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DC BUS CONTROL OF VARAIBLE SPEED WIND TURBINE USING A BUCK BOOST CONVERTER

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ABSTRACT:

The fossil fuels are gradually decreasing now a days, alternatively to avoid this we are using electricity. And again to generate the electricity we are using fossil fuels which is the major defect to the our environment it release a lot of pollutions. To reduce this, the entire world decided to use the renewable energy to generate electricity. Among those renewable energy source the Wind Energy is one of the is the major generation path for electricity. But, it depends on the wind blades. If the wind blades rotates fast more wind power is produced and vice-versa. A sudden power fluctuations in the wind power tend to damage the generator . To avoid this, problem we use the controllers. The controller called Buck-Boost controller is used to achieve the maximum control of wind turbine driven permanent magnet synchronous generator(PMSG). The turbine speed settles down on the maximum power point by the proposed MPPT control method. The energy efficiency is increased by 24%.

Keywords: fuzzy logic controller ,pitch angle ,robust,buck boost, aerodyanamic drag

INTRODUCTION:

For industrial applications like variable-speed drives and to address problems with grid power quality such utility voltage sags and swells, AC-AC power converters are frequently employed. The output ac voltage's amplitude, phase, and frequency can be easily controlled using indirect ac-dc-ac converters with a constant dc-link. They do, however, feature two-stage power conversion (ac to dc and dc to ac), and at the dc-link, they need a sizable, short-lived electrolytic capacitor. On the other hand, single-stage ac power conversion can be achieved without the dc-link capacitor using direct PWM ac-ac converters and matrix converters (MCs) . The majority of the energy needed in the current scenario is provided by wind energy. Every year, the capacity of the world's wind farms grows by about 45%.

Countries are compelled to focus on renewable energy sources like wind power by the UN's recently enacted environmental laws. By employing wind energy, the European Union hopes to fulfil over 40% of its whole demand. By 2020, the range's total installed wind capacity may be close to 1.3 million MW. This growth eventually opened the door for the turbine framework's increase in size. The escalating fatigue pressures on the structural components would drive the wind turbines to increase in size. The wind turbine's structural lifetime would be impacted by both periodic and non-periodic loads. As a result, expanding the size of the turbine necessitates intense monitoring and management. Pitch control, torque control, and yaw angle control are the three basic categories into which the control of wind turbines can be placed. Based on the reference torque that the wind turbine generators are expected to produce, the torque control monitors and sends control signals to the generator. The electrical circuits in the wind turbine receive their reference from the torque controller . By preventing the electrical runaway of the generator, this controller is crucial to the turbine's smooth operation when a strong wind gust hits the rotor surface.

To manage the pitch angle of a wind turbine, a number of writers have put forth several control algorithms .A straightforward PI for regulating a wind turbine's pitch angle has been covered by several writers . The adaptive fuzzy-PID controller by K. Vijaya Lakshmi has been presented to adjust the pitch angle. For the purpose of controlling the speed of induction motor drive and wind energy conversion systems (WECS), Naik has presented an intelligent 3-level fuzzy controller. For maximal power-point tracking for WECS, Koutroulis has proposed a fuzzy-based controller. The transient features, robustness to variations in wind speed, and steady-state have not been examined, however, as all of these research investigations are focused on maximising power production for WECS. Distributed generation (DG) describes the installation and operation of generating units close to customers. The high operational costs, resource depletion, and unfavourable environmental effects of conventional power generation systems are effectively offset by them.

