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# Area Electrification using Renewable Energy

**Madhuri B. Jadhav, G. M. Kulkarni, A. R. Sonawane**
Department of Electrical Engineering
Guru Gobind Singh Polytechnic, Nashik, India

**Abstract:** *This paper presents an optimized approach to the design and implementation of a discrete Proportional-Integral-Derivative (PID) controller for precise speed regulation of DC motors using MATLAB. DC motors are critical components in various industrial and robotic applications, where maintaining accurate speed control is essential for efficient operation. The study explores the dynamic modeling of a DC motor and the application of discrete PID control techniques to achieve superior performance in terms of transient response, stability, and disturbance rejection. MATLAB/Simulink is utilized for system simulation, parameter tuning, and performance evaluation. Advanced tuning methods, including Ziegler-Nichols and heuristic techniques, are employed to optimize controller gains, ensuring minimal overshoot, reduced settling time, and robust steady-state accuracy. Simulation results validate the proposed approach, highlighting its effectiveness in achieving high-precision speed regulation under varying operational conditions. This study provides a valuable resource for engineers and researchers focused on enhancing DC motor control systems*

**Keywords:** Discrete PID controller, DC motor speed control, MATLAB/Simulink, control systems, Ziegler-Nichols tuning, speed regulation, transient response, steady-state performance, optimization, industrial automation

## I. INTRODUCTION

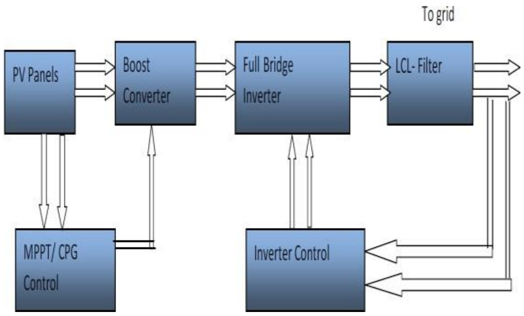
In this paper, a new MPPT technique is proposed which suggests a modified perturb and observe algorithm to reach fast to the MPP compared to the conventional perturb and observe technique. This work explains the PV equivalent circuit, current-voltage, power-voltage characteristics of photovoltaic systems 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 genera to r 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



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## III.SIMULATION CASE STUDIES

**Solar PV array** In MATLAB/Simulink 2016 environment Solar PV array block

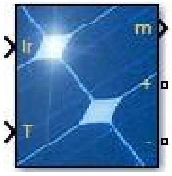


Fig 3.1.1 Solar PV block

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 IL (light-generated current), diode (I0 and nI parameters), series resistance Rs, and shunt resistance Rsh to represent the irradiance- and temperature-dependent I-V characteristics of the modules.

