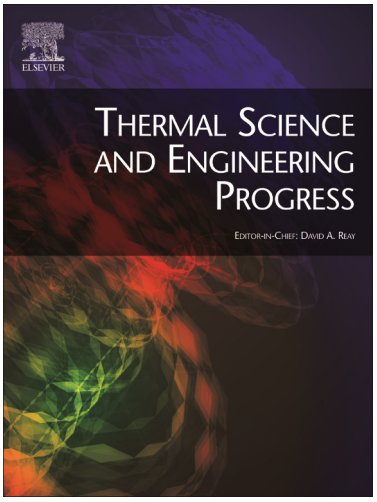

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Prediction of heat transfer of two different types of roughened solar air heater using Artificial Neural Network technique

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Abstract

In the present article, the Feed forward Neural Network (FFNN) model has been used to predict the heat transfer from roughened absorber plate to air passing through the ducts of solar air heater and compare with actual experimental data. One side and three sided roughened absorber plates have been taken up for experimental study of solar air heater (SAH) heat transfer analysis. Total 50 data sample have been used in the present neural model. Artificial Neural Network (ANN) model developed with feed forward back-propagation (FFBP) multi -layer perceptron using five parameters (number of rough surfaces side, relative roughness height, relative roughness pitch, roughness size and Reynolds Number) and one parameter (Nusselt number) have been used in input layer and output layer respectively. Levenberg-Marquardt (LM) algorithm with 6-12 neurons has been used to find out the optimal model. The 10 numbers of neurons in hidden layer model has been found as optimal on the basis of statistical error analysis. The 5-10-1 neural model predict the heat transfer characteristics as Nusselt number with higher value of R^2 gives satisfactory results. The values of root mean square error (RMSE), mean absolute error (MAE) and coefficient of determination (R^2) were found 0.89202, 0.66261 and 0.99532 respectively during training stage. Similarly for testing stage these values were 0.55094, 0.3168 and 0.99791 respectively. The traditional statistical multiple linear regression (MLR) model has also been used in prediction of heat transfer. The MLR model has been compared with ANN model. The Performance criteria show that the ANN model performs better as compared the MLR model. The average value of coefficient of determination for the ANN model was higher by 1.79 % than for the MLR model. The results indicated that the proposed ANN model successfully predicts the heat transfer analysis of roughened solar air heater.

Keywords: Solar air heater, Artificial Neural Network, Levenberg-Marquardt Learning algorithm, Nusselt Number, Heat transfer