High Performance Model Preditive Technique For Mpptgrid-Tied Pv System Using Chopper

[1]Vimala.M, [2]Dr.C.B.Venkataramanam
[1]Master scholar, [2]M.E.PH.D, Associate Professor
Department of Electrical and Electronics engg
Sona college of technology, Salem-636006.

Abstract- In this paper a single-stage grid-tied MPPT used for extracting the maximum available power and feeding the power to the grid. The proposed technique predicts the future behavior of the photovoltaic side voltage and current by using a digital observer which estimates the parameters of the photovoltaic module. The proposed method features simultaneously reduction in oscillation around maximum power point (MPP) and fast convergence by adaptively changing the perturbation size using the predicted model of the system. The experimental results demonstrate fast tracking response under dynamic weather condition, small steady state error, small oscillation around MPP at steady state, and high MPPT efficacy for wide range of solar irradiance levels. DC–DC converter for stand-alone power systems is proposed to integrate solar and battery power. In the proposed topology, two coupled inductors are employed as voltage gain extension cells for high voltage output applications. Two sets of buck–boost type active-clamp circuits are used to recycle the energy stored in the leakage inductors and improve the efficiency

Key points: high power solar energy tracing using MMPT technique, DC-DC chopper. N- channel mosfet, micro controller pic16F87

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1. INTRODUCTION

DC to DC converters are important in portable electronic devices such as cellular phones and laptop computers, which are supplied with power from batteries primarily. Such electronic devices often contain several sub-circuits, each with its own voltage level requirement different from that supplied by the battery or an external supply sometimes higher or lower than the supply voltage). Additionally, the battery voltage declines as its stored power is drained. Switched DC to DC converters offer a method to increase voltage from a partially lowered battery voltage thereby saving space instead of using multiple batteries to accomplish the same thing.Most DC to DC converters also regulate the output voltage[1]. Some exceptions include high-efficiency LED power sources, which are a kind of DC to DC converter that regulates the current through the LEDs, and simple charge pumps which double or triple the input voltage.**Maximum power point tracking** (**MPPT**) is a technique that grid connected inverters, solar battery chargers and similar devices use to get the maximum possible power from one or more photovoltaic devices, typically solar panels,[1] though optical power transmission systems can benefit from similar technoogy.[2]Electronic switch-mode DC to DC converters convert one DC voltage level to another, by storing the input energy temporarily and then releasing that energy to the output at a different voltageThey are also available as a complete hybrid circuit component, ready for use within an electronic assembly.

One of the inherent approximations to the "**constant voltage**" ratio method is that the ratio of the MPP voltage to V_{OC} is only approximately constant, so it leaves room for further possible optimization. Photovoltaic cells have a complex relationship between their operating environment and the maximum power they can produce[3]. The fill factor, abbreviated *FF*, is a parameter which characterizes the non-linear electrical behavior of the solar cell. Fill factor is defined as the ratio of the maximum power from the solar cell to the product of Open Circuit Voltage V_{oc} and Short-Circuit Current I_{sc}. In tabulated data it is often used to estimate the maximum power that a cell can provide with an optimal load under given conditions, $P=FF*V_{oc}*I_{sc}$. For most purposes, FF, V_{oc}, and I_{sc} are enough information to give a useful approximate model of the electrical behavior of a photovoltaic cell under typical conditions[4].For any given set of operational conditions, cells have a single operating point where the values of the current (*I*) and Voltage (*V*) of the cell result in a maximum power output. These values correspond to a particular load resistance, which is equal to *V* / I as specified byOhm's Law[5]. MPLAB IDE is an integrated development environment that provides development engineers with the flexibility to develop and debug firmware for various Microchip devices.[6]]

I. EXISTING SYSTEM

The Existing System MPPT and the voltage balancing control methods for three-level boost-type converter. The Existing sampling strategy, the information of the PV power and the voltage imbalance can be provided for the proposed control methods. The PV power *P*PV is the product of the PV current *i*PV and the PV voltage *v*PV. By neglecting the power loss of the three level boost converter.

