A REVIEW ON STABILITY ANLYSIS USING SLIDING MODE CONTROLLER

[1]Nischal Kumar, [2]Prof. Balram Yadav, [3]Prof. Eknath Borkar
[1]Research Scholar, [2,3]Assistant Professor
SCOPE College of Engineering, Bhopal (M.P.)

Abstract: The performance of solar-PV power generating system with proposed control algorithms is demonstrated using simulation and experimental studies under various operating conditions. Sliding Mode Controller algorithms have been presented for the boost converter and DC-AC inverter used for solar-PV power generating system array tied with the grid. Detailed design and stability analysis for both control approaches have been discussed to confirm its applicability under various operating conditions. The proposed approach has minimized the requirements of PI controller and only single PI controller is employed for DC bus voltage loop. The obtained simulation and experimental results have established that presented control approach performs satisfactorily under different operating conditions without adjusting the controller parameters.
There are another factor which depend upon the different speed

1. VARIABLE-SPEED WIND TURBINES

Wind for instance can be an unappealing development from the viewpoint of nearby communities, mainly due to perceived decay in landscape aesthetics and threat posed to surrounding wildlife. Nonetheless, prospects of community ownership and ecological sitting considerations have been shown to ease these tensions In hopes of meeting the majority of their jurisdictions' emission reduction targets within the electric power sector. A problem faced by these utilities, and others hoping to pursue similar aggressive wind integration strategies, is the loss of controllability on the supply-side, as the fuel source wind energy is non-dispatch able, and therefore new methods of maintaining grid stability are required.
The typical power system control architecture has provided a robust framework for maintain system performance, with problems now becoming apparent in systems intended to integrate large amounts of intermittent renewable generation, in particular wind. Wind displays a high level of temporal variability, and is difficult to accurately predict over short time-scales (minute-to-minute). Indication of the scales over which wind power production displays variability is given by Apt. Measured and compiled performance data from a population of geographically dispersed wind turbines is used by Apt to show that wind power production follows the Kolmogorov spectrum over a time-scale ranging from 30 seconds to over 2 days. As a result, Apt was able to conclude that although wind variability can be somewhat accommodated by the variability in demand, a considerable amount of wind power fluctuates over different time-scales[1].

2. CURRENT WIND-POWER TECHNOLOGY

In ancient period the wind energy is used for the ship navigation in Nile. Then European start using wind power to pump the water and for grain grinding in late 1700 and early 1800s. The first wind turbine generator which has capacity of 2W was commissioned in 1979. Then after this another 3-MW turbine was commission in 1988 on the Berger hill on Orkney. In starting period electric power generated by the wind power generator is utilized to lightning building which is located at the remote places where the power by conventional means is not possible. In preset day the wind power generators are available in compact size for the stand alone system and also the large generators are available which are connected with the electricity grids. From a survey report present in 2003 the total worldwide wind power capacity is found to be 39,294 MW and in India its total capacity is 1550 MW
Variable-Speed Concept Utilizing Doubly Fed Induction Generator (DFIG): here converter will decouple mechanical & electrical frequencies & thus makes the process of variable speed thinkable, and thus by this we can make the variations in the rotor frequency. As in this the turbine will not be operated on its full range from the zero to its highest speed, but here speed range is acceptable. Thus we can also say that here that ration between the converter size & wind turbine ration is almost half of the rotor-speed span. As the converter size is smaller in this case thus the losses associated with this are also less. Thus here the control abilities of reactive power are almost same as full power-converter system. Thus in this we can get the variable speed condition by the dissipation of energy under the resistor which is placed in the rotor as in Fig. 1thus by using this technology the efficiency of system will be decrees with the increase in slip and thus here the speed control range is limited to the narrow margin range. Thus this scheme will contains the power converted and a resistor in rotor[2]. Thus from there we can get the Trigger signals by using the optical coupling. As almost all such kind of energy grids are equipped with the multi pole synchronous generator, and this is also possible to use the induction generator here along with the gear box. Thus there are various advantages are obtained after removing the gear box from system like the losses are minimum and the cost is minimized because here we did not use any expensive equipment, and the reliability is also increase because there is no rotating element is present in the system.

