

TRULY PRACTICAL HIGH-ORDER METHODS FOR INDUSTRIAL APPLICATIONS

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ABSTRACT

The industrialisation of high-order methods is already well under way within major aeronautical companies such as Airbus and Rolls-Royce. Advances in GPU-based and heterogeneous high-performance computing, together with efficient matrix-free implementations, are making high-order finite and spectral element methods increasingly attractive for large-scale PDE simulations, enabling highly accurate solutions that can, in some cases, approach the DNS range. Their superior accuracy and convergence properties are well established; however, practical applications, particularly those involving transport-dominated or nonlinear problems, often require stabilisation, limiting, or other algorithmic modifications to ensure robustness. Because these enhancements can alter the formal properties of the underlying discretisation, an important question remains: under what conditions are high-order methods truly practical, and when do they provide a meaningful advantage over lower-order schemes?

This minisymposium brings together researchers developing and applying high-order discretizations across a range of computational science and engineering applications to address this question from different perspectives. Topics include structure-preserving discretizations (e.g., energy-conserving and entropy-stable methods), stabilization strategies, positivity- and bounds-preserving schemes, and robust solver technologies. Applications span weather and climate modeling, compressible flows, turbomachinery, wave propagation, and other large-scale multiphysics simulations. By highlighting common challenges and successful strategies across disciplines, this minisymposium aims to identify the algorithmic and computational principles that make high-order methods practical for production-scale scientific computing.

SPEAKERS

1. Krzysztof Fidkowski (University of Michigan): Efficient Hybrid and Embedded DG Solvers for Practical High-Order Problems.
2. Guglielmo Vivarelli (University of Liverpool): Building a Gas Turbine Virtual Wind Tunnel: High-Fidelity Modelling for Complex High-Speed Flows.
3. Andrew Wheeler (University of Cambridge): High fidelity simulation supporting aerothermal design.
4. Maria Lukacova (Johannes Gutenberg University Mainz): Numerical study of dissipative weak solutions for the Euler system.
5. Tristan Montoya (University of Saskatchewan): Information-Geometric Regularization for High-Order Spectral-Element Methods.
6. Antonio Ghidoni (University of Brescia): An Efficient High-Order Discontinuous Galerkin Framework for RANS Turbomachinery Simulations.