SIMULATION OF ANN BASED MPPT FED BLADELESS WIND POWER GENERATOR

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Abstract

The utilization of non conventional energy sources has been increasing from the last few years due to the advantages of low power interruptions, unlimited power supply and non pollutant power generation. The wind power generation is one of the clean energy whose utilization will be an effective solution for global warming and power interruptions. This paper presents the design and simulation of bladeless wind power generation utilizing wind as an energy source and generating power without the use of blades. As wind energy is not constant, an MPPT with artificial neural network has been designed to maintain the voltage and current of bladeless wind generator at its maximum peak values irrespective of weather conditions. The output of the wind generator has been fed to the single phase induction motor which can be used for water pumping applications. The design of the proposed wind generator and the results are simulated by using MATLAB simulink.

Keywords: Bladeless wind generator, artificial neural network, maximum power point tracking.

I. Introduction

Now days, there is huge increase in the global warming and power interruptions due to the depletion of fossil fuels which have been in use for power production. So the use of renewable energy sources is an effective solution for the above mentioned problems. The wind source is an efficient renewable energy source which provides an environmental friendly and clean power production. The conventional horizontal axis wind turbine has been in usage from the last few years for wind energy generation, but the conventional wind power generation suffers from some disadvantages like noise production, requirement of high wind speeds for rotation of blades, high maintenance[¹,IX]. To avoid these disadvantages and utilize the wind energy to the maximum extent, bladeless wind power generation is an excellent solution which involves low noise, power production at low wind speeds.
and low maintenance due to the absence of blades [III]. This bladeless wind generator involves the use of transducer for converting the oscillations of mast to electrical energy due to its low cost and maintenance compared to the crack and pinion mechanism[IV]. As the output of the transducer may not be directly used for running the induction motor, high gain boost converter has been chosen instead of conventional boots converter which suffers from the problems of high inductor ripple current, large duty cycle for boosting the voltage. Also as wind is not constant, to track and maintain the maximum power at all the conditions, maximum power point tracker has been used for tracking the output of the bladeless wind power generator. Perturb and observe maximum power point tracking (MPPT) has been chosen due to its simple in structure. Also artificial neural network fed MPPT has been designed for the proposed generator to enhance the performance of MPPT Tracker.

The paper is organized as follows; the first section deals with the explanation of proposed bladeless wind generator, the second section deals with proposed ANN fed MPPT controller, the third section deals with the software realization of the proposed system and the fourth part deals with the conclusion[II,VII,X].

II. Proposed bladeless wind power generator

The block diagram of the proposed bladeless wind power generator is shown in below figure. The proposed system consists of mast which oscillates when passed by the wind. The oscillation of the mast has been converted into the AC electrical energy with the use of AC transducer which generates AC electrical energy at the secondary windings with the movement of core of the transducer. The AC electrical energy has been converted into DC electrical energy with the use of single phase diode bridge rectifier. To boost up the output of diode bridge rectifier, high gain step up converter has been designed which steps up the voltage at lower duty cycle compared to the conventional boost converter. This DC output of the converter can be stored in the battery of which lithium ion battery has been chosen due to its advantages like low cost and less maintenance[V]. The output of the converter can be stored in the battery if the load is in OFF condition and can be discharged through the battery to the load when the wind source is not available[VI]. The DC output of the high gain converter can been converted into AC electrical energy with the use of single phase three level inverter. The AC output of the inverter can be used to run the single phase induction motor load for pumping water for irrigation applications.
2.1 Proposed ANN fed MPPT controller

- As it is known that wind is not constant and so to constant power may not be obtained from the system all the times. So a controller which tracks the maximum power has to be designed which is Perturb & observe maximum power point tracker.
- But at the same time fast and dynamic response is also required and so Artificial neural network fed MPPT controller which continuously tracks maximum power based on all the environmental conditions has been designed.

The voltage and current outputs from the solar panel are fed to the perturb and observe MPPT which continuously tracks the maximum power at all the weather conditions.
conditions and finds the maximum voltage that can be collected across the panel. The maximum or peak voltage is compared with the actual voltage of the solar panel and the error is fed to the artificial neural network to generate the processed error. The processed error is fed to the comparator to compare the processed error with the carrier signal and generates the duty cycle for the high gain boost converter.

An neural network consists of number of neurons and all the neurons will be arranged in the form of different layers like input layer, one or more hidden layer and output layer. Each layer contains number of neurons and the inputs at the input layer will be passed through the other layer through the synaptic weights, then all the input information will be summed up and passed through the activation function whose threshold value decides passing the information through the layers. The following figure shows the artificial neural network with two layers having signum tangent function as threshold function to generate the output.

The equations related to the above diagram can be given as

\[ X = \sum x_i W + b \]  \hspace{1cm} (1)
\[ Y = f(X) \]  \hspace{1cm} (2)

Fig. 3: Internal Structure of ANN
III. Software realization of the proposed wind generator

The proposed bladeless wind generator has been simulated using MATLAB simulink and the following are the results that are obtained from the wind generator. The below figure shows the displacement obtained from the mast of the bladeless wind generator whose value is 0.22m.

![Displacement of the mast](image1.png)

Fig. 4: Displacement of the mast

The displacement of the mast is fed to the transducer which generates AC electrical whose waveform is shown in below figure.

![output voltage of transducer](image2.png)

Fig. 5: output voltage of transducer

The output from the diode bridge rectifier is fed to the high gain boost converter whose voltage waveform is shown in below figure for different wind speeds.
The output from the diode bridge rectifier is fed to the high gain boost converter whose current waveform is shown in below figure.

The output from high gain boost converter is fed to three level inverter whose voltage and current waveform is shown in below figure.
The output from the three level inverter is fed to the single phase induction motor whose speed and torque waveform is shown in below figure.

![Fig. 9: speed and torque waveforms of single phase induction motor](image)

**IV. Conclusions**

The design and simulation of bladeless wind power generator has been presented in this paper. As wind energy is not constant, an MPPT with artificial neural network has been designed to maintain the voltage and current of bladeless wind generator at its maximum peak values irrespective of weather conditions. The output of the wind generator has been fed to the single phase induction motor which can be used for water pumping applications. The design of the proposed wind generator and the results are simulated by using MATLAB simulink.

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