Project title: Quantitative MRI and machine learning for diagnosis and prognosis in multiple sclerosis

This studentship develops and combines quantitative microstructural MRI techniques, building on (Zhang et al Neuroimage 2012; Grussu et al Neuroimage 2015), with state-of-the-art machine learning, building on (Wottschel et al Neuroimage Clinical 2015), to address current diagnostic and prognostic needs in multiple sclerosis. The studentship is associated with the Horizon 2020 CDS-QUAMRI project and will be based at UCL supporting a long-term collaboration between the Microstructure Imaging Group (MIG) (mig.cs.ucl.ac.uk) of the Centre for Medical Image Computing (cmic.cs.ucl.ac.uk) in the Faculty of Engineering and the NMR Research Unit, Department of Neuroinflammation (https://www.ucl.ac.uk/ion/departments/neuroinflammation) of the Institute of Neurology (ion.ucl.ac.uk) in the Faculty of Brain Sciences (Medical School).

Magnetic Resonance Imaging (MRI) is an important clinical tool employed routinely in neurological conditions. Conventional methods allow the detection of macroscopic effects of diseases, such as focal lesion number and volume or brain shrinkage due to tissue atrophy. Such measures provide useful information, but alone are not enough to characterise exhaustively the complexity of the underlying pathological mechanisms. Quantitative MRI, and in particular the recent microstructure imaging paradigm, uses mathematical modeling to relate MR signals to features of tissue microstructure. The approach uniquely provides maps of tissue features normally accessible only by invasive biopsy and histology, but non-invasively from MRI.

Multiple sclerosis (MS) is a disabling, inflammatory and neurodegenerative disease of the central nervous system. Although conventional MRI is a key tool for diagnosing and monitoring MS, accurate prognosis from the onset of the first symptoms is extremely challenging. Novel and more specific imaging biomarkers are urgently needed to characterise microscopic, widespread damage that occurs in tissues, and for earlier diagnosis, more accurate prognosis and more precise treatment deployment and monitoring.

The aim of this PhD project is to improve the classification and the stratification of MS patients by exploiting the latest microstructure imaging techniques. The candidate will work with MIG and NMR Unit researchers to advance the latest imaging technology and acquire state-of-the-art data from healthy controls and MS patients using a clinical 3T MRI system. Furthermore, they will exploit the new information through supervised learning techniques, such as random forests, support vector machines, or deep neural networks, and potentially other more sophisticated machine learning approaches.

The successful applicant will have strong computer programming and mathematical skills. Prior experience/knowledge of parameter estimation, inference and classification, MRI, and translational/clinical research are all advantageous. Funding is limited to EU applicants. **Deadline for application:** 17th of May 2016 23:59 (BST).
Contacts for further information

- Professor Daniel Alexander <d.alexander@ucl.ac.uk>
- Professor Claudia Gandini Wheeler-Kingshott <c.wheeler-kingshott@ucl.ac.uk>
- Francesco Grussu <f.grussu@ucl.ac.uk>

Application

Please apply via the UCL CDT web site: http://medicalimaging-cdt.ucl.ac.uk/

The project is listed among those in the “External projects” page: http://medicalimaging-cdt.ucl.ac.uk/news/index/category:External%20Projects/#content

References