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Control Of Small Wind Turbines In High Wind Speed Areas

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Abstract: **The strategy developed also addresses a system start-up problem that prevents the generator from accelerating to an uncontrollable operating point in high wind speed conditions. This is accomplished with voltage and current sensors only, and does not require direct measurements of wind speed or generator. The proposed method is applied to a small wind turbine system consisting of a permanent magnet synchronous generator (PMSG) and a simple transducer topology. Experimental and simulation results are included to demonstrate the performance of the proposed method. The document also shows the limitations of using stator driving force to estimate rotor speed in a PMSG connected to a rectifier, due to large d-axis current at high load.**

Keywords: **Synchronous Generator; Rectifier; Boost Converter; H-Bridge Inverter;**

INTRODUCTION:

An inherent disadvantage of wind and photovoltaic systems is their intermittent nature making them unreliable. However, by combining these two intermittent sources and integrating maximum power point tracking (MPPT) algorithms, the efficiency and reliability of the system's power transmission can be greatly improved [1]. The integration of renewable energy sources and energy storage systems has been one of the new directions in electronic energy technology. The increasing number of renewable energy sources and distributed generators require new strategies for their operations in order to maintain or improve the stability and quality of electricity supply. A mixture of multiple renewable resources has prevailed through a common DC bus of the transducer due to the convenience of integrated monitoring and control and consistency in the structure of control units compared to the common AC type. The dynamic behaviour of the wind and the solar system is analyzed. A model of the wind turbine system has been developed and compared to a real system. Various methodologies for optimal design or unit size. Most applications are intended for autonomous operation, where the main control goal is to balance local loads. Some grid-connected systems consider the grid only a backup method to be used when there is not an adequate supply of renewable resources. Originally designed to meet local load requirements with potential power loss for a specified period. Focused on providing sustainable energy for your loads, these hybrid systems pay little attention to the quality or flexibility of the energy delivered to the grid [2]. However, from a utility perspective, a hybrid system with less volatile energy injection or the ability to flexibly regulate its power is more desirable. To effectively achieve these modes of operation, two modified technologies are applied; Modified battery charger / discharger idle control strategy and medium power technology with a low pass filter. The concept and principle of the hybrid system and its supervisory control are described. Classic maximum power monitoring technologies are applied in the control of PV panels and wind turbines. The dynamic modeling and simulation was based on the Computer Aided Design for Power Transient Current Electromagnetic Systems (PSCAD / EMTDC), Power System Transient Analysis Software [3]. The program was based on Dommel's algorithm, which was specially developed to simulate high-voltage direct current systems that are efficient for transient simulation of power systems under electronic power control.

RELATED STUDY:

Wind turbines are most commonly described in terms of power rating, also known as power rating or rated capacity. Power rating is the instantaneous output of the turbine (measured in watts) at a specific wind speed (called the rated speed) at a standard temperature and height. Small wind turbines have a nominal power rating of 1,000 to 100,000 watts. One thousand watts equals one kilowatt. Large wind turbines include all those that weigh more than 100 kilowatts. Although residential wind turbines and their energy source, wind, have some disadvantages, wind power is an abundant and renewable resource. Unlike oil and natural gas, the winds will not end for the foreseeable future [4]. Small-scale wind power can also help reduce our dependence on low and expensive oil supplies, if electricity generated by the wind is used to power electric or hybrid, electric or electric cars and cars, which would replace gasoline, which would be refined from petroleum. Ultimately, the wind could also reduce our dependence on nuclear power. A future powered by solar and wind energy may be subject to lower inflation. This does not mean that wind power will be free from price increases. While the fuel itself (the wind) is free, the price of wind generators is likely to increase [5]. This is because it requires energy to extract and process minerals to produce the steel and copper needed for wind turbines and towers. It also requires energy to manufacture, charge, and install turbines and towers. As the prices of conventional fuels and raw materials rise, so will the cost of wind power. Another advantage of wind-generated electricity is that it uses existing infrastructure, power grid and technologies [6]. The transition to wind energy could go smoothly.

