ISSN: 0974-5823 Vol. 7 No. 1 January, 2022

International Journal of Mechanical Engineering

The quality of energy and the efficiency of the PV system, connected to the triplex stagesgrid 25 MVA by using VSI

[1]Abbas SwayehAtiyah,
Department of Electronics and communications Engineering
College of Engineering
AL-Muthanna University

[2]Mohammed ZuhairAzeez
Department of Electronics and communications Engineering
College of Engineering
AL-Muthanna University

[3] SamahMutasherGatea
Directorte of General vocational Education Ministry of Education
Muthanna Iraq

Abstract

There is a lot of renewable resources energy where solar energy is highly promising due to the abundance of sunlight,so itmight be used to generate electricity in addition to beinga clean and environmentally friendly source of energy. The optical system network connection has many topologies; an in-depth simulation of a three-phase voltage source connected to an inverter is provided during this paper using MATLAB/SIMULINK. The PV module is linked to converter as DC-DC boost, and a Maximum Point Tracking (MPPT)system allows the PV array to provide maximum power to the grid as weather changes, then including it in the AC utility network.

Keywords: optical, inverter, network, connected, MPPT, PLL, VSI.

Introduction

Increased demand for electricity for daily uses and the sustainability of work in large factories require the use of highly efficient and accessible energy sources. One of these sources is photovoltaic power, which is available in sunny tropical countries, including Asia and Africa [1]. Photovoltaic systems supply active energy to the networkthrough the distribution network (DN) in several stages. It is an effective solution to the rapidly increasing demand for electricity, but this will have adverse effects on the whole (DN). This is due to the irregular behavior of photovoltaic electricity, which thus affects the reliability, availability, and efficiency of the distributed network. Besides, due to this sporadic presence and the combined real power injection at diverse stages, itsmethod beingso complex that uses a few readings in a different location to make accurate estimates of the energy circulation in the distribution network. The entire energy system would be out of reach in the event of a high PV production level and there was a potential major reverse power rotation risk, thus producing inappropriate voltage, as of [2-4] case grid voltage.

Given the dominance of photovoltaic generation over environmental conservation and sustainability, it is considered one of the most technical expectations for content and technology. The main photovoltaic technology of power grid is invertertechnology. Since a solar-grid interface device, the inverterof grid plays a crucial function in new electricity production and use, directly influencing the generation system of photovoltaic grid efficiency and economy [5]. Recently, researchers have focused on improving the efficiency of reflective photovoltaic network work and the quality of transmission and synchronization. Several reports are made on the photovoltaic side and hence the network side by making the DC/DC surge converter and the DC / AC inverter, this paper focuses on the photovoltaic aspect. Methods designed to harvest and supply the load with *Maximum point trackingofpower* (MPPT). Such depends on the energy produced and the accuracy of the MPPT. Increased connectivity (InCond) and different algorithms can result in accurate tracking (MPP) under rapidly changing weather conditions, which can lead to severe energy loss [6-7].

Inverterof light

Inverterconsidered as a vital photovoltaic system part. It's the photovoltaic scheme centerpiece. Aninverteras photovoltaic or solar can even be electrical invertertype designed to convert DC (DC) from a photovoltaic system to AC (AC). Since the array of PV might be source of DC, the inverteris requisitefor convertingpower of DC used in our homes and offices to the normal frequency current. The batteries are used to conserve electricity, only operating the sun, and should be placed away from the sunlight directly in cold positions [8]. Cell as solar thatcontainsPN intersection whichchangesdirectly light energy into electricity is the PV module primary component. Alternatively, the solar cell circuit appears in figure (1) [9].

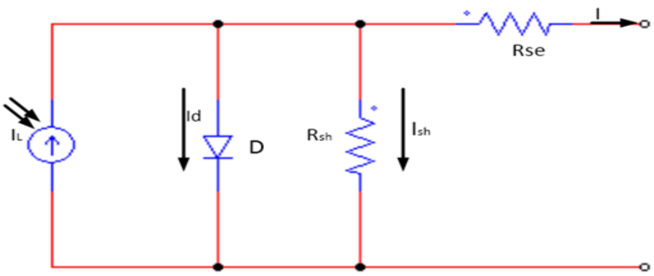

Figure 1: Equivalent to a solar cell circuit

IL: Current produced by light, diode current, Rsh: Shunt resistor to determine current leakage, Rs: the resistor that defines the diameter.

