Least Mean Fourth Based Algorithm for Single-Stage Three-Phase Grid Integrated Solar Photovoltaic System

N. Narasimhulu[1] B.S.Kishore Kumar[2] K.Swathi[3] Dr. R. Ramachandra[4]
[1]Head of Dept. [2]PG Student [3]Assistant Professor [4]Principal
[1,3]Department of Electrical and Electronics Engineering
[1,2,3,4]SKD College of Engineering, Gooty, AP, India

Abstract— The objective of this paper is to develop model of least mean square fourth (LMF) based algorithm for single stage three phase grid connected photovoltaic (PV) system. The proposed LMF based control algorithm has been implemented for the harmonics extraction from the sinusoids. It is viewed as better from existing ordinary calculations (SRFT, IRPT and so on.) in ways that it includes straightforward calculation, simple to actualize as it influences utilization of basic mathematical blocks for computation though SRFT and IRPT to include complex squares, more steady, sets aside less opportunity to settle and is turned out to be more dependable. The reproductions were performed in the earth of MATLAB/SIMULINK.

Key words: LMF, Photovoltaic, SRFT

I. Introduction

Interest for spotless, temperate, and sustainable power source has expanded reliably finished the previous couple of decades. Among an assortment of sustainable power source resources accessible, sunlight based vitality gives off an impression of being a noteworthy contender because of its wealth and contamination free change to power through photovoltaic (PV) process. Expanding enthusiasm for PV systems, requests development in innovative work exercises in different angles, for example, Maximum Power Point Tracking (MPPT), PV clusters, anti-islanding insurance, dependability and unwavering quality, power quality and power electronic interface. With increment in penetration level of PV systems in the current power systems, these issues are relied upon to wind up plainly more basic in time since they can have recognizable effect on the general system execution. More proficient and financially savvy PV modules are being created and fabricated, in light of the worries raised by the PV system engineers, utilities and clients. Various measures have been intended to address power quality and lattice coordination issues. Broad research in the field of MPPT has brought about quick and streamlined strategy to track the maximum power point. With respect to electronic converter to interface PV exhibits to the matrix, Voltage Source Inverter (VSI) is a broadly utilized topology to date.

II. Photo Voltaic System

One technology to generate electricity in a renewable way is to use solar cells to convert the energy delivered by the solar irradiance into electricity. PV energy generation is the current subject of much commercial and academic interest. Recent work indicates that in the medium to longer term PV generation may become commercially so attractive that there will be large-scale implementation in many parts of the developed world.

The integration of a large number of embedded PV generators will have far reaching consequences not only on the distribution networks but also on the national transmission and generation system. If the PV generators are built on the roof and sides of buildings, most of them will be located in urban areas and will be electrically close to loads.

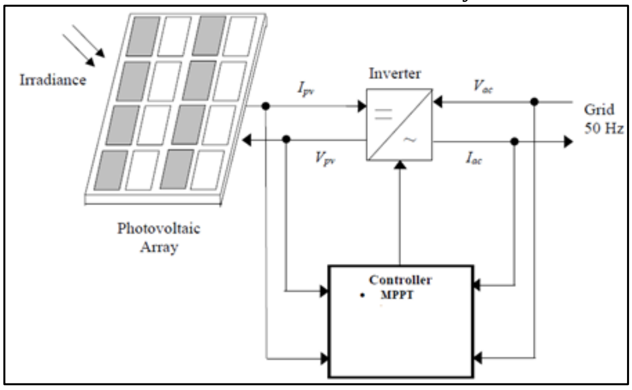


Fig. 1: Schematic diagram of Grid Connected PV Generation

Figure 1 shows a functional diagram of the basic configuration of a grid-connected PV system. The dc output current of the PV array Ipv is converted into ac and injected into the grid through an inverter. The controller of this inverter implements the entire main control: Maximum Power Point Tracking (MPPT). Solar irradiance is the radiant power incident per unit area upon a surface. It is usually expressed in w/m2. Radiant power is the rate of flow of electromagnetic energy. The most extreme changes in the yield power of PV systems more often than not happen at maximum irradiance level around twelve. This period normally harmonizes with the off-crest stacking time of the electric system, and along these lines, the working penetration level of the PV system is most noteworthy.

