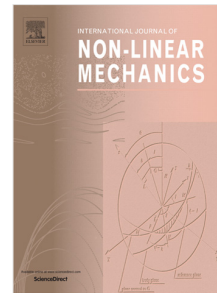


Accepted Manuscript

Numerical modelling of thermo-electro-viscoelasticity with field-dependent material parameters

Markus Mehnert, Mokarram Hossain, Paul Steinmann



PII: S0020-7462(18)30298-1
DOI: <https://doi.org/10.1016/j.ijnonlinmec.2018.08.016>
Reference: NLM 3074

To appear in: *International Journal of Non-Linear Mechanics*

Received date: 18 May 2018
Revised date: 27 August 2018
Accepted date: 29 August 2018

Please cite this article as: M. Mehnert, M. Hossain, P. Steinmann, Numerical modelling of thermo-electro-viscoelasticity with field-dependent material parameters, *International Journal of Non-Linear Mechanics* (2018), <https://doi.org/10.1016/j.ijnonlinmec.2018.08.016>

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

Numerical modelling of thermo-electro-viscoelasticity with field-dependent material parameters

Markus Mehnert*

Markus Mehnert^a, Mokarram Hossain^{b,*}, Paul Steinmann^a

^a*Chair of Applied Mechanics, University of Erlangen-Nuremberg, Paul-Gordan Strasse 3,
91054 Erlangen, Germany*

^b*Zienkiewicz Centre for Computational Engineering, College of Engineering, Bay Campus,
Swansea University, Swansea, UK*

Abstract

In this contribution, we propose a mathematical framework and its numerical implementation for thermo-electro-viscoelasticity taking into account field-dependence of the relevant material parameters appearing in the constitutive model. Polymeric materials are typically viscoelastic and highly susceptible to thermal fluctuations. Several experimental studies suggest that major material parameters appearing in a constitutive model of a thermo-electro-mechanically coupled problem evolve with respect to temperature as well as the applied electric field. Hence we propose a framework for the realistic modelling of polymeric materials under coupled thermo-electro-mechanical loads in which the temperature and electric field are not only considered as independent fields but also show an effect on the material parameters. Furthermore we present the numerical discretization of the coupled balance laws within the context of the finite element method. To demonstrate the performance of the proposed thermo-electro-mechanically coupled framework, several boundary value problems are solved numerically.

1. Introduction

Among the class of smart materials, electro-active polymers (EAPs) drew special attention in the past decade thanks to their large actuation mechanisms and relative low production cost. Upon the application of an external electric field, EAPs can undergo both changes in size and shape as well as in their mechanical attributes, such as stiffness or viscosity. Potential applications of EAPs have already been provided in a large variety of engineering fields, e.g. artificial muscles in soft robotic mechanisms, optical membranes for shape correction in lenses, or energy harvesting [32, 51], to mention a few. Due to the interplay of the mechanical and the electric field the system of governing equations needs

*Corresponding author. Tel.: +44 07482959957

Email addresses: markus.mehnert@ltm.uni-erlangen.de (Markus Mehnert),
mokarram.hossain@swansea.ac.uk (Mokarram Hossain),
paul.steinmann@ltm.uni-erlangen.de (Paul Steinmann)

Download English Version:

<https://daneshyari.com/en/article/10152385>

Download Persian Version:

<https://daneshyari.com/article/10152385>

[Daneshyari.com](https://daneshyari.com)