NORTHERN RESEARCH PARTNERSHIP

Imaging and Sensing in Medicine and the Life Sciences

Workshop

Wednesday 22nd February 2012: 09.00 - 15.00

Court Senate Suite, Collins Building, University of Strathclyde, Glasgow G1 1XQ

Whether imaging individual molecules within cells or imaging whole body systems, rapid developments are being made in imaging and sensing biological processes.

This workshop is proposed as the start of a new initiative to span all of the current pooling initiatives within Scotland and industry. Taking the format of short, high-impact talks, this workshop aims to identify critical problems in the area of "Imaging and Sensing in Medicine and the Life Sciences" which could be addressed by collaborations between partners in SU2P, SINAPSE, NRP / SRPe, SUPA, SULSA, SICSA and Industry.

Coffee and lunch breaks will be scheduled with ample time to allow networking and follow-up of topics introduced in the presentation sessions.

Two forms of contribution will be presented:

- Academic staff and industrial researchers will deliver 5-minute presentations, with an additional 1-minutes provided for questions. Presentations will highlight a promising scientific or technical capability, or alternatively will define an important unsolved problem in the theme area.
- Students and post-doctoral researchers, or those that prefer to do so, have submitted posters for display during the coffee and lunch breaks.

Registration is CLOSED

Agenda

8.45	Registration and Coffee
Session 1: Chair Frank Gunn-Moore	
9.15	Keynote: Derek Swan, Optos (www.optos.com)
9.45	12 off 6-minute Presentations (5mins + 1min question)
11.00	Coffee and posters
Session 2: Chair Sandy Cochran	
11.30	12 off 6-minute presentations (5mins + 1min question)
12.45	Wrap-up - Professor David Wyper, University of Glasgow, SINAPSE Director
13.00	Lunch, Networking and Posters
15.00	Close (rooms available to 15.00 to allow for networking)

Talks Session 1

1	Prof Kurt Anderson	The Beatson Institute for Cancer Research	Mouse Imaging at the Beatson Advanced Imaging Resource	An important challenge is to develop imaging approaches to exploit the power of mouse models for the molecular level investigation of disease and therapy. We have integrated multiple imaging systems into a pipeline, enabling probes and experimental parameters to be characterized first in vitro and then translated into mouse models. Our main system is a LaVision BioTec multiphoton TRIM scope equipped with Ti:Saph and OPO lasers, 3 non-descanned detectors, and a 16 channel TCSPC FLIM detector.
2	Dr Tomas Cizmar	St Andrews	Photonics through disorder	We present a powerful approach towards control of laser light within turbid environments and especially multimode optical fibres. Transmission of light within such media introduces randomization of laser beam amplitude, phase and polarization. We discuss the importance of each of these factors and introduce an experimental geometry allowing full analysis of the light transmission and subsequent beam-shaping.
3	Dr Graeme Clark	Lein Applied Diagnostics Ltd	Confocal metrology for medical sensing	Lein's confocal technology is now being used in company and university laboratories, for applications including pharmacokinetics and tissue engineering. Our technology offers unique advantages in size, cost and performance, enabling non-contact optical measurements in parts of the body and materials that haven't been possible before. The presentation will describe the technology and some of the current applications.
4	Prof Sandy Cochran	University of Dundee	Dexterous manipulation of particles and cells with ultrasound	Ultrasound devices can provide larger forces and manipulate on larger particles, cells and groups of cells than other manipulation techniques. Consequently, they have applications in life sciences for sorting, investigation of cell characteristics and positioning cells at sensors. We report the design, fabrication and experimental demonstration of electronically controlled Sonotweezer devices for controlled trapping, translation and positioning of particles within a microfluidic channel.
5	Prof David Cumming	Glasgow	High speed video proton imaging	We have developed a CMOS imaging system that senses ion species directly without the need for optical mediation. Using this device we have been able to show that we can observe the mixing and diffusion patterns of vital ions in realtime on the microfluidic scale. The data may then be modelled to extract a direct measurement for the diffusivity over the sensor surface. We can also show direct observation of chemical reactions as they occur on the sensor surface.
6	Dr Christine Demore	University of Dundee	Ultrahigh resolution ultrasound imaging for life sciences research	Ultrasound penetrates into the depth of tissue; therefore, it can provide information about tissues not possible with optical methods. We present high resolution (~50 m) cross-section images through the depth of ex vivo mouse bowel to show the quality of images possible with high frequency (40 MHz) ultrasound transducers. We also present progress towards ultrahigh resolution 3D ultrasound imaging (<10 m), suitable for resolving, and possibly tracking, individual cells.

