# Conferences لد Extrica

ISSN ONLINE 2538-8479 ISSN PRINT 2345-0533

> February 2023 VOLUME 48

Mechanical Engineering

Multidisciplinary Engineering

Materials Science and Technology

# Vibroengineering Procedia





#### Editor in Chief

Minvydas Ragulskis Editorial Board Mahmoud Bayat Rafał Burdzik Maosen Cao Jinde Cao Sezgin Ersoy W. H. Hsieh Vassilis Kappatos Chen Lu Luis E. Muñoz Nicola Nisticò Vytautas Ostaševičius Grigory Panovko

Subhash Rakheja Vinayak Ranjan G. Eduardo Sandoval-Romero

Miguel A. F. Sanjuan Gangbing Song Shigeki Toyama Piotr Vasiljev

Vincentas Veikutis Jānis Vība Xiao-Jun Yang Krzysztof Kamil Żur

#### Kaunas University of Technology, (Lithuania)

Roudehen Branch, Islamic Azad University, (Iran) Silesian University of Technology, (Poland) Hohai University, (China) Southeast University, (China) Marmara University, (Turkey) National Formosa University, (Taiwan) Center for Research and Technology Hellas, (Greece) Beihang University, (China) Universidad de los Andes, (Colombia) Sapienza University of Rome, (Italy) Kaunas University of Technology, (Lithuania) Mechanical Engineering Research Institute of the Russian Academy of Sciences, (Russia) Concordia University, (Canada) Bennett University, (India) The National Autonomous University of Mexico, (Mexico) University Rey Juan Carlos, (Spain) University of Houston, (USA) Tokyo A&T University, (Japan) Lithuanian University of Educational Sciences, (Lithuania) Lithuanian University of Health Sciences, (Lithuania) Riga Technical University, (Latvia) China University of Mining and Technology, (China) Bialystok University of Technology, (Poland)

minvydas.ragulskis@ktu.lt

mbayat14@yahoo.com rafal.burdzik@polsl.pl cmszhy@hhu.edu.cn jdcao@seu.edu.cn sersoy@marmara.edu.tr allen@nfu.edu.tw vkappatos@certh.gr luchen@buaa.edu.cn lui-muno@uniandes.edu.co nicola.nistico@uniroma1.it vytautas.ostasevicius@ktu.lt gpanovko@yandex.ru

subhash.rakheja@concordia.ca vinayak.ranjan@bennett.edu.in eduardo.sandoval@ccadet.unam.mx

miguel.sanjuan@urjc.es gsong@uh.edu toyama@cc.tuat.ac.jp piotr.vasiljev@leu.lt

vincentas.veikutis@lsmuni.lt janis.viba@rtu.lv dyangxiaojun@163.com k.zur@pb.edu.pl

#### **VP** Vibroengineering PROCEDIA

Vibroengineering PROCEDIA Volume 48 contains papers presented at the 62nd International Conference on Vibroengineering held in Almaty, Kazakhstan, February 10-11, 2023. The main theme of the Conference is "Advanced Engineering, Transport and Energy".

#### Aims and Scope

Journal publishes original papers presenting the state of the art in vibroengineering of dynamical systems. The list of principal topics:

- Measurements in engineering
- Mathematical models in engineering
- Acoustics, noise control and engineering applications
- Mechanical vibrations and applications
- Fault diagnosis based on vibration signal analysis
- Vibration control, generation and harvesting
- Seismic engineering and applications
- Modal analysis and applications
- Vibration in transportation engineering
- Flow induced structural vibrations
- Oscillations in biomedical engineering
- Chaos, non-linear dynamics and applications
- Oscillations in electrical engineering
- Fractional dynamics and applications
- System dynamics in manufacturing system modeling
- Dynamics of smart and functionally graded materials

