WIND POWER GENERATION USING FUZZI LOGIC.

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Abstract

Renewable power generation systems have been recently getting more and more attention due to the cost competitiveness, and are environment friendly as compared to the fossil fuel and nuclear power generation. Besides the conventional renewable power generation such as hydro and pumping storage, wind power generation has been considered as the most cost effective with developing potential. The increase of unit size and enhancement of performance with higher loading factor and reliability have made wind power generation more attractive and its unit generation cost becomes very competitive as compared to traditional fossil generation. The main objective of most of the wind energy systems is to extract the maximum power available in the wind stream. However, the wind regime varies continuously and thus the system controllers should be updated to follow these variations. This paper is intended to apply fuzzy logic control techniques to overcome the effect of the wind speed variations on the parameters of the wind turbines and their controllers.

Keywords- Fuzzy Logic, MPPT-Maximum Power Point Tracking, Power Coefficient, Pitch Angle c. Define scientific Management?

. INTRODUCTION

According to EWEA estimation, 12% of the power demand of the whole world will be provided by wind generation for year 2020. At present, the total installation capacity of wind power generators has reached 31128 MW and the generation cost per kilowatt-hour has been reduced from 38 cents in 1982 to 4 cents in 2001. The wind power generators can be installed by grid connection with the electrical network. For the offshore islands or remote area which cannot be reached by bulk power system networks, the wind power generators can be operated standalone or integrated with diesel generators and photovoltaic (PV) panels to serve the power demand.

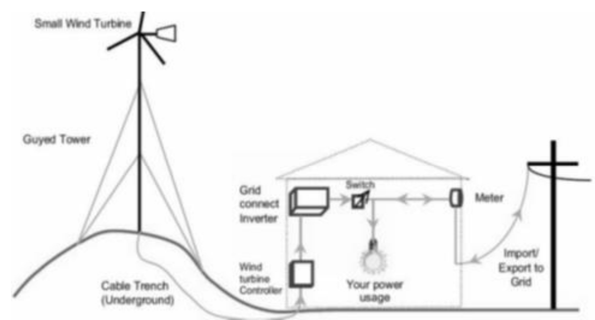


Fig.1 Grid connected wind turbine

The utilization of wind energy may be an attractive alternative in places such as offshore islands, where fuel is usually expensive and wind regimes are particularly favorable. The wind power is mainly generated by rotating the blade of wind turbines via the airflow to convert the wind energy into electrical energy. The wind power generation can be assumed to be varied with the wind speed. Dispersed power generation systems are expected as important electric power supply systems for the next generation. Wind power generation system (WPGS) is widely being introduced in the worldwide power utilities. The WPGS output power fluctuates due to wind speed variations. Hence, if a large number of wind power generators are connected to the grid system, their output can cause serious power quality problems, that is, frequency and voltage fluctuations may happen. In order to solve these problems, the smoothing control of wind power generator output is very important. In addition, Superconducting Magnet Energy Storage (SMES) is surely one of the key technologies to overcome these fluctuations. The SMES can compensate even small disturbances. With these points as background, this paper deals with.

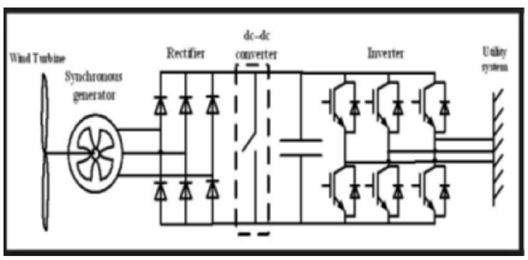


Fig.2Wind generator with electrical circuit

History of wind power

The first windmill used for the production of electricity was built in Scotland in July 1887 by Prof James Blyth of Anderson's College, Glasgow. Blyth's 10 m high, cloth-sailed wind turbine was installed in the garden of his holiday cottage at Marykirk in Kincardineshire and was used to charge accumulators developed by the Frenchman Camille Alphonse Faure, to power the lighting in the cottage. Thus making it the first house in the world to have its electricity supplied by wind power. Blyth offered the surplus electricity to the people of Marykirk for lighting the main street, however, they turned down the offer as they thought electricity was "the work of the devil. Although he later built a wind turbine to supply emergency power to the local Lunatic Asylum, Infirmary and Dispensary of Montrose the invention never really caught on as the technology was not considered to be economically viable. Across the Atlantic, in Cleveland, Ohio a larger and heavily engineered machine was designed and constructed in the winter of 1887-1888 by Charles F. Brush, this was built by his engineering company at his home and operated from 1886 until 1900.The Brush wind turbine had a rotor 17 m (56 foot) in diameter and was mounted on an 18 m (60 foot) tower. Although large by today's

