EAI Endorsed Transactions
on Energy Web

Research Article EAI.EU

Study on Dynamic Response Characteristics of Offshore Floating Wind Turbine Pitch System

Xin Guan[1,2,*a], Shiwei Wu[1,b], Mingyang Li[1,c], Yuqi Xie[1d]

[1]College of New Energy, Shenyang Institute of Engineering, Shenyang, China
[2]Shenyang Key Laboratory of Refined Comprehensive Utilization and Scheduling Energy Storage of Clean Energy, Shenyang, China

Abstract

Due to its special working conditions, offshore wind turbine will bear large direct and indirect loads under the combined action of air flow and wave flow. In this paper, a variable pitch system composed of variable pitch motor and variable pitch bearing is improved, and the characteristics of system's bending moment, torque, vibration and other physical quantities under the action of multiple physical loads are verified, and the mechanical response characteristics of floating wind turbine under the control of unified variable pitch and independent variable pitch are studied under the running conditions at sea. The results show that mechanical structure of uniform pitch is compared with that of independent pitch, the independent variable pitch structure can effectively reduce the mean oscillation value of wind turbine tower in the parallel direction of air flow by optimizing control strategy, and reduce the thrust at the hub of wind turbine and the bending moment at the root of tower, but increase the vibration frequency and fatigue load of offshore wind turbine tower along parallel direction of air flow. Reduce the fatigue life of equipment. The research results can be used as a reference to reduce the variable pitch control and vibration suppression of offshore wind turbines and improve the reliability of wind turbines.

Keywords: Offshore wind turbines, Simulation test, Vibration suppression, Dynamic characteristics, Reliability

Received on 15 November 2023, accepted on 09 April 2024, published on 16 April 2024

doi: 10.4108/ew.5800

1. Introduction

Wind turbine is the main power generation equipment of new energy. Onshore wind power equipment has entered the stable running stage, and the running reliability is basically guaranteed. The construction of smart wind farm is gradually advancing, but the disadvantages of poor stability of onshore wind resources and low quality of wind power are still unavoidable. The corresponding offshore wind resources has the advantages of relatively stable wind power, high wind power quality andutilization, small transformation of natural environment and small impact on human living environment, so it is favored by domestic and foreign power construction units.

Variable pitch system plays an important role in offshore wind turbines, which has been identified as the future development and research direction of wind power equipment by experts and scholars at home and abroad, and it is considered as the core technology for large-scale development and utilization of offshore wind power. However, offshore wind turbines are subjected to the combined effects of uncertain environmental loads such as air flow and wave flow, especially under the cut-out wind speed. There are some practical problems such as poor system stability, large structural load and unstable driving power, which pose new challenges to the running stability and equipment reliability of offshore wind turbines.

Aiming at the problem of structural overload of offshore wind turbines, many researchers have been carried out by domestic and foreign scholars for a long time, and blade pitch control method has been proposed. The research shows that variable pitch control can effectively stabilize power output and reduce structural load at high wind speed. Bossanyi et al. [1] proposed a basic variable pitch controller based on PI or PID algorithm. By measuring a single signal such as generator speed or output power, the blade pitch angle required by the system under different running

[a*]Corresponding author. Email: xin.guan@sina.com
[b]2312782286@qq.com, [c]549431996@qq.com, [d]yuqi_xie7725@163.com