## NIH/NIAMS 1R01 AR062581-01A1 (PI: Du) Quantitative UTE MR Imaging: Sensitive Biomarkers for Osteoarthritis Goal: To develop quantitative UTE image biomarkers for osteoarthritis.



Selected interleaved 4-echo UTE acquisitions with a TE of 8  $\mu$ s (A), 0.4 ms (B), 0.8 ms (C), 2.2 ms (D), 4.4 ms (E), 6.6 ms (F), 11 ms (G), 16 ms (H), 20 ms (I), 30 ms (J), echo subtraction (K), and bi-component T2\* analysis for calcified cartilage (L), superficial cartilage (M) and meniscus (N).

NIH/NIAMS 1R01 AR0689874-01 (PI: Du) Ultrashort Echo Time (UTE) Magnetic Resonance Imaging of Bone Goals: To develop 3D UTE techniques to image and quantify cortical and trabecular bone.



3D UTE images of the tibia midshaft of a 42y volunteer in the axial (A) and oblique sagittal (B) planes, and the corresponding IR-UTE images (C, D). UTE images show a bi-component decay with a short  $T_2^*$  of 0.34 ms (69% of the signal), and a longer  $T_2^*$  of 7.05 ms (31% of the signal). A single  $T_2^*$  was observed for IR-UTE images, suggesting the inversion and nulling of signals from pore water.

NIH/NINDS 1R01 NS092650-01 (PI: Du) UTE Magnetic Resonance Imaging: New Biomarkers for Multiple Sclerosis Goals: To develop morphological and quantitative UTE imaging biomarkers for MS.



Clinical PD-FSE (A),  $T_2$ -FSE (B) and FLAIR (C) imaging as well as IR-UTE (D) imaging of a brain specimen from a 28 year old female donor with confirmed MS. MS lesions are hyperintense (thin arrows, A, B) on the PD-FSE and  $T_2$ -FSE images, and hypointense (thin arrows, C) on the FLAIR image, and show signal loss on the IR-UTE image (thin arrows, D). Complete myelin loss is obvious in regions indicated by the thin arrows. Partial loss of signal is seen in the IR-UTE image (thick arrow, D) where the PD-FSE,  $T_2$ -FSE and FLAIR images appear normal (thick arrows, A-C).

## NIH/NIAMS 1R21 AR063894-01A1 (PI: Du) Magnetic Resonance Imaging of Bound and Free Water in Cortical Bone Goals: To develop MRI techniques to image and quantify bone water.



Clinical FSE (A) and IR-UTE (B) imaging of a forearm specimen. The ulna, radius and tendons show as high signal and contrast with the IR-UTE sequence, but zero signal with the FSE sequence.

GE Healthcare (PI: Du) Ultrashort Echo Time Magnetization Transfer (UTE-MT) Imaging Goals: To develop 3D UTE MT imaging techniques for MSK applications.



UTE-MT imaging of the Achilles tendon of a 54y old healthy volunteer with the MT pulse off (A) and on (B), their subtraction (C), a MTR map (D) and clinical MT imaging (E). A MTR of ~40% was shown with UTE-MT, but not assessable with clinical MT sequences.