Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

Toward models for fluctuating wall quantities in incompressible turbulent flows[1] AARON TOWNE, XIANG YANG, PARVIZ MOIN, Center for Turbulence Research, Stanford University — Wall models for large-eddy simulation have been developed that provide accurate estimates of mean wall quantities such as shear stress, heat transfer, and pressure. However, these models typically do not deliver accurate predictions of the space-time fluctuations of these quantities. In this presentation, we describe some first steps toward constructing new wall models that predict the spatiotemporal properties of wall quantities by taking advantage of recent advances in our ability to identify and model the coherent structures that are known to play a central role in the near-wall dynamics. We first analyze data from a direct numerical simulation of a channel at $Re_\tau = 1000$ using spectral estimation techniques to isolate the contribution from different scales to fluctuating wall quantities and correlation analysis to link different spatial locations. Then, we explore how modes obtained via singular value decomposition of the resolvent operator, which is obtained from the linearized flow equations, could be used to model these fluctuations. This analysis provides a starting point for leveraging these model reduction ideas to improve the prediction of near-wall fluctuations using wall-modelled large-eddy simulation.

[1]Funded by NASA grant no. NNX15AU93A and PSAAPII grant no. DE-NA0002373

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Date submitted: 01 Aug 2017 Electronic form version 1.4