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SENSORLESS CONTROL OF VSI FED PMSM FOR HIGH SPEED OPERATIONS USING SVPWM METHOD

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ABSTRACT

The objective of this project is to investigate the sensorless control methods for PM Synchronous machines. A sensor less method of high speed control is proposed based on the modulation of Space Vector Pulse Width Method. The conventional control scheme has some problems such as low efficiency, low switching frequency and switching losses. In order to avoid the above mentioned problems, VSI FED PMSM sensor less control is implemented. In addition SVPWM technique provides flexible control of output voltage and output frequency for Permanent Magnet Synchronous Machines. This Space Vector Modulation is implemented to prevent the distortion due to low switching frequency. A detailed study and analysis regarding the influence of low switching frequency, frequency loss and efficiency is carried out. It is found that, by using the proposed scheme and modulation scheme and by the proper control of VSI fed PMSM can be estimated for sensor less operations. Experimental results are provided to verify the proposed control method.

Index Terms: Current-source converter (CSC), high frequency(HF) injection (HFI) methods, high-power drives, interior permanent magnet (IPM) synchronous machine, medium-voltage drives, zero-speed sensor less control methods.

INTRODUCTION

The development and availability of very high-energy density Permanent Magnet materials has contributed to an increased use of the permanent magnet synchronous motor (PMSM) in high performance applications. High-speed electric machines are of interest as direct drives for high-speed milling machines, compressors and pumps, yielding a high output power at rather small machine dimensions. The high-speed permanent magnet Synchronous motor with sinusoidal currents is the best choice for high-speed operation because of the high efficiency, low torque ripple, low noise and excellent control performance. The PMSM eliminates rotational cogging torque due to permanent magnet preferred positions, decreases core loss and thus increases efficiency, provides excellent torque to volume and power-to volume ratios and has a linear current versus torque relation. In the PMSM, in order to generate smooth torque and thus reduce noise and vibration, the current waveform should match the shape of the motor electromotive force (emf).

The Three phase voltage- fed PWM inverters are recently showing growing popularity for multi-megawatt industrial drive applications. The main reasons for this popularity are easy sharing of large voltage between the series devices and the improvement of the harmonic quality at the output as compared to a two level inverter. In the lower end of power, GTO devices are being replaced by IGBTs because of their rapid evolution in voltage and current ratings and higher switching frequency.

The Space Vector Pulse Width Modulation of a three level inverter provides the additional advantage of superior harmonic quality and larger under- modulation range that extends the modulation factor to 90.7% from the traditional value of 78.5% in Sinusoidal Pulse Width Modulation.

An Adjustable Speed Drive (ASD) is a device used to

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provide continuous range process speed control (as compared to discrete speed control as in gearboxes or multi-speed motors). An ASD is capable of adjusting both speed and torque from an induction or synchronous motor. An electric ASD is an electrical system used to control motor speed.

ASDs may be referred to by a variety of names, such as variable speed drives, adjustable frequency drives or variable frequency inverters. The latter two terms will be used to refer to certain AC systems, as is often the practice, although some DC drives are also based on the principle of adjustable frequency.

EXISTING METHODOLOGY

- Field oriented control- reduction of reliability, additional cost and sensitivity to noise and vibration.
- Sensor less algorithm based on machine model- this methods work well at medium and high speeds but speed decreases, their performance deteriorates or instability at low speed.
- High frequency injection (HFI) method- To operates at low switching frequency, the injection method could be a challenge.
- The large filter capacitor and the low switching frequency might complicate the design

EXISTING BLOCK DIAGRAM

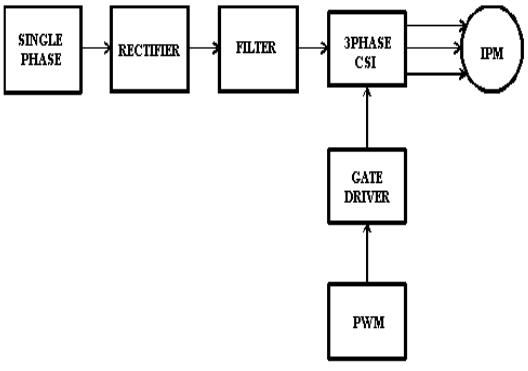

Fig:1.1 Block Diagram of Existing System

DRAWBACKS OF EXISTING METHOD

- The more number of SCR has used.
- In this unidirectional process the circuit has designs for an power generating method. The Rectifier has damaged.
- Circuit is complex. Each SCR contains follower circuit.

