

# Lecture Notes in Civil Engineering

Volume 204

## Series Editors

Marco di Prisco, Politecnico di Milano, Milano, Italy

Sheng-Hong Chen, School of Water Resources and Hydropower Engineering,  
Wuhan University, Wuhan, China

Ioannis Vayas, Institute of Steel Structures, National Technical University of  
Athens, Athens, Greece

Sanjay Kumar Shukla, School of Engineering, Edith Cowan University, Joondalup,  
WA, Australia

Anuj Sharma, Iowa State University, Ames, IA, USA

Nagesh Kumar, Department of Civil Engineering, Indian Institute of Science  
Bangalore, Bengaluru, Karnataka, India

Chien Ming Wang, School of Civil Engineering, The University of Queensland,  
Brisbane, QLD, Australia

**Lecture Notes in Civil Engineering (LNCE)** publishes the latest developments in Civil Engineering—quickly, informally and in top quality. Though original research reported in proceedings and post-proceedings represents the core of LNCE, edited volumes of exceptionally high quality and interest may also be considered for publication. Volumes published in LNCE embrace all aspects and subfields of, as well as new challenges in, Civil Engineering. Topics in the series include:

- Construction and Structural Mechanics
- Building Materials
- Concrete, Steel and Timber Structures
- Geotechnical Engineering
- Earthquake Engineering
- Coastal Engineering
- Ocean and Offshore Engineering; Ships and Floating Structures
- Hydraulics, Hydrology and Water Resources Engineering
- Environmental Engineering and Sustainability
- Structural Health and Monitoring
- Surveying and Geographical Information Systems
- Indoor Environments
- Transportation and Traffic
- Risk Analysis
- Safety and Security

To submit a proposal or request further information, please contact the appropriate Springer Editor:

- Pierpaolo Riva at [pierpaolo.riva@springer.com](mailto:pierpaolo.riva@springer.com) (Europe and Americas);
- Swati Meherishi at [swati.meherishi@springer.com](mailto:swati.meherishi@springer.com) (Asia - except China, and Australia, New Zealand);
- Wayne Hu at [wayne.hu@springer.com](mailto:wayne.hu@springer.com) (China).

**All books in the series now indexed by Scopus and EI Compendex database!**

More information about this series at <https://link.springer.com/bookseries/15087>

Magd Abdel Wahab  
Editor

# Proceedings of the 2nd International Conference on Structural Damage Modelling and Assessment

SDMA 2021, 4–5 August, Ghent University,  
Belgium

 Springer

*Editor*

Magd Abdel Wahab  
Faculty of Engineering and Architecture  
Ghent University, Laboratory Soete  
Zwijnaarde, Belgium

ISSN 2366-2557

ISSN 2366-2565 (electronic)

Lecture Notes in Civil Engineering

ISBN 978-981-16-7215-6

ISBN 978-981-16-7216-3 (eBook)

<https://doi.org/10.1007/978-981-16-7216-3>

© The Editor(s) (if applicable) and The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2022

This work is subject to copyright. All rights are solely and exclusively licensed by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, expressed or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

This Springer imprint is published by the registered company Springer Nature Singapore Pte Ltd.

The registered company address is: 152 Beach Road, #21-01/04 Gateway East, Singapore 189721, Singapore

# Organising Committee

## Chairman

Prof. Magd Abdel Wahab, Ghent University, Belgium

## International Scientific Committee

Prof. S. Abdullah, Universiti Kebangsaan Malaysia, Malaysia

Dr. H. T. Ali, University of Bristol, UK

Dr. I. Hilmy, International Islamic University Malaysia

Prof. G-R. Gillich, Eftimie Murgu Univ Resita, Romania

Dr. S. Khatir, Ghent University, Belgium

Dr. C. Le Thanh, Open University Ho Chi Minh City, Vietnam

Prof. N-A. Noda, Kyushu Institute of Technology, Japan

Prof. K. Oda, Oita University, Japan

Prof. R. V. Prakash, Indian Institute of Technology, India

Prof. T. Rabczuk, Bauhaus University Weimar, Germany

Prof. A. Rudawska, Lublin University of Technology, Poland

Prof. J. Toribio, University of Salamanca, Spain

Dr. L. V. Tran, Sejong University, South Korea

Prof. L. Vanegas Useche, Universidad Tecnológica de Pereira, Colombia

Dr. C. Wang, Liaocheng University, China

Prof. H-N. Xuan, Hutech University, Vietnam

Dr. X. Zhuang, Leibniz Universität Hannover, Germany

Prof. Yongtao Bai, Chongqing University, China

Prof. Maria Korovina, Lomonosov Moscow State University, Russia

Prof. Dr. Hovik A. Matevossian, Russian Academy of Sciences, Russia

Dr. Y. L. Zhou to Xi'an Jiaotong University, China

# Preface

This volume contains the proceedings of the 2nd International Conference on Structural Damage Modelling and Assessment (SDMA 2021), August 4–5, 2021, Online and at Ghent University, Belgium. The conference is a major international forum for research topics relevant to damage modelling and assessment of engineering structures and systems including numerical simulations, signal processing of sensor measurements and theoretical techniques, as well as, experimental case studies. The presentations of SDMA 2021 are divided into 2 main sessions, namely: (1) Damage in Civil Engineering and (2) Damage in Mechanical and Materials Engineering.

