Certain Analyses on Static Compensated Voltage and Frequency Modulation in the Wind Energy System using the Solar PV Interface QZSI Impedance Source Network

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Abstract

The generation of electricity from wind and solar Photovoltaic (PV) systems is entirely dependent on weather conditions and variable nature causes output will sag and swell. As a reason, the requirement for efficient techniques for energy transmission and distribution networks is becoming increasingly critical. In the proposed system Quasi Impedance Source Inverter (QZSI)-based Static Compensator (STATCOM), is used to improve power quality in hybrid distributed power generating systems. The Photovoltaic (PV), Wind Energy Conversion System (WECS), and battery energy storage system are all components of the distributed power generating system.DFIG is made up of stator windings that are directly linked to the fixed frequency and voltage-based converters that are allowed directly in rotor windings. The phrase doubly fed refers to the fact that the stator voltage is obtained from the mains even though the rotor voltage is generated by the power converter.Each unit is linked to a DC Bus parallel to the battery to provide backup power. All three units are linked in series by multiple programmable switches for PWM, which are controlled by a DC voltage regulator of an MPPT (Maximum Power Point Tracking) Based Swarm Integral Neural Controller technique controller. The module is a series connection of two or more sources with high-frequency switches attached between the source converters to obtain varied voltage levels as required by the application.

The output result of sag and swell in large transmission networks can be reduced, and the fluctuation decreased by the usage of controller technique can be improved by power quality-based simulation using MATLAB tool. The proposed strategy decreases the stator and rotor over-currents, electromagnetic torque oscillations, and DC-link over-voltage and also supports grid voltage by supplying reactive power into the grid. In this way, the DFIG can efficiently theFault Ride through (FRT) requirements of the latest grid codes.

Keywords: Fault Ride through (FRT), Photovoltaic (PV), Wind Energy Conversion System (WECS), Static Synchronous Compensator (STATCOM).

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1. INTRODUCTION

A variation of equipment can be used to improve power quality, from inexpensive (providing low security or compensation), and expensive equipment (high level of protection or compensation) to the requirements of improving power quality. Figure 1 represents the intermediate voltage suppressors used to detect flotation and reduce them to safer conditions, while voltage regulators maintain voltage output within a certain range, despite fluctuations in input. Isolation transformers can be useful in compensating for the high or low voltage required to change the voltage. The quality of the force depends on the network topology of the force, the amount of energy injected into the network of conforming non-linear loads, and the intensity of the transition transients.

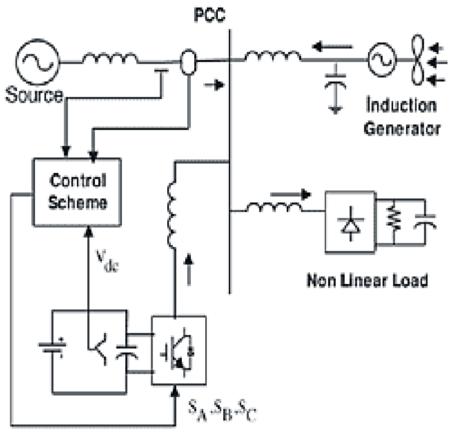

Figure 1Structure for power quality linked to the grid that has capacitance on its DC connection

The wind turbines (WTs) that are the subject of this thesis are Doubly Fed Induction Generators (DFIGs), which may operate at various speeds. Real power and reactive power can both be managed by a DFIG's power electronic converter. In order to assist maintain stable DC connection voltages at individual wind turbine inverters during disturbances, a STATCOM was used to manage the voltage at the bus. This feature will make it easier for each wind turbine to continue to run even when there are disruptions, allowing the wind farm to take part in grid-side voltage and power regulation.

STATCOMs can address transient occurrences more quickly and with higher performance at lower voltages. The system voltage does not affect the STATCOM's maximum compensating current. A STATCOM enhances the system's transient stability and offers dynamic voltage management and power oscillation damping. The current flow between the converter and the ac system is managed by adjusting the phase angle.

Many systems, particularly those that deal with communications and tools, depending on filters. Filters pass through one band while rejecting another. It is often used in one of three technologies: switch capacitor filters, active RC filters, or passive RLC filters. At very high frequencies, crystals and SAW filters are frequently employed. Passive filters perform effectively at high frequencies, but the triggers needed at low frequencies are cumbersome and unattractive. The inductors are also difficult to manufacture in a single shape and are not compatible with many contemporary assembling methods.

Active RC filters are employed to create functional thick film and thin film technologies, functional amplifiers, resistors, and capacitors. The operational amplifier's performance determines how effective these filters may be (e.g., frequency response, bandwidth, noise, offset, etc.). Monolithic switch-capacitor filters often offer superior performance at a lower cost. Made with the use of function amplifiers, switches, and capacitors. Poorly performing filters often modify the frequency spectrum of the input signal in accordance with the strength of the transmission function, as opposed to passive LC or active RC filters. As the signal passes through the filter, its phase characteristics are modified. The amount of reactive power provided also depends on the nearby sources of reactive power in the system

1.2 LITERATURE SURVEY

S. Hasanzadeh(et al., 2022) STATCOM on many levels multilevel inverters are widely used in various areas of the power system and industry due to features such as correct output waveform (voltage and current). There are numerous controllers available for multilayer STATCOM control. One of the most basic and cost-effective controllers is the one-cycle controller, which is commonly used in DC / DC and DC / AC converters. Voltage sag and swell, voltage disruptions, harmonics, and transient outages are all beneficial. The multilayer STATCOM is also tested and compared to standard PWM control to demonstrate how well the recommended controller performs. The simulation results show that multilayer STATCOM will remove the disturbances.

S. Biswas (et al., 2022), the reliability of protection for transmission lines linking high-capacity wind farms with doubly fed induction generators and corrected by (STATCOM) static synchronous compensators is a drawback of fixed-impedance-based distance relaying techniques. The effectiveness of the distance relay protecting these transmission lines is examined in this article, which also proposes an advanced protection scheme that uses the signs of the superimposed -aerial components of the measured currents at the line ends and STATCOM location to identify faults and fault sections. Dual-time transform (TT) is also used to extract appropriate characteristics from the measured currents at the relay end, which are then fed into a decision tree classifier for fault classification.

