A Predictive LES Wall Model using Optimal Control Techniques[1]

JEREMY TEMPLETON, MENG WANG, PARVIZ MOIN, Center for Turbulence Research — A wall model for large-eddy simulation (LES) based on optimal control theory has been developed. Reynolds-averaged Navier-Stokes equations, coupled to both the LES and control, is used near the wall to provide a target velocity profile which can be used to define a cost function. The control then minimizes this cost function by modifying the wall stresses, used as boundary conditions by the LES. This significantly generalizes the previous work of Nicoud *et al.* (Phys. Fluids 13(10), 2001) in that no *a priori* target profiles are needed, making the wall model truly predictive. In addition, the restriction to basing the control sensitivity to the near-wall region means that away from the wall, where the subgrid scale model is more accurate, the flow is allowed to evolve according to the LES equations. This wall model has been successfully tested in a plane channel flow on a coarse grid for Reynolds numbers up to $Re_\tau = 20,000$. In the case of $Re_\tau = 4,000$, the mean velocity and rms velocity fluctuations are found to be comparable to those of Nicoud *et al.*

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