A PQ Grid Connection Secs using IC MPPT Method PI Controller with Better Performance Based on VSC Switching Operation

[1]L Nadam, [2]Ch Krishna, [3]P Lavanya, [4]Lakavath Renuka
[1,2,3]Assistant Professor, [4]UG Student, [1,2,3,4]Department of Electrical and Electronics Engineering, Brilliant Institute of Engineering and Technology, Hyderabad, India.

Abstract
The power quality (PQ) of PI-based Grid-Connected Solar Energy Conversation Systems (SECS) when nonlinear loads are coupled to a distribution network is discussed in this paper. When non-linear loads, such as three-phase bridge rectifiers, are connected to a network, harmonics are generated in the network as a result of the switching action. This PQ problems are severe impact on dynamic performance of the SECS, this are solved by employing PI controller based voltage source converters. Satisfactory results are produced using verified simulation results in MATLAB.
Key words – SECS, PQ, PI controllers

1 Introduction

Due to its numerous benefits, such as not contributing to greenhouse gas emissions, being environmentally friendly, and not harming the ozone layer, sources of renewable energy have been rapidly expanding during the course of the generation of power. Due to the components they include, the many RES areas that are accessible, including geothermal, solar, wind, and many others, have been popular for adapting power distribution production.

SECS are broadly classified into Stand-alone PV systems and the grid- connected PV systems, categorizes [1- 5]. The main difference between these two SECS is that in stand-alone systems, PV output is evenly balanced with load demand, whereas in grid connected SECS, both PV and grid are accountable for meeting load demand. When non linear loads, such as a three-phase bridge rectifier, are connected in the circuit grid, power quality concerns such as harmonics, voltage sags, and voltage swells occur. The existence of non linear loads in the distribution causes these power quality issues (load).

The voltages produced from arrays PV have been preserved in battery as exhibited in contribution [6-7]. The solar cell rating for current and voltage has been augmented by interlinking, leads of solar cells in parallel and series combinations. The solar cell does not have capability of storage; generate electricity from the solar that has been preserved in batteries. The commercial and industrial rating of power generation of solar voltage rating varies from the 300-1000v, where rating of current varies in range of 5-10A. The enhancement of power quality of grid linked to solar system has been described already by numerous researchers. That detail explores in the following. The work [8] has been explored cell simulation modeling with one diode method and examined outcomes of simulation in MATLAB. The work [9] presents detailed data regarding highest power tracking implementation model. The work [3] explored regarding reactive power based on p-q power compensation concept.

The concept comprises data reactive compensation power, harmonics current mitigation & power factor enhancement for non-linear and linear loads. The harmonics filtering produced in the load-side aimed at non-linear loads eradicated by utilizing filtering model. The work [4] provides filtering circuit aimed at harmonics eradication. The power point tracing utilizing perturb band perceive model has been experimented by considering B reference.

The work [1] provide brief introduction of divergent kinds of MPPT schemes. Several tuning PI control stated former for controlling Voltage switching pattern[10-12].

The primary concentration of this manuscript has been examined demand for enhancing the electrical energy daily, the fossil fuel availability sources reducing every day. This made me for thinking regarding solar energy source.

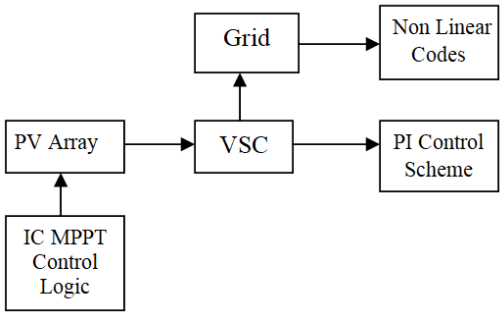

Fig.1. Grid connected SECS system with PI control scheme

The next sessions of this paper is organized as follows, grid connected SECS system configuration section –II, Proposed PI controller approach in section III, discussed MATLAB simulation results in Section IV and summarized/concluded in section. V.

