International Journal of Research
Available at https://edupediapublications.org/journals
e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 15
May 2018

Optimization Technique for Improving the Performance of PV based Self-Lift Luo Converter

K.Raghuveer & Dr.Moinuddin K Syed
M.Tech.,(Ph.D)
Sairaghu22@gmail.com
Research Scholar Department of Electrical Engineering, Himalayan University,Itanagar, India
moinuddin_syed@hotmail.com
Professor EEE Department SCIENT,Hyderabad,India

Abstract— *The paper presents a self-lift Luo converter for photo-voltaic (PV) based application. Proposed Luo converter exhibits high-gain characteristics yielding high output DC level required for PV applications. The photovoltaic cells are operated at their maximum power point using Maximum Power Point Tracking (MPPT) techniques. Illumination, temperature, radiation intensity are some of the factors that can influence the maximum power point. Particle swarm optimization (PSO) based Maximum Power Point Tracking (MPPT) is employed with PID controller to track the maximum power from the PV cell. Duty cycle for Luo converter is generated by sensing the panel voltage, current and the corresponding power values. Simulation analysis is presented using MATLAB/SIMULINK software for PV with Luo converter with PSO technique.*

Keywords — PV module, Maximum power point tracking, PSO ,Super-lift Luo converter.

I.INTRODUCTION

An Analysis is done on basic DC-DC converter, which is used in high voltage applications, to implement the Improved Negative Output Super-Lift Luo Converter. By using VL technique The NOSLC converter produces high negative voltage. By applying this VL technique effectively to increases the output voltage and overcomes the results of parasitic elements. . Therefore, from source voltage these DC/DC converters produces higher output voltage with greater efficiency and a simple structure. The block diagram describes that the supply voltage is fed to the INOSLC and then the output from it is given to the load. By comparing the as the output from the converter with the reference voltage an error is generated as the output.This output is fed to the controller block. As result the controller produce the duty ratio. To generate the required pulse for the operation of the system this duty ratio is given to the switch. The PhotoVoltaic systems arise with a problem of poor efficiency, to overcome this disadvantage "Maximum Power Point Tracking (MPPT)".method is used.

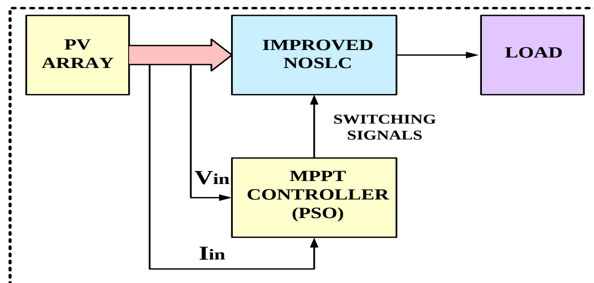

Fig. 1 Block Diagram

A variety of maximum power point tracking (MPPT) method is developed. The methods vary implementation complexity, sensed parameters, range of operation, convergence speed and cost, popularity and their application. Particle Swarm Optimization is a combinatorial method implied with PID controller. This MPPT method helps in tracking maximum power by sensing panel voltage and current.

II. PV CELL MODEL AND CHARACTERISTICS

PV CELL MODEL

Photo voltaic is method of generating electrical power by converting solar power into direct current electricity using semiconductors that exhibits the photo voltaic effect. Photovoltaic power generation employs solar panels composed of a number of solar cells containing a photovoltaic material. The equivalent circuit of PV module is given by,

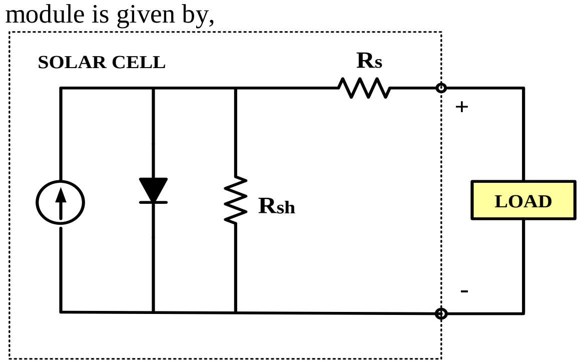

Fig. 2 Block diagram representation

International Journal of Research
Available at https://edupediapublications.org/journals
e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 15
May 2018

