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Editorial

Editorial: Advances in Mathematical Modeling for Structural Engineering and Mechanics

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Mathematical modeling is a cornerstone in addressing complex problems across science and engineering, showcasing its inherently multidisciplinary nature. In structural engineering and mechanics, the development of robust and precise numerical schemes has been instrumental in deepening our understanding of physical phenomena and driving innovation in computational methodologies. This Special Issue is dedicated to exploring advanced mathematical modeling approaches that tackle the diverse challenges faced in these fields.

1. Central Themes

A key focus of this issue is the automation and systematization of complex mechanical problems, which are essential for reducing computational effort and achieving significant time savings. The integration of numerical and computational techniques has further enhanced problem-solving efficiency, enabling engineers and researchers to address intricate structural issues with greater precision. Additionally, the development of hybrid analytical–numerical methods has provided powerful tools that combine theoretical rigor with computational adaptability, advancing the field significantly.

2. Scope of Contributions

The contributions in this Special Issue span a wide array of topics, including:

- The design of robust computational methods and simulations;
- Parameter fitting techniques;
- Inverse problem strategies in differential equations;
- Numerical simulations in structural engineering;
- Optimization of complex structural systems, and;
- Integrated computational methods that bridge mathematical theory with engineering applications.

3. Innovative Research Highlights

The articles featured in this issue exemplify the innovative approaches researchers are taking to address critical challenges in structural engineering and mechanics. Notable studies include:

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1. **Biomimetic optimization**: a study extending the meshless natural-neighbor radial-point interpolation method, which applies a bi-evolutionary, bone-remodeling-inspired algorithm to optimize automotive parts, highlighting the synergy between computational mechanics and biomimetic principles.
2. **Deep learning in diagnostics**: a novel fault diagnosis method for rolling bearings that utilizes Swin Transformer and Generalized S Transform, showcasing the potential of deep learning in engineering diagnostics.
3. **Fluid–structure interactions**: numerical simulations of shock waves in gas-water interactions, offering valuable insights into fluid–structure interactions crucial for various engineering applications.
4. **Innovative material design**: investigations into auxetic lattice structures for impact absorption, emphasizing the importance of innovative material design in mechanical engineering.
5. **Computational efficiency:** a p-refinement method leveraging transition elements to enhance finite element applications, demonstrating advancements in computational efficiency.
6. **Open-source tools**: the introduction of Seismo-VLAB, an open-source software with new capabilities for soil–structure interaction analysis, underscoring the importance of accessible computational tools in engineering research.

4. Additional Contributions

Other significant studies include:

- **Advanced composite materials**: free vibration analysis of stiffened functionally graded graphene-reinforced composite multilayer cylindrical panels, providing insights into advanced composite materials.
- **Structural connections**: experimental and numerical analyses of in-line connections in structural elements, offering valuable data for improving connection performance.
- **AI in mechanical engineering**: a self-evolving neural network-based control technique for vibration suppression in carbon nanotubes, showcasing the intersection of artificial intelligence and mechanical engineering.
- **Fracture mechanics**: a comprehensive review of multi-crack fracture mechanics, consolidating experimental, theoretical, and numerical advancements in the field.

5. Conclusions

The diverse range of topics covered in this Special Issue reflects the evolving landscape of mathematical modeling in structural engineering and mechanics. By integrating computational advancements with engineering principles, these studies pave the way for future innovations in the field. We extend our gratitude to all contributors, reviewers, and researchers whose dedication and expertise have enriched this collection, providing valuable resources for further exploration and development in mathematical modeling and engineering mechanics. We also acknowledge the excellent collaboration with the publisher, the constant assistance provided by the MDPI associate editors in bringing this project to completion, and the great support of the Managing Editor of this Special Issue, Ms. Helene Hu.

Conflicts of Interest: The authors declare no conflicts of interest.

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