W. Rohouma(et al., 2022), Distributed energy resources have had an influence on the traditional electrical system (DERs). By delivering power closer to the consumer, grid-connected photovoltaic (PV) systems shift the paradigm from centralized to distributed generation. Voltage fluctuations can develop abruptly as a result of stochastic PV output power. Reactive power compensation is necessary to change the voltage profile and meet the criteria. Traditional technologies, such as switching capacitors, are incapable of providing continuously variable reactive power over short time scales.

Y. Neyshabouri(et al., 2022), the functioning of STATCOM using a Cascaded H-Bridge (CHB) after a submodule failure (SMEs). Switch failure results in bypassing of the associated defective SM. To provide the highest line-to-line voltage during post-fault operation, a Zero-Sequence Voltage (ZSV) is injected into the converter phases. The fundamental ZSV component (FZSV) is reduced using a clamping approach following CHB STATCOM's operating point. FZSV, however, results in an uneven flow of active power into the converter stages.

J. Ballestín-Fuertes (et al., 2022), in the coming seasons, it will be important to solve the issues that Distributed Energy Resources (DERs) are providing. Distribution networks in particular are becoming more crucial to the functioning of the power system. Additionally, this network's three-phase, four-wire design contributes to the emergence of imbalances and several issues that result from them. Distribution system operators (DSOs), who are primarily in charge of the distribution grid in this situation, are required to guarantee the quality of the supply to customers. To correct current imbalances in low-voltage power lines, this article uses a four-legged D-STATCOM.

A. Mahesh (et al., 2016), An adaptive network-based fuzzy inference system as a method for managing energy in a hybrid PV/Wind/Battery (PWB) energy system (ANFIS). Power fluctuation is a major concern with renewable energy sources, which the energy management system aims to alleviate. Another objective for extending battery life is to keep the Battery State of Charge (SOC) within the allowable ranges. The ANFIS has been in charge of the grid, sources, and batteries.

P. D. Patel (et al., 2019), for system dependability to be active at a remote point where a wind turbine is linked to the grid, DFIG based variable speed wind turbine system is simulated using GSC and RSC. When there is a power quality issue, the PI and PID controller system gives an apparent error between the real and reference load. Here Utilizing CPD improves the power quality. The inverter is used to improve the overall quality of the power while also converting solar-generated DC power into AC power. The controller increases THD in the network by reducing the reactive power sent by the PV and battery.

B. S. V. Sai (et al., 2022), Maximum Power Point Tracking (MPPT) in a wind energy conversion system based on a doubly fed induction generator (DFIG). P-characteristic non-linearity is shown in DFIG. Therefore, several traditional and optimization-based MPPT techniques have been devised. The suggested SSM-PSO approach has successfully eliminated the flaws in the traditional Perturb and Observe (P&O) methodology. The traditional Perturb and observe Grid search technique causes a variation in DFIG output in response to a sudden change in wind speed because of its weather-insensitive nature. The proposed SSM-PSO approach has set maximum and minimum restrictions for the ideal rotor speed to get around this issue.

R. Ryndzionek(et al., 2022), A three-phase traditional stator power supply is combined with a five-phase power supply from the generator's rotor side in this new design concept. Modern three-phase doubly-fed induction generators are the most often used in Wind Energy Conversion Systems (WECS). This type of solution is vulnerable to rotor side inverter failure, which results in the loss of at least one phase of the rotor side power supply. The proposed design solution, which takes the shape of a multi-phase power supply in the rotor circuit, aims to reduce system downtime caused by power electronic system failure by extending the generator system's range of possibly fault-free operation.

A. Saxena (et al., 2022)Invasive Weed Optimization (IWO) is employed for sensor-less speed management of a Doubly Fed Induction Generator (DFIG) in both balanced and unbalanced conditions. A balanced condition is an example of a healthy condition, whereas unbalanced conditions include three-phase faults, single line-to-ground faults, line-to-line faults, and double line-to-ground faults. The DFIG is grid-connected and powered by wind. The IWO technology has two advantages: less data computation and a simple mathematical technique. The two back-to-back converters that generally comprise DFIG are the Grid Side Converter (GSC) and the Rotor Side Converter (RSC) (RSC). The RSC is a regulated converter, whereas the GSC is an uncontrolled converter.

Rajaram. K et.al [2010] proposed a detection system for identifying malicious node in mobile ad hoc networks and also proposed power-aware routing system using on-demand multipath routing protocol for efficient packet transfer without any packet loss and for better communication in MANET.

Palaniswami, S et.al [2012] suggested an enhanced distributed certificate authority scheme for authentication in mobile ad hoc networks and trust based cross-layer security protocol malicious node detection. The modified security scheme for data integrity for manet was suggested for security in network communication.

Premanand, R. P et.al [2020] Enhanced data accuracy based PATH discovery using backing route selection algorithm in MANET was proposed for better network communication.

Anand, R. P et.al [2020] suggested Effective timer count scheduling with spectator routing using stifle restriction algorithm in manet for timely scheduling packets and rapidly communication at emergency situations.

Rajaram, A et.al. [2019] presented Energy efficient and node mobility-based data replication algorithm and a high certificate authority scheme for authentication for MANET an approach for stable path routing scheme for improving packet delivery.

3. Materials and Method

In the existing method, technology, and efficient power source, wind power is the fastest developing and most reliable renewable energy resource among them.The Squirrel-Cage Induction Generator serves as the system's renewable energy source (SCIG). A capacitor (C) is linked on the DC-link voltage side to operate as the DC voltage source in order to transform a DC voltage source into an AC voltage. A DC-DC converter, a battery bank, and a coupling inductor are then used to connect the power grid-side inverter to the grid. It consists of a SCIG, two voltage source converters (rear-to-back) built of Insulated Gate Bipolar Transistors (IGBTs), and a DC-The BESS controls the frequency and voltage of the grid's DC-link. Voltage and current sensors also figure out what the output source's voltage and current are. The proposed method facilitates stator-side control without an internal magnetic sensor.

The quality of the power delivered to the distributed system may be improved using this method's power electronic-based power conditioning equipment. A special power tool called STATCOM was created to make up for source current and load voltage inaccuracies. This technique suggests the construction of a hybrid PV and Wind power generating system that operates in tandem with a power quality conditioner. The STATCOM is an active filtering-based compensator with a power electronics foundation. A series circuit, solar panels, and wind turbines coupled to a DC connection, which can account for voltage sag, swell, harmonics, and voltage interruption, have been added to the proposed system to improve it.

