 degree-centrality.

Conclusions:

Leaders with higher degree centrality may significantly affect invest strategies of followers who have lower influence. Super leaders may change followers potential decision.

Keywords: *Network Centrality – P2PLending – Herding Behaviour*

Email correspondence: gxg862@bham.ac.uk