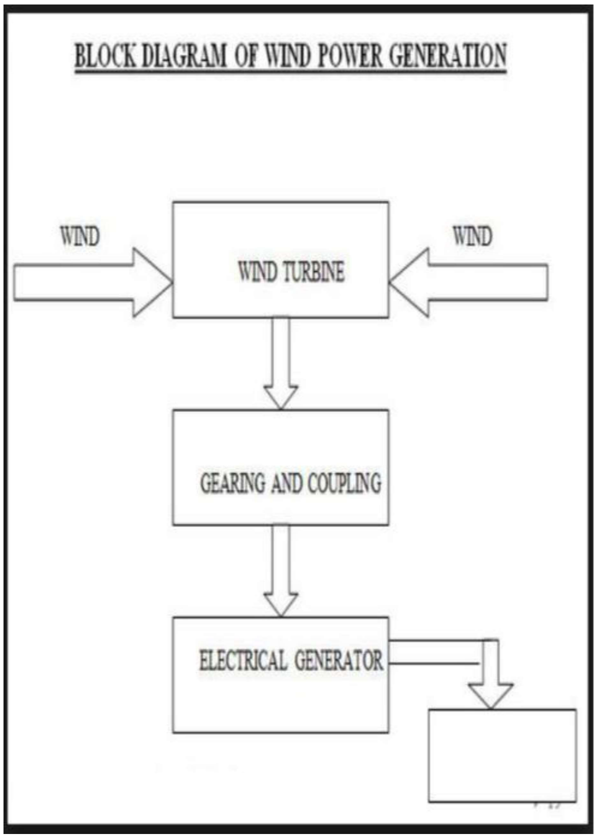
standards, the machine was only rated at 12 kW. The connected dynamo was used either to charge a bank of batteries or to operate up to 100 incandescent light bulbs, three arc lamps, and various motors in Brush's laboratory.

Fig.3 wind mill

Wind farms

A wind farm is a group of wind turbines in the same location used for production of electricity. A large wind farm may consist of several hundred individual wind turbines distributed over an extended area, but the land between the turbines may be used for agricultural or other purposes. A wind farm may also be located offshore. Almost all large wind turbines have the same design –

a horizontal axis wind turbine having an upwind rotor with three blades, attached to a nacelle on top of a tall tubular tower. In a wind farm, individual turbines are interconnected with a medium voltage (often 34.5 kV), power collection system and communications network. At a substation, this medium-voltage electric current is increased in voltage with a transformer for connection to the high voltage electric power transmission system.



How wind energy works

Fig.4 block diagram wind power generation

When wind blows past a turbine, the blades capture the energy and rotate. This rotation triggers an internal shaft to spin, which is connected to a gearbox increasing the speed of rotation, which is connect to a generator that ultimately produces electricity. Most commonly, wind turbines consist of a steel tubular tower, up to 325 feet, which supports both a "hub" securing wind turbine blades and the "nacelle" which houses the turbine's shaft, gearbox, generator and controls. A wind turbine is equipped with wind assessment equipment and will automatically rotate into the face of the wind, and angle or "pitch" its blades to optimize energy capture.

Applications of wind power generation

1) Wind powered vehicles
2) Wind/kite powered cargo ships
3) Wind powered sports
4) Wind powered water pumps
5) In agriculture area
6) In municipal waters
7) Home powering and lighting etc.

There are four distinct categories of wind power, these are:

- Small, non-grid connected
- Small, grid connected
- Large, non-grid connected
- Large, grid connected

II. FUZZY LOGIC

Fuzzy logic is a complex mathematical method that allows solving difficult simulated problems with many inputs and output variables. Fuzzy logic is able to give results in the form of recommendation for a specific interval of output state, so it is essential that this mathematical method is strictly distinguished from the more familiar logics, such as Boolean algebra. This paper contains a basic overview of the principles of fuzzy logic. Today control systems are usually described by mathematical models that follow the laws of physics, stochastic models or models which have emerged from mathematical logic. A general difficulty of such constructed model is how to move from a given problem to a proper mathematical model. Undoubtedly, today's advanced computer technology makes it possible; however, managing such systems is still too complex.

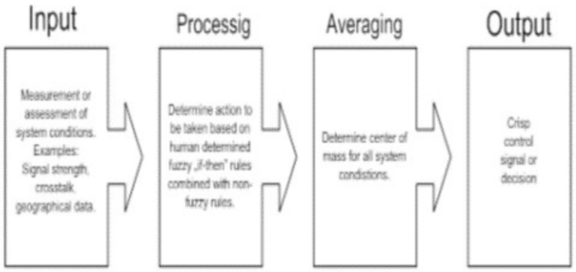


Fig.5 fuzzy logic control –analysis method

Usually fuzzy logic control system is created from four major elements presented on fig 10, fuzzification interface, fuzzy inference engine, fuzzy rule matrix and defuzzification interface

