EAI Endorsed Transactions
on Energy Web
Research Article EAI.EU

Research on Wind Power Prediction Model Based on Random Forest and SVR

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Abstract

Wind power generation is random and easily affected by external factors. In order to construct an effective prediction model based on wind power generation, a wind power prediction model based on principal component analysis (PCA) noise reduction, feature selection based on random forest model and support vector regression (SVR) algorithm is proposed. First, in the data preprocessing stage, PCA is used for sample data denoising; then the random forest model is used to calculate the importance evaluation value of each feature to optimize the selection of feature parameters; finally, The SVR algorithm is applied for training and prediction. Experiments show that the prediction effect of the model based on random forest and SVR is excellent, the root mean square error(RMSE) is 0.086, the average absolute percentage error(MAPE) is 23.47%, and the coefficient of determination(R^2) is 0.991. Compared with the traditional SVR model, the root mean square error of the method proposed in this paper is reduced by 95.9%, and the prediction accuracy and the fit of the prediction curve are significantly improved.

Keywords: PCA; random forest; SVR; wind power; prediction

Received on 18 November 2023, accepted on 6 April 2024, published on 12 April 2024

doi: 10.4108/ew.5758

1. Introduction

Wind power can reduce greenhouse gas emissions and help alleviate the current energy crisis [1,2]. The use of new energy to replace traditional thermal power and coal power will become an inevitable trend. Wind energy resources are widely distributed, clean and zero-emissions, etc., which have attracted the attention of all countries. There are many large-capacity wind farms in China, and wind power instability characteristics can affect the power output of wind turbine generation, making the grid unstable after wind power is connected to the grid. There is a need to construct a model that can accurately predict the wind power generation power [3-4]. This has important applications in grid-connected wind power [5], which can ensure stable operation of the power system [6].

Currently, wind power forecasting studies mainly includes probabilistic statistical methods, machine learning methods and deep learning methods. This paper discusses the application of machine learning methods in wind power forecasting. Machine learning methods can be divided into single prediction models and composite models. However, the single model is less sensitive to the sample data, which affects the final prediction accuracy. In response to the above problems, some scholars have proposed the use of combined forecasting models for wind power forecasting. For example, the literature [7] combined time series and neural networks, and wind speed data with time-series characteristics were fed into the neural network for training, achieving better prediction results [8]. The literature [9], on the other hand, combined statistical and machine learning models with better results than the time-series and RBF models. Literature[10] proposed a wind power signal prediction method based on improved empirical mode decomposition and SVM, this method is an improved method for the abatement of undershoot phenomena. Taking the wind power data of a wind farm as a training sample, firstly, the wind power signal is decomposed into a set of relatively stable sub-sequence components by IEMD, which is effective in reducing the number of undershoot points. Then, the IEMD-SVM combined prediction model of wind power signal intermediate frequency component is constructed based on SVM, the experiments illustrate the model's high prediction

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