The Future of ISM

4th November 2019

"The future did not come by itself. Someone brought it"

Anonymous

CISMA
COLLOQUIA IN INTELLIGENT SENSING, MEASUREMENT AND ACTUATORS

UofG OS

Programme

0900 – **Registration** and coffee
0930 – **Session 1 - Metrology**
0940 – Prof Andy Mount
1010 – Dr Tushar Semwal
1040 – Coffee break and posters
1110 – Prof Walter Johnstone
1140 – Prof Colin Campbell
1210 – Dr Paul Fitzsimons
1240 – Lunch break and Posters
1330 – **Session 2 - Biomedical Imaging**
1340 – Dr Leo Carlin
1410 – Dr Gabrielle Thomas
1440 – Miss Anna Magdalena Koester
1510 – Refreshment break and posters
1540 – Dr Madeleine Cunningham
1610 – Dr Jonathan Taylor
1640 – Gifts and farewell
1700 – Close

This event has been fully funded by the Centre of Doctoral Training in Intelligent Sensing and Measurement (CDT-ISM) – www.cdt-ism.org Network Support from OSA and SPIE.

Pushing the Boundaries: Advances in electrochemical sensing, monitoring and analysis

Prof Andy Mount

This talk will outline developments in electrochemical sensing and monitoring at Edinburgh, which build on novel systems design, microfabrication and measurement. These measurements both provide insight into fundamental electrochemical response and demonstrate enhanced sensor system performance. The talk will also highlight the application of these systems to measurement at the micro and nanoscale and in challenging and/or extreme operating environments where sensing and monitoring is of real interest.

Sensing and Robotics Opportunities in Offshore Industries

Dr Tushar Semwal

Offshore industries such as Oil and Gas, and Wind energy are facing a shortfall in the human workforce primarily owing to the harsh and dangerous working environment. Besides, increasing oil and energy prices have led these industries to seek cost-effective and safe methods for asset monitoring and integrity. This talk will cover different sensing and robotics applications, use-cases, and challenges found in offshore energy industries. I will also share our research solutions as carried out under the ORCA Hub project. We will primarily discuss real-world problems and solutions for different industrial environments.

Laser Imaging of Chemical Species in Extreme Environments: Aero-engines

Prof Walter Johnstone

The pressure to reduce emissions from gas turbine engines is building ever faster with new understanding of the adverse impact aviation has on both the global environment (climate) and local air quality (impact on human health). As such the industry has a strictly timetabled roadmap of severe emissions reduction targets which will be enforced through legislation and certification. Compliance will require new engine and fuel technologies with improved efficiency to achieve vast reductions in CO2, NOx and Soot (in particular). In the words of

Lord Kelvin "if you can't measure it you can't improve it". Hence, new disruptive measurement technology is required to gain better understanding of the combustion and emissions generation processes, both in the exhaust plume and the combustion zones of engines. This talk will outline the current UK state of the art in 2D cross-sectional imaging of the concentration and temperature of key target species in the exhaust plumes of gas turbine engines and plans to make such measurements in the combustion zones. The technology is applicable to other applications and some of the work on these will be introduced.

Shining Light on Life

Prof Colin Campbell

Life is complicated. Raman spectroscopy, the process of shining light on a sample and analysing how the light changes as a result of its interaction with the sample can be hugely informative if interpreted properly. I'll present some studies where my group has helped answer fundamental questions about how life works, and specifically how cystic fibrosis and atherosclerosis work, using Raman spectroscopy.

Supercontinuum Lasers for Biomedical Imaging Applications

Dr Paul Fitzsimons

Pulsed broadband laser light sources are enabling discoveries in biology, material and chemical sciences not achievable with any other technology. The supercontinuum lasers behind the highest resolution optical microscopes have been around for less than 20 years and allow both full spectroscopic investigations between 260nm to 2200nm, and simultaneous dynamic investigations of effects on the picosecond to nanosecond time scale. This talk will introduce the technology behind supercontinuum generation and provide application examples of how it is used to advance research within bioimaging.

Imaging Immune Cells in Cancer

Dr Leo Carlin

Cells of the immune system have been implicated in almost every stage of cancer development. However, even though the immune system is our evolved defence against infection and pathogenesis, it is not always protective in cancer, and anti-cancer immunity can be opposed by pro-tumour immune behaviour. We use innovative light microscopical approaches to image immune cells in live and fixed tissue from tumour models to gain a spatiotemporal appreciation of immune cell dynamics in cancer. We are using this information to better understand how tumour cells interact with the immune system, how therapies influence these interactions, and how they might be better timed, combined or targeted in the future.

The Aurora Airy Beam Light Sheet Microscope for Imaging Complex Biological Samples

Dr Gabrielle Thomas

From the discovery of bacteria to the tracking of individual molecules, optical microscopes have been instrumental to our understanding of disease, disorders, and life itself. But microscope users increasingly need to image large, complex, living 3D samples over long periods of time. Based on cutting-edge IP from the University of St Andrews, M Squared have developed a novel light sheet microscope that uses Airy beam illumination to address these needs – the Aurora Airy beam light sheet microscope. In this talk, I'll present an overview of Aurora's development story to date, along with some incredible images captured by our development partners.

Investigating Spatio-Temporal Dynamics of Glut4 Dispersal in Cardiomyocytes

Miss Anna Magdalena Koester

Individuals with Type 2 diabetes mellitus (T2DM) are at significantly increased risk of cardiovascular disease. One of the major hallmarks of T2DM is a significant decrease in myocardial glucose uptake. Glucose transport in fat, skeletal and cardiac muscle is mediated by the glucose transporter GLUT4 that is mobilized to the cell surface from intracellular stores in response to insulin. Stochastic optical reconstruction microscopy (STORM) revealed that insulin not only regulates GLUT4 translocation to the plasma membrane (PM) but also its distribution within the PM in adipocytes. In my project, I applied STORM to investigate spatio-temporal dynamics of GLUT4 dispersal using cardiomyocytes as a model system. Key research questions include does exercise regulate GLUT4 dispersal in cardiomyocytes, how specific is the dispersal process and it is impaired in conditions of insulin resistance.

Imaging calcium changes in *ex vivo* mouse models of axonal Guillain-Barré syndrome

Dr Madeleine Cunningham

Guillain-Barré syndrome (GBS) is a peripheral neuropathy that causes acute paralysis. Calcium is an important mediator of injury in GBS as it activates a protease that degrades axonal proteins. Our aim was to develop a method by which we could detect and quantitate changes in axonal calcium in our *ex vivo* model of GBS. Using tissue from mice that express a genetically encoded FRET-based calcium indicator in axons we monitored calcium changes up to 1 hour following injury using a Zeiss LSM 7MP. This method provides a useful tool to study the effects of calcium on axon degeneration in our GBS mouse models.

Clean image-based measurements in messy biological environments

Dr Jonathan Taylor

What makes a good optical "measurement" in biology? The optical resolution performance of a microscope is only half the story. A biologist must be able to analyze the resultant images and draw meaningful conclusions from them. Other considerations include: the statistical benefits (but optical challenges) of longitudinal imaging of a single specimen; minimally-invasive imaging that does not cause physical, photochemical or thermal damage to a sample; motion-stabilized imaging. I will discuss the challenges, present some approaches to overcome them, and pose open questions. Finally, I will consider whether image formation is needed at all, in order to make a complex optical measurement.

Collaborators

ISM

EPSRC

OSA The Optical Society Glasgow Student Chapter

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