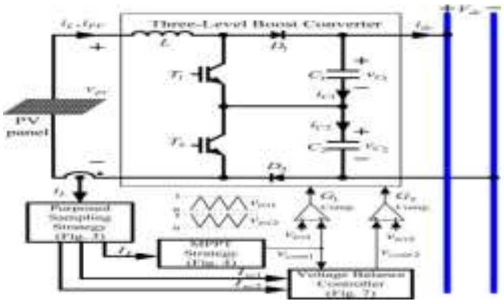

Fig.I Existing system

II. PROPOSED SYSTEM

The PV-fed converter, sensing both PV current and PV voltage is required to achieve the maximum power point tracking (MPPT) control. Additionally, for three-level Buck-Boost-type converter in modified SEPIC Converter, sensing additional capacitor voltages is also required to detect the voltage imbalance and force both capacitor voltages to be balanced in additionally using Inverter Dc-Ac Implemented using Output RL Load. By properly setting the sampling instants of the inductor current sensor, the average inductor current and the voltage imbalance can be detected by the proposed sampling strategy. It means that sensing only PV current (i.e., the inductor current) is able to achieve both MPPT function and the voltage balancing function. Then, both the MPPT and voltage balancing control will be achieved only by using the proposed sampling strategy of sampling the inductor current values. This paper PV source fed induction motor drive is proposed with SEPIC converter and voltage source inverter as interface circuits. Perturb and Observe (P&O) MPPT Algorithm is used to extract the maximum power point of PV module. Pulse width modulation technique is employed for the control of voltage source inverter constructed to run the single phase induction motor.

A.OPERATION

The Input Generate renewable Based source PV-fed converter, sensing both PV current and PV voltage is required to achieve the maximum power point tracking (MPPT) control.The three-level converter is connected to a well-regulated dc voltage V_{dc}, the sum of two capacitor voltages is assumed to be fixed. Due to the input inductor L and two diodes $D1$ and $D2$ in the three-level boost-type converter, both switches can be turning on at the same time.Because the dc-bus voltage V_{dc} is well regulated, the PV power P_{PV} is directly proportional to the product of the average inductor current I_L and the duty ratio $(1-v_{cont1})$. By using the simple perturbation and observation method, the MPPT method with sensing only inductor current.

The new voltage balancing control loop without sensing capacitor voltages. the voltage balancing control loop is applied at $t1$, both control signals v_{cont1} and v_{cont2} are larger than 0.5 and thus, $v_{cont1} + v_{cont2} > 1$.Three-phase converters have been developed to a matured level with improved power quality in terms of power-factor correction, reduced total harmonic distortion at input ac mains, and regulated dc output in buck- boost power flow.The SEPIC (**Single-ended primary-inductor converter**) converter allows a range of dc voltage to be adjusted to maintain a constant voltage output.Pulse width modulation technique is employed for the control of voltage source inverter constructed to run the single phase induction motor.

