

Area Electrification using Renewable Energy

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Abstract—This paper proposed an advance technique of power control strategy by limiting the maximum fed in power of PV system, which can insure a smooth and fast transition between Constant Power Generation (CPG) and maximum power point tracking. Anyway of the solar irradiance levels, stable operation and high-performance are always obtained by the proposed control strategy. The above technique improve the PV output power according to the set point and drive the PV system to operate at the left side of the maximum power point without stability problem.

keyword— constant power generation, constant power control, maximum power point tracking, PV systems, power converters.

I. Introduction

In this paper, a new MPPT technique is proposed which suggests a modified perturb and observe algorithm to reach fast to the MPP compared to the conventional perturb and observe technique. This work explains the PV equivalent circuit, current-voltage, power-voltage characteristics of photovoltaic systems and the operation of the some commonly used MPPT techniques.[1]

The fast maximum power point tracking (MPPT) control algorithm for the photovoltaic (PV) in a hybrid wind-PV system, in which the PV generator may also need to work in a reduced power mode (RPM) to avoid dynamic over loading. The two control modes, MPPT and RPM, are inherently compatible and can be readily implemented, without the need of a dumping load for the RPM. Following the establishment of a dynamic system model, the study develops the guidelines to determine the variables of a direct hill-climbing method for MPPT: the perturbation time intervals and the magnitudes of the applied perturbations. These results are then used to optimally set up a variable-step size incremental conductance (VSIC) algorithm along with adaptive RPM control. The power tracking performance and power limiting capability are verified by simulation and experiment.[2]

solar cells are generally connected in series or parallel to form PV modules. Operating point of solar cells depends on many factors such as temperature, insolation, spectral characteristics of sunlight and so on. Changes in insolation on panels due to fast climatic changes such as cloudy weather and ambient temperature can change the photovoltaic array output power. An individual solar cell can only produce a small amount of power. To increase the electrical output power of a system.[3]

II. OVERALL SYSTEM

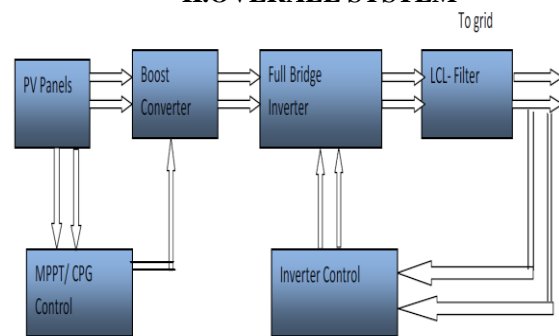


Fig.2.1 Overall System Block Diagram

Block diagram is as shown in figure It consist PV panel which converts solar radiation in to electrical power output PV panel is control by MPPT/control which controls output of PV panel. The output power characterizes by i.e. voltage and current are set up in MPPT so that output of panel remains constant. Output of PV panel is given to boost converter which boost up generated power. This power is given to single phase full bridge inverter which invert DC power in to AC power and further fed to LCL filter which removes and smoother the output waveform. Inverter controller block controls the output characteristics i.e. V-I characteristics of inverter .It acts as feedback system which varies output characteristics of inverter according to output of LCL filter

III. SIMULATION CASE STUDIES

A) Solar PV array In MATLAB/Simulink 2016 environment Solar PV array block

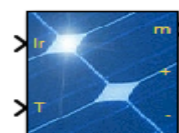


Fig 3.1.1 Solar PV block

The PV Array block implements an array of photovoltaic (PV) modules. The array is built of strings of modules connected in parallel, each string consisting of modules connected in series. This block allows you to model preset PV modules from the National Renewable Energy Laboratory (NREL) System Advisor Model as well as PV modules that you define. The PV Array block is a five parameter model using a current source I_L (light-generated current), diode (I_0 and nI parameters), series resistance R_s , and shunt resistance R_{sh} to represent the irradiance- and temperature-dependent I-V characteristics of the modules.