To make PV units and photovoltaic arrays, a variety of PV cells are attached. The following equations contain the mathematical model of simulating PV units or arrays.

$$n_P I_L - n_P I_{rse}\left[exp\left[\frac{qV}{KTAn_s}\right] - 1\right] = I$$

(1)

Where I: the current output of the PV array, NP: number of parallel-connected solar cells, Iris: saturation reverse current, q: charge electron, K: constant of Boltzmann, T: cell temperature, A: ideal factor, ns: number of connected cells.

$$= I_{rr}\left[\frac{T}{T_r}\right]^3 exp\left[\frac{qE_g}{KA}\left[\frac{1}{Tr} - \frac{1}{T}\right]\right]$$

(2)

IRR: reversing the saturation of the current of the photocell at the reference temperature, TR: reference temperature, For example, the energy semiconductors used in the solar cell.

$$I_g = [I_{scr} + K_i(T - T_r)]\frac{G}{100}$$

(3)

Iscr: current short circuit, Ki: temperature coefficient of (Iscr). G solar radiation in mW / cm2.

2. The inverter connected to the grid is the source of voltage (VSI)

There are two control strategies: Current control and voltage control, to organize three-phase voltage source network converters (VSI). To regulate the flow of the facility, the VI voltage it controls uses the phase angle between the voltage produced by the inverterand thus the network voltage. Within the current-controlled VSI, using *Pulse WidthModulation* (PWM) techniques, active and interactive components from the present injection into the network are controlled. The reason for preferring the current console is the smaller size, sensitivity to phase voltage shifts along distortion within the voltage of network. It's quicker to respond. The control voltage module is sensitive to errors of small-stage and currents as massive harmonic might take placewhen the voltage of grid is distorying. It is suggested that the current control within the network control - connected - is because the current control unit prefers the current control unit is less sensitive to distortion and phase voltage shifts within the voltage of network. It's quicker to respond. The voltage module control is sensitive to errors of small phase, massive currents being harmonic might take place when the voltage ofgrid is distorting.Control being current is proposed along the control of connected network-inverter. The VSI control current of 3-phase module has avital role in guiding network-related reflectors. The applied standard current control affects the inverter system performance [10]. The common mostly control algorithm utilized to compensate for error of current is the controller of PI as a change between the inverter measured output current and the required current injected into the network, the PI controller calculates an error value, and the control unit then tries to mitigate the error between them, two separate fixed parameters, the ki relativity constant and thus Ki is an integral constant, are involved in the PI calculation algorithm. The term relativity is calculated by gaining the KP multiplied by the error signal. Gradually, suchhave a tendency totominimize error as overall. The relative term effect, however, won'tminimize error to 0 and definite fixed state error is there to fix the errors of a simple fixed state, the term "integration" of the control unit is used. The term Integral is error integrating and multiplies it then by continuous Ki, thus, the term integral becomes the output of an integrated PI controller, and it removing the state error being constant and speeds system speed (11).