The intrinsic shunt resistance ,Rsh and series resistance, Rsare used in PV cell . The current source represents the cell photo current. Usually the value of Rsh is muchgreater than the value of Rs.
Equations of pv module is modeled mathematically is given by, Module photo-current ($\mathbf{I_{Ph}}$)

$$I_{ph}=[I_{sc}+k_i(T\text{-}T_r)]X$$

Where X is the module illumination T_r is the reference temperature I_{sc} is the short circuit current of the PV module at reference temperature, k_i is the short circuit current temperature co-efficient is the module operating temperature .
Module reverses saturation current-I_r

$$I_r=\frac{I_{sc}}{[exp\left(\frac{qVoc}{NskAT}\right)-1]}$$

Where Ns is the no of cells connected in series, Voc is the open circuit voltage, A is the ideality factor, q is the electron charge, k is the Boltzman constant. The Module saturation current Io varies with the cell temperature, which is given by

$$I_s = I_{rs}\left(\frac{T}{T_r}\right)^3 * e^{\left(\left(\frac{qEg}{KA}\right)*(1/T_r-1/T)\right)}$$

Eg is the band gap for silicon.
The current output of pv module is

$$I_{pv} = \mathrm{I_{ph}} - \mathrm{I_s} * \left[\frac{e^{\wedge}(q(Vpv + IpRs))}{NsAKT} - 1\right]$$

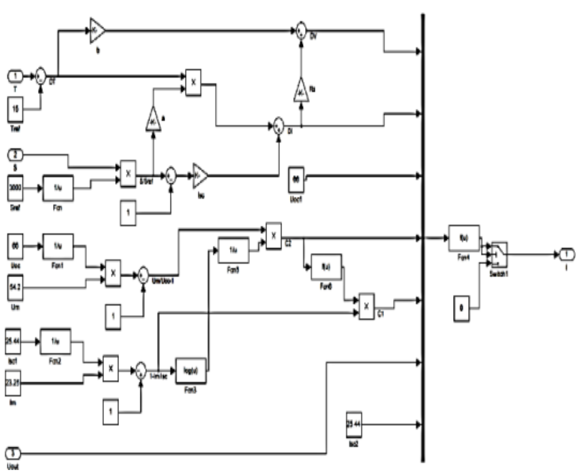

Fig 3 Modeling of Solar Panel

III.IMPROVED NEGATIVE OUTPUT SUPER-LIFT LUO CONVERTER

The basic converter shown in Fig. 4 is NOSLC.The circuit consists of a MOSFET switch S, Diodes D1, D2, Inductor L1,Capacitors C1, C2 and load resistance R .From the above two figures it is observed that to the NOSLC circuit,the modifications is brought to the INOSLC circuit by adding an additional inductor and a diode to it.

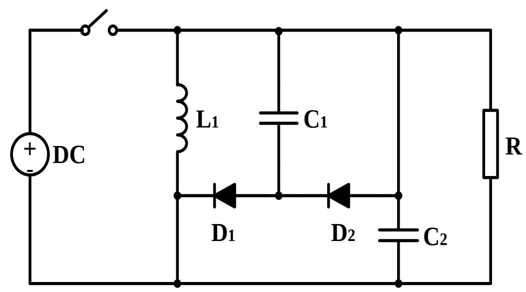

Fig.4 Basic NOSLC Circuit

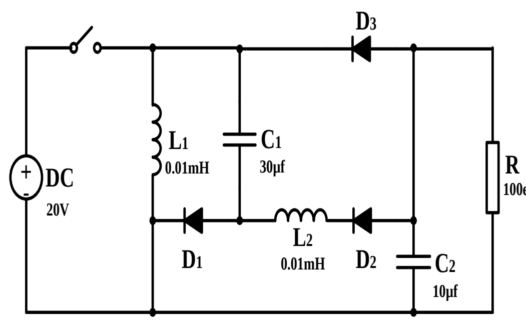

Fig. 5 Circuit Diagram of INOSLC

ANALYSIS OF INOSLC

The switching topologies of the proposed circuit in fig. 2 is shown in fig. 3 and fig. 4 as follows.

