



UDC: 621

ISSN 1451-2092

---

University of Belgrade  
Faculty of Mechanical Engineering

# FME TRANSACTIONS

---

**New Series, Volume 44, Number 4, 2016**

---

## Editor:

**Boško Rašuo**

University of Belgrade

## Associate Editor:

**Stevanović Vladimir**

University of Belgrade

## Editorial Board:

**Avellan François**

Swiss Federal Institute of Technology, Zurich, Switzerland

**Cizmas Paul**

Texas A&M University, College Station, USA

**Dulikravich S. George**

Florida International University, Miami, USA

**Đorđević Vladan**

University of Belgrade

**Ehmann F. Kornel**

Northwestern University, Evanston IL, USA

**Felix Hong**

Wayne State University, Detroit, USA

**Gabi Martin**

Karlsruher Institut für Technologie (KIT), Germany

**Gajić Zoran**

Rutgers University, USA

**Jakirlic Suad**

Technische Universität Darmstadt, Germany

**Jovanović Jasmina**

University of Belgrade

**Kartnig Georg**

Technische Universität Wien, Austria

**Klimenko A. Sergei**

National Academy of Sciences, Kiev, Ukraine

**Komatina Mirko**

University of Belgrade

**Meerkamm Harald**

Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany

**Mester Gyula**

University of Szeged, Szeged, Hungary

**Minak Giangiacomo**

Alma Mater Studiorum - University of Bologna, Italy

**Nedić Novak**

University of Kragujevac

**Plančak Miroslav**

University of Novi Sad

**Putnik Goran**

University of Minho, Portugal

**Radovanović Miroslav**

University of Nis

**Sedmak Aleksandar**

University of Belgrade

**Soutis Constantinos**

The University of Manchester, Manchester, UK

**Stamenović Dimitrije**

Boston University, Boston, USA

## Technical Editor:

**Sedmak Simon**

University of Belgrade

## Published by:

University of Belgrade

Faculty of Mechanical Engineering

## On line service:

<http://www.mas.bg.ac.rs/transactions>

## Volume 44, No 4, 2016, pp. 325 – 430

## CONTENTS

	PAGE
<b>Cristiano Fragassa, Ana Pavlovic</b>	327
<i>Compacted and Spheroidal graphite irons: experimental evaluation of Poisson's ratio</i>	
<b>C. Fragassa, L. Berardi, G. Balsamini</b>	333
<i>Magnetorheological Fluid Devices: an Advanced Solution for Active Control of the Wood Manufacturing Process</i>	
<b>Riccardo Panciroli</b>	340
<i>Assessment of a Structural Health Monitoring technique through synthetic data generation</i>	
<b>Sakineh Fotouhi, S. Mohammad Reza Khalili</b>	348
<i>Analysis of dynamic stress intensity factor of finite piezoelectric composite plate under a dynamic load</i>	
<b>H. Saghafi, T.M. Brugo, A. Zucchelli, C. Fragassa, G. Minak</b>	353
<i>Comparison the effect of preload and curvature of composite laminate under impact loading</i>	
<b>Franco Bulian, Cristiano Fragassa</b>	358
<i>VOC Emissions from Wood Products and Furniture: a Survey about Legislation, Standards and Measures Referred to Different Materials</i>	
<b>M. Djapic, Lj. Lukic, A. Pavlovic</b>	365
<i>An Approach to Machine Tools Structure Selection for Wooden Product Machining Based on Evidence Networks</i>	
<b>Aleksandar Vujovic, Zdravko Krivokapic, Rade Grujicic, Jelena Jovanovic, Ana Pavlovic</b>	374
<i>Combining FEM and Neural networking in the design of optimization of traditional Montenegrin chair</i>	
<b>S. Sfarra, C. Ibarra-Castanedo, F. Sarasini, C. Santulli, X.P.V. Maldague</b>	380
<i>Basalt Fibre Laminates Non-Destructively Inspected After Low-Velocity Impacts</i>	
<b>Nenad Grujovic, Ana Pavlovic, Milan Sljivic, Fatima Zivic</b>	386
<i>Cost optimization of additive manufacturing in wood industry</i>	
<b>Milan Sljivic, Ana Pavlovic, Mico Stanojevic, Cristiano Fragassa</b>	393
<i>Combining Additive Manufacturing and Vacuum Casting for an Efficient Manufacturing of Safety Glasses</i>	
<b>A. Pavlovic, M. Zivkovic</b>	398
<i>Roll Cage Design and Validation for a Rally Vehicle</i>	
<b>Loris Giorgini, Chiara Leonardi, Laura Mazzocchetti, Giorgio Zattini, Massimo Cavazzoni, Ivan Montanari, Cristian Tosi, Tiziana Benelli</b>	405
<i>Pyrolysis of Fiberglass/Polyester Composites: Recovery and Characterization of Obtained Products</i>	
<b>N. Fallahi, G. Nardoni, H. Heidary, R. Palazzetti, X.T. Yan, A. Zucchelli</b>	415
<i>Supervised and Non-supervised AE Data Classification of Nanomodified CFRP During DCB Tests</i>	
<b>M. Sljivic, M. Stanojevic, D. Djurdjevic, N. Grujovic, A. Pavlovic</b>	422
<i>Implementation of FEM and Rapid Prototyping in Maxillofacial Surgery</i>	

