Multi-dimensional limiting strategy for hyperbolic conservation laws: Finite Volume Methods to Discontinuous Galerkin Approximations

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ABSTRACT Accurate computation of flows admitting discontinuous solutions is one of the most challenging issues in hyperbolic conservation laws. This talk introduces author's continuous efforts of exploring the limiting strategy for multi-dimensional high speed compressible flows (or multi-dimensional hyperbolic conservation laws in general). From the previous works, the multi-dimensional limiting process (MLP) turned out to possess superior numerical characteristics over conventional limiting strategy, such as the efficient controlling of multi-dimensional oscillations and the accurate capturing of both discontinuous and continuous multi-dimensional flow features within the finite volume framework. Oscillation-control mechanism in multiple dimensions has been established by combining the local maximum principle and the multi-dimensional limiting (MLP) condition, which leads to the formulation of the efficient and accurate MLP-u slope limiters. The MLP limiting strategy can be extended into the discontinuous Galerkin (DG) framework. By designing the smooth extrema detector based on the behavior of local extrema near vertex point, and by combining the extrema detector with the augmented MLP condition, the hierarchical DG-MLP method within the RKDG formulation has been developed up to the DG-*Pn* reconstruction. Through numerical analyses and computations on triangular and tetrahedral grids, it is shown that the proposed DG-MLP approach yields the desired order of accuracy in smooth region and captures detailed physics of non-compressive as well as compressive flow features.