

A Review Paper on Improved Power Quality using Three-Phase Pulse Width Modulated Rectifier and MPPT

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Abstract— The compensation of area load harmonic current utilizing one weight unit interfacing convertor could create the increase of supply voltage harmonics delicate burdens, particularly when the elemental grid voltage is incredibly mutilated. Pulse width-modulated (PWM) rectifier technology is increasingly used in industrial applications like variable-speed motor drives, since it offers many desired options like curved input currents, manageable power issue, bidirectional power flow and prime quality DC output voltage. To achieve these features, however, an effective control system with quick and correct current and DC voltage responses is required. Unlike the task of brought together Unified power quality conditioners (UPQC) with game plan gadget, another consonant current give voltage and framework current symphonious pay approach is arranged using quicken administration of two shunt interfacing converters. Using the proposed technique, the present Total Harmonic Distortion (THD) of the lattice is decreased underneath as far as possible and in this way the general power nature of the framework is moved forward. The proposed show configuration dependent on three segment beat measurement balance.

Keywords— Pulse Width Modulation Rectifier, THD, PV Cell, Wind Power, MPPT, Battery, Voltage Source Inverter, LCL Filter.

I. INTRODUCTION

An intensive research in the neighborhood of variable-speed AC drives has been carried out over the last four decades. For an extended time the stress of the analysis has been placed on the motor electrical converter and its management, whereas the AC to DC rectification has been accomplished by associated degree uncontrollable diode rectifier or a line commutated section controlled Thyristor Bridge. Though each these converters supply a high dependability and easy structure they even have major inherent drawbacks. The output voltage of the diode rectifier can't be controlled and also the power flow is simplex also, the information current of the diode rectifier incorporates a nearly high bending. By overwhelming the terminating edge, the DC voltage of the Thyristor Bridge is frequently directed. Additionally control be expected the DC feature to the AC aspect is doable, anyway because of the extremity of the DC voltage ought to be switched for

this to happen, a thruster connect isn't a proper rectifier for applications wherever a snappy unique reaction is required. Truth be told, the DC voltage extremity revision isn't permitted in light of the electrolytic capacitors for the most part utilized in the DC connection of a voltage supply gadget. By interfacing two thyristor spans ant parallel, bidirectional power stream is likely without DC voltage extremity inversion, be that as it may, thus, the quantity of the power switches is multiplied. Furthermore, the power factor of the thyristor connect rectifier diminishes when the terminating edge increments and the line current twisting can be a much more terrible issue than that of the diode rectifier.

Accompanied by the previous twenty years the enthusiasm for amending units has been rapidly developing in the principle the expanding worry of the electrical utilities and complete clients concerning the adapted Contamination in the power framework. As a result, pulse width modulated (PWM) rectifiers are of explicit interest and that they became engaging particularly in industrial variable-speed drive applications within the power vary from one or two of kilowatts. up to many megawatts. This is partly due to the reduced costs and improved performance of both the power and control electronics components but most of all due to the numerous benefits the using of the PWM rectifiers offers.

There has been a requirement to regulate disturbances to the provision network virtually since it had been initial made within the late nineteenth century the primary of these was British Lighting Clauses Act of 1899 that kept uncontrolled curve lights from causing flash on radiant lights.

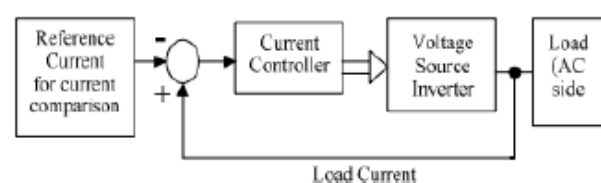


Fig.1.1 Basic block diagram of current controller for VSI

1.2 OVERVIEW OF VOLTAGE SOURCE PWM RECTIFIER

A typical voltage source PWM rectifier configuration is shown schematically in Fig. 1.2. It consists of three parts: line filter, Rectifier Bridge and DC voltage link. Series inductors, which are so-called L-filters, are the most commonly used line filters. Also the LCL-topology, illustrated in Fig. 1.3, has lately become popular due to its higher attenuation above the resonance frequency and better line voltage disturbance rejection capability compared to the L filter. The purpose of the line filter is to attenuate the current ripple produced by PWM switching and, at the same time, to act as energy storage for voltage boost operation. The inductance of the line filter inductor is denoted with L . The bridge circuit, which is identical to a conventional inverter bridge, is constructed of six controllable power switches and anti parallel diodes. In low voltage applications the power switches are typically IGBTs with switching frequency from a few kilohertz to a few tens of kilohertz. At medium-voltage levels GTOs or IGCTs are often used. The switching frequency of these devices is typically a few hundred hertz.

