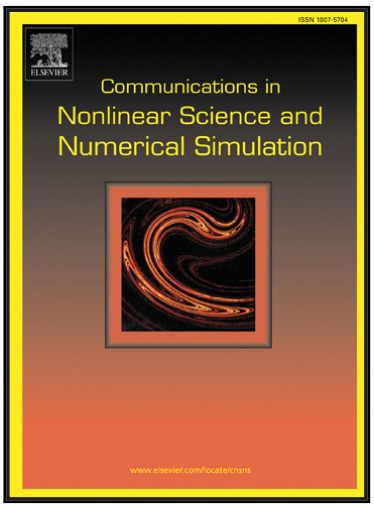

A Class of Time-Fractional Hemivariational Inequalities with Application to Frictional Contact Problem

Shengda Zeng, Stanisław Migórski

PII: S1007-5704(17)30267-8
DOI: 10.1016/j.cnsns.2017.07.016
Reference: CNSNS 4272

To appear in: *Communications in Nonlinear Science and Numerical Simulation*

Received date: 6 April 2017
Revised date: 24 June 2017
Accepted date: 20 July 2017

Please cite this article as: Shengda Zeng, Stanisław Migórski, A Class of Time-Fractional Hemivariational Inequalities with Application to Frictional Contact Problem, *Communications in Nonlinear Science and Numerical Simulation* (2017), doi: 10.1016/j.cnsns.2017.07.016

A Class of Time-Fractional Hemivariational Inequalities with Application to Frictional Contact Problem *

Shengda Zeng † and Stanisław Migórski

Jagiellonian University in Krakow
Faculty of Mathematics and Computer Science
Chair of Optimization and Control
ul. Lojasiewicza 6, 30-348 Krakow, Poland

Abstract. In this paper a class of elliptic hemivariational inequalities involving the time-fractional order integral operator is investigated. Exploiting the Rothe method and using the surjectivity of multivalued pseudomonotone operators, a result on existence of solution to the problem is established. Then, this abstract result is applied to provide a theorem on the weak solvability of a fractional viscoelastic contact problem. The process is quasistatic and the constitutive relation is modeled with the fractional Kelvin-Voigt law. The friction and contact conditions are described by the Clarke generalized gradient of nonconvex and nonsmooth functionals. The variational formulation of this problem leads to a fractional hemivariational inequality.

Key words. Hemivariational inequality, Rothe method, Clarke subdifferential, Caputo derivative, fractional viscoelastic constitutive law, friction.

2010 Mathematics Subject Classification. 35L15, 35L86, 35L87, 74Hxx, 74M10.

1 Introduction

It is well known from rheology that the idealized elastic and viscous properties of the substance are modeled with two elements, the linear spring and Newton dashpot, respectively, which obey the laws of the form

$$\sigma_e = E\,\varepsilon_e \ \text{(Hooke's law)} \quad \text{and} \quad \sigma_v = \eta\,\dot{\varepsilon}_v \ \text{(Newton's law)},$$

respectively. Here, the coefficient $E > 0$ is Young's modulus of elasticity, σ_e and ε_e are the stress and strain of the linear spring element, respectively, $\eta > 0$ is the Newtonian

* Project supported by the National Science Center of Poland under Maestro Project No. UMO-2012/06/A/ST1/00262.

† Corresponding author. E-mail address: zengshengda@163.com.