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UNDERSTANDING OF DIFFERENT MPPT ALOGORITHMS TO IMPROVE THE PERFORMANCE OF BOOST CONVERTER

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Abstract

The performance of a photovoltaic (PV) array connected to a boost converter plays a vital role in harnessing solar energy efficiently and integrating it with the electrical grid. This abstract summarizes the key aspects of the performance evaluation of such a system.The PV array, comprising multiple solar modules, converts solar energy into electrical energy. The boost converter, an essential component of the system, steps up the EMF of the array to match the grid requirements.Efficiency is a crucial performance metric, representing the system's ability to convert solar energy into usable electrical power. By optimizing the power extraction at the appropriate power point of the PV array, the boost ac to dc system enhances system efficiency. Power quality considerations are equally important in grid integration. Techniques such as soft-switching and advanced control algorithms can be employed to mitigate power losses and improve power quality. The boost converter's control strategies, such as pulse width modulation (PWM), voltage feedback loops, and current control methods, play a critical role in achieving a fast and accurate response. MATLAB/SIMULINK model represents the enhancement of volatge levels with respect to input given.

Introduction

Overview of Photovoltaic (PV) Arrays:

Photovoltaic (PV) arrays consist of multiple interconnected PV modules, which are made up of individual solar cells. These arrays are designed to harness solar energy and convert it into usable electrical energy.PV cells within the array absorb sunlight and generate direct current (DC) electricity through the photovoltaic effect, which involves the conversion of sunlight into electric current in semiconductor materials. The PV array's output power depends on various factors such as the intensity of solar radiation, temperature, shading effects, and the electrical characteristics of the PV modules.PV arrays are commonly used in grid-connected systems, off-grid applications, and hybrid systems to provide clean and renewable energy.

Introduction to Boost Converters:

A boost converter is a DC-DC power converter that enhances the generated electromotive force from a lower level to a higher level. It is mostly employed in PV systems to possibly convert the low-EMF output of the PV array to a higher voltage required for various applications. Boost converters typically consist of a power switch (usually a transistor), an inductor, a diode, and a capacitor. These components work together to regulate the voltage and control the power flow. The boost converter operates based on the principle of energy storage in the inductor during the switch-on period and the release of stored energy during the switch-off period. During the switch-on period, the inductor stores energy from the input voltage source (the PV array) by building up a magnetic field. In the switch-off period, the stored energy is transferred to the output, resulting in an increased voltage. The boost converter provides voltage step-up capabilities, allowing the PV system to operate at higher voltages required for efficient power transmission, grid integration, or charging energy storage systems.

Application of Boost Converters in PV Systems:
Maximum Power Point Tracking (MPPT): One of the key applications of boost converters in PV systems is MPPT, which enables the system to operate at the possible highest power point of the PV array. MPPT algorithms continuously monitor the output EMF and rate of flow charge of the PV array and adjust the duty cycle of the boost converter to optimize power extraction.

Voltage Regulation: Boost converters play a crucial role in maintaining a stable and regulated DC output voltage from the PV system. They can compensate for fluctuations in solar radiation, temperature variations, and changes in the load to ensure a constant and reliable output voltage.

Energy Storage Systems: In PV systems with energy storage, boost converters are used to rise up the low-voltage PV array output to charge the energy storage devices, such as batteries or supercapacitors. The boost converter ensures efficient energy transfer from the PV array to the energy storage system.

Grid Integration: Grid-connected PV systems require the voltage from the PV array to be boosted to match the grid voltage level. Boost converters enable seamless integration of the PV system with the grid by stepping up the PV array voltage to the grid voltage level, ensuring efficient power transfer and compliance with grid standards.

Boost converters in PV systems provide voltage regulation, power optimization, and grid integration capabilities, contributing to the overall efficiency and performance of the PV system. Their flexibility and ability to adapt to varying operating conditions make them an essential component in modern PV applications.

PV Array Configuration: Discussion of different PV array configurations, such as series, parallel, or series-parallel combinations. Consideration of factors like voltage and current matching, shading effects, andmaximum power point tracking (MPPT) techniques. please provide information, Here's a discussion of each configuration and the factors to consider:

Series Configuration:In a series configuration, PV modules are connected in a daisy-chain fashion, with the anode terminal of one module connected to the cathode terminal of the coming module.
The total voltage of the array increases with each module added in series, while the current remains constant.
Series configuration is suitable when a higher voltage is required to match the system's voltage requirement, such as grid integration or charging high-voltage batteries.
Factors to consider:

Voltage Matching: Ensure that the module voltages are compatible and add up to the desired array voltage without exceeding the system's voltage limits.
Shading Effects: Series configuration is sensitive to shading effects as shading on one module can significantly reduce the current output of the entire array. Shade on one module affects the performance of the entire series string.
Maximum Power Point Tracking (MPPT): Series configuration allows for a single MPPT tracking system to optimize the power output of the entire array.

