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Using Deep Neural Networks for Data-Driven Prediction of Fluid Forces on Aerofoils THARINDU MIYANAWALA, PASAN HENADEERA, NALAKA SAMARAWEERA, University of Moratuwa, RAJEEV JAIMAN, University of British Columbia — We present an efficient deep learning technique for the prediction of fluid forces on aerofoils. The proposed technique relies on Convolutional Neural Network (CNN) technique. The aim is to predict the fluid forces for different aerofoil shapes at different angles of attack. The convolution with nonlinear rectification is employed to approximate the mapping between the aerofoil shape and the fluid forces. The deep neural network is fed by the Euclidean distance function and inviscid flow fields as the input and the target data generated by the XFOIL software and the full-order CFD computations for 525 aerofoil cases. The CNN is iteratively trained using the stochastic gradient descent method to predict the forces of different geometries and the results are compared with the full-order computations. A systematic convergence and sensitivity study is performed to identify the best dimensions of the deep-learned CNN. Within the error threshold, the prediction based on CNN got a speed-up an order of magnitude compared to the CFD results and consumes a fraction of computational resources. The proposed CNN-based approximation procedure will have a profound impact on the parametric design of aerofoils.

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