IMPROVING THE EFFICIENCY OF SOLAR PHOTOVOLTAIC POWER GENERATION USING IMPROVED MPPT METHOD

Mohammed Fouad Kareem
Department of Electrical and Computer Engineering
Altinbas University,Istanbul,Turkey
ma_1990d@yahoo.com

Sefer Kurnaz
Department of Electrical and Computer Engineering
Altinbas University,Istanbul,Turkey
sefer.kurnaz@altinbas.edu.tr

***Abstract*—The use of solar energy is a sensible and effective way to deal with the worldwide energy crisis. Studies of improving the efficiency of the solar portion are very necessary in order to reduce the cost of solar power. We have proposed several methods to improve the efficiency of solar energy on the basis of a transverse contrast method and have conducted surveys and research. The analysis showed that in order to enhance the performance of the solar power we should review the techniques for conversion of panels; the integration of automatic panels with solar energy; the use of maximum power monitoring technologies in solar power controls and the use of battery charging and discharge technology in battery storage; the use of total panorama technology The experience has shown that the use of these technologies will boost solar power generation output effectively.**

Keywords— SVC, ANN, PV, MPPT.

I. INTRODUCTION

Photovoltaic devices are expected to serve as a major energy source to meet global energy needs. PV systems can be deployed in two main areas: off grid or autonomous technologies, and on grid or grid-connected applications. The implementation of power systems is feasible. Stand-alone PV systems can be used to power remote loads with no connection to power grids, whereas grid-connected applications are used to power local loads and power sharing with power grids. The medium-sized suburban grid photovoltaic network has been commonly used. In order to generate usable voltage and current, PV panels are linked in series and parallel. The voltage can be calculated through series relation levels and the current density can be increased by parallel contact [1]. Therefore, Converter configuration should be effective and economical. Through optimizing the friction profiles and reducing power loss in the delivery feeder, maintenance costs and the loading of transformer tap changers at peak hours, panel systems can boost the function of power systems [2].

PV systems remain facing significant difficulties and some adverse effects for the system, compared with other renewable technologies such as feed overload, harmonic pollution, high investor cost, poor efficiency and low reliability, preventing their widespread application [3]. In addition, shifts in solar irradiation may induce energy variability and voltage fluctuations, creating undesirable effects in power system PV systems with high penetration. For improving the efficiency of photovoltaic systems other control methods such as Maximum Power Point Tracking (MPPT). Both the induced voltage and PV array current should be regulated in such controllers [5, 13, 14, 15]. The PV device configuration can be complicated by that failure probability when maximum power is monitored in unpredictable weather conditions. After the network is linked from the power grid under faulty circumstances, PV device-based distributed generations (DGs) will control the local charges. All accidental in these circumstances [8]. The nonlinear charges in a power distribution network tend to be the main sources of harmonic distortion. Nonlinear load-based harmonic currents are introduced back into power distribution systems via the typical coupling point (CCP). Such (harmonically) fluctuations are the source of numerous problems in power supply electric devices. Many systems have been proposed to increase the quality of power by taking into consideration current distortion limits for non-linear loads [10].

This paper analyzes and simulates SAPF-connected PV systems to remove harmonics and compensate for reactive strength. The SAPF injects the current to account for source current in the same range and reverse step of the load present. The major challenge is to handle the nonlinear characteristics of the PV array using PV power generation systems. The PV properties are depending on the irradiance and temperature point. Thanks to moving storms, neighbor constructions or foliage, PV array encounters various irradiance rates. Eco factor variables such as solar irradiation and temperature rates influence the output power voltage (P-V) and the control voltage characteristic (I-V). One of the key factors that influences the performance and overall cost of the photovoltaic device is the determination of the maximal extractable power at the nonlinear output function of the PV system. Fuzzy MPPT dependent reasoning, without the expertise of the PV team, results in rapid radiation transition. The ANN approach and the Artificial Neuro Fuzzy Interference System (ANFIS) method can be implemented with the system that can collect enough training data to allow rapid changes in irradiation and partial shading. In order to compare the optimal duty period of the DC-DC boost converter to IC-based approaches, this paper recommends an ANFIS related MPPT. The performance strength of photovoltaic panels (PV) is well known to be extremely non-linear. At a certain voltage, a certain maximum power point (MPP) shall be available for a certain temperature and irradiation. With the exposure and, above all, the voltage of the MPP increases and the temperature changes. Therefore, the device needs to be controlled by the MPP of the PV series, irradiation, temperature, or other factors no matter how much it is. In addition, the produced PV energy system, mainly supplied by the power grid, should not only have sinusoidal capacity, but should also satisfy power grid specifications such as no DC input in the inverter present, harmonics

