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SPEED CONTROL OF FIVE PHASE INDUCTION MOTOR DRIVE BY EMPLOYING FUZZY CONTROLLER

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Abstract

Since the beginning of the century, the field of multi-phase variable-speed motor drives in general and multi-phase induction drives in particular has expanded substantially. There have been worldwide studies and various interesting developments in the literature have been published. This paper introduces speed control of five-phase induction motor drive by employing fuzzy logic controllers. The controller is based on the technique of the indirect rotor field control. The five-phase IM drive has specific characteristics to improve the motor's torque output ability. The proposed controller is a five-phase induction motor drive suitable for high output. The aim is to develop and implement a five-phase induction motor drive system speed control system using a fuzzy logic control system (FLC). The control parameters of the systems are modified by a fuzzy rule-based framework, which is a functional model for human actions to control processes. FLC's key advantages over traditional controllers are that the FLC architecture does not need the system's exact mathematical model and can handle nonlinear functions of arbitrary complexity. The speed control algorithm is based on the vector control indirect. The advantages of inductor multi-phase machines, multi-phase induction machine models, simple vectors and direct torque control systems and PWM voltage source inverters are all covered.

Keywords: Five phase Induction Motor drive, Fuzzy logic controller, Voltage source inverter, IFOC

I.INTRODUCTION

The Ac machines are multi-phase machines with a stator winding that consists of a generic number of phases. Multi-stage system provides many advantages in today's electric drive&generation technology over conventional 3-stage machines, such as reducing amplitude and rising torque pulsation, reducing the harmonic rotor current per phase without increasing voltage per phase, reducing the harmonics of fiber dc-link current, and greater efficiency, high fault tolerance. Previously not used multiphase engines as a result of the downside that there is no supply available for the multiphased motor. The VSi output has been immensely increased with the Development in Power Electronics [1-3] since high-power electronic devices are used as a voltage source inverter (VSI) switch [4]. This multi-phase drive is specialized in applications requiring high reliability, including electric/hybrid vehicles [7], aerospace, ship propulsion and high-power traction in the Locomotive. This paper describes modelling and simulation of the five-phase induction motor that is operated by an inverter voltage source[8-11].

Power Electronics has a so large range that control over each computer has perhaps been made possible during the last decades with the production of advanced controls and systems[12]. The 'inverter' is one of the simplest and most critical power electronics applications. The Inverter allowed DC quantities to be converted at the desired power flow rate into AC quantities. Electricity is now a fundamental human need, and in the power industry there is not a field that does not use electrical power[13-14]. We minimize losses, control the effects of harmonics present because of non-linearity of the system, control the effects of parameters, regulate the effect of system faults and much more, simply using semiconductor devices in an economical way [15].

Two techniques, the direct torque control and the field-orientated control, are only prominent from all control techniques[16]. The coordinate transform, pulse width regulator and location encoder are therefore not needed compared to field oriented control direct torque control, so it is very straightforwards to use. The torque and flux estimates differ according to the desired torques. The speed shift is taken into account for the induction motors while the speed remains constant with torque fluctuations in the case of synchronous motors [17-18]. DTC provides many advantages including quicker torque control, high torque, and high sensitivity to low speeds[19-20].

II. LITERATURE SURVEY

[1] N.S.R. Abjadi, J. Soltani, Gh. Arab Markadeh, Ahmadi, S.M., "Full Sensorless Control Six Phase Series Two Induction Motor Running Drives," Electrical Engineering Review No. 3, May - June 2009.

A six-phase induction or a synchronous press is a typical choice in this paper with two three-phase windings on the stator. Spatial displacement of the two three phase windings is 30 and neutral points may be separated or connected between the two windings. The machine is called a quasi-six phase machine. In the pre-pulsewidth-modulation era of the voltage source inverter (VSI) controller, the key purpose was to eliminate the asymmetrical six-phase winding (60 displacement between any two consecutive phases), the sixth harmonic of the torque, [1].

[2] "Vector control schemes of series – connected six-phase 2 – drive systems" by E. Levi, M. Jones and S.N. Vukosavic, IEE Proc.-Electrical system. Appl Power. , Number 2, March 2005.

It has been shown that by connecting the Multiphase Machines in series stator windings in the proper way, it is possible to independently control all machines in the community using vector controls, even if a single multi-phase inverter supplies the whole drive system (VSI). The conception was so far studied only for true n-phase machines (i.e., machines with a spatial change between two consecutive phases equal to 2 ± n) and the inverter current controls within the stationary reference system are restricted to all available considerations. In addition, all available proofs of decoupling dynamic control are based on simulation.

