ISSN:2348-2079

Volume-7 Issue-2

International Journal of Intellectual Advancements and Research in Engineering Computations

# Stability analysis of hybrid wind and solar system with super capacitor storage

**Dr. R. Devarajan[1], A.Kumaran[2]**

[1]Professor, M.E,Ph.D/EEE, Department of EEE, Vinayaka Mission's Kirupananda Variyar Engineering College, Salem. Tamilnadu, India

[2]PG Scholar M.E, Department of EEE, Vinayaka Mission's Kirupananda Variyar Engineering College, Salem. Tamilnadu, India

## ABSTRACT

This paper introduces an intelligent extraction of optimum power and its dispatch by using Ant colony algorithm (ACO) from a grid tied hybrid generation system comprising of a permanent magnet synchronous generator based fuel cell, wind turbine and a low concentration photovoltaic generator. For photovoltaic generator, maximum power point tracking control is implemented using ACO logic under varying solar irradiance. Power extracted from wind turbine is designed as a ACO function of the dc link voltage error, its rate of change and error in the direct axis current of the inverter. This reduces high frequency oscillations in the wind extracted power. Such an extraction is considered as a novelty of this paper. A failure mode and effect analysis is done for power converters and possible mitigation schemes are suggested for different faults. A 1:1 delta wye-grounded transformer is used at the inverter output to eliminate the triplet harmonics. Further, dynamic performances of both ACO proportional-derivative and integral (PD+I) controller and classical proportional integral (ACO) controller, to control the inverter currents, are compared. The proposed method results in an enhanced power dispatch and improvement in distortions and oscillations in the converter currents. This also reduces the probability of failures in the converter switches and other passive components.

**Keywords:** Dfig, Wind, Photovoltaic, Dc bus, Storage.

## OBJECTIVE

Objective of this project is to maintain voltage stability and reduce harmonics level in the transmission line to reduce losses to increase efficiency

## INTRODUCTION

Hybrid energy system is the combination of two energy sources for giving power to the load. In other word it can defined as “Energy system which is fabricated or designed to extract power by using two energy sources is called as the hybrid energy system.” Hybrid energy system has good reliability, efficiency, less emission, and lower cost. In this proposed system solar and wind power is used for generating power. Solar and wind has good advantages than other than any other non-conventional energy sources. Both the energy sources have greater availability in all areas. It needs lower cost. There is no need to find special location to install this system.

Hybrid energy system is the combination of two energy sources for giving power to the load. In other word it can defined as “Energy system which is fabricated or designed to extract power by using two energy sources is called as the hybrid energy system.” Hybrid energy system has good reliability, efficiency, less emission, and lower cost. In this proposed system solar and wind power

**Author for correspondence:**
Department of EEE, Vinayaka Mission's Kirupananda Variyar Engineering College, Salem. Tamilnadu, India

is used for generating power. Solar and wind has good advantages than other than any other non-conventional energy sources. Both the energy sources have greater availability in all areas. It needs lower cost. There is no need to find special location to install this system [1].

After satisfying the basic needs of life such as food, clothing and shelter energy is the next need of the human beings to improve the quality of life. The energy requirement in the past was limited to man's ability to irrigate, cultivate and survive; but now the energy covers the basic requirements plus minimally reasonable quality of life in developing world to a high quality of life in industrially developed world. The consumption of energy is directly related to the economic growth of a country. The power is growing at a rate of less than 15% while the gross domestic product (GDP) growth as per eleventh plan is 9 % (GDP of India website).The GDP growth rate of the country is less than 10% and it is between 8% and 9% presently (GDP of India website). This is due to the slower growth rate of consumer demand, under performance of manufacturing industries in the country and larger demand for the foreign products. The GDP growth rate of India for different plan periods is presented in Table 2.1 [2-5].

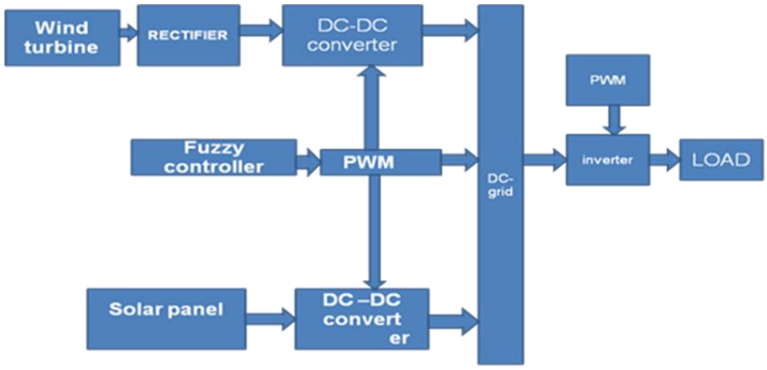
**Table 2.1 GDP growth rate of India (1980-2007)**

| Plan | Year | Target | Act |
|---|---|---|---|
| Sixth | 1980- | 5.2 | 6.0 |
| Seven | 1985- | 5.0 | 6.0 |
| Eight | 1992- | 5.6 | 6.8 |
| Ninth | 1997- | 6.5 | 5.4 |
| Tenth | 2002- | 8.0 | 7.2 |
| Eleve | 2007- | 9.0 | - |