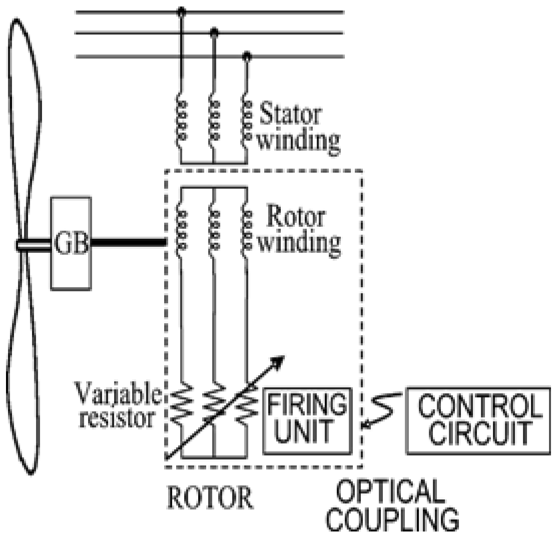

Fig. 1: Single doubly fed induction machine controlled with slip power dissipation

In the Fig. 1we displays system for the full power converter in a wind turbine. In this machine the machine phase converter will work as the driver which will control the torque generation, and it sues the vector control scheme. As there the grid size three phase converters will use the wind energy transfer in the grids and thus it will permit the control over the amount of active and reactive power deliver to grid. Thus by this ti will improve the quality of power which is deliver to the public. Thus the main aim of a dc link is to act as the energy storage device, thus in this we store the energy obtain from the wind in the form of charge in capacitors and thus it will then inject to the grid for supply. Thus here we set the control signal to the limit so that it will maintain the static reference to dc link voltage Vdc.

Wind for instance can be an unappealing development from the viewpoint of nearby communities, mainly due to perceived decay in landscape aesthetics and threat posed to surrounding wildlife. Nonetheless, prospects of community ownership and ecological sitting considerations have been shown to ease these tensions [8]. In hopes of meeting the majority of their jurisdictions emission reduction targets within the electric power sector. A problem faced by these utilities, and others hoping to pursue similar aggressive wind integration strategies, is the loss of controllability on the supply-side, as the fuel source wind energies non-dispatch able, and therefore new methods of maintaining grid stability are required.

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As in IGBTs we can get the higher switching frequency as compare to the IGCTs, so that they will produce lesser distortion to the grids. Generally the IGCT are made from the disk shape devices. And as they get hot thus they have to be cool with the cooling plates by the electrical contact over high-voltage side. Thus this major issue here because due to this the higher EM emission will happen. Here we can measure the number of permitted load cycles. As in this we perform the heating and cooling of devices and this will cause the thermal stresses over the devices in the silicon chip, and thus it will damage the chip completely. Thus this Isaso a major issue and this is generally occurs in the wind turbine applications. And the other device which is IGBT is made from the modular device. Thus this will increase the lifetime of the device upto ten times.

Voltage Fault Ride-Through Competence of Wind Turbines: as in case when the wind capacity is increase than the network operator must ensure that the consumer will to be effected due to this. Thus to ensure the large scale of wind turbine technology without any compromise with the stability of the power system, the turbine must be in connection and makes the contribution to the grid in case of disturbances like the voltage drip. The wind farms must be generated like the convention power plant and thus the reactive and the active power frequency will be occur immediately after fault.

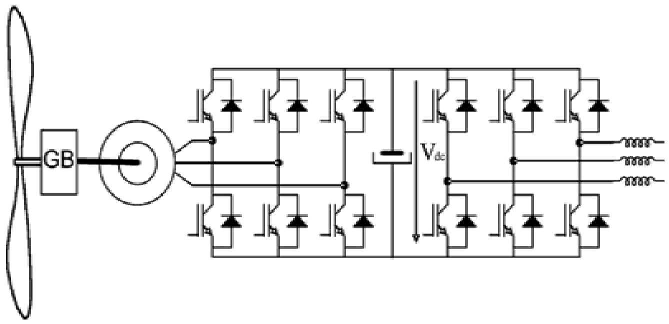

Fig.2: Dual 3-phase VSI.

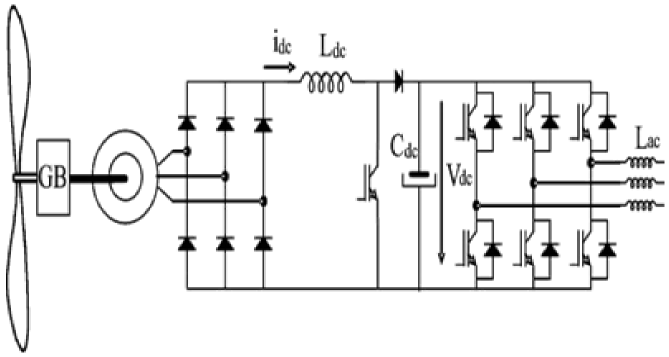

Fig. 3: Step-up converter in the rectifier circuit and full power inverter topology.

