Design and Analysis of FLC based Speed Control for a Five-Leg Inverter Fed a Dual-Induction Motor System

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ABSTRACT

This paper proposes progressed speed control for a five-leg voltage source inverter (FLVSI) that drives the double three-phase induction motor framework utilized in mechanical assembling measures. The serious speed control technique comprises of two regulators: 1) the first is a slip regulator that fulfills the application necessity, i.e., to control the mechanical speed of two engines similarly paying little mind to the heap condition. 2) The second is a point regulator that fulfills the FLVSI necessity, i.e., to control the stage point distinction between the two engines for limiting the regular leg current on the grounds that the basic leg current can be twice higher than other leg's current relying upon the activity state of the double motor. Dependability investigation of the two regulators under current speed control is actualized, and the entire presentation of the serious speed control for the FLVSI-took care of double engine drive framework is appeared to recognize its attainability through the simulation results.

INTRODUCTION

A five-leg voltage source inverter (FLVSI), which is a sort of a double engine drive framework, can spare two switches contrasted and two three-leg voltage source inverters (TLVSI). Many control strategies have been proposed for the FLVSI double engine drive framework, for example, the two-arm adjustment strategy the twofold zero arrangement (DZS) technique, space vector tweak strategy [13], direct force control strategy [14], and hysteresis control strategy [15]. These control techniques permit two engines to freely control and improve the voltage usage factor [16]. In the FLVSI for a double engine drive framework, as appeared in Fig. 1, one period of each engine is associated with the regular leg of the FLVSI. Consequently, when the double engine framework is driven, the pinnacle estimation of the regular leg current can be higher than different legs, contingent upon the working conditions [17]. In the most pessimistic scenario, the pinnacle estimation of the regular leg current can be twice higher than the other leg's current. The pinnacle estimation of every leg current is a significant factor for deciding the evaluated state of the exchanging gadget, for example, the protected door bipolar semiconductor (IGBT) that arranges the FLVSI [18]. On the off chance that the peak estimation of the normal leg current is diminished, an exchanging gadget with a lower appraised condition can be chosen. That is, by limiting the pinnacle estimation of the normal leg current, the size, weight, and capital expense of the inverter can be decreased.

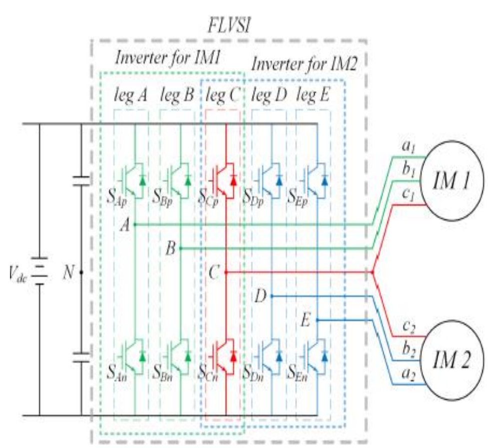

Fig. 1. Circuit configuration of the FLVSI driving a dual motor.

PROPOSED SYSTEM

In this paper, progressed speed control is proposed for the FLVSI to drive a double IM framework utilized in mechanical assembling measures. From the application, the principal necessity is proposed as the two engines ought to work at a similar speed paying little mind to the heap state of two engines. The subsequent prerequisite is to limit the normal leg current got from the applying FLVSI. By and large, when the two engines are controlled freely by each broad corresponding vital (PI) speed regulator, contingent upon the stage distinction between the two engines, the pinnacle estimation of the normal leg current can be higher than the other leg's current. On the off chance that the pinnacle estimation of regular leg current is controlled to the base paying little heed to the working condition and burden condition, the evaluated current of the exchanging gadget for the normal leg can be diminished. In any case, the control technique for limiting the pinnacle estimation of the regular leg current has not been contemplated. This paper proposes a serious speed control conspire that limits the basic leg current of the FLVSI controlling two engines driven at a similar speed. The serious speed control comprises of two regulators.

1) The first is a point regulator that controls the stage point distinction between the two engines. Accordingly, the two engines are controlled freely to have a consistent stage point distinction. The pinnacle estimation of the regular leg current can be limited.

2) The second is a slip regulator that keeps the mechanical speed of the two engines a similar when the heap states of the two engines are unique.

Fig. 1 presents the arrangement circuit of the FLVSI driving the two engines. It comprises of a dc-source, two engines, and the FLVSI. In Fig. 1, the two engines share the normal leg C. Stages a1 , b1 , and c1 of induction engine 1 (IM1) are associated with legs A, B, and C, individually. Stages a2, b2, and c2 of induction engine 2 (IM2) are associated with legs E, D, and C, separately. The dc-interface voltage is controlled by the evaluated worth with the end goal that the full working scope of one IM can be accomplished.

A. Carrier-Based PWM Strategy:

In this paper, the DZS strategy for [13] is utilized for the FLVSI driving the double engine framework. The square graph for the DZS strategy is appeared in Fig1.

