ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijareeie.com

Vol. 6, Issue 2, February 2017

Examination of Energy Management Strategy for Grid Connected Hybrid Energy Power System

Anna Ranganadh

Assistant Professor, Dept. of EEE, Gurunanak Institute of Technology, Hyderabad, India

ABSTRACT: Objectives: The proposed framework assesses the working of half and half power framework utilizing fluffy based Maximum Power Point Tracking (MPPT) controller. In our proposed half and half power plant both Photovoltaic (PV) cluster and Proton trade film energy component (PEMFC) are associated parallel to the matrix and they are controlled by controllers.

Strategies/Statistical investigation:
For the most part Photo Voltaic (PV) exhibit uses greatest power point following (MPPT) procedure to convey most extreme energy to stack ceaselessly and the PV cell ends up noticeably wild source when light and temperature change happens for consistent power stream in a lattice framework Photo Voltaic (PV) cluster can be joined with PEMFC cells.

The cross breed control stream model can be controlled in two modes Feeder-Flow Control (FFC) mode and Unit Power Control (UPC) mode. The estimation of dynamic and receptive energy of burdens will be measured with the assistance of different measuring instruments, with these dynamic and responsive estimations of energy, the control mode will be exchanged either as UPC or FFC mode. The control operation will be finished with the assistance of versatile fluffy controller, in view of the yield control from the power plants.

Findings: The proposed versatile fluffy controller based MPPT strategy will improve the power yield from the power plants and the proposed controller can be utilized to give heartiness and upgrade the execution of matrix. The fluffy controlling system likewise discovered proficient for constantly shifting burdens. The proposed demonstrate is executed and examined utilizing MATLAB/Simulink programming.

Application/Improvements: Operating methods of PEMFC cell can be utilized productively in numerous vitality administration frameworks. These adaptable working modes will expand the steadiness of the framework.

KEYWORDS: Photovoltaic (PV) array, Proton Exchange Membrane Fuel Cell (PEMFC), Fuzzy logic, Unit Power Control (UPC) mode, Feeder-Flow Control (FFC) mode.

I. INTRODUCTION

Due to increased power demand and due to many environmental factors power sectors are concentrating more towards alternative energy sources such as renewable energy. The power outputs from conventional renewable energy sources are not constant all the time because of changing environmental condition.

To overcome this disadvantage the concept of hybrid system are proposed, where two different types of power plants are combined together to deliver constant amount of energy to the power grid. This will improve the power quality save cost and provides uninterruptible power service [1&2]. To combine two power plants to deliver a constant output a central controlling unit is needed, this will be done with the help of Maximum Power Point Tracking (MPPT) controllers are used. For example, the power produced from the PV array will be maximum in day time, so the

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijareeie.com

Vol. 6, Issue 2, February 2017

controller should reduce the power produced from the fuel cells. The power produced from the PV arrays will be zero in night time; therefore the controller should draw maximum power from the fuel cells. This is the basic working of MPPT controllers. The power produced from this sources are DC in nature, so DC/DC or DC/AC power converters are used to deliver energy from source to grid confirming consistent, steady and sustainable operation [3]. The converters will be monitored by the controller systems [4 & 5]. The block diagram of proposed Hybrid energy power system is shown in Fig 1.

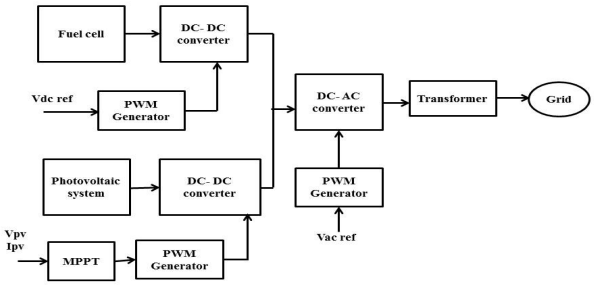


Fig 1: Block diagram of Hybrid Energy Power System

There are many control strategies, for example, Perturb and watch, Incremental conductance, neural systems and so on. Among the various methods, fluffy deduction framework is quicker when contrasted with other control systems [6]. In writing [7] a nitty gritty outline and reenactment of dynamic model of PV/FC/UC based cross breed framework were portrayed. A complete model for the breeze/PV/electrolyzes/FC framework and a power administration instrument that uses versatile fluffy rationale control is additionally portrayed before.

