

Study on MPPT Algorithms for Solar and Wind Energy and Comparison with other Techniques with Issue related to the Conventional P&O MPPT Scheme

¹Prateek Kumar Lamoria & ²Dr. Amit Jain

¹Research Scholar, OPJS University, Churu Rajasthan (India)

²Assistant Professor, OPJS University, Churu, Rajasthan (India)

ARTICLE DETAILS

Article History

Published Online: 15 April 2019

Keywords

solar, MPPT, algorithms, wind energy.

ABSTRACT

Worldwide energy emergency and environmental change dangers are among the significant concerns looked by the present acculturated world. The restricted repositories of petroleum products and discharge of ozone depleting substances are the major recognized explanations behind the above concern. Sustainable power sources (RES, for example, solar, wind, and tidal are viewed as the answer for defeat these worries. In this paper two new MPPT algorithms are created for solar energy change framework and one MPPT algorithm is produced for wind energy transformation framework.

1. Introduction

Sustainable power sources are turning into an other energy sources to the ordinary energy sources. Solar and wind energy are the significant piece of sustainable power source resources. To get maximum energy from wind and solar the maximum power point following algorithm is followed. There are numerous MPPT algorithms are accessible solely for wind and solar separately. Gradual conductance, Perturb and Observe and Hill climbing techniques are the fundamental maximum power point following algorithms. Insight methods such hereditary algorithm, Neural system, Fuzzy Logic and so forth., are in some cases embraced in the MPPT algorithm. Analysts have created half breed algorithm consolidating the essential and knowledge algorithms. In this exploration two new MPPT algorithms are created for solar energy transformation framework and one MPPT algorithm is produced for wind energy change framework.

The P&O strategy is exceptionally well known among every one of these plans. It is additionally ordered into different kinds of P&O MPPT plots and is embraced by the specialists. The ostensible estimation of capacitors associated in parallel with solar PV is taken as a parameter to screen in extraction of power. In any case, Xiao and Dunford have proposed a versatile plan to separate the power.

The P&O technique may give bogus outcomes, i.e., when solar light is expanded, the ordinary P&O algorithm moves toward high power. It fixes the working point, which isn't maximum power point (MPP). Additionally, the other issue is consistent state motions because of the idea of the P&O MPPT plot. The confinement of the P&O strategy has been featured under expanded solar illumination condition. Nonetheless, the MPPT conduct with resistive burden change has not been tended to appropriately. These issues are tended to appropriately for other MPPT plans, for example, gradual conductance

2. MPPT For Solar System

Three are two MPPT techniques proposed for the solar energy change framework. Initial one is mixture MPPT algorithm, which joins the steady conductance and slope climbing algorithm. Second one is Fuzzy Logic based MPPT

algorithm. The proposed algorithms are tried for three diverse solar lights, for example, 500w/m², 600w/m² and 1000w/m². For each solar illumination solar PV voltage, current and power created are given in table 1.

Table 1 Comparison of MPPT for solar power system

Solar Irradiation (W/m ²)	Hybrid MPPT			FLC based MPPT		
	Voltage (V)	Current (A)	Power (W)	Voltage (V)	Current (A)	Power (W)
500	72	11.66	840	34.1	18.2	620
600	68	13.97	950	35.4	22.5	760
1000	50	22.40	1120	42.2	25.1	1050

The proposed half and half MPPT algorithm offers high power yield contrasted with FLC based MPPT algorithm for all the solar illumination experiments, for example, for example, 500w/m², 600w/m² and 1000w/m². The two proposed MPPT algorithm offers high yield power to the corresponding increment in solar illumination. Solar PV yield current is step by step expanding relating to the expansion in solar illumination.

In the crossover MPPT algorithm time taken to arrive at the maximum power point is expanding is step by step expanding when the solar illumination changes. Time taken to arrive at the maximum power point is appeared in Table 2.

Table 2 Time taken to reach Maximum Power Point

Solar Irradiation (W/m ²)	Time in Seconds	
	Hybrid MPPT	FLC based MPPT
500	13	5
600	14	5
1000	16.5	5

From the information on the solar PV energy change framework adequate guidelines are shaped in the FLC based MPPT algorithm. The fuzzy set and the scope of qualities for each fuzzy set for the info and yield factors are framed for the FLC based MPPT algorithm. Since the guidelines and fuzzy set are appropriately made for the solar power framework, the FLC based MPPT algorithm takes fixed time of 5 seconds to arrive

at the maximum power point in solar PV energy change framework.

