

RECENT ADVANCES IN HIGH-ORDER METHODS: THE ROAD TO LARGE-EDDY SIMULATIONS AND SHOCK-DOMINATED FLOWS

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ABSTRACT

High-order numerical methods have emerged as a cornerstone of next-generation simulation tools for complex fluid flows, offering unprecedented accuracy, scalability, and spectral-like resolution on modern computing architectures. In recent years, substantial progress has been made in extending these methods to challenging regimes characterized by turbulence, multiscale dynamics, and strong discontinuities. In particular, their growing maturity has opened a promising pathway toward reliable large-eddy simulations (LES) and the robust treatment of shock-dominated flows.

This minisymposium brings together recent advances in high-order discretization techniques, time integration strategies, and stabilization mechanisms that enable accurate and efficient simulations across a wide range of flow conditions. Topics include—but are not limited to—entropy-stable and shock-capturing formulations, adaptive mesh and polynomial enrichment strategies, positivity-preservation strategies, the effect of real gas/chemical models in simulation (compared to ideal gas models), subgrid-scale modeling tailored to high-order frameworks, and performance considerations on emerging heterogeneous architectures.

Emphasis is placed on both theoretical developments and practical implementations, highlighting how modern high-order methods bridge the gap between accuracy and robustness in under-resolved turbulent flows. Through contributions spanning fundamental analysis, algorithmic innovation, and large-scale applications, this minisymposium aims to provide a comprehensive overview of the current state of the art and to identify open challenges and research directions on the road toward predictive LES and simulations of shock-dominated flows.