

44th Solid Mechanics Conference

Book of Abstracts

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September 7–10, 2026
Kraków, Poland

44th Solid Mechanics Conference



Book of Abstracts

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and

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and

Polish Association for Computational Mechanics

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Preface

This volume of electronic proceedings contains abstracts of contributions accepted for presentation at the 44th Solid Mechanics Conference SolMech 2026, held in Kraków on September 7–10, 2026.

The Solid Mechanics Conferences are a series of biennial international meetings which have been organized by the Institute of Fundamental Technological Research of the Polish Academy of Sciences (IPPT PAN) since 1953. They aim at facilitating discussions on research topics in solid mechanics, maintaining high scientific standards and providing a friendly atmosphere. This time, the Conference is hosted and co-organized by the Cracow University of Technology.

This 44th edition of the Conference brings together more than 270 participants from 27 European and non-European countries, with nearly 40% of attendees coming from outside of Poland. The scientific programme features more than 245 presentations organized within 15 thematic sessions, including 8 invited plenary lectures and 25 keynote lectures. Approximately 60 presentations are delivered by PhD students, reflecting the strong commitment of the organizers to support early-career researchers.

The plenary speakers are internationally recognized leaders in their respective fields. The list of keynote speakers in the thematic sessions comprises both internationally recognized senior scientists with established expertise across the various fields of solid mechanics and outstanding early-career researchers who have already demonstrated scientific excellence. Notably, three keynote lectures are delivered by recipients of the Professor Michał Życzkowski Prize for Outstanding Young Scientists, awarded by the Committee for Mechanics of the Polish Academy of Sciences during the two years preceding the Conference. Overall, the composition of the thematic sessions reflects the scientific vitality of solid mechanics, as well as the strength, diversity and generational renewal of the research community, demonstrating the field's potential for future development.

On behalf of the Scientific and Organizing Committees of the 44th Solid Mechanics Conference SolMech 2026 we would like to thank all presenters of plenary, keynote and standard papers for their contributions to the meeting. Moreover, we would like to express gratitude to the organizers of the thematic sessions, and to all people and institutions supporting the organization of SolMech 2026. We wish all participants inspiring discussions and enjoyable time in Kraków.

Katarzyna Kowalczyk-Gajewska

Jerzy Pamin

Chair and Co-chair of SolMech 2026

Thematic Sessions and Their Organizers

TS1: Advanced continuum theories

W. Sumelka (*Poland*), Ł. Madej (*Poland*), G.Z. Voyiadjis (*USA*), Y. Sun (*China*), J. Lian (*Germany*)

TS2: Atomistic and nanoscale modelling

M. Giersig (*Poland*), K. Kempa (*USA*), M.J. Naughton (*USA*), D. Carnahan (*USA*)

TS3: Biomechanics and biomaterials

G. Milewski (*Poland*), E. Majchrzak (*Poland*)

TS4: Computational and experimental mechanics in engineering applications

P. Baranowski (*Poland*), K. Jamroziak (*Poland*), J. Małachowski (*Poland*), P. Sielicki (*Poland*)

TS5: Computer methods in solid mechanics

W. Cecot (*Poland*), W. Rachowicz (*Poland*), R. Sauer (*Poland*), G. Zboiński (*Poland*)

TS6: Contact and interface mechanics

F.M. Andrade Pires (*Portugal*), A. Javili (*Turkey*), S. Stupkiewicz (*Poland*)

TS7: Experimental mechanics

Z.L. Kowalewski (*Poland*), S.D. Pastramă (*Romania*), A.M. Pascu (*Romania*)

TS8: Geomechanics and granular materials

J. Tejchman (*Poland*), W. Wu (*Austria*)

TS9: Mechanics of advanced materials and smart structures

E. Pieczyska (*Poland*), D. Jarząbek (*Poland*), A.D. Lantada (*Spain*)

TS10: Micromechanics of heterogeneous and multi-component materials

K. Kowalczyk-Gajewska (*Poland*), S. Mercier (*France*), G. Vadillo (*Spain*), A. Srivastava (*USA*)

TS11: Multiphysics and coupled problems

J. Rojek (*Poland*), Ł. Figiel (*UK*), B. Peters (*Lithuania*)

TS12: Nonlinear dynamics, structural control and monitoring

J. Hou (*China*), Ł. Jankowski (*Poland*), K. Kęcik (*Poland*), K. Mendrok (*Poland*), P. Perlikowski (*Poland*)

TS13: Plasticity, damage and fracture mechanics

R. Kouhia (*Finland*), A. Menzel (*Germany/Sweden*), J. Pamin (*Poland*), H. Petryk (*Poland*), B. Skoczeń (*Poland*)

TS14: Structural optimization and optimum material design

B. Błachowski (*Poland*), M. Bruggi (*Italy*), T. Lewiński (*Poland*)

TS15: Shells, plates, and lattices as macroscopic or microscopic structures

M. Kuczma (*Poland*), N. Fantuzzi (*Italy*), M. Guminiak (*Poland*), M. Kamiński (*Poland*), P. Wriggers (*Germany*)

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Sensitivity of Mechanically Admissible Squat Motion to Joint Moment Capacity Distribution

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KEYWORDS: *Biomechanics, Constrained Optimization, Elasto-Plastic Joints, Human Motion, Load Transfer.*

This contribution presents a computational framework for analyzing the sensitivity of mechanically admissible squat motion to the distribution of joint moment capacities. The approach builds upon a previously developed model of load-constrained motion reconstruction, in which human movement is represented as the solution of a constrained optimization problem.

A three-dimensional multi-segment rigid-body system is considered, including feet, shanks, thighs, pelvis, and torso. Joint behavior is modeled using smooth elasto-plastic rotational elements with bounded moment capacity. A reference squat trajectory is first generated kinematically, and subsequently corrected by solving a frame-wise optimization problem subject to geometric and mechanical constraints.

The problem is formulated as minimization of the total mechanical cost [1,2],

$$J(\mathbf{q}) = \frac{1}{2}(\mathbf{q} - \mathbf{q}_{ref})^T \mathbf{K}(\mathbf{q} - \mathbf{q}_{ref}) + \sum_i \Psi_i(\Delta\theta_i) + W_{ext},$$

where the first term enforces trajectory tracking, the second term represents joint-level elasto-plastic energy contributions, and the last term accounts for external loading due to the barbell.

A parametric study is performed by varying the critical moment capacities assigned to individual joints while maintaining identical external loading conditions. The results demonstrate that the admissible squat posture is strongly governed by the relative distribution of joint strength, leading to systematic changes in pelvis backshift, torso inclination, and redistribution of rotational demand between lower-limb joints.

The study shows that squat technique should be interpreted not only as a response to external load but also as a consequence of internal mechanical capacity constraints, providing a consistent framework for analyzing strength-dependent movement adaptations.

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