Regression analysis on artificial roughness shape impact on heat transfer enhancement in a circular pipe

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Results of numerical modeling and regression analysis are presented for turbulent airflow inside a circular pipe provided with artificial roughness of squared and delta-shaped elements. The effect of the parameters under consideration (roughness height and pitch, flow Reynolds number) on heat transfer enhancement, pressure drop, and total performance is assessed. A regression problem of predicting these values given input parameters is solved with deep learning algorithms. The first part (126 samples) of the acquired dataset of numerical results for squared elements is utilized for training a 3-layer feedforward neural network. Predictions of this model are then merged with 20 other samples (the results for delta-shaped elements), and proceeded to 1-layer network, representing model stacking technique [1] widely used in terms of the lack of data. Both models are showing promising results (less than 2% mean percentage error on k-fold and hold-out validation) for industrial applications.

[1] Goodfellow I J, Bengio Y and Courville A 2016 *Deep Learning* (Cambridge, MA, USA: MIT Press) `http://www.deeplearningbook.org`