Error in Constitutive Equations Approach for Elasticity and Viscoelasticity Imaging

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We present an inverse problem methodology based on the Error in Constitutive Equations (ECE) approach for the identification of material properties in the context of frequency-domain elastodynamics. In the ECE approach, we define a cost functional based on an energy norm that connects a set of kinematically admissible displacements and a set of dynamically admissible stresses. The set of kinematically admissible displacements is composed of fields that satisfy essential boundary conditions and possess sufficient regularity (i.e. smoothness). The set of dynamically admissible stresses is composed of fields that satisfy conservation of linear momentum and natural (i.e. traction) boundary conditions. The inverse problem is solved by finding material properties along with admissible displacement and stress fields such that the ECE functional is minimized. Experimental data is introduced in the formulation as a quadratic penalty term added to the ECE functional. The talk will focus on the reconstruction of elastic and viscoelastic properties in heterogeneous materials in the context of frequency-domain dynamics. Our findings indicate that ECE methods provide faster and more accurate results than conventional least-squares minimization. We will show numerical and experimental results that demonstrate the salient features of the method.