TERASCALE DIRECT NUMERICAL SIMULATION OF TURBULENT COMBUSTION

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The rapid growth in computing power has presented both opportunities and challenges for high-fidelity simulations of turbulent reacting flows. The advent of tera- and peta-scale supercomputers has made it possible to glean fundamental physical insight into fine-grained 'turbulence-chemistry' interactions in simple laboratory-scale turbulent flames with direct numerical simulations**.** In the direct numerical simulations all of the relevant fluid dynamic and flame scales are numerically resolved using higher-order accurate finite-difference methods. Such simulations are costly, requiring several million cpu-hours on a terascale computer, up to a billion grid points, and generating 10's of terabytes of data. Recent DNS results will be presented to describe how a lifted autoignitive turbulent jet flame is stabilized, the mechanisms by which a flame reignites following local quenching, and premixed flame propagation in the thin-reaction zones regime. Experimental validation within the context of simple laminar and turbulent laboratory-scale flames will be discussed. Outstanding challenges with extracting salient information from terabytes of data, and strategies for mapping DNS solvers to multi-core petascale architectures will also be discussed.