The production of wind energy is increasing globally, on average, by 20%. The use of wind energy often minimises the impact of global warming, carbon emissions, and the dependence on fossil fuels. As a result, it has evolved into a trendy, competitive renewable energy. The adoption of renewable energy sources has been prompted by all these causes, and by the end of 2016, there were around 341,320 wind turbines operating worldwide

The high WES penetration causes the power system to have a number of problems. When a single three-phase short circuit defect occurs in an instant and is quickly resolved on the network, it increases the WES's speed and creates instability. The pitch angle controller is a typical sort of technique used to increase the rotor stability of WES. It adjusts the wind turbine's pitch angle throughout the fault in order to control the mechanical toque. The development of renewable energy sources has gotten attention recently due to worries about environmental contamination caused by the burning of fossil fuels. One of the most viable options for producing green power without emissions or air pollution is the use of wind energy. Although asynchronous generators serve a crucial and important function in electrical systems, using them in wind turbines can be challenging due to the changing nature of wind speed. As a result, induction generators are used as the producing unit for wind turbines rather than asynchronous generators. The induction generator offers various benefits, including minimal maintenance costs, variable speed operation, and power network connectivity. In recent years, wind energy has experienced significant growth and is now the most competitive renewable

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energy source. However, wind power is not yet economically viable. As a result, for wind energy to successfully enter the electrical market, new technology development will be essential. Advanced control system implementation is thought to be a potential strategy for increasing wind energy conversion and lowering wind energy costs. The primary goals of controlling wind turbines are to maximise the conversion of wind energy and to lessen the dynamic loads placed on the plant's mechanical construction. Dynamic loads, which primarily dictate the design of mechanical components and, as a result, their cost, have little to no impact on the lifetime of wind turbines. In this study, a control system layout that maximises the energy conversion rate while minimising the mechanical loads placed on the turbine drive train during the whole operating region is provided. The Takagi-Sugeno multiple linear model serves as the foundation for the controller synthesis.

Fuzzy logic controller using pitch angle

The proposed fuzzy logic controller is put into practise using with two input signals and one output signal. With regard to input signal, initial signal derived from active power deviation creation of a generator from its rated value, which is regarded as 1 per unit, referred to as an error signal. Consequently, optimistic In contrast to negatives, values imply proper operation.

excessive energy production at wind speeds exceeding the recommended limit. As a result, the controller should modify the pitch angle degree It should be raised from its starting value. When things are normal, pitch the adjustment for angle degree is set at zero, which signifies that the greatest amount of mechanical energy that can be converted from wind increasing pitch angle from zero degrees while using energy the blades with the wind angle attached

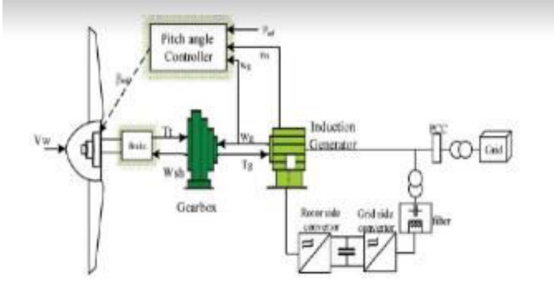

fig 1: wind turbine pitch control system with fuzzy adaptive PID

A pitch angle with fuzzy logic built in that is intended to control a wind turbine's output when the wind speed is higher than expected in its assessed value, speed. The gains that are used to correct errors Fuzzy logic controller with selected input signal to scale 0.5 and 10 for the wind speed simulated wind speed, which is rated. The output signal of fuzzy logic was defined by a wind turbine at 12 m/s. Gain is multiplied by 100 to rescale the controller. pitch velocity is physically limited to 10 o/s when instructed by the actuator up to. The rate limiter setting of 6 o/s has been used in this work been modified to obtain using new, contemporary servo systems a realistic answer that stems from the practical limitations Blade rotation is actuated by a servo motor.