978-1-7281-9352-6/20/$31.00 ©2020 IEEE

minimizing as a result of the lack of harmonic power grid emissions, etc. The inverter with a high level of control is needed by these specifications. The problem is how the above criteria are to be fulfilled at a minimum price that most designers have to face. Photovoltaic power system usually requires maximum power tracking points (MMPPTs) to get full photovoltaic capacity. DP / DVs should be measured to determine the maximum power point (MPPs) for the disturbance-observation process. Although implemented relatively easily, the MPP cannot be tracked by quick changes of irradiation, and rather than by tracking the MPP. The progressive conducting approach will easily control the MPP, however raises the algorithm's sophistication, and requires DI / DV measurement. The 76 percent open circuit tension as a MPP and short-circuit current is the simple method, but it does not always track MPPs accurately. AI-based approaches are best suited for optimizing the maximum power monitoring dynamics. The AI methods provide a simple, versatile and computationally demanding solution to the MPPT problem, taking into account the non-linear characteristics of the Solar PV module. Fuzzy logic controller and artificial neural networks are two main approaches to AI which are used for MPPT.

II. Proposed Scheme

The ANFIS input reference configuration is degree of irradiance and operating temperature. The ANFIS reference model gives the crisp value of the PV module's maximum usable power at a given temperature and point of irradiance. The actual output power of the PV module is measured at the same temperature and radiance level using multiplication algorithm on sensed working voltage and currents. Two powers are compared, and the error to generate control signals is given to a proportional integer controller. The pulse provided by the PI control signal is transmitted to the IGBT for triggering purposes. Those signals control the near-z-source inverter's operating cycle to change the PV module's operating point. The aims of the proposed control system are

- Maximum tracking of power points.
- Wanted stable grid output power. The inverter output power should be adjustable and controlled according to the users ' demand for the Grid.

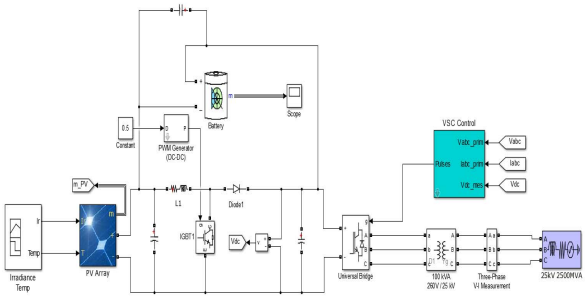

Fig. 1. Simulation Model of the Proposed System

The voltage, the size and the frequency constants irrespective of changes in input conditions. Using weather transmitter's arrangements, the solar radiance and temperature and other weather data are collected. Solar irradiance outputs and temperature transducer are current / voltage signals that are logged on to standard data loggers in real time. This data is then transmitted via the ANFIS controller to the machine to further process or enforce a real-time control device.

The nonlinear equations are based on solar radiation occurrences, cell temperature and the reference values. PV modules manufacturers are usually responsible for certain reference values for specified operating conditions such as STC in which the radiance is 1000W / m2 and the temperature of the cell is 25oC. Human cases are always different from standard conditions of service and the consequences of mishandling can affect the true values of these meat requirements.

