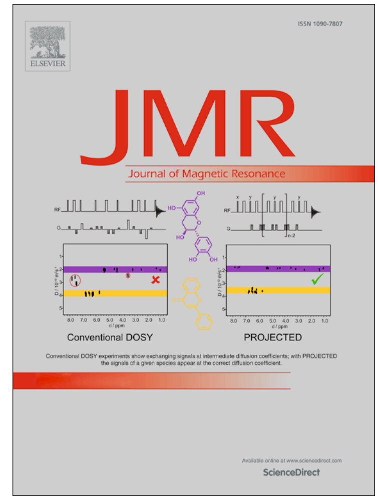

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Abstract

Magnetic Resonance Elastography (MRE) detects induced periodic motions in biological tissues allowing maps of tissue mechanical properties to be derived. In-vivo MRE is commonly performed at frequencies of 30-100 Hz using external actuation, however, using cerebro-vascular pulsation at 1 Hz as a form of intrinsic actuation (IA-MRE) eliminates the need for external motion sources and simplifies data acquisition. In this study a hydraulic actuation system was developed to drive 1 Hz motions in gelatin as a tool for investigating the performance limits of IA-MRE image reconstruction under controlled conditions. Quantitative flow (QFLOW) MR techniques were used to phase encode 1 Hz motions as a function of gradient direction using 3D or 4D acquisition; 4D acquisition was twice as fast and yielded comparable motion field and concomitant image reconstruction results provided the motion signal was sufficiently strong. Per voxel motion noise floor corresponded to a displacement amplitude of about 20-30 microns. Signal to noise ratio (SNR) was 94 $\pm$ 17 for 3D and dropped to 69 $\pm$ 10 for the faster 4D acquisition, but yielded octahedral shear stress and shear modulus maps of high quality that differed by only about 20 % on average. QFLOW measurements in gel phantoms were improved significantly by adding Mn(II) to mimic relaxation rates found in brain. Overall, the hydraulic 1 Hz actuation system when coupled with 4D sequence acquisition produced a fast reliable approach for future IA-MRE phantom evaluation and contrast detail studies needed to benchmark imaging performance.

Keywords: `elastography, 1 Hz imaging, stiffness maps, shear modulus`

1. Introduction

Many disease processes involve changes to the cellular microstructure, which often lead to alterations in the macroscale mechanical properties of tissue.[1] One example is breast cancer, which is commonly identified as a hard lump through manual palpation. The field of Elastography produces quantitative and spatially resolved images of tissue mechanical properties, with potential applications in diagnosis and monitoring of

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