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Estimation of turbulent channel flow based on the wall measurement with a statistical approach YOSUKE HASEGAWA, The University of Tokyo, TAKAO SUZUKI, The Boeing Company — A turbulent channel flow at $Re_tau = 100$ with periodic boundary conditions is estimated with linear stochastic estimation only based on the wall measurement, i.e. the shear-stress in the streamwise and spanwise directions as well as the pressure over the entire wavenumbers. The results reveal that instantaneous measurement on the wall governs the success of the estimation in y+ ¡ 20. Degrees of agreement are equivalent to those reported by Chevalier et al. (2006) using a data-assimilation approach. This suggests that the instantaneous wall information dictates the estimation rather than the estimator solving the dynamical system. We feed the velocity components from the linear stochastic estimation via the body-force term into the NavierStokes system; however, the estimation slightly improves in the log layer, indicating some benefit of involving a dynamical system but over-suppression of turbulent kinetic energy beyond the viscous sublayer by the linear stochastic estimation. Motions inaccurately estimated in the buffer layer prevent from further reconstruction toward the centerline even if we relax the feedback forcing and let the flow evolve nonlinearly through the estimator. We also argue the inherent limitation of turbulent flow estimation based on the wall measurement.

Yosuke Hasegawa
The University of Tokyo

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