II. SYSTEM DESCRIPTION

2.1 Structure of Grid-Connected Hybrid Power System

The proposed half and half framework comprises of Photo Voltaic (PV) [9&10] and Fuel Cell (PEMFC) [4&8] cross breed source; they are associated with a network through many advance up and venture down converters. Keeping in mind the end goal to keep up current and voltage in stage with recurrence in network, the created control is coupled to the DC side of DC/AC inverter [9] and with a stage corrector circuit. The controller planned in our proposed framework will be associated with DC/DC buck-support converter. The converter will advance up or venture down the yield voltage in view of the estimation of control flag. The proposed strategy utilizes versatile fluffy based MPPT controller. The controller examinations the distinction between the dynamic power conveyed by source at various time interim and it will likewise look at the dynamic power request by stack. In view of the examination esteem the versatile fluffy controller will convey the yield contingent upon the fluffy run instated in the controller.

2.2 PV Array Model

The mathematical model of Photo Voltaic array [9 &10] is expressed as

$$I = I_{ph} - I_{sat} \{ e^{[q / AKT (V + IRS)] - 1} \} \ldots\ldots\ldots\ldots (1)$$

Equation (1) explains the output characteristic of a solar panel (PV). It shows that the output delivered from solar power panel is nonlinear and affected by factors such as solar irradiation, load, and temperature in the surrounding.

Where *Iph* is Photocurrent which is directly proportional to solar radiation *Ga* and cell temperature T_S it can be represented by following equation, $I_{ph}(G_a, T) = \dfrac{I_{scs} G_a}{G_{as}[1 + \Delta I_{SC}(t - T_S)]} \ldots\ldots\ldots (2)$

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijareeie.com

Vol. 6, Issue 2, February 2017

Isat depends on solar irradiation and cell temperature and it can be mathematically expressed as

$$I_{sat}(G_a,\ \mathrm{T}) = \frac{I_{ph}(G_a,T)}{e(V_{OC}(T)/V_t(T))-1} \quad \ldots\ldots\ldots (3)$$

2.3 PEMFC Model

The PEMFC steady-state feature of a PEMFC source is assessed by means of a polarization curve, which shows the nonlinear relationship between the voltage and current density. The PEMFC output voltage [8] is as follows:

$$V_{out} = V_{nerst} - V_{act} - V_{ohm} - V_{conc} \quad \ldots\ldots\ldots\ldots (4)$$

Where V_{nerst} is Nernst voltage and V_{act} will be the activation voltage given by

$$V_{act} = T(a + b\ln(l)) \ldots\ldots (5)$$

V_{ohm} is the ohmic voltage due to resistance caused by polymer membrane and electrodes, V_{conc} is the concentration voltage drop, it is expressed as

$$V_{conc} = -(RT/ZF)\ln(1 - l/l_{\lim it}) \ldots\ldots\ldots (6)$$

III. OPERATING STRATEGY OF THE HYBRID SYSTEM

To acquire most extreme yield control from the plant the control method of the half and half power framework should be introduced viably. There are two sorts of control modes used by our proposed framework. They are Unit Power Control (UPC) and FFC modes. The yield of the framework will be controlled inside a predefined control farthest point to the heap in UPC mode; so this UPC mode can be utilized as a part of instance of low power request. This kind of control mode will influence the framework for continually fluctuating burden request, so another control mode called as Fast Feeder Control (FFC) is presented. On the off chance that the estimation of PFC low, PFCup and PFC max are known, the controller needs to direct voltage produced by the cross breed framework to the feeder. Because of this control mode, the half and half framework yield can be coordinated with request of load. The control mode chips away at the premise of fluffy rationale. In the UPC mode, the reference yield energy of the cross breed source relies upon PV yield and the imperatives of the Fuel Cell yield will influence the framework to yield steady or certain. The stream graph of UPC mode is appeared in Figure 2.

