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Research and Application of Wind Turbine Blade Drone Inspection Online Detection System based on 5G +

Mingjun Teng[1, a], Peipeng Chen[2, b], Jianxin Chen[2, c]

[1] Jieyang Qianzhan Wind Power co., LTD, Jieyang 522000, China

[2] China Mobile Communications Group Guangdong co., LTD. Jieyang branch, Jieyang 522000, China

[a]tengmingjun@spic.com.cn, [b]13822986700@139.com, [c]13925696262@163.com

Abstract

With the development of technology and the transformation of the global energy structure,Offshore windpower has become an important area for the development of clean and renewable energy.China has abundant marine resources and advanced drone technology, which provide unique advantages for the development of the offshore wind power industry.However, the maintenance and inspection of offshore wind power facilities is a highly challenging issue, especially the inspection of wind turbine blades.In summary, it is highly necessary to develop an automated wind turbine inspection system using drones.The system should be able to automatically identify the orientation of the fan, select the optimal inspection path, and automatically collect data and identify defects on the during the inspection process without the need for a certified pilot, thus effectively assisting the inspection personnel in completing the inspection work.

Keywords

Online Detection System; Drone Inspection; Wind Turbine Blade.

1. Introduction

With the development of technology and the transformation of the global energy structure,Offshore windpower has become an important area for the development of clean and renewable energy.China has abundant marine resources and advanced drone technology, which provide unique advantages for the development of the offshore wind power industry.However, the maintenance and inspection of offshore wind power facilities is a highly challenging issue, especially the inspection of wind turbine blades. Since the wind turbine blades are located at high altitudes, traditional inspection methods are difficult to implement. In order to improve the efficiency and accuracy of, the research project on online monitoring technology for wind turbine blades based on 5G drone inspection came into being.

2. The Applications Advantages of Drone Inspection Online Detection System

2.1 Traditional Inspection System

The current inspection of wind turbine blades adopts the principle of Unattended Operation.There are several disadvantages of current inspection of wind turbine blades.First, the inspection standards are not uniform. Manual inspection has uncontrollable human factors. Risk of manipulation still exists despite the use of drones. Second, operating costs of inspection is high. The operation and maintenance (O&M) vessels have high costs for going out to sea and labor. The number of fans to be inspected is large. repetitious work is large, take up a lot of time and manpower. Third, fault diagnosis is over-reliant on experience. Hidden dangers is accumulated, overhaul is passived, which affects

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power generation. Task systems are independent, not interconnected. Because of the interconnection, manual investigation is inefficient with long cycle.

2.2 Wind Turbine Blade Drone Inspection Online Detection System based on 5G +

At present, in domestic and international,application of acoustic emission technology see Fig. 1.is normal. The working principle is dealing data analysis of amplitude of wind turbine blade ,to find damaged part.

Segment detection is used on wind turbine blade, which is judged by acoustic emission feedback of each part. This technology is expensive with low detection efficiency, and need install sensors on wind turbine blade.

