

HIGH-ORDER METHODS AND AI-ENABLED SCIENTIFIC COMPUTING AT EXASCALE

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ABSTRACT

High-order discretizations provide a powerful foundation for fast, efficient, and accurate scientific simulations on exascale and emerging computing architectures. At the same time, artificial intelligence and scientific machine learning are creating new opportunities to accelerate simulation, enhance solution accuracy, construct scalable surrogate models, and enable data-driven discovery and optimization.

This minisymposium will highlight advances at the intersection of high-order numerical methods, performance-portable software, exascale computing, and AI-enabled scientific computing. Topics will include finite and spectral element algorithms; high-order computational kernels and lightweight portable libraries; scalable solvers and preconditioners; performance portability across heterogeneous architectures; and exascale applications. The minisymposium will also feature AI and machine-learning approaches that complement high-fidelity simulation, including physics-informed learning, neural operators, reduced-order and surrogate models, super-resolution methods, foundation models, and AI-assisted simulation, design, and control.

SPEAKERS

1. Misun Min (Argonne National Laboratory): Efficient Data-Driven HPC Modeling and Simulation for Energy Science

2. Paul Fischer (University of Illinois Urbana-Champaign): Recent developments for scalable SEM-based Poisson solves
3. Tzanio Kolev (Lawrence Livermore National Laboratory): High Performance Differentiable Simulations with MFEM
4. Spencer Shirwin (Imperial College London): Re-development and Application of Spectral/hp Element for Complex Geometry Flow Simulation in Nektar++
5. Elia Merzari (Penn State): Perspectives on exascale simulations of fission and fusion systems: recent advances and new directions
6. Peter Ohm (RIKEN): Matrix-free HP-Multigrid Method for Computational Fluid Dynamics Applications”
7. Stefan Kerkemier (Argonne National Laboratory): Developing nekRS in the Age of AI: Opportunities, Challenges, and Lessons Learned
8. Yohann Dudouit (Lawrence Livermore National Laboratory): Surrogate-Accelerated Multiphysics Simulation of Laser Powder Bed Fusion