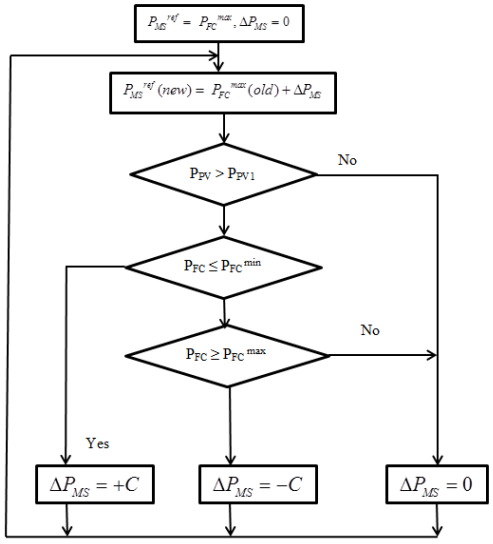


Fig 2 Algorithm of hybrid system in UPC mode

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijareeie.com

Vol. 6, Issue 2, February 2017

The control algorithm allows PV and FC to deliver power at its maximum efficiency to supply power to the load. In the UPC mode, the hybrid source regulates the output power by a reference value given below.

$$P_{PV} + P_{FC} = P_{MS}^{ref} \quad \ldots\ldots\ldots\ldots\ldots\ldots (7)$$

The above equation (7) shows the comparison of PV output and Fuel Cell stack system with a regulated nominal value called reference power P_{MS}^{ref} . However, FC output must satisfy its constraints and it should set an appropriate value [11].

IV. PROPOSED ADAPTIVE FUZZY CONTOLLER

The info factors of the fluffy controller are blunder E and change of mistake CE. The conduct of FLC relies upon participation elements of the run base waveform. Corresponding Integral Controlled framework is less receptive to quick modifications in state thus the framework will be slower to achieve set point. The flowchart of proposed versatile fluffy controller (AFC) is as appeared in figure 3.

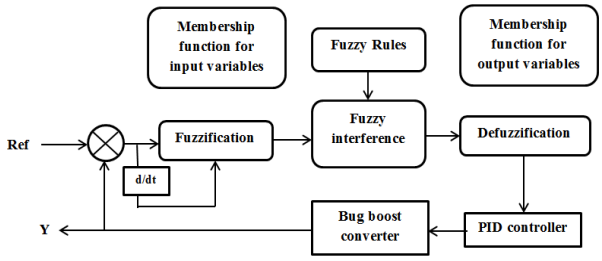


Fig 3 Proposed Adaptive fuzzy controller

To acquire the most extreme power purpose of half breed framework Fuzzy controllers are utilized and the proposed framework performs well as far as strength, quick because of dynamic changes. Fluffy controller will work in two essential modes, one is coarse and the second one is fine modes. There are three phases in this fluffy based control calculation, specifically fuzzification, derivation and defuzzification [12] and it is appeared in Figure 4. A mistake work (E) and change of blunder (ΔE) are made amid fuzzification. At that point these factors are contrasted with pre planned esteems amid deduction mode to anticipate suitable reaction. Defuzzification is utilized to change over the fluffy subset of control to participation work esteems. The fluffy principles are appeared in Table 1.

Table 1: Fuzzy set of rules

E / ΔE	NB	NS	NC	PS	PB
NB	PB	PB	NB	NB	NB
NS	PS	NC	NS	NS	NS
NC	NC	NC	NC	NC	PS
PS	NS	PS	PS	NC	NC
PB	NB	PB	PB	NC	NC

Fuzzification and Defuzzification

Fuzzy sets are subdivided in fuzzy sets as Negative Big (NB), Negative Small (NS), Positive Small (PS), and Positive Big (PB). The value of output (E) and control value (ΔE) are calculated by input factors (β_{de} , β). The fuzzy

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

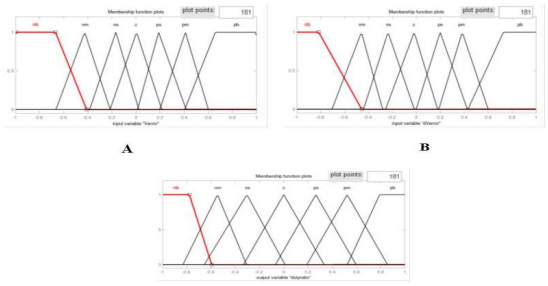
International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijareeie.com

Vol. 6, Issue 2, February 2017

set values are scaled between values -1 and 1. The output function will be specified by MIN (minimum) operator and MAX (maximum) operator [13 & 14] from the fuzzy sets. Once fuzzification operation is performed, output fuzzy range is traced. Centroid defuzzification is used to defuzzify the coded values in proposed model.

