

# Journal of Mechanics of Materials and Structures

## PREFACE

Corina S. Drapaca, Stefan Hartmann, Jacek Leszczyński, Sivabal Sivaloganathan  
and Wojciech Sumelka

Volume 12, No. 1

January 2017



## PREFACE

This special issue presents full versions of selected talks given at the minisymposium “Theoretical, Computational and Experimental Mechanics for Coupled Field Problems and Multiphase Materials”, held during the joint scientific meeting that took place in Gdansk, Poland on September 8–11, 2015, uniting the Third Polish Congress on Mechanics (PCM) and the Twenty-First International Conference on Computer Methods in Mechanics (CMM).

The investigation of coupled field problems is of pressing interest in many areas of science. Coupling effects influence experimental measurements, which in turn creates the need for sophisticated physical models and presents challenges for their numerical treatment, bringing to bear a vast array of scientific techniques. Modeling tools designed to incorporate size effects in time and space, such as fractional derivatives, enrich the underlying concepts. This drives new research in many subfields of mechanics.

The papers contained in this special issue address topics related to the constitutive modeling and numerical treatment of coupled field problems and multiphase materials. Emphasis is placed on relating theory to experimental observations, on nonconventional mathematical methods, and on new concepts and developments in the computational algorithms for the solution of the governing equations. The general topics addressed include model adaptation to experimental data, model identification and validation, fractional calculus and its applications in mechanics, nonlocal (scale) effects, and new concepts in the computational treatment for mechanical and thermomechanical problems.

The Guest Editors express their thanks to the *Journal of Mechanics of Materials and Structures* for the opportunity to edit this special issue.

CORINA S. DRAPACA  
Pennsylvania State University

STEFAN HARTMANN  
Clausthal University of Technology

JACEK LESZCZYŃSKI  
AGH University of Science and Technology, Kraków

SIVABAL SIVALOGANATHAN  
University of Waterloo

WOJCIECH SUMELKA  
Poznań University of Technology

*Guest Editors*

# JOURNAL OF MECHANICS OF MATERIALS AND STRUCTURES

[msp.org/jomms](http://msp.org/jomms)

Founded by Charles R. Steele and Marie-Louise Steele

## EDITORIAL BOARD

ADAIR R. AGUIAR	University of São Paulo at São Carlos, Brazil
KATIA BERTOLDI	Harvard University, USA
DAVIDE BIGONI	University of Trento, Italy
YIBIN FU	Keele University, UK
IWONA JASIUK	University of Illinois at Urbana-Champaign, USA
C. W. LIM	City University of Hong Kong
THOMAS J. PENCE	Michigan State University, USA
GIANNI ROYER-CARFAGNI	Università degli studi di Parma, Italy
DAVID STEIGMANN	University of California at Berkeley, USA
PAUL STEINMANN	Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany

## ADVISORY BOARD

J. P. CARTER	University of Sydney, Australia
D. H. HODGES	Georgia Institute of Technology, USA
J. HUTCHINSON	Harvard University, USA
D. PAMPLONA	Universidade Católica do Rio de Janeiro, Brazil
M. B. RUBIN	Technion, Haifa, Israel

**PRODUCTION** [production@msp.org](mailto:production@msp.org)

SILVIO LEVY Scientific Editor

---

Cover photo: Ev Shafir

See [msp.org/jomms](http://msp.org/jomms) for submission guidelines.

---

JoMMS (ISSN 1559-3959) at Mathematical Sciences Publishers, 798 Evans Hall #6840, c/o University of California, Berkeley, CA 94720-3840, is published in 10 issues a year. The subscription price for 2017 is US \$615/year for the electronic version, and \$775/year (+\$60, if shipping outside the US) for print and electronic. Subscriptions, requests for back issues, and changes of address should be sent to MSP.

---

JoMMS peer-review and production is managed by EditFLOW<sup>®</sup> from Mathematical Sciences Publishers.

PUBLISHED BY

 **mathematical sciences publishers**  
nonprofit scientific publishing

<http://msp.org/>

© 2017 Mathematical Sciences Publishers



## Special issue on Coupled Field Problems and Multiphase Materials

<b>Preface</b>	<b>CORINA S. DRAPACA, STEFAN HARTMANN, JACEK LESZCZYŃSKI, SIVABAL SIVALOGANATHAN and WOJCIECH SUMELKA</b>	<b>1</b>
<b>Variational methods for the solution of fractional discrete/continuous Sturm–Liouville problems</b>	<b>RICARDO ALMEIDA, AGNIESZKA B. MALINOWSKA, M. LUÍSA MORGADO and TATIANA ODZIJEWICZ</b>	<b>3</b>
<b>Analytical and numerical solution of the fractional Euler–Bernoulli beam equation</b>	<b>TOMASZ BLASZCZYK</b>	<b>23</b>
<b>Fractional calculus in neuronal electromechanics</b>	<b>CORINA S. DRAPACA</b>	<b>35</b>
<b>Time-adaptive finite element simulations of dynamical problems for temperature-dependent materials</b>	<b>MATTHIAS GRAFENHORST, JOACHIM RANG and STEFAN HARTMANN</b>	<b>57</b>
<b>Computer simulation of the effective viscosity in Brinkman filtration equation using the Trefftz method</b>	<b>JAN ADAM KOŁODZIEJ, MAGDALENA MIERZWICZAK and JAKUB KRZYSZTOF GRABSKI</b>	<b>93</b>
<b>Numerical simulations of mechanical properties of alumina foams based on computed tomography</b>	<b>ZDZISŁAW NOWAK, MARCIN NOWAK, RYSZARD PEŁCHERSKI, MAREK POTOCZEK and ROMANA ŚLIWA</b>	<b>107</b>
<b>Gradient-enhanced large strain thermoplasticity with automatic linearization and localization simulations</b>	<b>JERZY PAMIN, BALBINA WCISŁO and KATARZYNA KOWALCZYK-GAJEWSKA</b>	<b>123</b>