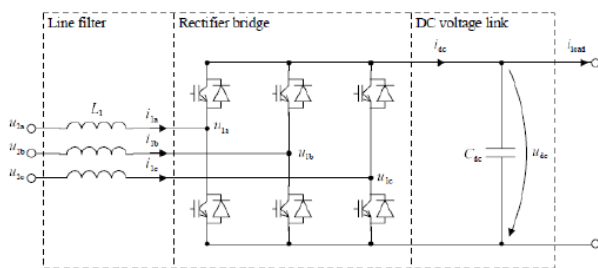


Fig. 1.2: Main circuit of a voltage source PWM rectifier with L-filter

There phase of the magnitudes and phases of the fundamental components of the converter phase voltages to the line phase voltages U_{2a} , U_{2b} and U_{2c} together with the impedance of the line filter determine the fundamental component of the line currents i_{1a} , i_{1b} and i_{1c} . There occur also current harmonics produced by the corresponding harmonic voltage of the PWM rectifier, but their magnitude is essentially reduced because the impedance of the line filter increases as the frequency increases.

1.3 HISTORY OF PV (PHOTOVOLTAIC)

The main ordinary photovoltaic cells were created in the late 1950s, and all through the 1960s were essentially used to give electrical capacity to earth-circling satellites the 1970s, upgrades in delivering, execution and nature of PV modules diminished costs and showed assortment of chances for fueling remote earthbound applications, together with battery charging for bearing guides, signals, broadcast communications instrumentation and diverse

basic, low-control needs. Inside the 1980s, photovoltaic's turned into a favored power supply for customer electronic gadgets, together with adding machines, watches, radios, lights and diverse little battery charging applications. Following the vitality emergencies of the 1970s, essential endeavors moreover started to create PV control frameworks for private and business utilizes, each for finish, remote power likewise concerning utility-associated applications. Following the energy crises of the 1970s, important efforts additionally began to develop PV power systems for residential and business uses, each for complete, remote power also as for utility-connected applications. Throughout identical amount, international applications for PV systems to power rural health clinics, refrigeration, water pumping, telecommunications, and off-grid households increased dramatically, and stay a serious portion of the current world marketplace for PV product. Today, the industry's production of PV modules is growing at some 25 % annually, and major programs within the U.S., Japan and Europe square measure speedily fast the implementation of PV systems on buildings and interconnection to utility networks.

