SPEED CONTROL OF THREE PHASE INDUCTION MOTOR USING PREDICTIVE TORQUE METHOD

Ms. P.M.Sneha Angeline[1],N.Haripriya[2],S.Kalaivani[3],V.Kowsalya[4] and M.Sowmya Bharathi[5]

Assistant Professor[1],UG Scholar [2,3,4,5] ,Department of EEE,

KPR Institute of Engineering and Technology, Coimbatore.

kprprojectbatch9@gmail.com

ABSTRACT

Our paper deals with the four-switch three-phase (B4) inverter, having a reduced number of switches, was designed for the possibility of reducing the inverter cost but if has more benefits than expected as it can be utilized in fault-tolerant control to solve the open and short-circuit fault of the six-switch three-phase (B6) inverter. However, due to imbalance of the phase current causes fluctuation of two dc link capacitor voltages; therefore, its application is limited. This can be overcome with a predictive torque control (PTC) scheme for the B4 inverter-fed induction motor (IM) with the offset suppression of dc link voltage. The three-phase currents are made to be balanced by simply controlling the stator flux With the predictive view, the voltage offset of the two dc-link capacitors is modeled and controlled. The vectors voltage of the B4 inverter under the fluctuation of the two dc-link capacitor voltages are taken for prediction precisely and control of the torque and stator flux using genetic algorithm.

Key words: B4 inverter, fluctuation, predictive torque

INTRODUCTION

DIRECT TORQUE CONTROL STRATEGIES

Currently and more than two decades of investigation, several DTC strategies have been proposed so far. These could be classified within four major categories: 1) strategies considering variable hysteresis band controllers; 2)strategies with space vector modulation (SVM)-based control of the switching frequency 3) strategies using predictive control. Schemes and 4) strategies built around intelligent control approaches. Nevertheless, the gained performance is allied to significant increase of implementation schemes. Commonly, the voltage source inverter (VSI) feeding IM under DTC is the six switch three-phase inverter (B6). This said, some applications such as electric and hybrid propulsion systems should be as reliable as possible. Within this requirement, the reconfiguration of the B6 into a four-switch three phase inverter (B4), in case of a switch/leg failure, is currently given an increasing attention. A DTC strategy dedicated to B4-fed IM drives has been proposed. In spite of its simplicity, this strategy is penalized by the low dynamic and the high ripple of the torque. These drawbacks are due to the application of unbalanced voltage vectors to control flux and torque with a subdivision of the Clarke plane limited to four sectors. Recently, an attempt to discard the previously described disadvantages has been proposed in where a DTC scheme using a 16-sectorvector selection table has been implemented.

B4 PERFORMS DTC SCHEMES

It has been noted that the drive performance remains relatively low due to the increase of the CPU time which is linked to the complexity of the involved vector selection table. In order to achieve a constant switching frequency and to decrease the torque ripple, many DTC schemes based on SVM, using the B4 as a VSI, dedicated to control induction and permanent-magnet synchronous motor have been reported in the literature. These strategies offer high performance in

terms of torque ripple reduction allined to the control of the inverter switching losses. However, these performances are compromised by the complexity of their implementation schemes

PREDECTIVE TORQUE CONTROL

With the development of fast and powerful microprocessors ,increasing attention has been dedicated to the use of model predictive control (MPC) in power electronics. The main concept is based on calculating the system's future behavior to obtain optimal values for the actuating variables. With this intuitive concept, predictive control can be applied to a variety of systems, in which constraints and nonlinearities can be easily included, multivariable case can be considered, and the resulting controller is easy to implement. These features render the approach very attractive and effective for the control of power electronics system, including drive control, especially predictive torque control (PTC).

UNIQUE FEATURES

Our project deals with predictive torque control. The predictive torque control is based on pre-calculation of the best switching state in order to keep the state variables close to desired values. The control scheme uses a proportional-integral controller inside of predictive control in order to improve the steady state response. The stator flux that determines the stator voltage is pre-calculated by means of predictive torque control in order to remove the need for speed sensor.

BLOCK DIAGRAM

PROPOSED SYSTEM

In this proposed idea, the fuzzy logic is replaced by Genetic algorithm. Genetic algorithm has following merits. It can solve every optimization problem.It solves problem with multiple solutions. Genetic algorithms are easily transferred to existing simulation and models.

FOUR SWITCH THREE PHASE INVERTER MODEL

Here, the Figure 1 shows the power circuit of four switch inverter fed Induction motor drive. A three phase system is obtained by connecting the phase 'c' terminal of the stator windings directly to the centre tap of the DC link capacitors. The single phase AC supply is rectified by the front-end rectifier. The capacitors are used to level the output DC voltage.