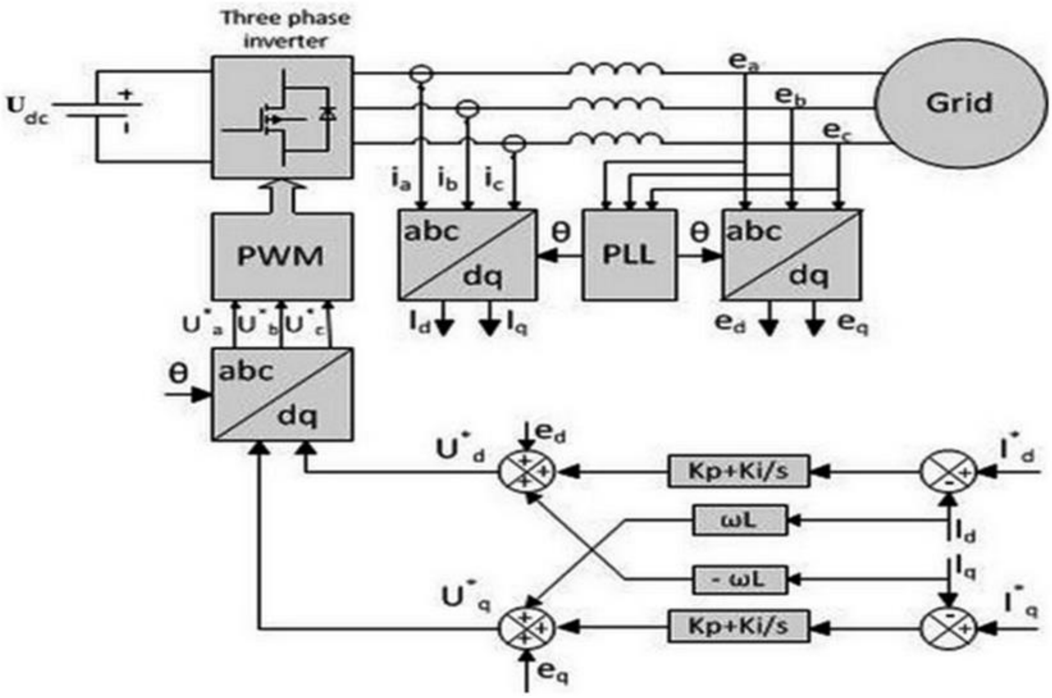

Figure (2): Joint Synchronous Control Unit Structure

The synchronous diagram of control unit of the network-linked inverteris presented in Fig. 2, which shows suchinverterof2 PI controllers for compensating the current vectors components which are definite in the synchronous coordinates system (DQ) due to the coordination of transitions, intelligence and identity are the components of the capital**,** PI compensation reduces the error (s) among the current * identifier (* Iq) and thus the current actual number (Iq) to 0. The energy factor and the resulting one are often organizedviacurrent d-axis changing and the Q-axis as current. To improve the PI controller performance in the structure, the termsof conjugation and voltage feed are utilized [12].

3. **VSI network connection simulation**

This section offers the invertermethod, a model that supports the theoretical fundamentals already introduced. The device was designed and simulated using MATLAB/SIMULINK to see the control structure effectiveness and to measure parameters of output. The complete diagram of the control and configuration methodology is shown in figure 3.

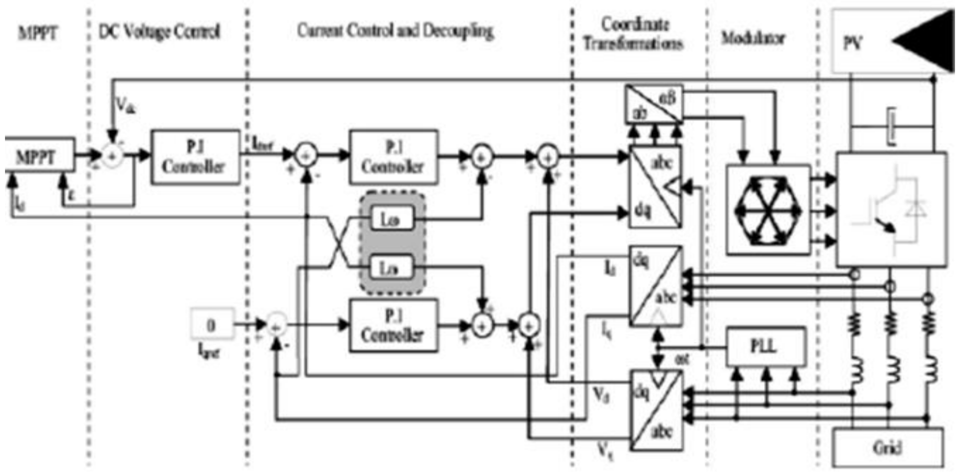

Figure (3) MPPT with a connected PV system network.

Figure 4 shows a model and a simulation system. The PV array is built of strings of connected PV units at the same time and uses 64 parallel strings each, consisting of 5 connected string units. A lift converter including the PV module. The full point tracking and amplification voltage are managed by the batch converter. The MPPT algorithm used is the P & O algorithm. The inverterwith minimal harmonic distortion is regulated by the VSC control that penetrates PLL, the current regulator, and thus the VDC regulator.

