Booklet of Abstracts

"1st International Conference on Mathematical Modelling in Mechanics and Engineering"

Mathematical Institute of the Serbian Academy of Sciences and Arts
Belgrade, 08.-10. September 2022.

Editors: Ivana Atanasovska, Milan Cajić, Danilo Karličić

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PREFACE

It's our pleasure to be the chairs of the '1st International Conference on Mathematical Modelling in Mechanics and Engineering', organized by the Mathematical Institute of the Serbian Academy of Sciences and Arts, and co-organized by the Faculty of Mechanical Engineering, University of Belgrade; the Faculty of Mechanical and Civil Engineering in Kraljevo, University of Kragujevac; and Institute for Information Technologies, University of Kragujevac. The conference will be held in hybrid form at the Mathematical Institute of the Serbian Academy of Sciences and Arts, Belgrade, Serbia, from 8th to 10th of September, 2022.

This conference is planned as the first event in the series of conferences which will be held every two or three years and bring together leading academic scientists, researchers and research scholars to exchange and share experience and research results on various aspects of mathematical modelling in mechanics and engineering. It will bring an interdisciplinary platform for researchers, practitioners and educators to present and discuss the most recent innovations, theories, algorithms, as well as practical challenges encountered and solutions adopted in the fields of Classical Mechanics, Solid and Fluid Mechanics, Computational Mechanics, Biomechanics, Applied Mathematics and Physics, Structural Mechanics and Engineering. A considerable number of prominent scientists and professors submitted their abstracts and confirmed their attendance at the conference. The scientists and researchers from different countries in Europe and the world (Netherlands, UK, Norway, Greece, Spain, USA, Kazakhstan, Italy, Montenegro, India, Malaysia, Slovenia etc.) also have confirmed participation at the conference. We expect that the conference presentations will cover modelling with analytical/numerical and data driven solutions to study complex media, composite aerospace and periodic structures and metamaterials, and capture essential features of linear and nonlinear dynamics and wave propagation behaviour that can lead to new designs of such systems. Some presentations will include new experimental setups to study engineering materials and novel control strategies based on classical or fractional derivative models used to control the dynamics of multibody, flexible and/or electromechanical systems. Finally, we believe that the sessions' discussions will have high potential to give significant contribution to the developments of new and advanced mathematical models of real-world engineering mechanical systems.

We're very proud to announced that the number of accepted contributions to be presented at this Conference is 106, with 7 plenary and 4 invited lecture presentations. We would like to express our gratitude to the institutions that support conference financially: The Ministry of education, science and technological development of the Republic of Serbia; METALFER STEEL MILL doo, Serbia; and SHIMADZU, Serbia. We are especially grateful to the members of the Scientific committee and participants who gave their contribution to this international scientific meeting with their advices and abstracts' reviews. We also thank to the support of the co-organizers of this Conference: The Faculty of Mechanical Engineering, University of Belgrade, Serbia; The Faculty of Mechanical and Civil Engineering in Kraljevo, University of Kragujevac, Serbia; and Institute for Information Technologies, University of Kragujevac, Serbia.

We hope that this conference will be success beginning of a recognized series of international conference events during next decades. We use the opportunity to wish to all participants a successful presentation of their scientific results.

Cordially,

Ivana Atanasovska, Conference Chair
Milan Cajić, Conference Vice-Chair
Danilo Karličić, Conference Vice-Chair

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1st International Conference on Mathematical
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A SIMULATION-INFORMED MODELING OF DEPTH OF PENETRATION OF RIGID RODS INTO QUASIBRITTLE SOLIDS

Sreten Mastilovic

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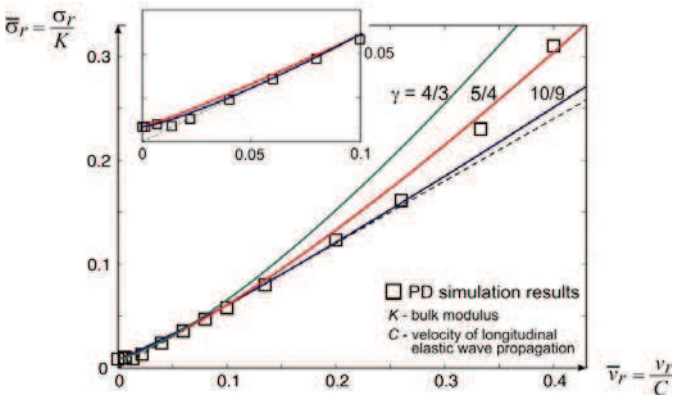
Keywords: Penetration depth, Particle dynamics, Cylindrical cavity expansion.

ABSTRACT

The present study proposes a model aimed to provide a rational estimate of the penetration depth of rigid projectiles into quasibrittle solids. Penetration at normal incidence into massive targets, made of materials predisposed to microcracking, is marked by a high level of aleatory variability and epistemic uncertainty. This inherent stochasticity is addressed by the model developed based on the particle dynamics simulations that provide the key modeling ingredient – the estimate of the radial traction required to expand a cylindrical cavity at a prescribed rate

$$\bar{\sigma}_r = \mathcal{B} + \mathcal{A}\cdot \bar{v}_r^{\gamma}, \quad \gamma \in \Re^+, 1<\gamma<2 \tag{1}$$



Considering Eq. (1), the expression for the depth of penetration

$$D = \frac{KE}{\alpha}\cdot {}_2\mathrm{F}_1\left(1, \frac{2}{\gamma}, 1+\frac{2}{\gamma}, -\frac{\beta}{\alpha}\left(\frac{v}{C}\right)^{\gamma}\right), \quad KE = \frac{1}{2}mv^2 \tag{2}$$

can be derived for the conical-nose rods using Newton's second law of motion. In Eq. (2), m and v designate the projectile mass and striking velocity, respectively, and α and β – the model parameters defining the penetration resistance based on the ansatz (1). The use of the power law radial traction dependence upon the expansion rate (1) yields both the penetration-resistance force and the penetration depth (Eq. (2)) defined in terms of the hypergeometric functions ${}_2\mathrm{F}_1(a, b; c; f(z))$. These expressions are readily evaluated and offer a reasonable estimate of the penetration depth.

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