[3].Sharma, Palak G., S. ISSN: 2319-7064 Volume 2 Issue 2, February 2013, Rangari International Journal of Science and Research (IJSR), Germany

"Multi-phase motor drives a technological status review" involves the advantages of multi-phase induction machinery and multi-phase induction modelling, basic vector control and direct torque control systems. The authors also provide a thorough description of the control strategies for five phase and six-phase asysmmetric induction motor drives and an overview of the approaches to the design of fault tolerant strategies for the post-fault motor operation.

[4] IEEE International Signal Processing Systems Meeting, Dody Ismoyo and Mohammad Awan, "Harmonic 240V AC Power Supplies with TMS320C6713 DSK," Pages 224- 227, 2009. [4]. [4]. A harmonic analyzer using FFT was used for this document on TMS320C6713 DSK.

Here, the harmonic content of 240V, a 50Hz power supply, was analyzed using two samples. To match the power rating of the DSK input, the power voltage is first reduced to 5V by a voltage divisor. Secondly, a step-down transformer is used to decelerate the supply voltage.

[6]L. J.E. Williams, B.W. Zheng and X. Fletcher. He, "Five-stage induction machine dual-plane vector control for an enhanced flux pattern," IEEE Trans. It's Ind. Elect. Elect. Vol. Elect. 55, no. 5, 1996-2005, May 2008. May 2008

The dual-plane vector control and synchronous fluxes are used to boost flux patterns in a five-phase inductive machine. The analytical model and vector control in the two orthogonal vector planes, d 1-q 1 and d-q-s, is achieved in the decomposition of the vector space. In each vector plane it is possible to regulate independently the degree and rotating speed of the related fluxes (foundation and third harmonic).

III. PROPOSED SYSTEM

The devices with 5 or 6 phases etc. show the same properties over three phases, but they are not possible with one or two phases. A five-phase induction motor model is built in variable phase form initially. A transformation is implemented on model and so-called d-q-x-j-0 versions of the machine are designed or developed in order to simplify the model by eliminating the time variations in inductance terms. A five-phase induction machine is designed along the circumference of the stator with ten steps, each 36 degrees. Thus (α=2 drain / n where n is a number of stages n=5), the spatial displacement between phases is 72 degrees. The rotor winding is regarded as a five-phase winding similar to the stator winding characteristic. The rotor winding, using the winding transformation ratio, is assuaged to be already referred to as stator winding. In the simpower block collection, the built-in induction motor cannot be used because it only corresponds to 3 phases. Since a phase-variable model is transformed by a mathematical transformation of a physical multi-phase machine, the number of variables before and after the processing shall be the same. The original computer model is transformed with the transformation matrix (Clarke's) [16], which replaces original sets of n variables with new sets of n variables. The x-y-component pairs are completely isolated from all other elements, and the stator does not appear with the rotor connection[13]. The x-Y elements of the rotor are completely isolated from each other and from each other. Since the winding of the rotor is short circuited, there can be no x–y and no sequences of components, zero sequence of the stator as well as the rotor components may be omitted due to the short-circuit winding of the rotor and the star winding of the stator. In no star-connected multiphase system with no neutral driver for odd phase numbers, a zero-sequence component does not exist; only zero components are available while the phase number is uniform. Finally, vector control is applied; the equations for x-y components can be omitted from further analysis (i.e. only d-q axes current components are generated). In an arbitrary reference frame the 5-phase induction machine is therefore similar to the 3-phase induction machine. For five-phase inductive devices, the five-phase mathematical model in [6-7] is used to simulate the data found in Appendix 1. Voltage equations of the system in the common frame of reference:

$$V_{ds} = R_s i_{ds} - \omega_a \Psi_{qs} + P\,\Psi_{ds}$$

$$V_{dr} = R_r i_{dr} - (\omega a - \omega)\,\Psi_{qr} + P\Psi_{dr} \qquad (1)$$

$$V_{qs} = R_s i_{qs} - \omega_a \Psi_{qs} + P\,\Psi_{qs}$$

$$V_{qr} = R_r i_{qr} - (\omega a - \omega)\,\Psi_{dr} + P\Psi_{qr} \qquad (2)$$

$$V_{xs} = R_s i_{xs} + P\,\Psi_{ds} \qquad V_{xr} = R_r i_{xr} + P\Psi_{xr} \qquad (3)$$

