Evaluating the Capability of the Flux-Limiter Schemes in Capturing the Turbulence Structures in a Fully Developed Channel Flow

Authors : Mohamed Elghorab, Vendra C. Madhav Rao, Jennifer X. Wen

Abstract : Turbulence modelling is still evolving, and efforts are on to improve and develop numerical methods to simulate the real turbulence structures by using the empirical and experimental information. The monotonically integrated large eddy simulation (MILES) is an attractive approach for modelling turbulence in high Re flows, which is based on the solving of the unfiltered flow equations with no explicit sub-grid scale (SGS) model. In the current work, this approach has been used, and the action of the SGS model has been included implicitly by intrinsic nonlinear high-frequency filters built into the convection discretization schemes. The MILES solver is developed using the opensource CFD OpenFOAM libraries. The role of flux limiters schemes namely, Gamma, superBee, van-Albada and van-Leer, is studied in predicting turbulent statistical quantities for a fully developed channel flow with a friction Reynolds number, Re_T = 180, and compared the numerical predictions with the well-established Direct Numerical Simulation (DNS) results for studying the wall generated turbulence. It is inferred from the numerical predictions that Gamma, van-Leer and van-Albada limiters produced more diffusion and overpredicted the velocity profiles, while superBee scheme reproduced velocity profiles and turbulence statistical quantities in good agreement with the reference DNS data in the streamwise direction although it deviated slightly in the spanwise and normal to the wall directions. The simulation results are further discussed in terms of the turbulence intensities and Reynolds stresses averaged in time and space to draw conclusion on the flux limiter schemes performance in OpenFOAM context. **Keywords :** flux limiters, implicit SGS, MILES, OpenFOAM, turbulence statistics

Conference Title : ICETMM 2018 : International Conference on Engineering Turbulence Modeling and Measurements **Conference Location :** Paris, France

Conference Dates : February 19-20, 2018

1