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Modeling the pressure term in finite-volume LES with unresolved wall layers[1] HENRY CHANG, ROBERT MOSER, University of Texas at Austin — In the incompressible Navier-Stokes equations, the fluctuating pressure term serves to keep the velocity field divergence-free. Here we consider the role of incompressibility and the pressure in LES with finite-volume filter and unresolved wall layers. In particular, we use a uniform staggered-grid finite-volume discretization, where $\Delta y^+ = 50$ in the wall-normal direction. The standard treatment of pressure in such a finite-volume discretization results in an LES field that satisfies a discrete divergence-free condition. However, solutions to the incompressible Navier-Stokes equations–when volume-averaged–are not discretely divergence-free. In fact, the discrete divergence increases sharply close to the wall. It is also found that the resulting discrete pressure does not represent well the pressure contribution to the evolution of the filtered Reynolds stress tensor. It appears, therefore, that the standard pressure solution is not appropriate for finite volume LES of wall-bounded turbulence. Using the techniques of optimal LES, alternative pressure models are being developed which: (1) do not strictly impose the discrete divergence-free condition and (2) correctly represent the contribution of pressure to the evolution of Reynolds stress.

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