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DESIGNING OF HYBRID SYSTEM BASED ON MODEL PREDICTIVE CONTROLLER OF AN OFF GRID RENEWABLE SOURCE

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Abstract

Referable to the final decade of fossil fuels, renewable energy plays a really significant function to raise the power to meet our load needs. The most disadvantage of renewable energy system is its installation price that is extremely high and renewable energy sources are primarily unpredictable. To get rid of the drawbacks in renewable energy, hybrid system plays a substantial part. The hybrid system is an interconnection of two or additional sources. During this project alternative energy and wind are used as a distinct sources. Power from the alternative energy is boosted by boost device and boost device act as a resistance matching network. Once the internal resistance of the star is matched with the boost device resistance power are going to be transferred from supply to the load. Energy from wind is converted into DC by exploitation rectifier and the end product of the rectifier is fed as input to spice up device. The output power of each wind and star are boosted by boost device and output of boost device is employed to run the DC load. Throughout excess power battery gets charged and through deficit power battery energy is employed to run the load. The projected work is done by using MATLAB software package.

Introduction

The global penetration of renewable energy in power systems is increasing chop-chop particularly for star electrical phenomenon (PV) and wind systems. The renewable energy counted for around nineteen of the ultimate energy consumption worldwide in 2012 and continued to rise throughout the year 2013 as per 2014 renewables world standing report. star and wind generation is of course intermittent and might produce technical challenges to the grid power offer particularly once the number of star and wind generation integration will increase or the grid isn't robust enough to handle speedy changes in generation levels. Additionally, if star or wind are accustomed offer power to a complete system, energy storage system becomes essential to ensure continuous offer of power. The scale of the energy storage depends on the intermittence level of the star or wind.

Independent power systems are of nice significance for remote areas locating out of national power grids, and a number of other new freelance grid models were projected in recent years. Among those models, electrical phenomenon (PV) generators are generally used, attributable to environmental issues. Star PV energy has been adopted in several countries as a complement for national power grids. This paper presents a unique energy dispatching supported MPC for AN off-grid Hybrid system supported turbine and PV panels for battery potency.

Literature review

There are alternative novel techniques, like electrical conduction, that are developed so as to store and deliver power instantly. Atomic number 1 is another appropriate possibility as a result of its ability to figure as a reliable fuel for nearly each application, particularly in transportation devices. What is more, atomic number 1 may be regenerate to electricity, and is in a position to heat additional expeditiously than fossil fuels. Combining atomic number 1 fuel with alternative sources of energy makes the system additional reliable, secure, and versatile with reference to completely different energy management techniques. One amongst the foremost environmentally-friendly and technically-mature procedures to provide atomic number 1 from electricity is by victimization an electrolyzer, that in an exceedingly position is ready} to work in a giant vary of capability with high potency, combined with varied energy production sources.

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Kaldellis et al. developed a strategy for complete PV-battery configuration with minimum life-cycle energy needs. They highlighted that, all told cases examined, the contribution of the battery part exceeded twenty seventh of the system life-cycle energy needs.

Hiendro et al. administrated a techno-economic practicability study of a PV/wind hybrid system victimization Hybrid improvement Model for electrical Renewable (HOMER) software system and highlighted that WT and battery were basically needed to satisfy demand masses at the hours of darkness hours though they represent the very best value to the system.

Kaabeche et al. suggested an integrated PV/wind hybrid system improvement model that utilizes repetitive improvement technique following deficiency of power offer likelihood, relative excess power generated, total web gift value (TNPC), total annualized value (TAC) and break-even distance analysis (BEDA) for power responsibility and system prices. They found that the configuration with the bottom TNPC, TAC and Baeda gave the optimum one. The bottom levelized value of Energy for complete hybrid PV/wind power generating systems that meet the required LPSP depends mostly on the renewable energy potential quality. An energy management strategy for a hybrid star PV and wind system was conferred. It gave a discount up to half a mile in LPSP as a results of victimization prediction of future generation.

Modeling of System

The modeling of the hybrid system consisting of solar panel, wind turbine and battery. They are discussed as follows.

Photovoltaic System

The circuit diagram of an one-diode model of a PV cell is shown in Figure one. The model will be represented on Kirchoff's current law.

