Shear Wave Diffusion Observed by Magnetic Resonance Elastography

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Abstract Dynamic elastography is a noninvasive imaging-based modality for the measurement of viscoelastic constants of living soft tissue. The method employs propagating shear waves to induce elastic deformations inside the target organ. Using magnetic resonance elastography (MRE), components of harmonic shear wave fields can be measured inside gel phantoms or in vivo soft tissues. Soft tissues have heterogeneous elastic properties, giving rise to scattering of propagating shear waves. However, to date little attention has been paid to an analysis of shear wave scattering as a possible means to resolve local elastic heterogeneities in dynamic elastography. In this article we present an analysis of shear wave scattering based on a statistical analysis of shear wave intensity speckles. Experiments on soft gel phantoms with cylindrical glass inclusions are presented where the polarization of the shear wave field was adjusted relative to the orientation of the scatterers. A quantitative analysis of the resulting fields of shear horizontal (SH) waves and shear vertical (SV) waves demonstrates that the distribution of wave intensities in both modes obeys restricted diffusion in a similar order. This observation sets the background for quantification of shear wave scattering in MRE of body tissue where SH and SV wave scattering occur simultaneously.

1 Introduction

Magnetic resonance elastography (MRE) has been developed for measuring viscoelastic constants in living soft tissue. The method employs propagating shear waves to induce elastic deformations inside the target organ [1, 2]. Current research is focussed on human muscle [3, 4], liver [5, 6], breast [7], brain [8, 9] and heart [10]. The acquired shear wave images allow the determination of the underlying

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