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Reconstruction of Turbulent High-resolution DNS Data Using Deep Learning PRANSHU PANT, AMIR BARATI FARIMANI, Carnegie Mellon University — Within the domain of Computational Fluid Dynamics, Direct Numerical Simulation (DNS) is used to obtain highly accurate numerical solutions for fluid flows. However, this approach for numerically solving the Navier-Stokes equation is extremely computationally expensive mostly due to the requirement of greatly refined grids. Large Eddy Simulation (LES) presents a more computationally efficient approach for solving fluid flows on lower-resolution (LR) grids but results in an overall reduction in solution fidelity. Through this paper, we introduce a novel deep learning framework DNS-SR Net, which aims to mitigate this inherent tradeoff between solution fidelity and computational complexity by leveraging deep learning techniques used in image super-resolution. Using our model, we wish to learn the mapping from a coarser LR solution to a refined high-resolution (HR) DNS solution so as to eliminate the need for DNS simulations on highly refined grids. Our model efficiently reconstructs the high-fidelity DNS data from the LES like low-resolution solutions while yielding good reconstruction metrics. Thus our implementation improves the solution accuracy of LR solutions while incurring only a marginal increase in computational cost required for deploying the trained deep learning model.

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