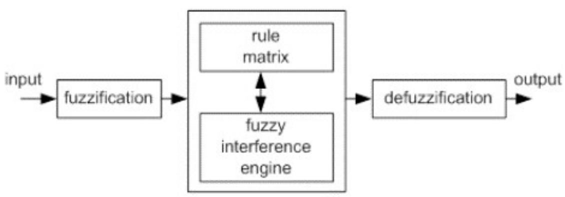


Fig.6 fuzzy logic controller

Use of fuzzy logic in wind power generation Control Wind energy generation has brought about many challenges to electrical power system engineers. The problems encountered in the electrical network comprising wind energy systems are due to the continuous variations in the wind regime. These variations may inflect undesirable fluctuation in the network and thus has limited the capacity of the wind energy systems which can be integrated with the network to a modest penetration factor. Various techniques have been proposed to cope with the variations in the wind speed to ensure high performance and steady output for the wind energy systems and hence contribute to allow for higher penetration factor. The effect of the variation in the wind speed may result in:

1- Change in the output voltage

2- Change in the output frequency

3- Change in the output power

4- Shift in the operating point (to track maximum power point on the operating curves)

The shift in the operating point occurs due to the variation in the wind turbine characteristics at different speed and other climate variations. These variations require that the parameters of the controller should be continuously updated to ensure that the wind turbine operating at the optimal point. To cope with the fact the wind speed change in unpredictable manner, it is proposed to use fuzzy logic controllers.

Capacity Factor (CF)

The fraction of the year the turbine generator is operating at rated (peak) power Capacity Factor = Average Output / Peak Output ≈ 30% CF is based on both the characteristics of the turbine and the Site characteristics (typically 0.3 or above for a good site).

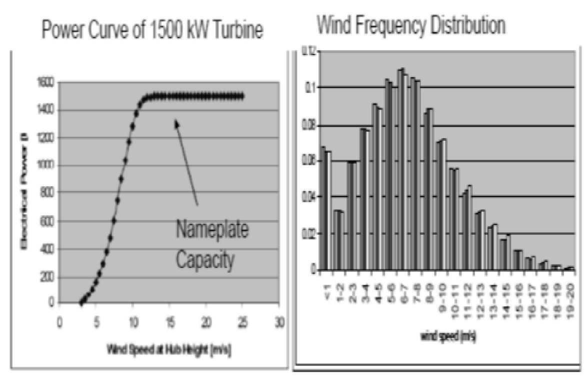


Fig.7 power curve and frequency distribution pattern

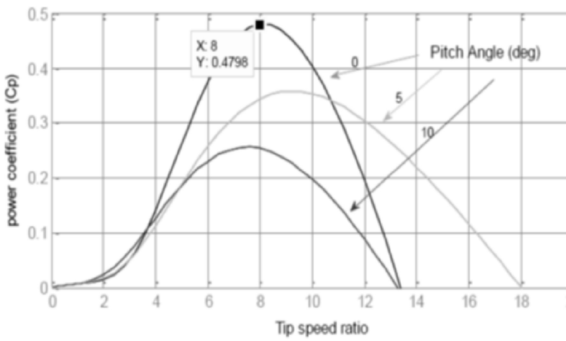


Fig. 8 power coefficient characteristics of wind turbine

MAXIMUM POWER TRACKING VIA FUZZY SYSTEMS

To overcome the previously mentioned uncertainties, we propose a fast and efficient fuzzy based MPPT technique. The proposed method is designed and Simulated for a Doubly-Fed Induction Generator (DFIG) variable-speed WECS, the traditional power tracking loop, which will be replaced by our proposed fuzzy systems, is shown. The block diagram of the proposed fuzzy based MPPT. The proposed method consists of two parts: First, the main fuzzy MPPT, and second, the fuzzy HCS adaptation. The main fuzzy MPPT replaces the traditional PSF method which is used for MPPT. The main fuzzy MPPT has one input, the measured rotor speed, while the output is the reference Q-axis current. traditional power tracking loop block diagram Fuzzy logic provides a convenient method for constructing a maximum power point tracking algorithm. An adaptive fuzzy logic technique for maximum power point tracking (MPPT) under different aerodynamic conditions is proposed. The adaptive feature allows the algorithm to be robust under wind turbine parameters uncertainties. The mechanical output power at a given wind speed is drastically affected by the turbine's tip speed ratio (TSR)

CONCLUSIONS

Paper gives the brief idea about wind generation and the proposed fuzzy logic MPPT technique which can extract maximum power from wind. And trends related to time and speed. The proposed method is completely independent of the properties of turbine and generator. This new MPPT doesn't need the wind speed measurements but the voltage and current load is measured. So, this method is not using any mechanical sensor which will result in reduced costs and increased reliability of the system. Moreover, this control strategy is comparatively easy, and has high practical value.

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