The energy demand is directly related to the national per capita income. It has been Rs 25956 per annum during 2005-2006 to Rs 29642 per annum during 2006-07 (Central Statistical office report).Thus, the income of a person is about 2500 rupees per month, which corresponds to Rupees 80 per day (approximately for 2005-2007 periods). The present cost of labor is more than Rs 100 per day in the rural areas and 130-200 rupees in the urban areas. This leads to tendency of the people to move from villages to the cities. These villagers thus get accustomed to the facilities of the city life such as light, fan, communication etc. Thus the power consumption in the cities is increasing with the increase in the city population on one hand and on the other hand, increase of the innovative practices for power generation in the villages such as battery operated vehicles, renewable energy based power generation etc. India is one among the countries which have fastest economic growth. With due consideration to inflation the per capita income growth rate for India is 8.1%. The people spend 71.83% of their income, out of which 35.6% on mobile phones, T.V., news papers travel etc.

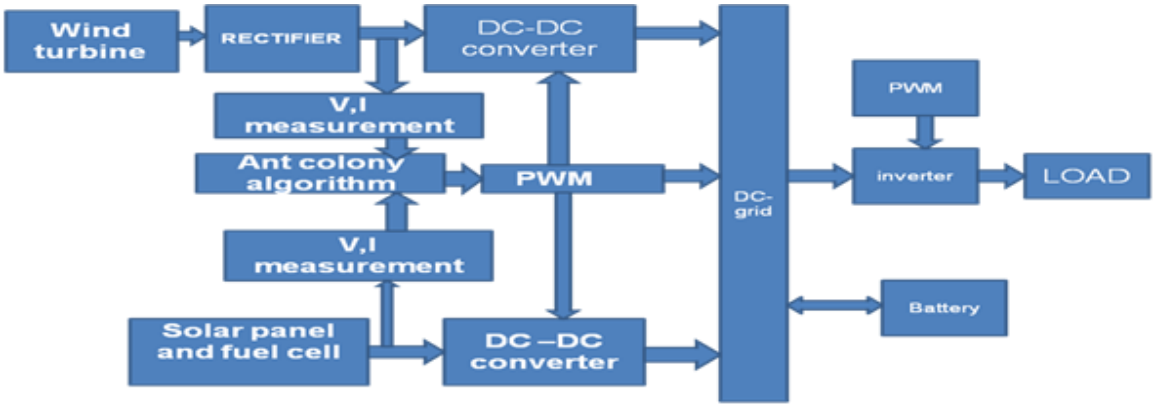
The energy consumption in India has been higher in urban places compared to rural areas. Most of the people in India are living in rural areas, India can therefore be considered as a rural economy based country primarily depending on cultivation based activities as predicted in Table

## EXISTING BLOCK DIAGRAM




A no isolated interleaved, dc/dc boost converter with a high efficiency is proposed for using in photovoltaic system applications. For realizing zero voltage soft switching (ZVS), two active clamp circuits are used for each phases of the boost converter. By utilizing a voltage doubler configuration at the converter's output terminal and connecting the secondary side of coupled [6]. Inductors in series, high conversion ration can be achieved. The capacitor is also connected in series with output capacitors to transfer leakage energy to the output. Interleaved structure is used in input side to minimize current ripple and reduce magnetic component. So, the converter not only operates with a higher voltage gain, but also is able to operate more efficiently and can be used in photovoltaic (PV) applications [7-10].

## PROPOSED BLOCK DIAGRAM




## WORKING

We implemented VSI so harmonics create in in system is low. Due to VSI harmonics compensation Harmonic will less than 2% in proposed system. Implementation of ACO controller will reduce the response time for DC grid voltage stabilization. An intelligent extraction of optimum power and its dispatch by using Ant colony algorithm (ACO) from a grid tied hybrid generation system comprising of a permanent magnet synchronous generator based fuel cell, wind turbine and a low concentration photovoltaic generator. For photovoltaic generator, maximum power point tracking control is implemented using ACO logic under varying solar irradiance. Power extracted from wind turbine is designed as a ACO function of the dc link voltage error, its rate of change and error in the direct axis current of the

inverter. This reduces high frequency oscillations in the wind extracted power. Such an extraction is considered as a novelty of this paper. A failure mode and effect analysis is done for power converters and possible mitigation schemes are suggested for different faults. A 1:1 delta wye-grounded transformer is used at the inverter output to eliminate the triplet harmonics. Further, dynamic performances of both ACO proportional-derivative and integral (PD+I) controller and classical proportional integral (ACO) controller, to control the inverter currents, are compared. The proposed method results in an enhanced power dispatch and improvement in distortions and oscillations in the converter currents. This also reduces the probability of failures in the converter switches and other passive components.