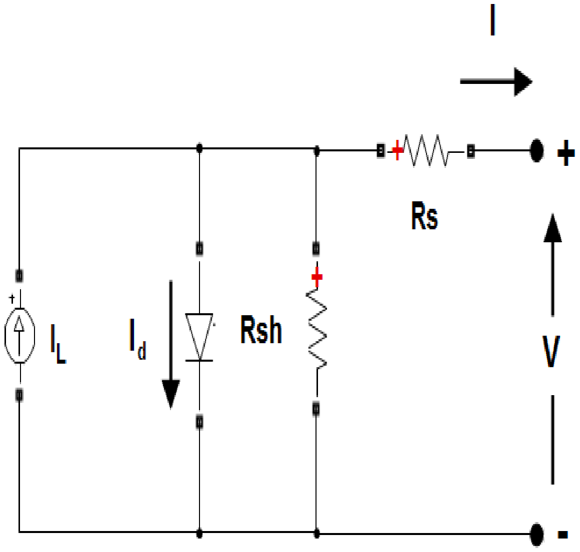


Fig 3.3.2single PV circuit

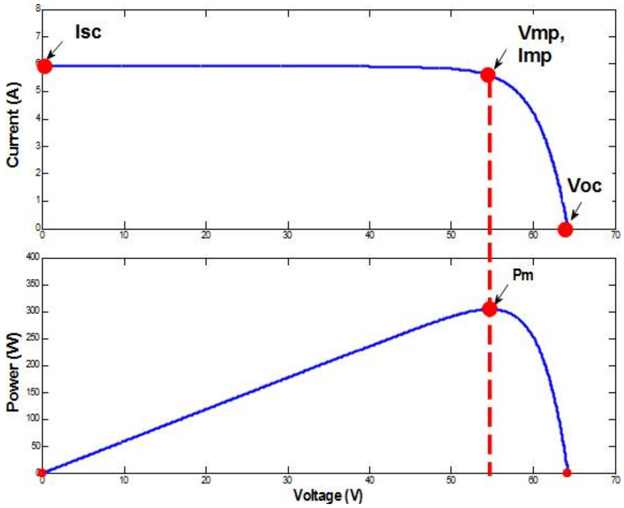


Fig.3.3.3 IV and PV with Vmmp Number of strings of series-connected modules that are connected in parallel. The default value is 40.

**Series-connected modules per string** Number of PV modules connected in series in each string. The default value is10.

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/m$^2$, temperature=25 degrees C).[4]

When you select a module, this data from the BP365TS database updates when you apply your changes: Ncell, Voc, Isc, Vmp, Imp maximum power, as well as temperature coefficients of Voc and Isc. The function computes the five corresponding model parameters (IL, I0, nI, Rsh, Rs) 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 (Ncell, Voc, Isc, Vmp, Imp, and temperature coefficients of Voc and Isc

**Temperature coefficient of Voc (%/deg.C)**

Defines variation of *Voc* as a function of temperature. The open-circuit voltage at temperature *T* is obtained as

*VocT* = *Voc* (1 + *beta_Voc*(*T*–25),

where *Voc* is the open-circuit voltage at 25 degrees C, *VocT* is the open-circuit voltage at temperature *T* (in degrees C), *beta_Voc* is the temperature coefficient (in %/degrees C), and *T* is the temperature in degrees C. **Temperature coefficient of Isc (%/deg.C)** Defines variation of *Isc* as a function of temperature. The short-circuit current at temperature *T* is obtained as

*IscT* = *Isc* (1 + *alpha_Isc*(*T*–25),

where *Isc* is the short-circuit current at 25 degrees C, *IscT* is the short-circuit current at temperature *T* (in degrees C), *alpha_Isc* is the temperature coefficient (in %/degrees C) and *T* is the temperature in degrees C.

**PV GENRATION DATASHEET PARAMETER**

Table 1- PV Genration Datasheet Parameter

| **Modul e(BP365TS) Parameter** | **Value** |
|---|---|
| Maximum Power | 213.15W. |
| Cell per module | 18 |
| Open circuit voltage( Voc) | 18v |
| Short circuit current( Isc) | 8.1A |
| Voltage at | 8.7v |

| | |
|---|---|
| Maximum power point( Vmp) | |
| Current at maximum power pointb (Imp) | 7.5A |
| Temperature coefficient of (Voc) | 0.355%/deg.C |
| Temperature coefficient of (Isc) | 0.0028395%/deg.C |

**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 IL (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 Rsh (ohms)**

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

**Series resistance Rs (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 –genrated current | 8.1225 A |
| Diode saturation current | 10A |
| Diode ideality factor | 0.9768 |
| Shunt resistance (Rsh) | 49.9925Ω |
| Series resistance( Rs) | 0.39383Ω |

**Break algebraic loop in internal model**

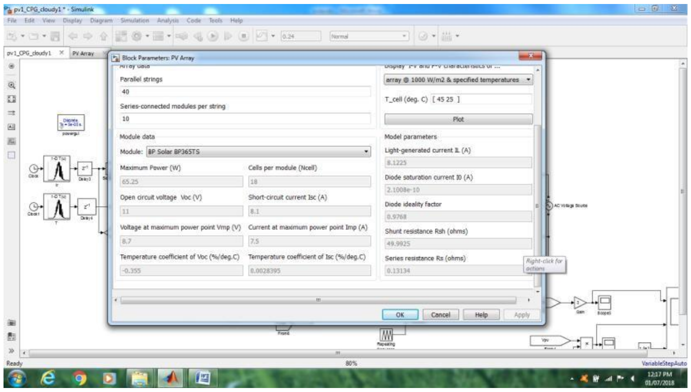
By default this parameter is not selected. You then get an algebraic loop in the internal diode model, both in a continuous model or in a discrete model. If you use the block in a discrete system using large sample times, this algebraic loop is required to get an iterative, accurate solution for the 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**