#### All published papers are peer reviewed and crosschecked by plagiarism detection tools.

More information is available online https://www.extrica.com/journal/vp

#### Vibroengineering PROCEDIA is referred in:

Scopus: ELSEVIER Bibliographic Database. EI Compendex: ELSEVIER Bibliographic Database.
EBSCO: Academic Search Complete;
<b>1</b>
Computers & Applied Sciences Complete;
Central & Eastern European Academic Source;
Current Abstracts;
TOC Premier.
Gale Cengage Learning:
Academic OneFile Custom Periodical;
Science in Context.
Inspec: OCLC. The Database for Physics, Electronics and Computing.
Scilit: https://www.scilit.net
Dimensions: https://www.dimensions.ai
Semantic Scholar: https://www.semanticscholar.org
Google Scholar: https://scholar.google.com
CORE: https://core.ac.uk
Ulrich's Periodicals Directory: https://ulrichsweb.serialssolutions.com
CNKI Scholar: http://eng.scholar.cnki.net
cnpLINKer (CNPIEC): http://cnplinker.cnpeak.com
TDNet: https://www.tdnet.io
WorldCat Discovery Services: https://www.oclc.org/en/worldcat-discovery.html
MyScienceWork: https://www.mysciencework.com
Crossref: https://search.crossref.org

#### Content is archived in Martynas Mazvydas National Library of Lithuania

Internet:	https://www.extrica.com
E-mail:	publish@extrica.com
Publisher:	JVE International Ltd., Geliu ratas 15A, LT-50282, Kaunas, Lithuania

#### 62nd International Conference on VIBROENGINEERING

February 10-11, 2023, in Almaty, Kazakhstan

#### The main theme of the conference: Advanced Engineering, Transport and Energy

#### **General Topics of the Conference:**

- Rail traffic management
- Safety engineering
- Human factors and ergonomics
- Renewable energy
- Internet-of-Things and smart manufacturing
- Logistics hubs and clusters
- Internet-of-Things in logistics
- Rail wagon engineering
- Locomotives
- Telecommunications
- Robotic systems and AI
- Biomedical engineering
- Automation systems
- Modeling and simulation
- Logistics and supply chain management
- Civil infrastructure
- Bridge engineering
- Hydraulic engineering
- Transportation structures

#### **Chairs:**

Saltanat N. Amirgalieva	Academy of Logistics and Transport, Kazakhstan
Minvydas Ragulskis	Kaunas University of Technology, Lithuania
Gani Balbayev	Academy of Logistics and Transport, Kazakhstan

#### Scientific Organizing Committee Members

G. B. Serikova	Academy of Logistics and Transport, Kazakhstan
Y. Seitkulov	L. N. Gumilyov Eurasian National University, Kazakhstan
T. Iliev	University of Rousse, Bulgaria
J. Plotkin	Hochschule für Wirtschaft und Recht Berlin, Germany
A. Ivanov	Academy of Logistics and Transport, Kazakhstan
T. Chigambaev	Institute "Transport Engineering", Kazakhstan
A. K. Kaltayev	Institute "Logistics and Management", Kazakhstan
A. Toigozhinova	Institute "Automation and Telecommunication", Kazakhstan
K. Ozhikenov	Satbayev University, Kazakhstan

#### Local Organizing Committee Members

G. B. Serikova Academy of Logistics and Transport, Kazakhstan	A. B. Seriktegi	Academy of Logistics and Transport, Kazakhstan
· · · · · · · · · · · · · · · · · · ·	G. B. Serikova	Academy of Logistics and Transport, Kazakhstan
M. S. Zharmaganbetova Academy of Logistics and Transport, Kazakhstan	M. S. Zharmaganbetova	Academy of Logistics and Transport, Kazakhstan
A. Ivanov Academy of Logistics and Transport, Kazakhstan	A. Ivanov	Academy of Logistics and Transport, Kazakhstan
T. Chigambaev Institute "Transport Engineering", Kazakhstan	T. Chigambaev	Institute "Transport Engineering", Kazakhstan
A. K. Kaltayev Institute "Logistics and Management", Kazakhstan	A. K. Kaltayev	Institute "Logistics and Management", Kazakhstan
A. Toigozhinova Institute "Automation and Telecommunication", Kazakhstan	A. Toigozhinova	Institute "Automation and Telecommunication", Kazakhstan