3. TRENDS IN WIND-POWER TECHNOLOGY

1) Transmission Technology for Connecting Wind Generation to Grid: Due to the scarcity of fossil fuels and emission of carbon di-oxide and greenhouse gases, environmental aspects, it becomes necessary to consider the renewable energy sources for the generation of electric power. Renewable energy source like wind energy plays important role in safe and clean environment and production of electricity at minimum running cost. Generation electric power by wind power is growing very fast for the purpose of clean environment and reduction of CO_2 emission level, government is introducing subsidy in various form. The uncertainties like variable nature of wind rate and variability of electricity price have to be faced the power producing companies. The market participants have to consider these challenges for the formulation of problem. The innovative result shows the importance of accurate modeling of imbalance prices for optimal participation of wind power[4].
As now days the demand of air conditioning system is continuously increased due to which the energy consumption is also greatly increased. From a survey report this has been observed that about 50% of world energy consumption is consumed by the HVAC systems in industries and commercial buildings. [9]. With the increasing consumption in HVAC system and limitations of energy resources with increasing in price from time to time, it is therefore essential to find ways to improve the efficiency of systems.

In the figure given above the conventional HVDC transmission systems which is based on the current source converter along with the obviously commuted thyristors is discussed, and these are also named line-commutated converters. But the system which is based on the VSC is have various advantages over other techniques. Thus here we can control active & reactive power self-reliantly, which will minimize requirement of the reactive-power compensation.

As the common feature among all these five topologies discussed above is that in theoretical studies these topologies can be designed to have the arbitrary number of levels, and in practical they some of them are much simpler to realize than other techniques [5].

As here the rating of component will raise and the switching and the conducting operation will be improved thus his main advantage of using these multilevel converters is that they are becoming more and more evident. In some previous studies this has been stated that we can formulate a balance problem in terms of model of converter and thus this kind of formulation will allow to solve the balancing problem by the direct modification of reference voltage level with the relatively lower computational load as the current trends in the wind power market will increase the nominal power and because of voltage and current ratings. The main limitation of using these multilevel converters is that in this is necessary to get the different dc voltage independent source for multilevel modulation.

2) Direct-Drive Technology for Wind Turbines: as now days the direct drive applications are used in market extensively because in this the use of gear box is complexly eliminated. As in comparison with the conventionally used gearbox-coupled wind-turbine generator, the direct drive system will minimize size of the system in a compact size, and also provide the much flexible control over the method and provide the much faster responses in answer to the wind variations. Thus the complete design for the low-speed direct-drive permanent-magnet generator to use in the wind applications is shown in figure 2.4.

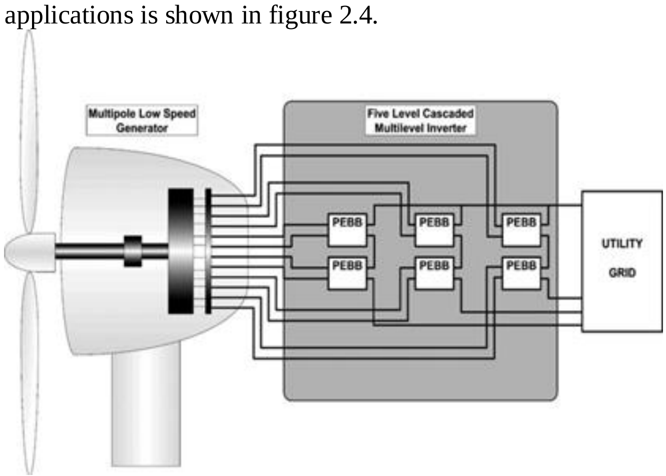

Fig. 4: Five-level cascaded multilevel converter connected to a multiple low-speed wind-turbine generator

Thus we can use such kind of novel machines in the small scale wind and water-turbine direct-drive generators because from this we can get the higher density and we can obtain it in much simple way.
3) Future Energy-Storage Technologies Applied in Wind Farms: by using energy storage system we can makes the improvement in technical & economical attractiveness of wind power, generally when it rises from the 10% of total system energy. Thus it will inject or absorb the energy in a much shorter period to make the contribution for the grid-frequency stabilization[6].

4. SLIDING MODE CONTROLLER

We can use this method when there is modeling disturbances, variation in parameters, which will facilitate that the upper boundary of the absolute value is not known. Such kind of modeling inaccuracies will cause due to the changes in plant parameters, or by choosing the simple representation of system dynamics. Thus the sliding mode controller technique will provide the satisfactory solution to maintain the stability in presence of modeling parameters. Generally this method is best for the tracking the motor controls, the robotic manipulators which changes the mechanical load in a wide range. Thus here we use the induction motor as the actuator which has the very complex trajectories.
Soto and Yeung and Utkin [7] present a study in which he applied the sliding mode control technique to induction motor drive. Thus in the study the sliding model control technique is used for the indirect vector measured induction machine to control the speed and position. It is used in the

anther study where is used t control the position loop for the indirect control induction motor drive and did not uses any rotor resistance identification method. Thus in such cases the motor flux and the speed is control by the sliding mode controllers which having variable switch gain. Thus in the study we present the sliding mode controller with rotor flux in case of induction motors. Here we also estimate the rotor flux by using the sliding mode observations.

