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A Data-Driven Neural-Network Algorithm for building wake predictions using RANS and LES

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ABSTRACT

A machine-learning algorithm has been developed to numerically predict the flow around a finite square and rectangular based cylinder, representing buildings of different sizes. RANS (Reynolds-Averaged Navier–Stokes) turbulent model is utilized for analyzing the wake of cylinders with different height to width (aspect ratio) and length to width (depth ratio) characteristics. The Reynolds number of 2500 is used to guarantee that the flow regime is fully turbulent. LES (Large Eddy Simulation) turbulent model is adopted for training the data in this investigation. There are 49 case studies to understand the effect of increasing aspect ratio(AR) and depth ratio (DR) on wake behavior. The principal idea behind this study is to reduce the computational cost and time by training an artificial neural network (ANN) that transforms key wake predictions from the limited accuracy of RANS models to that of LES which can assist to facilitate the calculation of the wind load around rectangular buildings with different sizes. ANN works with AR, DR, and RANS results as inputs and some hidden layers as activation functions to estimate the output, such as recirculation length, top-recirculation zone and, base pressure.

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