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About

Dr Mullinger is an expert in simultaneous EEG-fMRI. She focuses on understanding the sources of the EEG artefacts and how to reduce them at source. Using the best EEG-fMRI techniques available she investigates neurovascular coupling to better understand brain function.

See Dr Mullinger's Nottingham profile (http://www.nottingham.ac.uk/physics/people/karen.mullinger)

Qualifications

- **PhD** (2005-2008) Physics and Astronomy
- **BSc** (2001-2004) Physics with Medical Physics
  Degree Classification: First Class with Honours

Biography

Dr Mullinger has gained unique and wide-ranging experience in the development and application of simultaneous electroencephalography (EEG) and functional magnetic resonance imaging (fMRI) over the past 7 years whilst working with the first MR-compatible EEG system (from Brain Products, Germany) at the SPMMRC, Nottingham. This has involved collaboration with academic and industrial research leaders (e.g. Brain Products and Philips Medical Systems).

Dr Mullinger undertook a BSc in Physics with Medical Physics at the Univeristy of Nottingham and went on to complete her PhD at the Sir Peter Mansfield Magnetic Resonance Centre, Univeristy of Nottingham. Her PhD addressed many aspects of simultaneous EEG-fMRI recordings including: improving EEG artefact correction, reducing artefacts at ultra-high field to make simultaneous recordings feasible, and identifying the major sources of MR image distortion due to EEG hardware. Subsequently, as a Sir Peter Mansfield Research Fellow and Anne McLaren Research Fellow, she has played a leading role in research aimed at understanding the origins of the gradient and pulse artefacts in EEG data, as well as in the development of beamformer techniques for localising EEG sources in EEG-fMRI experiments. She has established a number of collaborations with academic and industrial research leaders.

The success of her work is reflected not only in her publication record, but also in three personal invitations to contribute book chapters. Additionally she has been invited to speak at several international conferences. The importance of her contribution in advancing EEG-fMRI research was recognised by the recent award of the prestigious International Society of Magnetic Resonance in Medicine Junior Fellowship (May, 2011).

She has recently taken a joint Lecturer post between the University of Birmingham (Psychology) and the University of Nottingham (Physics). She will use this unique post to develop her research interests and facilitate collaborations between the universities.

Postgraduate supervision

Currently she supervises a number of postgraduates at the University of Nottingham.

If you would like to contact her about her research and supervision please email or call her.

Research

Research interests

Dr Mullinger's research interests are focused on simultaneous EEG-fMRI. Combing these two techniques is highly desirable since they provide complementary information regarding brain function. She is interested in both the technical aspects of combining these two techniques as well as using them to investigate neurovascular coupling to gain a better understanding of brain function.

Technical aspects of EEG-fMRI

Performing EEG and fMRI together is very challenging as the MRI environment is extremely hostile for measuring small electrical signals from neurons using EEG. Whilst simultaneous EEG-fMRI has been available as a research tool for over a decade there are still significant limitations in the areas of brain function which can be researched with this neuroimaging tool due to the artefacts in the EEG signals. Dr Mullinger therefore investigates the sources of these artefacts. She uses this knowledge to develop methods to reduce the problematic artefacts through better experimental set-up and new EEG hardware design.

Neurovascular Coupling

BOLD fMRI is non-invaisive and is the most widely used technique to study brain function in humans. However, the BOLD signal is caused by an interaction of changes in blood flow, volume and oxygenation related to changes in neuronal activity. As a result this complex single is often difficult to interpret and the origins of changes in the BOLD signal can be unclear. Dr Mullinger uses simultaneous EEG-fMRI to measure EEG, BOLD and blood flow changes related to a stimulus to interrogate the origin of aspects of the BOLD response which are currently poorly understood. Dr Mullinger believes a better understanding of the BOLD signal this will open new avenues of

research into brain function in health and disease.

Publications

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Chowdhury, M. E., Mullinger, K. J., Glover, P. and Bowtell, R. (2013). "Reference layer artefact subtraction (RLAS): A novel method of minimizing EEG artefacts during simultaneous fMRI." Neuroimage.

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Yan, W. X., Mullinger, K. J., Brookes, M. J. and Bowtell, R. (2009). "Understanding gradient artefacts in simultaneous EEG/fMRI." Neuroimage 46(2): 459-471.

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