Block Parameters: PV Array

Parallel strings: 40
Series-connected modules per string: 10
Module data
Module: BP Solar BP365TS
Maximum Power (W): 65.25
Cells per module (Ncell): 18
Open circuit voltage Voc (V): 11
Short-circuit current Isc (A): 8.1
Voltage at maximum power point Vmp (V): 8.7
Current at maximum power point Imp (A): 7.5
Temperature coefficient of Voc (%/deg.C): -0.355
Temperature coefficient of Isc (%/deg.C): 0.0028395
Display I-V and P-V characteristics of ...: array @ 1000 W/m2 & specified temperatures
T_cell (deg. C): [ 45 25 ]
Model parameters
Light-generated current IL (A): 8.1225
Diode saturation current I0 (A): 2.1008e-10
Diode ideality factor: 0.9768
Shunt resistance Rsh (ohms): 49.9925
Series resistance Rs (ohms): 0.13134

Fig 3.3.4PV array block parameter

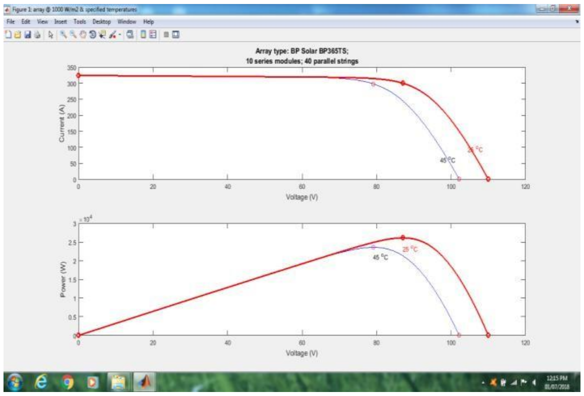


Fig. 3.3.5.IV and PV Graph

## II. 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..

## REFERENCES

**[1].** ’New Perturb And Observe Mppt Algorithm And Its Validation Data From Pv Module”, Bikram Das,Anindita Jamatia , Abanishwar Chakraborti Prabir Rn.Kasari&Manik Bho International Journal of Advances in Engineering & Technology, July 2012.©IJAET ISSN: 2231-1963579 Vol. 4, Issue 1, pp. 579-591

**[2].** “A Fast PV Power Tracking Control Algo rithm With Reduced Power Mode”AshrafAh med; Li Ran; Sol Moon; Joung-Hu Park IEEE Transactions on Energy Conversion Year: 2013, Volume: 28, Issue: 3Pages: 565 – 575.

**[3].** “Incremental Conductance MPPT Method for PV Systems”. A. Safari and S. Mekhilef IEEE CCECE 2011. “Research Article Mathematical Model for Computing Maximum Power Output of a PV Solar Module and Experimental Validation” V. P. Sethi,1 K. Sumathy,1 S. Yuvarajan,2 and D.

**[4].** S. Pal3 Ashdin Publishing Journal of Fundamentals of Renewable Energy and Applications Vol. 2 (2012), Article ID R120312

**[5].** “High-Performance Constant Power Generation in Grid-Connected PV Systems”, Ariya Sangwongwanich, Yongheng Yang, Member, IEEE, and Frede Blaabjerg, Fellow, IEEE , IEEE Transactions On Power Electronics, Vol. Pp, No. 99, 2015

**[6].** A Review of Single-Phase Grid- Connected Inverters Soeren Baekhoej Kjaer, Member, IEEE, John K. Pedersen, Senior Member, IEEE, and Frede Blaabjerg, Fellow, IEEE Journal Of Photovoltaics, Vol. 3, No. 3, July 2013.

**[7].** “Design and implementation of MPPT solar system based on the enhanced P&O algorithm using Labview”, GAGA Ahmed, ERRAHIMI Fatimay, ES-SBAI Najia ©2014 IEEE.

**[8].** Modified Perturb and Observe MPPT Algorithm for Drift Avoidance in Photovoltaic Systems”, Muralidhar Killi, and Susovon Samanta, Member, IEEE, 2015 IEEE Transactions On Industrial Electronics.

**[9].** “Design and Simulation of Incremental Conductance MPPT Using Self Lift Cuk Converter”, M.Latha Devi, Mr.M.Chilambarasan, 2013 International Conference on Renewable Energy and Sustainable Energy [ICRESE’13].