B. BLOCK DIAGRAM

Conversion methods

- Electronic
- Linear

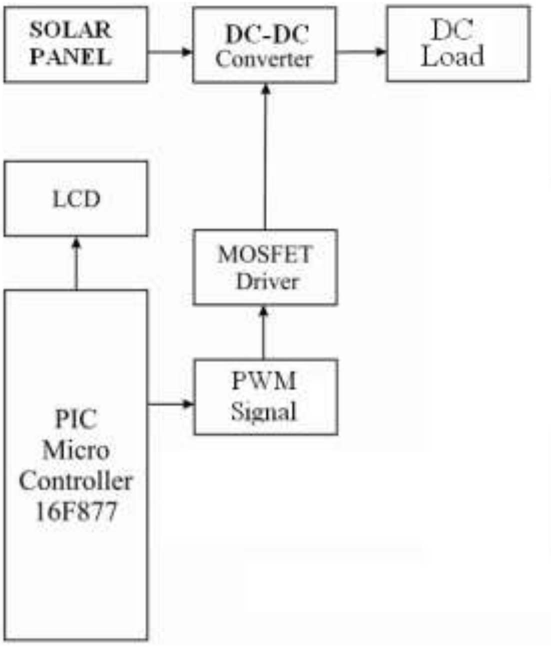

Fig. Block diagram of proposed system

Main article: linear regulator.Linear regulators can only output at lower voltages from the input. They are very inefficient when the voltage drop is large and the current is high as they dissipate heat equal to the product of the output current and the voltage drop; consequently they are not normally used for large-drop high-current applications. The inefficiency wastes power and requires higher-rated and consequently more expensive and larger components. The heat dissipated by high-power supplies is a problem in itself and it must be removed from the circuitry to prevent unacceptable temperature rises.Linear regulators are practical if the current is low, the power dissipated being small, although it may still be a large fraction of the total power consumed. They are often used as part of a simple regulated power supply for higher currents: a transformer generates a voltage which, when rectified, is a little higher than that needed to bias the linear regulator. The linear regulator drops the excess voltage, reducing hum-generating ripple current and providing a constant output voltage independent of normal fluctuations of the unregulated input voltage from the transformer/bridge rectifier circuit and of the load current.Linear regulators are inexpensive, reliable if good heat sinks are used and much simpler than switching regulators. As part of a power supply they may require a transformer, which is larger for a given power level than that required by a switch-mode power supply. Linear regulators can provide a very low-noise output voltage, and are very suitable for powering noise-sensitive low-power analog and radio frequency circuits. A popular design approach is to use an LDO, Low Drop-out Regulator, that provides a local "point of load" DC supply to a low power circuit.

2.MPPT ALGORITHM

Solar cells have a complex relationship between solar irradiation, temperature and total resistance that produces a non-linear output efficiency which can be analyzed based on the I-V curve.

It is the purpose of the MPPT system to sample the output of the cells and apply the proper resistance (load) to obtain maximum power for any given environmental conditions. MPPT devices are typically integrated into an electric power converter system that provides voltage or current conversion, filtering, and regulation for driving various loads, including power grids, batteries, or motors.

- Solar inverters convert the DC power to AC power and may incorporate MPPT: such inverters sample the output power (I-V curve) from the solar cell and apply the proper resistance (load) so as to obtain maximum power.
- MPP (Maximum power point) is the product of the MPP voltage (V mpp) and MPP current(I mpp): some solar panels have a higher maximum power than others.

A. I-V CURVE

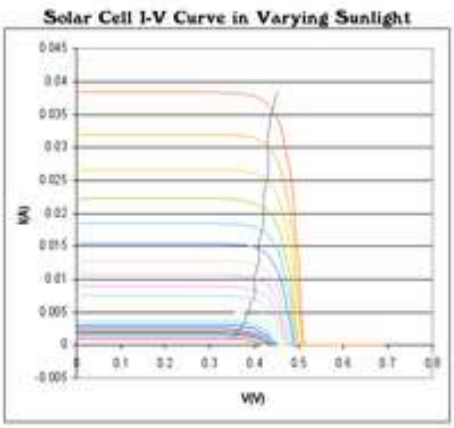

Fig. 6.I- Solar cell I-V curves where a line intersects the knee of the curves where the maximum power transfer point is located.

