MRI Visualization of Wood Samples with Ultra Short TE Sequences

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Introduction

Samples with short T2 values produce little or no detectable signal by conventional MR pulse sequences. Ultrashort TE (UTE) pulse sequencing allows the use of TE values 20-50 times shorter than those of traditional sequences, thus enabling signals from short T2 components to be detected [1,2]. To develop UTE methods, we have employed a model of dry spruce blocks with knots for evaluating variations in wood moisture content and wood preservative distribution. Conventional MR pulse sequences do not allow the visualization of the clear wood or the knot structures as such samples possess very short T2 values similar to other biological tissues, e.g., bone. Thus, this readily available and non-degradable model will provide a suitable phantom for the development and optimisation of UTE sequences for MRI of biological tissues with extremely short T2 values. The UTE sequence used on our model system is a constant time-3D (Ct3D) MRI sequence.

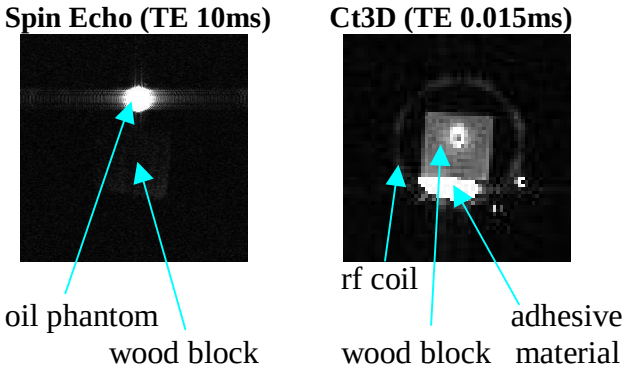
Methods

Spruce wood blocks (1.5 x 1.5 x 3cm) with knots were completely saturated with water and allowed to dry under ambient conditions to achieve a 12% moisture content. These dry blocks were individually placed into a ^{1}H tuned volume coil and imaged at 9.4T on an Inova MRI scanner (Varian Inc., USA). Two transverse MRI scans were performed: (1) conventional spin echo sequence (TR 1000ms, TE 10ms, FOV 45mm x 45mm, matrix size 256 x 128, 4 averages, 10 contiguous slices of 2mm thickness) and (2) Ct3D sequence (TR 30ms, TE 0.15ms, FOV 45mm x 45mm x 30mm, matrix size 64 x 64 x 15 and 1 average). An oil phantom was placed on top of the wood samples for the spin echo imaging to determine the position of the block.

Results and Discussions

The wood blocks were not readily visualized using standard spin echo sequences; whilst both the knot structures and the clear wood were revealed by UTE methods (Fig. 1). Conventional MRI is able to image wood [3], *albeit* with much higher moisture content than in our study, and in such images, knots were of low intensity providing minimal information regarding structure. By using UTE methods, the knots are enhanced compared to the clear wood and the location of the knots, readily defined. Thus, UTE methods (with improved resolution) may aid the determination of knot structure and characteristics. It is interesting to note that in addition to imaging the wooden block, UTE imaging also allows the visualization of both the MRI coil and the adhesive material used to maintain the position of the wooden block.

Fig. 1: Central slices from the MRI image data sets.



Conclusions

Using UTE imaging techniques, it is possible to image dry wood samples, not readily visualized by conventional MR imaging. The clear and knot wood are readily distinguished by UTE, thus providing a means to assess moisture content and preservative distributions between these woody tissues. The dry wood phantoms have the added benefit of providing a challenging imaging model with which to develop UTE imaging techniques.

References

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