PHOTO VOLTAIC BASED THREE PHASE GRID CONNECTED SYSTEM USING FUZZY LOGIC

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ABSTRACT *Solar power is considered a very promising source for electric power generation. The abundance of sunlight over a large area of the earth surface gives rise to several applications of photovoltaic systems. Electricity can be generated from sunlight either directly by employing the photovoltaic effect, or by using energy from the sun to heat up a working fluid that can be used to power up electricity generators. These two technologies are widely used today to provide power either to standalone loads or for connection to the power system grid. Maximum power point tracking (MPPT) is a very important consideration that is taken into account when building a new photovoltaic power system. This is needed in order to extract maximum power output from a PV array under varying atmospheric conditions to maximize the return on initial investments. The proposed system is a 3-phase two stage grids tied with SPV system. The first stage is a boost converter, which serves the purpose of MPPT (maximum power point tracking) and feeding the extracted solar energy to the DC link of the PV inverter, whereas the second stage is a two-level VSC (voltage source converter) serving as PV inverter which feeds power from a boost converter into the grid. Proposed system uses an adaptive DC link voltage, which is made adaptive by adjusting reference DC link voltage according to CPI (common point of interconnection) voltage. Maximum power point tracking (MPPT) is a very important consideration that is taken into account when building a new photovoltaic power system. This is needed in order to extract maximum power output from a PV array under varying atmospheric conditions to maximize the return on initial investments. There is also a need for developing control techniques for three-phase grid connected, PV systems including a method for DC link voltage control that can stabilize the voltage at the inverter input. This area of research is currently growing with the increase in number of PV installations backed up by government incentives in several countries.*

Keywords:

INTRODUCTION

The electrical energy has a vital role in development of human race in the last century. The SPV system has been proposed long back but the cost of solar panels have hindered the technology for long time. Generates power from abundantly available sunlight, without any pollution made of PV arrays, which in turn are made up of panels, which are made of PV cell. The solar energy based systems can be classified into standalone and grid interfaced systems. The energy storage management is the key component of standalone system. Grid connected PV system Preferred over standalone system due to efficient operations. The power electronic devices such as DC-DC converters and DC-AC inverters are used as an interface between them. The grid acts as an energy buffer and all the generated power can be fed into the Grid.

Fuzzy logic is a mathematical logic that attempts to solve problems with an open, imprecise spectrum of data that makes it possible to obtain an array of accurate conclusions. Fuzzy logic is designed to solve problems by considering all available information and making the best possible decision given the input. Fuzzy logic stems from the mathematical study of fuzzy concepts, which also involves fuzzy sets of data. Mathematicians may use a variety terms when referring to fuzzy concepts and fuzzy analysis. Broadly and comprehensively, these terms are classified as fuzzy semantics.

SYSTEM CONFIGURATION

The system configuration for the proposed system is shown in Fig. 1. A two-stage system is proposed for grid tied SPV system. The first stage is a DC-DC boost converter serving for MPPT and the second stage is a two- level three phase VSC.

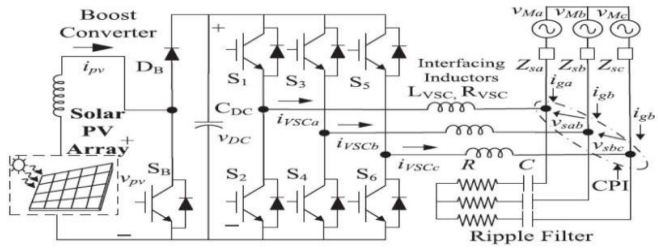


Fig. 1. System Configuration

The equivalent circuit model of a PV cell is needed in order to simulate its real behavior. One of the models proposed in literature is the double exponential model depicted in Fig. 2. Using the physics of p-n junctions, a cell can be modeled as a DC current source in parallel with two diodes that represent currents escaping due to diffusion and charge recombination mechanisms. Two resistances, Rs and Rp, are included to model the contact resistances and the internal PV cell resistance respectively. The values of these two resistances can be obtained from measurements or by using curve-fitting methods based on the I-V characteristic of the cell.