$$V_{ys} = R_s i_{ys} + P\,\Psi_{ys} \qquad V_{yr} = R_r i_{yr} + P\Psi_{yr} \qquad (4)$$

$$V_{os} = R_s i_{os} + P\,\Psi_{os} \qquad V_{or} = R_r i_{or} + P\Psi_{or} \qquad (5)$$

$$\Psi_{ds} = (L_{ls} + L_m) i_{ds} + L_m i_{dr}$$

$$\Psi_{dr} = (L_{lr} + L_m) i_{dr} + L_m i_{ds} \qquad (6)$$

$$\Psi_{qs} = (L_{ls} + L_m) i_{qs} + L_m i_{qr}$$

$$\Psi_{qr} = (L_{lr} + L_m) i_{qr} + L_m i_{qs} \qquad (7)$$

$$\Psi_{xz} = L_{ls} i_{xs} \qquad \Psi_{xr} = L_{lr} i_{xr}$$

$$\Psi_{ys} = L_{ls} i_{ys} \qquad \Psi_{yr} = L_{lr} i_{yr}$$

$$\Psi_{os} = L_{ls} i_{os} \qquad \Psi_{or} = L_{lr} i_{or} \qquad (8)$$

$$T_e = \frac{5P}{2} M(i_{dr} i_{qz} - i_{dz} i_{qr})$$

$$T_e = P L_m [i_{dr} i_{qs} - i_{ds} i_{qr}]$$

$$T_e - T_L = \frac{J}{P} \frac{d\omega}{dt} \qquad (9)$$

The engine inputs are the 5-phase voltage supply derived from the inverter voltage source.

IV.CIRCUIT TOPOLOGY OF FIVE PHASE VOLTAGE SOURCE INVERTER

The five-phase VSI power circuit topology that Ward and Harer possibly used for the first time (1969). In a multi-phase inverter the number of phases can be created since every leg of the inverter constitutes a phase, thereby increasing the number of steps in the inverter. We need five leg inverters[1-3] for the 5-phase engine. The topology of the 5-phase VSI fundamental circuit is shown here.

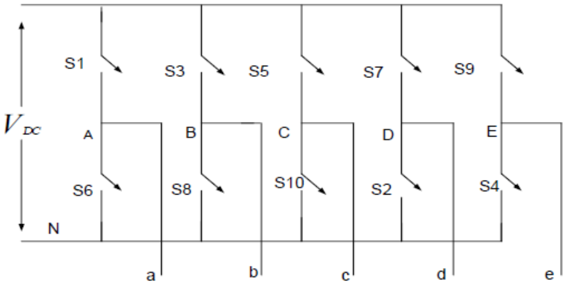

Fig 1. Five-phase voltage source inverter power circuit.

Each circuit switch consists of two anti-parallel power semiconductor devices. One such semiconductor is completely controllable, such as a bipolar or IGBT transistor, while the second one is a diode[5]. The anti-parallel diodes have a backstream path, which allows a power terminal and an input terminal to be connected if a particular IGBT is installed. The input to the inverter is a dc voltage that is furthermore known to be stable. Below is the topology of the IGBT and Diode five-phase inverter.

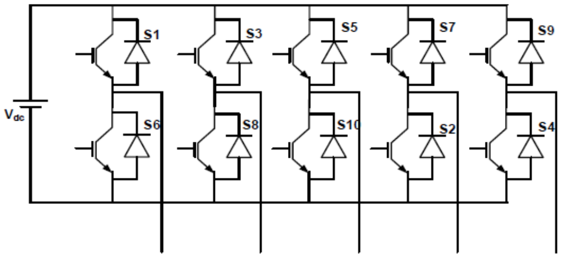

Fig 2. Line-to-line voltages of a five-phase star-connected load

The output of the inverter is given in Fig.1 with lower case symbols (a, b, c, d, e), while the output connection points with the inverter legs have a capital letter symbol (A,B, In five phase inverter three switches from the upper switches and two from the lower switches are turned on at a time and vice versa. The two switches which form the leg of the inverter are complimentary to each other, for example when switch S1 is on Switch S6 is off so as to avoid short circuit.C,D,E). The five-phase VSI's fundamental operating principles are established as a result of the ideal conversion and zero voltage decrease. It is supposed that each switch is operated at 180°, leading to 10-step operation[6-7].