Boost Converter : A boost converter, also known as a step-up converter, is a DC-DC power converter that increases the input voltage to a higher output voltage. It operates based on the principle of energy storage and transfer between an inductor and a capacitor.

Boost Converter Control Strategies: Design and implementation of control strategies for the boost converter in the PV system. Consideration of control

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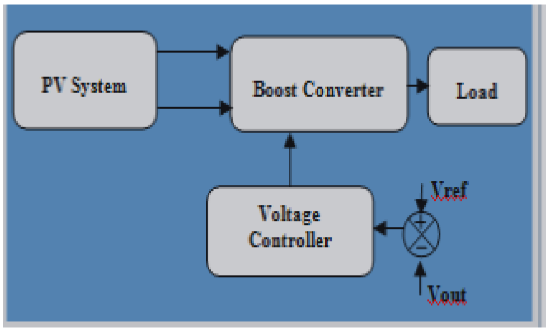
techniques like pulse width modulation (PWM), voltage feedback loops, and current control methods. Analysis of control parameters and their impact on converter performance.

Boost Converter Control Strategies: The control strategies for the boost converter in a PV system play a crucial role in regulating the output
voltage and optimizing power transfer from the PV array. Here's an overview of the design and implementation of control strategies, considering techniques such as pulse width modulation (PWM), voltage feedback loops, and current control methods:
in solar irradiance, temperature, and load profiles, and assess its ability to maintain optimal performance and power output

CIRCUIT DIAGRAM



PROPOSED DIAGRAM

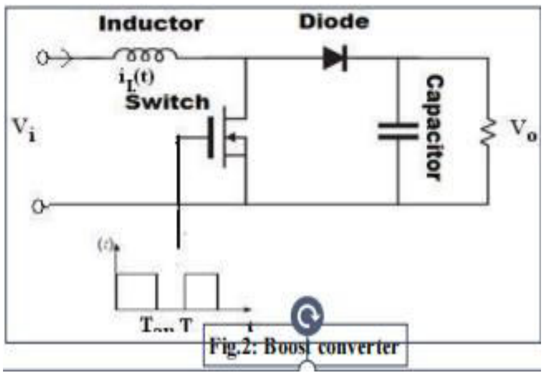
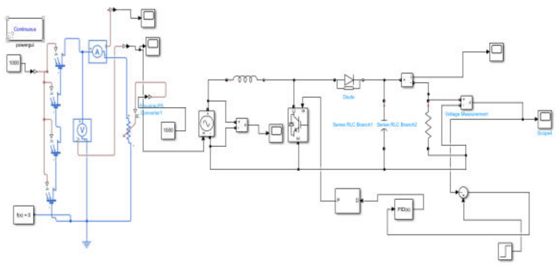


Fig.2: Boost converter

By combining experimental testing and simulation studies, it is pensively evaluate the performance of a PV array connected to a boost converter. This approach provides valuable insights into system behavior, helps optimize system design and control strategies, and enables the identification of areas for improvement in terms of efficiency, power output, and response to varying operating conditions.

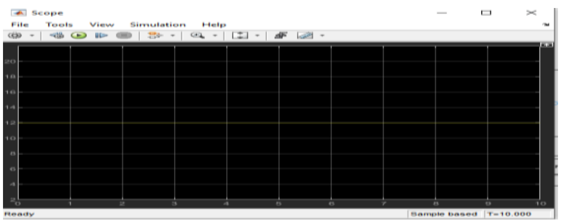
Results and Discussion: Analysis of control performance in terms of stability, power quality, and response time. Evaluation of power flow regulation capabilities. Comparison of the feed-forward decoupling control strategy with other control methods Results and discussion are crucial to assessing the effectiveness of the feed-forward decoupling control strategy in a grid-connected PV system. Here's an analysis of control performance, power flow regulation capabilities, and a comparison with other control methods:



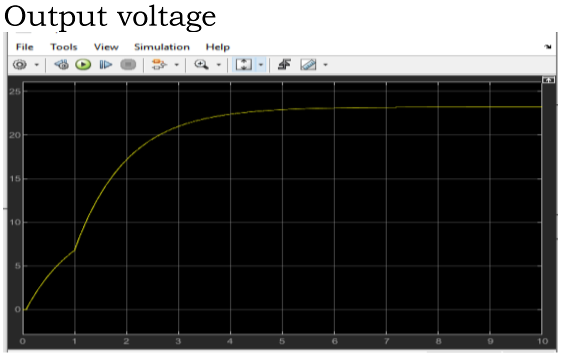
The proposed solar array connected to BOOST CONVERTER with PID controller

RESULTS

Input voltage



Output voltage



Discussion

The above results obtained from PV array of 12 volts connected in series and connected to Boost converter with PID controller has suffered from initial transient conditions .The disturbance occurred from above PID methods reduced by evolving MPPT control techniques

Like incremental conductance method,P&O Algorithms,CUCKOO Search algorithmic

Algorithm Implementation:

The MPPT algorithm is implemented in a microcontroller or digital signal processor, which continuously monitors the PV array's voltage and current.

Based on the selected MPPT technique (e.g., P&O, INC, HC), the algorithm adjusts the operating point by perturbing the duty cycle of the boost converter.

Communication with Boost Converter:

The MPPT controller communicates with the boost converter's control circuitry to provide the desired duty cycle adjustment.

The duty cycle adjustment ensures that the boost converter operates at the voltage required to maximize power transfer from the PV array to the load or energy storage system.

Feedback Control:

The boost converter's control loop receives feedback from the output voltage or current sensors to regulate the converter's operation and maintain stability.

The MPPT controller continuously updates the duty cycle based on the PV array's operating conditions, optimizing power extraction.

By integrating the MPPT algorithm with the boost converter control, the PV system can efficiently operate at the MPP, maximizing the power output from the PV array and improving overall system performance and energy harvest.

Grid Integration: The boost converter ensures the PV system's seamless integration with the grid, enabling power injection and synchronization with the grid's voltage and frequency.Power Flow Regulation: The boost converter facilitates power flow regulation, allowing for the control and management of power exchange between the PV array and the grid. Flexibility in Design and Implementation: The PV array connected to a boost converter offers flexibility in system design, scalability, and installation options, making it suitable for various applications and environments. However, there are challenges associated with this configuration

Future research directions and advancements in PV array and boost converter technology include: Advanced Control Techniques: Integration of advanced control techniques, such as model predictive control or machine learning algorithms, to further enhance system performance, efficiency, and response to dynamic operating conditions. Improved Modeling and Parameter Estimation: Develop more accurate and robust models for PV arrays and boost converters, accounting for nonlinear behavior, temperature effects, and uncertainties. Improve parameter estimation techniques for better system performance under varying conditions.

REFERENCES

I.H Atlas, A.M Sharaf, "A photovoltaic Array Simulation Model for Matlab-Simulink GUI Environment", Proce. of
IEEE International Conference on Clean Electrical Power, ICCEP 2007, Capri, Italy.Rick zaitu "Voltage Mode
Boost Converter small Signal Control Loop Analysis Using The TPS61030", Application Report-may 2007, Texas
Instruments.

[2] H.K Hussein, I. Muta, T. Hoshino, M. Osakada, "Maximum photovoltaic power tracking: an algorithm for rapidly
changing atmospheric conditions", *IEE Proc.-Gener. Trans. Distrib., Vol. 142, No. 1*, January 1995.

[3] Villalva M.G, Gazoli J.R, Ruppert E.F, "Comprehensive approach to modeling and simulation of photovoltaic
arrays," *IEEE Trans. Power Electron., 25, (5), pp. 1198–1208*, 2008.

[4] Villalva, M.G., Gazoli, J.R. and Filho, E.R., "Modeling and circuit-based simulation of photovoltaic arrays," *Power
Electronics Conference, IEEE 2009. COBEP '09. Brazilian*, December 2009, pp. 1244 - 1254

[5] Xiao W, Dunford W.G, Palmer P.R, Capel A, "Regulation of photovoltaic voltage," *IEEE Trans. Ind. Electron., 54, (3), pp. 1365-1374*, 2007.
[6] Zhihao Y, Xiaobo W, "Compensation loop design of a Photovoltaic system based on constant voltage MPPT," *Power and Energy Engineering Conf., Asia-Pacific, 27–31 March 2009, pp. 1–4*, 2009.
[7] Hasaneen, B.M. and Elbaset Mohammed, A.A., "Design and simulation of DC/DC converter," *Power System Conference, 2008. MEPCON 2008. 12th International Middle-East*, July 2008, pp. 335 - 340.
[8] Muhammad H. Rashid, "*Power Electronics Circuits, Devices and Applications*", Third Edition