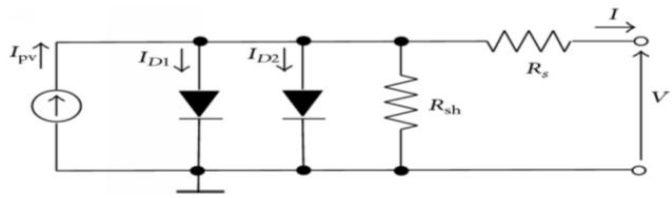


Fig. 2. Photovoltaic Cell

The boost DC converter is used to step up the input voltage by storing energy in an inductor for a certain time period, and then uses this energy to boost the input voltage to a higher value. The circuit diagram for a boost converter . When switch Q is closed, the input source charges up the inductor while diode D is reverse biased to provide isolation between the input and the output of the converter. When the switch is opened, energy stored in the inductor and the power supply is transferred to the load.

The main requirement in a power transmission system is the precise control of active and reactive power flow to maintain the system voltage stability. This is achieved through an electronic converter and its ability of converting electrical energy from AC to DC or vice versa. The circuit diagram for Voltage Source Converter is shown in Fig. 4.

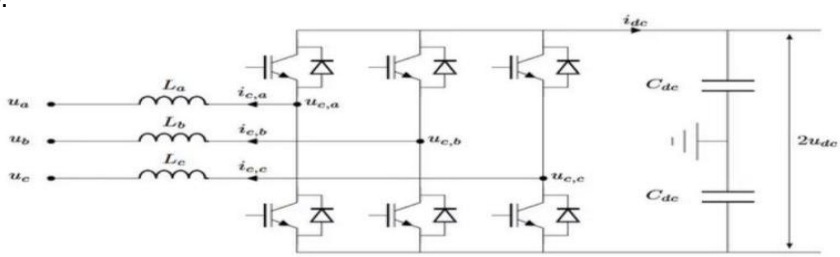


Fig. 4. Voltage Source Converter

CONTROL APPROACH

The basic control approach for the SPV system is shown in Fig. 5.

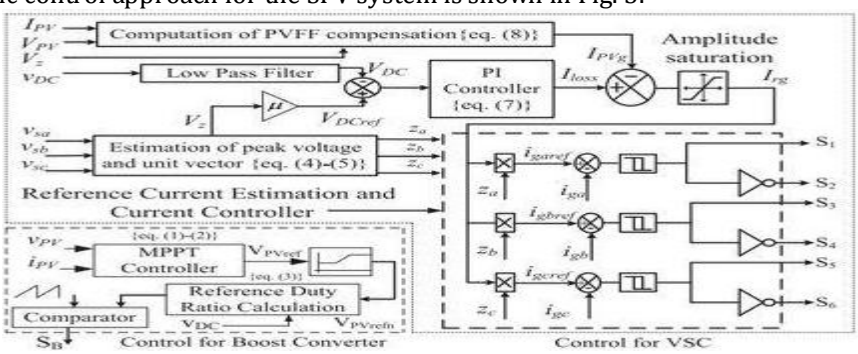


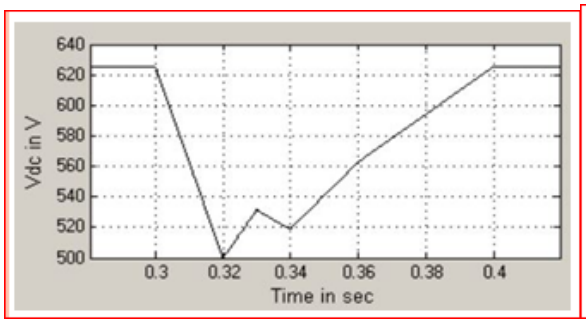
Fig. 5.Block Diagram of Control Approach

RESULTS:

