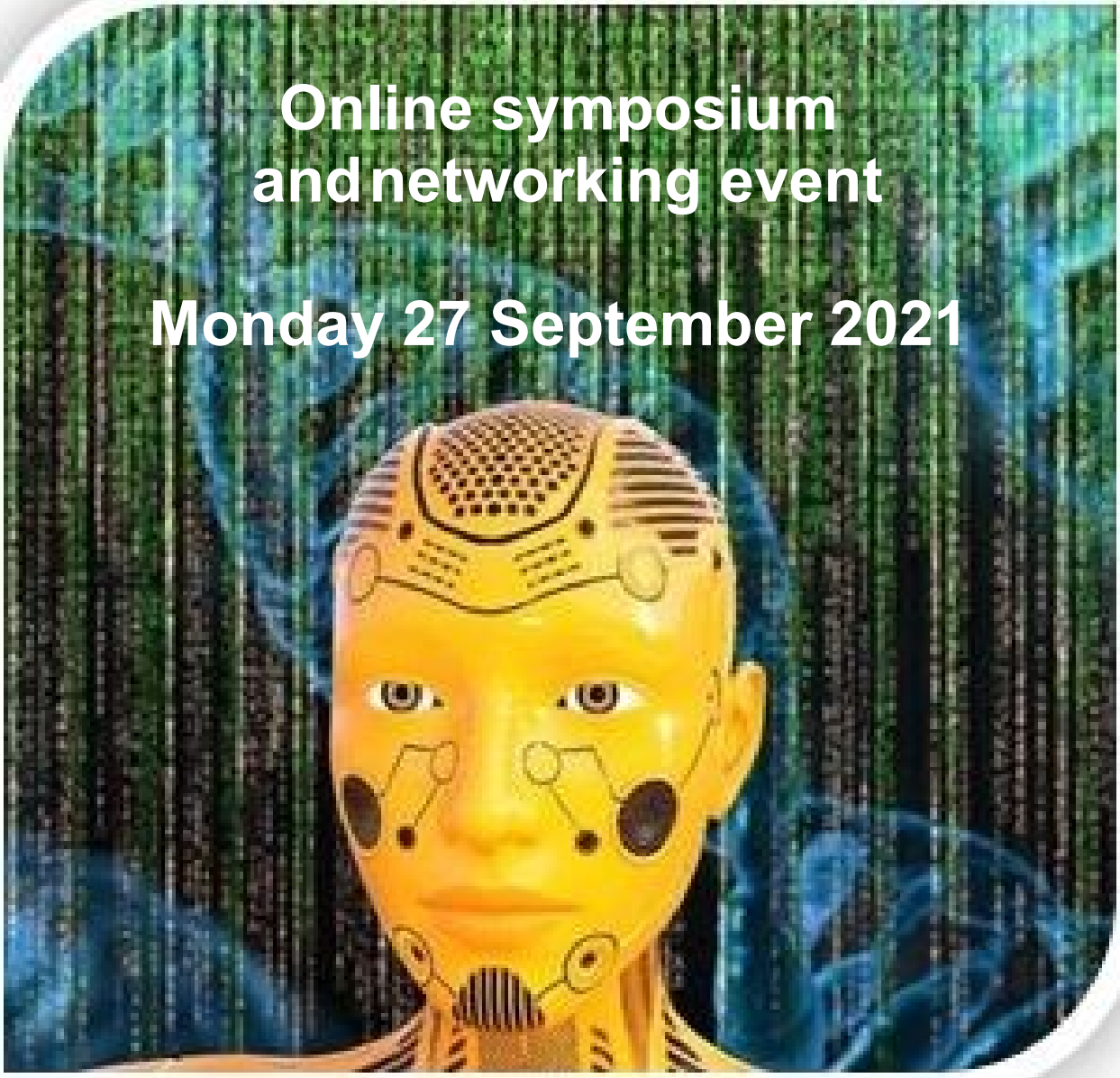
Technology and Biomedicine: A Cambridge Showcase



DELEGATE PACK

UNIVERSITY OF CAMBRIDGE
Chemical Engineering and Biotechnology

Cambridge Metabolic Network

Contents

Foreword

Welcome to our online symposium and networking event.