# Advances in Industrial Engineering

In this Special Issue advanced materials and new experimental methods are presented and discussed in relation to the potential impact they offer on the progress of the Industrial Engineering. In particular, the objective of these researches and researchers is to propose emerging industrial solutions that can make use of traditional materials for innovative applications or even totally new material concepts that can be readily utilized in the future industrial products.

A relevant characteristic of this Special Issue is represented by the International Collaboration because the majority of the papers were done by transnational teams and the contributions come from researchers working in eight different countries.

Furthermore, the papers presented in this Special Issue are based in part on the outcomes of the Ipa-Adriatic project Adria-hub ([www.adria-hub.eu](http://www.adria-hub.eu)). In fact, one of the aims of that project was to focus resources and attention on a specific industrial sector, the wood processing industry, relevant for the whole Adriatic area developing methods and prototype solutions in respect to several environmental and eco-friendly aspects. The selected papers, which were presented at the local Italian conference: AIAS – Associazione Italiana per l'analisi delle sollecitazioni, 43° Convegno Nazionale, 9-12 settembre 2014, Alma Mater Studiorum – Università di Bologna, are included in this Special Issue of FME Transactions.

Coming deeper to the technical contents, the first paper titles as “*Compacted and Spheroidal graphite irons: experimental evaluation of Poisson's ratio*” by Cristiano Fragassa and Ana Pavlovic presents useful experimental data aiming at fostering the use of the specific family of compacted graphite cast iron in extraordinary industrial applications.

The second paper “*Magnetorheological Fluid Devices: an Advanced Solution for Active Control of the Wood Manufacturing Process*” by Luca Berardi and Guglielmo Balsamini and Cristiano Fragassa illustrates a solution in controlling of machine tools during wood machining that can be considered as particularly relevant where highly accuracy torque control is required. Results also demonstrate the need to develop specific software algorithms to fill the time gap between the expected and measured torque.

The paper “*Assessment of a Structural Health Monitoring technique through synthetic data generation*”, by Riccardo Panciroli, assesses the accuracy of a structural health monitoring technique that relies on a modal decomposition method and is intended to reconstruct the distributed deflection and strain fields from point-wise strain.

Sakineh Fotouhi and S. Mohammad Reza Khalili in the paper “*Analysis of dynamic stress intensity factor of*

*finite piezoelectric composite plate under a dynamic load*”, present the dynamic response of a central crack in a finite piezoelectric layered composite plate under impact load. Their results show that the maximum dynamic stress intensity factor depends on the thickness and material properties of the piezoelectric layer. Thus, these ones are crucial parameters in the design and evaluation of every piezoelectric material.

The following paper “*Comparison the effect of preload and curvature of composite laminate under impact loading*”, by Hamed Saghafi *et al.*, considers the effect of preload on impact response of composite laminates. The comparison of the impact responses shows that, in the case of similar curvatures, the preload condition leads to a lower damaged area. These results can be conveniently used for designing curved composite components.

Then, we have the paper “*VOC emissions from wood products and furniture: a survey about legislation, standards and measures referred to different materials*”, by Franco Bulian and Cristiano Fragassa, which presents a summary about the legislative and normative scenario on indoor emissions with the evidence of some experimental data referred to parquet floorings coated with different coating substances. The work, represents a point of reference on the subject for all operators in the sector given the innovative nature and however strong impact that the VOC issue currently plays in this industrial segment.

