

MATHEMATICAL CERTIFICATION FOR COUPLED PROBLEMS IN THE ERA OF ARTIFICIAL INTELLIGENCE

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ABSTRACT

Artificial Intelligence and Machine Learning provide new approaches for huge classes of engineering problems including coupled ones. However, such data-based methods often fail when it comes to issues like physical interpretability, explainability, reliability, certification and a posteriori error control, just to name a few.

In this session we aim to discuss approaches to combine numerical efficiency, mathematical certification and data assimilation.

Possible methods may include nonlinear model reduction, structure preservation, manifold learning, deep learning, data-based models, nonintrusive methods, adaptivity, space-time coupling, and many more. However, the focus of the session is on the development and justification of mathematical rigor in terms of (e.g.) error estimates, convergence proofs (qualitative and quantitative), well-posedness, approximability, reducibility, structure preservation and efficiency.

There are several recent advances in that direction which will be addressed in this session with particular emphasis on coupled problems.