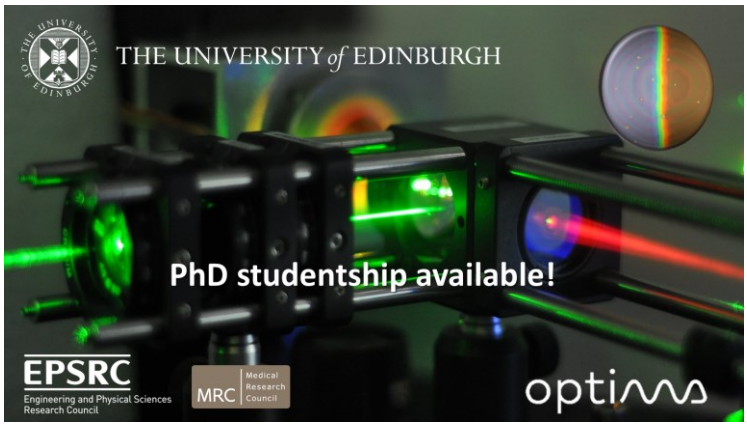
Funded PhD opportunity in:

Tuneable liquid crystal lasers for fluorescence-based retinal disease diagnostics



Supervisor: Dr Philip Hands (School of Engineering)

Second Supervisors: Dr Toby Hurd, Dr Ann Wheeler (IGMM)

Clinical Partner: Prof Baljean Dhillon

Description:

This PhD research project will develop newly-emerging tuneable and highly-customisable liquid crystal laser sources, and apply them to the field of fluorescence-based retinal imaging, for the detection of age-related macular degeneration and other ophthalmic diseases.

Autofluorescent (or fluorescent-tagged) biomarkers such as lipofuscin, within the retinal pigment epithelium, can be optically probed using lasers to search for ophthalmic medical abnormalities. Despite the potential capabilities of this technique, its clinical adoption is somewhat limited, restricted to specialist laboratories. Each fluorescent biomarker has its own specific optical absorbance range, and so medical equipment must compromise between detection versatility (i.e. containing multiple lasers with different wavelengths, each targeting a different marker, and hence be large, bulky and expensive), or portability (i.e. contain only a single laser source addressing a single fluorophore, and hence be small and portable). Compromised systems must also be built around the availability of existing light sources, which do not cover the full colour spectrum, resulting in poor signal strength and signal ambiguity due to overlapping absorbances between multiple fluorophores.

Newly-developed liquid crystal (LC) lasers use self-assembling chiral nanostructures to create tuneable laser cavities only 10 μm thick, and when doped with organic dyes enable simple, highly efficient and customisable laser emission over the visible spectrum (450-850 nm). They have great potential as small, low-cost, switchable and tuneable light sources for medical imaging applications, thus eliminating the requirement to compromise between versatility, portability and cost, and potentially enabling cheaper, smaller and more effective diagnostics tools. Tuneable LC lasers can be designed to perfectly match the absorbance requirements of the biomarkers, maximising detection capabilities. They also provide a simple route to providing new modalities of detection, such as ratiometric imaging and fluorescence lifetime imaging, through temporal control of rapidly changing pulsed wavelength patterns.

Working in collaboration with engineers, biomedical scientists, ophthalmic clinicians and a world-leading microscopy manufacturer on a highly interdisciplinary project, the student will demonstrate a proof-of-concept system using LC lasers to perform clinically-relevant fluorescence imaging of the retina for disease diagnostics. They will use cleanroom microfabrication, opto-mechanical and electro-optical approaches to construct bespoke LC laser and microscope systems (with properties including tuneable wavelengths and temporal control of single or multiple simultaneous beams). LC lasers will be designed to optimally probe multiple common fluorescent retinal markers simultaneously, and their performance advantages compared to conventional sources will be validated. Further investigations will also be made into the clinical opportunities of techniques such as ratiometric imaging and fluorescence lifetime imaging, enabled by LC lasers, to provide improved data to the field of point-of-care ophthalmic disease detection. Opportunities for commercial development will also be explored, in collaboration with our industrial partners.

Further information:

This Sept 2017 entry PhD is offered through the Centre for Doctoral Training (CDT) in Optical Medical Imaging (OPTIMA): http://www.optima-cdt.ac.uk/

The successful applicant will join a cohort of OPTIMA CDT students on a 4 year program of research and integrated study at the University of Edinburgh. They will be primarily based at the School of Engineering, Institute for Integrated Micro and Nano Systems (IMNS), but will collaborate closely with the MRC Institute of Genetics and Molecular Medicine (IGMM). Clinical guidance and support is also provided from a Consultant Ophthalmologist, and opportunities also exist for collaboration and commercialisation with industry partners.

This is a highly interdisciplinary research project, involving aspects of physics, chemistry, biology and engineering, and has a strong emphasis on experimental work.

To apply or for further enquiries, please send a cover letter and a full CV with details of two academic referees to philip.hands@ed.ac.uk and imaging.cdt@ed.ac.uk. The cover letter should clearly state your eligibility and why you are interested in applying for a studentship with OPTIMA.

Eligibility:

Note: The successful applicant must take up the position from September 2017.

Minimum entry qualification - an Honours degree at 2:1 or above (or International equivalent) in a relevant science or engineering discipline, possibly supported by an MSc Degree. Experience of photonic systems development would be of advantage. Further information on English language requirements for EU/Overseas applicants.

Please note OPTIMA studentships are subject to Research Council funding eligibility criteria (e.g. EPSRC student eligibility rules, including 3 years previous residency in UK). We do have a limited number of studentships for which EU nationals can apply. OPTIMA cannot support tuition fees for overseas students but welcome applications from self-funding international students.

Funding:

OPTIMA studentships cover fees and stipend for four years funded by the EPSRC and MRC. Further fees information and other funding options.