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# A Review Paper on Solar- Wind Hybrid Micro-Grid System with Voltage Control using STATCOM Device

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***Abstract:*** Renewable energy sources play an important role in electricity generation. Various renewable energy sources like wind, solar, geothermal, ocean thermal and biomass can be used for generation of electricity. Energy from the sun is the best option for electricity generation as it is available everywhere and is free to harness. Electricity from the sun can be generated through the solar photovoltaic modules (PV). Electricity generation from the wind and solar photovoltaic (PV) systems are highly dependent upon weather conditions. Their intermittent nature leads to fluctuations in their output. Therefore, the need for rapid compensation for energy transmission and distribution systems is increasingly important. Static Synchronous Compensator (STATCOM) can be adopted for reactive power compensation and for decreasing the voltage fluctuation caused by the system and renewable energy sources. This study presents modelling of a Solar PV-Wind Hybrid Micro-grid and the increase of the stable operating limit of the system in case of the incorporation of STATCOM is examined. The major contribution of this paper is the optimization of gain parameters of four PI controllers in STATCOM based on genetic algorithms (GA) and therefore obtaining better responses and voltage stability in terms of nonlinear nature of solar-wind hybrid micro-grid**.**

***IndexTerms*** **-Renewable energy sources, SOLAR PHOTOVOLTIC, STATCOM, Hybrid micro grid**

## I. INTRODUCTION

Rapid depletion of fossil fuel resources on a worldwide basis has necessitated an urgent search for alternative energy sources to cater to the present days' demand. Therefore, it is imperative to find alternative energy sources to cover the continuously increasing demand of energy while minimize the negative environmental impacts Recent research and development of alternative energy sources have shown excellent potential as a form of contribution to conventional power generation systems. There is a huge potential for utilizing renewable energy sources, for example solar energy, wind energy, or micro-hydropower to provide a quality power supply to remote areas. The abundant energy available in nature can be harnessed and converted to electricity in a sustainable way to supply the necessary power demand and thus to elevate the living standards of the people without access to the electricity grid.

## II.Literature survey

**Hale Bakir, Ahmet Afsin Kulaksiz[1]:**Electricity generation from the wind and solar photovoltaic (PV) systems are highly dependent upon weather conditions. Their intermittent nature leads to fluctuations in their output. Therefore, the need for rapid compensation for energy transmission and distribution systems is increasingly important. Static Synchronous Compensator (STATCOM) can be adopted for reactive power compensation and for decreasing the voltage fluctuation caused by the system and renewable energy sources.This study presents modelling of a Solar PV-Wind Hybrid Micro-grid and the increase of the stable operating limit of the system in case of the incorporation of STATCOM is examined. The major contribution of this paper is the optimization of gain parameters of four PI controllers in STATCOM based on genetic algorithms (GA) and therefore obtaining better responses and voltage stability in terms of nonlinear nature of solar-wind hybrid micro-grid.The Simulink models of the system architecture include a 2 MW wind turbine model based on a doubly fed induction generator (DFIG), 0.4 MW solar PV power system model and a STATCOM rated at 3 MVAR. It is certified that the voltage fluctuation at the end of the bus bar is reduced by 8 % using conventional PI controller. The results obtained by GA-based optimization of PI controllers are compared with that of the conventional controller and better results attained.

**Prashant M. Chavan, Gayatri P. Chavan[2]:**

In this paper hybrid power system is connected to grid with the help of STATCOM. In hybrid power system we use solar and wind power source. Output of these two sources is not constant. This two source is cannot connect directly in grid.

In this paper we use STATCOM for maintain the hybrid power system output is constant. STATCOM input is variable but output is constant with the help of IcosΘ controller. This is first objective of this paper. In this proposed system use static compensator and maintain constant output of hybrid power system. Hybrid power system is interfacing with electrical power grid with the help of static compensator. In system load can be variable but we are maintain source current profile and grid power quality can be improve. Using Icos Θ controller and generate control pulse and control static compensator.In this paper we improve power quality of at point of common coupling. Currently load is continuous variable.Customer want continuous, reliable and quality of electrical power. That is customer demand can be increases day by day, load side continuous variable. This condition is effected the source side and power quality problem can be occurs. In this paper we are minimize this power quality problems at point of common coupling. This is second object of this paper.Using MATLAB software and simulated proposed system, IcosΘ controller, solar energy source, wind energy source, STATCOM circuit and obtained output waveform.

