# Implementation of MPPT Technique Applied to Wind Power Generation System

**Kaushal Kishor Tripathi**
Assistant Professor
BNCET Lucknow India

*Abstract*— The escalation in electrical energy costs associated with fossil and nuclear fuels, and enhanced public awareness of potential environmental impacts of conventional energy systems has created an increased interest in the development and utilization of alternate sources. Wind energy is being increasable recognized as cost effective generation sources in small isolated power systems. Today, more than 32,000 wind turbines systems are installed all over the world. Wind energy systems are being firmly studied because of its benefits as an environment friendly and sustainable source of energy. Due to its erratic nature, power execution concepts are necessary for extraction as much power as possible from the wind energy.

***Key words:*** MPPT, Tip Speed Ratio, PSF

## I. INTRODUCTION

Wind energy has been used since the earliest civilization to pump water from deep wells. In recent few decades, the industry has been perfecting the wind turbine to convert the power of the wind into electricity. It prevents pollution as generator does not produce any harmful emissions during the generation of the electricity, unlike many other generation sources. In order to regulate the output power of the system a DC/DC converter is used.

### *A. Power Signal Feedback Method*

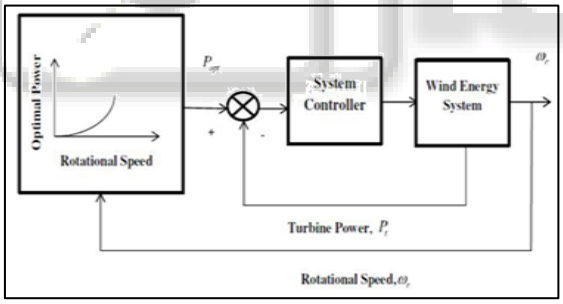


Fig. 1: Power Signal Feedback Method

The Power Signal Feedback method is used as a reference power which has maximum power at that particular wind speed. This presents an issue, as the prior knowledge of the wind turbine characteristics and wind speed measurements is required.

When this reference power is obtained from the power curve at that wind speed, a comparison of output is done with the present power. Then error produced drives a Control algorithm. PI control refers to Proportional (P), integral (I) control. It contains P and I part that are manipulated to reduce the error between a known set point and the instantaneous values of the measured values

## II. WIND ENERGY GENERATION SYSTEM

Mathematics of Wind Power the amount of mechanical power captured from wind by a wind turbine can be formulated as

$$Pm = (1/2)\,\rho A C p v^3$$

ρ= Air density (Kg/m3)
A = Swept area ($m^2$)
CP = Power coefficient of the wind turbine
V = Wind speed (m/s)

In the wind turbine is mainly characterized by the $C_P$-λ curve;

Where the tip speed ratio, λ, is given by

$$\lambda = \omega R)/v$$

Fig.2 shows a typical "Cp- λ" curve for a wind turbine. It shows that CP has its maximum value at λopt, which results in optimum efficiency; therefore, maximum power is captured from wind by the turbine.

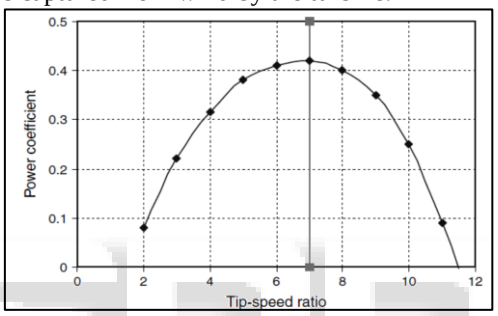


Fig. 2: Power Coefficient vs. Tip-Speed Ratio

## III. MPPT ALGORITHM

MPPT based on Fuzzy logic method does not require any knowledge of the photovoltaic panel. Since it has two inputs and single output. Mamdani method (Fuzzy Logic Toolbox) is used here for inference and the centroid of fuzzy method for defuzzification and the duty cycle is calculated [6], [7] and using FLC based technique to find the maximum value of power.