Mode 1: Switch S ON

In this mode the switch is closed and the source voltage results in flow of current through the inductor L1 and capacitor C1. Since capacitor C1 has zero impedance to current the capacitor C1 charges faster than inductor thus diode D1 gets forward biased.

International Journal of Research
Available at https://edupediapublications.org/journals
e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 15
May 2018

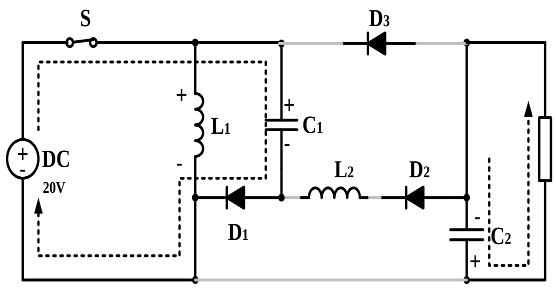

Fig. 6(a) Mode 1 Switch is ON

$$\Delta I_{L1} = \frac{(V_{in}kT)}{L_1} \quad (1)$$

$$I_{C_{2,on}} = I_0 = \frac{(CdV_0)}{dt} \quad (2)$$

Mode 2: Switch S OFF

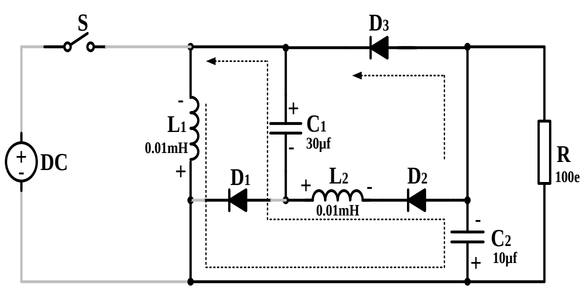

Fig. 6(b) Mode 2 Switch is OFF

In this mode the switch is opened, thereby the energy that is stored in the inductor L1,L2 and the capacitor C1 discharges across the nodal points of the capacitor C2 thus boosts the output voltage. The inductor L1 supplies the load current.

$$\Delta I_{L_1} = \frac{(V_0 - V_{in})(1-k)T}{L_1} \quad (3)$$

$$\Delta I_{L_2} = \frac{(V_0 - V_{in})(1-k)T}{L_2} \quad (4)$$

Equating (1) &(3)

$$V_0 = \frac{2V_{in}}{1-k} \quad (5)$$

Where n = 1 (elementary circuit)

Voltage transfer gain $G = \frac{V_0}{V_{in}}$ (6)

During steady state, the current through C2on time capacitor current equals C2off time capacitor current.

$$KT_{ic_{2on}} = (1-k)T_{ic_{2off}}$$

$$\text{For } I_{C_1}, KT_{ic_{2on}} = (1-k)T_{ic_{1off}} \quad (7)$$

$$I_{C_{1on}} = \frac{k}{(1-k)I_{c_{1off}}}$$

$$i_{C_{2off}} = \frac{kI_0}{(1-k)} \quad (8)$$

From ModeII,By nodal equation,

$$I_{L_1} + I_{L_2} = I_{C_{2off}} + I_0$$

$$I_{L_1} = \frac{I_0}{2(1-k)} \quad (9)$$

Variation ratio of Inductor I_{L1} $\varepsilon = \frac{k(1-k)R}{2GfL_1}$ (10)

The ripple Voltage of the Output Voltage is ΔV_o

$$\Delta V_0 = \frac{(1-k)V_0}{fC_2R}$$

Variation ratio of Output voltage V_o is $\varepsilon = \frac{(1-k)}{2fRC_2}$

The specifications of the parameters used in the circuit are as follows

TABLE I.CIRCUIT PARAMETERS

Parameter's name	Symbol	Value
Input voltage from PV Panel	V_{in}	12 V
Output voltage of the converter	V_o	-75V
Inductors	L_1,L_2	0.01mH,0.01mH
Capacitors	C_1,C_2	30µF,10µF
Nominal Switching Frequency	F_s	50KHz
Load Resistance	R	100Ω
Duty Cycle	K	0.67

IV PARTICLE SWARM OPTIMIZATION

Particle swarm optimization is a computational method that optimizes a problem by iteratively

International Journal of Research
Available at https://edupediapublications.org/journals
e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 15
May 2018

improves a candidate solution with regard to a given measure of quality. In this paper, to be realized as a MPPT algorithm, the particle position in PSO represents the duty-cycle, the velocity is the step-size of the duty-cycle, and the objective function is maximizing the converter power.

