CDT ISM Symposium in Microfluidics and Optics Agenda

Thursday, July 07, 2016

Welcome to the first student-led symposium from the Centre for Doctoral Training in Integrative Sensing and Measurement (CDT-ISM). The CDT-ISM encourages collaboration across disciplines. This is reflected in the multidisciplinary nature of the student cohort. We hope that you will enjoy this opportunity to engage with researchers at various stages in their careers working at the cutting-edge of microfluidics and optics.

10:00 am to 10:30 am	Registration
10:30 am to 12:00 am	**Opening Address** Lynn Paterson: **Application of microfluidics and optical forces to the early stages of biodiscovery** Marieke van der Putten: **Towards minimally invasive in vivo oximetry** Yongzhuang Zhou: **3D microfluidic particle tracking with complementary kernel matching imaging** Julien Reboud: **Acoustics and Microfluidics - integrating microfluidics functions using wave shaping with phononics**
12:00 am to 1:00 pm	Lunch
1:00 pm to 2:30 pm	Ewa Guzniczak: **Microfluidic approaches to particles separation, application of spiral channels for bioprocessing** Vytautas Zickus: **Optical measurement and modelling of blood flow in the developing heart of the zebrafish** Yash Diptesh Shah: **Fun with waveguides in THz quantum cascade lasers** Huabing Yin: **Integrated optical microfluidic platforms for bioanalysis**
2:30 pm to 2:50 pm	Break
2:50 pm to 4:20 pm	Richard Middlemiss: **Optical sensing: from shadows to interferometers** Rachel Offer: **Cavity-enhanced frequency up-conversion in rubidium vapour** Graham Gibson: **High-speed micro-manipulation & force measurements in holographic optical tweezers** David Phillips: **All optical scanning probe microscopy** **Closing Address**

7 / 07 / 2016
Room 312, Kelvin Building, University of Glasgow

Abstracts

Application of microfluidics and optical forces to the early stages of biodiscovery

Speaker: Dr Lynn Paterson (RCUK Research Fellow and Lecturer, Institute of Biological Chemistry, Biophysics & Bioengineering, Heriot-Watt University)

Abstract: Microorganisms contain an untold and untapped amount of new biology due to the diversity of species that continue to remain unculturable in the lab. We use ultrafast laser inscription and selective chemical etching to create devices with three dimensional microfluidic circuitry and waveguides to manipulate and isolate single cells with a view to create pure cultures or to perform single cell 'omics' studies.

Towards minimally invasive in vivo oximetry

Speaker: Ms Marieke van der Putten (PhD Candidate, Imaging Concepts Group, University of Glasgow)

Abstract: In this talk I will give a brief introduction to oximetry, and how this is accomplished with multispectral imaging. I will report my PhD work to date, relating to oximetry of mouse tendon tissue with models of inflammation. Finally, I will discuss plans for future work involving minimally invasive microendoscopic probes.

3D microfluidic particle tracking with complementary kernel matching imaging.

Speaker: Mr Yongzhuang Zhou (PhD Candidate, School of Physics, University of Glasgow)

Abstract: We describe a novel 3D particle tracking velocimetry (PTV) technique in microscopy using the wave-front coding method. Unlike conventional stereoscopic PTV, this technique has an extended depth-of-field (DOF) and requires only a single lens and detector.

Acoustics and Microfluidics - integrating microfluidics functions using wave shaping with phononics

Speaker: Dr Julien Reboud (Lord Kelvin Adam Smith Research Fellow, University of Glasgow)

Abstract: The drive towards the decentralisation of medical diagnostics has been hindered by the difficulties associated with providing highly sensitive devices that can function with complex patient samples. Here we will show how surface acoustic waves, mechanical waves propagating on the surface of materials, enable a large range of microfluidic functions, which can be integrated using phononic crystals, micro fabricated structures akin to holograms, onto low-cost point-of-care molecular diagnostic devices, with applications in infectious diseases.

Microfluidic approaches to particles separation, application of spiral channels for bioprocessing

Speaker: Ms Ewa Guzcinak (PhD Candidate, Heriot-Watt University)

Abstract: Spiral microfluidic channels can perform a fast, reliable and continuous separation of particles based on their intrinsic mechanical properties (size, shape, deformability). We are

exploring the potential of this technology to develop novel separation protocols for bioprocessing (e.g. for water quality control or stem cell-derived red blood cells purification).

Optical measurement and modelling of blood flow in the developing heart of the zebrafish

Speaker: Mr Vytautas Zickus (PhD Candidate, Imaging Concepts Group, University of Glasgow)

Abstract: By exploiting the optical transparency of the zebrafish embryos and combining selective plane illumination microscopy (SPIM) with micro particle image velocimetry (micro-PIV) we are able to acquire high spatio-temporal resolution flow fields in the vasculature and the heart. Reconstructed 3D flow fields from a phantom experiment, as well as preliminary zebrafish in vivo results, will be presented

Fun with waveguides in THz quantum cascade lasers

Speaker: Mr Yash Diptesh Shah (Research Assistant, Electronic and Nanoscale Engineering, University of Glasgow)

Abstract: Terahertz (10^{12} Hz) quantum cascade lasers are a compact, coherent and robust source in the electromagnetic spectrum between microwaves and infra-red. However, in a metal-metal waveguide (similar to transmission lines used in microwaves), these QCLs give the best temperature performance but a poor beam pattern. We look at a few ideas implemented to collimate and smoothen the beam pattern. I will talk about externally attaching waveguides to the QCL facets as well as intrinsically changing the waveguide that resulted in a less divergent beam pattern without any degradation in the performance of the lasers.

Integrated optical microfluidic platforms for bioanalysis

Speaker: Dr Huabing Yin (Senior Lecturer in Biomedical Engineering, University of Glasgow)

Abstract: Microfluidics has emerged as a powerful enabling technology for applications as diverse as advanced biological analysis and material synthesis. Key to these applications is the realization of effective on chip sample detection. In this context, optical detection offers many unique advantages, including being non-destructive, non-contact, specific and information-rich. In this talk, I will illustrate the potential of optical microfluidic platforms in advanced bioanalysis using two case studies, namely an integrated Raman-microfluidics system for single cell sorting and a miniaturized microspectrometer for fluorescence based analysis.

Optical sensing: from shadows to interferometers

Speaker: Mr Richard Middlemiss (PhD Candidate, Institute for Gravitational Research, University of Glasgow)

Abstract: I will discuss the development of optical sensors developed in the Institute for Gravitational Research (IGR) – that are used to measure the displacement of a MEMS gravity sensor.

High-speed micro-manipulation & force measurements in holographic optical tweezers

Speaker: Dr Graham Gibson (Research Fellow, School of Physics, University of Glasgow)

Abstract: Holographic optical tweezers use spatial light modulators to shape laser beams in a microscope, creating arbitrary 3D arrangements of optical traps. Trapped microparticles can be used as force measurement probes where a high-speed camera tracks the displacement of the particles from their equilibrium position. Applications include studying cell-cell interactions and measuring the local viscosity in microfluidic samples.

All optical scanning probe microscopy

Speaker: Dr David Phillips (Royal Academy of Engineering Research Fellow, University of Glasgow)

Abstract: A scanning probe microscope (SPM) enables the imaging of surfaces with nanoscale resolution. In this talk I will describe the development of an SPM using an optically trapped and controlled probe that is levitated using light, and can investigate samples inside sealed microfluidic chambers.