#### **Organizing Committee Members**

V. Babitsky	Loughborough University, United Kingdom
M. Bayat	Roudehen Branch, Islamic Azad University, Iran
K. Bousson	University of Beira Interior, Portugal
M. Brennan	University of Southampton, United Kingdom

R. Burdzik	Silesian University of Technology, Poland
M. Cao	Hohai University, China
F. Chernousko	Institute for Problems in Mechanics, Russia
Z. Dabrowski	Warsaw University of Technology, Poland
Y. Davydov	Institute of Machine Building Mechanics, Russia
J. Duhovnik	University of Ljubljana, Slovenia
A. El Sinawi	The Petroleum Institute, United Arab Emirates
R. Ganiev	Blagonravov Mechanical Engineering Research Institute, Russia
W. H. Hsieh	National Formosa University, Taiwan
Chen Lu	Beihang University, China
Y. Mao	Zhejiang Gongshang University, China
R. Maskeliūnas	Vilnius Gediminas Technical University, Lithuania
L. E. Muñoz	Universidad de los Andes, Colombia
G. Panovko	Russian Academy of Sciences, Russia
N. Perkins	University of Michigan, USA
L. Qiu	Nanjing University of Aeronautics and Astronautics, China
S. Rakheja	Concordia University, Canada
M. A. F. Sanjuan	University Rey Juan Carlos, Spain
G. Song	University of Houston, USA
S. Toyama	Tokyo A&T University, Japan
K. Uchino	The Pennsylvania State University, USA
P. Vasiljev	Lithuanian University of Educational Sciences, Lithuania
V. Veikutis	Lithuanian University of Health Sciences, Lithuania
J. Vība	Riga Technical University, Latvia
V. Volkovas	Kaunas University of Technology, Lithuania
J. Wallaschek	Leibniz University Hannover, Germany
A. Zhauyt	Almaty University of Power Engineering and Telecommunications, Kazakhstan

# VP Vibroengineering PROCEDIA

FEBRUARY 2023. VOLUME 48, PAGES (1-125), ISSN PRINT 2345-0533, ISSN ONLINE 2538-8479

## Contents

#### MECHANICAL VIBRATIONS AND APPLICATIONS

DYNAMICS OF A WHEELED ROBOT DRIVEN BY AN UNBALANCED ROTOR AND EQUIPPED WITH THE OVERRUNNING CLUTCHES VITALIY KORENDIY, OLEKSANDR KACHUR, VOLODYMYR GUREY, IGOR KUZIO, TETYANA HUREY, OLEKSANDR HAVRYLCHENKO	1
DYNAMICS OF A VIBRATORY SCREENING CONVEYOR EQUIPPED WITH A CONTROLLABLE CENTRIFUGAL EXCITER Oleksandr Kachur, Vitaliy Korendiy, Oleksii Lanets, Roman Kachmar, Ihor Nazar, Volodymyr Heletiy	8
SEISMIC ENGINEERING AND APPLICATIONS	
HORIZONTAL RESIDUAL DISPLACEMENT OF REINFORCED SOIL RETAINING WALL UNDER SEISMIC FORCING LIANG LU, PENG LIU	15
MODAL ANALYSIS AND APPLICATIONS	
DYNAMIC CHARACTERISTICS ANALYSIS OF A CIRCULAR VIBRATING SCREEN YUANCHEN WANG, ZHENQIAN WANG, MIN ZHANG, BOWEN XU, YUNHAO SONG	22
<b>BIOMECHANICS AND BIOMEDICAL ENGINEERING</b>	
<b>Development and simulation of a device for upper limb rehabilitation</b> Bizhanov Dauren, Nursultan Zhetenbayev, Gani Balbayev, Beibit Shingissov, Nussibaliyeva Arailym, Yussupova Saltanat	29
<b>Developing of a wearable ankle rehabilitation robotic device</b> Nursultan Zhetenbayev, Gani Balbayev, Duisebayeva Aknur, Algazy Zhauyt, Beibit Shingissov	36

