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(G*) Characterizing Shear Wave Propagation Using a Portable Magnetic Resonance Sensor: A Phase Interference-Based Approach

Wednesday 21 June 2023 16:30 (15 minutes)

Elastography is a growing area of research in which certain imaging modalities, such as magnetic resonance imaging (MRI), are employed to measure the response of materials to external stress allowing for quantitative estimation of viscoelastic properties. This has tremendous potential in a clinical setting, as changes in tissue viscoelasticity can be indicative of myriad health conditions. Although informative, the long-term clinical viability of conventional magnetic resonance elastography (MRE) techniques may be limited by the requirement of large and expensive MRI scanners and complex acquisition/processing schemes.

Growing trends toward the use of portable, low-field magnetic resonance (MR) instruments in specific, targeted applications motivate the development of portable MRE techniques. For motion encoding, the configuration of several small permanent magnets can be optimized to provide a region with a constant gradient. This "sensitive volume"serves as an integrator, encoding information on the spatial distribution of velocities within the region of interest through modulation of signal due to phase interference.

In past work, we have demonstrated that a constant gradient portable magnet array can be employed to detect longitudinal waves, allowing for relative measurements of viscoelastic properties. Current research is focused on extending this research to detect shear waves, where changes in viscoelastic properties influence the velocity distribution and amount of phase interference within the sensitive volume. Various experimental parameters can be adjusted to regulate phase interference and extract information on the wavelength present in the sensitive volume. Several approximations and limiting cases used in the signal analysis will be discussed, and experimental results depicting the dependence of MR signal on shear wavelength will be presented. Relatively fast measurement times, combined with the portability (a shoebox size) of the setup, and other advantages associated with portable MR, make for promising practical applications of the methodology.

Keyword-1

Portable magnetic resonance

Keyword-2

Shear wave elastography

Keyword-3

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