A . PSO WITH PI CONTROLLER

PSO with PID controller is method to extract the maximum power from photovoltaic PV Panel subject to partial shading. In this paper, PSO based method used for tracking maximum power point from non-linear PV characteristics of PV Panel. PID controller adjust the performance of the system by reaching reference value in less time and minimum steady state error. The PSO based optimization deals with different disturbances that can affect the normal operation of PV Panel. The mathematical expression for velocity update for PSO

$$V_{i(k+1)} = W_i * V_{ik} + C_1 x R_1 * (pbest - X_{ik}) + C_2 * R_2 * (gbest - X_{ik}) \quad (11)$$

The improved velocity updated for the PSO

$$V_{i(k+1)} = W_i * V_{ik} + C_1 * R_1 * (pbest - X_{ik}) + C_2 * R_2 * (gbest - X_{ik}) + C_2 * R_L * (gbest - X_{ik}) \quad (12)$$

Where

V_{ik} Current velocity of particle i at iteration k,

$V_{i(k+1)}$) updated velocity of particle i,

Wi different inertia weight of particle i,

$C_1, C_2,..C_L$ positive constants,

X_{ik} current position of particle i at inertia k,

$R_1, R_2, \ldots\ R_L$ random number between 0 and 1

L positive number (L = 1 … L)

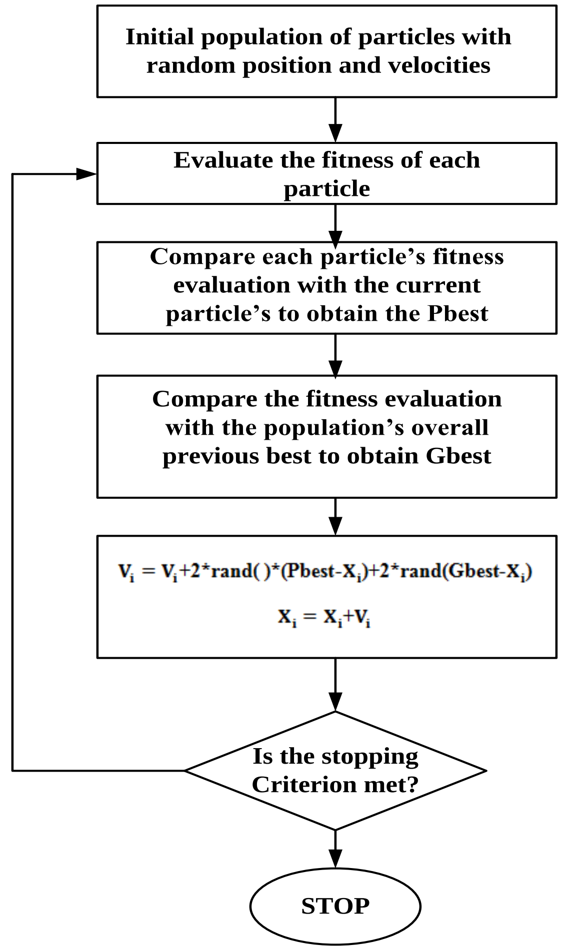

Fig .7 Flowchart of PSO

V SIMULATION RESULTS

The INOSLC with load resistance 100Ω, when fed with 12V DC input from PV Panel with the duty ratio of 67% gives the output voltage of -75V. The DC output voltage produced by PV module depends on variation in irradiation, intensity and temperature. The PV panel gives5.5A and 12V for Irradiation of 650W/m^2.The power input to the converter is 60W .The INOSLC produces output voltage six times of the input voltage .The proposed converter is connected with PV panel is shown in Fig.The INOSLC is simulated in MATLAB/Simulink soft ware .And the simulated outputs are shown in the following figures.