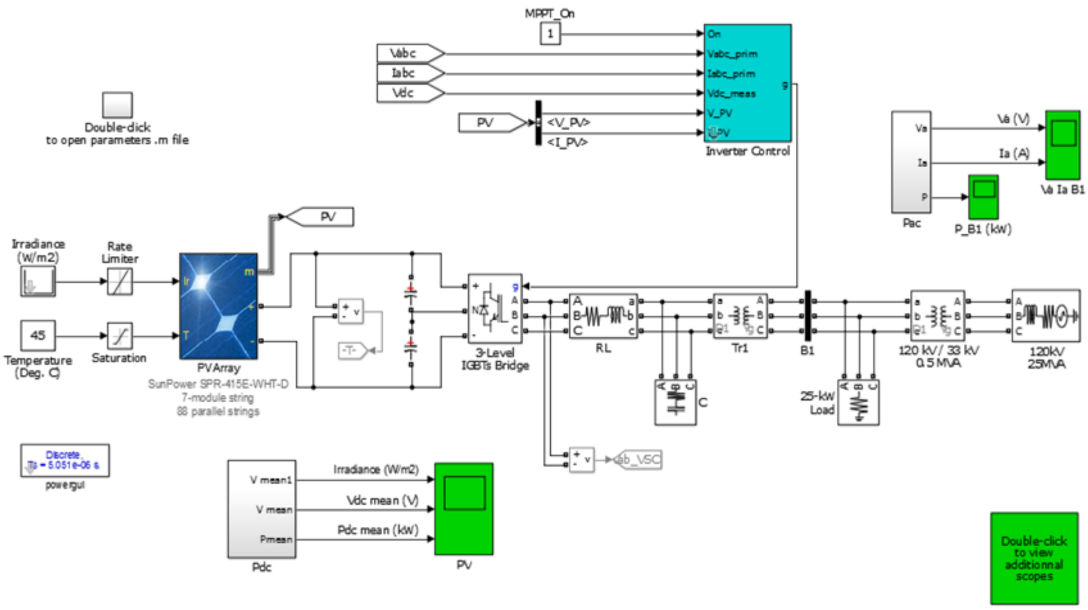

Figure 4. Simulation Service (25 MVA), VSI design network connection

The PI control module is used for the VDC connection voltage. The voltage of DC connection is compared to value as reference and thus fedding oferror to the PI controller thattries then to minimize the error. During such method, the VDC is often held in value higher than the peak network voltage value. Figure 5 displays a batch converter for DC/DC.

