International Conference on Numerical Combustion
Rome, Italy, October 14-17, 2025
www.icnc2025.com

Spectral element direct numerical simulations in laboratory-scale complex geometries

Christos E. Frouzakis
ETH Zürich, Switzerland

The spectral element method offers significantly lower numerical diffusion and dispersion errors at higher polynomial orders at a competitive cost compared to low order method. It is particularly well-suited for the DNS of turbulent flows, where the accurate time-advection of small features over long distances in complex geometries is required. Nek5000 and NekRS are two highly-efficient and scalable open source incompressible and low Mach flow solvers employing the high-order weighted residual technique. Through plugins, they have been extended to reactive flows and have been used in CPU and GPU-accelerated high performance computing systems to simulate combustion in laboratory-scale setups. Recent applications including soot modeling in the RQL burner at UCAM and lean hydrogen combustion in the TUDa optical engine are presented.