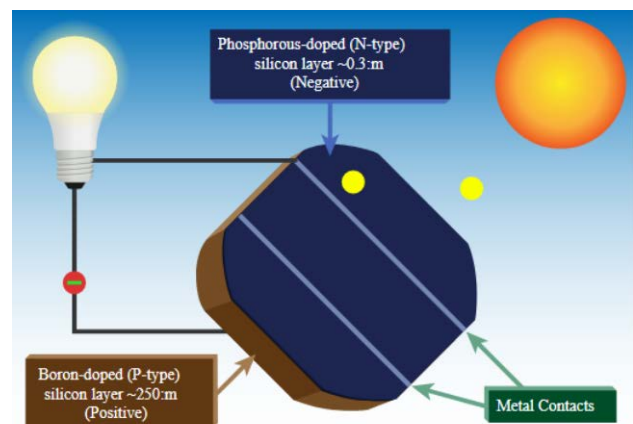


Fig.1.3 Diagram of a photovoltaic cell

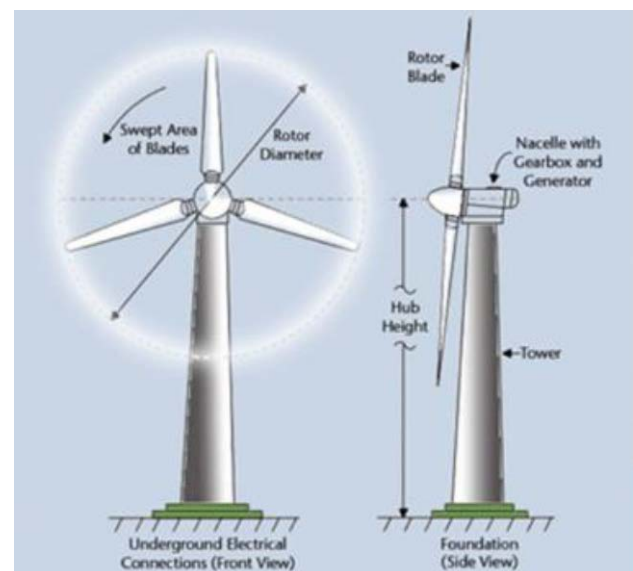


Fig.1.10 Wind turbines

1.4 WIND TURBINES

Wind turbines seem like plane propellers running on the spot—spinning spherical however going obscurity. They are serving a really helpful purpose, however. There is energy bolted in wind and their big rotors will capture a number of it and turn it instantly into electricity.

II. LITERATURE REVIEW

George C. Konstantopoulos et al. [1] —Nonlinear Control of Single-Phase PWM Rectifiers With Inherent Current-Limiting Capability, in this paper, a nonlinear controller with an innate current constraining capacity was proposed for single-stage rectifiers. The created methodology ensures nonlinear asymptotic solidness and combination to a novel arrangement consistently, while accomplishing the principle errands of the rectifier activity, i.e., precise yield voltage control and solidarity control factor task. A diagnostic depiction of the controller parameters choice was given to ensure that the info current will be constrained underneath a given an incentive amid drifters regardless of whether the network voltage fluctuates. Contradicted to the current control strategies, the proposed current-restricting controller is completely free from the framework parameters and does not require a PLL or the quick estimation of the network voltage, prompting a rearranged usage. Expansive test outcomes were given to help the speculative establishment of the proposed approach and check its practical movement.

George C. Konstantopoulos et al. [2] —Current-Limiting Non-linear Controller for Single-phase AC/DC PWM Power Converters, a current-constraining non-direct controller was proposed to accomplish PFC and yield voltage direction for single-stage air conditioning/dc control converters. The proposed CLNC acts autonomously from the framework parameters and can ensure shut circle framework solidness and a given limit for the information current. Since the CLNC has a straightforward structure and does not require the prompt estimation of the framework voltage or a PLL, its execution turns out to be exceptionally basic. Reenactment results utilizing Matlab/Simulink and a constant computerized test system appropriately checked the hypothetical examination for a few changes of the yield voltage reference.

Omar stihi et al.[3] —A Single-phase Current Controlled PWM rectifier, it is shown that by incorporating a butter worth filter in its voltage feedback loop, the single phase controlled current PWM rectifier can be made into a fast response stand alone system drawing near sinusoidal current waveform at unity power factor with bidirectional power flow capability. The possibility of feedback instability is identified and an experimentally verified approximate theoretical analysis is presented.

Wensheng Song et al. [4] —A Simple Model Predictive Power Control Strategy for Single-phase PWM Converters with Modulation Function Optimization, show prescient direct power control (MP-DPC) with the balance work enhancement for the prompt power control of single-stage PWM rectifiers is proposed in this paper. Based on SOGI, the momentary dynamic and responsive forces arrangement of single-stage converters is talked about in two-stage stationary organize outline. The streamlined regulation capacity of the received rectifier is gotten from the cost work minimization in MP-DPC. The proposed MP-DPC conspires joined with the PWM arrange comprises the general control arrangement of the embraced rectifier. What's more, the affectability of the MP-DPC conspire is researched, because of the air conditioner side inductor parameter confound. Based on this, the inductance parameter on-line estimation plot is proposed to wipe out its impact on the responsive power. The execution of the proposed MP-DPC plot is assessed dependent on a solitary stage PWM rectifier downsize test. Besides, it was contrasted and that of ordinary PI-based prompt current control (ICC) approach broadly embraced in the railroad footing application, and the limited control-set (FCS) MP-DPC plot. Also, Table IV demonstrates an execution correlation of these three control plots based on test results and hypothetical examination.

