

ENABLING DIGITAL TWIN TECHNOLOGIES IN COMPUTATIONAL SCIENCE AND ENGINEERING

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ABSTRACT

Digital twins are valuable assets in today's technology landscape, offering enormous benefits such as online prediction and optimization of complex industrial systems. Their potential and capabilities can only be fully realized by integrating multiple technologies from different disciplines. One of the key tasks for enabling digital twin technologies is the development of simulations describing complex industrial problems. This includes modelling of complex phenomena in structural mechanics and computational fluid dynamics, often based on established tools like FEM.

Improving the accuracy of the numerical experiments accelerates the design process in engineering, at the same time efficient use of computational resources also remains crucial in modern research. In this context, reduced-order modelling is a key to digital twins, providing real-time capable models that retain essential physical characteristics. Classical projection-based reduction relies on projecting the model equations onto a lower-dimensional subspace that approximates the solution domain. However, due to the use of well-established commercial software, the extraction of the high-fidelity system matrices is often impossible. For this reason, the data-driven methods are gaining more popularity and attention, as they do not require access to the solver routines.

At the same time, the extensive use of data introduces uncertainties from factors like measurement noise and other discrepancies, which affect the accuracy and robustness of reduced models. Therefore, it is essential to quantify the errors and uncertainties associated with data-driven methods.

In this minisymposium, we will explore the above mentioned key topics such as modelling approaches in computational science and engineering, model order reduction, and uncertainty quantification, all of which are crucial for real-time digital twins. Our goal is to connect innovative applications with theoretical and practical solutions to address industrial challenges.

REFERENCES

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