METHODOLOGY:

The electricity needs of a single home can be met by small wind turbines with a capacity of between 1 and 50 kilowatts (kW). On the other hand, some small PV modules can also meet the same electricity needs. In summary, given the very good wind and solar resources, small wind systems have some advantages over solar photovoltaic systems: the initial investment is less and the energy production is at least equal to that of solar photovoltaic systems. The costs of a solar photovoltaic system are often 20% 50% higher than those required for a wind system with equivalent production in terms of electricity. But this is really very abstract thinking. Wind energy systems rely more on wind resources than solar energy solutions, and these systems allow for a wide range of applications and have fewer site restrictions. The performance of wind systems is highly dependent on wind speed. Places with low or medium wind speeds produce very expensive electricity. Also, wind systems are not used in urban and suburban environments (for safety, obstruction and aesthetic reasons). Mitigate power fluctuations in the solar and wind power system, or change power generation to regulate power transmitted to the grid. The battery transformer connects the battery terminal bus and the common DC bus, whose voltage levels are mutually different, and controls the flow of current between the carriers. In some applications, the battery storage has been connected directly to a common DC bus without the use of an adapter. This configuration requires more battery cells than using a DC adapter, and therefore can reduce system economics.

IMPLEMENTATION:

A horizontal axis wind turbine consists of three main parts: (1) a rotor, (2) an alternator, and (3) a tail. As mentioned in Chapter 3, the rotor consists of blades attached to a central shaft covered by a head cone to improve aerodynamics. Most wind turbines have three blades. This entire group rotates when the wind passes through the blades, hence the name "rotor". In many small wind turbines, the rotor is attached to a shaft connected to a generator, which is a device that produces AC electricity. The name implies that, in HAWT, the rotor is oriented horizontally, that is, parallel to the ground. As a result, the rotor and generator rotate at the same speed. Although nearly all modern residential wind machines are direct-propelled, some small wind turbines have gearboxes. It is located between turbine rotor and generator rotor. Gearboxes increase the speed at which the generator rotates, which increases the output of the generator. This allows the generator to be much smaller and also keeps the rotor speed (blade speed) safe and quiet. These turbines are known as gear driven turbines. Another important component of most horizontal axis wind machines is the tail. The tail usually consists of an arm and a paddle. The tail lever connects the tail feather to the turbine body.

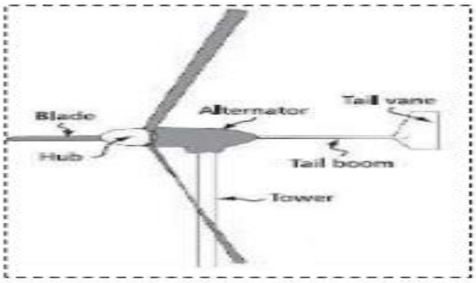

Fig. 4.1 Anatomy of a Wind Generator

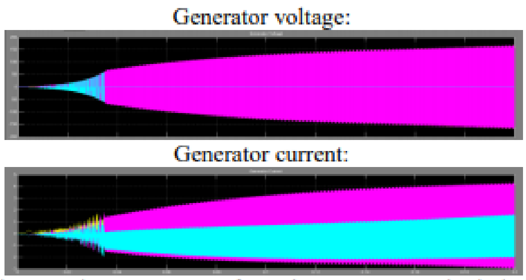

Fig. 4.2 Voltage and current output from the generator on both d and q axis.

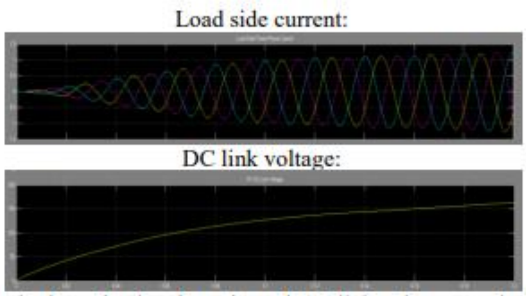

Fig. 4.3 phase load obtained on the d and q axis, and DC link voltage required for controlling method.

CONCLUSION:

Simulink is a multi-domain simulation and model-based design environment for compact and dynamic systems. Provides an interactive graphical environment and a customizable set of block libraries that allow us to design, simulate, implement, and test a variety of changing systems over time, including communications, controls, signal processing, video processing, and image processing. . The small wind turbine control strategy during high wind speed regions is implemented in both simulations and also as an experimental model. The simulation results for the three-phase network connections are shown above in Figures 4 and 5. This control method is effective only for operation associated with the three-phase network and less efficient for single-phase operation.

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