Yongchang Zhang et al. [5] —Performance Improvement of Two-Vectors-Based Model Predictive Control of PWM Rectifier, this paper proposes an improved two-vectors-based MPC (MPC2) for PWM rectifier. Different from prior MPC with duty cycle control (MPC1), which applies a nonzero vector and a zero vector during one control period. The proposed method relaxed the restriction on the second voltage vector, which is possibly a nonzero vector. In other words, in the proposed MPC2, it is possible to apply two nonzero vectors during one control nperiod to achieve better steady-state performance. The principle of the selection of the first vector and the second optimal vector is explained in detail and the theoretical study confirms that the optimal second vector is not necessarily a zero vector. By using the negative conjugate of complex power as the control variable, both the first and second voltage vector in the proposed MPC2 can be obtained in a very efficient way, which is favorable for the practical implementation. The vector duration is such derived that the power error is minimized at the end of one control period. The proposed MPC2 is compared with MPC1, DB-SVM, and andDB- 3VV. Both the simulation and experimental results prove that, compared to MPC1 at the same sampling frequency, the proposed MPC2 not only achieves better steady-state performance in terms of reduced power ripples, less current harmonics, and lower THD, but the switching frequency is also reduced by up to 29.5% in average. Furthermore, the current THD of the

MPC2 is also lower than those of DB-SVM and DB-3VV. Finally, the merits of MPC1 in terms of quick dynamic response and concentrating the current harmonics on the multiples of sampling frequency are maintained. Hence, it is concluded that the proposed MPC2 is an effective alternative to prior MPC1, DB-SVM, and DB-3VV.

Qing-Chang Zhong et al. [6] —Nonlinear Current-Limiting Control for Grid-tied Inverters, A nonlinear controller with a current-limiting property was proposed for single-phase grid-tied inverters with an LCL filter. The proposed controller can achieve the desired real and reactive power regulation with guaranteed closed-loop stability in the sense of boundedness. In light of the nonlinear elements of the framework and utilizing contribution to-state solidness hypothesis, a given limit for the inverter current is constantly demonstrated autonomously from the power reference esteems. Direction for choosing all the controller parameters was additionally introduced to get the total controller usage technique. The desired performance of the proposed current-limiting controller and the theoretical analysis were verified through extensive simulations.

Deepak Sharma et al. [7] —The principle techniques of current harmonics reduction and power factor improvement for power plants and the utilities: A review, Many new PWM control schemes are being developed which improve the performance of the converter. The indirect current control without the need of current sensors is an improvement over the hysteresis current control scheme as the switching frequency remains constant and all the advantages of HCC are retained. Computerized reasoning systems are being produced for the execution of control procedures in power hardware. A portion of these are fluffy rationale control, fake neural systems. Space vector balance execution is a lot simpler utilizing neural system preparing strategy when contrasted with the one that utilizes the d-q change.

III. PROBLEM FORMULATION

The existing method describes AC/DC converters are inherently nonlinear systems because of their change operative perform. Among these devices, the single-phase full-bridge or H-bridge rectifier represents a typical greenhouse emission device operative in pulse-width modulating (PWM) mode and its model is generalized within the three-phase device case.

The three-phase hysteresis current control has an extremely simple and robust structure and excellent dynamic performance. Nevertheless, this control scheme has also disadvantages such as varying and load-dependent switching frequency, wide line current spectrum, poor utilization of the converter zero voltage vectors and interaction between the phases in three-phase threewire

systems. A number of proposals have been put forward to overcome these problems. An adaptive tolerance band can be applied to achieve nearly constant switching frequency (Bose, 1990). To decrease the switching frequency and to compensate the phase interaction effect, the hysteresis current control based on space-vector approach, three-level comparator and lookup table can be used.

IV. PROPOSED METHODOLOGY

The planned methodology describes a nonlinear controller with a current-limiting property is planned to ensure correct dc output voltage regulation and unity power issue operation for three-phase pulse-width modulating rectifiers while not the requirement of a phase-locked-loop (PLL). To possess harmonic current alleviation of the provision voltage and also the grid current harmonics, a compensation technique utilizing expedited management of 2 parallel interfacing converters is planned during this section. To boost the ability quality and system performance and reduces the overall harmonic distortion mistreatment the 3 section pulse breadth modulating rectifier and MPPT ways.

