SINAPSE

PhD Project Proposal Template for PhDs with Industry starting in 2010

PROJECT
Title:

Development of a Hybrid Voxel Based Morphometry (VBM), Feature Based Morphometry (FBM), Support Vector Machine (SVM) Image Analysis Technique – Prediction of Treatment Non-Response using Individual Subject Neuroanatomical Scans in Attention Deficit Hyperactivity Disorder (ADHD)

Planned start date (month/year):

October 2010

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

University of Dundee

University first supervisor: contact details

Name: Prof Douglas Steele
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Second academic supervisor/ other university or other people in primary university involved with project

Dr Bill Moorhead, Neuroimaging Research Fellow, Division of Psychiatry, University of Edinburgh

Dr David Coghill, Senior Lecturer in Child and Adolescent Psychiatry, Division of Medical Sciences, University of Dundee

Benson Mwangi, University of Dundee

Prof Keith Matthews, Professor of Psychiatry, Division of Medical Sciences, University of Dundee

Prof Dick Lerski, Professor of Medical Physics, Division of Medical Sciences, University of Dundee

Industry

Siemens UK

Industry main contact details

Name: Craig Buckley
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Key Other Industry people involved with Project including Industry Supervisor (if different to Industry main contact above)

As above

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

The student will require to have a good BSc (hons) and/or MSc in a quantitative science (e.g. physics, computer science, mathematics or statistics). The sucessful candidate will not have to recruit subjects or undertake clincial assessment but will be expected to assist with image acquisition after training. Previous experience of quantitative image analysis and scan classification is not required.

Summary of proposed project (approximately 200 words):

Diagnostic categorisation of scans from individual subjects with 'functional' psychiatric disorders (e.g. depression, schizophrenia, ADHD, addictions) is not possible in radiology. Quantitative neuroimaging inferences (e.g. using SPM or FSL) have only been possible at a group level, not an individual level. Recently though, machine learning techniques, such as support vector machines (SVMs), have been applied to individual scan categorisation.[1,2,3] Typically about 80% of a neuroimaging data set is used to train a SVM classifier and the remainder is used to test the accuracy. Considerable success has been reported: e.g. ~85 to 95% accuracy in schizophrenia[1] and unipolar major depression.[2]

Attention Deficit Hyperactivity Disorder (ADHD) is the most commonly diagnosed psychiatric disorder in children affecting 3 to 5%. Whilst ~70% of children will respond to and tolerate methylphenidate (MPH), 30% do not. There are currently no ways to identify responders from non-responders without exposing the child/young person to a trial of the drug. Developing methods to identify stimulant non-responders at an individual level and prior to exposure is a clinically important under-researched area.

Neuroimaging studies have identified group level quantitative differences in brain structure, distinguishing treatment responders from non-responders.[4] and positive from negative developmental outcomes.[5] The successful candidate would focus on further developing the high accuracy, hybrid VBM-FBM-SVM image processing technique, started at Dundee University,[2] applying it to ADHD MPH response prediction. Given the accuracy of categorisation that has been achieved, further development of machine learning based image categorisation techniques has the potential to make a radical advance in neuroimaging, in general, by the introduction of quantitative methods that can inform clinical decisions on individual patients, with 'functional' psychiatric,[1,2] and other disorders.[3]

Key references (up to five):

1. Koutsouleris N, et al, "Use of neuroanatomical pattern classification to identify subjects in at-risk mental states of psychosis and predict disease transition". Arch Gen Psychiatry. 2009;66(7):700-712.
2. Mwangi B, Matthews K, Steele JD. "Neuroanatomical diagnostic classification of unipolar depressive illness: a multicentre translational biomarker study." under review. 2010.
3. Kloppel S, et al. "Automatic classification of MR scans in Alzheimer's disease." Brain. 2008;131(Pt 3):681-689.
4. Filipek PA et al "Volumetric MRI analysis comparing subjects having attention-deficit hyperactivity disorder with normal controls." Neurology. 1997;48(3):589-601.
5. Mackie S et al "Cerebellar development and clinical outcome in attention deficit hyperactivity disorder." Am J Psychiatry. 2007;164(4):647-655.