III. System Development

Certain requirement will fulfill including voltage point, frequency and phase series matching while synchronizing the grid and network linked PV device. PV inverter with advanced electronics technology is used for this synchronization. In the power voltage relationship, or the current voltage relationship of the system, it is common to see the electrical properties of a PV unit. These features vary directly from the solar irradiance with differences in cell and cell temperature. To translate changes in temperature and radiation into induced voltage and current of PV arrays, an effective simulation model is needed. In different weather conditions the dynamic performance of the PV network can be evaluated.

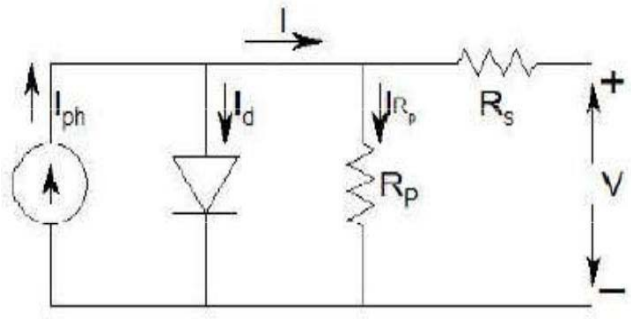

Fig. 2. Equivalent Circuit Diagram of PV Cell

The photovoltaic solar cell is basically a p-n junction type unit. It absorbs energy that is greater than band gap when exposed to sunlight. It produces those hole-electron pairs that are equal to radiation event. The inner electrical p-n connection fields and photo-course forms proportional to solar isolation are affected by these carriers. The nonlinear properties of PV cells differ according to radiation intensity and temperature. PV cells generate less than 3W at 0.5 to 0.6V, so cells are connected in series to produce enough electricity. As shown in Figure 2 the terminal equation of PV panels is given for current and voltage.

Where IPh is Light Current, V is Cell Terminal Voltage, I d is Diode Current, Io is Saturation Current, IP is Shunt Current, q = Electron Charge, k is Boltzmann Constant, T is Temperature, RD is Shunt Resistance RP.

Boost converter increases inverter voltage and MPPT control voltage levels. Boost converter output voltage exceeds the input voltage. The input current is the same as that of the induction current and is therefore not discontinuous as the

buck transformer. If high quality solar panels are installed then the booster converter requirement can also be relaxed and the conversion loss can be saved. DC voltage is generated by PV panels and AC is necessary for connecting the panels to the grid DC power. We need an inverter before connecting to grid to convert DC to sinusoidal AC. The output tension and frequency should be the same as the voltage and frequency of the grid. There are many topologies available for inverters. Voltage Source Inverter has been chosen for the suggested PWM scheme (modulated pulse width) for the step d-q principle. Inverter efficiency is similar to Sinusoidal. There are 6 switches and their switching is regulated by separate PWM signaling. Figure 3 displays the electronic inverter model.

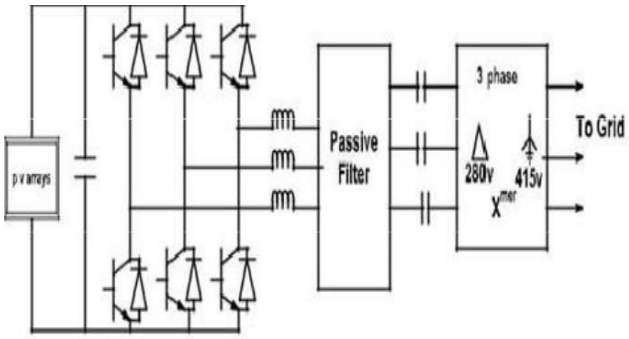

Fig. 3. PWM 3 Phase Inverter with Passive Filter

IV. RESULTS AND DISCUSSION

The MPPT system model MATLAB/SIMULINKK includes the 800 KW PV module, 3-stage inverter and 25KV grid. PV module is the polycrystalline type of silicone that produces 305,2 W at 1000 W / m2. Simulation work with the proposed technique and conventional EI algorithms for evaluation and comparison analysis was carried out under steady state and dynamic conditions using this PV module. The dc –dc input was approximately 271V, the output was 1000V and PWM operating cycle was approximately 50 percent. Time response, oscillation, over-shot and stability are major factors used to analyze the performance of every MPPT algorithm. Figure 4 shows a constant irradiation plot at 1000w / m2, with a rapid rate of changes of 1000w / m2 to 200w / m2 showing a partial PV shade effect.