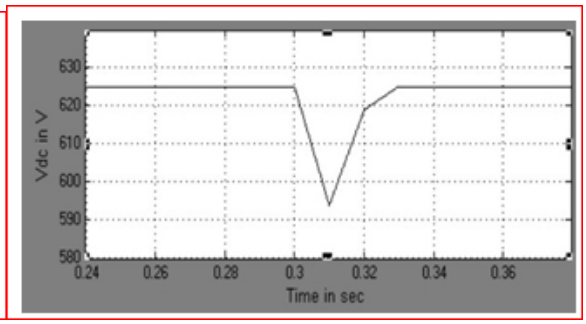
Case (1)

Change in Solar Insolation with out and with feed forward

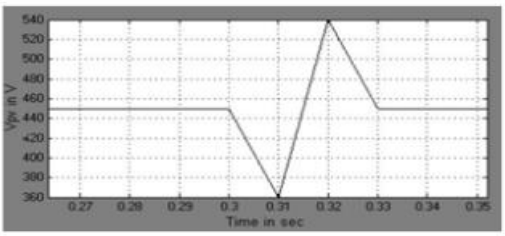
Simulated Performance for Change in Solar Insolation with Out and With Feed Forward For PV Contribution by Using PI Controller



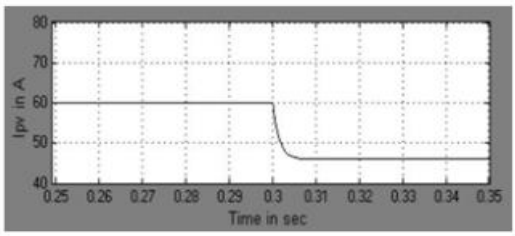
Voltage across DC (Vdc) link for change in solar insulation without Feed forward for PV contribution



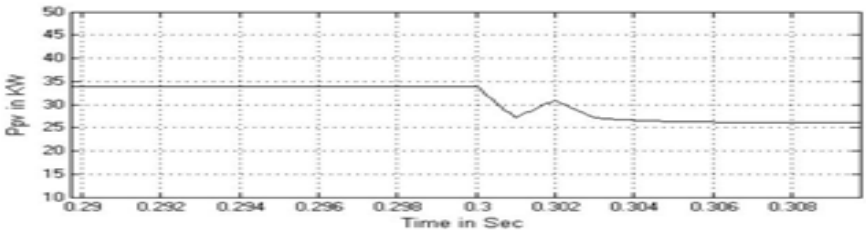
Simulated Performance for Change in Solar Insolationand With Feed Forward For PV Contribution byUsing FUZZY Controller



(a)



(b)

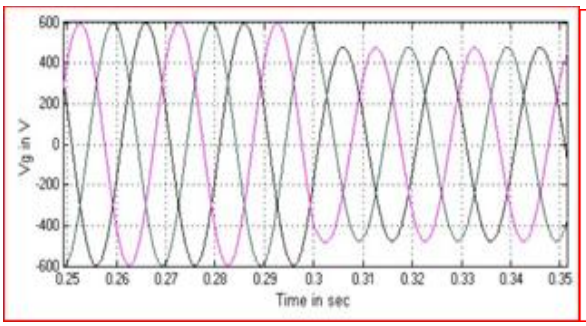


(c)

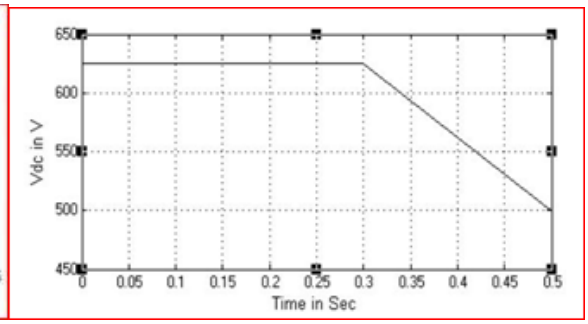
Parameters like (a) Voltage (Vpv) in volts, (b) Current (Ipv) in amperes, (c) Power (Ppv) in watts across PV cell with feed forward

Case (2) Normal to Under (415V to 375V) and Normal to Above (415V to 600V)

