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Space-time recovery of high-resolution turbulent flow fields with machine learning based super resolution KAI FUKAMI, KOJI FUKAGATA, Keio University, KUNIHIKO TAIRA, University of California, Los Angeles — In recent years, the use of machine learning based super-resolution analysis has enabled accurate reconstruction of high-resolution image from its low-resolution counterpart. Moreover, machine learning techniques referred to as inbetweening have also been developed to estimate data in between temporal snapshots. Here, we combine two of these approaches to reconstruct complex multi-scale turbulent flows both in space and time. A convolutional neural network-based architecture called hybrid Down-sampled Skip-Connection and Multi-Scale (DSC/MS) model is developed for the recovery of complex flow fields. The proposed model is applied to two-dimensional isotropic turbulence and three-dimensional turbulent channel flow at $Re_\tau = 180$ so as to demonstrate its capability in reconstructing spatio-temporal high-resolution turbulent flow fields from their coarse flow field data. We find that the present approach is able to accurately recover the high-resolution flow fields with only a modest amount of training data, despite the turbulent flow being complex and multi-scale in nature. The first two authors acknowledge the support by JSPS (18H03758). The last author thanks the support from ARO (W911NF-17-1-0118), and AFOSR (FA9550-16-1-0650).

Kai Fukami
Keio University

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