Table 1 Modes of Operation of 5 phase Voltage Source Inverter

Mode	Switches ON	Terminal Polarity
9	1,7,8,9,10	$A^+B^-C^-D^+E^-$
10	8,9,10,1,2	$A^+B^-C^-D^-E^+$
1	9,10,1,2,3	$A^+B^+C^-D^-E^+$
2	10,1,2,3,4	$A^+B^+C^-D^-E^-$
3	1,2,3,4,5	$A^+B^+C^+D^-E^-$
4	2,3,4,5,6	$A^-B^+C^+D^-E^-$
5	3,4,5,6,7	$A^-B^+C^+D^+E^-$
6	4,5,6,7,8	$A^-B^-C^+D^+E^-$
7	5,6,7,8,9	$A^-B^-C^+D^+E^+$
8	6,7,8,9,10	$A^-B^-C^-D^+E^+$

divided in 10 different modes shown in the figure. 4.3 and summarized in Table 1, there are five 'on' and five 'off' keys at any moment in time. The phase-to-neutral stress of the star load is most easily calculated by setting a voltage difference between the star point n of load and the negative rail of the dc autobus N.Phase delay between the two switches is equalling to 360°/5 = 72° in any corresponding two phases.

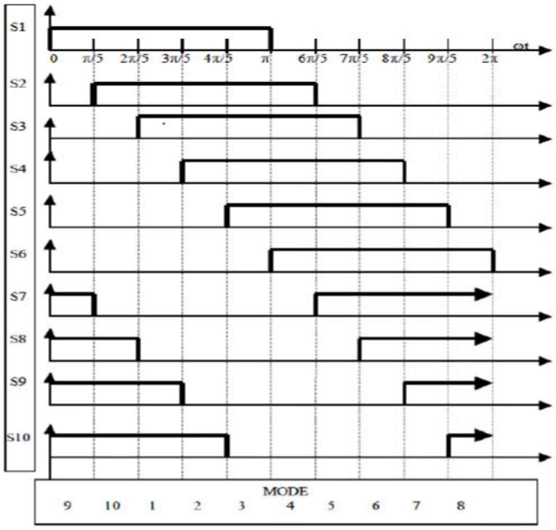

Fig 3. Driving switch signals of a five-phase voltage source inverter in the ten-step mode.

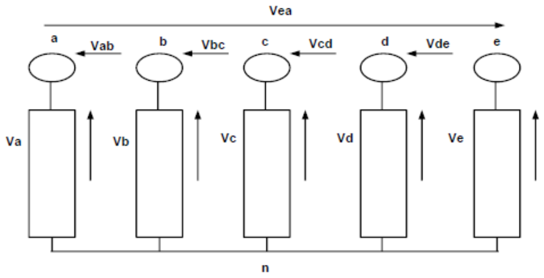

Fig 4. line-to-line voltages of a five-phase star-connected load

The following correlation then holds true:

$V_A = V_a + V_{nN}$

$V_B = V_b + V_{nN}$

$V_C = V_c + V_{nN}$

$V_D = V_d + V_{nN}$

$V_E = V_e + V_{nN\,4} \qquad (10)$

Since the phase tensions in a star are related to zero, the sum of the equations (11) returns

$V_{nN} = (1/5)(V_A + V_B + V_C + V_D + V_E) \quad (11)$

Replacement of (11) in (10) results in the phase-to-neutral load voltages as follows:

$V_a = (4/5)V_A - (1/5)(V_B + V_C + V_D + V_E)$

$V_b = (4/5)V_B - (1/5)(V_A + V_B + V_D + V_E)$

$V_c = (4/5)V_C - (1/5)(V_A + V_B + V_D + V_E)$

$V_d = (4/5)V_D - (1/5)(V_A + V_B + V_C + V_E)$

$V_e = (4/5)V_E - (1/5)(V_A + V_B + V_C + V_D) \quad (12)$

In terms of leg voltages, the relationship of phase-to-neutral inverter voltages and the dc connection voltage can be expressed by switching for five different inverter legs. Where the phase-to-neutral voltages are indicated by small letter suffix and the magnet letter suffix reflects leg voltages. The modeling of the component is carried out using simple block sets for the device. The power module based on IGBT is used.

