Abstract Submitted
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Predictions in Wall-bounded Turbulence Through Convolutional-network Models Using Wall Quantities[1] LUCA GUASTONI, KTH Royal Institute of Technology, ALEJANDRO GÜEMES, ANDREA IANIRO, STEFANO DISCETTI, Universidad Carlos III de Madrid, PHILIPP SCHLATTER, HOSSEIN AZIZPOUR, RICARDO VINUESA, KTH Royal Institute of Technology — Deep neural networks (DNNs) have been applied to a variety of fluid dynamics problems in recent years, providing encouraging results in flow prediction, modelling and control. Here we train two models based on convolutional neural networks, aiming to predict velocity fields in a turbulent open channel flow, using quantities measured at the wall. The first model is a fully-convolutional neural network (FCN) which directly predicts the flow fluctuations, while the second one, named FCN-POD, uses orthonormal basis functions obtained through proper orthogonal decomposition. The performance assessment is based on predictions of the instantaneous fields, turbulence statistics and power-spectral densities, at different wall-normal locations, for friction Reynolds numbers $Re_\tau = 180$ and 550. The FCN exhibits the best predictions closer to the wall, whereas the FCN-POD model provides better predictions at larger wall-normal distances. Both models are shown to perform better than traditional linear models, thanks to their ability to capture also non-linear interactions in turbulent flows. The potential of transfer learning between friction Reynolds numbers is also investigated.

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