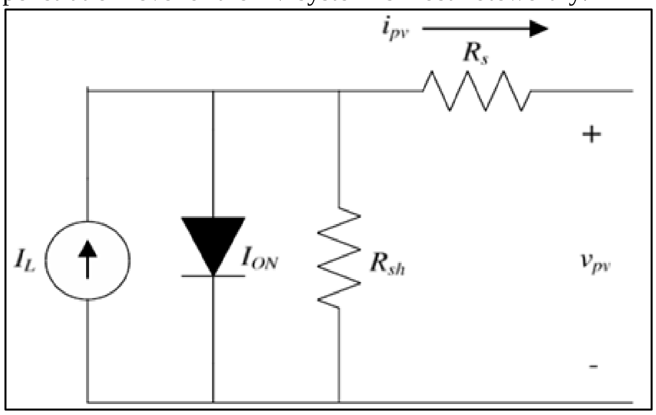


Fig. 2: Circuit diagram of PV cell

Figure 2 shows an equivalent circuit diagram of a PV cell which consists of a light-generated current source IL, a parallel diode, a shunt resistance Rsh, and a series resistance Rs.

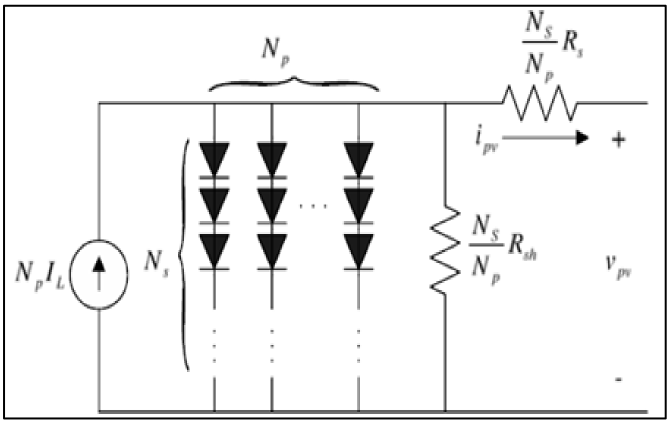


Fig. 3: Circuit diagram of PV array

Figure 3 shows an electrical equivalent circuit diagram of a PV array, where Ns is the number of cells in series and Np is the number of modules in parallel.

III. MPPT BASED PHOTOVOLTAIC

For maximum power exchange, the heap ought to be coordinated to the protection of the PV board at MPP. In this manner, to work the PV boards at its MPP, the system ought to have the capacity to coordinate the heap consequently and furthermore change the introduction of the PV board to track the Sun if conceivable. A controller that tracks the maximum power point locus of the PV cluster is known as a MPPT controller.

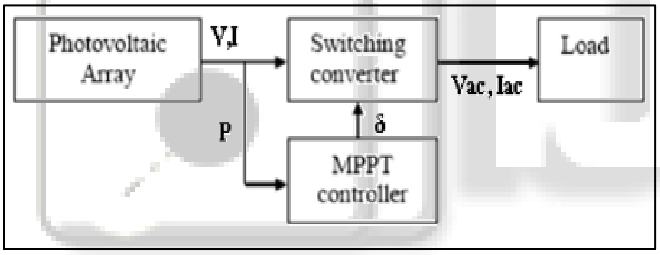
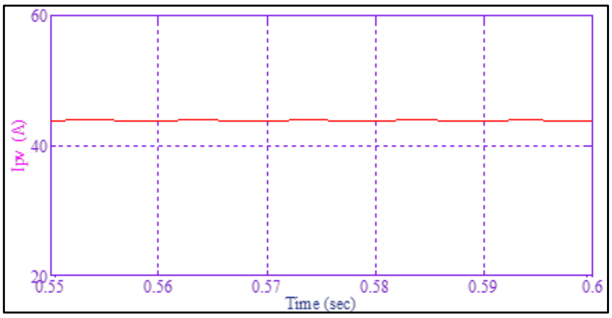


Fig. 4: Basic MPPT system

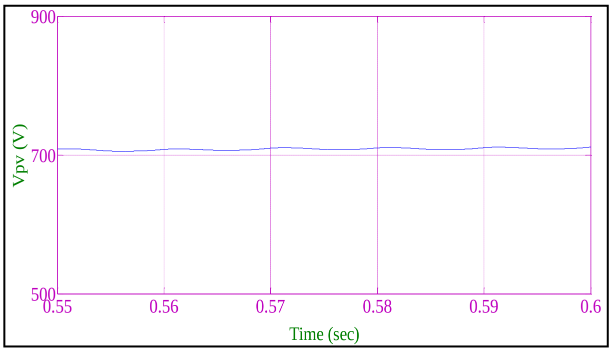
To generate gating signals for switching of the VSC, an indirect current control technique is used with a hysteresis regulator. The error current signal is calculated from the difference between reference grid currents (i∗sa, i∗sb, i∗sc) and sensed grid currents (isa, isb, isc).

