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ADAPTIVE MESH REFINEMENT FOR INDUSTRIAL APPLICATIONS

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ABSTRACT

Adaptive Mesh Refinement (AMR) has proven its ability to significantly reduce simulation runtime and memory requirements while keeping numerical errors low. Various approaches exist, with unstructured, block-structured and tree-based AMR being the most common. More recently, specialized algorithms tailored to modern hybrid computing architectures have emerged.

Despite these advantages, industrial adoption of AMR remains limited. However, NASA's CFD Vision Report [1] underscores the critical role of AMR in future computational fluid dynamics, highlighting automated in-situ meshes with adaptive control as a primary target. Beyond CFD, AMR offers broader industry benefits such as adaptive resolution and efficient data compression. This should motivate us to bring innovative AMR approaches into industrial practice.

In this session, we showcase practical implementations within simulation frameworks and explore novel domains where AMR improves computational efficiency and reduces memory footprints. Additionally, we examine newly emerging AMR algorithms specifically designed to tackle the scaling challenges of modern GPU-focused supercomputers and high-performance research clusters.

By exploring these techniques, this session aims to foster dynamic discussion and collaborative exchange between developers, researchers, and end-users to advance the broader industrial adoption of AMR.

REFERENCES

[1] CFD Vision 2030 Study: A Path to Revolutionary Computational Aerosciences, J. Slotnick, A. Khodadoust, J. Alonso, D. Darmofal, W. Gropp, E. Lurie, D. Mavriplis (2014)