The phase voltages for IM1 (va1, vb1, vc1) and the phase voltages for IM2 (va2, vb2, vc2) are expressed as

Where V1 and V2 are the stage voltage abundance of each engine, f1 and f2 are the activity frequency of each engine, and θ1 and θ2 are the rotor flux point of each engine. In the DZS technique, the balance signal (voffset, 1, voffset,2) is utilized, which is determined as

$$v_{\text{offset},i} = \frac{-\{\max(v^*_{ai}, v^*_{bi}, v^*_{ci}) + \min(v^*_{ai}, v^*_{bi}, v^*_{c}}{2}$$

V_{offset}, 1 and v_{offset}, 2 are added to (va1, vb1, vc1) and (va2, vb2, vc2), individually, as appeared in Fig. 2. Hence, the reference stage voltages for IM1 (v∗ a1, v∗ b1, v∗ c1) and the reference stage voltages for IM2 (v∗ a2, v∗ b2, v∗ c2) are determined as

$$v^*_j = v_j + v_{\text{offset},1} \quad (j = a_1, b_1, c_1)$$
$$v^*_k = v_k + v_{\text{offset},2} \quad (k = a_2, b_2, c_2) .$$

B.ADVANCED SPEED CONTROL:

A. Control Objectives The framework prerequisites are recommended as 1) the two engines ought to work at a similar speed paying little mind to stack states of the two engines and 2) IC ought to be limited. To successfully accomplish these two prerequisites by utilizing the FLVSI, the serious speed control technique contains two regulators. In the principal control strategy, which is the angle controller, δ is controlled as the steady worth, which 180° limiting IC is paying little heed to the heap conditions. The slip regulator, which is the subsequent regulator, is proposed to control the mechanical speed of two engines similarly paying little mind to the heap conditions.

B. Advanced Speed Control

Fig. 4.3 shows the control block chart of the FLVSI driving the two engines. To control two engines through the FLVSI, the rotor-motion arranged vector control technique for [25] and [26] is executed. Besides, it very well may be seen that the FLVSI is constrained by the serious speed control

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as indicated by the heap states of the two engines. In the heap state of case 1, where the creating force of IM1 (TIM, 1) is bigger than the producing force of IM2 (TIM,2), the q-axis reference current (I∗ qe,1) for IM1 is determined by the yield of the speed regulator. The d-axis reference current (I∗ de, 1 = I∗ de, evaluated, 1) for IM1 is determined by the appraised activity condition in [27] and it is communicated as

$$I^*_{de,\mathrm{rated},x} = \frac{\sqrt{2} \times V_{\mathrm{ll,rated},x} / \sqrt{3}}{\sqrt{R^2_{s,x} + (2\pi f_{\mathrm{rated},x} L_{s,x})^2}} \quad (x$$

Where Vll appraised are the evaluated line-to-line voltage of the engine, Rs,x are the stator opposition of the engine, frated,x are the appraised recurrence of the engine, and Ls,x are the stator inductance of the engine. Then again, the q-pivot reference current (I∗ qe,2) for IM2 is determined by the yield of the point regulator. The d-hub reference current (I∗ de, 2) for IM2 is determined as the aggregate of the d-pivot evaluated current (I∗ de, appraised, 2) and the remunerated worth (I∗ de, comp, 2) of the yield of the slip regulator. In the event of the heap state of case 2, in opposition to case 1, both of the proposed regulators are utilized to control the current for IM1. The activity condition (case 1 or case 2) is resolved by the forces (TIM,1, TIM,2) of the two engines, as appeared in Fig. 4.3. In this paper, just case 1 is examined.

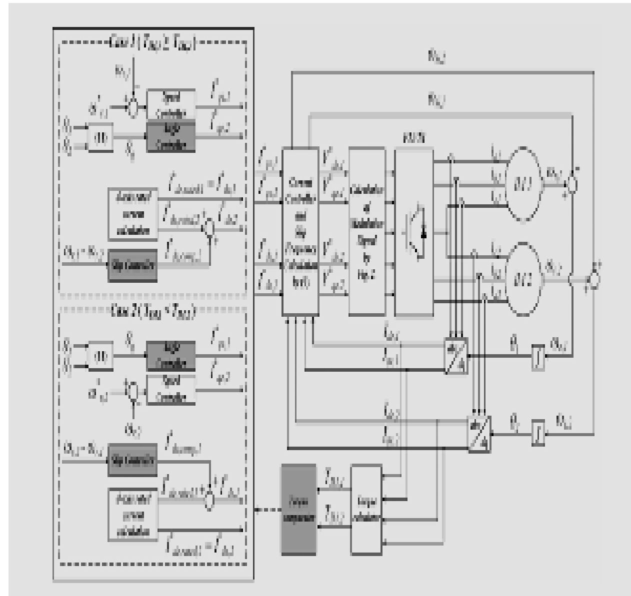

Fig. 2. Control block diagram of the FLVSI system driving two induction motors using the proposed method.