3. MPPT For Wind Energy System

Changed P&O algorithm is proposed to get maximum power from the wind energy transformation framework. At the point when the wind speed changes progressively from 6.5m/s

to 9.5m/s the stator dynamic power and converter yield power increments for a limited quantity. The obligation cycle is balanced and the converter yield voltages is made consistent to an estimation of 595V. The electromagnetic torque is diminishing from 1.5Nm to 1.3Nm. Comparison of factors in wind energy transformation framework is appeared in Table 3.

Table 3 Comparison of variable in wind energy conversion system

Wind speed (m/sec)	Stator active power(w)	Converter output power(w)	Converter voltage (Volts)	Electromagnetic torque (Nm)
6.5	375	358	595	1.5
7.5	386	372	595	1.4
9.5	395	384	595	1.3

For any variety of wind speed from 6.5m/s to 9.5m/s, the time taken to arrive at the maximum power point is 0.8 seconds. Change of power and change of voltage are considered to change the obligation cycle of the lift converter. The proposed altered algorithm reacts rapidly to change in wind speed.

4. Comparison With Other Techniques

The maximum power point got by the proposed strategy is contrasted and P&O technique created. Table 4 shows the maximum power point came to of the above said strategies.

Table 4 Comparison of maximum powers with other techniques for solar power conversion system

Solar Irradiation (W/m ²)	Hybrid MPPT (Watts)	FLC based MPPT (Watts)	Modified P&O (Mohammed et al. 2012) (Watts)
857	1080	950	900

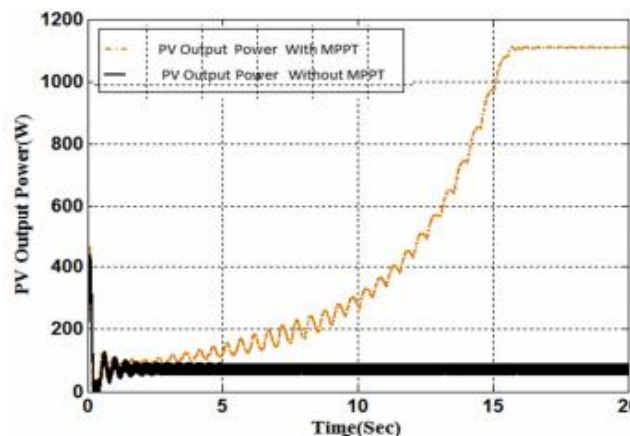


Figure 1 Output power for the solar irradiance (857 W/m²) in hybrid MPPT technique

Table 4 shows that the proposed strategies grow more power at the heap terminals in solar power energy transformation framework. The reaction of the proposed Hybrid

MPPT and FLC based MPPT systems are appeared in Figures 1 and 2 separately for solar irradiance of 857 W/m².

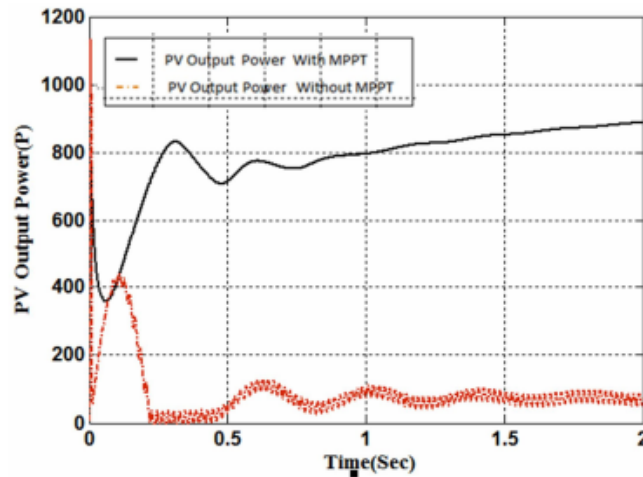


Figure 2 Output power for the solar irradiance (857 W/m²) in FLC based MPPT technique

The maximum power point acquired by the proposed strategy created. Table 5 shows the maximum power point technique is contrasted and versatile advance size P&O came to of the above said techniques.

Table 5 Comparison of maximum powers with other techniques for wind energy conversion system

Wind speed (m/sec)	Proposed Modified P&O method (Watts)	Adaptive step size P&O method (Zakariya et al. 2013) (Watts)
9	380	375

5. Issue Related to The Conventional P&O MPPT Scheme

The fundamental issue with the ordinary P&O MPPT plot is its inability to give the right MPP under quick changing climatic conditions as appeared in figure and is additionally talked about in Efram and Chapman. figure shows that the working point An under one environmental condition; an irritation in

reference signal (which is voltage in the figure) brings the working point at B. This algorithm is turned around back to working point A because of the abatement in power. In any case, if the solar light changes, the power bend moved from P2 to P1 in one inspecting period.

