The outlines of using ANN toolbox in MATLAB for forecasting

Using ANN toolbox in MATLAB goes over three main stages. First one includes preparing the input and target variables for training and testing processes, and building ANN structure. Secondly, training process must be performed to obtain ANN output that represents the forecasting variable $\hat{Z}_t$ for the training period. Testing process comes finally to obtain ANN forecasting $\hat{Z}_t$ for testing period.

Preparing inputs and targets data variables are important before beginning of ANN constructing. In the workspace of MATLAB, data variables are created by considering the number of variables as rows and the number of observations as columns. After creating inputs and target variables for training and testing periods, the main stages of ANN toolbox in MATLAB can be performed. By recalling "nntool" command from command window in MATLAB, data manager dialog box will be appeared such as in Figure A.1. Figure A.1 shows the fields of imported and generated data in data manager dialog box.

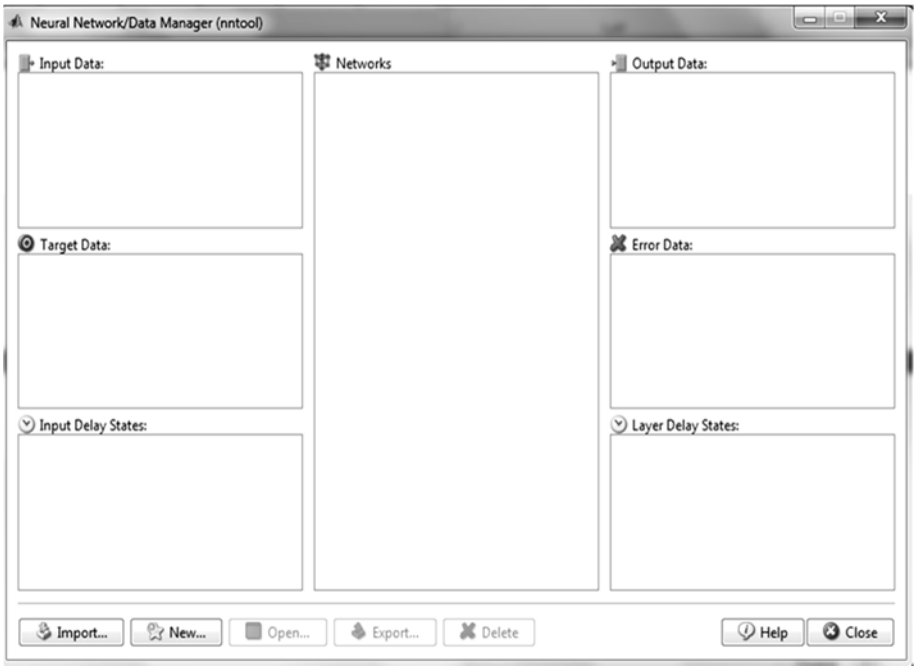

Figure A.1 Data manager dialog box

Import choice must be chosen to import the input and target variables for training and testing periods such as in Figure A.2.

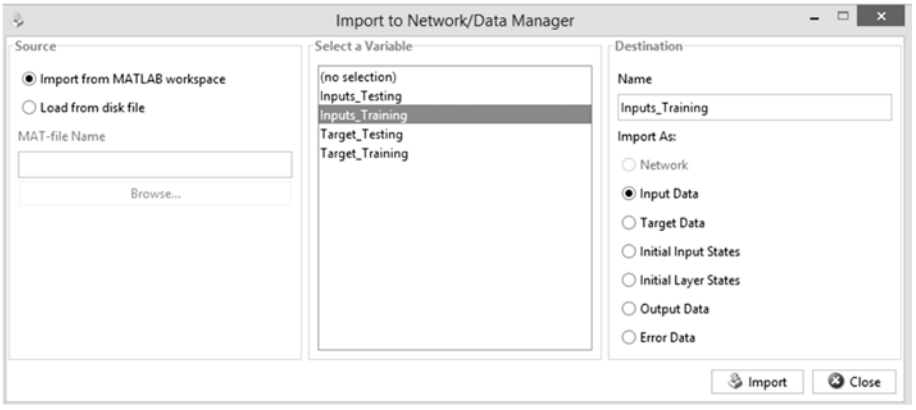

Figure A.2 Import dialog box

After importing input and target variables, ANN can be created as new network by determining the ANN training algorithm, training function, transfer functions types of input and hidden layers, number of neurons of hidden layer, and some other requirements such as in Figure A.3.

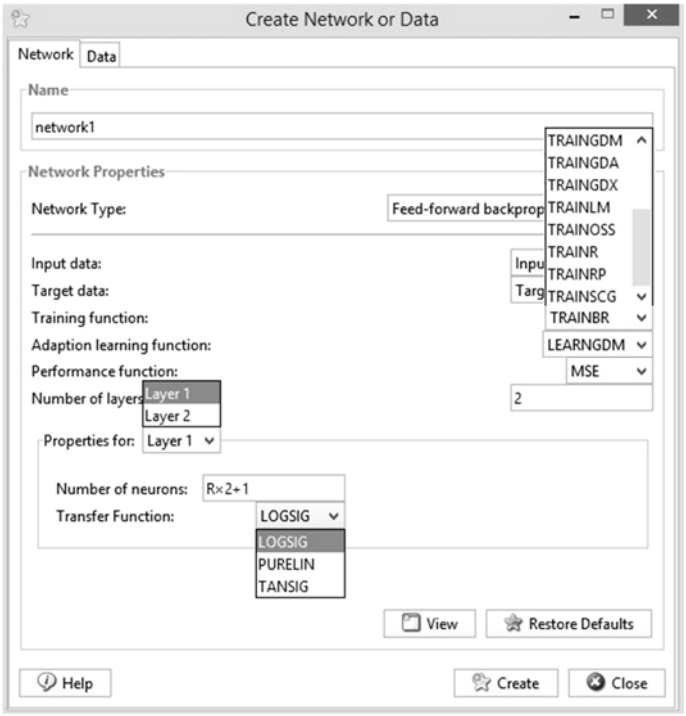

Figure A.3 Neural Network creation

From Figure A.3, the structure of ANN is constructed by determining the requirements such as listed below.

