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Investigation of a Shock-Detecting Sensor for Filtering of High-Order Compact Finite Difference Schemes

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High-order simulation of flows containing shock waves is an extremely difficult task because of the discontinuous changes in flow properties across the shock. The goal of this work is to investigate a shock-detecting sensor for filtering of high-order compact finite difference schemes to examine the shock-capturing in direct simulation of Navier-Stokes solver. Based on its accuracy and minimum dissipation error, the choice of this shock-detecting sensor has been made for the DNS studies. The implementation of high resolution simulations using sixth-order compact schemes with a fourth-order two-register Runge-Kutta method has been validated through selective test problems. Through several numerical experiments (including an inviscid shock/vortex interaction, a viscous shock/vortex interaction, and a shock/mixing layer interaction) the accuracy of the nonlinear filter is examined. It shows that the shock-detecting sensor works well, and can be used for future simulations of turbulent flows containing shocks.

Keywords: shock-detecting, shock-capturing, nonlinear filter, high-order scheme