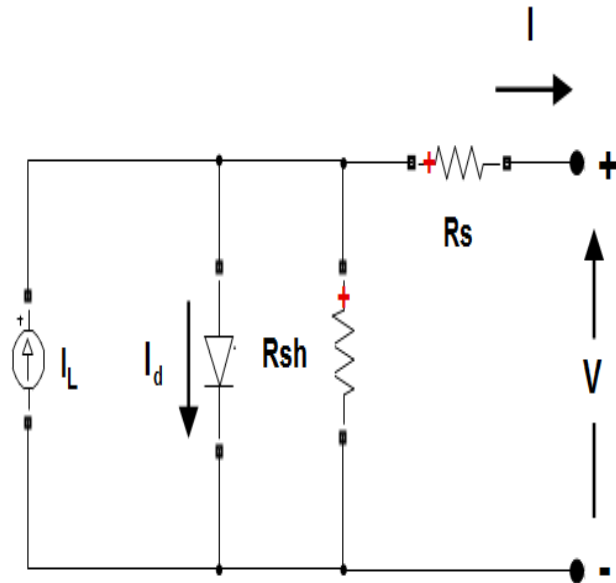


Fig 3.3.2single PV circuit

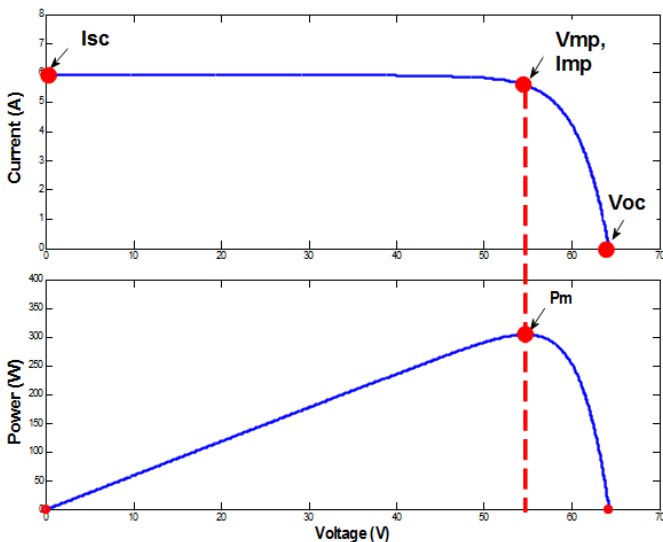


Fig.3.3.3Iv and Pv with Vmmp

Number of strings of series-connected modules that are connected in parallel. The default value is 40.

B)Series-connected modules per string

Number of PV modules connected in series in each string. The default value is 10.

C)Module

Select User-defined or a preset PV module from the BP Solar BP365TS System Advisory Model database. Over 10,000 modules are listed from main manufacturers, sorted in alphabetical order. The BP365TS database includes manufacturer datasheets measured under standard test conditions (STC) (irradiance=1000 W/m², temperature=25 degrees C).[4]

When you select a module, this data from the BP365TS database updates when you apply your changes: N_{cell} , V_{oc} , I_{sc} , V_{mp} , I_{mp} maximum power, as well as temperature coefficients of V_{oc} and I_{sc} . The function computes the five corresponding model parameters (I_L , I_0 , nI , R_{sh} , R_s) using an optimization function and displays them on the right side of the dialog box.

When you select User-defined, you can enter your own specifications for the module data (N_{cell} , V_{oc} , I_{sc} , V_{mp} , I_{mp} , and temperature coefficients of V_{oc} and I_{sc}

Temperature coefficient of V_{oc} (%/deg.C)

Defines variation of V_{oc} as a function of temperature. The open-circuit voltage at temperature T is obtained as

$$V_{ocT} = V_{oc} (1 + \beta_{V_{oc}}(T-25)),$$

where V_{oc} is the open-circuit voltage at 25 degrees C, V_{ocT} is the open-circuit voltage at temperature T (in degrees C), $\beta_{V_{oc}}$ is the temperature coefficient (in %/degrees C), and T is the temperature in degrees C.

Temperature coefficient of I_{sc} (%/deg.C)

Defines variation of I_{sc} as a function of temperature. The short-circuit current at temperature T is obtained as

$$I_{scT} = I_{sc} (1 + \alpha_{I_{sc}}(T-25)),$$

where I_{sc} is the short-circuit current at 25 degrees C, I_{scT} is the short-circuit current at temperature T (in degrees C), $\alpha_{I_{sc}}$ is the temperature coefficient (in %/degrees C) and T is the temperature in degrees C.

PV GENERATION DATASHEET PARAMETER

Table 1- PV Generation Datasheet Parameter

Modul e(BP365TS) Parameter	Value
Maximum Power	213.15 W.
Cell per module	18
Open circuit voltage(V_{oc})	18v
Short circuit current(I_{sc})	8.1A
Voltage at maximum power point(V_{mp})	8.7v
Current at maximum power pointb (I_{mp})	7.5A
Temperature coefficient of (V_{oc})	0.355%/deg.C
Temperature coefficient of (I_{sc})	0.0028395%/deg.C

D)Display I-V and P-V characteristics of one module

To display the I-V and P-V characteristics of one module or of the whole array, for variable irradiance or for variable temperatures, select an option:

T_{cell} (deg. C)

This parameter is available only if Display I-V and P-V characteristics of is set to array @ 1000 W/m2 & specified temperatures. Enter a vector of temperatures in degrees C.

Light-generated current I_L (A)

Current for one module under STC, flowing out of the controllable current source that models the light-generated current. An optimization function determines this parameter to fit the module data.

Diode saturation current I₀ (A)

Saturation current of the diode modeling the PV array for one module under STC. An optimization function determines this parameter to fit the module data.

Diode ideality factor

Ideality factor of the diode modeling the PV array. An optimization function determines this parameter to fit the module data.

Shunt resistance R_{sh} (ohms)

Shunt resistance of the model for one module under STC. An optimization function determines this parameter to fit the module data.

Series resistance R_s (ohms)

Series resistance of the model for one module under STC. An optimization function determines this parameter to fit the module data.

