

Voltage Balancing Control with Sensing Only Inductor Current for Photovoltaic-Fed Single Ended Primary Inductor Converter

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ABSTRACT: The objective of this project is to propose a three level BOOST converter have the problem of can only increase the output voltage and it produce high peak current flow through the transistor. This reduces system efficiency. In this proposed topology three level SEPIC converters have either higher or lower output voltage compared to input voltage. And it does not have the problem of high peak current. This improves the system efficiency. Three level SEPIC converters are widely used in modern power electronic applications such as ac/dc PFC applications. The feasibility of the design is validated through software simulation. The provided simulation and experimental results demonstrate the proposed method. Simulation results were obtained using MATLAB.

KEYWORDS: PV system, buck-boost converter IGBT switches, SEPIC

I. INTRODUCTION

The project is the dc-dc converter; buck converter, boost converter, buck-boost converter and cuk-converter have the problem of current ripple on source and load side, high switching losses and high voltage stress. In this SEPIC converter is used to reduce the current ripple. And it has low switching loss, because single switch is used in the circuit. SEPIC converter has either higher or lower output voltage compared to input voltage. DC-DC Converters can also be used as switched mode regulators. Switched mode regulators convert unregulated dc input voltage into regulated dc output voltage. Buck converters can only reduce voltage, boost converters can only increase voltage, and buck-boost, CUK, and SEPIC converters can increase or decrease the voltage. Some applications of converters only need to buck or boost the voltage and can simply use the corresponding converters. However, sometimes the desired output voltage will be in the range of input voltage. When this is the case, it is usually best to use a converter that can decrease or increase the voltage. Buck-boost converters can be cheaper because they only require a single inductor and a capacitor.

However, these converters suffer from a high amount of input Current ripple. This ripple can create harmonics; in many applications these harmonics using large capacitor or an LC filter. This often makes the buck-boost expensive or inefficient. Another issue that the complicate usage of the buck-boost converter is the fact that they invert the voltage. CUK converter solve both of this problem by using an extra capacitor and inductor. However both CUK and buck-boost converter operation cause large amount of electrical stress on the components, this can result device failure or overheating.

SEPIC converter has developed without this problem. 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.

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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.

II. PROPOSED VOLTAGE BALANCING CONTROL

In this section, the new voltage balancing control loop without sensing capacitor voltages is proposed.

2.1. PROPOSED SYSTEM BLOCK DIAGRAM

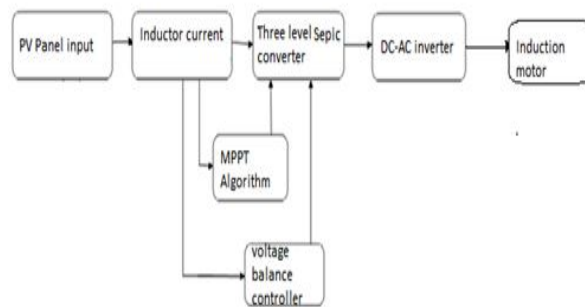


Figure.2.1. Proposed System Block Diagram

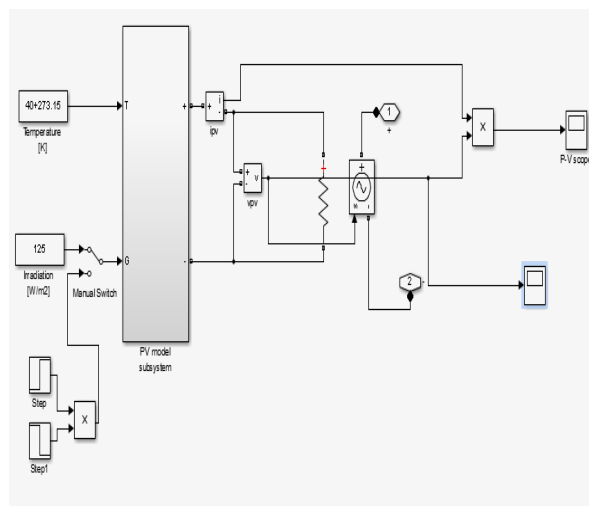


Figure.2.2. Proposed simulation subsystem PV panel diagram

2.2. CREATING A SUBSYSTEM BY ADDING A SUBSYSTEM BLOCK

The process of creating a subsystem before adding its component blocks usually consists of three major steps:

1. Copy the Subsystem block from the Ports & Subsystems library into your model.
2. Open the Subsystem block by double-clicking it. Simulink opens the subsystem in the current or a new model window, depending on the model window reuse mode that you selected.

