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High-order Extension of Roe's Solver for Unsteady Compressible Multi-Component Real Gas Flows LUC LECOINTRE, Universit Paris Saclay, ETIENNE STUDER, SERGEY KUDRIAKOV, Universit Paris Saclay, CEA, RONAN VICQUELIN, Universit Paris Saclay, CNRS, CentraleSupelec, CHRISTIAN TENAUD, Universit Paris Saclay, CNRS, LIMSI — In applications such as detonation phenomenon or atmospheric reentry, compressible effects are associated with important variations of temperature. In order to obtain accurate results, the nonlinear variation of the internal energy with the temperature must be taken into account while maintaining shock capturing with low numerical diffusion. For this purpose, a numerical strategy based on a high-order one-step shock-capturing scheme is considered using an extension of the Roes approximate Riemann solver for multicomponent real gas flows. This scheme minimizes numerical diffusion and presents accurate results around contact discontinuities and shockwaves, which feature strong variations in real gas properties. The method remains high-order in smooth regions. The scheme is coupled with the second-order Strang splitting procedure to consider viscous, diffusive, and combustion phenomena with the adapted numerical scheme. Adaptive mesh refinement is finally used to resolve the most relevant scales of the flow with gains on the CPU time and memory usage. The approach is validated with customized numerical test-cases with compressible effects on multicomponent flows. A 2D case of a flame acceleration phenomenon is then presented.

Luc Lecointre
Universit Paris Saclay

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