Efficient Choice of a Five Level Inverter for Integration of Hybrid Wind-Solar System

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ABSTRACT

The idea proposed in this work consists of improving the quality of the energy supplied by the hybrid system (wind-solar) to the network via multilevel inverters. By increasing the inverter level, we reduce the harmonics of the current supplied to the network and the torque ripples. Connecting multiple PV panels to the power grid via multi-level inverters improves power quality by reducing total harmonic distortion (THD). The results under Matlab/Simulink environment will be presented and analyzed.

Keywords: Hybrid System, Multilevel inverter, Total harmonic distortion (THD)

1 Introduction

Renewable energy sources (solar or wind) apparently constitute essential solutions to current energy and geostrategic problems. The work proposed in this article consists of improving the quality of the electrical energy supplied to the network by the hybrid system (wind and solar). These two energy sources are complementary in nature (see figure 1).

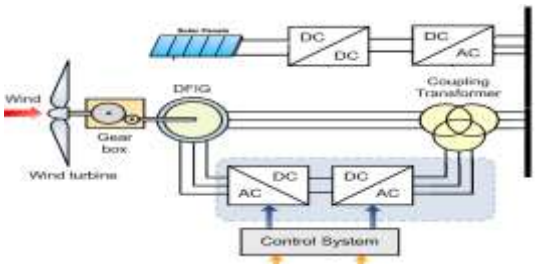

Figure 1: *Hybrid PV–Wind Turbin System*

Indeed, the connection of photovoltaic panels to the electrical network through multi-level inverters reduces considerably total harmonic distortions (THD) and improves the quality of the electrical energy produced, which allows to increase the power delivered by the PV generator. For the wind turbine, systems we can get an improved system responses by reducing the harmonics of the stator current delivered to the grid and reduces the torque ripples [1].

2 Methodology

The diagram block using DC/DC power converter with an adequate MPPT control algorithm follows the climatic changes of the irradiation with a remarkable speed and the proposed P&O technique ensures dynamic performance during an abrupt change in climatic conditions and ensures the maximum power supplied by the PV generator. The modelling of the NPC five-level inverter is as follows: The phases of the NPC inverter has five levels, each consisting of 8 controlled switches, unidirectional in voltage and bidirectional in current. They form combinations of an antiparallel transistor and diode and 6 holding diodes connected along the DC bus [2]. A continuous source E powers the inverter. The latter has 4 identical capacitors to form 4 separate voltage sources of value E/4. The three-phase structure of the NPC inverter has 5 levels [3]. The wind system Fed by multilevel inverters based on a DFIG, driven by a variable-speed wind turbine. The objective is to model the wind generator and to design a nonlinear control algorithm

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allowing control of the active and reactive stator powers of the DFIG independently. A three-phase NPC inverter with five-level structure ensures the DFIG feeding.

3 Results and Discussion

In the simulation, efficiency of the proposed separate power controller of DFIG-based wind system for two structures, the first when the DFIG is powered by a PWM inverter two-level and the second powered by a five-level inverter has been considered. The results are illustrated in the left of Figures 2 and 3. The powers perfectly follow their references for the two structures but the current delivered by the second structure presents a lower harmonic rate (THD %) than the first. In the right of the figures 2 and 3, the torque delivered by the DFIG powered by a five-level inverter has fewer oscillations (ΔT_e) than the conventional structure (see Table 1).

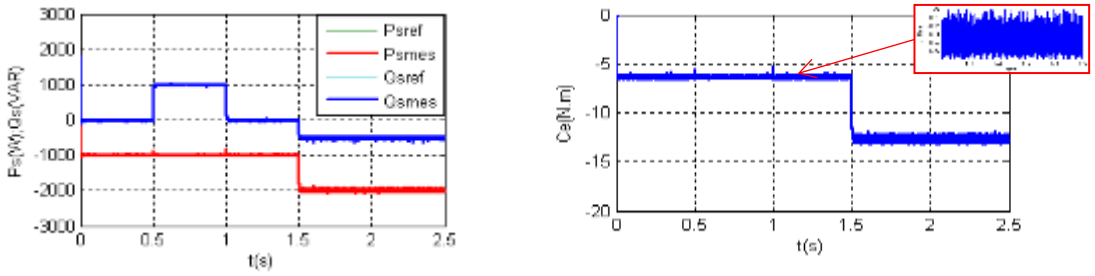

Figure 2: *DFIG Power by two levels inverter. Left - active powers; right - reactive powers*

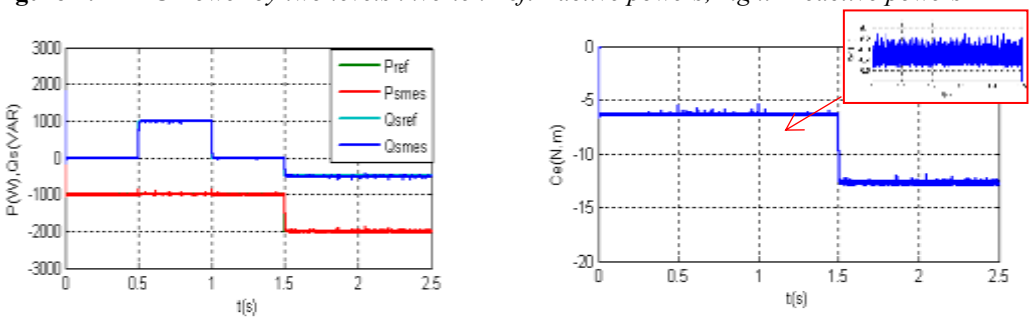

Figure3: *DFIG Power by five levels inverter. a- active powers; b- reactive powers*

Table 1: *Comparison of the Stator Current THD%*

Inverter	**2 Level**	**5 Level**
THD%	1.93	0 .9 8
ΔT_e(N.m)	0.6	0.25

4 Conclusion

The five level inverter reduces the (THD), of PV stations connected to the electric grid, thus improving the quality of energy and makes possible to increase the power delivered by the PV generator. The obtained results show that there are less harmonics in the current injected into the network and less oscillations in the torque, when the level of the inverter supplying the DFIG on the rotor side is higher.

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