MATLAB SIMULATING MODEL OF HYDRID POWER GENERATION FROM NATURAL RESOURCES FOR HIGHWAY

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Abstract

Renewable energy has become a popular alternative to electrical energy, where traditional methodsof generating electricity are unwise. In the past few years, solar power generation and wind power technology have been greatly expanded. This papers provides the review of the modeling and simulation of the stand-alone hybrid power generation system driven by two renewable energy sources (namely wind and solar) under different conditions using MATLAB. The proposed system includes the hybrid energy system that combines solar panels and wind generators instead of traditional power supplies such as thermal power and hydro power. The two systems are combined to run in parallel, the common bus collects the total energy from the wind, and the photovoltaic system usesit for the load and changes with the load.

Keyword: *Battery, Controller, Hybrid, Photovoltaic, Renewable, Wind*

Introduction:

The increase in the use of renewable energy resources have greatly helped to reduce the dependence on fossil- based energy. In order to maximize the use of renewable energy, the combined system of wind energy and solar photovoltaic (PV) generators is introduced into a unified distributed power generation unit. Integrating these two systems in a geographical area can provide additional benefits such as optimal use of land and capital resources, mechanical damping from local wind turbines to low inertia stand-alone solar PV generators, and improved overall power generation reliability. For both systems, changes in meteorological conditions (solar insolation and average annual wind condition) are important. The performance of photovoltaic and wind energy systems largely depends on the local climatic conditions. The power generated by the PV system is highly dependent on weather conditions.

In order to reduce the conversion losses from the source tothe load and improve energy efficiency, an independent method has been proposed, which has become an important research direction. Using MATLAB/SIMULINK software tools to simulate all energy sources to analyzetheir behavior. The simulation results prove the feasibilityand reliability of the system. In this paper, an isolated hybrid PV-wind model including PV, wind turbine and AC load is constructed.

Literature Survey:

"Review Paper on Hybrid Solar-Wind Power Generator" Vaibhav J. Babrekar (2017)

Today's energy is the need of the 21st century. Therefore, because renewable energy is easily available and cost free, it is used in large quantities. But these independent forms of energy have disadvantages such as unpredictability and always available. This can be overcome by hybrid energy systems. They basically consist of combination of renewable energy resources. They can provide effective response to voltage and frequency fluctuations, harmonic measurement and power problems in independent systems. Hybrid power systems provides through proper design, advanced rapid response, good optimization and control feasibility,

can reduce complexity, maintain the lowest unit cost, and energy fluctuation due to DPSP.

"Simulation and Control of Solar Wind Hybrid Renewable Power System" Ahmed Saidi (2017)

Power generation based entirely on sun and wind is considered an alternative source of green power generation, which can alleviate the problems of power demand. This paper describes, stand-alone hybrid power generation system consisting of solar and permanent magnet synchronous generator (PMSG), wind power and AC load. A supervisory control unit is designed to perform Maximum Power Point Tracking (MPPT) has been introduced to maximize the ability to simultaneously collect energy from the entire power generation process under different climatic conditions. According to the power generation and load requirement of each energy source, two types of contingencies are considered and classified. In PV system Perturb & Observe (P&O) algorithm is used as control logic for the Maximum Power

Point Tracking (MPPT) controller and Hill Climb Search (HCS) algorithm is used as MPPT control logic for the Wind power system in order to maximizing the power generated. The Fuzzy logic control scheme of the inverter aims to keep the load voltage and frequency of the AC power supply at a constant level, regardless of changes in natural conditions and loads. The Simulink model of the proposed hybrid system is developed in MATLAB. Thesystem has a MPPT controlled boost converter and a voltage-regulating inverter, which can be used for stand- alone application.

"Simulation of Grid Supported PV/Wind/Battery Hybrid System with Variable Load" Shaheer Zaffar Tak (2018)

Compared to old-fashioned power systems, hybrid power systems composed of more than one type of energy, especially renewable energy, are becoming more and more feasible. From the last decade, the growth of clean and renewable power generation in the power industry has accelerated due to the following reasons: increase environmental awareness and technological advancement of storage devices. Therefore, people have paid extensive attention to this field, and several models have been proposed in recent years to reliably and effectively absorb intermittent renewable energy in the power system to reduce the burden on the utility grid. This paper describes the simulation of a wind/solar/battery hybrid system using the utility grid as a back-up support for variable loads using the simulink tool. Wind turbines and photovoltaic (PV) array are used as primary energy suppliers for the load. In order to meet power and demand, a neuro-fuzzy controller is used to complete the grid connection and battery switching.

"Modelling and Simulation of the hybrid system PVWind with MATLAB/SIMULINK" Mohamed Yassine Allani (2018)

This paper proposes a hybrid power system connected to DC load. The hybrid power system consists of a photovoltaic generator, a wind generator composed of a turbine and permanent magnet synchronous generator, a three-phase uncontrolled rectifier converter and DC-DC boost power converter dedicated for each source and controlled by the command based on the method of Perturb and Observe. The purpose of this control is to extract the maximum power of each power supply under different input parameter changes from the proposed system. This system uses MATLAB/SIMULINK environment for modulation.

"Modeling and Simulation of gird connected hybrid power system integrated with solar PV/Wind and controlled by Voltage Regulator"

Vandana Chaoudhary (2019)

Due to the increase in prices of conventional source of energy, we pay attention to the approach of non-convectional source of energy. This paper proposes a grid-connected hybrid solar and wind energy system. The hybrid solar and wind system consists of wind energy, solar energy and ac loads. In the solar DC output system, it is boosted by boost converter. MPPT technology is used to maximize the output of the solar system. The wind sub-system consists of a permanent magnet synchronous generator, a rectifier and a boost converter to achieve maximum output. Voltage regulator is used to control hybrid solar-wind system. This paper explains the modeling of hybrid photovoltaic and wind turbine system controlled by a voltage regulator. In

order to improve the reliability and reduce reliance on a single source, we connected these two systems together.

