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Super-resolution of Finite Element spaces using Physics-informed Deep Learning Networks for Turbulent flows[1] ANIRUDDHE PRADHAN, RAJARSHI BISWAS, KARTHIK DURAISAMY, University of Michigan — High dimensional representation of turbulent flows present several challenges due to the wide range of spatial and temporal scales present in it. High Reynolds number simulations demand coarse-grained modeling, which requires an adequate representation of the impact of the unresolved scales. We present a deep learning (DL) based super-resolution technique to recover the fine scale information in the form of high-order Discontinuous Galerkin (DG) fields from a low-order DG solution. We train the DL models using coarse and fine scale data obtained by L^2-projection of the full order solution on low and high order DG sub-spaces respectively. The predictive and operational efficacy of the learning algorithms is then assessed. The performance of the model is improved by: (i) introducing non-dimensionalized physics-informed input and output features; and (ii) by weighting the loss with a prior obtained directly from the training data. The present approach is found to generalise to unseen data at different flow conditions as well.

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