Grid Connected SEC Configuration:

PV thermal technologies, solar irradiation are converted as heat energy. There are various approaches are available to produce heat energy and utilization. An absorber surface could be a flat surface made of metal, which absorbs the light and transfers the heat to a fluid like water or air as in flat collectors of solar water heater. The flat collectors are simple in design, but cannot provide high temperatures. Highertemperature (optics) gives more electrical energy. The complete block diagram of grid connected SECS with non linear loads is shown figure.2 below

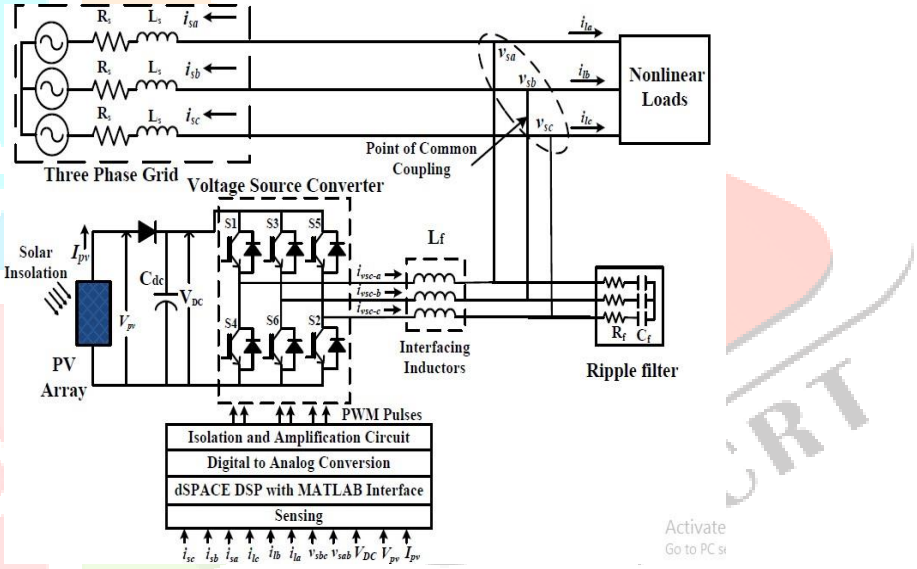

Figure.2. Block diagram of Grid connected SECS with Non linear loads

Modeling of PVarray

Shuntresistance (Rsh) and series resistance (Rse). Voltage and current profile of PV depends on Atmosphere temperature (T), and irradiance (S).

The yield power of PV is given by

P=V x I watts

The light generated current of Photo voltaic cell depends on the solar irradiation and the temperature.

MPPTAlgorithm

To get maximum power from sun we will adopts maximum power tracking methods such as perturb and observation (P&O), neural network (NN), estimated Perturb and observation (EPO) Incremental inductance (IC) method etc.In this article used IC basedMPPT algorithm and flow chart shown in below figure.3

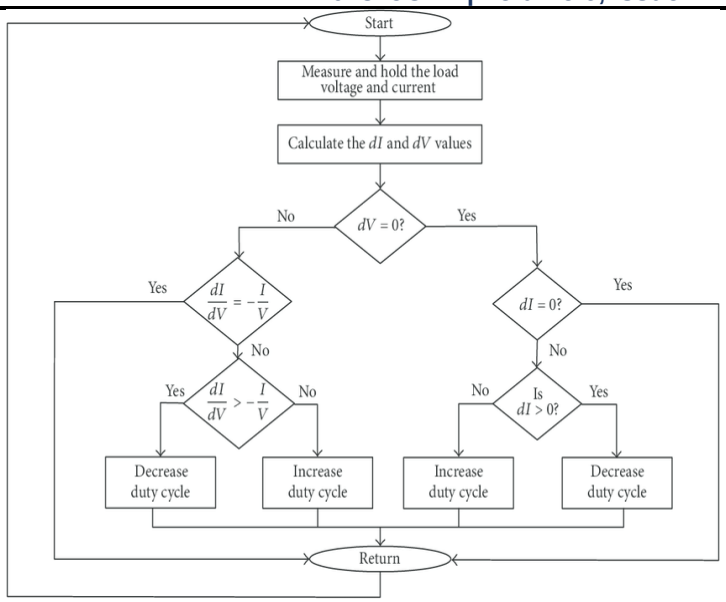

Fig.3. Flow chart diagram for incremental conductance method

Proposed ControlApproach

Design controllers such as sliding mode controllers, cascade controllers, synthesis method, model predictive power control (MPTC), adaptive control, and direct power control to run voltage source inverters (switch pattern) (DPC). Implementing these controller methods necessitates a significant amount of process understanding when designing PI controllers. The proportional gain (KP) value has a big impact. The research is still ongoing in this day since the intentions of PID controllers are frequently mistuned, resulting in some controllers being too destructive and others producing unacceptably poor responses.PID control strategies have been supplanted by complex control approaches such as model predictive control, which is developed as a supervisory control algorithm that offers set points to PID controllers in current control theory. The complete block diagram of a grid-connected SECS system with a PI control method is shown below.

