

Recent advances in high-order mesh generation and adaptation

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Abstract

High-order methods are attractive for the numerical solution of partial differential equations, offering accurate discretization of curvilinear geometries at a lower computational cost than low-order approaches for a given accuracy. Despite this promise, high-order mesh generation remains a significant bottleneck, particularly for complex, real-world configurations. Problems involving transient geometry and/or solution features add a further layer of difficulty, since no single static mesh can efficiently resolve the full range of scales and features encountered throughout a simulation. High-order mesh adaptation, through h -, r - and p -adaptivity, and combinations thereof, offers a route to accurate, efficient solutions without the cost of repeatedly regenerating meshes from scratch.

This minisymposium provides a forum to discuss recent advances in high-order mesh generation and adaptation, bringing together leading academic and industrial experts. Topics of interest include, but are not limited to: geometry handling and CAD integration for high-order workflows; curvilinear mesh generation and validity/untangling techniques; the use of machine learning to assist in high-order meshing; mesh curving strategies for complex and industrial-scale configurations; boundary layer and hybrid mesh generation; anisotropic and metric-based adaptation; error estimation to drive adaptive strategies; r -adaptivity and mesh deformation for moving/deforming domains; hp -adaptivity and its integration with high-order solvers. Last, applications of high-order meshing and adaptation algorithms for large-scale, parallel or industrial test-cases are encouraged.

Organization

For this minisymposium, we have contacted several researchers in the community. We are happy to report receiving a strong interest with the minisymposium. We note that there is intentionally no single application area, with talks from a both mesh generation and AMR designed to encourage a broad discussion of the most recent research in the both communities and specifically the synergy between them. Given an acceptance of the minisymposium, we plan to **extend our invitation** to a wider area of researchers in the community and hence anticipate to **fill two or three full sessions**.

Proposed talks by the researchers with tentative titles

- *Automatic Differentiation for High-Order Mesh Adaptivity in MFEM*
Tzanio Kolev, Vladimir Tomov, Ketan Mittal (LLNL)
- *High-Order Mesh Generation and Adaptation for Industrial Applications*,
David Moxey, Kaloyan S Kirilov, Ted Stokes (King's College London); Jingtian Zhou, Joaquim Peiró (Imperial College London).
- *Adaptive Mesh Refinement and DG Methods for Atmospheric Flows*,
Benedict Geihe (University of Cologne, Germany Aerospace Center (DLR))
- *Error Controlled Adaptive High Order Mesh Generation in HOHQMesh*,
David A. Kopriva, Andrew R. Winters, Jan Nordstrom (Florida State University, San Diego State University, Linkoping University)
- *High-Order Mesh Generation and Finite Element Solution for Cardiac Ablation*,
Suzanne M Shontz, Sumit Kumar (University of Kansas)
- *High-Order Conservative Solution Transfer between Curved Meshes*,
Per-Olof Persson* (University of California Berkeley)
- *Towards Element Quality Guarantees in High-Order Simplicial Mesh Generation*,
Marcel Campen* (Paderborn University)

Remark: * denotes interest and proposed talk with tentative status due to the early stage of the process.