## ANT COLONY ALGORITHM

Ant colony optimization is a technique for optimization that was introduced in the early 1990's. The inspiring source of ant colony optimization is the foraging behavior of real ant colonies. This behavior is exploited in artificial ant colonies for the search of approximate solutions to discrete optimization problems, to continuous optimization problems, and to important problems in telecommunications, such as routing and load balancing. First, we deal with the biological inspiration of ant colony optimization algorithms. We show how this biological inspiration can be transferred into an algorithm for discrete optimization. Then, we outline ant colony optimization in more general terms in the context of discrete optimization, and present some of the nowadays best performing ant colony optimization variants. After summarizing some important theoretical results, we demonstrate how ant colony optimization can be applied to continuous optimization problems. Finally, we provide examples of an interesting recent research direction: The hybridization with more classical techniques from artificial intelligence and operations research.

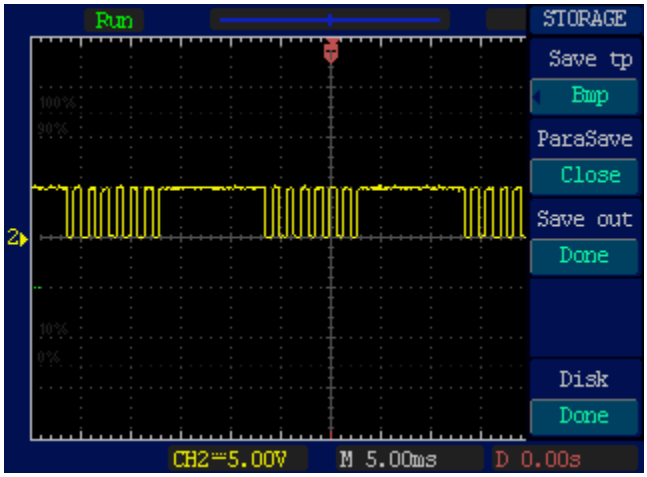
$$\tau_i \leftarrow (1-\rho)\cdot\tau_i + \rho\cdot \sum_{\{s\in S_{upd} | c_i \in s\}} w_s \cdot F(s),$$

We implemented ACO controller for estimation of harmonics and voltage ripples in DC line so dynamic response of ACO control is quick

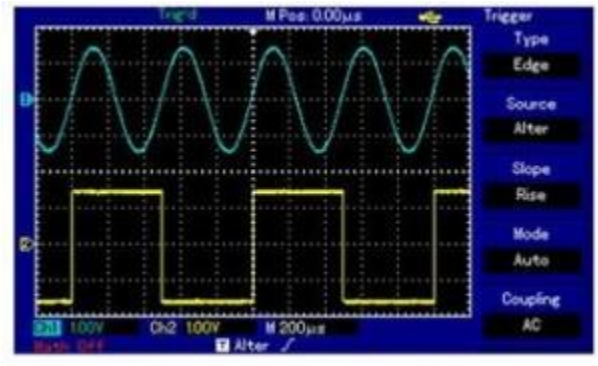
Then harmonics is low and DC grid voltage is more accurate