Results and Discussion

Summarized Simulation results of grid connected SECS with unbalanced loads is in figure 5a. and figure 5b figure 5c.

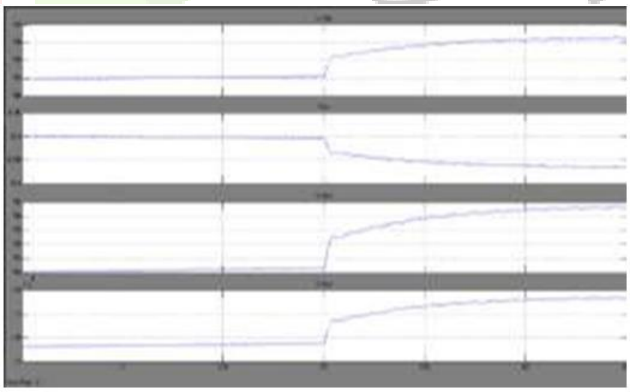

Fig.4. Vdc – DC Bus-voltage, Ipv – PV current, Vpv – PV voltage, Ps – Real Power produced of grid

Simulation time consider up to 0.65 sec non linear load is inserted in the network at the time of 0.5 secs. So after 0.5secs variation of Vdc, Ipv, andPs

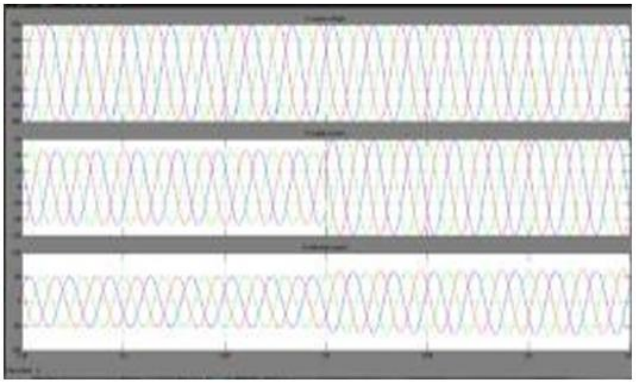

Fig.5. Vs – Three phase grid voltages, Is – three phase grid currents, Vinv – VSC converter output

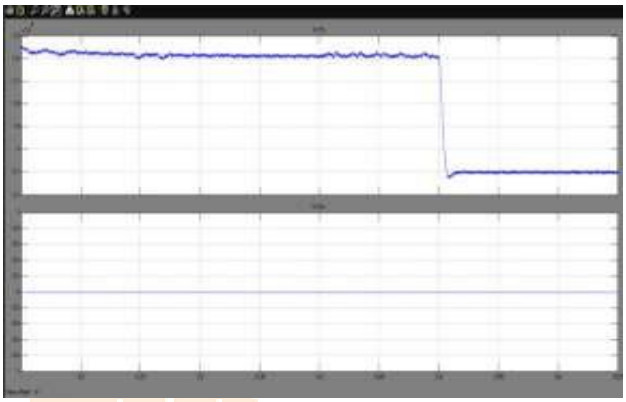

Fig.5c. Variation of grid active power and reactive power when unbalanced load are connected in after 0.5secSimulation results of Performance of grid connected SECS system with unbalance and PI controllers is shown in fig.6a. and fig.6b. When at 0.5 secsnon linear load connected to the network PV power production are increases and balance the network.