Figure 2 shows the proposed system can inject active power into the grid in addition to its ability to the improvement of power quality in the distribution system. System improvements for steady state and transient stability are possible with STATCOM. Because it can inject or absorb real and reactive power at its output terminals, the static compensator is regarded as a solid-state semiconductor switch.

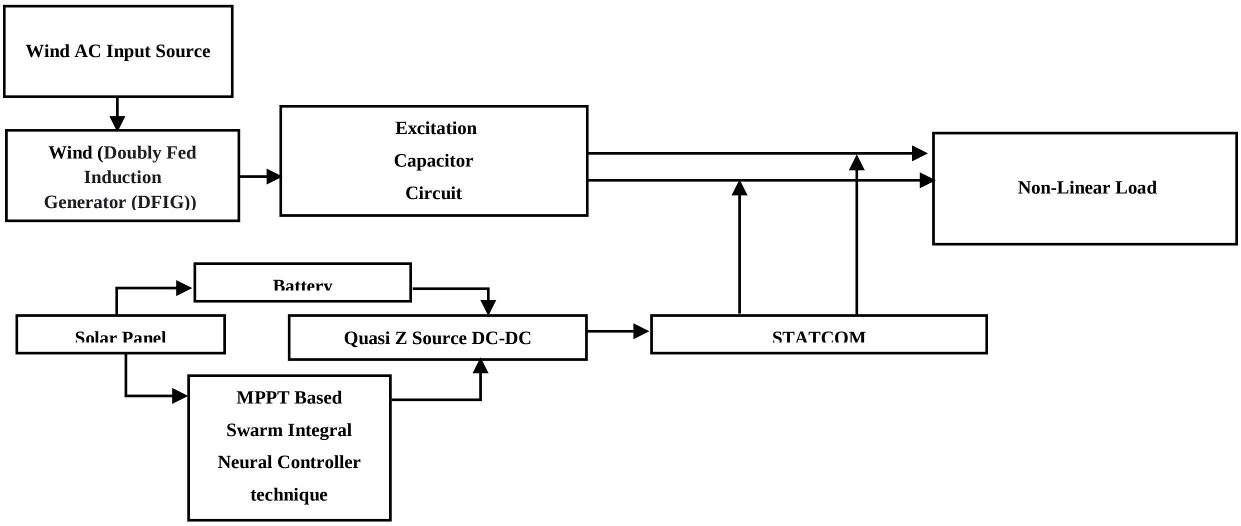

Figure 2Block Diagram of Proposed system

3.1 Wind (Doubly Fed Induction Generator (DFIG))

A wound rotor induction machine is referred described as being "doubly fed" if the rotor and stator are both hooked to electrical sources. The three-phase windings on the rotor are driven by three-phase currents. These rotor currents produce the rotor magnetic field. The magnetic fields of the stator and rotor interact to produce torque. The magnitude of the torque depends on the strength of the two fields (the stator field and the rotor field) and the angle between the two fields. Mathematicians refer to torque as the vector sum of the forces acting on the stator and rotor (see Figure 3). Fundamentally, connects the magnetic fields of the respective rotor and stator, which in this case are magnet poles of opposite polarity.

Two "parasitic" components on the stator side, L (s), and R s, respectively, stand in for the resistance of the stator phase winding and the leakage inductance of the phase winding. The leakage inductance replicates all of the flux created by current in the stator windings, which does not close the air gap of the machine and is therefore worthless for producing torque. The stator resistance naturally derives from the fact that the materials used to manufacture the windings are good conductors but have finite conductance (hence resistance). The armature winding branch simulates the machine's creation of useable flux, or flux that passes from stator to rotor or vice versa across the air gap.

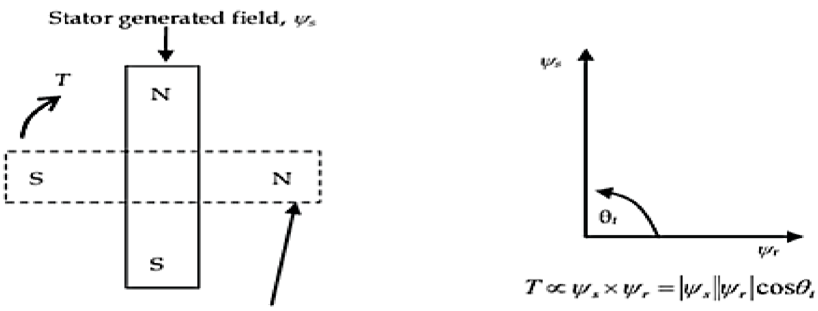

Figure 3 Supplied by currents in the stator and rotor windings is a magnetic pole system.

3.2 Excitation Capacitor Circuit

The oscillations occur at a specific frequency when the generator's inductive and capacitive impedances are equal. If the R-L load is withdrawn at startup and switched back on after a normal voltage gain, the oscillations are more apparent. Fluctuations are started by residual magnetism in the induction generator, which results in low voltage output. A variation in capacitance will alter the machine's speed by altering the frequency of oscillation. It is discovered that at a specific shaft power input, a reduction in capacitance leads to a rise in speed. For big loads, the change is more significant than for load variations.

Figure 4 shows the generate its magnetic field and draws reactive power from the associated line. In contrast to active power, reactive power moves in the other direction. The slide above the synchronous speed directly affects the active power. A collection of capacitors linked across the machine outputs can also provide the necessary reactive power. Without the need for an external source, this system can be used to deliver a positive sequence load. With no external source, the frequency generated is just a little bit harder than that load.