"A Hybrid Wind-Photovoltaic Generation System Modeling and Performance Evaluation" Amr Ahmed A. Radwan (2019)

This paper proposes a novel power electronic converter topology that is used to interconnect large wind turbines and solar photovoltaic (PV) arrays to the utility grid. Back-to-back voltage source converters are used as energy processing interfaces, and since dc-dc converters are not used, system efficiency is maximized. The machine-side converter is used to realize the maximum power point tracking of the wind turbine, and the grid-side converter is used to maximize the PV power and inject the captured wind and power generated by the PV into the utility grid. The use of vector control strategy can realize the regulation of the power converter. The MATLAB/SIMULINK platform is used to evaluate the system performance, where time-domain simulation showsthe effectiveness of the proposed system.

"Hybrid Solar PV-Wind Generation System Coordination Control and Optimization of Battery Energy Storage System for Rural Electrification"Irene Masenge (2020)

The scarcity of power grids in rural areas inevitably makes renewable energy sources (RESs) such as solar photovoltaic (PV) and wind energy, produce hybrid power. These RESsprovide reliable power, and a large-scale energy storage system (ESS) must be deployed to meet the loss requirements that require high investment costs. In order to reduce the ESS requirement, the best hybrid system design is essential. By optimizing the battery ESS, the system cost can be effectively reduced. This paper presents the modeling, coordination, control and optimal BESS of a hybrid solar PV-wind power generation system using Mixed Integer Linear Programming (MILP). The purpose of this scheme is to maintain the power flow between the DC-AC bus by ensuring a constant voltage and system frequency at the Point of Common Coupling (PCC). The simulation results obtained on MATLAB/SIMULINK confirm the excellent performance of the proposed system.

Proposed System:

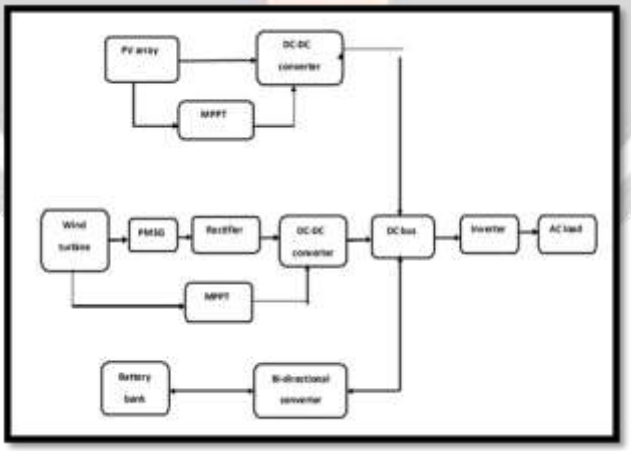

Fig 1: Block diagram of the proposed system

As shown in Fig 1, the entire hybrid system includes PV and wind systems photovoltaic systems are powered by the large amount of solar energy available in nature. PV modules and maximum power point tracking system and DC-DC converter comprises a photovoltaic energy system. The light incident on the PV cell is converted into electrical energy by the solar collector. The maximum power point tracking system with Perturb & Observe algorithm is used, which extracts the maximum possible power from the PV module. The dc-dc converter changes the voltage level to match the electrical appliances provided by the system.

Wind turbine, Permanent magnet synchronous generator, rectifier, dc-dc converter and MPPT are included in the wind energy system. Wind turbines are used to convert wind energy into rotating mechanical energy. The mechanical energy available on the turbine shaft is converted into electrical energy through a permanent magnet synchronous generator (PMSG). The AC output of the PMSG is rectified into DC output by the rectifier and provided to a DC-DC converter. In order to enforce the maximum power of the wind system, we use MPPT.

A bi-directional converter can provide current in both directions. When there is surplus power the bi-directional converter is used to charge the battery, and when there is power shortage, the energy stored by the battery is discharged to the load. Both energy systems use bi- directional converter to charge the battery. Bi-directional converters and battery constitutes a common additional load for wind energy and photovoltaic energy systems. In order to convert the energy output of the photovoltaic system into energy storage and provide constant power by the wind turbine, and efficient energy storage mechanism is required which is can be achieved by battery bank.

Conclusion:

This paper reviews the challenges and opportunities of using solar photovoltaic and wind energy resources for power generation. The main challenge of grid-connected system and stand-alone system is the intermittent nature of solar photovoltaic and wind energy. By integrating the two resources into an optimal combination, the impact of the variability of solar and wind energy resources can be partially eliminated, and the entire system can be operated more reliably and economically. This undoubtedly has greater impact on the stand-alone generation. The integration of renewable energy and battery storage backup system is becoming an independent and cost- effective solution. This PV-wind battery hybrid configuration can meet the system loads, including peak hours. Energy management strategies should ensure high system efficiencies as well as reliability and lowest cost. Good planning and accurate prediction of weather pattern, solar radiation and wind speed can help reduce the impact of intermittent energy. Voltage and frequency fluctuation and harmonics are the main power quality problems of both grid-connected as well as stand-alone systems, which have a greater impact when the grid is weak. Through proper design, advanced rapid response control equipment and good optimization of the hybrid system, this problem can be resolved to a large extent. The paper outlines research works related to optimal sizing, power electronics topologies, and grid-connected and stand-alone hybrid solar PV and wind energy systems control. Solar photovoltaic and wind energy hybrid systems can be connected by common DC or common AC bus, regardless to whether they operate in grid-connected mode or stand- alone mode.

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