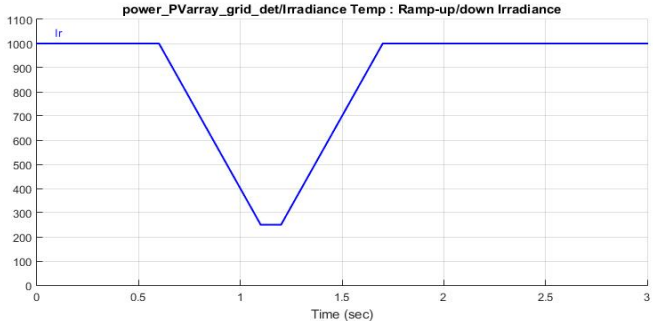

Fig. 4. Plot of Irradiance

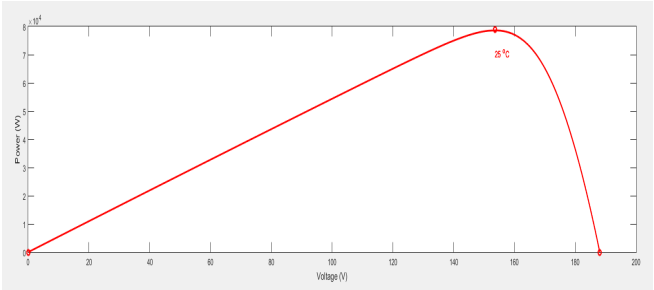

Fig. 5. The Power Output Performance of the Solar System

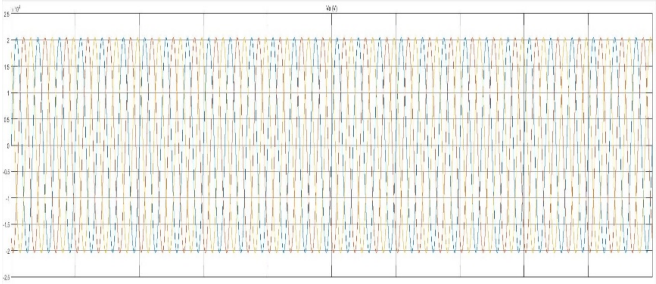

Fig. 6. The 3 Phase Performance

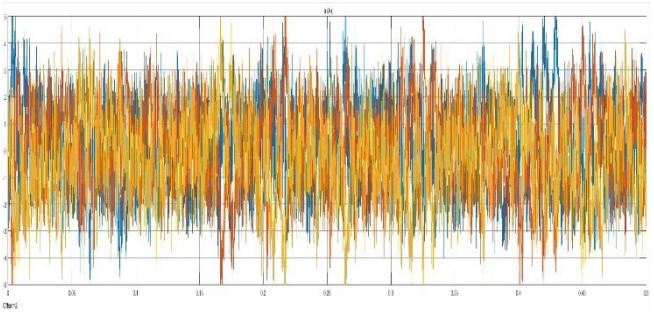

Fig. 7. The Current Output Performance of the Proposed System

Fig. 8. Voltage Comparison

V. CONCLUSION

The paper proposes the use of a grid convergence photovoltaic device. An active filter completes the interface between the source and the grid. ANFIS controls the shot through duty ratio to maximize the power of the PV system. Operation of the modulation index of the filter controller changes the Grid side voltage and frequency. The monitoring targets are thus assured by simultaneous regulation of the job shot and the modulation table. The proposed control approach is verified by simulation and experimental results. In addition, the hybrid wind and solar method for the planned scheme using the ANFIS-MPPT process will be published. There has been

discussion of a wide range of irradiation levels, constant rapid change. The output measurement is done on the basis of time taken to measure the maximum power point (MPP) and numerous significant variables such as reliability, consistency, configuration period, power overhead and voltages before hitting the MPP so that precise measurements are collected. The research is undertaken on the basis of the time necessary to monitor maximum power.

