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Estimating Uncertainties in Statistics Computed from DNS[1] NICHOLAS MALAYA, TODD OLIVER, RHYS ULERICH, ROBERT MOSER, University of Texas at Austin — Rigorous assessment of uncertainty is crucial to the utility of DNS results. Uncertainties in the computed statistics arise from two sources: finite sampling and the discretization of the Navier-Stokes equations. Due to the presence of non-trivial sampling error, standard techniques for estimating discretization error (such as Richardson Extrapolation) fail or are unreliable. This talk provides a systematic and unified approach for estimating these errors. First, a sampling error estimator that accounts for correlation in the input data is developed. Then, this sampling error estimate is used as an input to a probabilistic extension of Richardson extrapolation in order to characterize the discretization error. These techniques are used to investigate the sampling and discretization errors in the DNS of a wall-bounded turbulent flow at $Re_\tau = 180$. We will show a well-resolved DNS simulation which, for the centerline velocity, possesses 0.02% sampling error and discretization errors of 0.003%. These results imply that standard resolution heuristics for DNS accurately predict required grid sizes.

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Nicholas Malaya
University of Texas at Austin

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