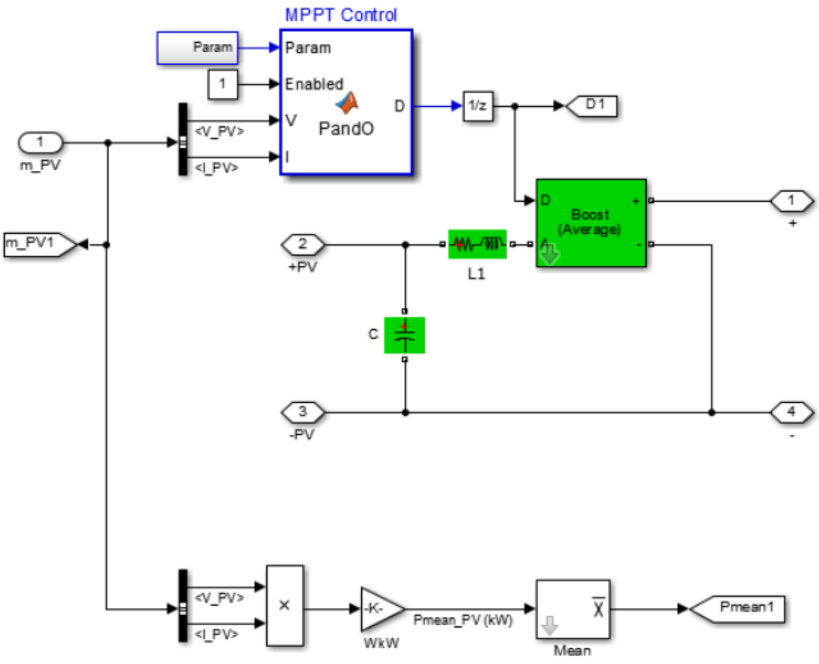

Figure 5: DC / DC enhanced converter

The inverterused in the design can be a global bridge of VSC based on an average model of specific power electronic devices. The facility's electronic converters are represented by a completely average voltage source converter model. This model uses (Uref) reference signals representing the quality voltage produced on the bridge's ABC stations, unlike other electronic control devices. Harmonics are not denotedvia this model. They are often used and therefore maintain the quality of voltage dynamics with larger mpletimes. The Control circuit is meant to manage the inverter'soperation. The control module consists of a VDC regulator, a current regulator, PLL, and Nadel measurements. The frequency and inverterphase should be equivalent to that of the grid voltage provided that proper transmission of power to the grid.The current on the grid, iGrid, is compared to iGrid ref, and thus feddingfor error is into module of PI control. Thus, it was urged to switching the pulses to the inverter, and it contrasts with the output of the PI with the triple signal.

Results and discussions

The results obtained are discussed from modeling and simulating the inverterassociated with the 33 kV- 25 MVA network connected to a three-phase effort source network below. Figure 6 is three-phase voltages of 26.44 kV, 26.11 kV, 26.57 kV per phase, and 18.7 kV for RMS.

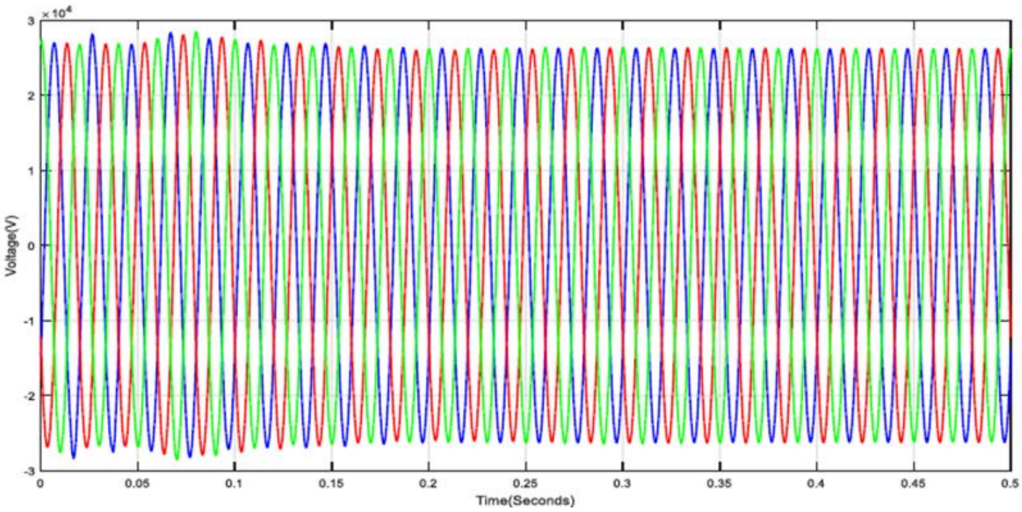

Figure 6: The AC voltage output response.

Figure 7, each phase of the frequency currents with the resulting three phases are 28.6A, 30A, and 28.4A. 20.22A, 21.21A, and 20.08A are RMS values respectively, due to the capacitors in the DC link, waves began with the current inrush. The starting transient also suffers from an absolute that connects the PV units to the DC vector inverterentrance.

