Phys. Med. Biol. 57 (2012) 2329–2346 doi:10.1088/0031-9155/57/8/2329

Multifrequency inversion in magnetic resonance elastography

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Received 22 December 2011, in final form 1 February 2012
Published 30 March 2012
Online at stacks.iop.org/PMB/57/2329

Abstract

Time-harmonic shear wave elastography is capable of measuring viscoelastic parameters in living tissue. However, finite tissue boundaries and waveguide effects give rise to wave interferences which are not accounted for by standard elasticity reconstruction methods. Furthermore, the viscoelasticity of tissue causes dispersion of the complex shear modulus, rendering the recovered moduli frequency dependent. Therefore, we here propose the use of multifrequency wave data from magnetic resonance elastography (MRE) for solving the inverse problem of viscoelasticity reconstruction by an algebraic least-squares solution based on the springpot model. Advantages of the method are twofold: (i) amplitude nulls appearing in single-frequency standing wave patterns are mitigated and (ii) the dispersion of storage and loss modulus with drive frequency is taken into account by the inversion procedure, thereby avoiding subsequent model fitting. As a result, multifrequency inversion produces fewer artifacts in the viscoelastic parameter map than standard single-frequency parameter recovery and may thus support image-based viscoelasticity measurement. The feasibility of the method is demonstrated by simulated wave data and MRE experiments on a phantom and *in vivo* human brain. Implemented as a clinical method, multifrequency inversion may improve the diagnostic value of time-harmonic MRE in a large variety of applications.

(Some figures may appear in colour only in the online journal)

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