

ATELIER NSDC « ANALYSE DE DONNÉES DIRECTIONNELLES AVEC APPLICATIONS EN BIOMÉCANIQUE
ET EN IMAGERIE MÉDICALE »

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**NICDS WORKSHOP “THE ANALYSIS OF DIRECTIONAL DATA WITH APPLICATIONS TO
BIOMECHANICS AND BIOMEDICAL IMAGING”**

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Directional Measurements of Water Diffusion using MRI

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By simply measuring the degree and directionality of diffusion of the ubiquitous water molecule in tissue, usually in brain, diffusion tensor magnetic resonance imaging (DTI) can infer non-invasively the 3-dimensional orientation and “integrity” of the underlying structure at the micron level. Summary parameters reflecting the degree of anisotropy and the overall diffusion are calculated from the diffusion tensor; however, it has been shown that the eigenvalues may correspond to specific changes such as axonal damage or myelin loss. In a very unique application, the eigenvectors, particularly the one associated with the largest eigenvalue, are used to track the various white matter tracts (i.e. brain “wiring”) throughout the brain. The goals of the presentation are to provide an overview of the basics of diffusion anisotropy, the biological basis, how DTI data is acquired, some of the acquisition issues that need to be taken into account if subsequent image analysis is going to be meaningful, how the tensor is analyzed (from the simplest point of view), the rotationally invariant summary parameters typically calculated from the diffusion tensor, the role of the eigenvalues, how to perform tractography, and typical ways of utilizing DTI data to better understand human disease.