Branch- ELECTRICAL

(Ac drives)

A five-level inverter scheme using single dc link with reduced number of floating capacitors and switches or open-end im drives

Abstract: A fuzzy logic based closed loop V/f control drive system for speed control of open-end winding induction motor fed by five-level inverter is proposed in this paper. In the proposed drive system one end of the open-end winding induction motor is fed by 3-phase, 3-level cascade inverter while the other end is fed by 3-phase, 2-level inverter to generates five-level in the motor phase voltage. A reverse mapping based space vector pulse width modulation technique is used to generate optimize switching signals for the devices to get required phase voltages. To achieving closed loop V/f speed control a fuzzy logic based auto tune controller is designed. The controller is capable of reducing undesirable sustained oscillations which are commonly occurred at low frequencies in constant V/f control variable speed induction motor drive. The complete drive system is simulated in MATLAB and results are presented for the entire speed range during both light and high load conditions.

Existing Method: In the last few decades multilevel voltage source inverters have gaining popularity in the field of medium and high voltage induction motor (IM) drive because of their inherent quality of low total harmonic distortion (THD), less switching losses and small dv/dt stress on semiconductor devices [1], [2]. Three classical topologies [3]–[5] for multilevel inverters are neutral point clamped (NPC), flying capacitor (FC) and cascaded H-bridge (CHB) inverter. All these topologies suffer from a common problem that is with the increase in number of levels in the output voltage the structure becomes complex and less reliable due to use of large number of switching devices. Several circuit topologies of multilevel inverters and their control scheme to address these issues are reported in the literature [6], [7]. H. Stemmler and P. Guggenbach proposed a new concept of open-end stator winding induction motor [8] fed by two level inverter from both ends in 1993.
**Propose Method:-** In the proposed drive system speed control of open-end winding induction motor is carried out by maintaining V/f ratio constant. The complete block diagram of the proposed drive system is shown in Fig. 1. The pulses generated by encoder used as feedback signal to computes the angular speed of the rotor \( \omega_r \) from these pulses. The rotor speed \( \omega_r \) is compared with reference speed \( \omega^* \) and speed error \( \omega_{er} \) is generated. The speed error \( \omega_{er} \) and change in speed error \( d\omega_{er} \) are given to the fuzzy logic controller which generates the slip frequency \( f_{sl} \). Now the reference frequency \( f_{ref} \) is generated by adding the slip frequency \( f_{sl} \) to the rotor frequency \( f_r \). This reference frequency is given to the constant V/f control and boost voltage selection logic which generate the reference phase voltage for five-level space vector modulation (SVM) logic. The five-level SVM logic generates the appropriate gating signals for five-level inverter depending upon reference voltage \( V_{ref} \) and reference frequency \( f_{ref} \). A reverse mapping based space vector pulse width modulation (SVPWM) technique is used to increase the DC link voltage utilization and reduced the switching losses.

**Advantages:-** In this paper a fuzzy logic based closed loop V/f control open-end winding induction motor drive system is proposed. One side of the open-end winding stator is fed by three-level inverter while other side is fed by two-level inverter. The combined effect of these two inverters is generation of five-level in motor phase voltage. To generate control pulses for inverters space vector pulse width modulation (SVPWM) technique is used. The used SVPWM scheme does not require identification of sector where actual instantaneous reference space vector lies. It uses sector identification only at the two level and by reverse mapping technique actual sector and the optimum switching vectors are generated for five-level operation. A fuzzy logic based auto tune speed controller for closed loop V/f speed control is designed.

**Application:-** Space vector pulse width modulation (SVPWM) is well established technique to generate gating signals for switches in multilevel inverters. In the SVPWM technique, the reference voltage space vector is generated by switching the nearest voltage space vectors among the inverter voltage vectors [14]. The three main steps of implement of SVPWM are the sector identification, switching-time calculation and switching-vector determination. As the number of level increased identification of the sector where actual reference vector lies, becomes very difficult. To overcome this problem a scheme is proposed in [15], in which
the actual sector where the tip of the instantaneous reference space vector lies need not to be identified to generate switching signals. For speed control of induction motor constant V/f control scheme is widely used because of its low cost and simple implementation. But at the lower speed range the performance of drive get deteriorates due to voltage drops across stator resistances, which causes deterioration of air gap flux. In addition of this problem of sustained oscillation which also in varying nature depending upon load at lower speed range is also another issue to be addressed. Several compensation scheme to address these problems are reported in literature.