Radial Basis Function Based Shock Detector for Hybrid Compact-WENO Finite Difference Scheme in Solving Hyperbolic Conservation Laws

Waisun Don (曾维新)
Ocean University of China

Ever since the development of the high order WENO finite difference scheme by Jiang and Shu, it has been widely adopted for solving hyperbolic conservation laws that captures shocks essentially non-oscillatory while resolving fine scale structures efficiently. Numerous advances have been proposed to reduce the dissipation and dispersion errors by improving/modifying certain critical components of the WENO reconstruction procedure, such as, the definitions of nonlinear weights and the smoothness indicators and the tuning of existing parameters. In this talk, I will present some recent works on the hybridization of high resolution linear compact scheme and shock capturing nonlinear WENO finite difference scheme with high order shock detector methods that based on the polynomial (multi-resolution analysis), trigonometric (conjugate Fourier method) and radial basis function (RBF) approximations. I will give a general discussion that addresses various numerical and theoretical aspects of each approach, some critical implementation issues (such as ill-conditioning, fast algorithm for finding the inverse of a perturbed Toeplitz matrix and domain decomposition in the RBF based shock detection method) and their respective performance in terms of accuracy, efficiency and robustness. Numerical examples in several one- and two-dimensional shocked flows will be presented to demonstrate the efficacy and sharp capturing of discontinuities of the hybrid scheme in solving hyperbolic conservation laws in comparison with the classical WENO-Z scheme.