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ADAPTIVE CONTROL OF THREE-PHASE INVERTER FOR AC MOTOR DRIVE FED BY SINGLE-PHASE AC SOURCE

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ABSTRACT

If a small dc-link capacitor is used in the dc link fed by a single-phase ac source, then the dc-link voltage severely fluctuates at twice of the source frequency. To handle this fluctuation, the concept of "average voltage constraint" is proposed in this study. On the basis of this concept, a flux-weakening scheme, generating the d-axis current reference (irds∗) for the interior permanent-magnet synchronous machine, is devised. The q-axis current reference (irqs∗) is modified for the unity power factor operation in the viewpoint of an ac source without an additional sensor. The proposed scheme has been applied to the inverter-driven 1-kW compressor of an air conditioner. From the experimental results, it has been verified that the compressor operates well at the required operating condition, regardless of the severe fluctuation of dc-link voltage, because of the reduced dc-link capacitance. The frequency spectrum of the ac source current reveals that the harmonics of the source current meet the regulation of IEC 61000-3-2 Class A and that the overall power factor is above 96% without any additional circuit, such as an input filter and a power factor correction circuit.

Index Terms: Capacitors, electrolytic capacitor less inverter, flux-weakening operation, harmonics regulation, home appliance, interior permanent-magnet synchronous motor (IPMSM), inverter, power factor, variable-speed drives, voltage constraint.

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 objective of the project is to drive the permanent magnet synchronous motor by three phase sinusoidal stator currents. The trapezoidal current drive systems are popular because of the simplicity of their control circuits but suffer from a torque ripple problem during commutation. Trapezoidal commutation is inadequate to provide smooth and precise motor control of PMSM, particularly at low speeds. Sinusoidal commutation solves this problem. In order to generate smooth sinusoidal current waveform, high resolution rotor position feedback is required. This high resolution rotor position is typically provided by an incremental encoder or resolver attached to the shaft of the motor. Hall sensors which are installed in the stator by the motor manufacturer are often used. Hall sensors require little volume in comparison to the resolver or encoder, but provide low-resolution rotor angle feedback - usually 60 electrical degrees resolution. The use of hall sensors with these PMSM results in a torque ripple and

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vibration whose frequency is RPM dependent. Sinusoidal commutation results in smoothness of control that is generally unachievable with trapezoidal commutation.

EXISTING SYSTEM

The DC-LINK capacitor with large capacitance of several hundred or thousand microfarads is generally used to keep the dc-link voltage almost constant in a few kilowatt ac-dc-ac power conversion system fed by a single-phase ac source. The electrolytic capacitors generally have been used ac dc-link capacitors in this system because of large capacitance per unit volume. Due to the large capacitance in the dc-link, the ac source current I_{in} is severely distorted and the input power factor is deteriorated. In addition, a huge inrush current flows through a rectifier to the capacitor at turning on the drive system. In order to deal with these issues, the additional circuits, power factor correction circuit, an input filter, and a recharging circuit, are normally employed.

The existing system based on discrete-time Takagi–Sugeno (T–S) fuzzy speed regulator system is used for speed regulation of Permanent-Magnet Synchronous Motor (PMSM). In olden days, linear control methods such as PID controllers are used. But their performance was very poor. So, we go for fuzzy based PI controller. Fuzzy algorithms have some drawbacks that the rules for the algorithm are not very direct and also it is impossible to follow all the rules. They tend to vary from researcher to researcher.

PROPOSED SYSTEM

The proposed method is "Design and Implementation of Speed Regulator for a PMSM using Fuzzy algorithms". In this proposed method, the speed error of the closed-loop system converges to zero is proved. By the use of simulation results, it was clearly proven that the proposed method gives very remarkable speed regulation performance under model parameter.

The FA has found many applications in the area of the automatic tuning process for conventional and intelligent controllers. Some research has been conducted using Fuzzy algorithms to help online or off line control systems. It has primarily been utilized as an off-line technique for performing a directed search for the optimal solution to a problem. In this paper, the FA is used on-line in real-time controller implementation to adaptively search through a population of controllers and determine the member most fit to be implemented over a given sampling period.

EXPLANATION OF PROPOSED SYSTEM

The system consists of a AC source, rectifier, three phase inverter, PMSM, current measurement, Fuzzy controller and a SHEPWM. AC supply is fed to the rectifier. It converts AC supply into a DC then the DC supply is given to three phase inverter then the three phase AC supply is given to PMSM. The output of the PMSM is measured by a current sensing unit and it will be given to Fuzzy controller. Fuzzy controller generates Fuzzy rules values. These values are given to the SHEPWM driver and firing angle is generated it will be fed to the gate of the three phase inverter Then the speed of the PMSM is controlled.

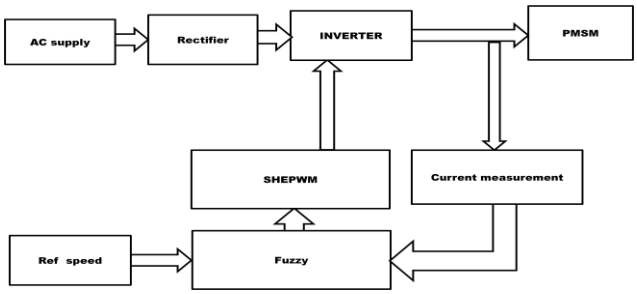

Fig 4.1 Proposed systems Block Diagram

CONCLUSION AND FUTURE WORK

In this paper, Fuzzy technique has been studied for the speed control of PMSM system. Since the standard Fuzzy method is difficult to balance the chattering and the anti-disturbance capacity, three kinds of improved Fuzzy control methods have been developed from different considerations. An improved method based on linear varying gain and an improved method based on extended state observer have been developed, respectively. To further improve system performance and take advantages of the both improved methods, an adaptive Fuzzy method based on combination of linear varying

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