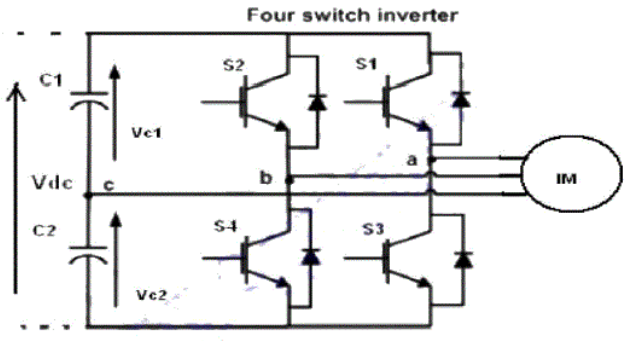

Figure 1 Power circuit of the drive system

The voltage vectors of the B4 inverter under the fluctuation of the two dc-link capacitor voltages are derived for precise prediction and control of the torque and stator flux. The balanced three-phase currents are achieved and the capacitor voltage offset is suppressed in the proposed scheme. The theory ,design ,and performance evaluation of the proposed scheme for the B4 IM drive are investigated. The proposed B4 IM drive has been found acceptable for high performance industrial variable speed-drive applications considering its cost reduction and other inherent advantageous features.Certainly, the additional work is still remained to develop more efficient PTC scheme and gives solution for the robustness toward parameter deviation, parameter sensitivity of this scheme, for the parameter values may vary in the motor drives, while in other cases it is difficult to get a precise value of the parameters.

SIMULATION RESULT

These values are obtained by a simulation-based heuristic procedure. In order to analyze the effects of weighting factors, extensive simulations are performed

in MATLAB/Simulink. This environment allows comparing the performance of different weighting factors. The ratings and parameters of the B4 inverter and induction machine, used in the simulation as well as in the experimental study.

TORQUE & FLUX ESTIMATOR SIMULINK BLOCK

The circuit consist of two blocks, the reference model and adaptive model. By using suitable adaptive mechanism the speed can be estimated and taken as feedback. PI controller is used to optimize the error speed.

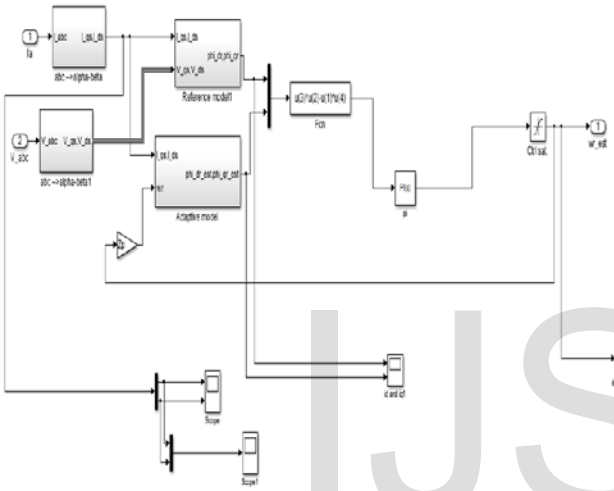

Figure 2 Torque & Flux estimator simulink block

OUTPUT WAVEFORM

X axis 1div=0.5s, Y1 axis 1div=20A, Y2 axis 1div= 50Nm, Y3 axis 1div=500Rpm

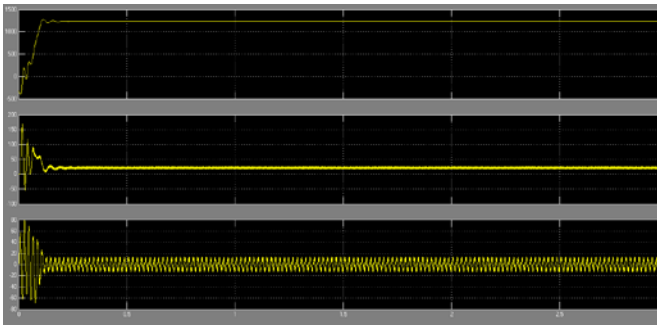

Figure 3 The output Speed, torque and current waveform of the induction motor

CONCLUSION

This paper focuses on the special issues on using the famous PTC control scheme for a B4 inverter-fed IM drives are analyzed and discussed.The voltage vectors of the B4 inverter under the fluctuation of the two dc-link capacitor voltages are derived for precise prediction and control of the torque and stator flux. The proposed B4 inverter-fed IM drive has been found acceptable for high performance industrial variable-speed-drive applications considering its cost reduction and other inherent advantageous features .We have proposed the system by replacing PI by Genetic Algorithm (GA) which increases the efficiency of the B4 inverter system and the parameters of speed ,torque and current waveform with better response have been gained, with these results the further optimized form of parameters can also be obtained.

REFERENCES

[1] J. Kim, J. Hong, and K. Nam, “A current distortion compensation scheme for four-switch inverters,” IEEE Trans. Power Electron., vol. 24, no. 3–4,pp. 1032–1040, Mar.–Apr. 2009.

[2] R. Wang, J. Zhao, and Y. Liu, “A comprehensive investigation of four switch three-phase voltage source inverter based on double Fourier integral analysis,” IEEE Trans. Power Electron., vol. 26, no. 10, pp. 2774–2787, Oct. 2011.

[3] B. El Badsi, B. Bouzidi, andA.Masmoudi, “DTCscheme for a four-switch inverter-fed induction motor emulating the six-switch inverter operation,” IEEE Trans. Power Electron., vol. 28, no. 7, pp. 3528–3538, Jul. 2013.

[4] S. Mariethoz, A. Domahidi, and M. Morari, “Sensorless explicit model predictive control of permanent magnet synchronous motors,” in Proc. IEEE Electric Machines Drives Conf., Int., 2009, pp. 1250–1257.

[5] B. A. Welchko, T. A. Lipo, T. M. Jahns, and S. E. Schulz, “Fault tolerant three-phase AC motor drive topologies: A comparison of features, cost, and

limitations," IEEE Trans. Power Electron., vol. 19,
no. 4, pp. 1108– 1116, Jul. 2004.