The following paper “*An Approach to Machine Tools Structure Selection for Wooden Product Machining Based on Evidence Networks*”, by Mirko Djapic, Ljubimir Lukic and Ana Pavlovic is focused on new methods for the conceptual design of a machine tool, providing interesting considerations as in the case of the the determination of the best structure of machining center in the phase of conceptual design for a predefined group of wooden parts that are being machined on them.

Aleksandar Vujovic *et al.*, in the paper “*Combining FEM and Neural networking in the design of optimization of traditional Montenegrin chair*”, present the results of tests and analysis on the strength of a traditional Montenegrin chair using Finite Element Method. This investigation has been realized according to the safety procedure described in the most relevant European standards. Based on these results a neural network, able to automatically select several relevant design parameters of the traditional Montenegrin chairs in the way to provide a satisfactory solution, has developed and trained.

In the following paper “*Basalt Fibre Laminates Non-Destructively Inspected After Low-Velocity Impacts*”, the authors S. Sfarra *et al.*, the use of

advanced thermo graphic techniques for the post-impact defect detection in basalt fibre reinforced composite laminates have been investigated. They show that the non-thermal part of the infrared spectrum can be coupled with the thermal part providing a complete infrared vision beyond what is perceptible to the naked eye in the visible spectrum.

Then, Nenad Grujovic *et al.* in the paper “*Cost optimization of additive manufacturing in wood industry*”, consider the optimization of the production costs of fabricated elements in case of small-scale production, and optimization of variable costs.

The paper “*Combining Additive Manufacturing and Vacuum Casting for an Efficient Manufacturing of Safety Glasses*”, by Milan Sljivic *et al.*, presents the possibility of integration of modern techniques of additive manufacturing and vacuum casting in the rapid manufacturing of complex parts. The prototype of safety glasses is directly developed from a CAD model, which is used as a main model for making moulds in a vacuum casting process.

The following paper is devoted to the numerical simulation. In fact, “*Roll Cage Design and Validation for a Rally Vehicle*”, by Ana Pavlovic and Miroslav Zivkovic, presents the design of an appropriate roll cage to be installed on a rally vehicle and its validation by Finite Elements. CAD frame is modelled by CATIA software using shell elements. Geometrical and material nonlinear FEM analysis is implemented by PAK code. By means of experimental tests in displacement control conditions, critical forces on the structure are also determined. Numerical results are then compared with experimental ones, permitting to refine the simulation model and validated the design for safety.

The following paper is focused on the recyclability of plastic based composites. “*Fiberglass/Polyester Composites: Recovery and Characterization of Obtained Products*”, by Loris Giorgini *et al.* presents glass fiber reinforced polyester composite (GFRPs) scraps from manufacturing of polyester laminates pyrolyzed at 500, 550 and 600°C in an 70 Kg innovative batch pilot plant. The effects of both pyrolysis and oxidative step on the glass fibers, obtained in different process conditions, are evaluated by SEM and Raman spectroscopy.

N. Fallahi *et al.* in the paper “*Supervised and non-supervised AE data classification of nanomodified*

*CFRP during DCB tests*” use acoustic emissions to study the effect of electrospun nylon 6.6 Nanofibrous mat on carbon-epoxy composites during Double Cantilever beam (DCB) tests. Supervised neural network is applied to verify clustered signals. Results have shown that clustered acoustic emission signals are a reliable tool to detect different damage mechanisms.

In the last paper “*Implementation of FEM and Rapid Prototyping in Maxillofacial Surgery*”, Milan Sljivic *et al.*, investigate the possibility of implementing FE simulations and rapid prototyping techniques on titanium implant in maxillofacial surgery case based on osteotomy. The approach they have used facilitates the preparation of complex shaped implants in swept and lofted form, what had to be in high degree of conformity to anatomy surface.

## ACKNOWLEDGMENTS

The Guest Editors would like to thank the papers' authors for their innovative contribution and the reviewers for their useful and timely comments on the papers submitted to this Special Issue. The Guest Editors would also like to express a sincere thanks to Prof. Boško Rašuo, the Editor of the Journal, for this kind opportunity and his great support along the development of this Special Issue.

### Guest Editors

Giangiaco Minak  
*Associate Professor*

*Alma Mater Studiorum – University of Bologna,  
Department of Industrial Engineering  
Via Fontanelle 40 Forli, Italy  
E-mail address: giangiaco.minak@unibo.it*

Milosav Ognjanović  
*Professor*

*University of Belgrade,  
Faculty of Mechanical Engineering  
11120 Belgrade, Serbia  
E-mail address: mognjjanovic@mas.bg.ac.rs*

July 2016