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Artificial Neural Network Approach for Modeling Very Short-Term Wind Speed Prediction

Authors : Joselito Medina-Marin, Maria G. Serna-Diaz, Juan C. Seck-Tuoh-Mora, Norberto Hernandez-Romero, Irving Barragán-Vite

Abstract : Wind speed forecasting is an important issue for planning wind power generation facilities. The accuracy in the wind speed prediction allows a good performance of wind turbines for electricity generation. A model based on artificial neural networks is presented in this work. A dataset with atmospheric information about air temperature, atmospheric pressure, wind direction, and wind speed in Pachuca, Hidalgo, México, was used to train the artificial neural network. The data was downloaded from the web page of the National Meteorological Service of the Mexican government. The records were gathered for three months, with time intervals of ten minutes. This dataset was used to develop an iterative algorithm to create 1,110 ANNs, with different configurations, starting from one to three hidden layers and every hidden layer with a number of neurons from 1 to 10. Each ANN was trained with the Levenberg-Marquardt backpropagation algorithm, which is used to learn the relationship between input and output values. The model with the best performance contains three hidden layers and 9, 6, and 5 neurons, respectively; and the coefficient of determination obtained was r^2=0.9414, and the Root Mean Squared Error is 1.0559. In summary, the ANN approach is suitable to predict the wind speed in Pachuca City because the r^2 value denotes a good fitting of gathered records, and the obtained ANN model can be used in the planning of wind power generation grids.

Keywords : wind power generation, artificial neural networks, wind speed, coefficient of determination
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