Part I: Diffusion Tensor Fitting in MRI

Diffusion Tensor Imaging (DTI) is an MRI-based neuroimaging technique designed to quantify the diffusivity of water molecules within biological tissues, particularly in the brain.

The physical basis of MRI relies on the nuclear spin properties of hydrogen protons

signal under diffusion weighting decays exponentially:

Where:

is the baseline signal obtained without diffusion sensitisation,

is a constant scalar known as the diffusion weighting factor, and

is the normalised gradient direction vector.

Given the symmetric nature of the diffusion tensor , there are only six independent tensor components that must be estimated at each voxel, which are .