www.ijecs.in
International Journal Of Engineering And Computer Science ISSN: 2319-7242
Volume 5 Issue 11 Nov. 2016, Page No. 18781-18785

Maximum Power Point Tracking Using DRCC and MRAC With Modified Mit Rules For PV Cells

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Abstract: This paper is about improving the maximum power point tracking by using the Discrete time Ripple Correlation Control and Model Reference Adaptive Control with MIT rules. MPPT technologies have been used in photo-voltaic systems to deliver the maximum power output to the load under changes of solar insolation and solar panel's temperature. Where as in the existing models combined feature of ripple correlation control (RCC), and the model reference adaptive control (MRAC) are used in Photovoltaic systems to reduce pertabations.This paper includes the improved version of both RCC and MRAC ,a model two layer architecture which provides promising increase in tracking efficiency and accuracy. The performance of the pro-posed technique was observed and developed by MATLAB/simulink software.

Keywords: Maximum power point tracking, solar energy conversion system, MRAC, RCC, DRCC, MRAC with MIT rules.

I. INTRODUCTION:

Photovoltaic system is a component to achieve the solar energy conversion to electricity. Maximum power point tracking algorithm (MPPT) keeps the photovoltaic systems to deliver the power continuously irrespective of the load and environmental conditions.MPPT mostly uses Different maximum power point tracking algorithms like Perturb and observe algorithm, incremental conductance, etc. Among this P&O, is widely used because of its simplicity and easy to understand [1].But P&O has the disadvantage of producing ripples at their output. For this issue we are using RCC.

RCC is a Ripple correlation control provides updation of the output with the duty cycle, It is a type of nonlinear control approach applicable to power electronic circuits, which makes use of voltage, current, or power ripple and correlates the ripple with switching functions to effect control, It also determines the cost- function minimization and maximization [2].maximum power point tracker (MPPT) methods are designed to operate solar panels at their maximum operating points . Replacing the RCC with the emerging technology of **discrete time Ripple Correlation Control** will increase the efficiency. It updates the sample rate can be as fast as the switching frequency, with the help of microcontroller and analog-to-digital converter (ADC) system. And to get the effective Optimization and power maximization we are using the MRAC with MIT rules which is the advanced version of MRAC. This will improve the maximum power tracking with increased gain and reduced ripples.

II.DRCC:

Although Ripple correlation control (RCC) provides a high-performance real-time optimization for MPPT, it has limited sample time and the process is slow because of ripples in output voltage. This can be reduced by transforming the RCC into a discrete time domain, so the signals can be sampled at high rate .It also provides the transformation of analog output into the digital one. DRCC has a stable operating point .It uses mode-switching algorithm. In this the maximization and minimization can be achieved by changing the sign of K.

$$\text{Sgn K} = -\text{sgn}\ \frac{d\phi}{dt}$$

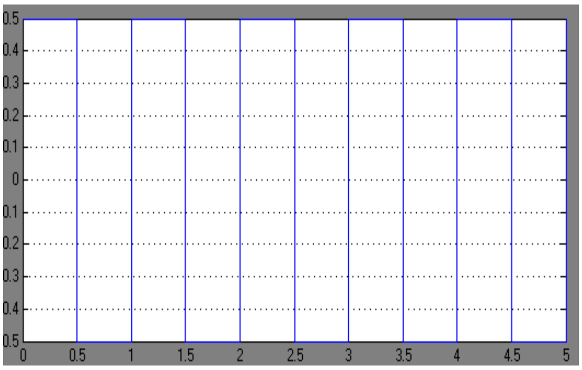

Fig1.Simulation output of DRCC

The DRCC uses the integer time delay which provides delay to the sample time so the efficient duty cycle is achieved.

III.MRAC with MODIFIED MIT rules:

The conventional MRAC (Model Reference Adaptive control)may not perform well because of the variation in process as there is a changes in environmental conditions and variation in the character of the disturbances that occur in the environment.

To overcome this controller is designed for a second order system with Model Reference Adaptive Control (MRAC) scheme using them MIT rule for adaptive mechanism [4].

Mathematical approaches like MIT rule, Lyapunov theory and theory of augmented error can be used to develop the adjusting mechanism . In this paper we are using MIT rule with Normalized Algorithm and the technique is then referred as Modified MIT rule[5]. In this, a cost function uses the error between the outputs of the plant and thereference model, and controller parameters are adjusted to produce minimum cost. But is very sensitive to the changes in theAmplitude of reference signal.

For normal reference adaptive control,

y m(t) is the output of the reference model and y(t) is the output of the actual plant and difference between them is denoted by e(t).

e(t) = y(t) - ym(t)

In this a cost function is defined as,

J(θ)/2

Where e is the error between the outputs of plant and the model, and θ is the Adjustable parameter.

Parameter θ is adjusted in such a fashion so that the cost function can be
minimized to zero. For this reason, the change in the parameter θ is kept in the
Direction of the negative gradient of J that is obtained from the following derivative:

$$\frac{d\theta}{dt} = -\gamma\,\frac{\partial J}{\partial \theta}$$

$$\frac{d\theta}{dt} = -\gamma e \frac{\partial e}{\partial \theta}$$

the partial derivative term$\frac{\partial e}{\partial \theta}$ is called as the sensitivity derivative of the system. This term indicates how the error is changing with respect to the parameter θ

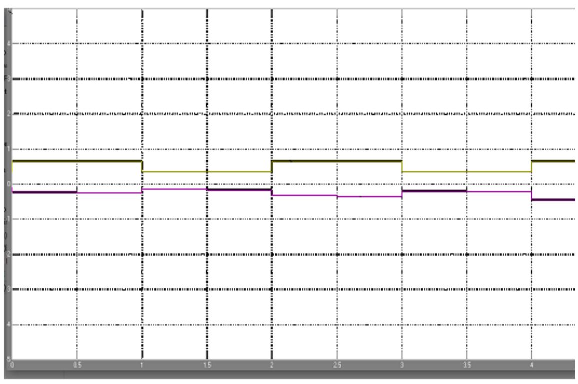

Fig.2.Simulation of the MRAC with modified MIT rules

DOI: 10.18535/ijecs/v5i11.09

But this MIT rules cannot be adapted for very large values. So the adaptive laws are used to avoid unstablity.The unstable conditions are due to variation with change in amplitude.

