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Reconstruction of turbulent data with deep generative models for semantic inpainting from TURB-Rot database MICHELE BUZZICOTTI, Department of Physics and INFN, University of Rome Tor Vergata, FABIO BONACCORSO, Center for Life Nano Science@La Sapienza, Istituto Italiano di Tecnologia and INFN, PATRICIO CLARK DI LEONI, Department of Mechanical Engineering, Johns Hopkins University, LUCA BIFERALE, Department of Physics and INFN, University of Rome Tor Vergata — We study the applicability of tools developed by the computer vision community for feature learning and semantic image inpainting to perform data reconstruction of fluid turbulence configurations. The aim is twofold. First, we explore on a quantitative basis, the capability of Convolutional Neural Networks embedded in a Deep Generative Adversarial Model (Deep-GAN) to generate missing data in turbulence, a paradigmatic high dimensional chaotic system. In particular, we investigate their use in reconstructing two-dimensional damaged snapshots extracted from a large database of numerical configurations of 3d turbulence in the presence of rotation, a case with multi-scale random features where both large-scale organised structures and small-scale highly intermittent and non-Gaussian fluctuations are present. Second, following a reverse engineering approach, we aim to rank the input flow properties (features) in terms of their qualitative and quantitative importance to obtain a better set of reconstructed fields. Finally, we present a comparison with a different data assimilation tool, based on Nudging, an equation-informed unbiased protocol, well known in the numerical weather prediction community. M. Buzzicotti, et al. arXiv preprint arXiv:2006.09179 (2020).

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