**Hale Bakir, Ahmet Afsin Kulaksiz[3]**

The major contribution of this paper is the optimization of gain parameters of four PI controllers in STATCOM control circuit based on genetic algorithms (GA) and Bacteria Foraging Algorithm (BFA) and therefore obtaining better responses and voltage stability in terms of nonlinear nature of solar-wind hybrid micro-grid. The Simulink models of the system architecture include a wind turbine model, a solar PV power system model and a STATCOM. It is certified that the voltage fluctuation at the end of the bus bar is reduced by 8% using conventional PI controller, by 10% for GA-based PI controller, and by 15% for BFA based PI controller under variable load. The results obtained by GA and BFA-based optimization of PI controllers are compared with that of the conventional controller and better results attainedhere.

**Souvik Sengupta, Ashwani Kumar, Sukriti Tiwari[4]**

The transient stability enhanment of IEEE-14 bus system integrated with the hybrid wind-PV farm incorporating a static synchronous compensator (STATCOM) has been scrutinized critically in the present work.The hybrid wind-solar PV farm consists of wind farm employing variable speed doubly-fed induction generator (DFIG), and a solar farm based on variable irradiation. Steady-state analysis corresponding to different operating conditions are performed to find the best combination of variable wind speed and solar irradiation for stable operation. Symmetrical and unsymmetrical faults are created at different locations of the integrated power system to examine voltage profile, active and reactive power, with and without the STATCOM at the point of common coupling (PCC). The main factor responsible for the instability of the power system has been found to be an imbalance of reactive power. It can also be concluded that STATCOM is able to compensate reactive power and improve voltage stability throughout the time domain. The transient stability analysis shows the effectiveness of STATCOM which ultimately improves the power system stability during fault conditions. Finally, it is concluded that STATCOM with series compensation subject to the condition of having solar irradiation 1017 W/m2 and wind speed of 11m/s, improves the hybrid wind-PV system stability in a better way.A remarkable improvement in the voltage profile of the hybrid power system has been found in the presence of flexible alternating current transmission System (FACTS) device.

**Bhagyashree Parija, Santi Behera, Ruturaj Pattanayak, Sasmita Behera[5]:**

The emanate use of distributed energy sources in electricity grid has created new ultimatum for the utility load as regard to power quality, voltage stabilization and efficient energy utilization. Wind and Solar are considered as the most assuring source of renewable energy.However, the standalone operation of either Photo-voltaic or wind energy system does not offer a very reliable source of electricity production, mainly due to the unpredictability over the availability of the wind and solar irradiance. Thus, an assortment of wind and solar power generation structure can form a very much potential and reliable source of electricity.In this work a hybrid model of wind and Photo-voltaic system has been presented. This kind of system is very beneficial and useful to the remotely located or islanded areas where grid integration is not very economical.However, the interfacing of power electronic devices to DG systems induces very severe power quality problems, such as, harmonic generation and the reactive power compensation that disturbs the power distribution system. In this work, a simulation model of hybrid wind-PV generation system of capacity 750 KW has been presented. The performance of this system with grid connected mode is analyzed.

## III. PROPOSED TOPOLOGY

Electricity generation from the wind and solar photovoltaic (PV) systems are highly dependent upon weather conditions. Their intermittent nature leads to fluctuations in their output. Therefore, the need for rapid compensation for energy transmission and distribution systems is increasingly important. Static Synchronous Compensator (STATCOM) can be adopted for reactive power compensation and for decreasing the voltage fluctuation caused by the system and renewable energy sources wind hybrid micro-grid.