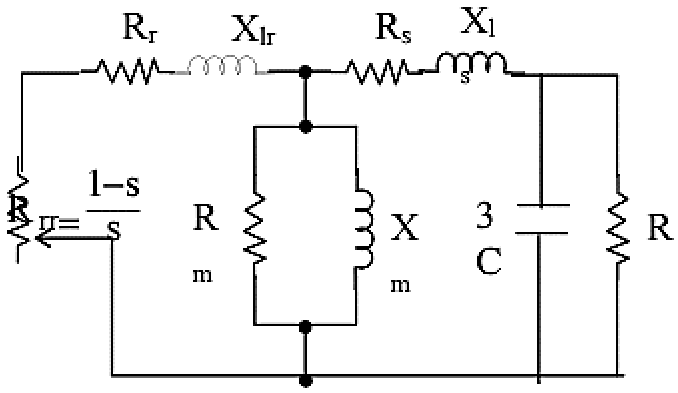

Figure 4 Circuit architecture of Excitation Capacitor Circuit

3.3 PV Array

Photovoltaic (PV) systems are one of the most efficient ways to create electricity, taking into consideration genuine green energy resources as well as prospects. When PV modules are directly linked to a load, the working point is almost never at maximum power or MPP. Figure 5 shows the PV arrays are uncontrolled DC power sources that must be calibrated enough to connect to the network. PV modules with maximum power point tracking are DC / DC converters (MPPT). An MPPT is used to extract the greatest power from solar modules and to transmit power. DC / DC converters (step-up / step-down) are intended for transforming the maximum power of a solar section into a load. DC / DC converters act as a link between the load and the volume. When the duty cycle is changed, the load impedance changes, as seen by the shift in the source of maximum power and the point source of peak power.

The MPPT circuit employs a voltage and current sensor that provides feedback to the controller to generate effective PWM to the converter. In addition, the battery charge controller is employed to implement backup. The workings and operations of the aforementioned devices are covered in the sections that follow. Solar cells are electronic devices that directly convert light energy into electrical energy without using the photovoltaic effect without any moving parts.

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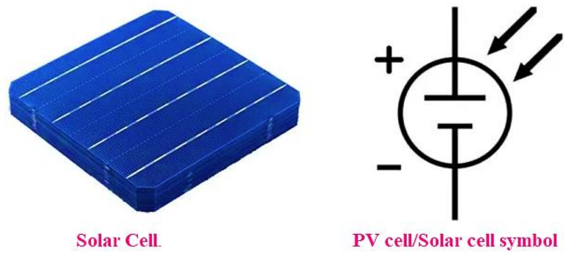

Figure 5 Solar Cell with its symbol

Although solar cells are a technological sector that is frequently used to accurately describe the generation of energy from the sun, practical uses of solar cells in the production of electricity from light have been researched. Is. Photovoltaic cells may exist even when the light source is not always sunlight (light, artificial light, etc.). In this situation, the cells are sometimes close together (for example, infrared detectors) and are employed as light detectors to detect light or other electromagnetic radiation in the visible light range or to quantify light intensity. It takes the shape of a photovoltaic cell (when light strikes electrical qualities such as current, voltage, or resistance), and when exposed to light, it produces electricity.

3.8 MPPT Solar Charge Controller

The maximum power point that is accessible is tracked by the MPPT solar charge controller. It changes the voltage of the batteries using the energy from the PV modules. The fact that MPPT is an algorithm and not a physical device is intriguing fact. The maximum power point is where the current and voltage combine to produce the most power at a given moment.

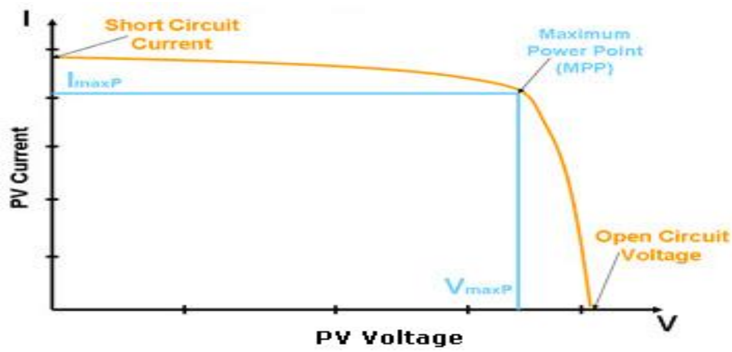

Figure 6: Voltage and Current Characteristic of MPPT

Moving on, the MPPT charge controller tracks this power and optimises the voltage between the batteries and the solar panels. This controller is used in off-grid systems that run without the grid mechanism

The sun irradiance, temperature, and load impedance all affect how much power a solar panel can produce. A converter is used to increase the performance of a solar panel because the load impedance varies depending on the application. The temperature and sun irradiation are constantly changing. As a result, an online algorithm that dynamically determines the solar panel's working point is needed. The Maximum Power Point Tracking (MPPT) method makes effective solar energy conversion possible. Swarm Integral Neural Controller technique algorithms have been proposed, including Perturb and Observe and Incremental Conductance.

Figure 6 shows the detection method based on the Current-Voltage (I-V) and Power-Voltage (P-V) properties of the solar cell is necessary since the maximum power point of a Photovoltaic (PV) array is variable. Due to its reliability of implementation, the Perturbation and Observation (P&O) MPPT method is frequently employed. It is based on the observation that if a PV array's operating voltage is perturbed in one direction and power consumed from the array rises, indicating that the operating point is moving toward the MPP, then another perturbation of the operating voltage must be made in the same direction.

The MPPT function is achieved by conducting impedance matching between a boost converter and a PV array using the P&O approach.When it comes to MPPT solar charge controllers, they have many benefits. Let’s have a look at each.

- The MPPT charge controller corrects the solar cell’s voltage and current variation.
- It ensures that maximum energy is drawn from the solar panels.
- This controller can be used in wind-power turbines and small water turbines.
- It eases the system’s complex operation.

A solar system is an essential piece of equipment that generates DC electricity using photovoltaic panels. This system's maximum power point tracking control is used to monitor the maximum power of the solar panel. The control systems are used to monitor solar panels and battery systems. A DC-DC converter converts DC power to the panel via a controller, which provides steady DC power to the battery system. When the battery is fully charged, the controller reduces the charge current and tells the user of the discharge current. The state of charge (SOC) is a critical metric in this system for increasing battery efficiency.

3.4 Algorithm steps for MPPT-Based Swarm Integral Neural Controller technique

Step 1: Start.

Step 2: To obtain balanced voltages at the load terminals, one must cancel the imbalance of the system voltage, therefore,

$$V_L(t) = V_s(t) + V_c(t) \quad \text{---- (1)}$$

$$V_{c0} = V_{s0}, V_{c-} = -V_{s-1} \quad \text{---- (2)}$$

V_L is the positive sequence.

V_c is injected positive sequence voltage.