We had hoped to have been able to meet face-to-face, but whilst the pandemic has prevented us from doing so, it has also created an exciting opportunity allowing participants from Cambridge and its environs to join us in the virtual world.

This collaboration between the Cambridge Metabolic Network and Department of Chemical Engineering and Biotechnology at the University of Cambridge, aims to showcase how innovative new approaches and technologies from mathematical, computing, engineering, physical and chemical sciences are helping to deliver impact and improve patient care.

The session includes a series of short talks from leading investigators followed by a panel discussion and then a number of flash-talks by Cambridge graduate students, post-doctoral and early career researchers, selected from submitted abstracts.

We are looking forward to exciting inter-disciplinary networking and discussion which we hope will provide a forum for exchange of ideas across disciplines to stimulate new perspectives.

Professor Sir Stephen O'Rahilly
Chair – Cambridge Metabolic Network

Professor Roisin Owens
Department of Chemical Engineering and Biotechnology, Cambridge

Cambridge Metabolic Network

UNIVERSITY OF CAMBRIDGE
Chemical Engineering and Biotechnology

Harassment, trolling, and unethical or abusive behaviour

The organisers have taken reasonable steps to ensure that issues such as trolling, hacking, abusive behaviour and comments will be dealt with swiftly and appropriately should they arise.

Whilst we welcome discussion, debate, networking and engagement within the symposium, participants should conduct themselves with professionalism, showing all other participants respect, courtesy and consideration. Any form of harassment, discrimination and bullying is unacceptable and will not be tolerated.

If a session is compromised, such as through abusive behaviour, we will remove those attendees and potentially end the session if necessary.

By registering for or speaking at this event, you are agreeing to adhere to this statement.

Privacy notice and data protection

We will be taking some screen shots during the event. Our Privacy Notice explains how we might use your data. Information you supply to us in connection with your booking will be held securely by Cambridge University on behalf of the Cambridge Metabolic Network. We will not otherwise, without your consent, supply your information to any third party except where we are required to do so by law. You have a right, under UK data protection law, to obtain certain information from us including a description of the data that we hold on you. Should you have any queries concerning this right please contact us.

Programme

Co-chairs: **Professor Sir Stephen O'Rahilly**, Wellcome-MRC Institute of Metabolic Science and **Professor Roisin Owens**, Department of Chemical Engineering and Biotechnology, Cambridge

09.00 – 09.30 Welcome and Introduction
Professor Sir Stephen O'Rahilly and **Professor Roisin Owens**

SESSION ONE

09.30 – 09.50 A 3D bioelectronic model of the human intestine - **Professor Roisin Owens**

09.50 – 10.10 Computer vision: real-time estimation of 3D body shape and glucose monitor transcription - **Professor Roberto Cipolla,** Department of Information Engineering.

10.10 – 10.30 Challenges of deep learning in biomedicine - **Professor Pietro Lio,** Department of Computer Science and Technology.

10.30 – 10.50 Panel Discussion

10.50 – 11.00 Break

SESSION TWO

11.00 – 11.20 Diabetes tech: the case of the artificial pancreas - **Professor Roman Hovorka**, Wellcome-MRC Institute of Metabolic Science and Department of Paediatrics.

11.20 – 11.40 Wearable devices for monitoring physical activity and health - **Dr Soren Brage**, Physical Activity Epidemiology group, MRC Epidemiology Unit.

11.40 – 12.00 Lipidomics - technological developments in data collection and analysis– **Dr Albert Koulman**, NIHR BRC Metabolomics and Lipidomics Facility, Wellcome-MRC Institute of Metabolic Science

12.00 – 12.20 Enhancing clinical outcomes in human adrenal and pituitary tumours through the use of molecular imaging - **Professor Mark Gurnell**, Wellcome-MRC Institute of Metabolic Science and Department of Medicine.