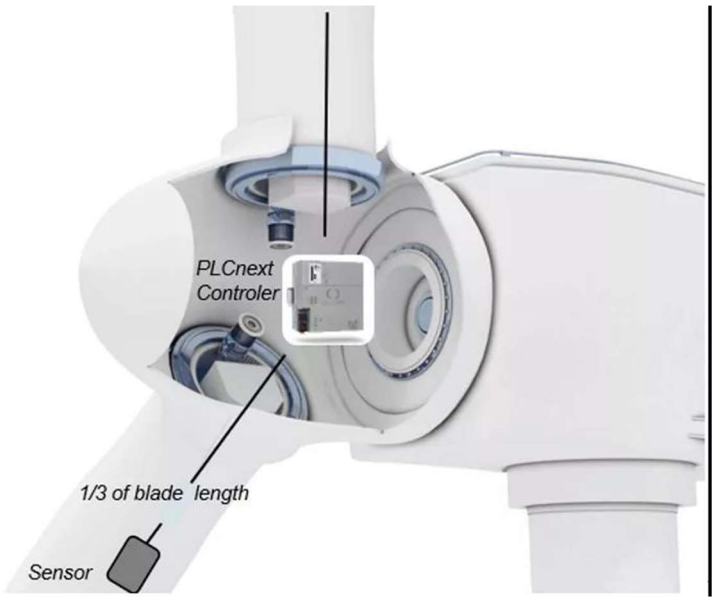

Fig. 1 acoustic emission technology

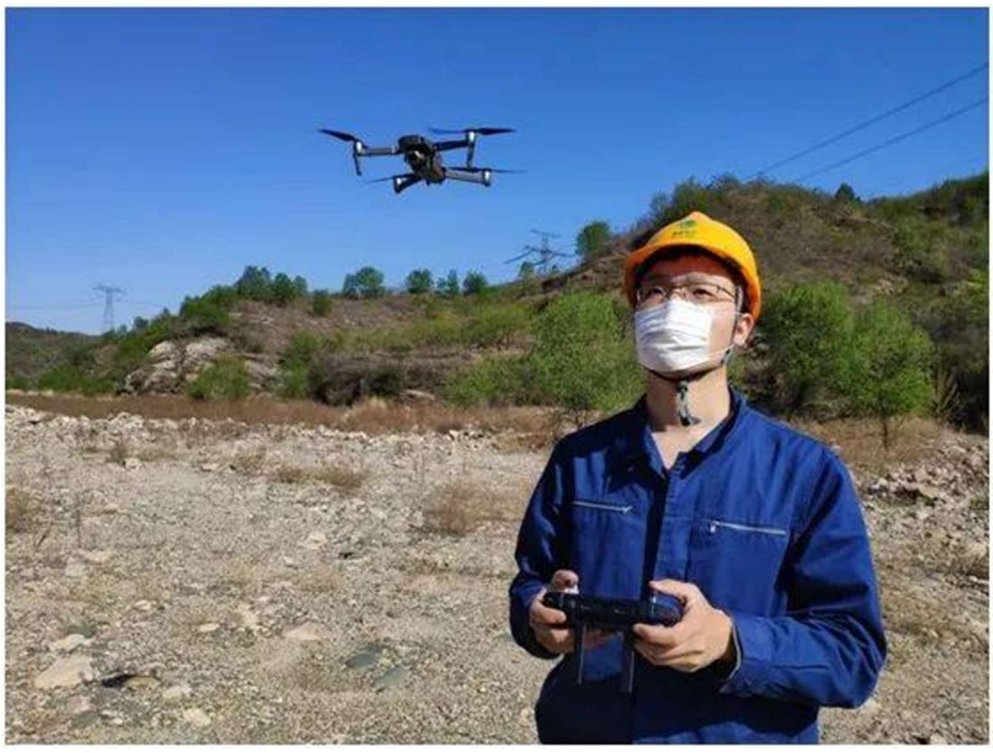

Fig. 2 pilot operate a drone shooting technique

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Many wind power station have used drone inspection on wind turbine blade, with pilot operate a drone shooting techniquesee Fig. 2.Drone scans wind turbine blade from top radar, start a comprehensive inspection automatically with certain flight path. Drone conducts real-time inspections ,information storage, compare. This method need shutdown wind turbine blade, settled in Y-shaped, pilot operate in close-range, data can not timely feedback, with high labor costs.