The system was created using the fuzzy logic control method. Fuzzy control is essentially an adaptive control system. Two fuzzy input variables were chosen to represent error and error change. The Mamdani is used as a rule base and fuzzy inference system. A defuzzification method is centroid. The output variable is the size of the angle change. Block

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diagram for fuzzy logic controlling mechanism

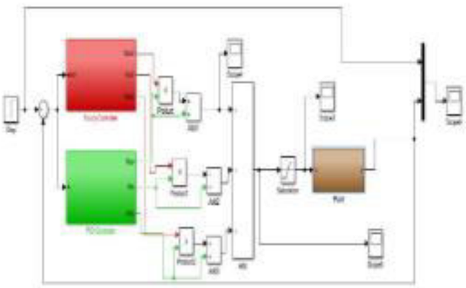


Fig 2:The block diagram of the fuzzy pitch angle controller.

Typically, pitch angle controllers are used to manage wind. wind speed exceeds the rated wind speed, the turbine will produce more power. Along with this, a pitch angle controller is also used to the system's transitory behaviour should be improved. Its goal is to the investigation of the WES's improvement during transient fault state. as a result, standard pitch angle controller It responds to a change in wind speed by altering the pitch-angle The rated speed mentioned above was not demonstrated. Rotor speed-pitch angle control is used to improve depicts the WES's transient stability. The carts between the threshold rotor speed (r) and the measured speed (r)fast The fuzzy logic controller processes to determine adjusts the pitch angle to control the rotor speed as necessary. Generally speaking, pitch angle controller

Fuzzy logic controller using robust

Variable speed variable pitch technology becomes the preferred structure for medium and large-scale wind plants to increase the produced energy and perform an efficient conversion of the aerodynamic power with low cost. Furthermore, the variable operation mode can help to reduce the impact of the transient behaviours of wind energy and subsequent stress of mechanical component. As depicted in Fig. 1, the wind system operates in three main regions with different objectives depending on wind speed range. Region 1 is the control region where the wind velocity is not sufficient to start-up. Thus, the torque is

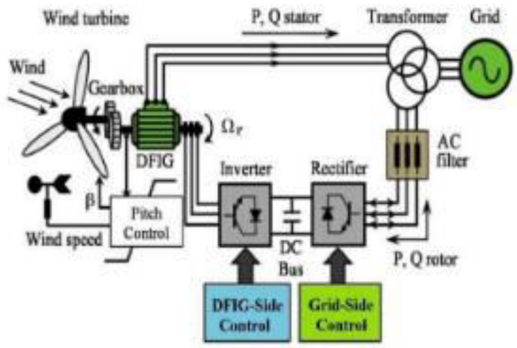
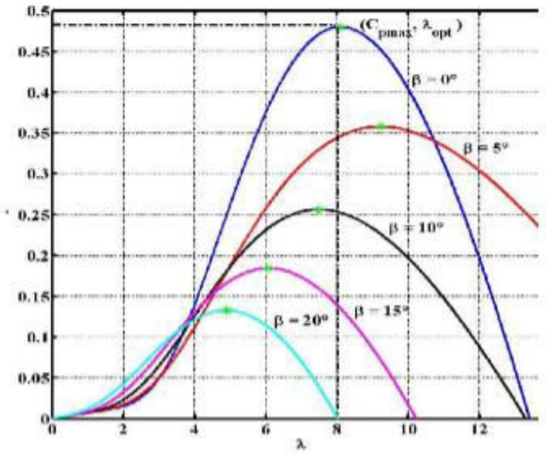


Fig 3 : Robust sliding-Backstepping mode control of a wind system based on the DFIG generator

zero and no power is captured. In region 2, the control objective is optimizing the power extraction. Here, the rotational speed is adjusted to keep the power coefficient at its optimal value and the pitch angle is held constant. The system operates in this partial load region as long as the wind speed does not exceed its rated value which corresponds the rated generating tempo. In Region 3, the pitch angle management is carried out to maintain the rated quantity when the wind speed is above it.Power by maintaining the generator's speed at its default setting. The extracted power will be reduced as the blade angle increases Regions 1/2 and 2/3 of the linear transition are connect these three key areas without difficulty

More and more large-scale wind systems are being created utilising pitch control technologies. This method is typically used to maintain the harvested wind power within the permitted nominal range. The service life of the wind turbine may be shortened and maintenance costs may rise with the use of such a system's ability to protect the blades from structural wind load damage. Furthermore, it can smooth out power oscillations to improve power quality above nominal conditions and respond more quickly than previous strategies (Yin et al., 2015). The energy harvested using this method is 8.2% greater than for the passive stall idea, and it will result in 1.6% more power than the passive stall concept, claim



Typical CP versus (β, λ) curve.

