II-11. DIRECT POWER AND TORQUE CONTROL SCHEME FOR SPACE VECTOR MODULATED AC/DC/AC CONVERTER-FED INDUCTION MOTOR

M. Jasinski, M. P. Kazmierkowski and M. Zelechowski
Warsaw University of Technology, Institute of Control & Industrial Electronics, ul. Koszykowa 75, 00-662 Warszawa, mja@isep.pw.edu.pl, mpk@isep.pw.edu.pl, zelechom@isep.pw.edu.pl WWW: http://www.ee.pw.edu.pl/icg

Abstract. A novel control scheme for PWM rectifier-inverter system is proposed. Fast control strategies such as line voltage Sensorless Virtual Flux (VF) based Direct Power Control with Space Vector Modulator (DPC-SVM) for rectifier and Direct Torque Control with Space Vector Modulator (DTC-SVM) for inverter side are used. These strategies lead to good dynamic and static behaviour of the proposed control system—Direct Power and Torque Control- Space Vector Modulated (DPTSVM). Simulations and experiment results obtained show good performance of the proposed system. Additional power feedforward loop from motor to rectifier control side improved dynamic behaviours of the power flow control. As a result, better input-output energy matching allows decreasing the size of the dc-link capacitor

Introduction

The adjustable speed drives (ASD) with diode rectifier nowadays is the most popular on the marked. Large electrolytic capacitor is used as an energy-storing device to decouple rectifier and the inverter circuits. The capacitors have some drawbacks: low reliability, high size, weight and cost. Hence, reliability of the dc-link capacitor is the major factor limiting the lifetime of the ASD systems [1].

Development of control methods for Pulse Width Modulated (PWM) boost rectifier (active rectifier) was possible thanks to advances in power semiconductors devices and Digital Signal Processors (DSP). Therefore, the Insulated Gate Bipolar Transistors (IGBT) AC/DC/AC converter controlled by PWM is used in motor drive systems (Fig.1). Thanks to active rectifier the dc-link capacitor can be reduced [2]. Farther reduction of the capacitor can be achieved by power feedforward loop from motor side to the control of the PWM rectifier. A lot of works are given attention to reduce the dc-link capacitor. However, a small capacitance leads to a high dc-voltage fluctuation. To avoid this drawback various dc-voltage control schemes have been proposed. Some of them take into account the inverter dynamics

S. Wiak, M. Dems, K. Komęza (eds.), Recent Developments of Electrical Drives, 261–274. © 2006 Springer
to improve the PWM rectifier current control by feedback linearization [3] and master-slave [1] manner. Another control methodology proposed a fast dc-link voltage controller which works with dc-voltage and motor variables as inputs [4]. Moreover, various methods of the output power estimation have been discussed in [5].

In the mentioned methods active and reactive powers of the PWM rectifier are indirectly controlled via current control loops. Besides, stator current controllers control the torque and flux of the motor too.

In this paper a line voltage sensorless Virtual Flux (VF) based Direct Power Control with Space Vector Modulator (DPC-SVM) is applied to control of the PWM rectifier.

The inverter with induction motor is controlled via Direct Torque Control with Space Vector Modulator (DTCSVM). Contrary to the scheme proposed in [6], our solution includes not stator flux controller but space vector modulator.

Hence, an AC/DC/AC converter of Fig. 1, is controlled by Sensorless Direct Power and Torque Control-Space Vector Modulated (DPT-SVM) scheme. In comparison to methods that control an active and reactive power, torque and flux in indirect manner the coordinates transformation and decoupling are not required. Moreover, the current control loops are avoided.

In respect of dynamic, of dc-voltage control the power balance between line and motor is very important. Therefore, to improve instantaneous input/output power matching, the additional feedforward power control loop is introduced.

Thanks to better control of the power flow the fluctuation of the dc-link voltages will be decrease. So the size of the dc-link capacitor can be reduced.