Microstructure – Effect on MRI

(Role Residual Dipolar Dephasing)

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Collagen

Most prevalent protein in human body
• Tendon
• Meniscus
• Nerves
• Skin
• Liver
• Etc., etc.
Water Motion

Isotropic liquid

Water trapped in collagen
Loss of Coherence = $T_2$

How much xy-mag

$M_{xy}(t)$

Time
NMR Spectra of Tendon

The Magic Angle Effect

Goat Knee Meniscus (Fibrocartilage)

GRE; TE=9 ms
Measure Intensity vs Orientation

Make MR images with several specimen to field orientations.
Generate Maps

Minimum Intensity

Coefficient of Variation
Input to Fiber Tracking

Standard Deviation Map

Direction Map

Use these with DTI software (FA and direction maps) to grow fibers.
Fiber Map

Circumferential fibers

DTI Studio Software
Kennedy Krieger
DAFI

Dipolar Anisotropy Fiber Imaging
Patella -- Effect of Orientation

Lowest intensity when fibers are parallel to $B_0$
Intensity changes depend on fiber content, direction of fibers and rotation axis.
IV Disc

- Annulus Fibrosus
- Nucleus Pulposus
- Lamellae
Dipolar Effects in IV Disc

Intensity of a voxel depends on fiber direction relative to $B_0$

Registration (FLIRT FSL)

Coefficient of Variation

Maps

Minimum Intensity
Meniscus
DAFI
(Dipolar Anisotropy Fiber Imaging)

- Various orientations with respect to $B_0$
DAFI Results
- Three distinct tissues – tumor, boundary zone, normal liver.
CV Map – EOVLEX007

- Based on 6 orientations (30 deg rotations).
Collaborators

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