7	Dr Andrea Di Falco	St Andrews	Integrated photonics solution for life science applications	We report on our portfolio of approaches to life science applications in an integrated photonic platform. In particular we discuss some of the smallest and most sensitive biosensors yet reported, based on slotted photonic crystal cavities; show how metallic gratings can act as filters for sensing applications, and how novel concepts such as transformation optics can reach super-resolution for on-chip imaging.
8	Dr Suzanne Duce	University of Dundee	Quantitative analysis of the lower legs of young adults with clubfoot	Leg anatomy of clubfoot/CTEV adults was investigated. 3D T1-images and magnetic resonance angiography were acquired. The leg, muscle, tibia and fibula volumes in affected legs of unilateral CTEV patients were consistently smaller compared to their contralateral unaffected leg. The proportion of muscle was reduced, proportion of intra-muscular fat increased. No abnormalities in location or branching of arteries were detected but hypoplasia was observed. Potential metric for CTEV were identified.
9	Dr Alan Fleming	University of Aberdeen	Improving care of people with eye disease and vascular diseases through automated retinal image analysis	We have developed well validated automated grading algorithms for diabetic retinopathy which are in operation in NHS. Automated image analysis and the extensive photographic data collected in a decade of systematic screening for diabetic retinopathy promises a better understanding of eye disease than ever before. Care of people with vascular diseases could be improved by making good use of the eye as a window for part of the vasculature which has similar physiology to the cerebral vasculature.
10	Dr Richard FU	University of West of Scotland	Lab-on-chip biosensing devices based on sputtered ZnO films	This talk presents the fabrication and characterisation of an integrated SAW microfluidic device using sputtered ZnO thin films on vairous substrates. Different functions of droplet separation, merging, streaming, mixing, pumping, nebulization and jetting have been realized. The ZnO SAW based device has also been used for biosensing using antibody and antigen. ZnO film based SAW devices have also integrated with microelectronics and other microfluidic/sensing technologies.
11	Prof Alan Greenaway	Heriot Watt	Depth tracking with nanometric acuracy	Techniques developed for wavefront sensing in astronomical adaptive optics allow simultaneous focus on multiple specimen planes in microscopy. This contribution will illustrate the use of such techniques for depth measurement in many microscope imaging modes and, in particular, application to achieve nanometric precision when imaging and tracking faint particles and high-speed processes.
12	Prof Andy Harvey	Glasgow	Spectral imaging in the eye	Spectral imaging promises a route to non-invasive imaging of chemical distributions in the retina. Light propagation in the translucent and scattering retina is, however, highly complex. Our research is focused on novel instrumentation, techniques and algorithms that enable absolute measurement of retinal blood oxygenation based on changes in the optical signature of blood with degree of oxygenation.