12.20 – 12.40 Panel Discussion

12.40 – 12.50 Break

SESSION THREE

12.50 – 13.40 Flash talks based on submitted abstracts
Co-chaired by **Davide Chiarugi,** Wellcome-MRC Institute of Metabolic Science
Verena Stoeger, Department of Chemical Engineering and Biotechnology

12.50 – 13.00 Segmentation and quantitative characterisation of endoplasmic reticulum structures in super-resolved sequential images by deep neural network-ERnet **Dr Meng Lu**, Department of Chemical Engineering and Biotechnology, University of Cambridge

13.00 – 13.10 Biofabrication: from bioelectronic fibres to 3D printing and Machine Learning Co-Modelling - **Dr Shery Huang,** Department of Engineering, University of Cambridge

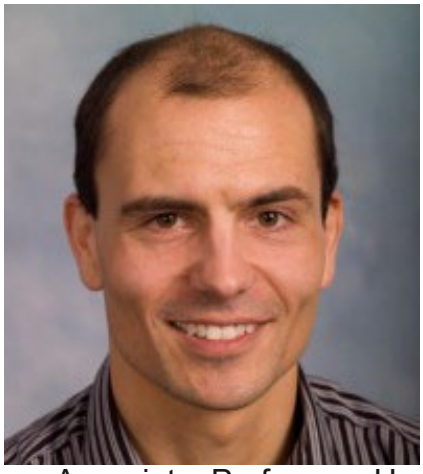
13.10 – 13.20 NASH Drug Discovery Using Human Microphysiological Systems - **Mr Raul Silva,** CN Bio Innovations, Welwyn Garden City, Herts

13.20 – 13.40 Panel Discussion

13.40 – 13.45 General discussion and close

Speaker Biographies

Dr Søren Brage



Søren Brage is the Group Leader of the Physical Activity Epidemiology group at the MRC Epidemiology Unit at the University of Cambridge. His research interests include developing and evaluating assessment methods for physical activity and fitness at population level, the descriptive epidemiology of physical activity, characterisation of the relationship between physical activity and metabolic disease, and how this relationship may be modified by genetic factors.

Søren has an MSc in Exercise Science and an honours degree in health research from the University of Southern Denmark (Odense) where he now holds a secondary position as Associate Professor. He also has MPhil and PhD degrees in Epidemiology from the University of Cambridge. During his PhD, he developed and evaluated techniques for objective assessment of physical activity and fitness in populations, using combined accelerometry and heart rate monitoring. These and similar objective methods have now been implemented in several population studies nationally and worldwide which form the basis of the Physical Activity Epidemiology group's work.

Professor Roberto Cipolla

Roberto Cipolla is Professor of Information Engineering at the University of Cambridge (since 2000) and Director Director of Toshiba's Cambridge Research Laboratory (since 2007).

After reading Engineering at the University of Cambridge (Queens' College, 1984) he completed his graduate research in Computer Vision and Robotics at the University of Oxford (Balliol College, 1991) where he received D.Phil. degree for his work on 3D reconstruction from smooth 2D contours.

His research interests are in the reconstruction, registration and recognition of three-dimensional objects from images. These include novel algorithms for the recovery of accurate 3D shape, visual localisation and semantic segmentation. Computer vision technology from his group is being exploited in new products by Toshiba (face recognition for access control in varying illumination and a gesture interface for laptops) and Wayve Technologies (semantic segmentation for autonomous driving).

He has authored two books: Active Visual Inference of Surface Shape in 1995 and Visual Motion of Curves and Surfaces (with Peter Giblin) in 2000; edited twelve books on computer vision and published over 400 articles in computer vision and related fields. See https://mi.eng.cam.ac.uk/~cipolla/publications_selected.htm

Professor Mark Gurnell

Mark Gurnell is Professor of Clinical Endocrinology in Cambridge, where he is Clinical Lead for Endocrine Services. He is Head of Section (Specialty Medicine Research & Training) in the Department of Medicine, and SubDean in the School of Clinical Medicine.

His clinical and research interests are focussed on pituitary, adrenal and thyroid disorders, with particular interests in:

- acromegaly
- Cushing's disease
- TSH-secreting pituitary adenomas
- secondary adrenal insufficiency
- primary aldosteronism

He is head of the Cambridge Endocrine Molecular Imaging Group (CEMIG) and has led the development of novel PET tracers for imaging pituitary adenomas and adrenocortical tumours, with several now in use in routine clinical practice.

