Any-Place Forecasting Method of Nationwide Time-Series Wind Speed Using Classified Forecast Models based on Wind Conditions

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Most of the methods forecasting the wind speed proposed so far are not universal and available only for specific area. In the present study, forecasting method of a time-series wind speed 24-hours ahead at any location in Japan was proposed, which was based on classified forecast models by wind conditions (called FCCM; Forecasting Method using Classified forecast Model). The model was structured by the radial basis function network (RBFN) and the performance was compared to the conventional feed forward neural network (FFNN). Figure 1 shows that structure of the RBFN which has 3 layers. The input vector $\boldsymbol{x}$ is inputted at the input layer. The hidden layer, it is function of u_j and σ_j, outputs h_j. Elements of output vector y_k are calclated from h_j and wait $\boldsymbol{w}_{kj}$.

The procedure of the FCCM was as follows; (1) All the points where wind speed had been measured by the Japan Meteorological Agency were divided into the groups depending on their wind conditions (mean wind speed and standard deviation of wind speed). Figure 2 shows that relatioship of mean wind speed and standard deviation of wind speed of 156 SDP points in winter. Group (a) and group (b) in this figure are mean wind speed: 1∼2 m/s, standard deviation: 1∼2 m/s and Mean wind speed: 5∼6 m/s, standard deviation: 2∼3 m/s, respectively. (2) RBFN was learned and the network model was optimized to forecast wind speed in each group. (3) If the wind speed was not measured in the forecast point, it was estimated by using measured data around there. (4) Then, the time-series wind speed of the forecast point was obtained by the network model for the group. The wind speeds at 6 points in Japan where the wind condition were different were forecasted by FCCM.

Figure 3 shows that MAE of forecasted wind speed in winter 2005 using measured wind speed and estimated wind speed, respectivery. As a result, the mean absolute error was about from 1.0 to 1.5 m/s. Although forecast error of RBFN and that of FFNN were similar, RBFN was able to learn fast than FFNN.

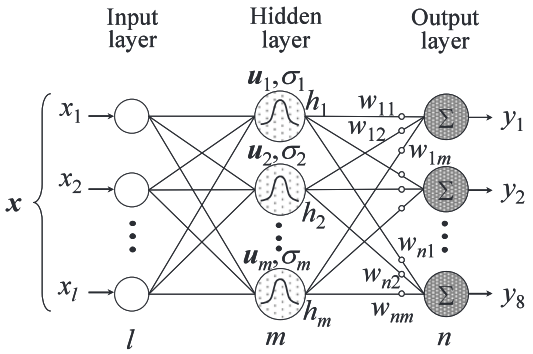

Fig. 1. Structure of radial basis function network (RBFN)

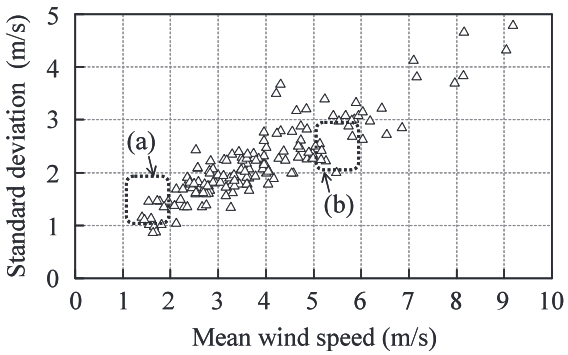

Fig. 2. Relationship of mean wind speed and standard deviation of wind speed of 156 SDP points in winter

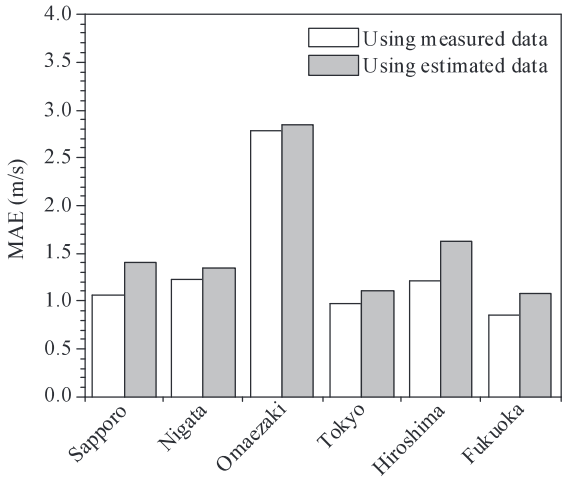

Fig. 3. MAEs of forecasted wind speed in winter 2005 using measured wind speed and estimated wind speed