PROPOSED BLOCK DIAGRAM

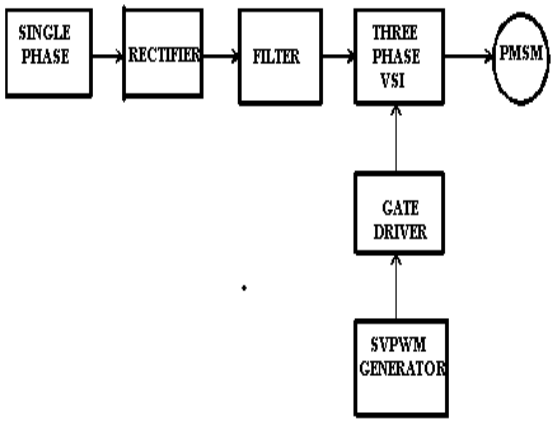

Fig:1.2 Block Diagram of Proposed System

EXPLANATION OF PROPOSED SYSTEM

The proposed system is to improve the dynamic response and reduce clamping signals. Modulation index control technique is proposed to operate PMSM motor at high frequency. SVPWM is proposed to prevent signal distortion. To enhance the dynamic response using a modulation index control with suitable dc-link current compensation technique. In addition a multisampling-space-vector-modulation method is proposed to prevent the distortion in the HF signal. The sensor less control scheme is proposed for VSI-fed PMSM drive system at high speed operation. To improve dynamic response and prevent clamp signal by using SVPWM method. The system consists of a DC source, three phase inverter, PMSM, encoder, driver circuit

and a controller for overall control. DC supply is fed to the three phase inverter. It converts DC supply into a three phase AC supply and it is given to PMSM. The output of the PMSM is measured by a sensing unit and it will be converted to mechanical motion into electronic signals using an encoder. Then it is given to the PID controller, the gain constant Kp, Ki . K_d are generated by using genetic algorithm. These values are given to the SVPWM driver and firing angle is generated it will be fed to the gate of the three phase inverter.

Advantages of Proposed Method

- High switching frequency
- Clamp signal can be avoided
- Circuit is simple and hence their control is easy
- High reliability low cost

CONCLUSION

As seen from the above discussion Space Vector PWM is superior as compared to Sinusoidal pulse width modulation in many aspects like:

The Modulation Index is higher for SVPWM as compared to SPWM. The output voltage is about 15% more in case of SVPWM as compared to SPWM. The current and torque harmonics produced are much less in case of SVPWM. However despite all the above mentioned advantages that SVPWM enjoys over SPWM, SVPWM algorithm used in three- level inverters is more complex because of large number of inverter switching states. Hence we see that there is a certain trade off that exists while using SVPWM for inverters for Adjustable speed Drive Operations. Due to this we have to choose carefully as to which of the two techniques to use weighing the pros and cons of each method.

REFERENCES

[1]. E. K. Kenneth, A. C. Liew, and T. A. Lipo, “New observer-based DFO scheme for speed sensor less field-oriented drives for low-zero-speed operation,” IEEE Trans. Power Electron., vol. 13, pp. 959–968, Sept. 1998.

[2]. A.Consoli, A. Musumeci, S. Raciti, and A. Testa, “Sensorless vector and speed control of brushless motor drive,” IEEE Trans. Ind. Electron, vol. 41, pp. 91–96, Feb. 1994.

[3]. R. Dhaouadi, N. Mohan, and L. Norum, “Design and implementation of an extended Kalman filter for the state estimation of a permanent magnet synchronous motor,” IEEE Trans. Power Electron., vol. 6, pp. 491–497, Sept./Oct. 1994.

[4]. M. Schroedl "Sensorless control of ac machines at low speed and standstill based on the ‘INFORM’ method", Conf. Rec. IEEE IAS Annu. Meeting, pp.270 -277 1996

[5]. E. Robeischl and M. Schroedl "Optimized INFORM measurement sequence for sensorless PM synchronous motor drives with respect to minimize current distortion", IEEE Trans. Ind. Appl., vol. 40, no. 2, pp.591 -598 2004

[6]. C. S.Staines , G. M. Asher and K. J. Bradley "A periodic burst injection method for deriving rotor position in saturated cage-salient induction motors without a shaft encoder", IEEE Trans. Ind. Appl., vol. 35, no. 4, pp.851 -858 1999

[7]. A.Consoli , G. Scarcella and A. Testa "Industry application of zero-speed sensorless control techniques for PM synchronous motors", IEEE Trans. Ind. Appl., vol. 37, no. 2, pp.513 -521 2001

[8]. A.Silva , G. M. Asher and M. Sumner "Hybrid rotor position observer for wide speed-range sensorless PM motor drives including zero speed", IEEE Trans. Ind. Electron., vol. 53, no. 2, pp.373 -378 2006

[9]. G.-D. Andreescu , C. I. Pitic , F. Blaabjerg and I. Boldea "Combined flux observer with signal injection enhancement for wide speed range sensorless direct torque control of IPMSM drives", IEEE Trans. Energy Convers., vol. 23, no. 2, pp.393 -402 2008

[10]. M. J. Corley and R. D. Lorenz "Rotor position and velocity estimation for a salient-pole permanent magnet synchronous machine at standstill and high speeds", IEEE Trans. Ind. Appl., vol. 34, no. 4, pp.784 -789 1998