The power P is given by *P=V*I*. A photovoltaic cell, for the majority of its useful curve, acts as a constant current source.[3]However, at a photovoltaic cell's MPP region, its curve has an approximately inverse exponential relationship between current and voltage. From basic circuit theory, the power delivered from or to a device is optimized where the derivative (graphically, the slope) *dI/dV* of the I-V curve is equal and opposite the *I/V* ratio (where d*P/dV*=0).[4] This is known as the **maximum power point** (MPP) and corresponds to the "knee" of the curve.A load with resistance *R=V/I* equal to the reciprocal of this value draws the maximum power from the device. This is sometimes called the 'characteristic resistance' of the cell. This is a dynamic quantity which changes depending on the level of illumination, as well as other factors such as temperature and the age of the cell. If the resistance is lower or higher than this value, the power drawn will be less than the maximum available, and thus the cell will not be used as efficiently as it could be. Maximum power point trackers utilize different types of control circuit or logic to search for this point and thus to allow the converter circuit to extract the maximum power available from a cell.

B. CLASSIFICATION

Controllers usually follow one of three types of strategies to optimize the power output of an array. Maximum power point trackers may implement different algorithms and switch between them based on the operating conditions of the array.[5]

- **Perturb and observe**
- **Incremental conductance**
- **Current Sweep Method**
- **Constant voltage**

The term "constant voltage" in MPP tracking is used to describe different techniques by different authors, one in which the output voltage is regulated to a constant value under all conditions and one in which the output voltage is regulated based on a constant ratio to the measured open circuit voltage (V_{OC}). The latter technique is referred to in contrast as the "open voltage" method by some authors.[15] If the output voltage is held constant, there is no attempt to track the maximum power point, so it is not a maximum power point tracking technique in a strict sense, though it does have some advantages in cases when the MPP tracking tends to fail, and thus it is sometimes used to supplement an MPPT method in those cases.

In the "constant voltage" MPPT method (also known as the "open voltage method"), the power delivered to the load is momentarily interrupted and the open-circuit voltage with zero current is measured. The controller then resumes operation with the voltage controlled at a fixed ratio, such as 0.76, of the open-circuit voltage V_{OC}.[16] This is usually a value which has been determined to be the maximum power point, either empirically or based on modeling, for expected operating conditions.[11][12] The operating point of the PV array is thus kept near the MPP by regulating the array voltage and matching it to the fixed reference voltage $V_{ref}=kV_{OC}$. The value of V_{ref} may be also chosen to give optimal performance relative to other factors as well as the MPPT, but the central idea in this technique is that V_{ref} is determined as a ratio to V_{OC}.One of the inherent approximations to the "**constant voltage**" ratio method is that the ratio of the MPP voltage to V_{OC} is only approximately constant, so it leaves room for further possible optimization.

3. Terminology

I Step-down - A converter where output voltage is lower than the input voltage (like a Buck converter)

A **buck converter** is a step-down DC to DC converter. Its design is similar to the step-up boost converter, and like the boost converter it is a switched-mode power supply that uses two switches (a transistor and a diode), an inductor and a capacitor.The simplest way to reduce a DC voltage is to use a voltage divider circuit, but voltage dividers waste energy, since they operate by bleeding off excess power as heat; also, output voltage isn't regulated (varies with input voltage). Buck converters, on the other hand, can be remarkably efficient (easily up to 95% for integrated circuits) and self-regulating, making them useful for tasks such as converting the 12–24 V typical battery voltage in a laptop down to the few volts needed by the processor.