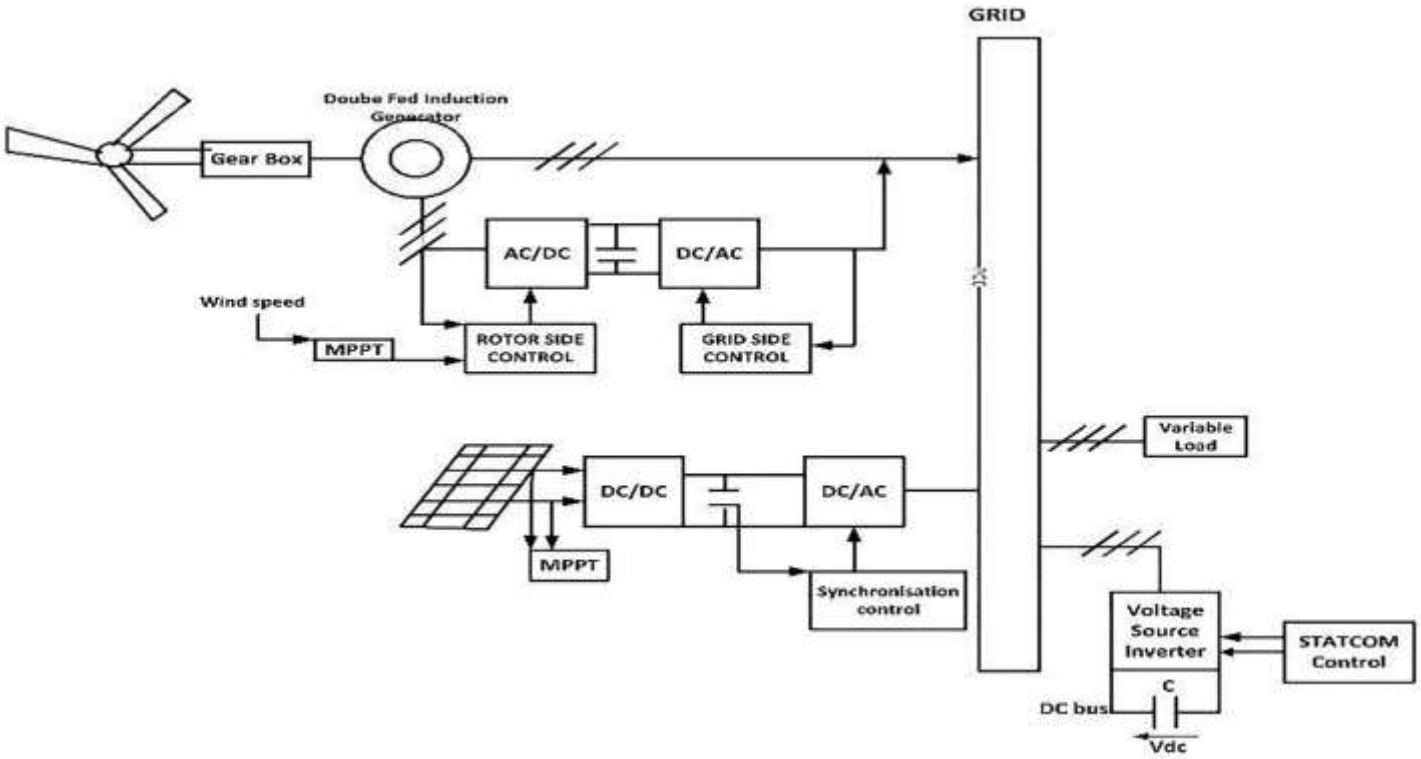


Fig.1. Solar-Wind Hybrid System including STATCOM

The proposed hybrid system architecture modeled in Simulink is shown in Fig. 9. A wind turbine based doubly fed induction generator was modeled and rotor side and grid side controls were performed. An indirect MPPT method was used according to wind speed and optimal torque production. The STATCOM was added to the Point of Common Coupling (PCC) for reducing the voltage fluctuation at the end of the busbar, and reactive power compensation. The current, voltage, reactive power values at the end of busbar are firstly measured for the system without STATCOM.

In this study, the time domain criterion is used to evaluate the PI controller in the STATCOM's control circuit for voltage stability. In the control system, if the controller tuning constants get improper value, the system's characteristics may deteriorate and the system may become unstable. For this reason, optimal adjustment of controller parameters and proper selection of tuning constants have an important role in the proper performance of this control.

## IV.CONCLUSIONS

In this project a micro grid model with solar PV, wind and battery is investigated. To actively achieve power demand using DG units, an enhanced DG unit control scheme proposed that uses the concept of Power demand control. In the proposed microgrid coordination strategy, the overall economic benefits are optimized with the day-ahead 24-hour power supply and the hourly micro-turbine operation, and the customer bills, demand energy quantity and voltage regulation are considered to guarantee the customer benefits. To ensure the optimization results are robust against the uncertain wind turbine outputs, PV outputs and load demands. The Matlab simulation of solar PV, wind and battery hybrid system is successfully developed. The grid integration of STATCOM device for Power Quality enhancement is required for the use of Non-Linear Load and grid unbalancing.

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