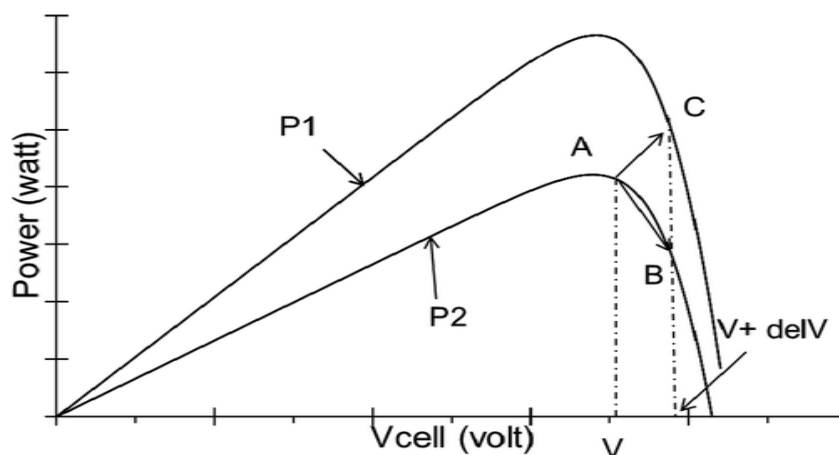


Fig. 3. Issue in P&O MPPT scheme under changing atmospheric condition

6. Conclusion

The proposed three MPPT algorithms are analyzed in this paper. The two algorithms proposed for the solar PV framework to be specific mixture MPPT algorithm and FLC based MPPT algorithm are looked at as far as solar PV yield

voltage, current and power. These algorithms are thought about for the varieties of three diverse solar illuminations. The reaction of the proposed adjusted P&O algorithm is analyzed for the three diverse wind speed varieties.

References

- [1] Nabil A. Ahmed and Masafumi Miyatake, "A StandAlone Hybrid Generation System Combining Solar Photovoltaic and Wind Turbine with Simple Maximum Power Point Tracking Control", IEEE Xplore 2006.
- [2] Joanne Hui, AlirezaBakhshai and Praveen K. Jain, "A Hybrid Wind-Solar Energy System: A New Rectifier Stage Topology", IEEE Xplore 2010.
- [3] Fernando Valencaga, Pablo F. Puleston and Pedro E. Battaiotto, "Power Control of a Solar/Wind Generation System Without Wind Measurement: A Passivity/Sliding Mode Approach", IEEE Trans. Energy Conversion, Vol. 18, No. 4, pp. 501-507, December 2003.
- [4] Yi Goo, John N. Jiang, and ChoonYik Tang, "Nonlinear Control of Wind Power Generation Systems," 2009 IEEE Xplore.
- [5] C. C. Hua and C. M. Shen, "Study of maximum power tracking techniques and control of dc-dc converters for photovoltaic power system," Proceedings of 29th annual IEEE Power Electronics Specialists Conference, vol. 1, 2008, pp. 86-93.
- [6] J. A. Gow and C. D. Manning, "Development of a photovoltaic array model for use in power-electronics simulation studies," IEE Proceedings- Electric Power Applications, vol. 146, no. 2, 2009, pp. 193-199.
- [7] W. D. Kellogg, M. H. Nehrir, G.Venkataramanan, and V. Gerez, "Generation unit sizing and cost analysis for standalone wind, photovoltaic, and hybrid wind/PV systems," IEEE Trans. Energy Conversion., vol. 13, no. 1, pp. 70-75, Mar.2008.
- [8] T. Senjyu, T. Nakaji, K. Uezato and T. Funabashi, "A hybrid System Using Alternative Energy acilities in Isolated Island," IEEE Trans. Energy Conversion, vol. 20, no. 2, pp. 406-414 June 2005.
- [9] L.-Q. Liu and Z.-X. Wang, "The development and application practice of wind-solar energy hybrid generation systems in China," Renewable and Sustainable Energy Reviews, no. 13, pp. 1504-1512, 2009.
- [10] F. Valenciaga and P. F. Puleston, "Supervisor control for a stand-alone hybrid generation system using wind and photovoltaic energy," IEEE Trans. Energy Conversion, vol. 20, no. 2, pp. 398-405, June 2005.
- [11] I. S. Kim, M. B. Kim, and M. J. Youn, "New maximum power point tracker using sliding-mode observer for estimation of solar array current in the grid-connected photovoltaic system," IEEE Transaction on Industrial Electronics, vol. 53, no. 4, 2006, pp. 1027-1035.