### *A. Modelling of Solar using Fuzzy MPPT*

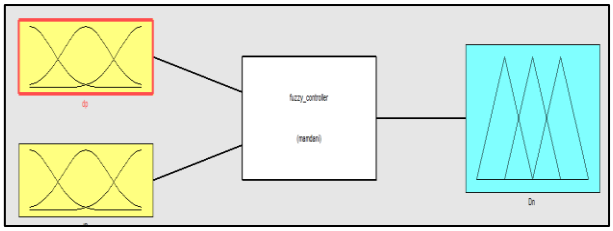


Fig. 3: FIS Structural Characteristics in Simulation

Table.1 shows rule base where linguistic variables nl, ml, nl, ms, vs, av, aav, bav are notations for output fuzzy set. Here notation nl is for negative large ,nm is for negative medium, ns is for negative small, z is for zero, pm is for positive medium and pl is for positive large. In same way vl is for very large, ml is for medium large , nl is for negative large, vs is for very very small av is for average aav is for above average bav is for below average. The rule base contains two dimensions corresponding to fuzzy controller having two inputs and one output. Every row provides the resultant

 

output fuzzy set for each combination of input fuzzy set. The entire rule base can be written in terms of IF-THEN rules, these are AND and OR combinations

| $dD_{n-1}$ | $dP_n$ | | | | | | |
|---|---|---|---|---|---|---|---|
| | nl | nm | ns | z | ps | pm | pl |
| nl | vl | vl | mv | bav | ms | vs | vs |
| nm | vl | ml | aav | bav | bav | ms | vs |
| ns | ml | aav | aav | av | bav | bav | vs |
| z | vs | ms | aav | av | aav | ml | vl |
| ps | ms | bav | aav | av | aav | aav | ml |
| pm | vs | ms | aav | aav | aav | ml | vl |
| pl | vs | vs | ms | ml | ml | vl | vl |

Table 1: Rule for a Fuzzy MPPT Controller

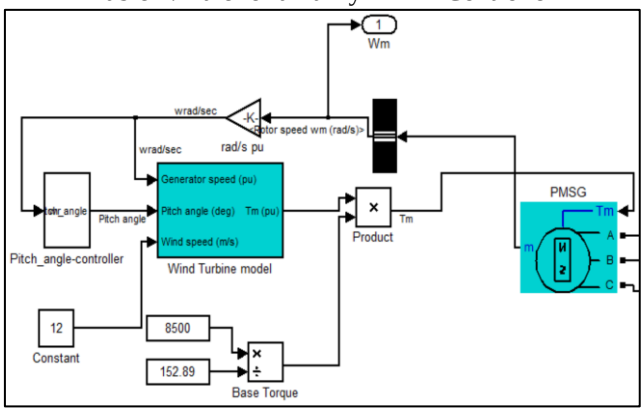


Fig. 4: Wind Turbine linked with Synchronous Generator

After modeling all building blocks of wind energy conversion system and solar energy developed SIMULINK block of hybrid system with MPPT is shown below in Fig.4

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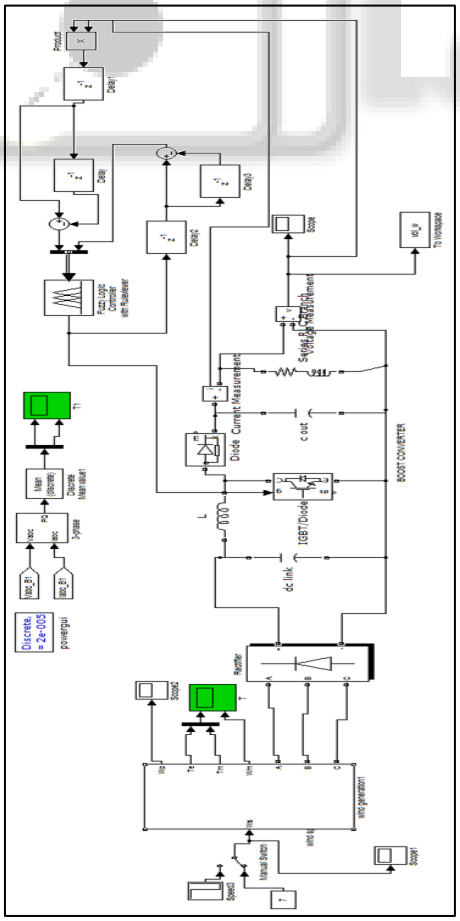