Therefore, the additional factor α are used.

Such that the equation governs

$$\frac{d\theta}{dt} = {-\gamma e\emptyset}\Big/{\alpha + \varphi'\emptyset}$$

Where,

$$\emptyset = \frac{\partial e}{\partial \theta}$$

For every value of α > 0 ,the $\emptyset$ becomes small.

IV. Two level architecture:

In this two level architecture the combined feature of both DRCC and MRAC with MIT rules are used .the two blocks are connected in series so the DRCC corrects the ripple by varying the duty and samples the signals according to that. It provides the output in a discrete time with appropriate time delay $Z^{-1.}$

the MRAC with MIT rules provides a reference adaptive control by adjusting the value of θ based on the value of the samples signals.The combined feature increases the efficiency and increases the cost.

That is cost maximization and error minimization.

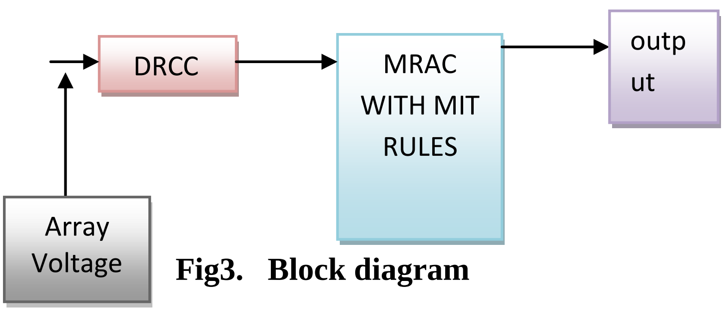

Fig3. Block diagram

In this the PV array voltage and current are given as a input to MPPT which includes the DRCC and Modified MRAC .The output of this two level architecture plays an important in increasing the efficiency of tracking maximum power.

At first the output of the PV panel is given to the Discrete ripple correlation control, this analyses the input and produces a correct signal at high sample rate [7].

The work of DRCC is to calculate the duty cycle of the input, and to determine the ripple from it.The calculated duty cycle are sampled with respective time delay of the z transform $^{Z-1.}$The discrete signals of the duty cycle are given as a input to the next level.

The output of DRCC is given to the Modified MRAC which uses the modified MIT rules [5].

This has the modification factor of α $and\ \emptyset$ and they are modified according to that rules .This takes the reference value of duty cycle and calculate the adaptive factor and corrects the output according to that value.

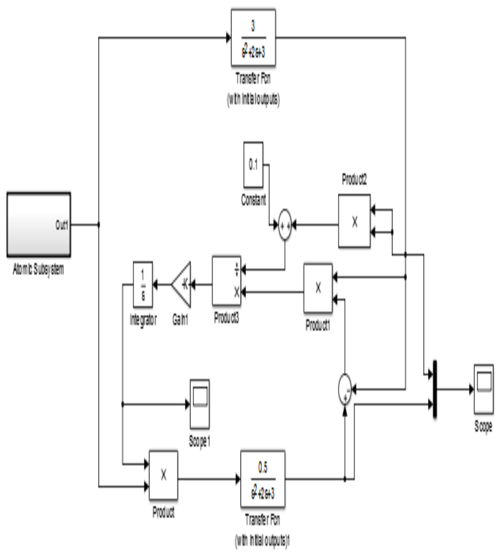

Fig.4. Simulation of two level architecture

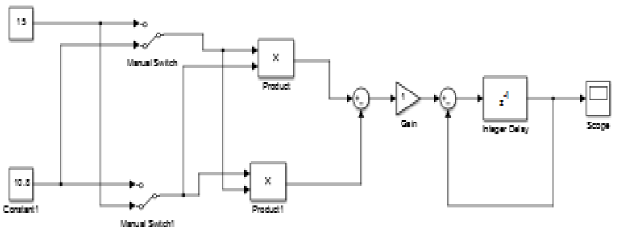

Fig.5. Simulation of subsystem

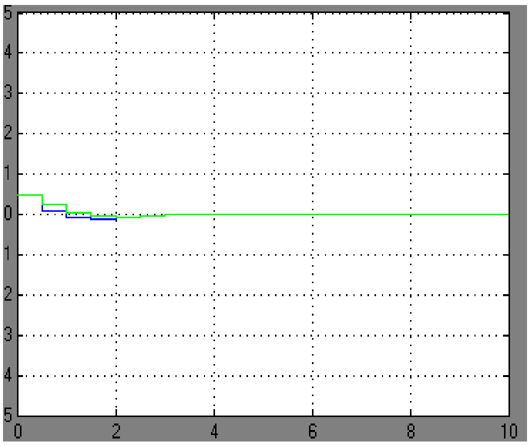

Fig.6.Simulation output of two level architecture

This shows that the maximum power is tracked. The output has increased efficiency compared to other methods.

V. CONCLUSION

In this paper the two level architecture are Used. Based on the gain values K of DRCC and α of the Modified MRAC with MIT rules, the combined output are produced. Fig 6 shows the simulated results.Hence the levels are created and simulated.

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