

Editorial: Envisioning the future of computational methods applied to engineering and sciences

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Nowadays, computational methods have become well established for both academic developments and industrial applications. There are some particular industries whose activity heavily relies on simulation, such as aeronautical, automotive, civil engineering and biomedical applications. The finite element model is the most widely used technique. However, new technologies have been emerging rapidly over the recent years, with the goal of making numerical predictions faster and more detailed at the same time.

In this special section, there is a sample of some of the contributions that young researchers are driving, demonstrating the applicability of computational methods to real-world problems as well as the development of new techniques that may help overcome some of the limitations of standard finite element approaches.

Four contributions have been selected after submission and peer review of manuscripts from participants of the 7th ECCOMAS Young Investigators Conference (YIC2023) held in Porto in June 2023.

[Ramalho Queiroz Pacheco \(2024\)](#) proposes new discretization techniques for very weak formulations in primal form, applicable to problems with low regularity where standard finite elements may fail. It is applied to the modeling of an aneurism, whose geometry is obtained from *magnetic resonance imaging (MRI)*.

As a matter of fact, biomedical applications are one of the main fields of research amongst young researchers participating in YIC2023. In total, 7 out of the 31 proposed mini-symposia have been dedicated to this subject, and 2 contributions are included in this special section. [Moura et al. \(2024\)](#) developed a detailed finite element model of the dorsolumbar column to support the decision on the optimal treatment technique for vertebral fractures, taking clinical considerations into account.

For a different type of injury, pelvic organ prolapse, new manufacturing technologies associated with 3D printing enable the development of biodegradable meshes that may overcome the issues encountered with synthetic meshes. In this context, [Vaz et al. \(2024\)](#) established a connection between simulation, experimental results and manufacturing by 3D printing, with the objective of assessing the biocompatibility of meshes with different geometrical features.

Finally, adaptive structures in civil engineering applications are also addressed by [Schwegmann et al. \(2024\)](#). A review of the application of this kind of structure is provided, where some numerical techniques employed for their optimization are mentioned.

Beyond the topics addressed in this special section, the current interests of young researchers include the usage of machine learning techniques and other reduced-order models to accelerate numerical simulation toward uncertainty quantification in complex systems. Such systems encompass from large infrastructures, such as railways, civil engineering structures and water systems, to small scales like material microstructures and the analysis of cancer cells. Optimization techniques applied to structural and design optimization, combined with additive manufacturing, are also the focus of current research, aiming at a more sustainable usage of resources in critical applications like the transportation industry.

In summary, the young researchers using computational methods are shaping the future of the community in such a way that they guarantee their paramount contribution to the response of several societal challenges.



References

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