He also co-leads the Cambridge REFTFTs service, which provides advice on the investigation and management of patients with unusual/atypical thyroid function test results.

He currently serves on various expert committees/panels, including:

- Council of the UK Society for Endocrinology (Treasurer)
- Education Committee of the European Society of Endocrinology
- US Endocrine Society's ESAP panel
- Royal College of Physicians (UK) Specialty Certificate Examinations Board (Endocrinology & Diabetes)

He holds a number of senior appointments in medical education and chairs the the Board of the UK Medical Schools Council Assessment Alliance. He leads the team of UK Assessment experts developing the forthcoming UK Medical Licensing Assessment (MLA) Applied Knowledge Test (AKT).

Professor Roman Hovorka

Roman Hovorka PhD FMedSci is Professor of Metabolic Technology Research at the Institute of Metabolic Science and Department of Paediatrics at University of Cambridge. He made seminal contributions to diabetes technology including the "Artificial Pancreas", a device that delivers insulin in glucose responsive fashion. He is Chief Investigator on several trials evaluating the Artificial Pancreas in populations such as young children and newly diagnosed type 1 diabetes.

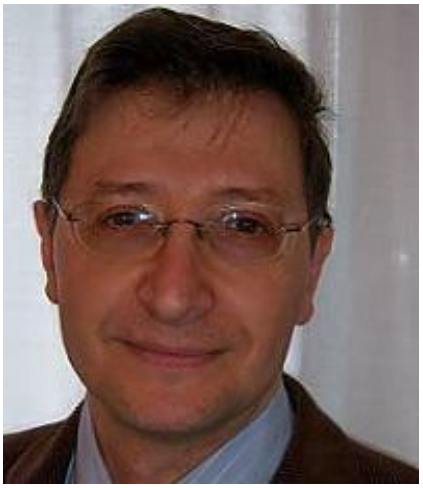
Dr Albert Koulman

Albert Koulman studied pharmaceutical science in Groningen (the Netherlands) and did his PhD in natural product analysis. At the end of his PhD, Albert started working on metabolomics and since then worked on plants, fungi, sheep and cows. In 2007 he moved to Cambridge and his work shifted to humans and model systems, developing methods focussed on lipid metabolism and nutritional biomarkers.

By developing and applying analytical methods, he has contributed to more than 100 publications.

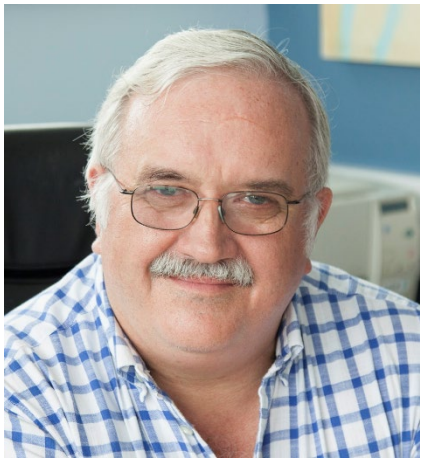
Currently he heads the core Metabolomics and Lipidomics Laboratory as well as the Nutritional Biomarker Laboratory at the University of Cambridge.

Professor Pietro Lio



Pietro Lio is an internationally leading researcher in both Bioinformatics and machine learning. He is member of the Cambridge center of AI and Medicine and The European Laboratory for Machine Learning (Ellis). PL holds one PhD in complex systems and non-linear dynamics and a second PhD in genomic sciences; his background enables deep interdisciplinarity and provides grounds for effective interfacing computer science, machine learning with biomedical fields. PL has an extensive knowledge in biological data integration which is very relevant for building predictive, multi scale, mechanistic (multiphysics) models of the relationships between the different omics, behavioural, clinical data and biomedical processes. This has resulted in the award of several EU grants and in the development of omic tools that explore the statistical dependencies among the different biological levels of complexity. Through these projects Pietro set up various collaboration networks with the best scientists in the field across Europe, and organised workshops, which have enabled extending these networks. PL develops new key methodologies in deep learning that are, yearly, well received in top conferences and journals such as Neurips, ICLR, ICLM. These methodologies also set the vision for future medicine biomedical tools.

