MULTI-DIMENSIONAL LIMITING STRATEGY FOR HIGHER-ORDER METHOD IN COMPRESSIBLE FLOWS

Chongam KIM [1]

1) *Department of Aerospace Engineering, Seoul National University, Seoul 151-744, KOREA*

Corresponding Author : Chongam KIM, chongam@snu.ac.kr

ABSTRACT

The present study deals with the robust and accurate multi-dimensional limiting strategy for higher-order method to analyze compressible flows. Multi-dimensional limiting process (MLP), which has been originally developed in finite volume method (FVM), provides an accurate, robust and efficient oscillation-control mechanism in multiple dimensions for linear reconstruction. Especially, this mechanism 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 philosophy is now hierarchically extended into higher-order *Pn* approximation. The resulting algorithm, called the hierarchical MLP, facilitates the accurate capturing of detailed flow structures in both continuous and discontinuous regions. This algorithm has been developed in the modal discontinuous Galerkin (DG) framework, but it also can be formulated into a nodal framework, most notably the correction procedure via reconstruction (CPR) framework. Troubled-cells are detected within the MLP concept, and then the projection procedure and MLP slope limiter adjust sub-cell distributions. Through extensive numerical analyses and computations on unstructured grids, it is demonstrated that the proposed method yields outstanding performance in resolving non-compressive as well as compressive flow features.

ACKNOWLEDGEMENTS

Author appreciates the financial supports provided by NSL (National Space Lab.) program through the National Research Foundation of Korea funded by the Ministry of Education, Science and Technology (Grant 2012-0009099) and by the EDISON program through the National Research Foundation of Korea(NRF) funded by the Ministry of Education, Science and Technology (Grant 2012-0006661). This work is also supported by Doosan Heavy Industries & Construction.

REFERENCES

1. Kim, K. H. and Kim, C. “Accurate, efficient and monotonic numerical methods for multi-dimensional compressible flows Part II: Multi-dimensional limiting process”, *Journal of Computational Physics*, Vol 208, 2005, pp. 570-615.

2. Yoon S.-H., Kim, C. and Kim, K. H. “Multi-dimensional limiting process for three-dimensional flow physics”, *Journal of Computational Physics*, Vol 227, 2008, pp. 6001-6043.
3. Park, J. S., Yoon S.-H. and Kim, C., “Multi-dimensional limiting process for hyperbolic conservation laws on unstructured grids”, *Journal of Computational Physics*, Vol 229, 2010, pp. 788-812.
4. Park, J. S. and Kim, C., “Multi-dimensional limiting process for finite volume methods on unstructured grids”, *Computers & Fluids*, Vol 65, 2012, pp. 8-24.
5. Park, J. S. and Kim, C., “Higher-order mutli-dimensional limiting strategy for discontinuous Galerkin methods in compressible inviscid and viscous flows”, *Computers & Fluids*, submitted.