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Turbulence inflow generation using generative adversarial network JUNHYUK KIM, CHANGHOON LEE, Yonsei University — Using unsupervised learning, we developed an inflow generator that performs better than previously proposed synthetic methods. Direct numerical simulations of turbulent channel flow were carried out at three Reynolds numbers, and then temporally successive flow fields in a cross-sectional (y-z) plane were collected. Using the collected data, we trained a novel model, RNN-GAN, which is composed of a recurrent neural network (RNN) and a generative adversarial network (GAN). Here, RNN represents time-variation of generated flow, while GAN represents a spatial correlation of the flow. Our trained RNN-GAN produces surprising results. First, the generated flow is qualitatively and statistically accurate as compared with DNS. Second, it is possible to generate the flow not only at the trained Reynolds numbers but also at the other Reynolds numbers, although the extrapolated case shows a little deterioration of statistical accuracy. The generated flow is stochastically varying over time, unlike a supervised learning method. Finally, the domain size of the generated flow is extendable. These results indicate that our model provides good inflow generator required for developing channel flow.

Changhoon Lee
Yonsei University

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