Step 3: To obtain the balanced system currents, the injected current must become zero and gets for the sequence components of the load current.

$$i_L(t) = i_s(t) + i_c(t) \quad \text{---- (3)}$$

$$I_{c0} = I_{L0}, I_c = 0, I_{c-} = I_{L-} \quad \text{---- (4)}$$

Step 4: Ensuring zero Real power injection absorption by the compensators. That the imbalance in both the system voltage and the load currents is cancelled by the UPQC.

Step 5: Reactive power injection by the compensators. The UPQC can supply part of the load reactive power through its shunt compensator.

Step 6: The new conditions for the injected shunt currents are

$$\mathrm{I_{c0}} = \mathrm{I_{L0}}, \mathrm{I_c} \neq 0, \mathrm{I_{c-}} = \mathrm{I_{L-}} \quad \text{---- (5)}$$

Step 7: The control of IEAT, reference injected voltages are computed from the difference of reference load voltage and source voltage.

Step 8: This three-phase reference injected voltages are given to a PWM voltage controller.

Step 9: Because the average values of the active and the reactive powers of the shunt converter depend only on the positive sequence current and its real power consumption.

Step 10: End.

3.5 Quasi Z Source DC-DC Converter

Figure 7 represents the inductor L1 is primarily responsible for the source's capacity to pull current. The shoot-through status is enabled and the operation is modified by the single diode and LC network coupled to the inverter circuit. When the shoot-through state manifests, it effectively shields the circuit from deterioration. They are shoot-through mode and active mode (non-shoot-through mode). The solar panel is utilized as an input, and the amount of irradiation and temperature have a significant impact on how much voltage is produced. It is suitable for converting the available dc voltage from photovoltaic panels to increase the output ac voltage thanks to the QZSI and the ZSI. By using the input from the PV panel.

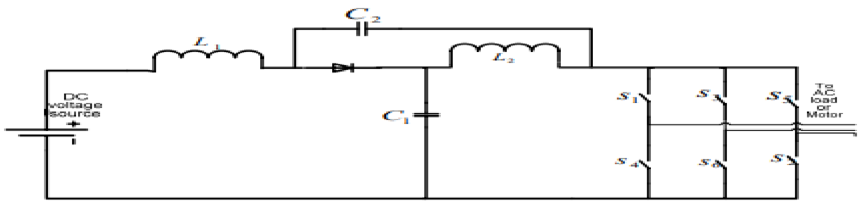

Figure 7 Circuit diagram of Quasi Z Source DC-DC Converter

3.6 STATCOM

STATCOM, or Static Synchronous Compensator, is a power electronic device that controls the reactive power flow over a power network and so improves the stability of the power network by employing force-commutated devices like IGBT, GTO, etc. STATCOM is a shunt device, which means that it is shunt linked to the line. Another name for a static synchronize compensator (STATCOM) is a static synchronous condenser (STATCON). It belongs to the FACTS (Flexible AC Transmission System) family of electronics. Synchronous in STATCOM refers to the ability to create or absorb reactive power in synchrony with the need to maintain the power network's voltage.

In the above reactive power flow equation, angle δ is the angle between V1 and V2. Thus, if we maintain angle δ = 0 then Reactive power flow will become

$$Q = (V2/X)\,[V1-V2] \quad \ldots\ldots\ldots.. \quad (5)$$

and active power flow will become

$$P = V1V2Sin\delta / X = 0 \quad \ldots\ldots\ldots\ldots.. \quad (6)$$

To summarize, we can say that if the angle between V1 and V2 is zero, the flow of active power becomes zero and the flow of reactive power depends on (V1 – V2). Thus, for the flow of reactive power, there are two possibilities.

1) If the magnitude of V1 is more than V2, then reactive power will flow from source V1 to V2.

2) If the magnitude of V2 is more than V1, reactive power will flow from source V2 to V1.

This principle is used in STATCOM for reactive power control. Now we will discuss the design of STATCOM for better correlation of working principle and design.

Figure 8 shows The STATCOM is made up of the following elements: a VSC, or voltage source converter. The DC input voltage is changed into an AC output voltage using a voltage-source converter. The following list includes two popular VSC kinds. Gate turn-off thyristor-based square-wave inverters: As the essential component of the converter output voltage is proportional to the DC voltage, the output AC voltage of this type of VSC is regulated by altering the DC capacitor input voltage. Insulated Gate Bipolar Transistors (IGBT)-based PWM inverters: It converts a DC voltage source with a typical chopping frequency of a few kHz into a sinusoidal waveform using the pulse width modulation (PWM) approach.

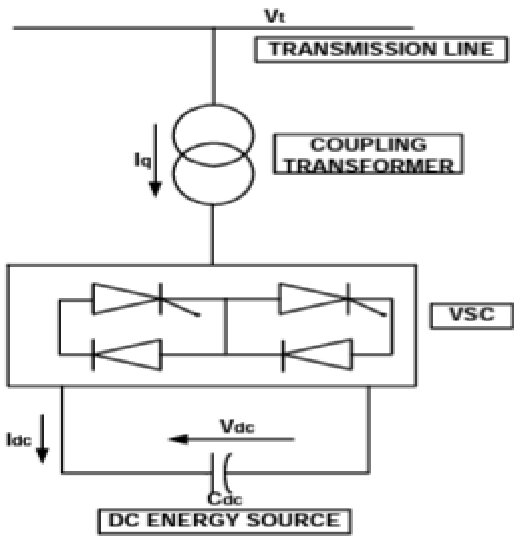

Figure 8 Static Synchronous Compensator (STATCOM)

At the point of connection, the STATCOM injects a roughly sinusoidal current with varying amplitude. Because it is closely in phase with the line voltage, this injected current simulates an inductive or capacitive reactance at the point of common coupling with the transmission line. Figure 9 depicts the STATCOM configuration, which consists of a coupling transformer, a solid-state synchronous Voltage Source Converter (VSC), and a DC capacitor.

The high-performance synchronous voltage source converter generates a balanced set of three sinusoidal voltages with quickly regulated amplitude and phase angle at the fundamental frequency

(VSC). STATCOM provides reactive power (Q) in capacitive mode. The inductive mode absorbs reactive power from the system in the same way. Because there is no need for or advantage from reactive power in floating mode, it is not provided or absorbed. The system voltage Vs differs from the STATCOM voltage.

Thus from the above discussion, the operation of STATCOM can be classified into two modes:

1) Voltage Regulation Mode

2) VAR Control Mode

The figure below well explains the above two modes of operation of STATCOM.

