Abstract

During the past decades, Large-Eddy Simulation (LES) has been demonstrated to be a useful research tool for understanding the physics of turbulence as well as an accurate and sophisticated predictive method for flows of engineering interest. The LES is a numerical technique and is based on the separation between large and small scales in which the large-scale motion is exactly calculated and the effects of small scales or so-called sub grid-scale motions are modelled. It is also important to note that the explicit or implicit filter representations like spectral cut-offs or numerical discretizations are commonly used in LES of turbulent flows. Strictly we can say that in LES we need to filter the Navier-Stokes equations in turbulence. Therefore, the study on the filtering approach in turbulence is the main objects of the present research, and in this study we have elaborately studied on this filtering approach and analyzed some general algebraic properties of the filtered representations. It is shown that the averaged equations are the same in terms of the generalized central moments, and then we have defined the resolved turbulence using these average properties. The algebraic consistency rules related with the resolved quantities to the turbulent stresses are derived and their possible use in sub grid-scale modelling is examined. In this study, we have also discussed about the standard Smagorinsky model for LES and then we derived an expression to determine the Smagorinsky constant dynamically, which suppose to be assured the
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consistency between the filter and the sub grid-scale model. Finally, we have derived the governing equations for LES by applying the filtering approach to the Navier-Stokes equations.

References

- Lilly, D. K. (1966): On the application of the eddy viscosity concept in the inertial sub-range of turbulence. NCAR, Boulder, Colorado, Manuscript 133

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