Abstract

It is very important to understand every aspect of the topic clearly to achieve the objective of the thesis successfully. The aspects that are to be taken care of in the chronology are the source of renewable energy, components used like proper converters and their control design, maintaining the power quality by harmonic reduction on grid connection as well as practical implementation and then finally heading to the achievement of ultimate proposed design.

In the present thesis different topologies has been developed and discussed in detail. The thesis presents a PV integrated grid system the use of series compensation under PSC, has possibly eliminated harmonics and improved voltage profile. The obtained results were compared with the standard and the existing reports. It was found that these results have not only mitigated significant number of harmonics but also regulates wider voltage variations. The experimental results of the prototype have also been presented to verify the simulated outputs. The three switching angles performance was equivalent to nine switching angles per quarter cycle in reducing harmonics, resulting in lower losses and improved system efficiency. A piecewise mixed-model approach has been used to store angles offline in the micro-controller for the online applications. Its application can be found in large power plants for effective control of output voltage as well as output harmonics. This research can be helpful in improving the quality of life in the remote grid-secluded regions.

Subsequently the thesis has introduced a topology based on harmonic suppression using the SAR-based optimization technique. A comparison of different optimization technique has been carried out in which SAR outperformed. The scheme deals with just three switching angles per half cycle, hence contributing to lower converter losses and an increase in system utility. The proposed series compensation has supported drastically eliminating lower-order harmonics and massively suppressing the higher-order harmonics. Also, a comparative analysis has been carried out with different literature and it was found that the present scheme has improved performance over others to achieve the aims mentioned. Also, at low wind speeds and wide voltage variations, it maintains the voltage on the grid. The results of the lab prototype corroborate the simulation results of the proposed scheme.

Further, a PV-Wind hybrid model was introduced in which MWOA optimization technique was used. It reduces the lower and higher-order harmonics obtained at the stator and rotor side of the DFIG system. The best performance of all was that of MWOA, considering factors such as

convergence time, minimum THD possible, etc. The angles obtained from the evolutionary techniques were stored offline in the microcontroller memory for online usage. Here, five switching angles gave equivalently good results as that of seven switches. A test system was also modelled for this scheme. Also, the other part of the chapter deals with the purpose of controlling the converters at higher wind speed. The aim was to achieving constant generated voltage at different wind speed was obtained. GWO search based algorithm was used to find out the angles for SHEPWM inverters. This paper also achieves the purpose of harmonic mitigation efficiently by the implementation of SHEPWM technique at any wind speed within the speed limit. This paper successfully achieves the purpose of controlling the converters at high wind speed and has satisfactorily met every aspect

Proper converters are required for the efficient conversion of DC to AC. Therefore, lastly a detailed comparative analysis of different switching methods for inverters was carried out to analyze which outperforms for the PV integrated microgrid system. For SHEPWM and CHB-MLI H-bridge inverters, GWO switching scheme works better for removing undesirable harmonics. The controller adjusts itself with the variation in load. The proposed method shows benefits in terms of power quality and switching frequency and the complex circuit designs thus, reducing the overall costing. Later, a comparison of PSO and GWO algorithms has been done on the basis of smoother and faster convergence, efficiency, THD minimization, and harmonic compensation etc. for calculation of optimum switching angled for minimum THD for three-levelled inverter. GWO outperformed PSO under wide range of modulation index for three levelled inverters. The switching angles are calculated offline by PSO and GWO technique and hence stored in controller memory in the form of look up table. The study has been carried out using MATLAB simulation.