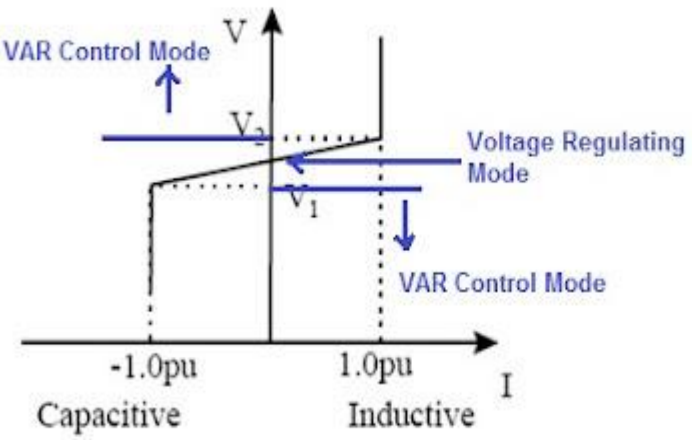

Figure 9: Working architecture

3.7 Buck-Boost converter

To obtain greater and lower stable voltage from the input power source (PV battery) than the system converter power output, high efficiency, and minimal ripple. It is possible to convert DC voltage to lower or higher voltage step-down converters in a very efficient manner.

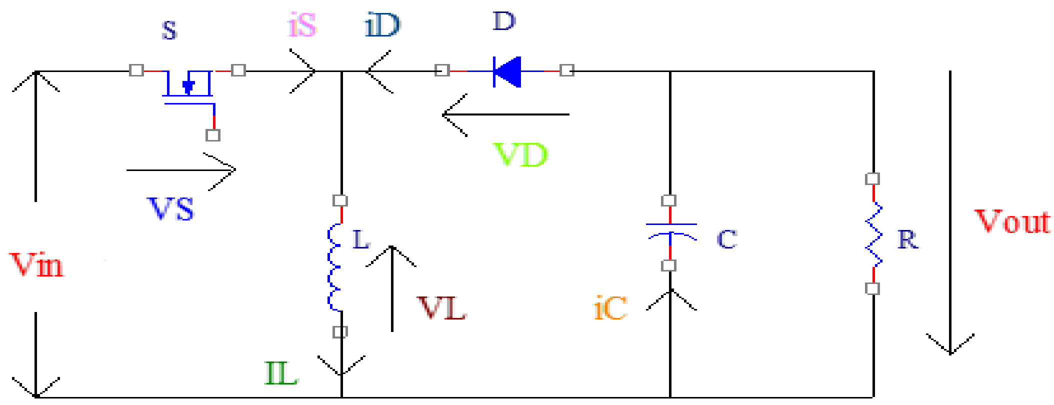

Figure 10:Circuit diagram for the Buck-boost converter

Figure 10 shows the circuit diagram of Buck-boost converters is very effective for determining maximum solar output. The objective in these circumstances is to use the most electricity feasible from the solar panels at all times, regardless of the kind of usage.

4. RESULT AND DISCUSSION

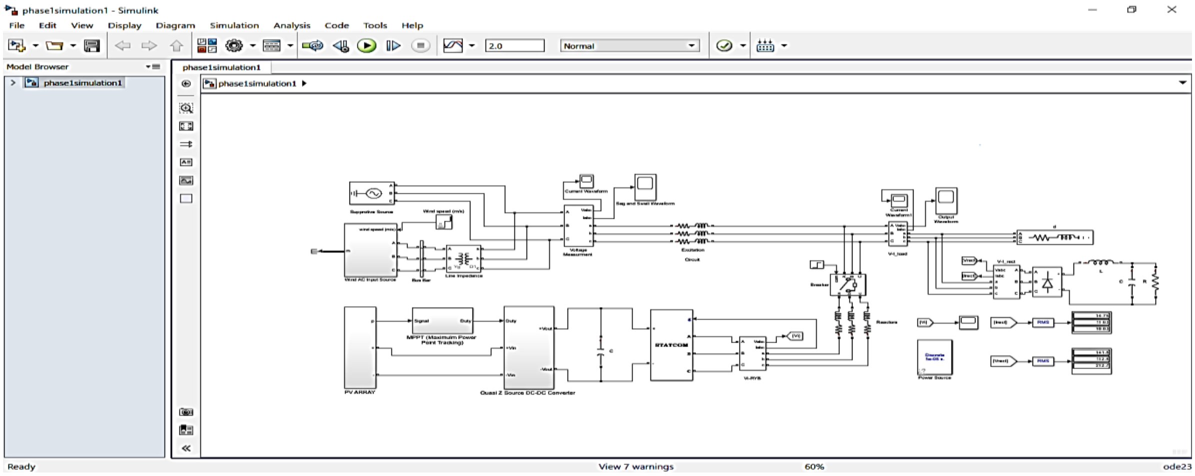

Figure 11: Mat lab Simulation Output

Figure 11 showsEffective management of the active and reactive power exchanges between the STATCOM and the ac system is made feasible by correctly regulating the phase and magnitude of the STATCOM output voltages, according to the recommended modelling study. This configuration allows a device to create or absorb controlled active and reactive power. The DC voltage of the inverter device is converted into a series of three-phase alternating current output voltages. Because of the reactance of the coupling transformer, these voltages are in phase with the alternating current system.