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3. In the empty Subsystem window, create the subsystem. Use Import blocks to represent input from outside the subsystem and Outpost blocks to represent external output.
4. From the Simulink Library Browser, go to the Ports & Subsystems subdirectory.
5. Open the subsystem block by double-clicking the subsystem block. Delete the line connecting In1 block and Out1 block.

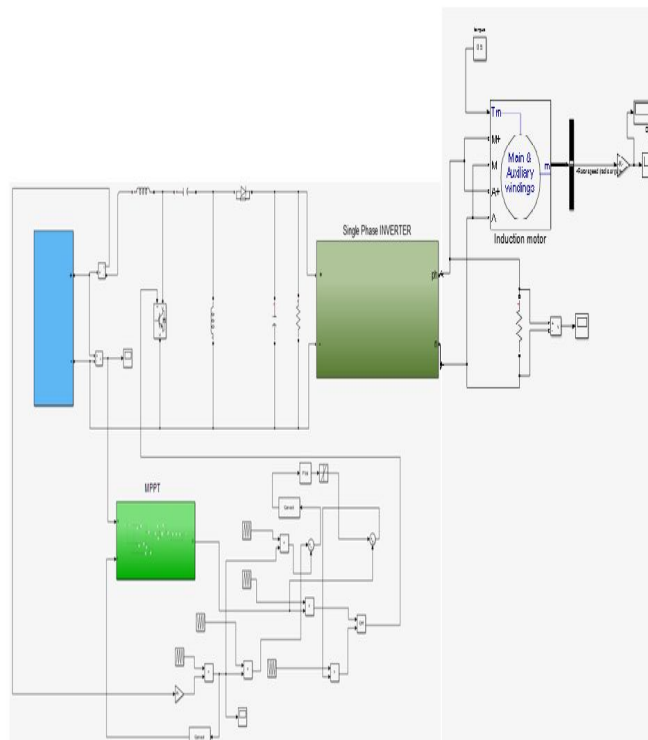


Figure.2.3. Main simulation circuit diagram

2.3. MAXIMUM POWER POINT TRACKING

MPPT techniques are used to control DC converters in order to extract maximum output power from a PV array under a given weather condition. The DC converter is continuously controlled to operate the array at its maximum power point despite possible changes in the load impedance. Maximum Power Point Tracking 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, though optical power transmission systems can benefit from similar technology. 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.

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

Solar PV panel:

Photovoltaic are solar cells that produce electricity directly from sunlight. The solar cells are made of thin layers of material, usually silicon. Photovoltaic are used throughout the nation and elsewhere to operate appliances,

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provide lighting, and to power navigation and communication aids. Photovoltaic panels provide power for equipment in space ships and satellites.

PV cells supply power needed to operate many kinds of consumer products such as calculators and watches. Photovoltaic systems provide electricity to remote villages, residences, medical centers, and other isolated sites where the cost of photovoltaic equipment is less than the expense of extending utility power lines or using diesel-generated electricity.

III. SIMULATION AND RESULT

3.1. INTRODUCTION TO SIMULINK

Simulink is a tool for simulating dynamic systems with a graphical interface specially developed for this purpose. Within the MATLAB environment, Simulink is a MATLAB toolbox that differs from the other toolboxes, both in this special interface and in the special “programming technique” associated with it. In the linear or nonlinear time-dependent processes that can be described using differential equations or (in the case of discrete times) difference equations.

Another common way of describing dynamic systems is with block diagrams. This is an attempt to understand the behaviour of the system by means of a graphical representation, which essentially consists of representations of individual components of the system together with the signal flow between these components. A graphical interface is used to convert a block diagram directly into Simulink and simulate the operation of the system. We note that a well-grounded use of Simulink requires some knowledge of control technology and systems theory.