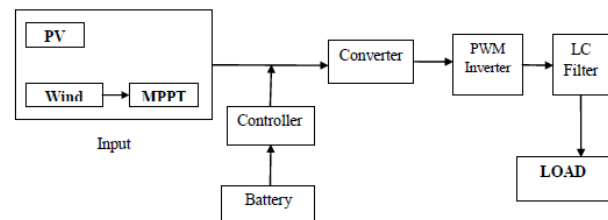


Fig.4.1 Block Diagram of Proposed System

V. SIMULATION RESULTS

Simulink contains all-inclusive library of sink, source, linear and nonlinear, and connecting blocks. If the blocks cannot meet your needs, however, you may create your own blocks. The intuitive condition improves the displaying procedure, taking out the need to detail differential and distinction conditions in a dialect or program.

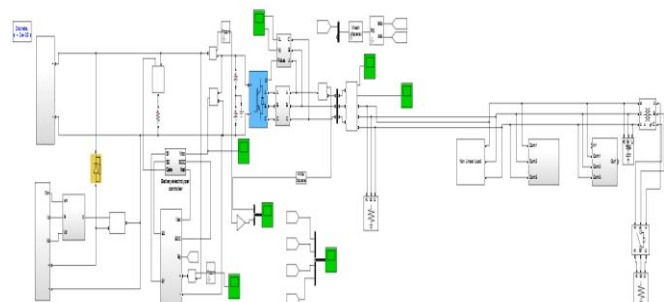


Fig. 5.1 Proposed Model

Simulink is a chunk outline environment for multi territory renovation. It generally bolsters confirmation of inserted frameworks, reproduction, and programmed code age.

Constant test and Simulink gives a graphical editorial manager, adaptable square libraries, and solvers for demonstrating and mimicking dynamic frameworks. It is coordinated with MATLAB®, empowering you to consolidate MATLAB calculations into models and fare recreation results to MATLAB for further investigation.

Figure 5.1 shows the proposed model, to have concurrent relief of the supply voltage and the matrix current music, a pay strategy utilizing composed control of two parallel interfacing converters is proposed in this area. The hardware and control outlines of the proposed framework are appeared in Fig.

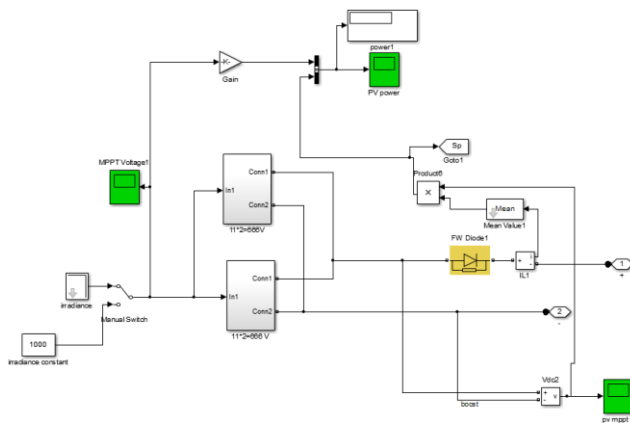


Fig. 5.2:- Subsystem of PV Systems

Proposed model has three sections. Section 1 is wind, second is PV cell (Photovoltaic Cell) and last section is battery block. In wind section basic focus is on pitch angle and wind speed. This wind model contains wind turbine that is related to static magnet synchronous generator that is directly driven by turbine while not exploitation case variety of PV panels connected in serial and/or in parallel giving a DC output out of the incident irradiance. Orientation and tilt of those panels are square measure vital style design parameters, furthermore as shading from close obstructions.

VI. CONCLUSION & FUTURE WORK

6.1 Conclusion

Proposed work reduces the total harmonic distortion and the system power quality is improved using maximum power point tracking, wind power, PV cell and three phase pulse width modulated. In the meantime, the harmonic current brought on by the nonlinear load and the principal converter is repaid by the second converter. Consequently, the nature of the network current and the supply voltage are both essentially progressed. To lessen the computational heap of DG interfacing converter, the organized voltage and current control without utilizing load current/supply voltage harmonic extractions or stage bolt loops is produced to acknowledge composing control of parallel converters. At the point when a single multi-

useful interfacing converter is received to compensating generation the harmonic current from nearby nonlinear burdens, the nature of supply voltage to neighborhood load can barely be enhanced in the meantime, specific once the basic network voltage is blended.

6.2 Future Work

Further investigation is required to obtain a generic structure that may be applied to both types of ac/converters with different operating conditions (e.g. constant power, constant current loads) and satisfy some additional practical limitations (e.g. saturation of the management input) with an improvement of the ability quality. These issues represent interesting topics for future research.

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