
An Introduction to Modern Methods of Brain Exploration with a Focus on Functional Magnetic Resonance Imaging (fMRI)

Course Overview

The brain is perhaps the most fascinating of all organs in the human body, as it is the foundation of human thought and behavior. Despite the explosion of brain research that has occurred over the past several years, the brain remains mysterious with many unknowns. Throughout history the ability to study the brain has been limited due to lack of technology. Over the past two decades however, a technique called functional Magnetic Resonance Imaging (fMRI) has led to the ability to study a living brain non-invasively and thus has become extremely popular among researchers. As fMRI requires some knowledge of physics, neuroscience, psychology, and statistics, it is an area which typically requires interdisciplinary teams to work together to fully understand the methods and to make proper inferences about the results. Furthermore, while it has advanced our understanding of the brain, its limitations and potential methods to overcome or minimize these limitations should also be considered. This course offers a detailed introduction to fMRI, starting with an overview of neuroscience and neuroanatomy and advancing to the functionality of the brain. Initially, a brief history of past and current techniques to study this functionality will be described, leading into a detailed introduction to MRI and fMRI. The second half of the course focuses on the theory and application of both MRI and fMRI. Principles of magnetic resonance and their application to imaging are covered, as well as how MRI progressed from a measure of structure to a measure of function. Practical applications, such as design of experiments, preprocessing, and analysis of data as well as limitations of these methods are also covered. Finally, the course offers an overview of how fMRI is used to study functional connectivity in the brain, and a brief introduction to diffusion tensor imaging, which is applied to study white matter tracks in the brain, is given. The final two lectures will be spent on current applications of fMRI to study cutting edge topics such as the processing of emotions, learning and memory, fear learning and extinction, and the effects of sleep. The course is designed for students with little or no background in neuroscience and imaging, although a basic background in biology and physics is highly preferred. Thus, the course is suitable for undergraduate students, graduate students, and other professionals with an interest in the brain.

Dates	November 7-18, 2016. Maximum Number of participants: 60.
You Can Attend if	Anybody with an interest in the course topic and adequate basic background in science, engineering, mathematics/statistics, psychology, medicine, etc. Basic notions of biology, calculus, and statistics at the higher-secondary level, and some experience with computation and programming will help the student assimilate course content better. Selection on the first-come-first-served basis after ensuring reasonable background (total capacity: 60; some seats reserved for students from the SP Pune University). Resume/CV with a brief statement of interest/purpose is required for selection and registration.
Fees	One-Time GIAN Registration: Visit http://www.gian.iitkgp.ac.in/GREGN/ Course Fees: People affiliated to SP Pune University or affiliated colleges: No fee, but registration is must. People affiliated to academic institutions, research institutes, NGOs, etc.: ₹1000. People from industry: ₹5000. Fees include tea with light snacks, any instructional material provided by the expert faculty, computer access during any tutorial sessions for the course, internet access via the SP Pune University campus network during the course. Out-station candidates need to arrange for transport and accommodation on their own. Full attendance necessary to be eligible for certificate of participation/attendance. Appearing for evaluations/examinations during the course is necessary for certificate of grades in the course.



Dr. Rebecca McNamee is a Senior Research Fellow at the University of Pittsburgh Medical Center in Pittsburgh, PA (US). She received her BS in Engineering Science and Mechanics at the University of Tennessee, Knoxville, and her MS and PhD in Bioengineering from the University of Pittsburgh. She has worked as faculty at the University of Pittsburgh and as a visiting researcher collaborator at Carnegie Mellon University for 8 years.

Dr. McNamee's areas of specialty include signal processing and image processing with a particular interest in functional MRI, a field she has worked in for over 16 years. Her engineering background has enabled her to specialize in fMRI methodology, particularly with respect to noise reduction and analysis techniques, while also applying these techniques to study teens at high risk for the development of substance use disorders. She has published several papers in these areas and also spent a year working with Positron Emission Tomography (PET) imaging in the University of Pittsburgh's Radiology Department.

Dr. McNamee was part of a team that taught Biomedical Imaging Courses at the University of Pittsburgh. She has also taught Biomedical Engineering courses at Robert Morris University in Pittsburgh, PA. She has experience working with graduate students and summer students who have an interest in imaging and signal processing.

Currently, Dr. McNamee is working on an imaging study that explores the effects of sleep (or lack of sleep) on fear learning and extinction. This work is sponsored by the Department of Defense and aims to help in the understanding of Post-Traumatic Stress Disorder, particularly in war veterans who are often times sleep-deprived when they enter into combat zones.

Course Coordinators

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**GIAN One-Time
Registration**

<http://www.gian.iitkgp.ac.in/GREGN/>