Institute for Pure and Applied Mathematics
University of California, Los Angeles presents a

Graduate Summer School:

Mathematics in Brain Imaging

July 12 - 23, 2004

Members of the Organizing Committee include **Paul Thompson**, Chair (UCLA), **Michael Miller** (Johns Hopkins University), **Thomas Nichols** (University of Michigan), **Stanley Osher** (UCLA) and **Russell Poldrack** (UCLA)

Scientific Overview:

This two-week intensive workshop will focus on mathematical techniques that can be applied to ***brain images*** to measure, map and model brain structure and function. Experts who are pioneers in medical image analysis will describe the mathematics used in brain imaging today. Topics will range from modeling anatomical structures in MRI scans, and mapping connectivity in diffusion tensor images, to statistical analysis of functional brain images from fMRI, EEG, and MEG. Current applications in radiology and neuroscience will be highlighted, as well as new directions in the mathematics of structural and functional image analysis. Mathematical topics covered will include computational anatomy, statistical analysis of functional images and time-series, ICA and random field theory, metric pattern theory, differential geometry, and computer vision approaches used in computational anatomy and functional imaging. Software implementing a wide range of algorithms will also be demonstrated, and tutorial notes will be provided. Talks will be of interest to newcomers and experts in the field.

Speakers:

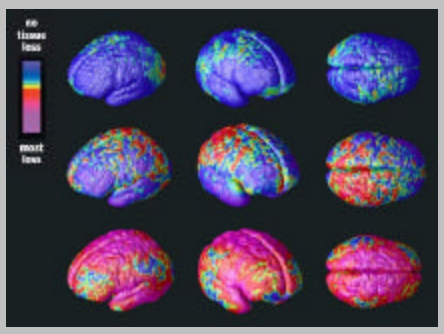
A schedule of the scientific program is available at ***www.ipam.ucla.edu/programs/mbi2004***.

WEEK 1: Computational Anatomy (July 12 - 16, 2004)

The first course will cover mathematical methods for extracting, representing and analyzing the shapes of biological structures in brain images. These methods show enormous promise in understanding how diseases such as Alzheimer's, schizophrenia, tumor growth and abnormal development emerge in the brain, and help in investigating their effects. Deformable models also help understand how biological structures, such as the brain during surgery, change dynamically over time. They can also capture statistics on how anatomy and physiology vary in healthy and diseased populations. We will cover the mathematics and algorithms to model anatomical elements in the brain as parameterized manifolds. Methods for comparing these structures will be outlined, including flat mappings of the cortex, conformal mappings, and high-dimensional image registration using elastic and fluid mappings. Statistical techniques will be described that combine geometrical models of anatomy and make inferences about disease effects, anatomical connectivity, and brain changes over time. We will introduce the underlying mathematics as well as its applications, drawing on techniques from differential geometry and topology, tensor mapping, non-linear image registration and segmentation, metric pattern theory, and random field theory.

WEEK 2: Functional Brain Mapping (July 19 - 23, 2004)

This second one-week course will cover the mathematics of functional brain imaging. Diverse mathematical techniques are now widely used for analyzing functional images of the brain. These include the analysis of time-series of images from functional MRI scanning, positron emission tomography, as well as MEG, EEG, and optical imaging of the cortex. Each technique has given rise to sophisticated mathematics for detecting and analyzing the underlying features in these images. Methods will be outlined for Bayesian analysis of fMRI time-series, as well as statistical analysis using ICA and PCA, random field theory, and integration of multiple functional brain imaging techniques.



Participation:

If you wish to apply for funding to attend the graduate summer school, please complete the application form at ***http://www.ipam.ucla.edu/programs/mbi2004***. Applications for funding will be considered from applicants at all levels, but the emphasis will be on supporting graduate students. Encouraging the careers of women and minority mathematicians and scientists is an important component of IPAM's mission and we welcome their applications.

Please visit our website at

http://www.ipam.ucla.edu/programs/mbi2004

or email questions to **mbi2004@ipam.ucla.edu**

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