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Super-resolution and Denoising of Fluid Flows Using Physics-informed Convolutional Neural Networks[1] JIAN-XUN WANG, HAN GAO, LUNING SUN, University of Notre Dame — High-resolution (HR) information of fluid flows, although preferable, is usually less accessible due to limited computational or experimental resources. In many cases, fluid data are usually sparse, incomplete, and possibly noisy. How to enhance spatial resolution and decrease noise levels of fluid flow data is important and practically useful. Deep learning (DL) techniques have been demonstrated effective for super-resolution (SR) tasks, which, however, largely relies on sufficient HR labeled data for training. In this work, we present a novel weakly-supervised or unsupervised DL-based SR framework based on physics-informed convolutional neural networks (CNN), which can generate HR flow fields from low-resolution (LR) inputs in high-dimensional parameter space. By leveraging conservation laws and flow conditions, the CNN SR model can be trained even without using any HR labeled data. Numerical examples of several fluid flows have been used to demonstrate the effectiveness and merit of the proposed method.

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