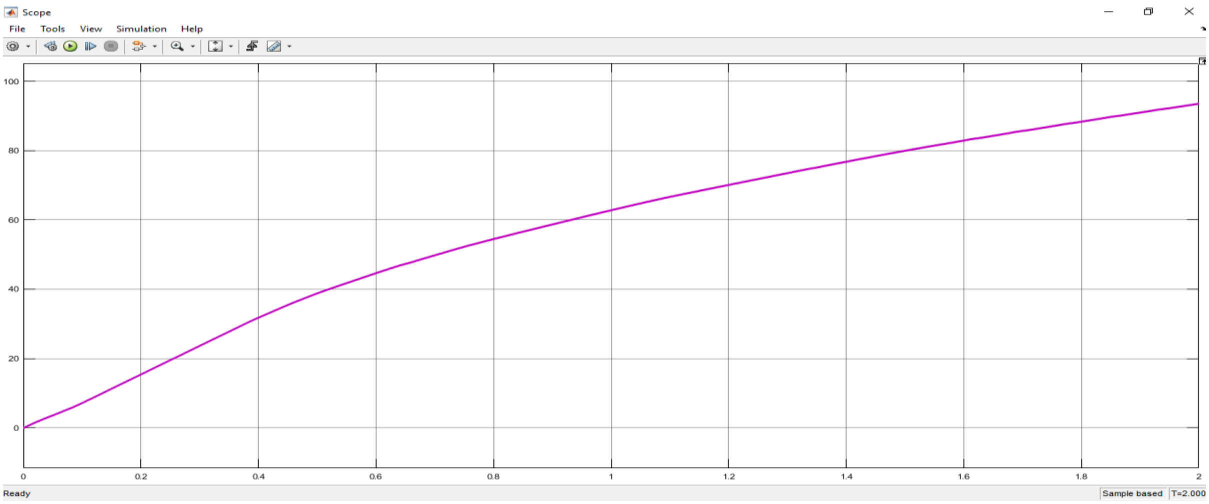

Figure 12: Output Scope of DC-DC Converter

Figure 12 identifies the Voltage dips, commonly referred to as "sags," which are drops in voltage of 10% or more from the usual or advised level of use. For example, a 120-volt outlet could drop to 90 volts. Voltage dips can cause many pieces of equipment to have a cascade effect, such as when a hair dryer is operated in one area and the lights in another room start to fade. The reverse of dips, voltage swells are spikes in voltage that are 10% or more over typical or advised consumption. Swells can happen when a heavy load, like a large motor, is turned OFF and the voltage on the power line briefly increases.