Professor Sir Stephen O'Rahilly



Stephen O'Rahilly's research has been concerned with the elucidation of the fundamental mechanisms underlying obesity, insulin resistance and Type 2 diabetes and the translation of those discoveries into improvements in patient care. His work has uncovered several previously unrecognised genetic causes of these diseases including some that are amenable to specific treatments. He graduated in Medicine from University College Dublin in 1981. From 1982 to 1991 he undertook postgraduate clinical and research training in general medicine, diabetes and endocrinology in London, Oxford and Harvard. In 1991 he obtained a Wellcome Trust Senior Clinical Fellowship and established his laboratory at the University of Cambridge. In 1996 he was appointed to a newly created Chair of Metabolic Medicine and in 2002 to the Chair of Clinical Biochemistry and Medicine. He is Co-Director of the Wellcome-MRC Institute of Metabolic Science (IMS), the establishment of which he led. Within the IMS, he is Director of the MRC Metabolic Diseases Unit and the Metabolic Research Laboratories of the University of Cambridge. He is also Scientific Director, NIHR Cambridge Biomedical Research Centre, Honorary Consultant Physician at Addenbrooke's Hospital, a Fellow of Pembroke College, Cambridge, an Associate Faculty Member of the Wellcome Sanger Institute and Chair of the Cambridge Metabolic Network. He has undertaken a substantial body of public service work for research charities, educational institutions and governmental organisations in the UK, Ireland and elsewhere.

He has won many awards including the Heinrich Wieland Prize, the Inbev Baillet Latour Prize, the Zülch Prize, the European Hormone Medal, the first EASD/Novo Nordisk Foundation Diabetes Prize for Excellence and the Banting Medal for Scientific Achievement. He gave the Harveian Oration of the Royal College of Physicians, London, in 2016. He was elected to the Royal Society in 2003, a Foreign Associate of the National Academy of Sciences USA in 2011, is an Honorary Member of the German Society for Internal Medicine and the Royal Irish Academy. He also holds honorary Doctorates from the Universities of Dundee, Warwick, Buckingham, University College Dublin and the Royal College of Surgeons in Ireland. He was appointed Knight Bachelor in 2013.

Professor Róisín Owens

Róisín M. Owens is Professor of Bioelectronics at the Dept. of Chemical Engineering and Biotechnology in the University of Cambridge and a Fellow of Newnham College. She received her BA in Natural Sciences (Mod. Biochemistry) at Trinity College Dublin, and her PhD in Biochemistry and Molecular Biology at Southampton University. Her current research centers on application of organic electronic materials for monitoring biological systems in vitro, with a specific interest in enhancing the biological complexity and adapting the electronics to be fit for purpose.

She has received several awards including the European Research Council starting (2011), proof of concept grant (2014) and consolidator (2016) grants, a Marie Curie fellowship, and an EMBO fellowship. She currently serves as co-I and co-director for the EPSRC CDT in Sensor Technologies, renewed in 2019. She is a 2019 laureate of the Suffrage Science award. In 2020

she became Scientific Editor for *Materials Horizons* (RSC). She is author of 80+ publications and 3 patents and her work has been cited more than 5000 times.

Speaker Abstracts

(in order of sessions)