IV. SIMULATION RESULT ANALYSIS

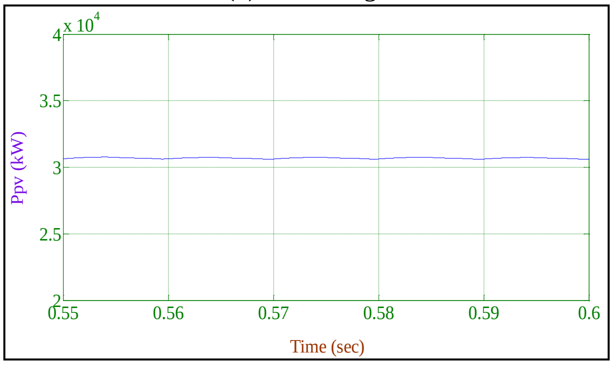
In this segment, reproductions are given to show the legitimacy and preferred standpoint of the proposed technique. The proposed single-arrange three stage SPV power producing system coordinated with the lattice is demonstrated and recreated in MATLAB/Simulink.



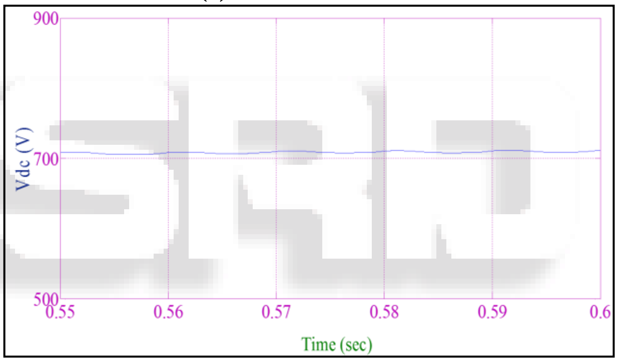
(a) PV output current



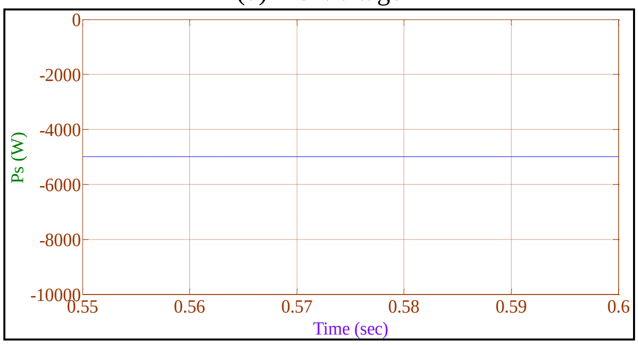
(b) PV Voltage



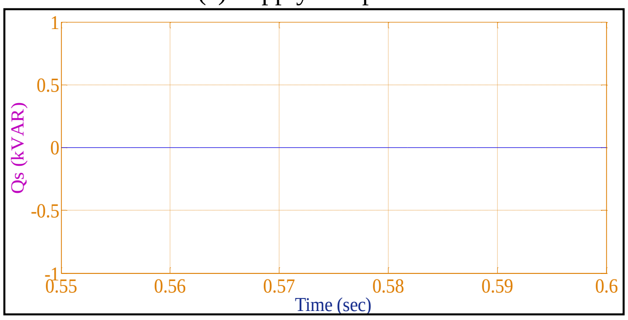
(c) Maximum Power



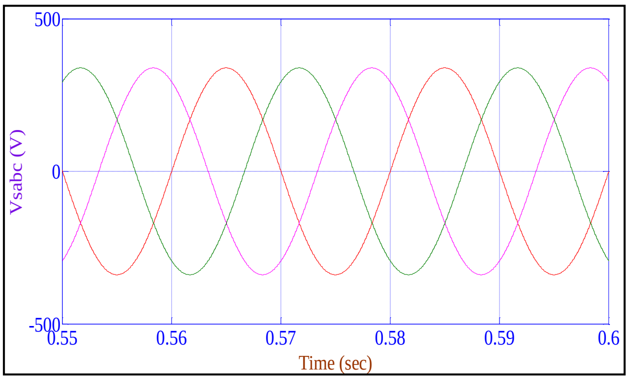
(d) DC Voltage



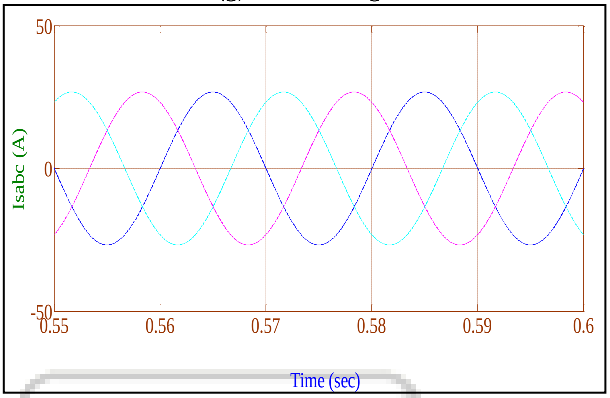
(e) Supply real power



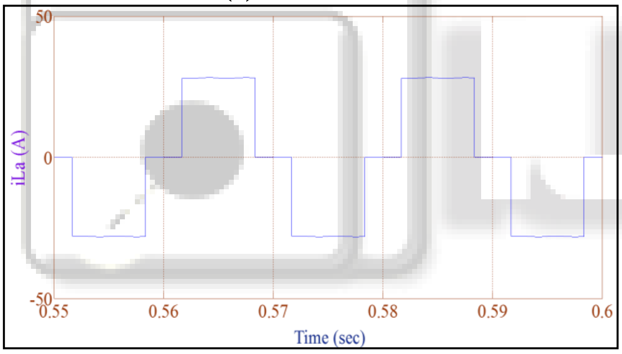
