**An efficient and robust all-Mach numerical scheme for the simulation of compressible multi-component fluids including surface tension**

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**Abstract**

We present an efficient, fully conservative numerical scheme valid in the entire range of highly to weakly compressible flows using a single-fluid four equation approach together with multi-component thermodynamic models. The approach enables handling of compressibility of all involved phases including surface tension and viscous effects. The methodology is validated against a series of reference cases, such as bubble oscillation/advection/deformation. An improved iLES is proposed for turbulence modelling. It is applied to simulate the three-dimensional primary break-up of a turbulent diesel jet in a nitrogen/methane mixture under typical dual-fuel conditions. The interface sharpening approach and the TDU idea are adopted to continually keep the thermodynamic relationship coupled among variables. The final results show that the methodology can easily be included into existing finite volume methods and enables robust and accurate simulations of compressible multi-phase/multi-component flows including surface tension and viscous effects on compact computational stencils without excessive spurious oscillations or significant numerical diffusion/dissipation.

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