SESSION ONE

A bioelectronic model of the human intestine - Professor Róisín Owens

In vitro models of biological systems are essential for our understanding of biological systems. In many cases where animal models have failed to translate to useful data for human diseases, physiologically relevant in vitro models can bridge the gap. Many difficulties exist in interfacing complex, 3D cell biology models with technology adapted for monitoring function. Polymeric electroactive materials and devices can bridge the gap between hard inflexible materials used for physical transducers and soft, compliant biological tissues. An additional advantage of these electronic materials is their flexibility for processing and fabrication in a wide range of formats. In this presentation, I will discuss our recent progress generating 3D conducting polymer devices, to simultaneously host and monitor complex multi-cellular models of tissues and organs. Electrophysiological recording of parameters such as tissue impedance, epithelial and endothelial barrier tissue integrity and neuronal activity, are all made possible thanks to the conducting polymer devices and are validated with traditional biological readouts such as immunofluorescence or cytokine analysis. Building on our previous work that showcased a bioelectronic model of the human intestine, we are now incorporating elements of the microbiome and the immune system as well as the enteric nervous system. Coupling this model with our model of the neuro-vascular unit (including blood brain barrier) currently in progress, will bring us to our goal of a physiologically representative in vitro model of the gut-brain-microbiome axis.

Computer vision: real-time estimation of 3D body shape and glucose monitor transcription - Professor Roberto Cipolla

The last decade has seen a revolution in the theory and application of computer vision. I will begin with a brief review of some of the fundamentals with a few examples of the reconstruction, registration and recognition of three-dimensional objects from RGB images. I will then look at two practical examples we have recently developed of computer vision algorithms running in real-time on a mobile phone camera to recover 3D human body shape and to transcribe the readings on a hand-held glucose meter automatically and without using wireless connectivity (see http://mi.eng.cam.ac.uk/~cipolla/publications/inproceedings/2020-BMVC-One-shot-digital-screen-reader.pdf).

Challenges of deep learning in biomedicine - Professor Pietro Lio

This talk focuses on a graph representation forecasting of patient's medical conditions. This is a general framework that composes advanced AI approaches and integrates mathematical modelling in order to provide a panoramic view over current and future pathophysiological conditions. Our modular architecture is based on a graph neural network forecasting clinically relevant endpoints (such as blood pressure) and a generative adversarial network providing a

proof of concept of transcriptomic integrability. The graph representation of a computational patient has potential to solve important technological challenges in integrating multiscale computational modelling with AI. We believe that this framework represents a step forward towards next-generation devices for precision and predictive medicine.

SESSION TWO

Diabetes tech: the case of the artificial pancreas - Professor Roman Hovorka

Artificial pancreas systems for managing type 1 diabetes have progressed from research into clinical practice, revealing important considerations for future advancements. To mimic the healthy pancreas, basal exogenous insulin administration replicates the background insulin produced by the pancreas and additional insulin boluses are required at mealtimes, when glucose concentrations rise in response to carbohydrate consumption. As the burden of diabetes self-management remains high, there is a growing need for devices that continuously monitor glucose concentrations and automatically adjust insulin delivery rates – the so-called 'artificial pancreas' – to help maintain blood glucose in a healthy range. The presentation shows advances in artificial pancreas systems and considerations for continued progress toward widespread clinical adoption.

Wearable devices for monitoring physical activity and health - Dr Soren Brage

The study of physical behaviours as people go about their daily lives has been greatly enhanced by the technological development of wearable devices that non-intrusively can measure aspects of physical activity over extended periods of time. This talk will cover what such devices actually measure and how we may turn the raw measurements into variables that enable biological insight and translation to public health action.

Lipidomics - technological developments in data collection and analysis– Dr Albert Koulman

Lipidomics gives the opportunity to take a high-resolution snapshot of metabolism. We have been developing and extending this technology and applied it in a wide range of studies and projects.

There are important limitation in only taking one snapshot, which does not provided us with is changing or responding and often limits us to look at associations. We have developed new data analysis approaches, which allow us to look at the distribution of lipids through the body (lipid traffic analysis), and how lipids over time change in relation to health outcomes.

In the talk I will present how we developed and applied these approaches and how these helped to further understand the role of lipids and metabolites in health and disease progression. For instance, we studied Growth faltering in children in the Gambia. These growth problems arises from metabolic and endocrine dysfunction driven by complex interactions between poor diet, persistent infections, and immunopathology. We used lipidomics to measure the progression of the plasma lipids in over 400 children and used panel vector autoregression methods to assess how lipids relate to growth faltering during the first 2 years of life. We observed that polyunsaturated fatty acids (PUFAs) containing lipid groups and phosphatidylcholines consistently predict future growth outcomes. Linear growth was dynamically associated with most of the lipids, indicating a higher nutritional demand to improve

height compared to weight among growth-restricted children. This work shows how econometric data analysis tools can be successfully used to obtain new insights in a longstanding problem as growth faltering.