The organising committee is grateful to keynote speaker: Professor Filippo Berto, Department of mechanical and industrial engineering, NTNU, Trondheim Norway, for his presentation entitled ‘Plant-cell-inspired interlocking structures: recent developments and future outcomes’.

Special thanks go to members of the Scientific Committee of SDMA 2021 for reviewing the articles published in this volume and for judging their scientific merits. Based on the comments of reviewers and the scientific merits of the submitted manuscripts, the articles were accepted for publication in the conference proceedings and for presentation at the conference venue. The accepted papers are of a very high scientific quality and contribute to advancement of knowledge in all research topics relevant to SDMA conference.

Finally, the organising committee would like to thank all authors, who have contributed to this volume and presented their research work at SDMA 2021.

Zwijnaarde, Belgium

Magd Abdel Wahab  
Chairman of SDMA 2021

# Contents

## Damage in Civil Engineering

<b>Finite Element Model Updating of Lifeline Truss Bridge Using Vibration-Based Measurement Data and Balancing Composite Motion Optimization</b> .....	3
Lan Ngoc-Nguyen, Samir Khatir, Hoa Ngoc-Tran, Hieu Nguyen-Tran, Binh Duc-Nguyen, Thanh Bui-Tien, and Magd Abdel Wahab	
<b>A Two-Step Approach for Damage Detection in a Real 3D Tower Using the Reduced-Order Finite Element Model Updating and Atom Search Algorithm (ASO)</b> .....	13
Hoang-Le Minh, Thanh Sang-To, Tran-Thanh Danh, Nguyen-Ngoc Phu, Magd Abdel Wahab, and Thanh Cuong-Le	
<b>Monitoring Bridge Frequencies Using Passing Vehicle</b> .....	27
Duong Huong Nguyen, Quoc Bao Nguyen, and Magd Abdel Wahab	
<b>Topology Optimization for a Large-Scale Truss Bridge Using a Hybrid Metaheuristic Search Algorithm</b> .....	37
H. Tran-Ngoc, H. Nguyen-Manh, H. Viet Tran, Q. Nguyen-Huu, N. Hoang-Thanh, T. Le-Xuan, T. Bui-Tien, N. Nguyen-Cam, and M. Abdel Wahab	
<b>Predicting the Displacement of Diaphragm Wall for Deep Excavation Problem on the Basing Thickly Soft Soil in an Urban Area Using Semi-Top-Down Construction Method</b> .....	49
Thanh Sang-To, Minh Hoang-Le, Magd Abdel Wahab, and Thanh Cuong-Le	
<b>Experimental Investigations and Numerical Simulations for the Seismic Assessment of a Masonry Building</b> .....	57
Mariella Diaferio, Marilena Venerito, and Michele Vitti	

**A Portable Scanning Device for Local Vibration Testing of Concrete Structures** ..... 71  
 Tatsuro Murakawa, Hideki Naito, Yusuke Fujisaku, Kohko Inaba, and Takatada Takahashi

**Detecting Delamination of Pavement Layers in Airfield Runways Using Local Vibration Testing and Machine Learning** ..... 83  
 Yusuke Fujisaku, Hideki Naito, Yu Shirai, Takuya Maeshima, Sonoko Ichimaru, and John E. Bolander

**Damage Evaluation of RC Structures Using Simplified Wave Propagation Analysis and Machine Learning** ..... 97  
 Ryu Hashimoto, Hideki Naito, Sonoko Ichimaru, and John E. Bolander

**Damage in Mechanical and Materials Engineering**

**Fracture and Damage Mechanisms of Slipper-Retainer Assembly in Axial Piston Machines** ..... 113  
 Gaston Haidak and Dongyun Wang

**Effect of Combined Substance Sorption on the Mechanical Performance of Carbon Fibre-Reinforced Polymer Composites** ..... 121  
 A. Mostafa, M. J. Lavelle, S. A. Hadigheh, K. Shankar, Y. Y. Lim, and N. Sirach

**Adaptive Phase-Field Modeling of Brittle Fracture** ..... 145  
 Krešimir Jukić, Tomislav Jarak, Karlo Seleš, and Zdenko Tonković

**Application of Multilayer Perceptron Neural Network for Damage Detection in Rectangular Laminated Composite Plates Based on Vibrational Analysis** ..... 163  
 Morteza Saadatmorad, Ramazan-Ali Jafari-Talookolaei, Mohammad-Hadi Pashaei, Samir Khatir, and Magd Abdel Wahab

**Adaptive Network-Based Fuzzy Inference for Damage Detection in Rectangular Laminated Composite Plates Using Vibrational Data** ..... 179  
 Morteza Saadatmorad, Ramazan-Ali Jafari-Talookolaei, Mohammad-Hadi Pashaei, Samir Khatir, and Magd Abdel Wahab

**Damage Identification in Frame Structure Based on Inverse Analysis** ..... 197  
 Samir Khatir, Samir Tiachacht, Brahim Benaissa, Cuong Le Thanh, Roberto Capozucca, and Magd Abdel Wahab