V. CONTROL SCHEME OF THE SYSTEM

The selection of the speed of the common reference frame is the basis of vector control. The speed of the referral frame is chosen as equal to the speed of the rotor flux-oriented space vector in the rotor flux control system. The space-flowing rotor vector is always in line with the real axis (d-axis), while the q-axis is perpendicular to the common reference frame. The space vector of the rotor flux is associated with the real axis, so its imaginary part remains zero. The same vector control schemes apply for a symmetrical multi-phase induction machine with sinusoidally distributed stator winds, regardless of the number of phases [8-9]. The only difference is that an n-phase collection of stator current or stator voltage references must be generated for the coordinate transformation depending on whether current control is stationary or rotational synchronous. Multi phase induction machine systems with these two types of current controls for indirect flux based (FOC) rotor systems [5]. Assuming the winding of the stator has a neutral singing point, the Fig scheme. 5 uses the latest controls stationary (m-1). The current part generating the torque is determined from:

$$\Psi_r + T_r \frac{d\Psi r}{dt} = L_m i_{ds} \quad (13)$$

$$(\omega_r - \omega)\ \Psi_r T_r = L_m i_{ds} \quad (14)$$

$$\omega_{sl} = \frac{Lmids}{Tr\Psi r} \quad (15)$$

$$T_e = p\,\frac{Lm}{Lr}\,\Psi_r i_{qs} \quad (16)$$

The vector control scheme for a current five-phase machine is similar to the schema for a current fed three-phase machine [4] while Tr = Lr/Rr It can be seen from (13) - (16) that the current stream and torque generating currents for five-phase machines are only d-5 components. The configuration for operation in the Basic Speed region of the indirect vector control is shown in Fig. 5 for the induction machine in five-phases. The values in Fig.5 are as follows (essentially equivalent to those for a three-phase induction machine with a rotor flux orientated indirect control), and are as follows:

$$i^*_{qs} = K_1 T^*_e = K_1 = i^*_{qs}/T^*_e = \frac{1}{p}\,\frac{Lr}{Lm}\,\frac{1}{\Psi{*}r} \quad (17)$$

$$I^*_{qs}/T^*_e = \frac{1}{p}\,\frac{Lr}{L2m}\,\frac{1}{i{*}ds} \quad (18)$$

$$\omega^*_{sl} = K_2 i^*_{qs} = K_2 = \omega^*_{sl}/i^*_{qs} = \frac{Lm}{Tr\Psi{*}r} = \frac{1}{Tri{*}ds}$$
(19)

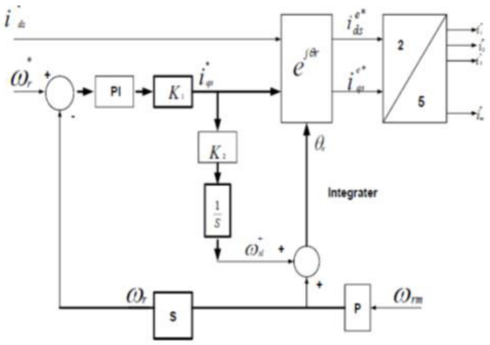

Fig 5.Indirect vector control of a five-phase induction machine in the base speed region

$$K_1 = \frac{1}{Tr\ ids} \quad (20)$$

$T_r = \frac{Lr}{rr}$ is the rotor time constant (21)

The reference speed q-axis stator current ids* corresponds to the references d -axis stat current, PI means an integral proportional controller, ee it is the immediate space vector flux rotor positions i1 *,i2 *,• • *,in * are the reference direction of the reference stator current currents (the electrical rotor velocity), the reference speed is q-axis stator current ids * is the reference d -axis stator current, the PI is the proportional integral controller. In the traditional ramp comparison the current control method provides the same output efficiency as with three-phase induction engine drives, either phase current or phase current components can be regulated in the fixed reference frame.

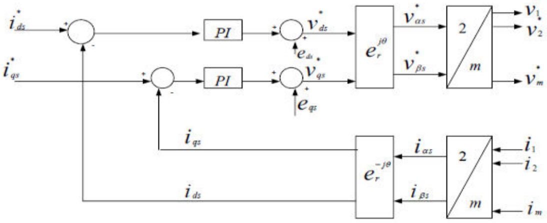

Fig 6.Indirect rotor field oriented control of a multiphase induction machine

The current in Fig.6 is in the reference frame revolving. The reference currents for the stator q and d axis and the direction of the rotor stream are obtained as shown in fig.5. is

$$e_{qz} = \omega_e L_\sigma i_{ds} + \omega_r \frac{Lm}{Lr} \lambda'_{dr} \qquad (22)$$

$$e_{dz} = -\omega_e L_\sigma i_{ds} + \frac{\gamma r Lm}{Lr\ 2} \lambda_{dr} \qquad (23)$$