International Journal of Research
Available at https://edupediapublications.org/journals
e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 15
May 2018

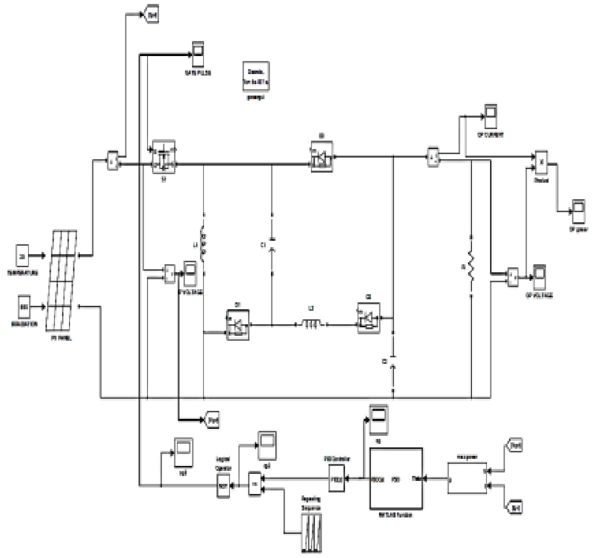

Fig.8 INOSLC connected to PV Panel with MPPT Tracking(PSO-PID controller)

