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Modeling wall-shear stress of turbulent flows through deep reinforcement learning JUNHYUK KIM, HYOJIN KIM, CHANGHOON LEE, Yonsei University — Deep reinforcement learning (DRL) of turbulent flows, which is very rarely studied, is challenging because state and action are spatio-temporally high dimensional. But, it would be useful for turbulence modeling and control. In the present work, we adopted DRL to wall modeling of large-eddy simulation (LES) in turbulent channel flow, developing a deep neural network mapping wall-shear stress from off-wall velocity. Our approach is cost-efficient since we use only wall-modeled LES rather than direct numerical simulation (DNS) and it is free from prior assumption used in supervised learning. Using deep deterministic policy gradient, an actor-critic algorithm, we automatically control the wall shear boundary condition to match the target statistics including mean and root-mean-square (RMS) velocity profiles, responses of which are delayed in wall-normal direction. As a result, an LES with the trained wall model well reflected the target mean profile in log-layer, and RMS profile by our model was improved than conventional equilibrium wall model.

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