SIMULATION RESULTS

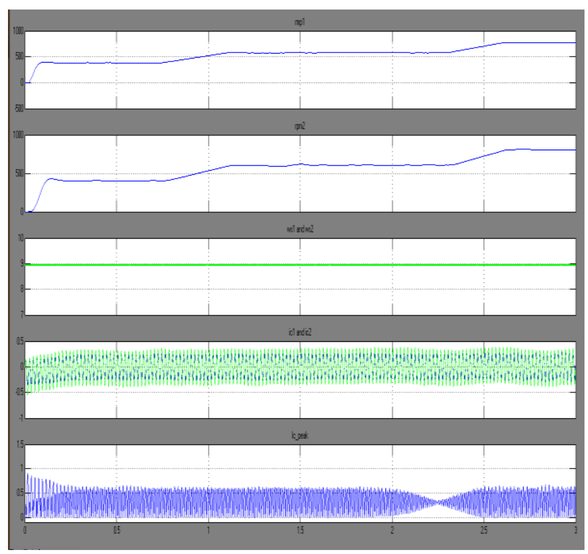

Fig: the same load condition (TL, 1 = 3Nm, TL, 2 = 3Nm) and the same speed (400rpm, 600rpm, 800rpm). ($\delta = 0$)

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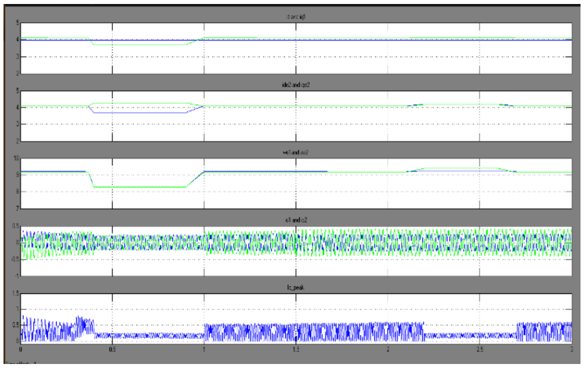

Fig. Simulation results obtained when the two motors are controlled by the proposed angle controller and slip controller under the variable load condition at 800rpm.

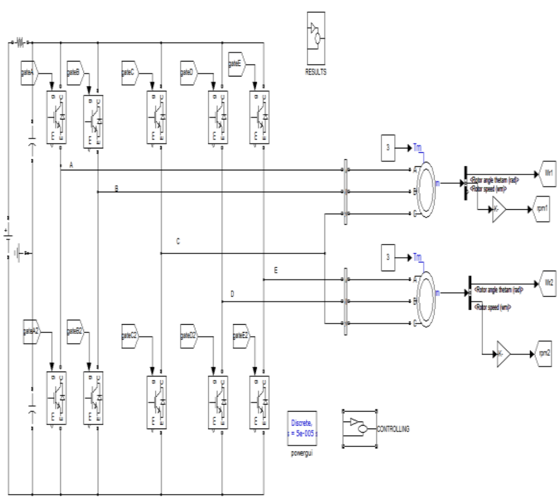

Fig: the same load condition (TL, 1 = 3Nm, TL, 2 = 3Nm) and the same speed (400rpm, 600rpm, 800rpm). ($\delta = 180$)

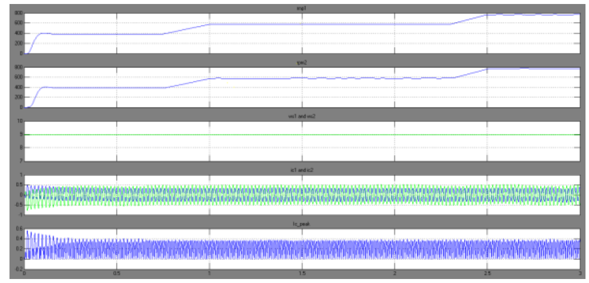

Fig: the same load condition (TL,1 = 3Nm, TL,2 = 3Nm) and the same speed (400rpm, 600rpm, 800rpm).($\delta = 180$)

CONCLUSION

This paper proposed a serious speed control technique for a FLVSI that drives a dual three-phase IM framework. When utilizing the overall PI speed regulator to control two engines took care of by the FLVSI, contingent upon the working states of two engines, the pinnacle estimation of IC can be higher than the other leg's current. The proposed control technique, paying little heed to stack conditions, can limit the pinnacle estimation of IC of FLVSI geography, which controls two engines driven at a similar speed. Subsequently, the proposed control plot applied to the FLVSI can be applied to different applications, (for example, mechanical assembling measures, transport line) utilizing double IMs. This procedure comprised of the two regulators (point regulator and slip regulator) for fulfilling two necessities: a similar speed activity of the two engines and the minimization of IC. The soundness examination of the two planned regulators was executed through the post zero guides and it brought about ensuring the strength. Also, the productivity of the inverter was examined by PSIM device simulation. From the simulation results, the exhibition of the serious speed control was demonstrated compensation little heed to the load states of the two motors.

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