

## **SINAPSE**

### **PhD Project Proposal for PhDs starting in 2009**

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

University of Aberdeen

**First supervisor: contact details**

**Name:** Prof. Christian Schwarzbauer  
**Department:** Division of Applied Medicine  
**Address:** Aberdeen Biomedical Imaging Centre, University of Aberdeen, Lilian Sutton Building, Foresterhill, Aberdeen AB25 2ZD, Scotland, UK  
**Email:** c.schwarzbauer@abdn.ac.uk                      **phone:** 01224 559723

**Second supervisor: contact details**

**Name:** Prof. Keith Muir  
**Department:** Division of Clinical Neurosciences  
**Address:** Division of Clinical Neurosciences, Ground Floor, Neurology Block  
Southern General Hospital, Glasgow, G51 4TF  
**Email:** k.muir@clinmed.gla.ac.uk                      **phone:** 0141 201 2474

**Speciality of first supervisor:**

MR Physics, Neuroimaging

**Speciality of second supervisor:**

Neurology, Clinical Imaging, Stroke

---

## **PROJECT**

**Title:**

Microvascular Magnetic Resonance Imaging based on the Blood Oxygenation Level Dependent (BOLD) Contrast

**Planned start date (month/year):**

November 2009

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

Essential skills:

- Background in physics, engineering, mathematics or a related field
- Proficiency in at least one high-level programming language (e.g. C, C++, Pascal, Fortran, Matlab, IDL)
- Good writing and communication skills

\*usually this would be the university in which the first supervisor is based.

**Summary of proposed project (approximately 200 words):**

Vessel size imaging (VSI) is a novel magnetic resonance imaging (MRI) technique that can be used to obtain structural information about the microcirculation far beyond the spatial resolution limit of MRI, such as the average vessel diameter (Tropres et al, 2001). The VSI technique makes use of differences in the gradient echo (GE) and spin echo (SE) contrast mechanisms to obtain information about the average vessel diameter based on a biophysical model of molecular diffusion in tissue. One major disadvantage of the original VSI approach is that it requires the injection of a paramagnetic contrast agent (Tropres et al, 2001; Kiselev et al, 2005). In a recent functional MRI (fMRI) study of visual stimulation it was demonstrated that the blood oxygenation level dependent (BOLD) contrast can be used to obtain information about the average vessel diameter (Jochimsen et al, 2008). Although this technique does not require the injection of a paramagnetic contrast agent, its application is limited to activated brain regions, i.e. areas in which a BOLD contrast change can be observed as a result of a specific cognitive stimulation paradigm. To overcome this limitation, we propose to use global physiological stimuli to alter the BOLD contrast in the entire brain, such as breathing low concentrations of carbon dioxide (see Rostrup et al, 2000 ). Potential applications of this novel imaging technique include normal ageing, vascular dementia, and stroke.

The PhD project will provide an excellent opportunity to conduct cutting-edge research in a multidisciplinary environment. It will include the development and optimisation of novel MRI techniques, the development of advanced biophysical tissue models, as well as the design and evaluation of imaging studies on healthy volunteers and patients.

**Key references (up to five):**

1. Tropres I et al. (2001). Vessel size imaging. *Magnetic Resonance in Medicine* 45:397–408.
2. Kiselev VG et al (2005). Vessel Size Imaging in Humans. *Magnetic Resonance in Medicine* 53:553–563.
3. Jochimsen TJ et al (2008). Increasing specificity in functional magnetic resonance imaging by estimation of vessel size based on changes in blood oxygenation. *NeuroImage* 40:228–236.
4. Rostrup E et al (2000). Regional differences in the CBF and BOLD responses to hypercapnia: A combined PET and fMRI study. *Neuroimage* 11:87-97.

**In what way does this PhD proposal meet the SINAPSE criteria as described in the call for proposals? (100 words)**

This proposal meets all the SINAPSE criteria outlined in the call for proposals. In addition it will enhance the collaboration between SINAPSE centres, in particular Aberdeen (Prof. Christian Schwarzbauer) and Glasgow (Prof. Keith Muir).

From a strategic point of view, this project makes excellent use of the key strengths and synergies within SINAPSE, and its highly relevant translational research context will be attractive to major funding agencies and the pharmaceutical industry.

**Please state the name of the local SINAPSE Centre Lead with whom you have discussed this project (Leads are listed on the Call for Proposals, applications submitted without prior discussion will not be considered.):**

Dr Alison Murray