(f) Reactive Powe



(g) Grid Voltage



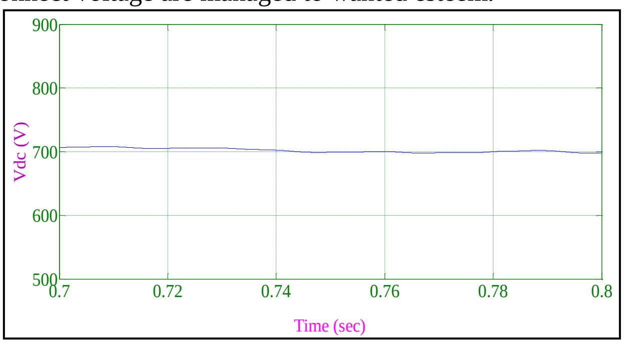
(h) Grid Current



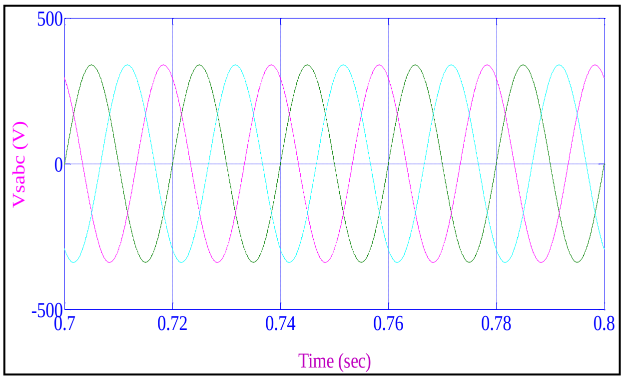
(i) Load Current

Figure5: Steady state response under nonlinear load

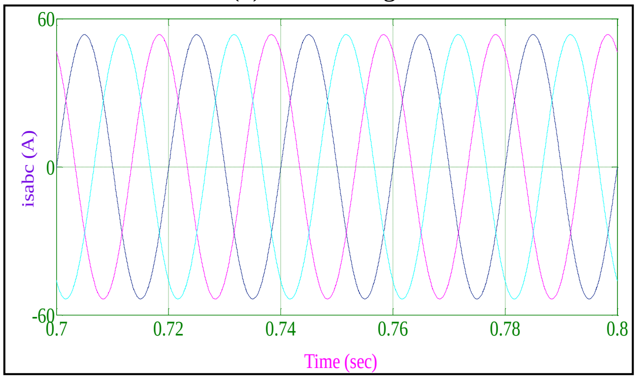
Figure 5 portrays the relentless state conduct of the proposed topology under a nonlinear load. Figure 6 demonstrates the dynamic conduct and middle of the road signs of proposed system individually under lopsided load from 0.70 to 0.75 s. Indeed, even under the heap unbalancing, the lattice streams are kept up sinusoidal with matrix voltages and the dc connect voltage are managed to wanted esteem.



