Deep learning the spanwise-averaged turbulent wake of a circular cylinder

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Abstract

Numerical simulations of long and flexible cylindrical structures become prohibitive at high Reynolds regimes because of the wide range of spatial and temporal scales that need to be resolved. We propose a new flow decomposition based on the spanwise average of the local three-dimensional (3D) strip which provides a two-dimensional formulation with additional statistical terms accounting for the 3D fluctuations. The latter unclosed terms are modelled through a convolutional neural network (CNN) trained on a high-fidelity dataset. The CNN is designed as a multiple-input multiple-output autoencoder inspired on image recognition architectures. The convolution operation ensures translational invariance and different inputs are tested aiming to provide a Galilean invariant model. *A priori* results display 90% correlation of the predicted turbulent fields and current work involves the *a posteriori* analysis of the model plus the investigation of the model generalisation for different geometries and flow regimes.