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Development of subgrid-scale model using machine learning MASATAKA GAMAHARA, Department of Applied Information Science, Tohoku University, YUJI HATTORI, Institute of Fluid Science, Tohoku University — Neural network, which automatically finds patterns or rules from big data, is applied to construct an improved sub-grid scale (SGS) model used in LES. SGS stress tensors are obtained by filtering data of direct numerical simulation (DNS) of turbulent channel flow. We use velocity gradient tensors and distance from the wall as inputs of the neural network aiming at improving conventional SGS models which include the Smagorinsky model. The back-propagation method is used in the learning process of the neural network. The results show that the neural network is able to learn SGS stress tensors. High correlation coefficients between SGS stress tensors obtained from DNS data and those estimated by the neural network are obtained. The results do not depend very much on the training data used for learning. Furthermore we investigate dependence on the size of training data, the filter size and the number of neurons. In particular the learning of neural network depends on the filter size. We also obtain high correlation coefficients at all Reynolds numbers tested. In order to find an explicit form of the estimated SGS stress tensors we try to identify the minimum set of independent variables by reducing the number of inputs. Physics behind the obtained model will be also discussed.

Masataka Gamahara
Department of Applied Information Science, Tohoku University

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