Accepted Manuscript

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PII: S0045-7825(15)00247-9
DOI: http://dx.doi.org/10.1016/j.cma.2015.07.025
Reference: CMA 10678

To appear in: *Comput. Methods Appl. Mech. Engrg.*

Received date: 17 December 2014
Revised date: 4 June 2015
Accepted date: 31 July 2015

Please cite this article as: M.I. Diaz, W. Aquino, M. Bonnet, A modified error in constitutive equation approach for frequency-domain viscoelasticity imaging using interior data, *Comput. Methods Appl. Mech. Engrg.* (2015), http://dx.doi.org/10.1016/j.cma.2015.07.025

A Modified Error in Constitutive Equation Approach for Frequency-Domain Viscoelasticity Imaging Using Interior Data

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Abstract

This paper presents a methodology for the inverse identification of linearly viscoelastic material parameters in the context of steady-state dynamics using interior data. The inverse problem of viscoelasticity imaging is solved by minimizing a modified error in constitutive equation (MECE) functional, subject to the conservation of linear momentum. The treatment is applicable to configurations where boundary conditions may be partially or completely underspecified. The MECE functional measures the discrepancy in the constitutive equations that connect kinematically admissible strains and dynamically admissible stresses, and also incorporates the measurement data in a quadratic penalty term. Regularization of the problem is achieved through a penalty parameter in combination with the discrepancy principle due to Morozov. Numerical results demonstrate the robust performance of the method in situations where the available measurement data is incomplete and corrupted by noise of varying levels.

1. Introduction

Inverse characterization of viscoelastic properties is of high relevance in many areas of science, engineering, and medicine. In particular, in the medical field, it is well-known that viscoelastic properties are correlated to tissue pathology [28]. This observation has

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