Based on fuzzy set theory and related concepts, fuzzy logic control is one of the most effective control strategies.

The fuzzy logic approach is appropriate for controlling wind turbines with sophisticated nonlinear models and parameters change. Figure 5 illustrates a fuzzy controller that employs perturbation and observation to track the ideal Without any prior knowledge of wind turbine characteristics, pitch angle Three crucial steps make up the fuzzy logic controller's basic structure: fuzzing, making decisions Unit and Unit of Defuzzification. Error and rate of change of error are chosen as the inputs for the fuzzification. and the reference pitch angle is the output. Each sample instant, say k, involves the calculation of the two input variables. where the generated and reference power at are, respectively, Pref(k) and Pg(k).

AERODYNAMIC DRAG AND DESIGN

Theoretically, the speed of an airborne moveable turbine produces a resistance force that acts on it. of the air that is forcing rotating blades. The It is possible to think about the lift and drag principles as an abstraction of the windmill.

When a rotor generates aerodynamic forces, turns [3]. the lift and drag created by aerodynamics are converted to an usable push (T) in the desired direction by the generator and reaction to rotation Forces (R). The aircraft's aerodynamic behaviour was a force's description of a wind turbine rotational turbine specifications. They include I Rotor bladetilt, Rotor blade speed, and Rotor blade angle of pitch turbine size and form (v) area whether the rotor geometry of the turbine

BUCK-BOOST CONVETER

A typical non-inverting buck-boost converter with four low impedance switches serves as the employed converter. It is possible to write the input equivalent resistance as The being the duty cycle, the clock period, and the inductance in the input buck-boost stage [1]. It's important to remember that, given a clock frequency, changing the The harvester noticed resistance after adjusting the duty cycle.

The output schottky diode is changed out for an ideal (active) diode, which lowers the voltage drop and uses less energy overall. The active diode control circuit drives a MOSFET switch to realise the perfect diode.

Squirrel-Cage Induction Generator (SCIG) Modeling Modeling requires the machine's parameters.

a SCIG. Since these values are not readily available and need to be obtained through extra testing, the corresponding double-cage induction generator parameters are used in this paper. The computer data are provided in.

The induction generator is operating in selfexcited mode in this paper, which raises questions about its ability to generate voltage at various rotational speeds. However, short-shunt excitation capacitor architecture is utilised to increase the operation speed range and to locally supply the generator with the necessary reactive power as shown in the singlephase equivalent circuit of the SCIG in FIG.

Conclusion

The wind energy system employed a unique control strategy. A control strategy was created to maintain the maximum converter efficiency and getting the most power ssible.The usage of PWM regulating techniques is proven to improve constant dc voltage. The proposed control approach was validated by simulation and experimental findings. As a result, non-traditional energy sources have significantly increased the domain's usefulness and efficiency.

a use for regulated power electronics in real life. This research studies the entire system instead of splitting it at the DC-link, unlike the majority of prior publications. The impact on the mechanical components of the wind turbine and the behaviour of the grid frequency can therefore be researched. It is demonstrated that if synthetic inertia depends on the turbines rated power, the grid-supporting behaviour is not available at all working points of the wind turbine. If, on the other hand, the synthetic inertia is based on the power that the turbine is producing at the moment of a frequency drop, more power can be delivered at any wind speed. Retroactive effects can be noticed in the fore-aft direction by increasing 5% of the current power for 10 seconds.

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