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Further reduction of near-wall resolution for wall-modeled LES[1]
ALEXANDRE MARQUES, QIQI WANG, Massachusetts Inst of Tech-MIT, JOHAN LARSSON, University of Maryland, GREGORY LASKOWSKI, GE Aviation, SANJEEB BOSE, Cascade Technologies — One of the greatest challenges to the use of Large Eddy Simulations (LES) in engineering applications is the large number of grid points required near walls. To mitigate this issue, LES is often coupled with a model of the flow close to the wall, known as wall model. One feature common to most wall models is that the first few (about 3) grid points must be located below the inviscid log-layer ($y/\delta \leq 0.2$), and the grid must have near isotropic resolution near the wall. Hence, wall-modeled LES may still require a large number of grid points, both in the wall-normal and span-wise directions. Because of these requirements, wall-modeled LES still is unfeasible in many applications. We present a new formulation of wall-modeled LES that is being developed to address this issue. In this formulation, LES is used to solve only for the features of the velocity field that can be adequately represented on the LES grid. The effects of the unresolved features are captured by imposing a balance of momentum integrated in the wall-normal direction. This integral momentum balance translates into a dynamic PDE defined on the walls, which is coupled to the LES equations. We discuss details of the new formulation and present results obtained in laminar and turbulent channel flows.

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