Fig. 5: Simulation Model of Proposed System

*B. Wind Power Generation*

The Matlab simulink model is shown below.

The conventional MPPT method for solar is shown here.

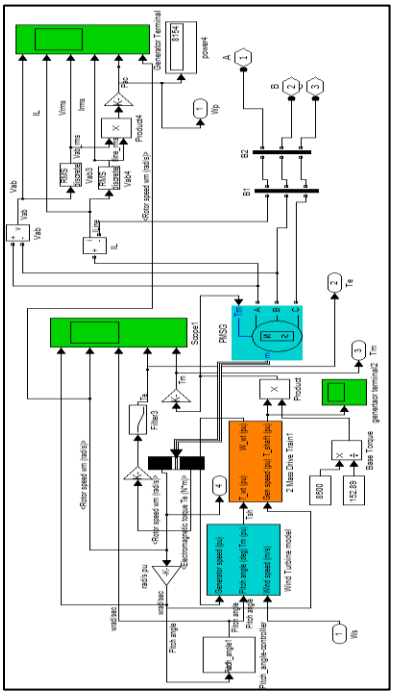

Fig. 6: Wind Turbine linked with Synchronous Generator

## IV. RESULTS

The output before and after mppt is shown below. The various parameters can be seen in the output

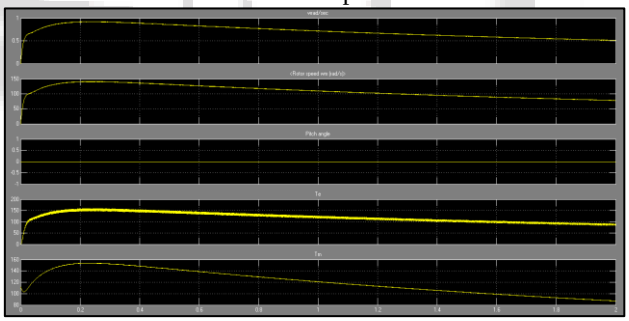

Fig. 7: Angular speeds and Mechanical Torque

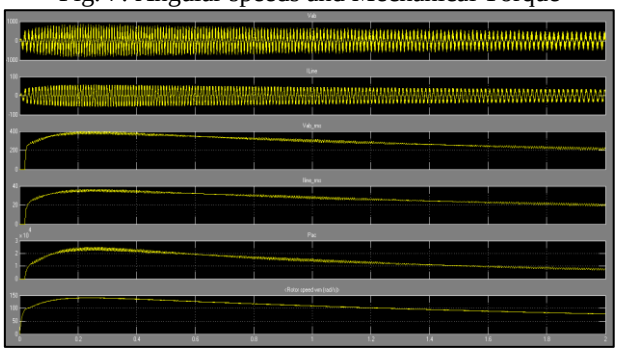

Fig. 8: Output Voltage after MPPT

The corresponding output voltage after MPPT is shown in Fig.8.

## V. CONCLUSION

This paper has presented a Maximum Power Point Tracking techniques related to their energy performance and

 

efficiency. Several MPPT techniques taken from different papers can be discussed. It is shown that there are several other MPPT techniques than those commonly included in literature reviews. This can be a useful in choosing the right MPPT method for specific wind turbine.

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