Dynamic systems (that are continuous in time) will be described by differential equations. Thus, when we describe the system with a block diagram and simulate the reaction of the system to an input signal, we are essentially looking for nothing more than the solution of the differential equation underlying the system. It is also possible to convert a differential equation into a block diagram and to solve the differential equation numerically with Simulink. Simulink is, therefore, a numerical differential equation solver.

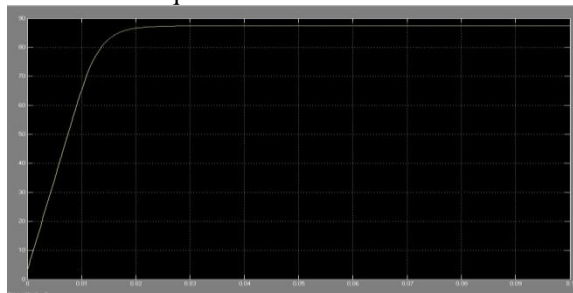


Figure-3.1. Experimental result for solar pcell output

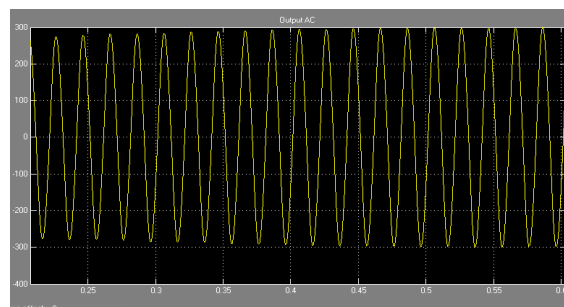


Figure.3.2. Proposed simulation output

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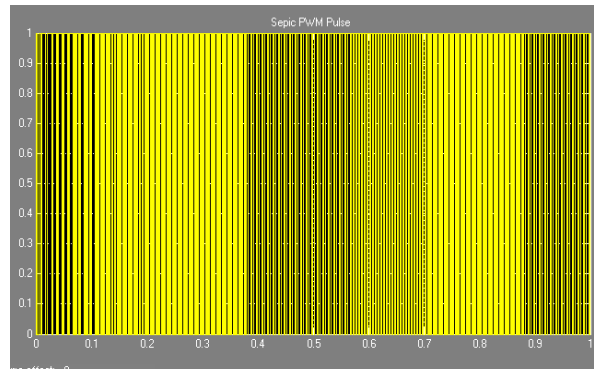


Figure.3.3. simulation SEPIC PWM pulse

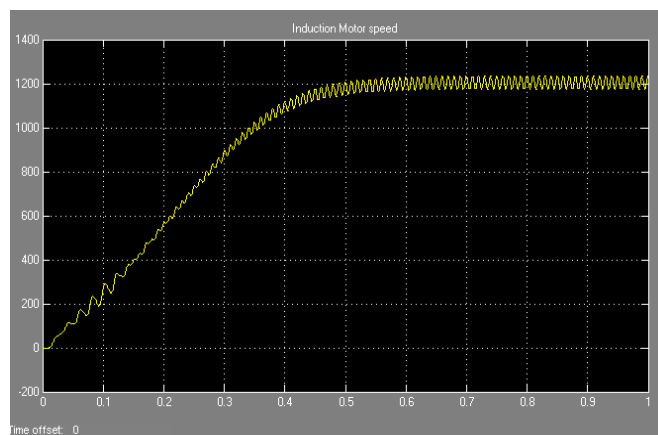


Figure.3.4. Proposed simulation of induction motor speed

ADVANTAGES

- SEPIC converter has non-inverted output.
- Low ripples current on the source and load sides.
- It has either higher or lower output voltage compared to input voltage.
- It provides better efficiency.

IV. CONCLUSION

The Conclusion part of PV Panel using MPPT and the voltage balancing control methods for three-level SEPIC 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. The provided simulation and experimental results demonstrate the proposed method three-level converter using Voltage balancing SEPIC Converter output DC-AC inverter output using RL Load Implement the Single Phase Induction Motor Drive using Software simulation MATLAB.

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