DNS AND MODELING OF STRUCTURES, COMPLEXITIES, FIBRES AND ROTATIONAL EFFECTS IN TURBULENT CHANNEL FLOW

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DNS has developed into a powerful tool for studying the physics of fluid flows, and during the recent years we have been able to include many different types of complex physical phenomena, such as effects of density stratification, particles, reactions etc, and at the same time, take this endeavors into a range of interesting Reynolds numbers. It is still a struggle to develop really efficient tools for DNS of flows with complexities such as e.g. particles, fibres or reactions. Even the flow case of turbulent pipe flow still offers challenges due to the complexity introduced by the cylindrical geometry and the centerline (if polar coordinates are used). I will briefly touch upon a new strategy for high accuracy simulation of this case. In anew study of finite size fibres in turbulent channel flow we have been able to study four-way interactions and the specific effects of finite size of the fibres in their interaction with the wall and the near-wall flow. In this case we have chosen a Lattice-Boltzmann Method as the tool for the simulations and made use of the specific advantages of this method for this specific case. The case of channel or boundary layer flows with density stratification are of central importance for the understanding of atmospheric flows. The case of unstably stratified case offers the challenge of high levels of vertical mixing near the wall, which leaves spectral methods with Chebyshev polynomial representation in the wall-normal direction unsuitable treasonably high Reynolds numbers. Indeed, in all these cases we have the challenge to make use of the DNS results to construct better sub-grid scale models for LES, in order to reach Reynolds numbers of relevance for practical applications. I will describe some efforts in this direction.