

Date of submission:
Project title:

1



SINAPSE

PhD Project Proposal Template for PhDs with Partner Support starting in 2011

PROJECT

Title: Widefield retinal scanning in diabetes and cardiovascular disease as a marker of cardiovascular and neurological impairment.

Planned start date (month/year):

October 2011

SINAPSE Centre (i.e. primary university to which this studentship will be attached):

University of Dundee

University supervisor: contact details

**Name: Graeme Houston (SINAPSE Chair of Clinical Imaging)
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Key other university people involved with project

**Dr Rory McCrimmon, Diabetes, (University of Dundee), Prof Manuel Trucco, (University of Dundee), Dr Alex Doney, Stroke Physician, (University of Dundee)
Prof Graham Leese, Consultant Diabetologist, (NHS Tayside), Peter Wilson (Ophthalmology, Dundee)**

Partner

Optos plc

Partner contact details

Name: Jano van Hemert

Key Other Partnership people involved with Project

Prof Arlene Astell, (University of St Andrews), Prof Edwin Van Beek, (University of Edinburgh), Prof Bal Dhillon (Honorary Professor of Ophthalmology), Dr Tom McGillivray (University of Edinburgh)

Likely background of suitable student (eg. Neuroscience, MR Physics, Chemistry, Psychology) and essential skills required prior to starting this PhD:

Background: Medical Physics, Neuroscience, Cardiovascular Disease, Life Sciences, Informatics, Computer Science, Biomedical Engineering

Essential Skills: Image processing, preferably biomedical. Medical knowledge would be a distinct benefit.

Summary of proposed project (approximately 200 words):

The retina offers opportunity for direct, non-invasive study of the human microvasculature and its relationship to cardiovascular (CVD) and neurological disease in diabetic and non-diabetic patients. The main challenge is the identification of early biomarkers of cardiovascular and neurological deficit in diabetes and CVD, i.e. subtle changes to structural features such as vessel width, branching angles and vessel tortuosity as observed in ultra-widefield retinal images captured by OPTOS camera systems. This is in addition to the established retinal scoring of diabetic eye disease.

The Optos system has been validated in Dundee (1) and at CRIC and Dundee University (Computing) and other international centres we have been developing software (VAMPIRE) for automatic quantification of retinal features. In addition, recent work undertaken by current SINAPSE PhD studentships in Dundee is examining the strength of link between retinal changes and cognitive impairment in diabetes compared to non-diabetic normal volunteers and between cardiovascular MRI in diabetes and non-diabetic patients. Dundee has multiple studies (TASCFORCE, CVMD NT 114, and EU SUMMIT study) which use cardiovascular MRI to assess whole body atheroma burden and cardiac function as biomarkers of cardiovascular disease.

Leveraging the existing clinical facilities and studies in Dundee and Edinburgh, and the neurosciences expertise in St Andrews, we intend to build a substantial repository of cross-linked image data and relate retinal biomarker data to MRI-derived indicators of cardiovascular disease.

The project will involve:

1. Acquiring retinal images using Optos widefield ophthalmoscope.
2. Participating in the development of novel post processing algorithms.
3. Processing and analysing images to investigate potential biomarkers.
4. Collecting MRI derived data whole body atheroma and cardiac function in diabetic patients, non-diabetic patients with and without vascular disease and screening asymptomatic volunteers.
5. Analysing relationships between retinal biomarkers and MRI indicators and serum biomarkers of cardiovascular and neurological disease.

Key references (up to five):

1. P. Wilson J. Ellis A. Ellingford J. Talbot C. MacEwen G. Leese Screening for diabetic retinopathy: A comparative trial of biomicroscopy, photography and scanning laser ophthalmoscopy. *Euretina* May 2009.
2. Tiew, Perez-Rovirez, Trucco, MacGillivray, Mahmood, Bishop, Aslam. (2011). Experience In Using The VAMPIRE Retinal Analysis Tool To Assess Tortuosity In Patients Undergoing Bevacizumab (Avastin) Treatment For Wet Age-related Macular Degeneration (AMD). *Association for Research in Vision and Ophthalmology (ARVO) 2011*
3. Perez-Rovira, MacGillivray, Trucco, Chin, Zutis, Lupascu, Tegolo, Giachetti, Wilson, Doney, Dhillon (2011). VAMPIRE: vasculature assessment and measurement for images of the retina. *Proc IEEE Int Symp on Engineering in Medicine and Biology*, Boston, Aug-Sep.
4. Waugh SA, Guntur Ramkumar P, Gandy SJ, Nicholas RS, Martin P, struthers AD, Belch JJF, Houston JG. *Optimisation of the Contrast Dose and Injection Rates in Whole Body MR Angiography at 3.0 T*. *JMRI* (2009) **30:5;1059 – 1067**.