Enhancing clinical outcomes in human adrenal and pituitary tumours through the use of molecular imaging - Professor Mark Gurnell

Although typically benign, adrenal and pituitary tumours cause major morbidity (incl. hypertension, diabetes, infertility, visual loss), increased mortality and significantly impaired quality of life. For many patients, surgery is the preferred treatment option and offers the only real chance of cure; when this is not possible, expensive medical therapies are used, but must often be continued life-long and are associated with side effects that adversely impact disease control.

Cross-sectional imaging (CT and/or MRI) is used to localise the causative adrenal or pituitary adenoma(s) prior to surgery. However, small tumours (<1 cm) are common and frequently evade detection; in addition, coincidental adrenal and pituitary lesions (so-called 'incidentalomas') are observed on 4-7% of adrenal CT and 10-15% of pituitary MRI scans performed for other clinical indications and may be mistaken for the causative lesion.

We have developed molecular PET tracers, which target dysregulated tumoral hormone synthesis, to enable detection of small functioning adrenal or pituitary adenomas. When combined with CT and MRI (hybrid imaging) functional imaging allows precise tumour localisation and targeted intervention. In this way, many patients who would otherwise be consigned to life-long medical therapy can instead be offered curative surgery. Two of these radiotracers (11C-metomidate and 11C-methionine) have now been approved in the UK for use in routine clinical practice with Cambridge the lead NHS centre.

In parallel work, in collaboration with the Departments of Applied Maths & Theoretical Physics (Universities of Cambridge & Bath) and GE Systems (UK), we are developing novel image analysis algorithms to enhance the detection of microscopic tumours and improve discrimination from adjacent normal tissue.

SESSION THREE – FLASH TALKS

Abstract No:	**1**
Presenting Author	**Dr Meng Lu**
Position	Research Associate
Affiliation	Department of Chemical Engineering and Biotechnology, University of Cambridge
Co-authors	Charles Christensen (CEB, University of Cambridge), Jana Weber (CEB, University of Cambridge), Alexei Lapkin (CEB, University of Cambridge), Pietro Lio (Computer Laboratory), Gabi Kaminski Schierle (CEB, University of Cambridge), Clemens Kaminski (CEB, University of Cambridge)
Abstract Title	**Segmentation and quantitative characterisation of endoplasmic reticulum structures in super-resolved sequential images by deep neural network-ERnet**
Abstract	Endoplasmic Reticulum (ER) is the biggest organelle that regulates the metabolism inside the cells. The defects of ER are associated with a variety of metabolic perturbation, such as cholesterol acumulation. However, characterisation of the dynamic structure of ER remains a challenge due to its complex structures and rapid reshaping. Here we introduce a workflow that segments ER structures into tubules and sheets and extract topological features in sequential images for quantitative analysis. The workflow integrates: 1) super-resolution imaging to record the dynamic motions of ER, 2) a deep-learning neural network termed ERnet to segment the ER structure and extract feature parameters, 3) a graph theory based method to quantitatively display the dynamics in different cell models. As a core construct in the workflow, ERnet is built in a Residual Channel Attention Network (RCAN) and provided as a graphical user interface, and learns to segment ER structures not only in spatial but also in temporal domain. Application of ERnet allows us to identify a novel structure of ER where tubules slide on sheet, which was not reported before.

Abstract No:	**2**
Presenting Author	**Dr Shery Huang**
Position	Lecturer
Affiliation	Department of Engineering, University of Cambridge
Co-authors	Iek Man Lei, University of Cambridge Andy Wang, University of Cambridge
Abstract Title	**Biofabrication: from bioelectronic fibres to 3D printing and Machine Learning Co-Modelling**
Abstract	The merging of biological matter with engineering components, could transform a number of emerging fields, including regenerative medicine and bio-machine interfaces. This presentation considers examples on how biofabrication could create small sensing fibres to interface with cells; and perform clinical informatics for cochlear implant patients by integrating 3D printing and neural network machine learning.