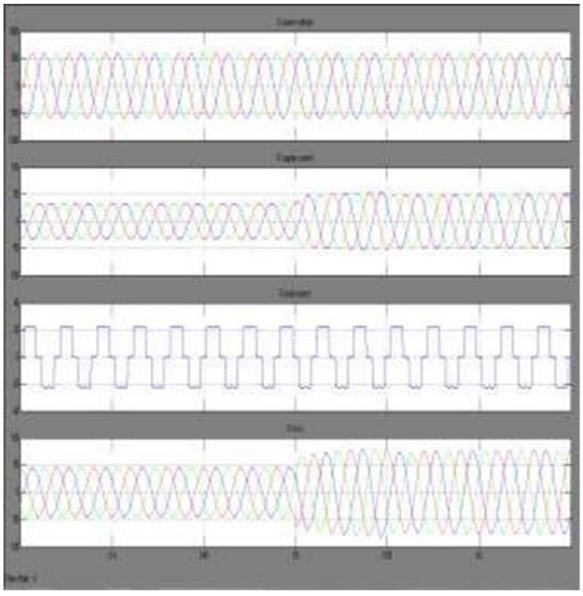

Fig.6. Vsabc – Grid voltages, Isabc– Grid currents, I_L – load current and I_{VSC} – VSC output

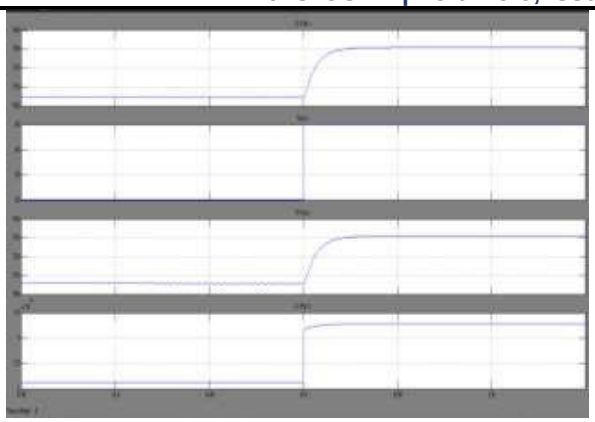

Fig.7. Insulation, DC bus voltage, PV voltage, PV real Power

Conclusion

Study is done on the dynamic and steady state performance of grid-connected SECS using PI controller-based switching for the VSC. After adopting a PI controller and solving PQ problems, the simulation results are validated, and pure sinusoidal voltages and currents are sent to the load. This paper's major focus is on the behavior of distribution networks when nonlinear connections are made and the solutions to their PQ issues.

References

1. Huajun Yu, Junmin pan, anxiang, "A multifunction grid connected pv system with reactive power compensation for the grid, "science direct-solar energy ., vol.79, pp. 101-106,2005.
2. Kelesidas.K, Adamidis.G, Tsengenes.g, "Investigation of a control scheme based on modified p-q theory for single phasesinglestage grid connected PV," pp.535- 540.
3. Jinjunliu, jun yang, Zhaon Wong, "a new approach for single phase grid connected harmonic current detection and its application in hybrid active power filter,"
4. Peter Gevorkian., "Large scale power system design".USA,2011.
5. Prabha, K,MalathiT,Muruganandam M, "Power quality improvement in single phasegrid connected nonlinear loads", vol.4, no.3, pp. 1269-1276,2015.
6. Hongpeng Lie, SHingongjing,wngwei, "maximum power point tracking based on double index modelof PV cell," pp.2113-2116, 2009.
7. Rama krishan, Yang rajsood, Uday Kumar, "Simulation and design for analysis of photovoltaic system based on mat lab," pp.647- 651, 2011.
8. Xuosongzhou, daichun song, Youjie ma, chengdeshu, "simulation and design based for MPPT of PV system based on incremental conductance method", international conference on information engineering, pp.314- 317,2010.
9. S.Charles,G.Bhuvaneswari,"Comparison of Three Phase Shunt Active Power Filter Algorithms," International Journal of Computer and Electrical Engineering., vol 2,no.1,pp.175-180,Feb 2010.
10. N. C. Sahoo, I. Elamvazuthi, NursyarizalMohd Nor, P. Sebastian and B. P. Lim,"" PV Panel Modelling using Simscape,"pp.10-14,2011
11. N. Femia, G. petrone, V. Spagnuolo, M. Vitelli, Optimization of Perturb and Observe maximum Power Point Tracking Method", IEEE Trans.on Power Electron., Vol. 20, No.4, July 2005
12. Y. Zhihao, W. Xiaobo: Compensation loop design of a photovoltaic system based on constant voltage MPPT". Power and Energy Engineering Conf., APPEEC 2009, Asia-Pacific, pp. 1- 4, March2009.