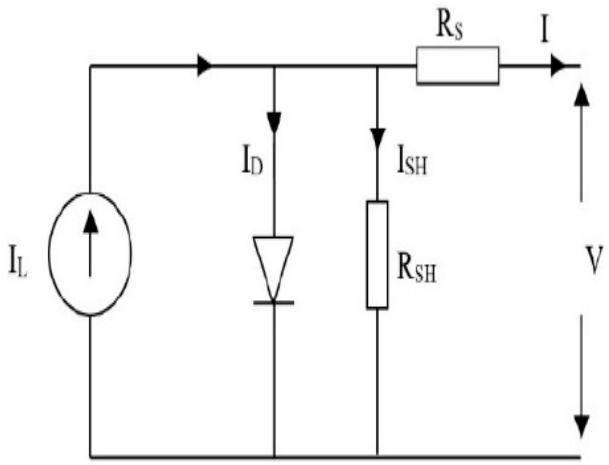

Figure 1 Circuit diagram of PV model

The determination of I-V characteristics of the cell by diode is given by,

$$I=I_L-I_D-I_{sh}$$
$$I_{ph} = I_{ph0}\,(1+K_0(T-300))$$
$$I_{sat} = K_1T^3e(-qv_g/\,kT)$$

A DC/DC convertor connects the PV panels to the DC bus. This convertor is controlled by employing a MPPT algorithmic rule. The MPPT algorithmic rule is chargeable for calculative the PV voltage love the utmost wall plug betting on irradiation and temperature conditions. The PV convertor controlled by this MPPT algorithmic rule varies the voltage of the PV panels consistent with the voltage outlined by the MPPT algorithmic rule so as to form the PV panels work on any time at the utmost power conditions. The MPPT algorithmic rule consists in a very fragmental electrical circuit voltage algorithmic rule that controls the voltage of the PV panels to be proportional to its open-circuit voltage. A PI controller generates the duty cycle of the DC/DC convertor from the comparison of the present PV voltage and also the electrical circuit voltage.

Wind Turbine

The selected wind turbine uses a turbine of 2 blades with fastened pitch angle and paired to a three-phase synchronous generator with permanent magnets. The model of the turbine is predicated on its steady-state

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power characteristics. The rotary engine output power is given by the subsequent equation:

$$P_{turb} = \frac{\rho}{2}\pi R^2 v_t^3 C_p(\lambda)$$

The output of this model is that the mechanical torsion of the rotary engine turbine, that depends on the turbine output power and speed:

$$T_a = \frac{P_{turb}}{w_t}$$

The power system of this model consists of a three-phase synchronous generator with permanent magnets, a convertor and a DC/DC converter, all of them sculptured as average worth equivalent models in Sim Power Systems.

The hybrid system model of the solar array and the turbine is shown in figure a pair of.

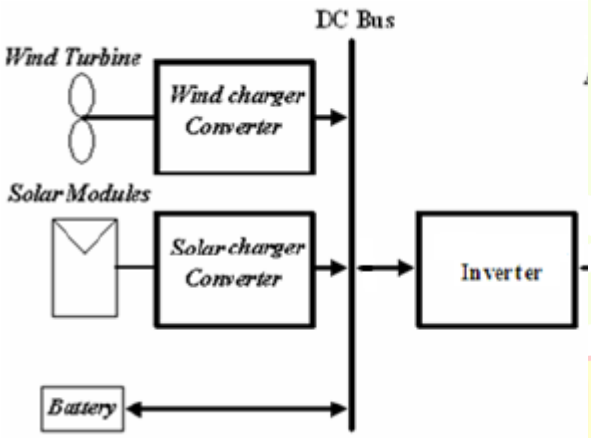

Figure 2 Hybrid system approach

Battery

The use of batteries as energy storage devices for off-grid power provides wide extended. Lead-acid batteries have better performance for this type of applications. The battery model was taken from the SimPowerSystems tool chest of Simulink that corresponds to the model. This model consists by a variable voltage supply and a series resistance.

DC to DC converters

These converters enable dominant the energy flow between the sources, adapting their variable voltages to the constant DC bus voltage. Average-value equivalent models (composed by current and voltage sources) represent these converters during this work. This reasonably model reproduces the dynamic of the converters for big sample times.