Table 2 PV circuit parameter

Parameter	Value
T-cell	45.25deg.C
Light –generated current	8.1225 A
Diode saturation current	10A
Diode ideality factor	0.9768
Shunt resistance (Rsh)	49.9925Ω
Series resistance(R _s)	0.39383Ω

E)Break algebraic loop in internal model

By default this parameter is not selected. You then get an algebraic loop in the internal diode model, both in a continuous model or in a discrete model. If you use the block in a discrete system using large sample times, this algebraic loop is required to get an iterative, accurate solution for the highly nonlinear diode characteristics. For example, the PV array connected to an average model of power electronic converter runs with a sample time as large as 50e-6 sec, and Simulink® can solve the algebraic loop. When the PV array block is connected to a detailed power electronic converter where real switches are simulated, you need to specify a small sample time to get accurate

resolution in PWM pulse generation (for example, 1e-6 sec with a 5 kHz PWM inverter). In this case, to speed up simulation, select this parameter to break the algebraic loop. When the model is discrete, break the algebraic loop by using a one-simulation-step time delay. This approach can cause numerical oscillations if the sample time is too large. When the model is continuous, break the algebraic loop by using a first-order filter. The **Time constant (s)** parameter then becomes visible. When the model uses an algebraic loop (i.e., the parameter is not selected), current and voltage measurement filters are used inside the continuous and the discrete model to help solve the algebraic loop. The **Measurement Filter Time constant (s)** parameter then becomes visible.

Time constant (s)

The filter time constant is visible in a continuous model only when **Break algebraic loop in internal model** is selected. The default value is 1e-6 sec.

Measurement Filter Time constant (s)

The measurement filter time constant is visible in both discrete and continuous model when **Break algebraic loop in internal model** is not selected. The default value is 5e-5 sec.

Input and Output

Ir: Connect to this input a Simulink signal representing varying sun irradiance in W/m2.

T: Connect to this input a Simulink signal representing varying cell temperature in degrees C.

m: Simulink output vector containing five signals. You can select these signals using the Bus Selector block in the Simulink library.

PV parameter

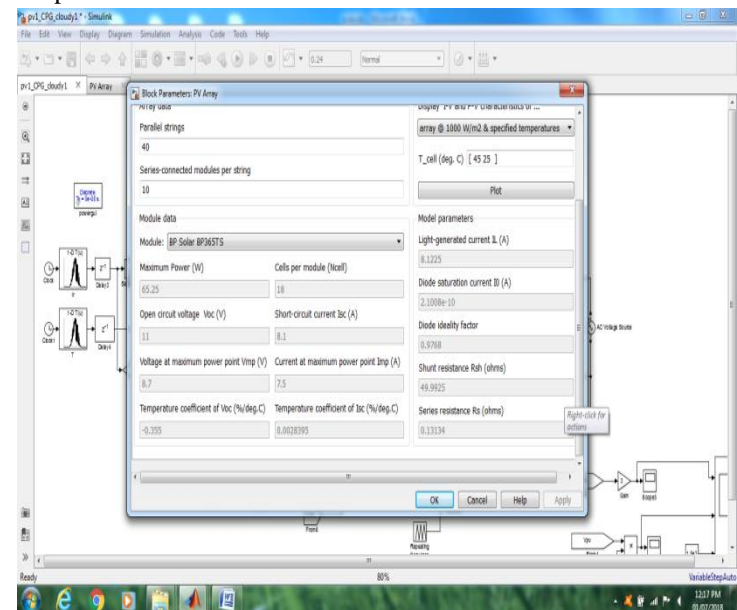


Fig 3.3.4PV array block parameter

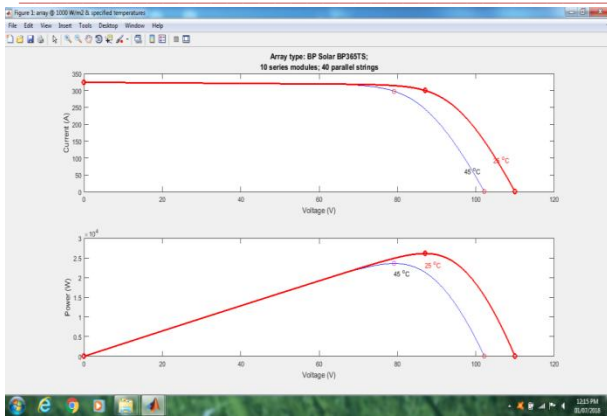


Fig. 3.3.5.IV and PV Graph

CONCLUSION

A high-performance active power control scheme by limiting the maximum feed-in power of PV systems has been proposed in this letter. The proposed solution can ensure a stable constant power generation operation. Compared to the traditional methods, the proposed control strategy forces the PV systems to operate at the left side of the maximum power point and thus it can achieve a stable operation as well as smooth transitions. Experiments have verified the effectiveness of the proposed control solution in terms of reduced overshoots, minimized power losses, and fast dynamics..

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