Implementation of the Maximum Power Point Tracking Algorithm on Indirect Matrix Converter Controlled DFIG wind Turbine

Ahmad Khajeh
Faculty of Electrical and Computer Engineering
University of Sistan and Baluchestan
Zahedan, Iran
akhajeh@ece.usb.ac.ir

Reza Ghazi
Faculty of Engineering
Ferdowsi University of Mashhad
Mashhad, Iran
rghazi@um.ac.ir

Mohamad Hosseini Abardeh
Islamic Azad University of Shahrood
Shahrood, Iran
mohamad.hosseini1@gmail.com

Abstract— **Nowadays, the doubly-fed induction generators (DFIG) based wind turbines (WT) are the dominant type of WT connected to power systems having MW power range. Traditionally the back-to-back converters are used to excite the rotor circuit of DFIG. In this paper, instead an Indirect Matrix Converter (IMC) is used to control the generator. Compared with back-to-back converters, IMCs have numerous advantages such as: higher level of robustness, reliability, reduced size and weight due to the absence of bulky electrolytic capacitor. Maximum Power Point Tracking (MPPT) is an important issue in wind turbines to capture the maximum power from the wind. A laboratory scale prototype of DFIG wind turbine controlled by the IMC is manufactured. Experimental results confirm the effectiveness of the proposed method.**

Keywords-Wind turbine, DFIG, Indirect matrix converter, MPPT

I. INTRODUCTION

One of the main resources of the renewable energy in the power systems is the wind power. Reports indicate that the cumulative installed capacity of the wind power throughout the world has been reached to the 370GW up to end of 2014 year. Due to their superior characteristics, most of the grid-connected WTs operate at a variable speed. Among the different variable speed types, the DFIG is the most promising one. The stator winding of DFIG is directly connected to the grid, while the rotor winding is connected to the grid through an ac-ac power electronic converter having bidirectional switches. Traditionally the back-to-back converters are used to excite the rotor circuit of DFIG. The presence of dc-link capacitor in this arrangement is a serious drawback as increases the costs and reduces the overall lifetime of the system and also makes the system bulky.

In this paper, the back-to-back converter arrangement is replaced by an indirect matrix converter (IMC) to control the generator. The main advantages of a matrix converter are: robustness, reliability with less size and weight due to the absence of the bulky electrolytic capacitor, controllable input power factor, nearly sinusoidal input current and output voltage with only switching frequency harmonics, along with bidirectional power flow. The direct matrix converter (DMC) encounters the commutation problems requiring a complex control circuitry. While in IMC all switches at the line side will turn on and off at zero current, so the commutation problems are eliminated [1]. Therefore, the IMCs are the most promising devices for wind energy applications regarding their robustness, reduced size and reliability concerns. Consequently, in this paper indirect matrix converter is used as power electronics converter instead of commonly used back-to-back converter as shown in Fig 1.

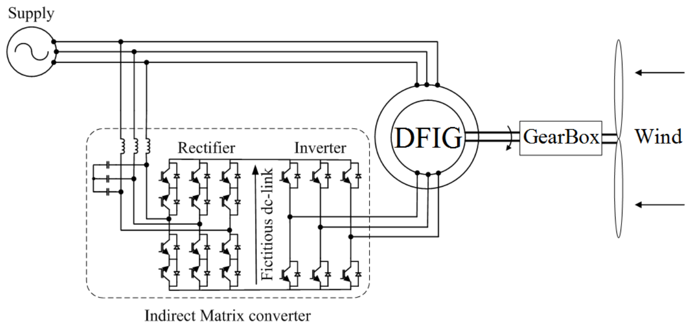

Fig 1. Wind Turbine based on the DFIG excited by IMC

Utilizing matrix converters in DFIG wind turbines is still in research phase [2]-[4]. The control of a DFIG using an indirect matrix converter, for dynamic performance evaluation under normal grid condition is presented in [2]. Sigma-delta modulator to control IMC switches of DFIG based WT is proposed in [3]. By using this modulation method, torque pulsations and harmonic content of currents are reduced. Therefore, the power quality of WT is improved. The

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