where $\omega_e = \frac{d\theta e}{dt}$

$$L_\sigma = L_z - \frac{L2\ m}{Lr} \qquad (24)$$

When Ls is the stator self inductance, Lr' is the rotor self-inductance of the stator side, the magnetizing inductance is the Lm, V1 *,V2 *,Vn * is the phase voltages in the reference stator, i1,i2,•••,in are the current of the stationary stator phase, Vα * and Vβ * are the stationary reference voltages, respectively iα and iβ are the stationary reference currents of the α and ßen axis. µdr' is the d-axis rotor flux relation. The Fig method. Just two controllers are currently available. However, because an n-phase machine has basically independent (m-1), the use of this scheme is only sufficient if no windings or supply asymmetries occur within the stator and/or supply of the m-phase winding system. The device also requires a suitable PWM inverter control method to prevent the production of unwanted low voltage stator harmonics [6]. Field Guided Control provides smooth movement and effective running at slow speeds at high speeds. Sinusoidal switching induces fluid motion at slow speeds, but at high speeds it is inefficient[8]. High-speed trapezoidal switching can be relatively effective, but it causes slow torque rift. The best in both worlds is Field Based Control.

The next factor is the PI speed controller. There are two distinct speed controllers, one continuous and one discrete[14]. In more simulations, both speed controllers are used. In the corresponding section of the simulation results the type of speed controller used along with any particular simulation will be indicated. First, we present the specification of the constant speed controller. To this end the entire current control loop is approximated with unit gain and a zero time delay, bearing in mind that the inverter current control in the stationary reference frame will be performed via the hysteresis or ramp comparison technique.

VI.PROPOSED FUZZY CONTROLLER

Dynamic control approach is Fuzzy's logic. Multivariable consideration and multi-regulatory resolution are accepted. Fuzzy MPPT has been very popular over the last decade. The willingness to deal with non-linearity and not an accurate mathematical model with incorrect inputs are some of the benefits of flippant logic controllers. The flow charts of the Fuzzy MPPT are shown at Fig.9 and the proposed Fuzzy MPPT Simulink model is shown at Fig.15. Error (E) and error change (CE) are two variables of FLC input. Output vector [14] is the service cycle (D). This allows fuzzy control algorithm to improve both linear and nonlinear load tracking efficiency compared to traditional methods. Therefore, it is ideal for nonlinear control, since Fuzzy logic does not use complex mathematical equations[15]. Figure.10 displays the Fuzzy logic controller block diagram (FLC). One element depending on the behavior of an

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FLC is the type of the membership functions of a rule basis.

In every respect, the fugitive logic box is extremely impressive. The fuzzy logic makes the architecture and design of smart systems an efficient tool. It's easy to use and easy to use the fuzzy logic box. Last, but not least, it offers a reader-friendly and up-to-date introduction to the philosophy and general applications of fuzzy logic.

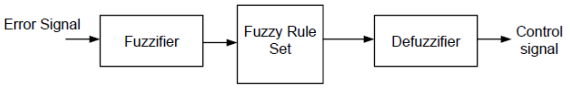
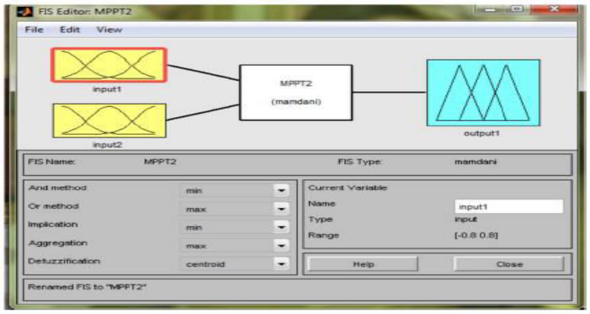


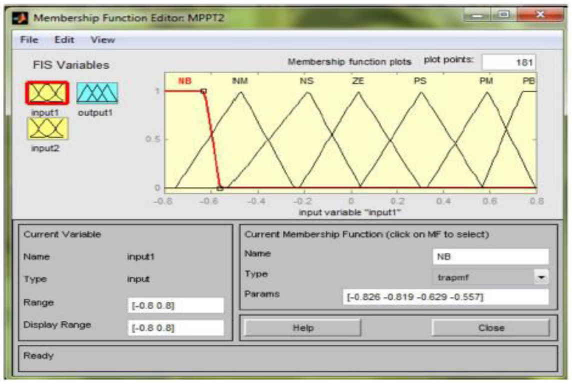
Fig .7 Block diagram of fuzzy logic controller

With the support of MATLAB's Fuzzy Logic Tool Box, membership functions and rule base have been created. Fig.4.Change of error is shown by Fig.5 and the fuzzy logic controller cycle is shown in Fig.8. the graphic view for error function is shown.