a. Feed-forward back propagation must be determined as a network type.

b. Input and target variables for training period must be inserted.

c. Only Levenberg Marquardt and Bayesian regularization training algorithms are used as the best training functions.

d. The weights and biased values are determined randomly depended on ANN toolboxes strategies.

e. The nonlinearity characteristic of wind speed time series data was obligated to choose a nonlinear transfer function such as tan-sigmoid or log-sigmoid for hidden layer to filter the nonlinearity.

f. The number of neurons in a hidden layer must be correctly calculated to create an ANN that can handle the nonlinearity (Forshed *et al.*, 2002; Mahamad *et al.*, 2010; Tien Bui *et al.*, 2012).

Training process can be started now after constructing ANN in order to obtain ANN output that represents the training forecast variable $\hat{Z}_t$ for training period. By inserting the inputs and target variables for training period such as in Figure A.4, ANN will be ready to start training process. As the results for training

process, the training forecast variable $\hat{Z}_t$ that corresponds the training period is obtained as an ANN output in addition to the forecasting error variable that represents the difference between the target and the output variables.

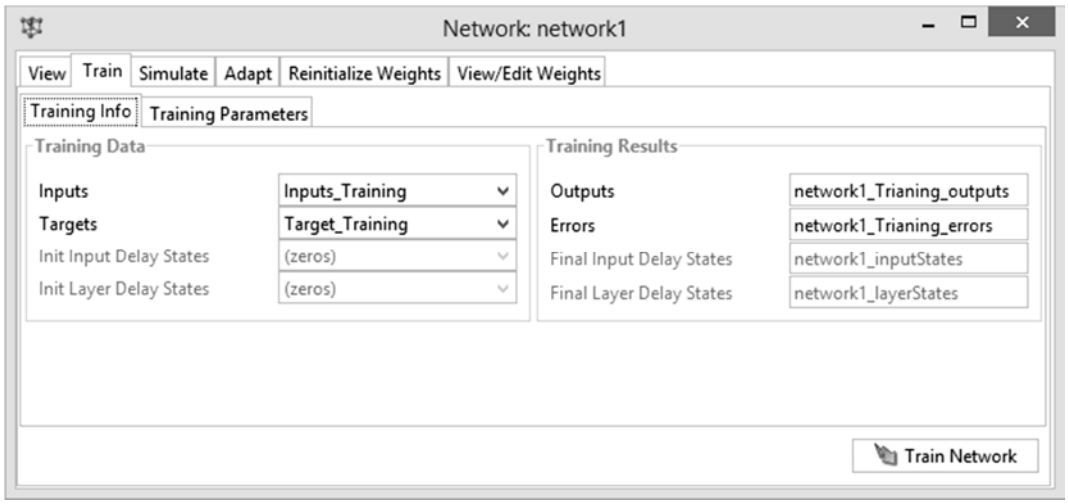

Figure A.4 Training process dialog box

The training is reiterated for many iterations in addition to adjust the weights and biased values until obtaining the most minimum forecasting error. Once any training iteration satisfies the most minimum forecasting error, the weights and biased values are saved to use them for testing process (Tien Bui *et al.*, 2012).

Testing process is also allowed after achieving ANN training process in order to obtain ANN testing forecast. By inserting the inputs and target variables for testing period such as in Figure A.5, ANN will be ready to start testing process.

As the results of testing process, the testing forecast variable is obtained as an ANN output in addition to its forecasting error.

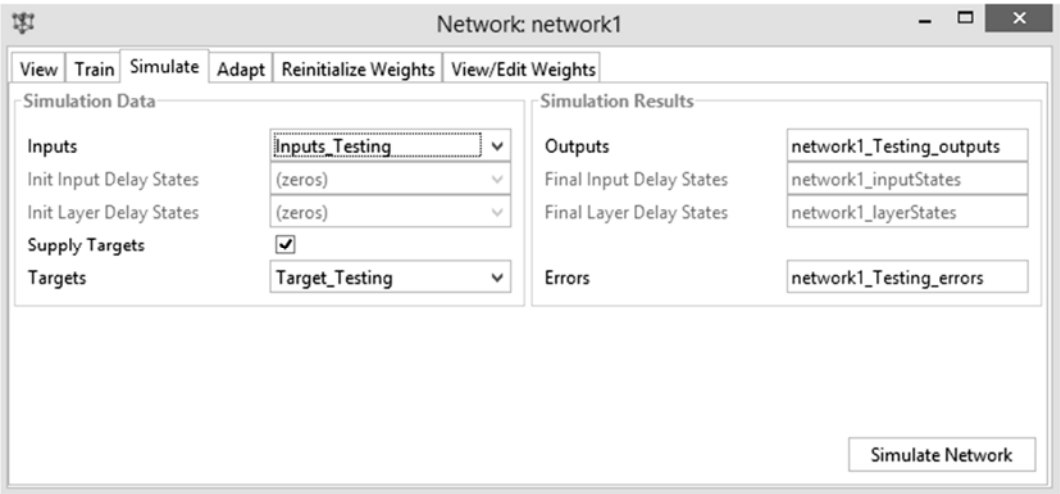

Figure A.5 Testing process dialog box