

High-Performance Computing of Complex Flows Related to Turbulent Fluid Flow, Mixing and Combustion

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An overview of some recent projects related to Computational Fluid Dynamics of turbulent flows with parallel computations will be presented. The approach uses both incompressible and compressible flow solvers and is based on domain decomposition, MPI and explicit time-stepping. Flows investigated are the jet-in-crossflow, the swirl-flow in a TECFLAM-burner, and the flame-vortex interactions to study local combustion and local extinction phenomena. Results from both Direct Numerical Simulations (DNS) and Large-Eddy Simulations (LES) will be discussed. A new LES-turbulence model (called WALES, Wavelet-Adapted LES) based on discontinuous wavelet decomposition and its performance/benefits will be presented.

Additionally, some recent applications like the burning processes in porous materials will be presented. The talk will end with some unresolved modeling issues connected with the parallelization of Lagrangean tracking of particles in fluid flows.