Talks Session 2

13	Dr Peter Hoskins	Edinburgh University	Measurement of tissue mechanical properties in-vivo elastography using ultrasound and MRI	Elastography is concerned with measurement of the mechanical properties of tissues. Initiation of shear waves is commonly performed using an external actuator for MRE, and acoustic radiation force for ultrasound. The propagation of shear waves through the tissues is tracked using the imaging system, and local wave speed is estimated, and elastic modulus estimated using a simple formula. I will describe our experience of MR and ultrasound elastography and on simulation of elastography.
14	Dr Weiping Lu	Heriot Watt	An automated particle tracking methods for life science applications	We present an automated system that can detect and track transport particles, including sub-resolution single molecules, in live cells under challenging low signal to noise ratio environments. The software has been successfully applied to very large PALM data sets comprising tens of thousands of single molecule tracks.
15	Prof David Lurie	University of Aberdeen	Field-Cycling MRI: 1000 Magnetic Fields in One Scanner	MRI is a very useful, non-invasive imaging method. However, standard MRI misses important information because each scanner only works at a single magnetic field value (e.g. 1.5 or 3.0 tesla). We have developed Fast Field-Cycling MRI, in which the magnetic field is switched rapidly between levels during the imaging procedure. The resulting magnetic field-dependent information (invisible to standard MRI) provides important information, especially pertaining to protein concentration and motion.
16	Dr Michael MacDonald	University of Dundee	Lightsheet Microscopy in Dundee	The Biophotonics Group in Dundee are currently developing lightsheet microscopes for a range of applications in the life sciences. A novel Lightsheet Tomography approach is taken for imaging plant roots in transparent soil, whilst a more sophisticated high speed Digitally Scanned Lightsheet Microscope (DSLM) has been developed for developmental physiology, imaging both dictyostelium discoideum and chick embryos.
17	Dr Keith Mathieson	Strathclyde	High-resolution implants for degenerative retinal diseases	Degenerative retinal diseases are amongst the most common causes of blindness in the developed world. Age-related Macular Degeneration and Retinitis Pigmentosa are two such diseases where the photoreceptor layer degenerates, while the inner retinal neurons survive. Electrically activating these neurons provides an alternative route for visual information, and raises hope for the restoration of sight to the blind. Recent results from high-resolution subretinal implants will be presented.
18	Ms Shona Matthew	St Andrews	The Development of Cardiac Magnetic Resonance Imaging for the Detection of Age and Disease Related Changes in the Human Heart.	Recent developments in magnetic resonance imaging (MRI) hardware and software have transformed cardiac MRI (CMRI) from a complicated, artifact prone technique that was largely avoided by the cardiac community, into an essential clinical tool that is now considered gold standard. This talk highlights why CMRI is superior to other imaging modalities for the assessment of age and disease related changes to cardiac mass, function and myocardial viability before discussing the potential of CMRI to provide a full cardiac assessment in a single imaging session.

19	Dr Steven Neale	Glasgow	Optoelectronic Tweezers as a medical diagnostic sensor	Optoelectronic Tweezers are a method of moving micro and nano particles with optically controlled electrical fields. The force different particles experience depends on their physical properties and hence can be used to differentiate between different species of particles. I will briefly describe a few applications including how we can help with the diagnosis of African sleeping sickness, how we can differentiate healthy from damaged sperm cells and determine the developmental stage of embryos.
20	Dr Ben Panter	Blackford Analysis Ltd.	Blackford Analysis - Fast Image and Volume Processing	Blackford Analysis develops cutting edge algorithmic solutions to problems requiring real-time analysis of datasets. A key focus for the company is the worldwide medical sector but it also undertakes software design and consultancy work for the oil and gas, and defence industries. Our first product performs 3D registration of large medical volumes. I will give a brief introduction to the image analysis and registration techniques we have developed, and the applications we are exploring.
21	Dr Sally Pimlott	Glasgow	MicroPET and MicroSPECT imaging: Translational research techniques	PET/SPECT are in vivo molecular imaging techniques that use radiotracers to monitor molecular pathways in living organisms. MicroPET/SPECT measure the biodistribution of small amounts (<10-10M) of radiotracers with sub-millimetre resolution. PET/SPECT radioisotopes penetrate tissues and thus radiotracers developed in small animals can be into a clinical setting. A limitation is the availability of radiotracers. SINAPSE is currently coordinating developments in Scotlands radiochemistry centres.
22	Mr Jim Small	mLED	Innovative light sources for medical applications	mLED, a spin out from the Institute of Photonics at University of Strathclyde are manufacturers of pattern-programmable solid-state micro-projectors. These light sources have found applications in the fields of Optogenetics, as optical tweezers and in other emerging technologies.
23	Dr Tom Baer	Stanford	Stem Cell Imaging at Stanford University	Video presentation.