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Abstract

The accurate simulation of flows in complicated devices and configurations at high Reynolds numbers is of importance in the development stage. Large eddy simulation (LES) or even direct numerical simulation (DNS) is desirable for the simulations since precise results can be obtained on appropriate meshes.

LES is based on the filtered Navier-Stokes equations and resolves the majority of the turbulence in a flow. Especially in the near-wall regions, where the turbulent structures are the smallest, a high grid resolution is required. Therefore, very fine computational grids are needed. Although computing power is increasing year to year, LES is still not feasible for many complex flow cases due to limitations in computing resources and time.

The reduction of computational costs can be accomplished by combining large eddy simulation (LES) with Reynolds-Averaged Navier-Stokes (RANS) to the so-called hybrid LES/RANS methods. By doing this, the advantages of the two modelling approaches are merged. However, the coupling of the two modelling procedures (LES and RANS) represents a challenge due to their different theoretical background.

The subject of the present thesis is the investigation of different hybrid LES/RANS modelling approaches. An existing two-layer hybrid LES/RANS model is tested and advanced on two-dimensional and three-dimensional complex cases. Furthermore, a seamless hybrid LES/RANS method is studied. A hybrid wall function for LES is implemented and analysed on different cases. Among other cases, the flow in a combustion chamber model is simulated. Finally, a so-called embedded LES method is proposed and evaluated.

The approaches presented in the present work aim to reduce computational costs by obtaining accurate simulation results.