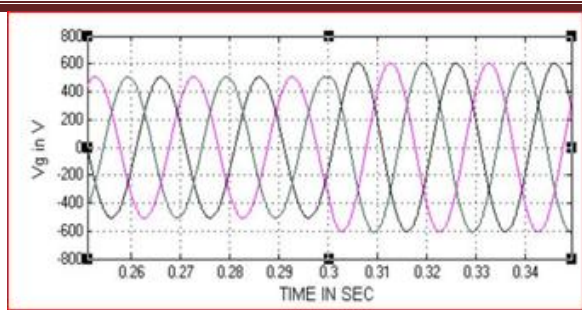
Simulated Performances for CPI voltage variation for normal to under and over voltage by using FUZZY control



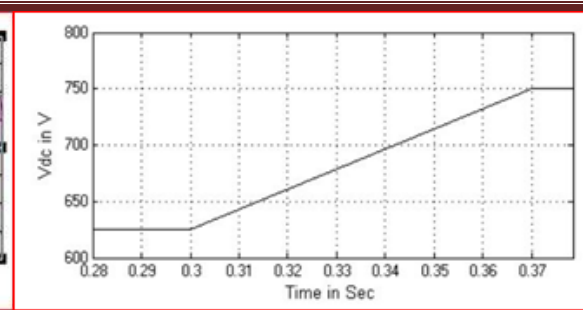
(a) Voltage (Vg) across grid from normal to under voltage (415v to 375v)



(a)Voltage across DC link from Normal to under voltage for PV contribution by using FUZZY Logic



(b) Voltage (Vg) across grid from normal to over voltage (415v to 600v)



(b)Voltage across DC link from Normal over voltage for PV contribution by using FUZZY Logic.

Simulated Performance of Grid Current (Ig) from Normal (415V) to Under Voltage (375V) &Normal (415V) to Over Voltage (600V) For PV Contribution by Using PI Controller

Simulated Performance of Grid Current (Ig) from Normal (415V) to Under Voltage (375V) &Normal (415V) to Over Voltage (600V) For PV Contribution by Using FUZZY Logic

As we observed in the existed results the simulated performances for change in solar insulation without feed forward and with feed forward for PV contribution by using PI controller is

Simulated performances for change in solar insulation without feed forward and with feed forward for PV contribution by using PI controller

1) There is stable voltage (Vg) and current (Ig) in the grid

2).There is better performance of voltage at DC link (Vdc) in feed forward condition with compared to without feed forward condition.

Simulated performances for change in voltage Normal to under and Normal to over voltage for PV contribution by using PI controller

1) In under voltage conditions the current will increase (Ig) and over voltage conditions the current (Ig) will decrease in grid.

2) In Photovoltaic cell all parameters like voltage (Vpv), current (Ipv) and power (Ppv) are constant or stable.

As we observed in the proposed results the simulated performances for change in solar insulation without feed forward and with feed forward for PV , Under Voltage(415V to 375V) and Above Voltage(415V to 480V) contribution by using FUZZY controller is

1) Simulated performances for change in solar insulation without feed forward and with feed forward for PV contribution by using FUZZY Logic There is stable voltage(Vg) and current(Ig) in the grid .

2) There is better Dynamic performance of voltage at DC link (Vdc) in feed forward and without feed forward condition with compared to PI Controller.

Simulated performances for change in voltage Normal to under and Normal to Above for PV contribution by using FUZZY Logic

1) Voltage across DC link also decreased in under voltage condition and increased in over voltage condition there is Better Dynamic Performance compared with PI Controller

CONCLUSION

Here the existed system, Photovoltaic Based Three Phase Grid Connected System.To get better performances, PI controller in the existed system was replaced by FUZZY logic controller.FUZZY Logic Controller shows the better dynamic performances than PI controller does.The diminishing conventional primary sources for electricity production have posed an energy scarcity condition in front of the world.The renewable energy sources such as solar, options, which solve the problem of energy scarcity.Incorporation of the partial shading effect of PV arrays.Improve the operation of the open loop MPPT algorithm by combining it with the incremental conductance technique.

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