Energy Dispatching based on the MPC

The figure 3 shows the general theme of the planned management strategy. Infobahn power is outlined as

$$\boldsymbol{P_{net} = P_{load} - P_{pv} - P_{wt}}$$

where Pload is that the power demanded by the load, Ppv is that the power generated by the PV panels and Pwt is that the power generated by the turbine.

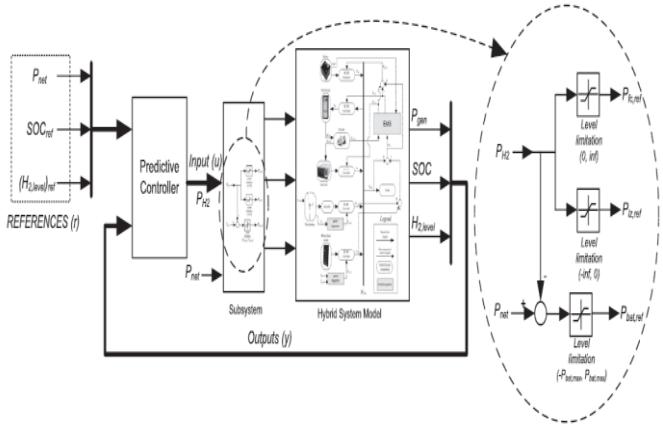

Figure 3 Energy Dispatching based on MPC

The state-space model of the system was obtained victimization the Simulink management style tool case. It permits to correct continuous-time, discrete-time (which is that the case of this work), or multirate Simulink models. The linearization purpose of the model corresponds to a steady-state operative purpose of the model that happens once the system is in equilibrium or trim condition which suggests that state variables that don't modification with time. The ensuing time-invariant model is in state-space type. Simulink management style uses a block-by-block approach to correct the models that on an individual basis linearizes every block of the complete model and combines the results to provide the linearization of the desired system. The controller ensures that the 2 needs are met: 1) track the load power; and 2) keep the battery SOC with their reference values. The MPC is completed with 2 auxiliary switches that disconnect the renewable power sources (PV and

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wind turbine) once the battery SOC is on top of ninety fifth. The MPPT controls of the PV and turbine are thought-about freelance of the energy dispatching.