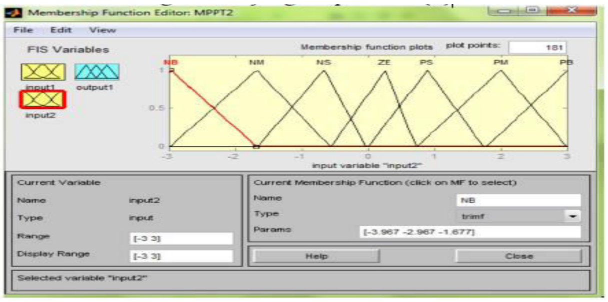
FIS Name: MPPT2
FIS Type: mamdani
And method: min
Or method: max
Implication: min
Aggregation: max
Defuzzification: centroid
Current Variable
Name: input1
Type: input
Range: [-0.8 0.8]
Renamed FIS to "MPPT2"

Fig.8 Fuzzy logic Implementation in Simulation



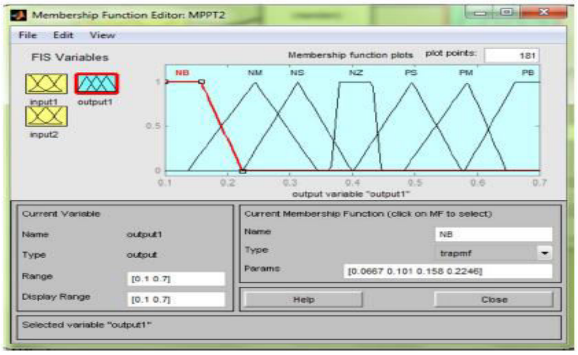
plot points: 181
Current Variable
Name: input1
Type: input
Range: [-0.8 0.8]
Display Range: [-0.8 0.8]
Current Membership Function (click on MF to select)
Name: NB
Type: trapmf
Params: [-0.826 -0.819 -0.629 -0.557]
Ready

Fig.9 Fuzzy logic input Error (E)



plot points: 181
Current Variable
Name: input2
Type: input
Range: [-3 3]
Display Range: [-3 3]
Current Membership Function (click on MF to select)
Name: NB
Type: trimf
Params: [-3.967 -2.967 -1.677]
Selected variable "input2"

Fig.10 Fuzzy logic input change of Error (CE)



plot points: 181
Current Variable
Name: output1
Type: output
Range: [0.1 0.7]
Display Range: [0.1 0.7]
Current Membership Function (click on MF to select)
Name: NB
Type: trapmf
Params: [0.0667 0.101 0.158 0.2246]
Selected variable "output1"

Fig.11 Fuzzy logic output (D)

Graphical view for (a) error signal (b) error signal shift and (c) the function cycle membership function. Various sub-sets were used for fugzy logical MPPT rules settings. Seven subsets were used in this case, based on 40-9 rules. The settlement of 49 rules is better accurate and complex, but time consuming.

RESULTS

A simulation program for indirect-flow-oriented 5-phase induction drive is written using the MATLAB/SIMULINK software. The engine is simulated in a stationary frame using a built d-q model. The unit is operated by a PWM inverter and controls the hysteresis current at the motor phase. In closed loop speed control mode, the drive is powered. The anti-windup property limits the saturation of the controller's integral part when operating in the restricted area. The torque is twice as high as the rate.

Asynchronous motors have recently been commonly used as workhorses in a wide variety of high-performance industrial applications. Due to their robustness and low maintenance, induction motors (IM) have wide applications in today's industry. However, for most applications, an intelligent and fast speed control device is in most cases a prerequisite. This work includes an intelligent IM control system based on the Levenberg–Marquardt algorithm using an Adaptive Fuzzy Logic Controller. The IM model consists of a synchronous revolving reference frame. One of the most difficult problems was the speed regulation to optimize the performance and torque of the IM. Indirect field-oriented control (IFOC) or indirect vector control techniques with robust AFLC provide an extraordinary dynamic response speed control. In this analysis the results of computer simulation using the MATLAB/Simulink Toolbox for traditional PI and AFLC are identified and analyzed. AFLC presents a robust IFOC IM speed oscillation compared to traditional PI for over-shooting, undershooting, rise time, fall time, and transient oscillation. Furthermore, the AFL controller is also tested for the load disruption refusal capability for the configured control device.