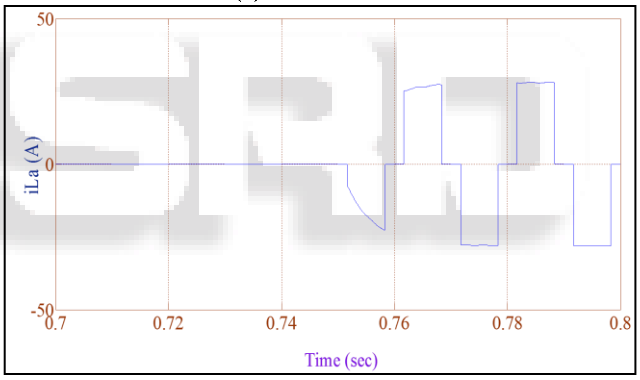
(a) DC Voltage



(b) Grid Voltage



(c) Grid Current



(d) Load current

Fig.ure 6: Dynamic response under unbalanced nonlinear load

V. CONCLUSION

In this paper, the control algorithm has been based on a least mean fourth adaptive filtering technique is proposed. This technique has been designed for grid connected Photovoltaic power system. The simulation results have depicted and maximum power is extracted from the solar photovoltaic power system. The results of the proposed system have proved to be efficient and consistent in comparison with existing conventional control algorithms.

REFERENCES

[1] P. Moutis, A. Vassilakis, A. Sampani, and N. D. Hatziargyriou, "DC switch driven active power output control of photovoltaic inverters for the provision of frequency regulation," IEEE Trans. Sustain. Energy, vol. 6, no. 4, pp. 1485–1493, Oct. 2015.

[2] B. Subudhi and R. Pradhan, "A comparative study on maximum power point tracking techniques for photovoltaic power systems," IEEE Trans. Sustain. Energy, vol. 4, no. 1, pp. 89–98, Jan. 2013.
[3] K. Sundareswaran, P. Sankar, P. S. R. Nayak, S. P. Simon, and S. Palani, "Enhanced energy output from a PV system under partial shaded conditions through artificial bee colony," IEEE Trans. Sustain. Energy, vol. 6, no. 1, pp. 198–209, Jan. 2015.
[4] C. Kai, T. Shulin, C. Yuhua, and B. Libing, "An Improved MPPT controller for photovoltaic system under partial shading condition," IEEE Trans.Sustain. Energy, vol. 5, no. 3, pp. 978–985, Jul. 2014.
[5] S. Saxena and Y. Hote, "Load frequency control in power systems via internal model control scheme and model-order reduction," IEEE Trans. Power Sys., vol. 28, no. 3, pp. 2749–2757, Aug. 2013.
[6] P. C. Sekhar and S. Mishra, "Takagi–Sugeno fuzzy-based incremental conductance algorithm for maximum power point tracking of a photovoltaic generating system," IET Renewable Power Gener., vol. 8, no. 8, pp. 900–914, Nov. 2014.
[7] S. K. Kollimalla and M. K. Mishra, "Variable perturbation size adaptive P&O MPPT algorithm for sudden changes in irradiance," IEEE Trans. Sustain. Energy, vol. 5, no. 3, pp. 718–728, Jul. 2014
[8] S. A. George and F.M. Chacko, "Comparison of different control methods for integrated system of MPPT powered PV module and STATCOM," in Proc. Int. Conf. Renew. Energy Sustain. Energy, Dec. 5–6, 2013, pp. 207–212.
[9] B. Singh, D. T. Shahani, and A. K. Verma, "IRPT based control of a 50 kW grid interfaced solar photovoltaic power generating system with power quality improvement," in Proc. IEEE 4th Int. Symp. Power Electron. Distrib. Gener. Syst., Jul. 8–11, 2013, pp. 1–8.
[10] B. Singh, D. T. Shahani, and A. K. Verma, "Neural network controlled grid interfaced solar photovoltaic power generation," IET Power Electron., vol. 7, no. 3, pp. 614–626, Mar. 2014.
[11] S. Kumar, A. K. Verma, I. Hussain, and B. Singh, "Performance of grid interfaced SPV system under variable solar intensity," in Proc. IEEE 6th India Int. Conf. Power Electron., Dec. 8–10, 2014, pp. 1–6.
[12] C. Jain and B. Singh, "A Three-phase grid tied SPV system with adaptive DC link voltage for CPI voltage variations," IEEE Trans. Sustain. Energy, vol. 7, no. 1, pp. 337–344, Jan. 2016.

