World Academy of Science, Engineering and Technology
International Journal of Computer and Systems Engineering
Vol:14, No:03, 2020

Efficient Implementation of Finite Volume Multi-Resolution Weno Scheme on Adaptive Cartesian Grids

Authors : Yuchen Yang, Zhenming Wang, Jun Zhu, Ning Zhao

Abstract : An easy-to-implement and robust finite volume multi-resolution Weighted Essentially Non-Oscillatory (WENO) scheme is proposed on adaptive cartesian grids in this paper. Such a multi-resolution WENO scheme is combined with the ghost cell immersed boundary method (IBM) and wall-function technique to solve Navier-Stokes equations. Unlike the k-exact finite volume WENO schemes which involve large amounts of extra storage, repeatedly solving the matrix generated in a least-square method or the process of calculating optimal linear weights on adaptive cartesian grids, the present methodology only adds very small overhead and can be easily implemented in existing edge-based computational fluid dynamics (CFD) codes with minor modifications. Also, the linear weights of this adaptive finite volume multi-resolution WENO scheme can be any positive numbers on condition that their sum is one. It is a way of bypassing the calculation of the optimal linear weights and such a multi-resolution WENO scheme avoids dealing with the negative linear weights on adaptive cartesian grids. Some benchmark viscous problems are numerical solved to show the efficiency and good performance of this adaptive multi-resolution WENO scheme. Compared with a second-order edge-based method, the presented method can be implemented into an adaptive cartesian grid with slight modification for big Reynolds number problems.

Keywords : adaptive mesh refinement method, finite volume multi-resolution WENO scheme, immersed boundary method, wall-function technique.
Conference Title : ICCFD 2020 : International Conference on Computational Fluid Dynamics
Conference Location : Prague, Czechia
Conference Dates : March 19-20, 2020