International Conference on Recent Trends in Engineering Science and Technology (ICRTEST 2017) ISSN: 2321-8169
Volume: 5 Issue: 1(*Special Issue 21-22 January 2017*) 288 - 290

Review Paper on a Quasi-Z-Source Direct Matrix Converter

Miss. Mona Mahajan, Mr. Nikhil Wanjari
[1]PG student, [2]Asst.Professor Dept. Of Electrical Engineering
Wardha,India
monamahajan27@gmail.com, wanjarinikhil1@gmail.com

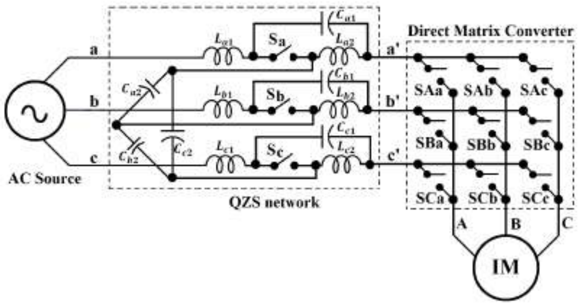
***Abstract*:-**This paper proposes a novel four-quadrant vector controlled induction motor (IM) adjustable speed drive (ASD) system based on a recently proposed matrix converter topology called quasi-Z-source direct matrix converter (QZSDMC). The QZSDMC is formed by cascading the quasi-Z-source impedance network and the conventional direct matrix converter (DMC). The QZSDMC can provide buck-boost operation with voltage transfer ratio controlled by controlling the shoot-through duty ratio and bidirectional operation capability. The control strategy, which is based on the indirect field oriented control algorithm, is able to control the motor speed from zero to the rated value under full load condition during motoring and regenerating operation modes.

Index Terms-*Direct matrix converter(DMC),Quasi Z-source converter (QZSC),Quasi Z-source Direct Matrix Converter (QZSDMC)*

*****

I. INTRODUCTION

The use of variable speed motor drives is a growing trend in industrial and automotive applications, guaranteeing high efficiency, increased energy saving, and higher versatility and flexibility. The back-to-back converter, which is formed by tying two VSI bridges together at their shared dc-link, is commonly applied in many motor drive applications. the back-to-back converter still has limitations since it requires a large capacitor in the dc-link and a heavy filter inductor at the input terminals. The drawbacks of conventional back-to-back converters are high cost, large size, heavy weight, relatively high energy losses, and sensitivity toward electromagnetic interference. The matrix converter is an attractive alternative to the back to-back converter because it can convert an ac voltage directly into an ac output voltage of variable amplitude and frequency without the need for an intermediate dc-link and capacitor. Furthermore, because of a high integration capability and higher reliability of the semiconductor devices, the matrix converter topology is a better solution for extreme temperatures and critical volume/weight application. Matrix converters can be divided into two categories: the DMC and IMC. The DMC performs the voltage and current conversion in one stage (direct) power conversion while the IMC features a two-stage (indirect)power conversion. The DMC and IMC circuit topologies are equivalent in their basic functionality. The difference in the categories. Therefore, the DMC will be investigated within this paper as a candidate topology to achieve highest conversion efficiency.



II. LITERATURE REVIEW

In this paper, a new power-circuit configuration for four-level inversion with an open-end winding induction motor is proposed. This configuration is suitable for an induction motor with 6n (n = 1, 2, . . .) number of poles. Two isolated dc power supplies, each rated for one third of the total dc-link voltage, are sufficient to realize this four-level inverter scheme. It is shown that it is possible to produce a voltage vector of 1-p.u. magnitude with a total dc-link voltage of 0.66 p.u., indicating that the dc-link utilization is enhanced by a factor of 33% with this power-circuit configuration. In the proposed power circuit, the zero-sequence current is arrested as the motor phase windings of the open-end winding induction motor are segmented into two separate groups in the ratio of 2 : 1, with one end of each group forming an isolated neutral point. Each phase group is then powered by two individual two-level inverters with two separate dc-power supplies with a common negative rail. The existence of this common negative rail is the principal cause of an increased dc-bus utilization. A simple decoupled space-vector pulse width modulation is adequate to control both of these inverters, which further demonstrates the simplicity of the drive control.[1]

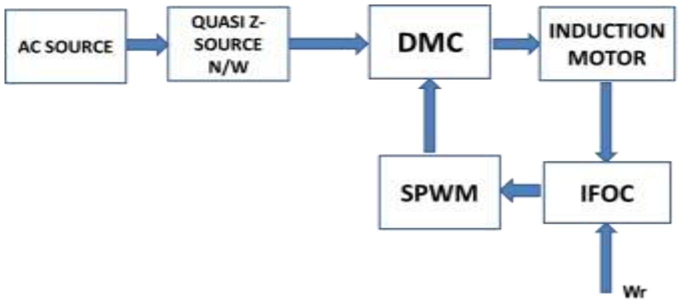
A proposal for a two-stage bidirectional electric drive for hybrid electric vehicle is presented in this paper. The system comprises a synchronous PM electrical machine (EM)directly connected to a Diesel internal combustion engine. The EM is fed by a three-level active neutral point clamped (ANPC) inverter connected to a bi-directional multi-phase interleaved DC/DC converter interfacing the high voltage dc-link with a low voltage battery. The electric drive design issues, control topics and the power converter prototype description are reported in this work. Simulation and experimental results are based on a prototype test bench, composed by two external rotor permanent magnet synchronous machines with the same speed/torque/power rating and connected to the same shaft, intended to emulate a hybrid traction system. The drive system is controlled by multiple digital signal controllers based on TMS320F28035 DSP.[2]

