Ph.D. Thesis Abstract for Yu-Chien Wu

Department of Medical Physics
University of Wisconsin - School of Medicine and Public Health
Madison, Wisconsin

QUICK LINKS: [Medical Physics Home Page] [Ph.D. theses, all years] [More 2006 Ph.D.'s]

Diffusion MRI: Tensors and Beyond

Yu-Chien Wu
Under the supervision of Professor Andrew L. Alexander
At the University of Wisconsin-Madison
August 27, 2006

Diffusion weighted imaging (DWI) has been applied widely in the human brain for both research and clinical applications in the last 15 to 20 years. Among DWI methods, the diffusion tensor imaging (DTI) is the most used and elegant approach. It successfully describes the diffusion behavior of water molecules at lower diffusion weighting (DW) (e.g., b < 1500 sec/mm^2). Fractional anisotropy of DTI represents the white matter coherence. The colormap and white matter tractography are valuable noninvasive tools to assess the alignment and orientation of neural fibers. In this thesis, a novel quantitative tool for directional statistic analysis on DTI is proposed; its application on helping differential diagnosis of oligodendroglioma from vasogenic edemas of human brains is also described. Errors of DW gradients may cause inaccurate estimates of diffusivity and DT orientation. Effects of gradient errors on DTI and a calibration method are discussed in this thesis. The DT is a good model for lower levels of DW. However, it does not appear to be consistently accurate in describing the signal behavior for higher levels of DW (e.g., b > 2000 s/mm^2) and for complex fiber structures. Many methods have been proposed to better detect complex structures at higher diffusion level including q-ball imaging (QBI), high angular resolution diffusion imaging, model fitting and diffusion spectrum imaging (DSI). An alternative q-space encoding method called hybrid diffusion imaging (HYDI) is described in this thesis. HYDI provides a convenient way for all kinds of data analysis using only one dataset. In the comparison studies of HYDI to conventional DSI and QBI schemes, HYDI combines their advantages and avoid disadvantages by switching between different analysis approaches.

More 2006 Ph.D.'s

Ph.D. theses, all years

Return to Medical Physics Home Page

last updated: 08/01/2008