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Positivity-preserving finite difference schemes for robust computations of multi-component flows KHOSRO SHAHBAZI, South Dakota School of Mines and Technology — The positivity-preserving property is of paramount importance in design of numerical schemes considering that violation of positivity not only yields unphysical solutions, but also causes the computation to fail (numerical codes crash) due to the appearance of complex (nonreal) characteristic speed. While the positivity enforcement in the single-phase flow context has gained significant development in recent years, hardly any research has been focused on compressible multi-phase flows involving shock wave bubble interactions ; with an exception being my own recent work using finite volume schemes, (Journal of Computational Physics (2017) 339 163-179). This is due to increased complexity of the multi-phase flow models and the fact that, unlike in single-phase flow model, in the multi-phase flow model the pressure function is no longer a concave function of the conservative variables, a property often exploited for the design of positivity scheme in the single phase flows. Therefore, in this talk I present the development, analysis and verification of an original high-order positivity-preserving finite difference scheme for robust two-component flow computations. The positivity enforcement is based on a minimal limiting of the high-order numerical fluxes toward the first-order monotone fluxes such that the density, modified pressure and order parameters, identifying each phase's transport, fall within the acceptable physical bounds. Compared to high-order finite volume counterpart, the proposed high-order finite difference schemes are easier to implement and are computationally less demanding.

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