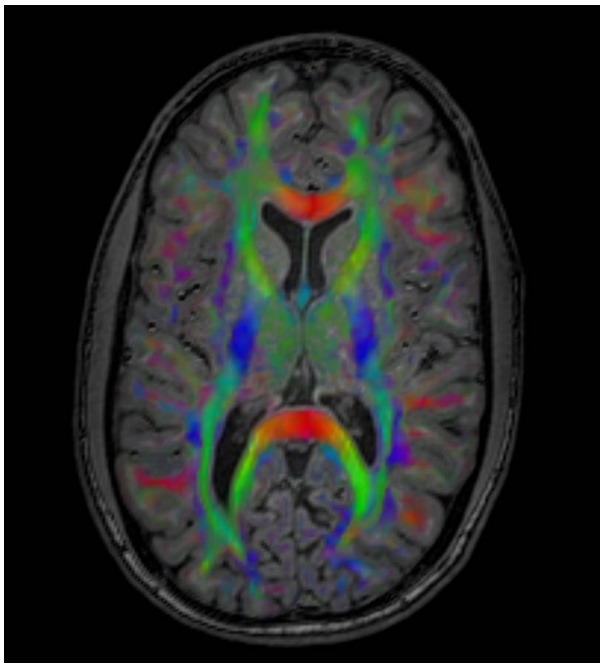
From Pulse Sequences to Clinical Application in the Brain: Diffusion Tensor Imaging

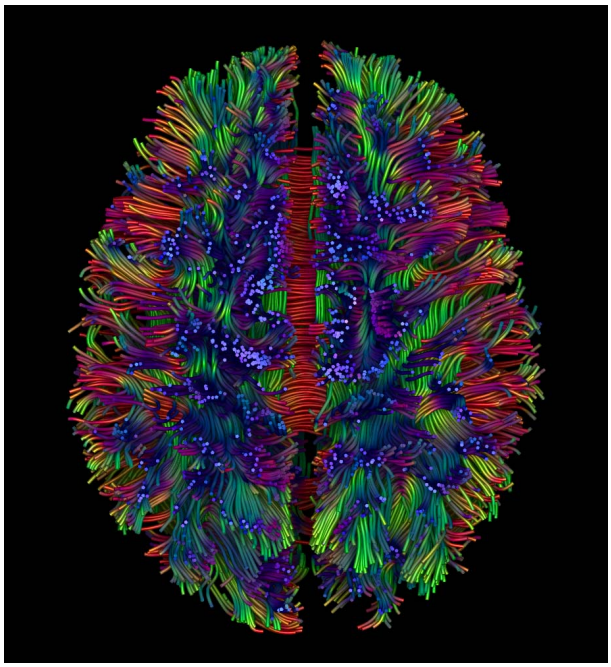
Alexander Leemans (Alexander@isi.uu.nl)

Image Sciences Institute, University Medical Center Utrecht, Utrecht, The Netherlands

Diffusion tensor imaging (DTI), pioneered roughly two decades ago by Peter J. Basser, has been widely used to investigate microstructural tissue properties in vivo [1]. By assuming that the dominant diffusion orientation is aligned with the underlying fiber tissue configuration, DTI has further enabled the virtual reconstruction of tract pathways with so-called “fiber tractography” (or “fiber tracking”) approaches [2-6] (see figures below). With this unique way of characterizing tissue organization, DTI has been used in a wide range of clinical and biomedical applications [7].

In addition to a brief introduction to the basic concepts of DTI, this lecture will cover practical guidelines on processing of diffusion MRI data for subsequent analysis. Several considerations regarding DTI limitations and data interpretation which are critical for clinical applications will also be presented [8-11].





Left: T1-weighted image fused with direction-encoded color (DEC) map; Right: ‘whole-brain’ fiber tracking.

References

[1] Basser PJ et al, Biophysical Journal, 1994; [2] Conturo TE et al, Proc Natl Acad Sci, 1999; [3] Jones DK et al, Magn Reson Med, 1999; [4] Mori S et al, Ann Neurol, 1999; [5] Basser PJ et al, Magn Reson Med, 2000; [6] Poupon C et al, Neuroimage, 2000; [7] Assaf Y et al, Journal of Molecular Neuroscience, 2008; [8] Jones DK et al, NeuroImage, 2012; [9] Jones DK et al, NMR Biomed, 2010; [10] Deprez S et al, Brain Imaging and Behavior, 2013; [11] Tournier JD et al, Magn Reson Med, 2011.