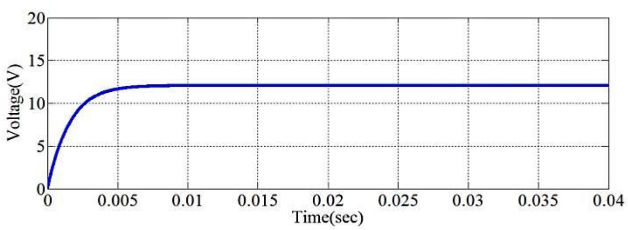

Fig.9 Input Voltage to the converter

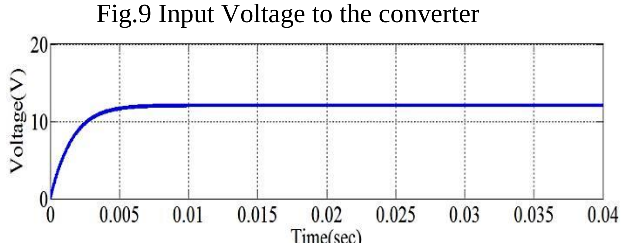

Fig. 10 Volatge across the Capacitor C_1

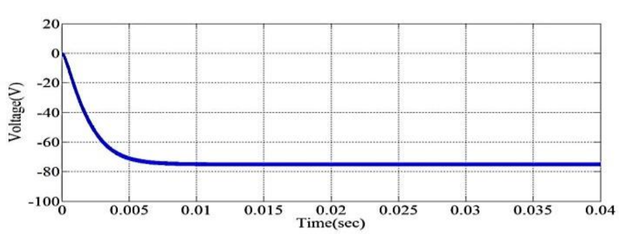

Fig. 11 Volatge across the Capacitor C_2

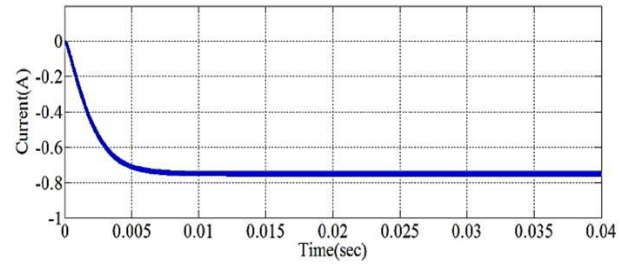

Fig.12 Output current of the converter

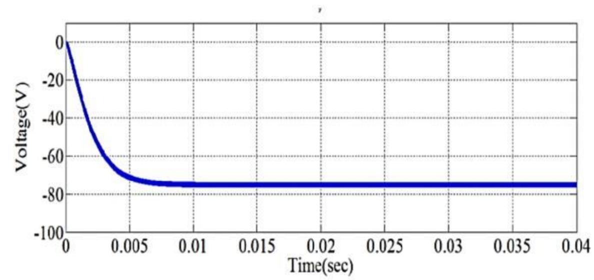

Fig .13 Output Voltage from the converter

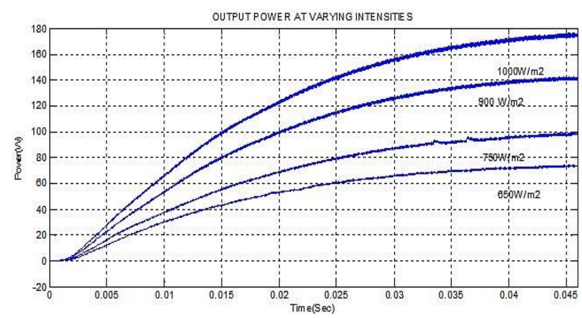

Fig. 14 Power at different radiations

TABLE II. Power at different radiations

RADIATION INTENSITY(W/m^2)	OUTPUT POWER(W)
650	76
700	90
750	110
800	120
900	150

X. CONCLUSION

By adding an inductor and a diode to the basic NOSLC circuit, the voltage gain is increased. By using PV Panel as input source to the converter from which maximum power is extracted using MPPT technique (PSO with PID controller).This method has achieve steady state in less time and has high convergence rate. PSO is combinatorial optimization used with PID controller. With less number of components the proposed converter produces same output as re-lift converter .

REFERENCES

[1] Fang Lin Luo, Senior Member, IEEE, and Hong Ye, Member, IEEE, "Negative Output Super-Lift Converters",IEEE Transactions on Power electronics, vol.18,no.5,September2003.
[2] Fang Lin Luo, Hong Ye, "Advanced DC-DC converters", CRC Press. [3] F. L. Luo and H. Ye, "Negative Output Super-Lift Luo-Converters," Proceedings (CD-ROM) of IEEE International Conference PESC'03, Acapulco, Mexico, June 15-19,2003,pp.1361-1366.
[4] V. Chamundeeswari ,R. Seyevhai ,A. Arul Robin ,"Stabilization and Robustification of Negative Output Super-Lift Luo Converter using Sliding Mode control Approach",International Journal of Advances inEngineeringand Technology,May 2012,ISSN:2231-1963.
[5]YefimBerkovich,BorisAxelrod,RotemMadar,AvrahamTwina,"ImprovedLuoConverteModificationswitch increasing voltageratio",International Journal on IET Power electronics,ISSN 1755-4535
[6]Kennedy,J.andEberhart,"ParticleSwarmOptimization"publishedinyear1995.
[7]Selvapriyanka.P,Vijayakumar.G."ParticleSwarm Optimization Based MPPT for PV System under Partial Shading Conditions" published in year 2014.
[8] Vijay kumar Gali, Hemakumar.K., "SEPIC converter based Photo voltaic system with Particle swarm Optimization MPPT" published in international IEEE Conference .
[9] Ze Cheng, Hang Zhou, Hongzhi Yang , "Research on MPPT control of PV system based on PSO algorithm", International Journal on IET Power electronics,2010.
[10]Brunton, S. L. M. and al. 2010. Maximum Power Point Tracking forPhotovoltaic Optimization Using RippleBased Extremum Seeking Control. IEEE Trans. On Power Electronics, Vol. 25, 2531-2540.
[11] Kashif Ishaque,Zainal Salam,Muhammad Amjad and Saad Mekhilef, "Improved PSO – Based MPPT for PV with Reduced steady state oscillation" ,IEEE Transactions on Power Electronics, 2012.
[12] Esram, T. and Chapman, P. (2007) "Comparaison of Photovoltaic Array Maximum Power Point Tracking Techniques'', IEEE Trans. On EnergyConversion.
[13] Li Xu-zhou, Yu Fei, Wang You-bo, "PSO Algorithm based online Self Tuning of PID Controller'', International Conference on Computational Intelligence and Security, 2007.
[14] Alrijadjis, Tanaka K, "Self-tuning PID controller based on PSO-RIW for ultrasonic motor'', International Journal of Engineering Innovation and Management, Vol.2 (2012), pp.3340.
.