3. The Applications of Drone Inspection Online Detection System based on 5G +

3.1 The Research Content Construction

Fully automatic drone inspection through 5G communication, achieve patrol flight over the target area, no need to power off and lock. The drone complete automatic takeoff, land, charge, download data ,AI analyzes data, generate report automatically, auto push.see Fig. 3..This project aims to conduct in-depth research on online monitoring and fault warning technology for wind turbine blades based on 5G drone inspection which specifically includes: First, Developing a drone hardware system suitable for offshore wind farm environments, capable of image acquisition, data transmission, and data processing for turbine blades. Deploying drone cabinets and 5G drone systems at the substation. Second, Developing an AI algorithm for fault detection in wind turbine based on drone inspections. Utilizing the AI algorithm for fully automatic inspection of wind turbine blades, achieving automated acquisition and analysis of blade defects. Third, a 5G drone inspection system for wind turbine blades, real-time access the AI algorithm analysis results of drone inspections for wind turbine blade fault detection.

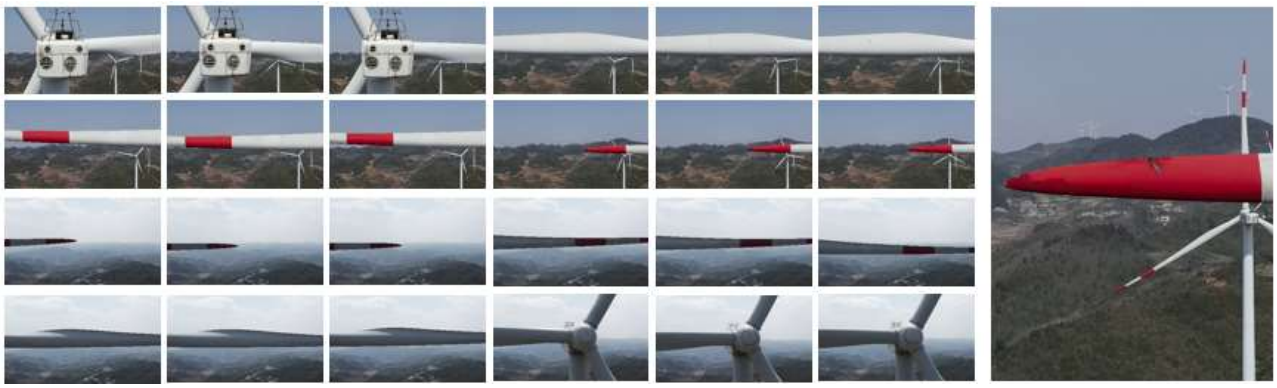

Fig. 3 fully automatic drone inspection

3.2 Principles of Technology

At the step-up substation, set drone cabinet and 5G drone system, establish inspection plan, inspection route, conducting fully automatic inspections on wind turbine blades, realize the application scenario of automated collection and analysis of blade defects, which can reduce the cost of manual inspection ,improve work efficiency .With 5G drone onboard computer,collect basic information of latitude and longitude, hub elevation, wind wheel radius, design and adjust automatic inspection flight route,utilize intelligent image recognition algorithm ,front-end drone shooting dynamic blade images, backend platform autonomously identifies defects, which include structural damage, blade lightning strike, crack, surface corrosion, gel coat peeling off.

4. Conclusion

In this project, drones can automatically inspect according to the planned route, without the need for a certified pilot, which greatly reduces the cost of manual and maintenance inspection. Which in traditional drone inspections, the inspector needs to manually operate the drone on-site. This project adopts an inspection method for fan blades without shutting down the machine, which has many

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advantages compared to traditional inspection methods that require the machine to stopped. First, there is no need to lock the machine, which greatly saves inspection time. Secondly, the detection only needs to reach the vicinity of the wind turbine, without any reporting or shutdown procedures, testing can begin once the wind is reached. Finally, with no power generation loss, the maximum saving loss is achieved, with time savings of more than 60% and cost savings of 50%, reducing the downtime of the generator by 2/3.In the case of unattended offshore substations, the deployment of the first offshore substation drone hangar is expected to achieve fully automated operation of hangar and automatic charging and swapping.The advancement of deploying drone hangars lies in facilitating drones to carry out inspection tasks. Finally, the flight distance of drones is shortened, making it efficient compared to traditional inspection methods.

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