The matrix converter (MC) and the Vector Switching Converter (VeSC) are employed as the building block in order to assemble a couple of dynamic voltage restorers (DVR). Their operating principles are reviewed and their performances under sag events are studied. Results are presented on small-scale prototypes.[3]

In this paper, a new T-type inverter topology based on multi-state switching cell is proposed. The topology presents five-levels voltage before of output LC filter, providing high order harmonics that are easily filtered. In this topology, the output filter ripple frequency is twice the switching frequency, therefore reducing the magnetic weight and volume. Other characteristics of the inverter are current sharing through the devices, facilitating its losses dissipation, due to increased contact area and few involved components in the current flow path. In order to verify its feasibility, a design example as well as experimental results for a 5 kW prototype is presented in this work.[4]

This paper proposes a novel dynamic voltage restorer(DVR) topology based on reduced-order matrix converter modules. The topology utilizes two modules for selective and independent sequence voltage synthesis. As a result, the DVR proposed herein can compensate for balanced as well as unbalanced voltage sags/swells. Each module is realized using a vector-switching matrix converter. The entire topology is energy storage free, and each module is pulse width modulated using simple dc duty ratios. This paper provides details on the DVR modeling, equivalent circuit, and feedback controller design. Thorough computer simulations and experimental prototyping are used to validate the approach.[5]

III. PROPOSED METHODOLOGY



The control block diagram of the IM drive system with QZSDMC .The speed encoder detects the rotor speed to compare it with the reference speed. The speed controller, a PI regulator, deals with the speed error and generates the required torque reference. The IFOC block generates the modulation signals, *v*abc, according to the operating conditions during different operating modes. The ST duty ratio, *D*, is designed according to the corresponding voltage gain *(G)* and output voltage can be obtained to meet the desired voltage value. The carrier based modulator generates the gating signals for the DMC and the additional switches in the QZS-network.. The QZSDMC-IM ASD system simulating model is tested during the motoring and regenerating operation modes .The system ability to perfectly track the speed and load torque references during different operation modes.

MATRIX CONVERTER

Matrix converters are based upon an association of nine bi-directional switches with turn-off capability, which allow the connection of each one of the three output phases to any one ofthe three input phases connected to a PMSM through a*rlC*filter. A nine–element matrix, with elements *Sij* representing the state of each bi-directional switch, is used to represent the matrix output voltages (*vA*, *vB*, *vC*) as functions of the input voltages(*va*, *vb*, *vc*).

$$\begin{bmatrix} v_A \\ v_B \\ v_C \end{bmatrix} = \begin{bmatrix} S_{11} & S_{12} & S_{13} \\ S_{21} & S_{22} & S_{23} \\ S_{31} & S_{32} & S_{33} \end{bmatrix} \begin{bmatrix} v_a \\ v_b \\ v_c \end{bmatrix}$$

The line to line output voltages (*vAB*, *vBC*, *vCA*) are functions of the *Sij*and of the input line toline voltages (*vab*, *vbc*, *vca*):

$$\begin{bmatrix} v_{AB} \\ v_{BC} \\ v_{CA} \end{bmatrix} = \begin{bmatrix} \frac{2}{3}(S_{11}-S_{21})+\frac{1}{3}(S_{13}-S_{23}) & \frac{1}{3}(S_{11}-S_{21})+\frac{2}{3}(S_{12}-S_{22}) & \frac{1}{3}(S_{12}-S_{22})+\frac{2}{3}(S_{13}-S_{23}) \\ \frac{2}{3}(S_{21}-S_{31})+\frac{1}{3}(S_{23}-S_{33}) & \frac{1}{3}(S_{21}-S_{31})+\frac{2}{3}(S_{22}-S_{32}) & \frac{1}{3}(S_{22}-S_{32})+\frac{2}{3}(S_{23}-S_{33}) \\ \frac{2}{3}(S_{31}-S_{11})+\frac{1}{3}(S_{33}-S_{13}) & \frac{1}{3}(S_{31}-S_{11})+\frac{2}{3}(S_{32}-S_{12}) & \frac{1}{3}(S_{32}-S_{12})+\frac{2}{3}(S_{33}-S_{13}) \end{bmatrix} \begin{bmatrix} v_{ab} \\ v_{bc} \\ v_{ca} \end{bmatrix} \quad (25)$$

Each *Sij*element of the 3×3 matrix represents the state of each bi-directional switch (if switch

*Sij*is off then *Sij*=0, else *Sij*=1).

