Renewable Energy and Power Quality Journal (RE&PQJ), ISSN 2172-038 X, No.9, 12th May 2011, Reference Paper: 428

Nowcasting of Wind Speed using Support Vector Regression. Experiments with Time Series from Gran Canaria

I. Espino, M. Hernández

SIANI
Universidad de Las Palmas de Gran Canaria
Campus of Tafira, 35017 Las Palmas, Canary Islands (Spain)
e-mail: **{iespino, mhernandez}@siani.es**

Abstract. The aim of this paper is to describe and evaluate a proposal for nowcasting wind speed for wind farm locations from historical time series, based on the method of regression by support vectors. To show the improvement over other methods, we used the ANEMOS Project standard evaluation protocol for forecasting against three reference models to compare, referred to a statistical approach: persistence, autoregressive and autoregressive moving average models. The obtained results show a good performance of the proposed method and how beat the classical reference models.

Keywords

Wind speed forecasting, nowcasting, support vector regression.

1. Introduction

In last times, environmental, economic and geostrategic considerations have prompted the use of wind power as a renewable energy resource. The biggest challenge in integrating wind power into the electric grid is its intermittency. As a consequence of the presence of an increasing fraction of renewable energy into the electric grid, its influence has grown into the grid security, system operation, and market economics problems.

Although wind energy may not be dispatched, the negative impact of wind energy onto the grid can be reduced if it can be scheduled using wind forecasting. So, the improvement of the wind power forecasting performance has significant impact on the system operation, obtaining as a consequence increasing wind power penetration without degradation in security or quality of service.

Classification of wind forecasting methods can be organized by time-scale in the following categories [1] with its related main applications:

- *Very short-term forecasting*: range from few seconds to 30 minutes ahead. Its main applications are in electric market clearing or regulation actions.
- *Short-term forecasting*: range from 30 minutes to 6 hours ahead. Its main applications are in economic load dispatch planning or load increment/decrement decisions.
- *Medium-term forecasting*: range from 6 hours to 1 day ahead. Its main applications are in generator online/offline decisions, operational security in day-ahead or electric market.
- *Long-term forecasting*: range from 1 day to 1 week ahead. Its main applications are in unit commitment decisions, reserve requirement decisions or maintenance scheduling to obtain optimal operating costs.

These previous limits of forecasting terms are not strictly defined and some relaxation may be granted depending on the application of the prediction model. Other authors [2] define *nowcasting* to short lead time weather forecast and, particularly wind forecast. The US National Weather Service specifies that zero to three hours ahead forecasting is considered nowcasting. For other agencies, forecasts up to six hours are called nowcasting.

The main wind power forecasting methods developed and reported in literature can be classified into the following approaches:

- *Persistence Approach*, where it is assumed that wind speed at time $t+k$ will be the same at time t. It is more accurate that most of another approaches for nowcasting, effective for very short-term and short-term forecast. Hence, it is considered as a reference and so, it is used as a benchmark to check the improvements of new forecasting solutions [3].
- *Statistical Approach*, which is based on tuning the parameters of a model, training it with historical measurement data. In this approach, the difference between the predicted and the actual model allows to tune the parameters [4]. It includes time-series based models and neural network based methods. Most popular models of time-series approach are autorregresive moving average (ARMA) and variations (ARIMA, ARMAX, ARX, ...). Neural network models can be feedforward networks, multilayer perceptrons, recurrent neural networks, radial basis function networks, etc.
- *Physical Approach*, that uses a numerical model of the physical description of the atmosphere (Numerical Weather prediction, NWP). Usually wind speed is computed on a coarse grid by a weather service at mesoescale and transformed by downscaling at the location of wind farm [5] under forecasting. Customarily, NWP are run several times a day due to the difficulties and high costs associated to gain information in short-time. This limits its usefulness to long-term forecasts (greater than 6 hours ahead). Moreover, the most stable the weather conditions are, the most accurate the predictions are.