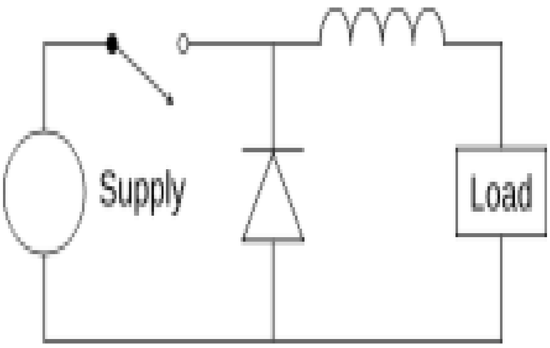

Fig 3.I buck converter circuit

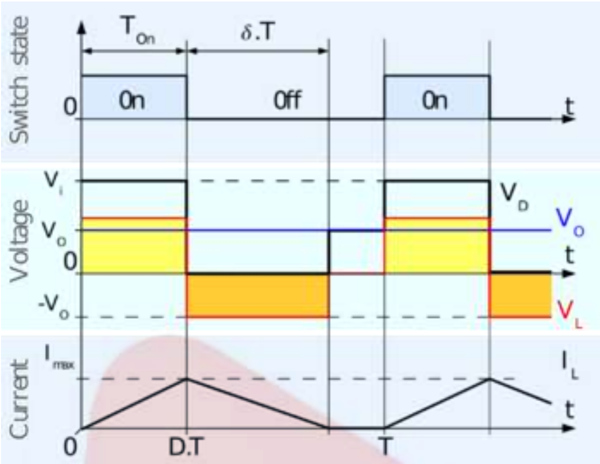

Fig.4.6.2. mode operation of buck converter

Continuous Current Mode - Current and thus the magnetic field in the inductive energy storage never reach zero.*Discontinuous Current Mode* - Current and thus the magnetic field in the inductive energy storage may reach or cross zero.*Noise* - Since all properly designed DC-to-DC converters are completely inaudible, "noise" in discussing them always refers to unwanted electrical and electromagnetic signal noise.*RF noise* - Switching converters inherently emit radio waves at the switching frequency and its harmonics. Switching converters that produce triangular switching current, such as the Split-Pi or Ćuk converter in continuous current mode, produce less harmonic noise than other switching converters.[1] Linear converters produce practically no RF noise. Too much RF noise causes electromagnetic interference (EMI).*Input noise* - If the converter loads the input with sharp load edges. Electrical noise can be emitted from the supplying power lines as RF noise, Which should be prevented with proper filtering in the input stage of the converter.*Output noise* - The output of a DC-to-DC converter is designed to have a flat, constant output voltage. Unfortunately, all real DC-to-DC converters produce an output that constantly varies up and down from the nominal designed output voltage. This varying voltage on the output is the output noise. All DC-to-DC converters, including linear regulators, have some thermal output noise. Switching converters have, in addition, switching noise at the switching frequency and its harmonics. Some sensitive radio frequency and analog circuits require a power supply with so little noise that it can only be provided by a linear regulator. Many analog circuits require a power supply with relatively low noise, but can tolerate some of the less-noisy switching converters.

4. **SOFTWARE DESIGN USING MAT LAB**

I. SIMULATION DIAGRAM OF THE SYSTEM

The following sections have to be functioning the system

- Simulink Circuit diagram of converter with photovoltaic system.
- Simulink diagram of pv panel system.
- Simulink diagram of MPPT panel.
- Input scope unit.
- Output scope unit.

II. CIRCUIT DIAGRAM USING SIMULINK

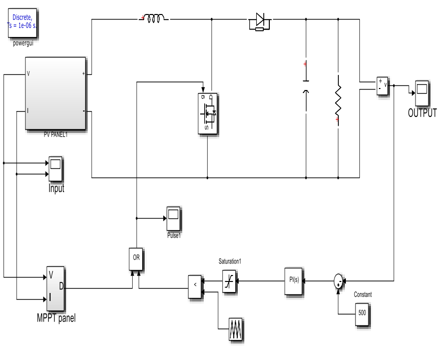

Fig 4.II. Circiut diagram using Simulink

A. PV SYSTEM SIMULINK DIAGRAM

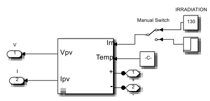

Fig.4.II.A. pv panel Simulink diagram

Specification of pv panel

This is a PV panel model subsystem. This includes number of series cells (Nss) number of Parallel cells (Npp) temperature(Temp),Irradiation (Irradiation).here no of series cells are 5 and no of parallel cells are 50.