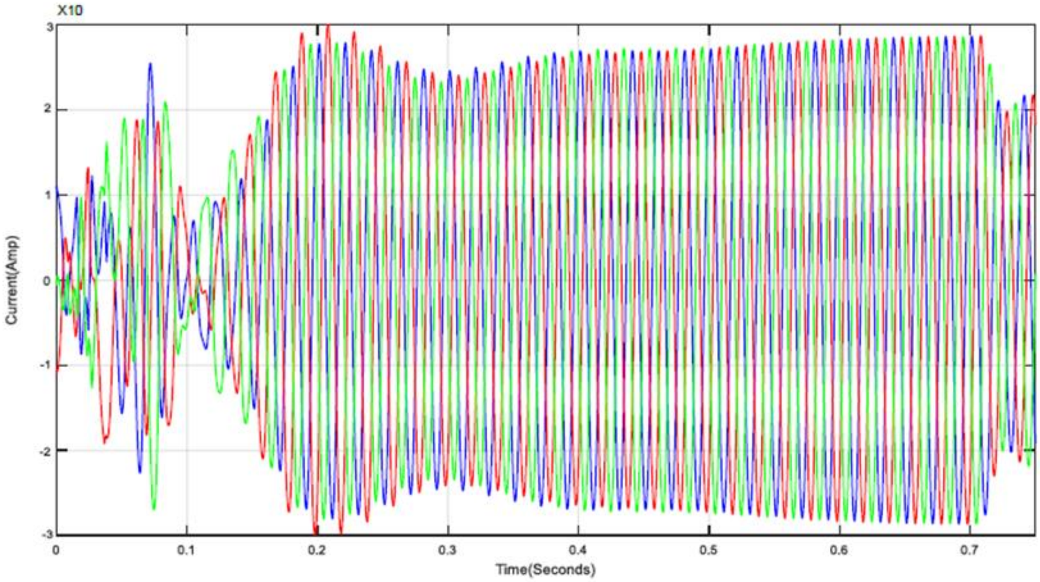

Figure 7: Current resulting AC response.

Figure 8 showed that it produced a force equal to 0.087MVA, the red one compared to the reference power (P reference) of 0.028 MVA, which is a blue one.

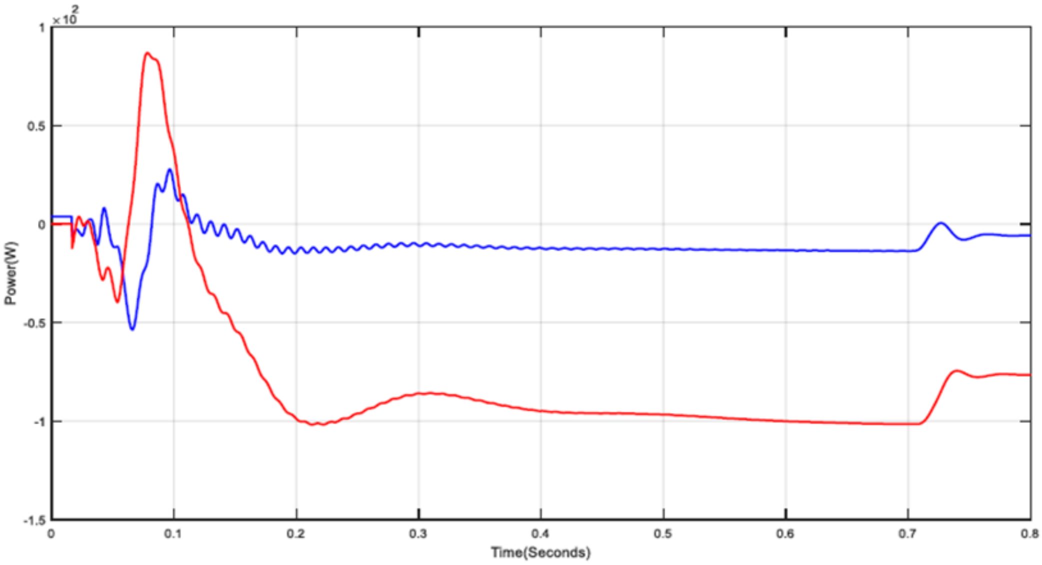

Figure 8: The resulting AC energy response.

Conclusion

MATLAB/SIMULINK is employed to model and simulate source as3-phase voltage inverterlinked to a network of 33 kV- 25 MVA. Because VSI requires photovoltaic voltage above the height of the voltage grid so that the power can be controlled because of the photovoltaic cells in the grid. The VI does not add a full photovoltaic voltage array. As a result, there is a need to increase voltage assessments of photovoltaic cells. To organize inverterfunctions, an impact circuit is performed. A control module consisting of a variable, VDC regulator, current regulator, PLL, and measurements using the signal error of the DC voltage control indicator control module, the radiator variation is calculated. The current part of the d-axis network is then used to live the entire change within the PV array. The DC/AC inverteris utilized to convert DC to AC, and before the converter and thus the network connection, the RL filter factor is used.

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