Abstract No:	**3**
Presenting Author	**Mr Raul Silva**
Position	Research Assistant
Affiliation	CN Bio Innovations, Cambridge
Co-authors	***CN Bio Innovations Ltd., Welwyn Garden City, Hertfordshire, United Kingdom:*** Tomasz Kostrzewski Paloma Maraver Larissa Ouro-Gnao Sophie Snow Alina Miedzik David Hughes ***Institute for Liver and Digestive Health, Regenerative Medicine and Fibrosis Group, Royal Free, University College London, United Kingdom:*** Ana Levi Krista Rombouts
Abstract Title	**NASH Drug Discovery Using Human Microphysiological Systems**
Abstract	Nonalcoholic steatohepatitis (NASH) is the most severe form of nonalcoholic fatty liver disease (NAFLD), for which there are currently no approved drug treatments. Our understanding of the genetic and molecular pathways underlying NAFLD/NASH progression has relied primarily on in vivo mouse models, and these do not fully represent the key aspects of the human disease state. We have developed a fully human in vitro NASH model using primary human hepatocytes, Kupffer and hepatic stellate cells, which are cultured together in 3D microtissue structures in a perfused microphysiological system (MPS). The microtissues are cultured in medium containing free fatty acids for at least 2 weeks to induce a NASH-like phenotype. The NASH model captures all key aspects of the human disease: intracellular fat accumulation, inflammation (secreted cytokines and chemokines) and fibrosis (extracellular matrix laydown). The transcriptomic profile of the model was shown to closely correlate with the profile of patient samples and the model was found to be responsive to dietary and pharmacological intervention. We demonstrate how the MPS NASH model can be used to model different aspects of clinical NASH and be used to investigate mechanisms of actions for novel NASH therapeutics.

PROGRAMME COMMITTEE

Davide Chiarugi, Bioinformatics and Biostatistics Core Facility, Wellcome-MRC Institute of Metabolic Science, University of Cambridge

Verena Stoeger, Department of Chemical Engineering and Biotechnology, University of Cambridge

Róisín M. Owens, Department of Chemical Engineering and Biotechnology, University of Cambridge

Angela Lumsdon, Co-ordinator, Cambridge Metabolic Network

The Cambridge Metabolic Network, is one of several Strategic Research Initiatives and Networks funded by the University of Cambridge to build on areas of existing research strength by bringing together a critical mass of expertise from across the University Schools and beyond. The four key aims of this approach are to:

- address large-scale inter-disciplinary research challenges
- strengthen research collaborations and knowledge transfer across disciplines
- increase research capacity and profile by providing a platform for large-scale funding applications, recruitment and international research partnerships
- enhance our ability to influence national and international research, policy and funding agendas.

Joining the Cambridge Metabolic Network is free and is open to Cambridge-based researchers, at any level of their career, with an interest in research relating to metabolism. The online researcher directory allows people to search for network members with interests or expertise in particular areas. We encourage everyone based in Cambridge and with an interest in metabolism to join us at Network events and we are always open to new ideas from our members.

www.metabolism.cam.ac.uk

Contact: Angela Lumsdon, Network Co-ordinator, aml95@medschl.cam.ac.uk

Twitter: @CamMetaboNet

UNIVERSITY OF CAMBRIDGE
Chemical Engineering and Biotechnology

The department of Chemical Engineering and Biotechnology at the University of Cambridge is one of the UK's leading research departments, ranking highly in both national and international university league tables. The department's research strategy responds to the global drive for sustainability, addressing the need for novel chemical engineering and biotechnology processes and materials.

We are committed to working at the interfaces of engineering, chemistry, biology and physics, with cross-collaborations between research groups working strongly encouraged. These interdisciplinary research activities are structured to provide novel solutions to technical and economic challenges, which affect most aspects of modern living.

Since 2017, the department has been based in a new, fit-for-purpose building on the University's West Campus that houses all of our research and teaching in a single building.

https://www.ceb.cam.ac.uk/

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