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Scatter-based magnetic resonance elastography

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Abstract

Elasticity is a sensitive measure of the microstructural constitution of soft biological tissues and increasingly used in diagnostic imaging. Magnetic resonance elastography (MRE) uniquely allows *in vivo* measurement of the shear elasticity of brain tissue. However, the spatial resolution of MRE is inherently limited as the transformation of shear wave patterns into elasticity maps requires the solution of inverse problems. Therefore, an MRE method is introduced that avoids inversion and instead exploits shear wave scattering at elastic interfaces between anatomical regions of different shear compliance. This compliance-weighted imaging (CWI) method can be used to evaluate the mechanical consistency of cerebral lesions or to measure relative stiffness differences between anatomical subregions of the brain. It is demonstrated that CWI-MRE is sensitive enough to reveal significant elasticity variations within inner brain parenchyma: the caudate nucleus (head) was stiffer than the lentiform nucleus and the thalamus by factors of 1.3 ± 0.1 and 1.7 ± 0.2, respectively ($P < 0.001$). CWI-MRE provides a unique method for characterizing brain tissue by identifying local stiffness variations.

Introduction

Examination of the body with the hands remains an elementary diagnostic procedure despite the enormous progress of modern medical imaging techniques. The physical quantity the physician examines by palpation is the shear modulus, which describes the response of

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