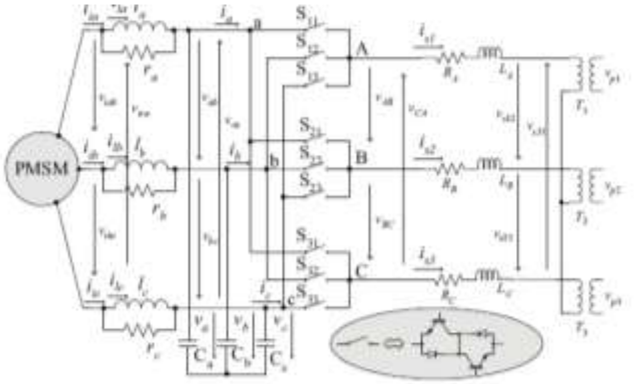


Fig. Matrix converter topology.

IV. CONCLUSION

New four-quadrant vector controlled IM ASD system based on the QZSDMC topology. The proposed system overcomes the reduced voltage transfer ratio limitations of traditional DMC-based ASD system, therefore, the proposed QZSDMC-IM-based ASD will increase the application of the DMC in different industry fields The proposed ASD system can operate at full load with small QZS network elements. The QZSDMC can achieve buck and boost operation with reduced number of switches needed, therefore achieving low cost, high efficiency, and reliability, compared with the traditional DMCs, in addition, there is no requirement of dead time with QZS-network, hence commutation of the QZSDMC is easier than the traditional DMC The proposed ASD system can provide a voltage gain larger than one and can operate in motoring and regenerating operation modes with perfect references tracking as verified by MATLAB simulation.

REFERENCES

[1] V. T. Somasekhar, Member, IEEE, Barry Venugopal Reddy, and K. Sivakumar, Member, IEEE "A Four-Level Inversion Scheme for a 6n-Pole Open-End Winding Induction Motor Drive for an Improved DC-Link Utilization" IEEE TRANSACTIONS ON INDUSTRIAL ELECTRONICS, VOL. 61, NO. 9, SEPTEMBER 2014

[2] Silverio BOLOGNANI, Mattia MORANDIN Department of Industrial Engineering Sandro CALLIGARO, Roberto PETRELLA, Alessandro PEVERE Department of Electrical, Management and Mechanical Engineering (DIEG), University of Udine (Italy) edlab@uniud.it978-1-4799-2325-0/14/$31.00 ©2014 IEEE. "Bidirectional PMSM Drive Employing a ThreeLevel ANPC Inverterand a Multi-Phase Interleaved DC/DC Converter for Hybrid Electric Vehicles"

[3] Ronny G. A. Cacau, René P. T. Bascopé, João A. F. NetoGrover V. T. Bascopé 0093-9994 (c) 2013 IEEE. Personal use is permitted, but republication/redistribution requires IEEE permission."Five-Level T-Type Inverter Based on Multi-State Switching Cell"

[4] Juan M. Ramirez, Member, IEEE, Pedro Garcia-Vite, Jose M. Lozano, and Fernando Mancilla-David. 978-1-4673-2729-9/12/$31.00 ©2012 IEEE "Dynamic voltage restorers based on AC-A topologies"

[5] Pedro M. Garcia-Vite, Fernando Mancilla-David, and Juan M. Ramirez, Member, IEEE IEEE TRANSACTIONS ON INDUSTRIAL ELECTRONICS, VOL. 60, NO. 12, DECEMBER 2013. "Per-Sequence Vector-Switching Matrix Converter Modules for Voltage Regulation"

[6] J. D. van Wyk and F. C. Lee, "On a future for power electronics," IEEE J. Emerging Sel. Topics Power Electron., vol. 1, no. 2, pp. 59–72, Jun. 2013.

[7] S. Bhowmik and R. Spee, "A guide to the application-oriented selection of AC/AC converter topologies," IEEE Trans. Power Electron., vol. 8, no. 2, pp. 156–163, Apr. 1993.

[8] T. Friedli, J. W. Kolar, J. Rodriguez, and P. W. Wheeler, "Comparative evaluation of three-phase AC-AC matrix converter and voltage DC-link back-to-back converter systems," IEEE Trans. Ind. Electron., vol. 59, no. 12, pp. 4487–4510, Dec. 2012.

[9] S. K. Maddula and J. C. Balda, "Lifetime of electrolytic capacitors in regenerative induction motor drives," in Proc. IEEE Power Electron.Specialists Conf., Jun. 2005, pp. 153–159.

[10] P. W. Wheeler, J. Rodriguez, J. C. Clare, and L. Empringham, "Matrix converters: A technology review," IEEE Trans. Ind. Electron., vol. 49, no. 2, pp. 274–288, Apr. 2002.

[11] M. Jussila and H. Tuusa, "Comparison of direct and indirect matrix converters in induction motor drive," in Proc. 32nd Annu. Conf. IEEEInd. Electron., Nov. 2006, pp. 1621–1626.