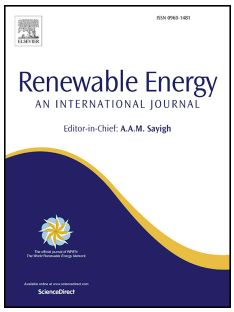
Accepted Manuscript



Research on a combined model based on linear and nonlinear features - A case study of wind speed forecasting

Kequan Zhang, Zongxi Qu, Yunxuan Dong, Haiyan Lu, Wennan Leng, Jianzhou Wang, Wenyu Zhang

PII: S0960-1481(18)30618-9

DOI: 10.1016/j.renene.2018.05.093

Reference: RENE 10145

To appear in: *Renewable Energy*

Received Date: 19 August 2017

Revised Date: 2 April 2018

Accepted Date: 27 May 2018

Please cite this article as: Zhang K, Qu Z, Dong Y, Lu H, Leng W, Wang J, Zhang W, Research on a combined model based on linear and nonlinear features - A case study of wind speed forecasting, *Renewable Energy* (2018), doi: 10.1016/j.renene.2018.05.093.

Research on a Combined Model Based on Linear and Nonlinear Features - A Case Study of Wind Speed Forecasting

Kequan Zhang [1], Zongxi Qu [1,*], Yunxuan Dong [2], Haiyan Lu [3], Wennan Leng [1], Jianzhou Wang [4], Wenyu Zhang [1]

[1] A key Laboratory of Arid Climatic Change and Reducing Disaster of Gansu Province, College of Atmospheric Sciences, Lanzhou University, Lanzhou 730000, China; zhangkq@lzu.edu.cn; quzx14@lzu.edu.cn; lengwn15@lzu.edu.cn; yuzhang@lzu.edu.cn
[2] School of mathematics and statics, Lanzhou University, China; dongyx15@lzu.edu.cn
[3] Faculty of Engineering and Information Technology, University of Technology, Sydney, Australia; haiyan.lu@uts.edu.au
[4] School of Statistics, Dongbei University of Finance and Economics, China; wjz@lzu.edu.cn
***** Correspondence: quzx14@lzu.edu.cn;

Abstract: As one of the most promising sustainable energy sources, wind energy is being paid more attention by the researchers. Because of the volatility and instability of wind speed series, wind power integration faces a severe challenge; thus, an accurate wind energy forecasting plays a key role in smart grid planning and management. However, many traditional forecasting models do not consider the necessity and importance of data preprocessing and neglect the limitation of using a single forecasting model, which leads to poor forecasting accuracy. To solve these problems, a novel combined model based on two linear and four nonlinear forecasting algorithms is proposed to adapt both the linear and nonlinear characteristics of the wind energy time series. In addition, a modified Artificial Fish Swarm Algorithm and Ant Colony Optimization (AFSA-ACO) algorithm is proposed and employed to determine the optimal weight coefficients of the combined models. To verify the forecasting performance of the developed combined model, several experiments were implemented by using ten-minute interval wind speed data in Shandong, China. Then, one-step (ten-minute), three-step (thirty-minute) and five-step (fifty-minute) predictions were conducted. The experimental results indicate that the developed combined model is remarkably superior to all benchmark models for the high precision and stability of wind-speed predictions.

Keywords: Wind speed forecasting; Combined model; Artificial fish swarm algorithm; Ant colony optimization.

1. Introduction

Wind energy, as an alternative to fossil fuel-generated electricity, has received increasing attention around the world due to its abundance, wide distribution, and economics as a non-polluting type of renewable energy [1]. The global cumulatively installed wind capacity reached approximately 539.58GW by the end of 2017, which an annual increase of 9.7%. Furthermore, researchers have noted that there will be a new round of installed wind energy in 2018-2021, and that 22% of the world's electricity will be supplied by wind energy by 2030 [2]. However, the intermittent