As there are several estimation algorithms and the sensor less schemes are develop in some last year due to the continuous development in this field, thus this proposes the simple, effective and lower estimation of sensitivity scheme for the lower power induction motor drives si not being that much explored. Thus to answer such kind of problems the sliding mode controller technique is the best technique. As in practical all the parameters are being affected due to uncertainty cause due to modeling error and presence of external disturbances.

While designing a sliding mode controller we generally have two steps (1) designing a sliding surface on the basis of required close loop performance and (2) to design a suitable control law. Thus here to eliminate the non-robust reaching phase we propose an integral sliding mode in literature [19, 20] which will permit the SMC to combine with the other techniques. Thus following are the main advantage of SMC:

1. While sliding mode the system is not able to match with the model uncertainty and the disturbances
2. In the case when the system is not a sliding manifold than in this case it will act as reduced order system w. r. t. original plant. As on basis of claimed robustness the practical implementation of SmC is not being performed by the major limitation which is known as chattering, this is a high frequency bang-bang type control action. The main reason behind the chattering is fast dynamics which we generally ignore in the ideal model of sliding mode, thus this control is assumed to switch the indefinite frequencies. As in real plants because of inertia of actuators and sensor as well as occurrence dissimilarities, the switching is performed with the high and definite frequencies. Thus due to this the main drawback is that the skidding mode will be performed only in the smaller region of sliding manifold,, which dimension is inverse of the control switch frequency. As while sliding mode because of the finite switching of the control signal the states will be switched about the sliding surface other than sliding directly over it. This kind of switching will also be performed over the higher frequencies and also knows as chattering.

5. PV TECHNOLOGY REVIEW

Generally photovoltaic technology is based on recent development in the power -electronic converters and on the state of the art of implementation of PV systems. The photovoltaic energy generation system is the most extensively used renewable power system and now this has been used in the hybrid structure due to continuous development in this field. Thus to maximize the PV system we have to achieve a highly reliable, cost effective and user friendly system in the proposed PV topologies

Soheil Derafshi Beigvand et.al [10] in this paper the author discus about the increase penetration effect due to which we have to use the distribution smart grids (SGs) because this penetration will makes the bidirectional flow of electric power. Here, two new technique which is VSI which is used for the radial distribution SGs and is based on real time measure voltage data.

Abhinav Kumar Singh et.al [11] in this paper the author present the suitable network scheme and the stability analysis of this framework which will develop the control over the inherent electromechanical oscillatory dynamics which we will observe in the power systems. As this system is found to be limited probability for the data dropout in the computation and the stability margin. Thus the results obtained from this study are being very useful for the specification of requirement for the communication infrastructure.

DiptarghaChakravortyet.al [12] in this study the author presents the small signal stability analysis for the distribution works which have electric springs (ESs) that are install in customer supply points. The main aim of these electrical springs is that they will produce only the reactive compensation. Thus the effect of distance over the electrical springs is in between the adjacent ESs & R/X ratio of network in smaller signal of system ad this is analyzes& compare by equivalent DG inverters case. Thus to validate the collective operation of electrical springs we perform the simulation of study on the standard distribution network.

M. Ayaret.al.[13]in this the author proposed a study for the investigation of increase in deployment of information technologies and also the lower inertial renewable energy resources in the smart grid fuels which have the various uncertainties and also reveal about the several security issues. Thus by the simulation results obtain we can validate the feasibility of this proposed work and the robust nature.

Petros Aristidou et.al.[14]in this system the deficiency of intelligent learning and the adaptation abilities of control method is discussing in the general control schemes, and also reveal the requirement for the rapid expert intervention in the controlling on non-linear systems. As the controller proposed in this study having very simple structure and it also contain only single input variable, three rule and the four design parameters.

6. CONCLUSION

In this paper we explain about the sliding mode controller and related theory in brief. Here we also identify the equation of induction motor control so that we can use them in our control techniques. Thus designing of the controller gain and the bandwidth by taking the several factors like rotor resistance variation, model in accuracies, and also to have an ideal speed tracking. Here we consider the case of load disturbance, and module the responses of SMC to get the satisfactory performance. This system also provides the better trajectory tracking performance.

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