#### MATERIALS AND MEASUREMENTS IN ENGINEERING

PREPARATION OF MULTISTAGE MICROPOROUS AND MESOPOROUS NITROGEN-DOPED CARBON NANOSPHERES AND STUDY ON ELECTROCATALYTIC OXYGEN REDUCTION HOUDONG RAO, SHUXI SHAN, DONGYANG ZHANG, LING ZHANG, WENFEI WANG	42
EFFECTS OF ADDITIVES ON PROPERTIES OF SELF-SKINNING POLYURETHANE FOAM FOR AUTOMOBILE STEERING WHEEL Houdong Rao, Dongyang Zhang, Jingrui Li, Ling Zhang, Wenfei Wang	49
A SIMPLE APPROACH TO FABRICATE PROTECTIVE COATINGS ON THE SURFACE OF AZ91 ALLOY AND ITS CORROSION RESISTANCE BO WANG, FENGGUANG ZUO, DIXING BAI, YINGCHEN YANG, CHENG LI, JUMEI ZHANG	55
EFFECT OF SCM435 INITIAL MICROSTRUCTURE AND ANNEALING PROCESS ON SPHEROIDIZATION GRADE AND PROPERTIES Shuai Zhu, Xianfeng Zhen, Guangshun Wang, Chunyu Ma, Changfa Cao	61
ZNCOHYDROTALCITE ON NI FOAM FOR HIGH-PERFORMANCE SUPERCAPACITOR YUBIN YANG, SHAOMIN ZHU, HONGFENG XU	67
Analysis and practice of reducing emissions of pollutants from road transport into the atmospheric air of the city of Almaty Yerkin A. Jailaybekov, Galym D. Berkinbayev, Natalia A. Yakovleva	74
STUDY ON THE PERFORMANCE OF FUEL CELL AIR FILTER WITH DIFFERENT CARBON CONTENT JIACHEN BIAN, SHUHONG WEI, PENGFEI JIAO, KUN BIAN, XIAOKUN FU	81
Assessment of carbon dioxide emissions in road transport, using exhaust gas cleaning technology, in the Republic of Kazakhstan Gabit Bakyt, Yerkin Jailaubekov, Seidulla Abdullayev, Galymzhan Ashirbayev, Irina Ashirbayeva	87
MATHEMATICAL MODELS IN ENGINEERING	
ENERGY INTENSITY STUDY FOR SOIL TRANSPORTATION BY INERTIAL ROTOR Rustem Kozbagarov, Kenes Zhussupov, Yerbol Kaliyev, Manarbek Yessengaliyev, Nurbol Kamzanov	93
EXPERIMENTAL STUDY ON ELECTROSTATIC ATOMIZATION EFFECT OF CAPILLARY-PLATE ELECTRODE JIANHE LIU, CHANGQING SUN	100
FINITE ELEMENT ANALYSIS OF THE INFLUENCE OF ICE TEMPERATURE EXPANSION FORCE ON SURFACE WATER QUALITY MONITORING SYSTEM JIGUANG JIANG, XIAOTIAN LI, CHENGZHI SU, XUANJI GUO, MINGZHIBO HE, YUE ZENG	107
SYSTEM DYNAMICS IN MANUFACTURING SYSTEM MODELING	
DESIGN OF NOZZLE DIVERTER CHANNEL SYSTEM BASED ON UNIFORM DISTRIBUTION PERFORMANCE JIANHE LIU, CHANGQING SUN	113

### THE PERFORMANCE OF DOUBLE-LAYER RUBBER SEALING RING UNDER THE ACTION120OF LOW TEMPERATURE ENVIRONMENT120

JIGUANG JIANG, XIAOTIAN LI, CHENGZHI SU, XIAOLONG HOU, KUN QI, YUE ZENG

Vibroengineering is an abbreviation of two words: vibration and engineering. Vibration phenomena play an important role in a wide range of mechanical, structural, electromechanical systems. Vibration engineering covers such topics as mechanical vibrations and applications, fault diagnosis based on vibration signal analysis, seismic engineering, acoustics and noise control, energy harvesting and vibration generation. Every consecutive Volume of Vibroengineering Procedia is dedicated to a separate conference in the series of International Conferences on Vibroengineering.





EXTRICA.COM