Results and Discussion

The proposed system hybrid model is designed using Simulink as shown in figure 4

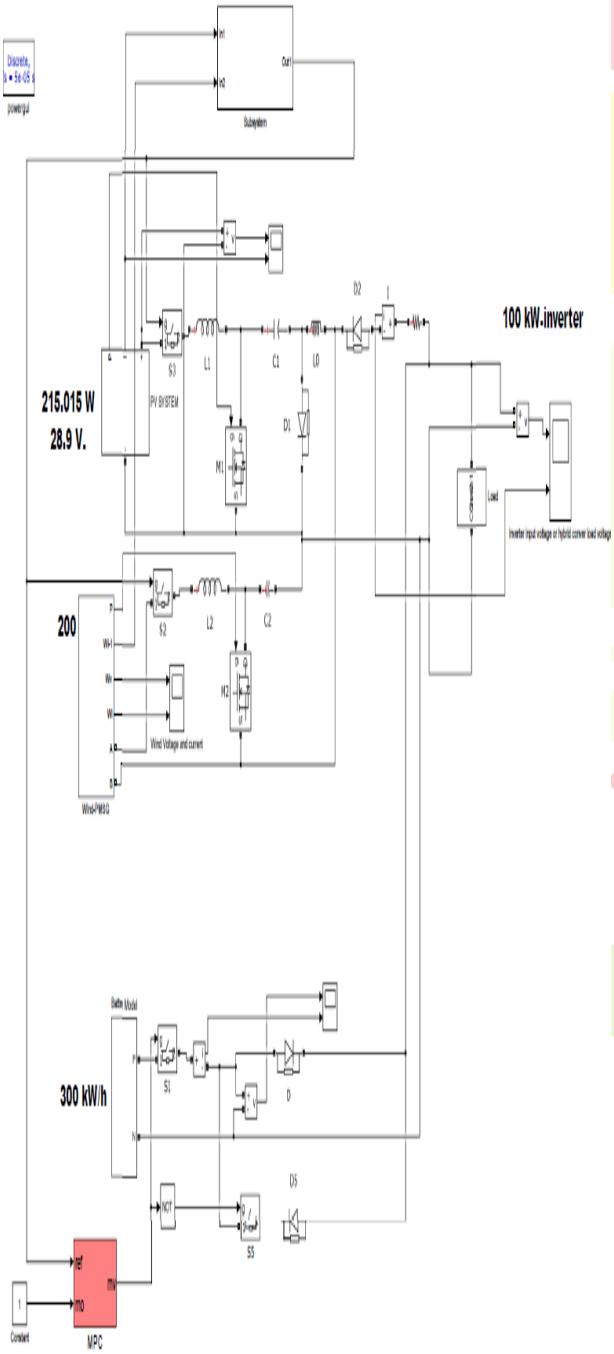

Figure 4 Hybrid system on MPC

The wind voltage and current obtained from the MPC of an off grid system for wind turbine is shown in figure 5.

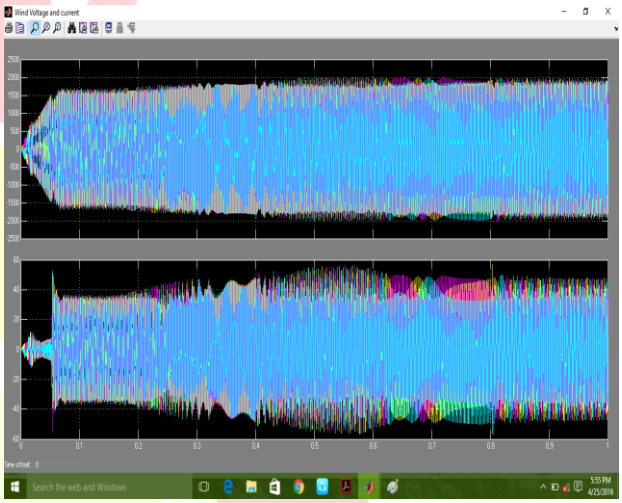

Figure 5 Wind voltage and current

The load voltage of hybrid converter is shown in figure 6.

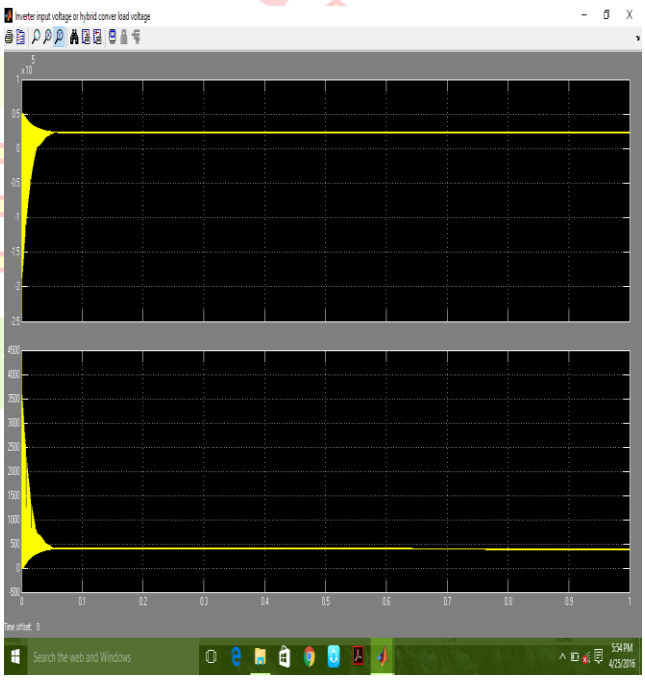

Figure 6 Hybrid converter load voltage

Conclusion

The primary contribution of this study has been to gift and valuate an energy is repair supported MPC for an off-grid Hybrid system desegregation turbine, PV panels and battery. The renewable energy sources generate the utmost accessible power, whereas the energy dispatching is to blame for dominant the operation of battery and element scheme. The battery power is obtained from the distinction between information superhighway power (load power minus PV power and turbine power). The energy dispatching supported MPC was valued by comparing with a dysfunction supported state management. The simulation results, obtained for the calculable lifespan of the hybrid system, incontestable that the energy dispatching supported MPC achieved a better world potency of the system, reassuring the off-grid load support and maintaining the battery SOC level between the specified in operation limits.

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