Imaging fluid flow in the brain – relation to dementia?

Medical Research Scotland PhD Studentship with support from Siemens Healthcare

Academic Supervisors: Prof Ian Marshall, Prof Joanna Wardlaw and Dr Michael Thrippleton, Centre for Clinical Brain Sciences

Industrial Supervisor: Dr Craig Buckley, Siemens Healthcare

The setting

This is a prestigious 4-year PhD funded by Medical Research Scotland and with support from Siemens Healthcare. It is set in a major centre for stroke and dementia research with a particular focus on small vessels. It benefits from both Siemens industrial collaboration and global academic collaborations with expert laboratories elsewhere.

The project

The brain depends on a network of small blood vessels for continual energy supply and waste removal. Many cases of dementia and stroke are due to the blood vessels not working properly, but the cause is not properly known due to difficulty in studying the vessels in life. Magnetic Resonance Imaging (MRI) offers some promising new ways to measure their function and its effects on the brain, but these scans currently take a long time and have not been widely tested.

In this project, we will investigate the pulsatility of blood vessels, brain tissue and cerebrospinal fluid (CSF). Advanced MRI techniques will be refined and tested in healthy volunteers and in a range of patients with mild stroke or cognitive problems.

Pulsatility will be measured using a '4D flow' (3D + time) protocol. We will optimise the balance between temporal resolution, spatial resolution and examination time, aiming to collect data with 1mm spatial resolution throughout a thick slab of the brain within 20 minutes. We will use a multi-channel head coil together with state-of-the-art acceleration techniques.

The 4D flow measurements will be compared with conventional measurements in feeding arteries and draining veins, conventional blood pressure and pulse wave velocity. Of particular interest will be the progression of pulse waveforms down the arterial branching structure, through brain tissue and CSF spaces, and into the veins, information that is not traditionally available.

Tissue motion will be studied using an experimental rapid imaging technique that has whole brain coverage every 100ms. Analysis of these images will be synchronised to the cardiac and respiratory cycles to investigate their influence on patterns of brain pulsation.

You

You will have a good honours degree in the physical sciences, computing, mathematics or engineering. Experience with MRI/NMR would be an advantage. Good interpersonal skills and the ability to work independently are essential.

You will develop your skills within a multidisciplinary imaging research environment, working alongside imaging scientists, radiologists and clinicians. Training will include novel MRI techniques, scanner pulse sequence programming, the handling of large data sets, and computational image analysis using packages such as Matlab and SPM. There will be the opportunity to attend conferences and spend some time with the industrial partner Siemens.

The studentship includes fees at the Home/EU rate, annual stipend and research consumables.

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Applications should be made through Edinburgh Neuroscience:

http://www.edinburghneuroscience.ed.ac.uk/project/EI4-CCBS-2018

Provisional closing date 6th April.

Interviews are likely to be held in the period late April – late May for September 2018 entry.