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NEW TRENDS IN INDUSTRIAL SIMULATION: TOWARD FAST, EFFICIENT AND INTELLIGENT APPROACHES

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ABSTRACT

This Invited Session (IS) aims at providing an overview and outlook on the use of numerical modelling to address current industrial challenges at the intersection of applied analysis, scientific computing and artificial intelligence (AI). High-fidelity numerical simulations (finite elements, finite differences) remain the gold standard for accurately representing complex physical systems such as mechanical structures, fluid flows, and wave propagation. However, their computational cost limits their use in industrial contexts requiring repeated evaluations. Typical examples are shape optimization, non-destructive testing, exploration, uncertainty quantification, or real-time decision support. We will build this IS around contributions focusing on strategies to overcome these barriers, in particular:

- the construction of reduced-order models, using linear algebra tools (SVD, eigenvalue decomposition, reduced bases) to project problems onto subspaces of limited dimension, while maintaining satisfactory fidelity to the reference model;
- the use of acceleration technologies (GPU computing, massive parallelization, accelerated iterative solvers) to process large-scale systems within time-frames compatible with operational constraints;
- the integration of AI into modelling, through surrogate models, physics-informed models (PINN, PINO), or hybrid approaches combining machine learning and physical knowledge of the problem.

We invite submissions presenting methodological developments or concrete industrial applications that illustrate the integration of these approaches for the design of digital twins, optimization, or decision support.