Comparison Study between SVM and PWM Inverter in Sliding Mode Control of Active and Reactive Power Control of a DFIG for Variable Speed Wind Energy

Youcef Bekakra*, Djilani Ben Attous*

*Department of Electrical Engineering, University of El-Oued, P.O. Box 789, El-Oued 39000,

‡ Corresponding Author; Youcef Bekakra,University of El-Oued, Algeria, 213699098988,
youcef1984@gmail.com, dbenattous@yahoo.com

Received: 15.06.2012 Accepted:16.07.2012

Abstract- In this paper, we present a comparative study between space vector modulation (SVM) and pulse width modulation (PWM) inverter in sliding mode control (SMC) of active and reactive power control of a doubly fed induction generator (DFIG) for variable speed wind energy. The feasibility and effectiveness of the two methods are demonstrated by simulation results. The obtained results showed that, the proposed SMC with SVM inverter have stator and rotor current with low harmonic distortion and low active and reactive powers ripples than PWM inverter.

Keywords- Doubly Fed Induction Generator, Wind Energy, Sliding Mode Control, Space Vector Modulation, Pulse Width Modulation.

1. Introduction

The most important advantages of the variable speed wind turbines as compared with conventional constant speed system are the improved dynamic behavior, resulting in the reduction of the drive train mechanical stress and electrical power fluctuation, and also the increase of power capture [1]. One of the generation systems commercially available in the wind energy market currently is the doubly fed induction generator (DFIG) with its stator winding directly connected to the grid and with its rotor winding connected to the grid through a variable frequency converter. One of the most advantages of this system is that the rating of the power converter is one third of that of the generator [2]. With DFIG, generation can be accomplished in variable speed ranging from sub-synchronous speed to super-synchronous speed [3].

Through studying the characteristics of wind turbine, the paper proposed the maximum power point tracking (MPPT) control method. Firstly, according to the DFIG character, the paper adopts the vector transformation control method of stator oriented magnetic field to realize the decoupling control for the active power and reactive power using sliding mode control (SMC).

The sliding mode control theory was proposed by Utkin in 1977 [4]. Thereafter, the theoretical works and its applications of the sliding mode controller were developed. Since the robustness is the best advantage of a sliding mode control, it has been widely employed to control nonlinear systems that have model uncertainty and external disturbance [5].

Traditionally the sinusoidal pulse-width modulation (SPWM) technique is widely used in variable speed drive of induction machine, especially for scalar control where the stator voltage and frequency can be controlled with minimum online computational requirement. In addition, this technique is easy to implement. However, this algorithm has the following drawbacks. This technique is unable to fully utilize the available DC bus supply voltage to the VSI. This technique gives more total harmonic distortion (THD), this algorithm does not smooth the progress of future development of vector control implementation of ac drive.