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LES of turbulent channel flow using an artificial neural network[1]

JONGHWAN PARK, HAECHEON CHOI, Seoul National University — Neural networks (NNs) are used to map the relation between subgrid-scale (SGS) stresses and various input sets, and *a priori* and *a posteriori* tests are conducted to investigate the performance of NNs in a turbulent channel flow at $Re_\tau \approx 180$. NN with stencils of the velocity components as the input shows the highest correlation coefficient between true and predicted SGS stresses, and also predicts backscatter very well. However, NN with the strain rate as the input shows the best agreement with the filtered DNS data for the averaged SGS shear stress, even if the correlation coefficient between true and predicted SGS stress is low. In *a posteriori* test, NNs which predict the backscatter well in *a priori* test provide inaccurate statistics. On the other hand, even without wall damping function or *ad hoc* clipping, NN with the strain rate as the input shows excellent agreements with the filtered DNS data for the mean velocity and Reynolds shear stress. The present NN predicts pointwise-SGS stresses without averaging in the homogeneous direction(s), which is often adopted for the use of the dynamic Smagorinsky model. The present NN model is applied to a higher Reynolds number ($Re_\tau \approx 720$) with the model trained at lower Reynolds number. The results also show good agreements with those of filtered DNS data.

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