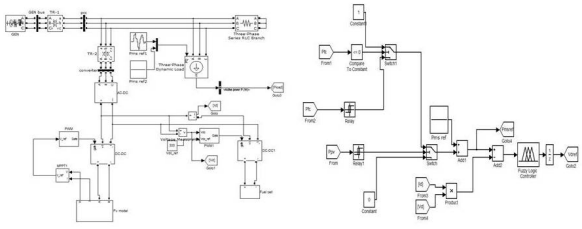


A B C

Fig 4 Fuzzification and defuzzification process(A - C); A - Membership function plots for 'e', B – Membership function plots for 'Δe', C - Membership function plots for 'U'

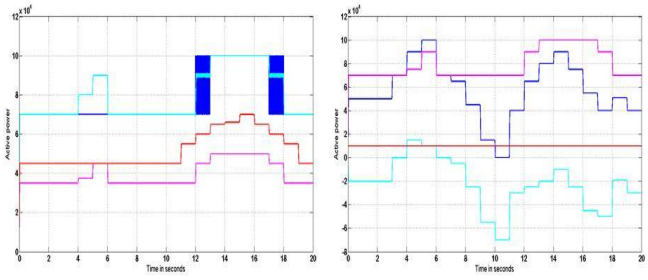
V. RESULTS AND ANALYSIS

An effective way to deal with draw greatest power from the half and half framework with dynamic load were proposed and executed. At the point when there is a distinction in temperature, illuminations amid control conveyance process, the PV framework moves to wild state, yield power can be controlled by PEMFC and mixture framework. The non-controlled dc yield voltage of PV is kept up by energy unit and it is sustained to the dc/dc help converter. The voltage will increment relies upon obligation proportion and it can be measured by rationale controller. At the point when there is an adjustment in voltage mistake and reference voltage, the fluffy controller makes control flag which is nourished to PWM flag generator which is then given to lattice inverter. Figure 5 demonstrates recreation of proposed fluffy based cross breed vitality administration framework utilizing MATLAB.



A B

Fig 5 Simulation of proposed fuzzy based hybrid energy management system using MATLAB, A - Simulation of proposed hybrid power system, B - Adaptive fuzzy logic controller for droop control system



A B

Fig 6 Results of hybrid system without fuzzy controller.
(A) Operation of the single system. (B) Operation of the entire system.

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijareeie.com

Vol. 6, Issue 2, February 2017

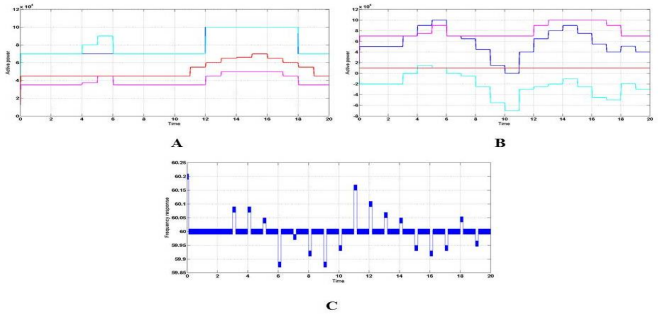


Fig 7 Performance comparison
(A) Operation of the hybrid source. (B) Operation of the whole system. (C) Variations of frequency in occur in the system.

Execution of cross breed framework without fluffy controller is appeared in fig 6 and execution upgrade by appropriate hysteresis alteration was appeared in fig 7. The framework will work in FFC modes, amid most extreme load introduce in the framework. The UPC mode is the principle working method of the framework and, later, the framework works all the more consistently. In this mode, the frameworks yield changes directly with each adjustment in stack request as in Fig. 7 (B). Enhancing Operation Performance by utilizing versatile fluffy Controller, varieties in reference voltage in unit control and spasmodic voltage control in feeder stream are killed by utilizing fluffy rationale and the proposed framework works all the more consistently in shifting conditions when contrasted with existing technique.