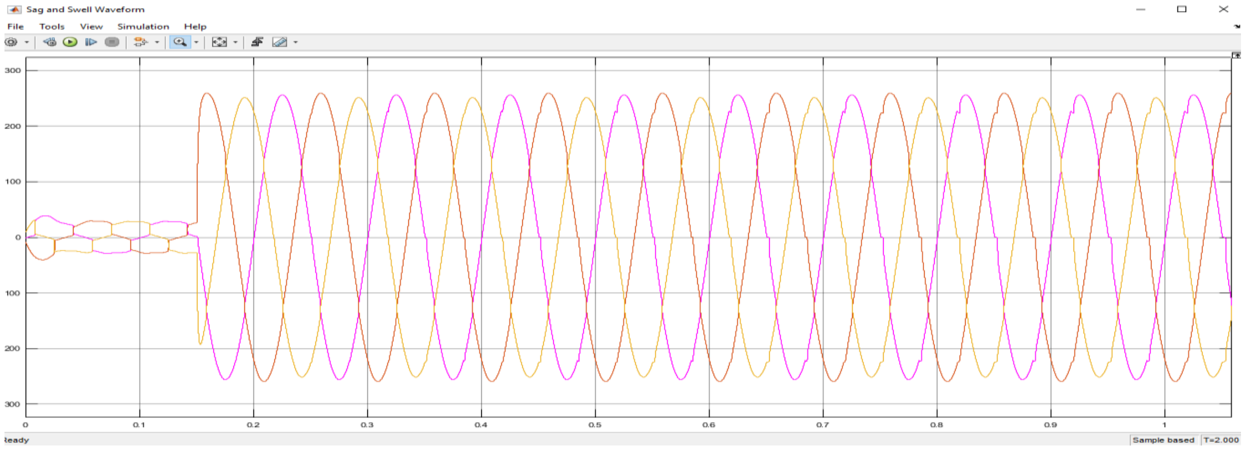

Figure 13: Output scope of Voltage Sag and Swell

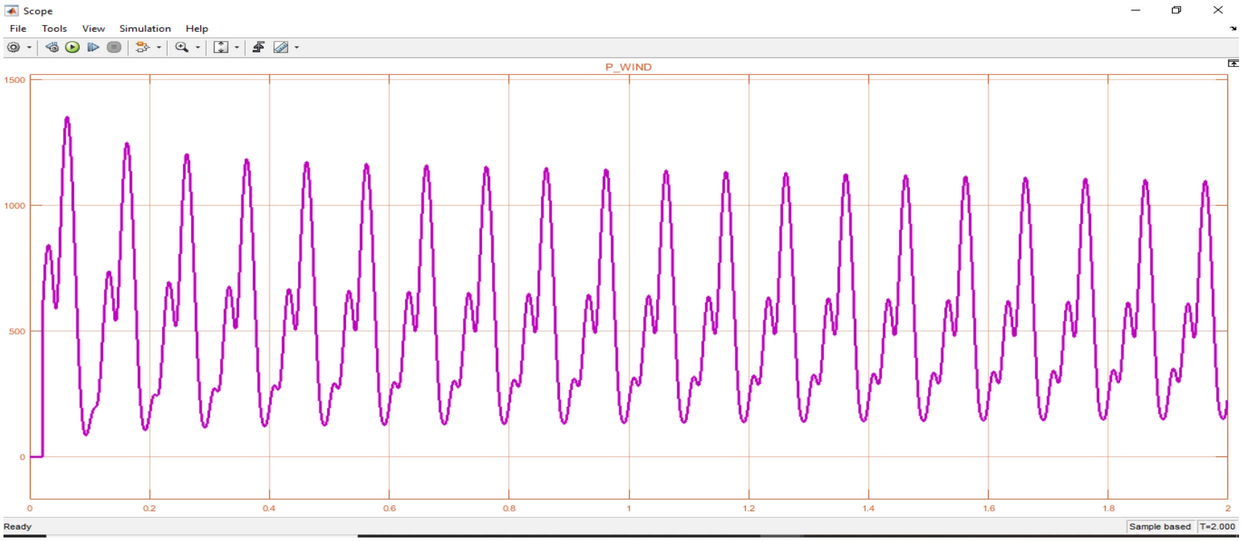

Figure 14: Output scope of Wind Output

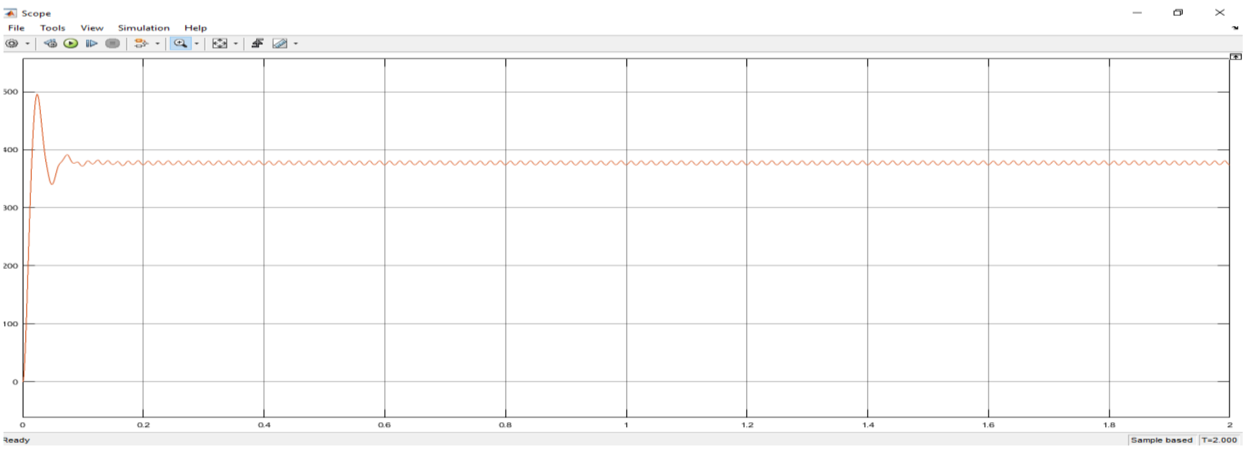

Figure 15: Output scope of Linear Voltage

Figures 13, 14 and 15illustrate the satisfactory operation in steady state, and dynamic situations such as load imbalance, insolation change, and voltage sag.

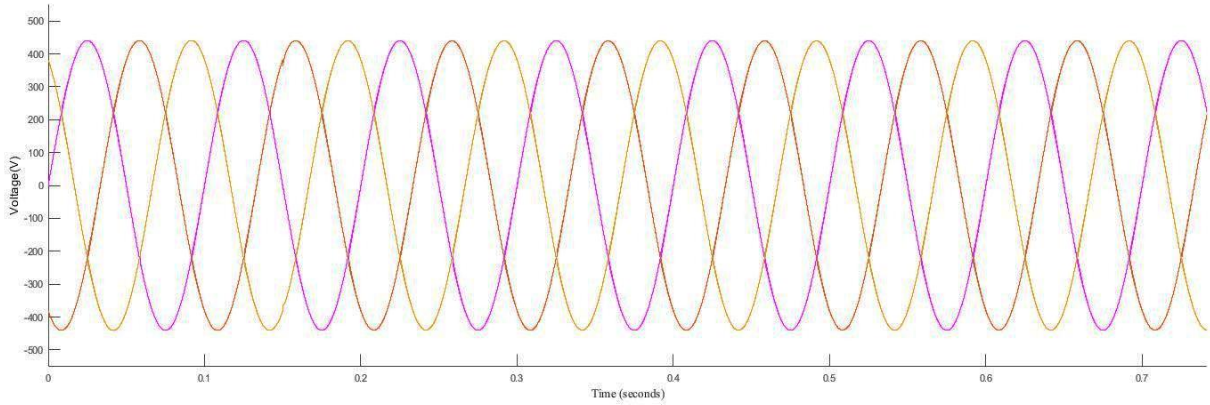

Figure 16: Output scope of without sag and swell simulation Output

The stability is represented in Figure 16. The suggested Swarm Integral Neural Controller technique-based performance is confirmed by analysis of the load voltage and current situation, and this system has minimal harmonics are shown in Figure 17.

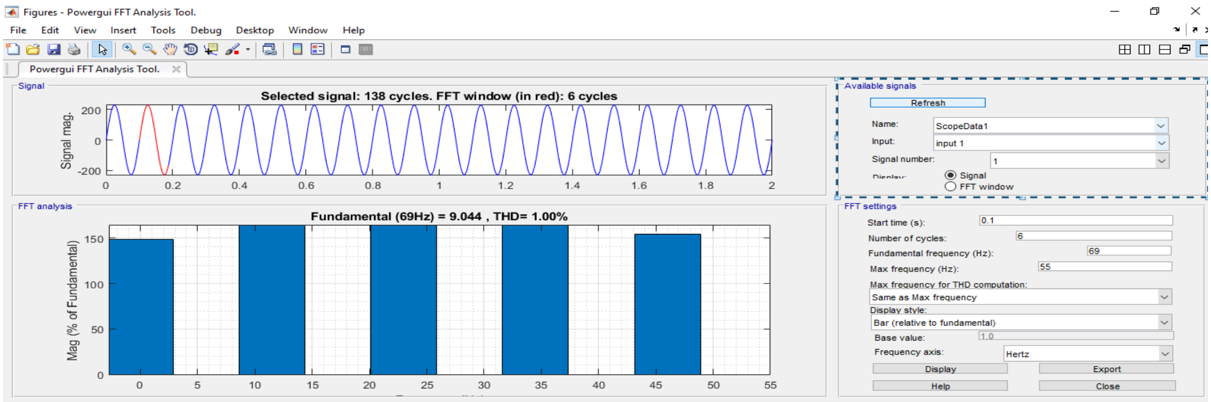

Figure 17: THD (Total Harmonic Distortion)

5. CONCLUSION

This study designed and developed a PV/wind DFIG hybrid based on STATCOM technology to increase transient voltage stability and therefore the wind turbine's ability to ride over grid failures to achieve uninterrupted operation. The power factor of the wind (Double Fed Induction Generator (DFIG)) power may be regulated, which enhances active power generation in the presence of STATCOM. A FACTS device, such as the Static Compensator STATCOM, is a power electronic-based switch used to control reactive power and thus bus voltages. The transformer and solar module are connected by a capacitor-inductor network in a quasi-Z-source at each stage of the power stabilizer. This Excitation Capacitor Circuit produces additional support during the voltage drop and keeps the voltage normal. In this proposed MPPT Based Swarm Integral Neural Controller technique is used to give the control pulse of the compensator and it reduces the harmonics and improves the power quality of this system and reduces Total Harmonics Distortion THD.

5.1 Future Work

STATCOM outperforms in several areas, including response time, power grid voltage stability, system power loss and harmonics reduction increased transmission capacity, and transient voltage limit. It also has the benefit of being smaller in size.

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