## RESULT AND DISCUSSION

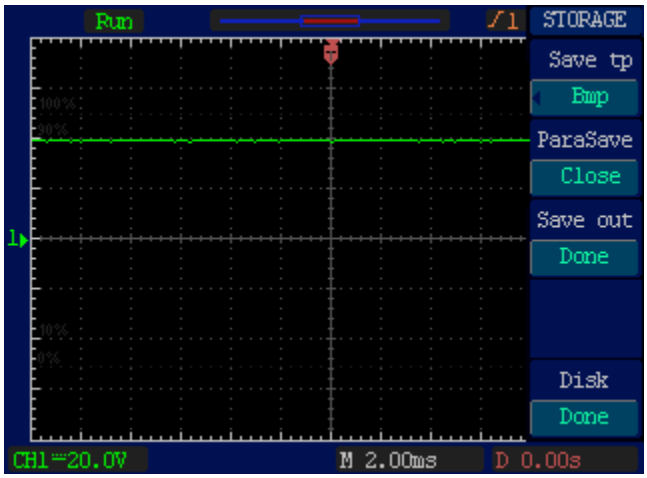
### PWM Pusle



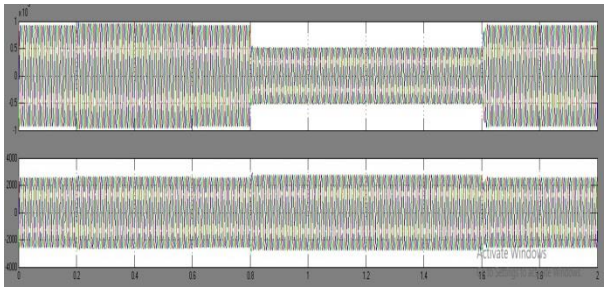
## Inverter voltage and gatepulse



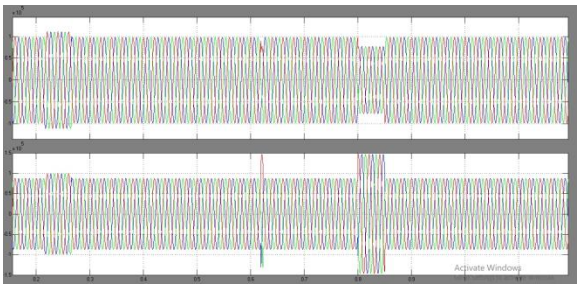

## DC grid voltage



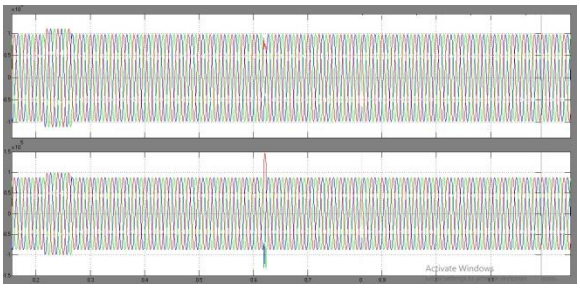

## Before Voltage stability



## After Stability



### After UC Implementation



## CONCLUSION

Hybrid power generation system is good and effective solution for power generation than conventional energy resources. It has greater efficiency. It can provide to remote places where government is unable to reach. So that the power can be utilize where it generated so that it will reduce the transmission losses and cost. Cost reduction can be done by increasing the production of the equipment. People should motivate to use the non-conventional energy resources. It is highly safe for the environment as it doesn't produce any emission and harmful waste product like conventional energy resources. It is cost effective solution for generation. It only need initial investment. It has also long life span. Overall it good, reliable and affordable solution for electricity generation

## REFERENCES

[1]. Sharma R, Sathans. Survey on hybrid (wind/solar) renewable energy system and associated control issues. In: Proceedings of the IEEE 6th India International Conference on Power Electronics; India. New York, NY, USA: IEEE. 8(10), 2014, 1-6.

[2]. Nehrir H, Wang C, Strunz K, Aki H, Ramakumar R, Bing J, Miao Z, Salameh Z. A review of hybrid renewable/alternative energy systems for electric power generation: configurations, control, and applications. IEEE T Sustain Energy 2, 2011, 392-403.

[3]. Han H, Hou X, Yang J, Wu J, Su M, Guerrero JM. Review of power sharing control strategies for islanding operation of AC microgrids. IEEE T Smart Grid 7, 2016, 200-215.

[4]. Davari M, Mohamed YARI. Robust vector control of a very weak-grid-connected voltage-source converter considering the phase-locked loop dynamics. IEEE T Power Electr 32, 2017, 977-994.

[5]. Pena-Alzola R, Liserre M, Blaabjerg F, Ordonez M, Yang YH. LCL-Filter design for robust active damping in grid-connected converters. IEEE T Ind Informa 10, 2014, 2192-2203.

[6]. Tran TV, Chun TW, Lee HH, Kim HG, Nho EC. PLL-based seamless transfer control between grid-connected and islanding modes in grid-connected inverters. IEEE T Power Electr; 29, 2014, 5218-5228.

[7]. Xu JM, Xie SJ, Tang T. Improved control strategy with grid-voltage feed forward for LCL-filter-based inverter connected to weak grid. IET Power Electron 7, 2014, 2660-2671.

[8]. Song Y, Nian H. Sinusoidal output current implementation of DFIG using repetitive control under a generalized harmonic power grid with frequency deviation. IEEE T Power Electr; 30, 2015, 6751-6762.

[9]. Zhang S, Jiang S, Lu X, Ge BM, Peng FZ. Resonance issues and damping techniques for grid-connected inverters with long transmission cable. IEEE T Power Electr 29, 2014, 110-120.

[10]. Suul JA, D'Arco S, Rodr´ıguez P, Molinas M. Impedance-compensated grid synchronisation for extending the stability range of weak grids with voltage source converters. IET Gener Transm Dis 10, 2016, 1315-1326.