VI. CONCLUSION

The present research considers proposes a successful approach for vitality administration strategy, to advance vitality delivered from sustainable power source little scale control plants. The proposed technique demonstrates the effectiveness of half breed control framework when contrasted with existing force framework utilizing fluffy rationale controller circuit. The numerical demonstrating of PV exhibit was concentrated to outline a proficient control procedure for control creation from half breed control framework. The control method additionally incorporates control of variances caused by PV control framework. Our proposed framework depends on two modes UPC and FFC mode. The UPC mode has the disservice of controlling to dynamic load in the framework. The FFC mode will deliver a change in the yield control created from PV cluster. Accordingly, our proposed versatile fluffy based control modes observes to be more effective in controlling dynamic load and give control in stage lattice control and diminishes control cancelation in network. The execution of half and half power framework with and without versatile fluffy rationale controller was considered; it is demonstrated that the proposed framework will be more effective when contrasted with other controlling methods. Operation of half and half power hotspot for changing recurrence was approved and comes about demonstrates that cross breed framework is proficient for differing recurrence.

REFERENCES

[1]. Khanh LN, Seo JJ, Kim YS, Won DJ. Power-Management strategies for a grid-connected PV-FC hybrid system. IEEE Transactions on Power Delivery. 2010 July; 25(3):1874–82.
[2]. Hua C, Lin JR. DSP-based controller application in battery storage of phototaic system. Proceedings of 22nd IEEE International Conference Industrial Electronics, Control, and Instrumentation; 1996 Aug 5-10; 3:1705–10.
[3]. Hajizadeh A, Golkar MA. Power flow control of grid connected fuel cell distributed generation systems. J Elect Eng Technol. 2008; 3(2):143–51.
[4]. Koutroulish K, Kaalitzakis K. Development of a microcontroller-based, phototvoltaic maximum power point tracking control system. IEEE Trans Power Electron. 2001 Jan; 16(1), 46–54.
[5]. Wang N, Shaw SR. Dynamic models and model validation for PEM fuel cells using electrical circuits. IEEE Trans Energy Convers. 2005 June; 20(2):442–51.
[6]. Rrezvani F, Mozafari B, Faghihi F. Power quality analysis for phototaic system considering unbalanced stage. Indian Journal of Science and Technology. 2015 July; 8(14):60194.

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijareeie.com

Vol. 6, Issue 2, February 2017

[7]. Rezvani A, Izadbakhsh M, Gandomkar M, Vafaei S. Implementing GA-ANFIS for maximum power point tracking in pv system. Indian Journal of Science and Technology. 2015 May; 8(10):982–91.
[8]. Hua C, Lin JR, Shen C. Implementation of a DSP-controlled phototaic system with peak power tracking. IEEE Trans Ind Electron. 1998 Feb; 45(1):99–107.
[9]. Hua C, Shen C. Comparative study of peak power tracking techniques for solar storage system. Proceedings of 13th Annual Applied Power Electronics Conference Expo; 1998 Feb 15-19; 2:679–85.
[10]. Sera D, Teodorescu R. Power flow control of grid-connected fuel cell distributed generation systems. J Elect Eng Technol. 2008; 3(2):143–51.
[11]. Bocklisch T, Schufft W, Bocklisch S. Predictive and optimizing energy management of phototaic fuel cell hybrid systems with short time energy storage. Proceedings of 4th European Conference PV-Hybrid and Mini-Grid; 2008. p. 8–15.
[12]. Kumari JS, Babu CS, Babu AK. Design and analysis of P & O and IP & O MPPT techniques for phototaic system. International Journal of Modern Engineering Research (IJMER). 2012 July-Aug; 2(4):2174–80.
[13]. Mosazade SY, Fathi SH, Radmanesh H. An overview of high frequency switching patterns of cascaded multilevel inverters suitable for pv applications and proposing a modified method. Indian Journal of Science and Technology. 2014 September; 7(9):1342–9.
[14]. Gheydi M, Effatnejad R, Ramezanpour P. Evaluation of uncertainty in hybrid plants, including wind turbine, phototaic, fuel cell, and battery system using fuzzy logic. Indian Journal of Science and Technology. 2014 February; 7(2):113–22.

BIOGRAPHY

ANNA RANGANADH received his B.Tech in EEE at Krishnachaitanya Institute of Technology and Sciences in 2012. And P.G received in EEE at Prakasam Engineering College in 2014. He is currently working as a assistant professor in EEE dept at Gurunanak Institute of Technology, Hyderabad. He has total 3.5 years of teaching experience.