III. MPPT SIMULINK DIAGRAM

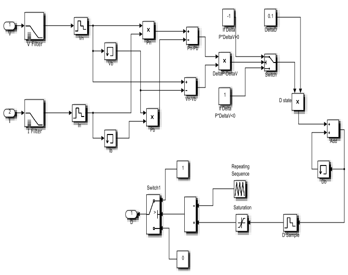

Fig 4.III.Mppt simulink diagram

A. INPUT SCOPE DIAGARM

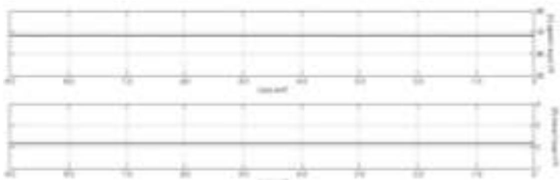

Fig. 4.III.A.Input scope diagram.

B. OUTPUT SCOPE DIAGRAM

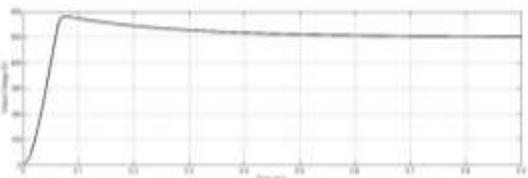

Fig 4.III.B Output scope diagram

5.**HARDWARE DESCRIPTION:**

A.CONCEPTS OF MICROCONTROLLER:

Microcontroller is a general purpose device, which integrates a number of the components of a microprocessor system on to single chip. It has inbuilt CPU, memory and peripherals to make it as a mini computer. A microcontroller combines on to the same microchip

- The CPU core
- Memory(both ROM and RAM)
- Some parallel digital i/o

Microcontrollers will combine other devices such as:

A timer module to allow the microcontroller to perform tasks for certain time periods.A serial i/o port to allow data to flow between the controller and other devices such as a PIC or another microcontroller.An ADC to allow the microcontroller to accept analogue input data for processing.

D.PIN OUT DESCRIPTION

Legend: I = input O = output I/O = input/output P = power
— = Not used TTL = TTL input ST = Schmitt Trigger input

CONCLUSION

The Conclusion part of PV Panel using MPPT and the voltage balancing control methods for three-level Buck and boost-type converter is proposed. By the proposed sampling strategy, the information of the PV power and the voltage imbalance can be provided for the proposed control methods. The simulation and experimental results show that the proposed methods with only sensing the inductor current are able to achieve the desired functions. The proposed methods reduce the sensor count and save the cost. In addition, the proposed voltage balancing control loop can be extended to other circuits which needs to avoid voltage imbalance.

REFERENCES

[1] N. Femia, et. Al. "Optimization of Perturb and observe Maximum Power Point tracking Method," IEEE Trans. Power Electron., Vol. 20, pp. 963-973, July 2005.

[2] E. Koutroulis; et. al , " Development of a Microcontroller-based photovoltaic maximum power tracking control system", IEEE Trans. On power Electron., Vol. 16, No. 1, pp. 46-54, 2001.

[3] J.A.Jiang et. Al. , "Maximum Power Tracking for Photovoltaic Power Systems," Tamkang Journal of Science and Engineering, Vol. 8, No. 2, pp. 147-153, 2005.. [4] S. Jain and V. Agarwal, "A New Algorithm for Rapid Tracking of Approximate Maximum Power Point in Photovoltaic Systems," IEEE Power Electronic Letter., Vol. 2, pp. 16-19, Mar. 2004.

[5] W. Xiao and W. G. Dunford,"A modified adaptive hill climbing MPPT method for photovoltaic power systems," 35th. Annual IEEE Power Electron. Specialists Conf. , pp. 1957-1963, 2004.

[6] Y. Kuo, et. Al., "Maximum power point tracking controller for photovoltaic energy conversion system," IEEE Trans. Ind. Electron., Vol. 48, pp. 594-601, 2001.