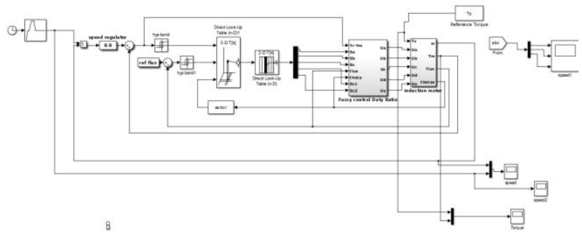


Fig.12 MATLAB/SIMULINK circuit of the proposed system

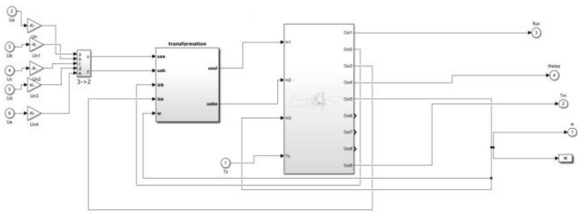


Fig.13 Simulation Model of 5 Phase Induction Motor

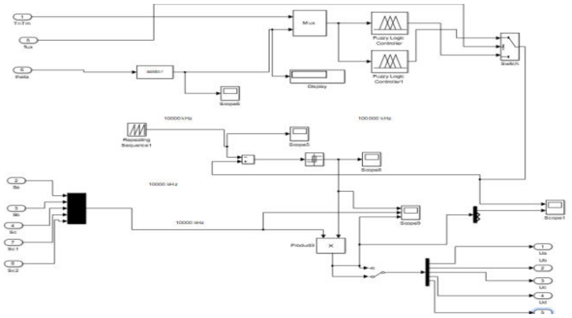


Fig.14 Proposed control system with fuzzy controller

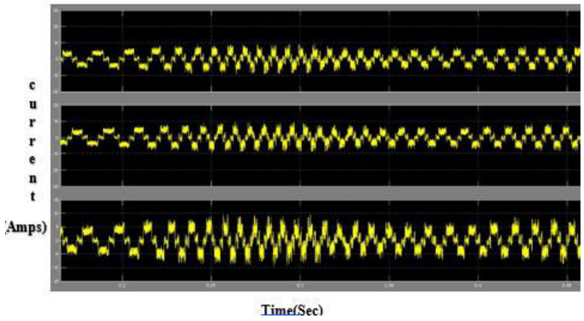


Fig.15 Stator Current

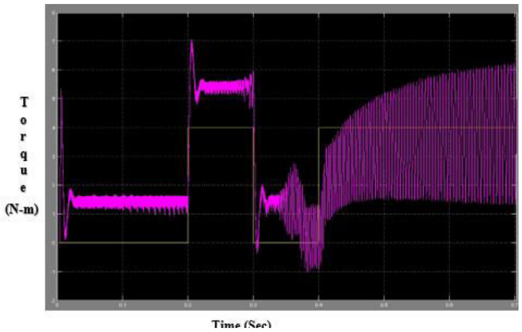


Fig.16 Torque

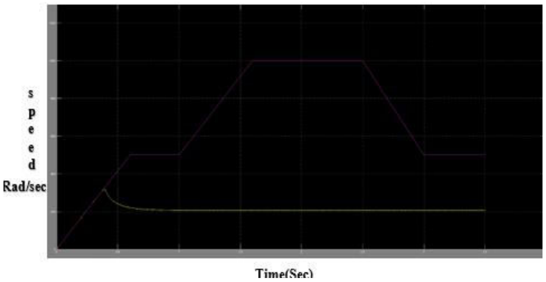


Fig.17 Speed With Speed Error

CONCLUSION

The project demonstrates the versatile application of fuzzy theory for the control of five-phase induction motor drive system. A simple structure of fuzzy logic controller has been proposed. This structure has been derived from the dynamic model of five-phase induction motor drive system using the vector control technique. The effectiveness of the fuzzy logic controller has been established by performance prediction of a simulation of five-phase induction motor drive over a wide range operating conditions. The simulation results showed better dynamic performance of the induction motor when using the FLC as compared with fixed PI controller. The FLC has improved the speed control of 5-ph IM over a wide range of operating conditions.

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