REFERENCES

[1] Masoud Farhoodnea, Azah Mohamed, Hussain Shareef, Hadi Zayandehroodi," power Quality Analysis of Grid- Connected Photovoltaic Systems in Distribution Networks ," ISSN 0033-2097, R. 89 NR 2A/2013

[2] Omran, W.A., M. Kazerani, and M.M.A. Salama.," A study of the impacts of power fluctuations generated from large PV systems ," in IEEE, PES/IAS Conference on Sustainable Alternative Energy (SAE), 1-6, 2009.

[3] Seok-Ju, L., P. Hae-Yong, K. Gyeong-Hun, S. HyoRyong, M.H. Ali, P. Minwon, and Y. In-keun ," The experimental analysis of the grid-connected PV system applied by POS MPPT ," In International Conference on Electrical Machines and Systems , 1786-1791,2007.

[4] Bin, W., H. Tianxiao, J. Bo, D. Xinzhou, and B.Zhiqian" Dynamic modeling and transient fault analysis of feeder in distribution system with MW PV substation" in 45th International Universities Power Engineering Conference (UPEC), 2010. 1-5

[5] Maximum power point tracking scheme for PV systems operating under partially shaded conditions. Patel, H., V.Agarwal, IEEE Trans. Ind. Electron. 2008, 55, 1689–1698.

[6] M. farhat, L.Sbita, Advanced ANFIS-MPPT Control Algorithm for Sunshine Photovoltaic pumping Systems, The First International Conference on Renewable Energies and VEhicular Technology, Hammamet, pp. 167

[7] Maximum Power Point Tracking (MPPT) Scheme for Solar Photovoltaic System, Ahteshamul Haque (2014) Maximum Power Point Tracking (MPPT) Scheme for Solar Photovoltaic System, Energy Technology & Policy, 1:1, 115-122, DOI: 10.1080/23317000.2014.979379

[8] An Improved Matlab-Simulink Model of PV Module considering Ambient Conditions, R.Ayaz, I. Nakir, and M. Tanrioven Hindawi Publishing Corporation International Journal of Photoenergy Volume 2014, Article ID 315893, 6 pages http://dx.doi.org/10.1155/2014/315893

[9] R. Belaidi, A. Haddouche, and H. Guendouz, "Fuzzy logic controller based three-phase shunt active power filter for compensating harmonics and reactive power under unbalanced mains voltages," Energy Procedia, vol. 18, pp. 560-570, 2012.

[10] K. Srikanth, T. K. Mohan, and P. Vishnuvardhan, "Improvement of power quality for microgrid using fuzzy based UPQC controller," in Electrical, Electronics, Signals, Communication and Optimization (EESCO), 2015 International Conference on, 2015, pp. 1-6.

[11] B. Bendib, H. Belmili, and F. Krim, "A survey of the most used MPPT methods: Conventional and advanced algorithms applied for photovoltaic systems," Renewable and Sustainable Energy Reviews, vol. 45, pp. 637-648, 2015.

[12] Y. Bouzelata, E. Kurt, N. Altın, and R. Chenni, "Design and simulation of a solar supplied multifunctional active power filter and a comparative study on the currentdetection algorithms," Renewable and Sustainable Energy Reviews, vol. 43, pp. 1114-1126, 2015

[13] K.H. Chao and C.-J. Li, "An intelligent maximum power point tracking method based on extension theory for PV systems," Expert Systems with Applications, vol. 37, pp. 1050-1055, 2010.

[14] B. Subudhi and R. Pradhan, "A comparative study on maximum power point tracking techniques for photovoltaic power systems," Sustainable Energy, IEEE transactions on, vol. 4, pp. 89-98, 2013.

[15] M. S. Hamad, A. Fahmy, and M. Abdel-Geliel, "Power quality improvement of a single-phase grid-connected PV system with fuzzy MPPT controller," in Industrial Electronics Society, IECON 2013-39th Annual Conference of the IEEE, 2013, pp. 1839-1844.