NOVEL TECHNIQUE FOR INDUCTION MOTOR SPEED CONTROL USING FUSION PID-FUZZY LOGIC CONTROLLER

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Abstract—

Induction motors are for the most part used in every industries. The speed of the induction motor has to be different according to application requirement. consequently, there is a require for further resourceful and reliable induction motor drive systems for modern and prospect applications. Induction motors are extremely non-linear systems, having uncertain time altering parameters mostly rotor resistance and subjected to unrevealed load disturbance. In accumulation, the rotor flux is unapproachable for state feedback control. captivating these complications into account, a variety of control strategies are proposed such as vector control method(VCM), direct torque control(DTC), and sliding mode control. The utilize of proportional plus integral (PI) controller for speed control of induction motor with greater than mention technique give practical performance in steady state operation. nevertheless, this performance categorized by an overshoot, slow transient rejoinder, steady state error and the main drawbacks of this variety of controllers is its understanding to difference in system's parameters and the fact that when with fixed gains the controller may not make available the required speed performance under variation in the motor load torque and operating circumstances. In order to conquer these challenge, novel fusion PID-Fuzzy Logic controller has been proposed for induction motor speed control.

Keywords— Induction Motor model, Conventional Direct Torque Control, Space Vector Modulation, fuzzy logic.

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I. INTRODUCTION

Induction Machine is an significant class of electric machines which discover wide applicability as a motor in manufacturing. usually, variable-speed drives for induction motors necessitate together wide operating range of speed and quick torque response, despite of load variations . To get better the motor effectiveness, the flux be required to be reduced by obtain a balance among copper and iron losses[1]. The difference of electrical parameters, the incorrectness of approximate fluxes will degrade the speed control performance [2]. The control of IM is multifaceted due to its nonlinear nature, and the parameters modify with operating conditions [4]. Speed judgment is an concern of exacting concentration with induction motor drives, where the mechanical speed of the rotor is usually dissimilar from the speed of the rotating magnetic field. Direct Torque Control (DTC) method controls the torque and speed of the motor, which is straight based on the electromagnetic state of the motor. The name straight torque control is derived from the information that on the source of the errors among the reference and the approximate values of torque and flux, it is probable to directly control the inverter states in direct to reduce the torque and flux errors inside the allowable limits. The major advantages of DTC are robust and fast torque reaction, no needs for coordinate transformation, needs for PWM pulse generation and current regulators . The DTC technique is a effortless and gives quick transient response next to the speed variation of the motor, therefore mainly of the industrial drives are up to with DTC. The different induction motor control were in development currently.

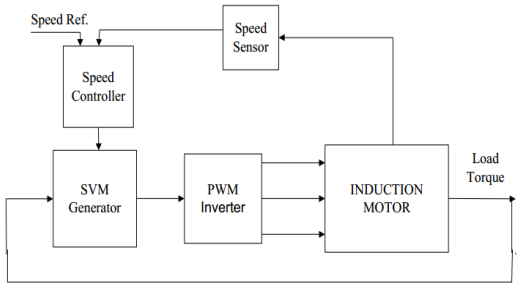

Figure 1: introduction DTC technique

The present paper concerns with the implementation of Fuzzy rule based technique to get better the speed/torque description of the induction motor. method such as DTC with space vector modulation (SVPWM) technique, artificial intelligence techniques etc. [5] [9]. The planned

ANFIS based DTC system was implemented in MATLB/SIMULINK platform. The presentation of the projected control technique was tested on 2.2Kw/400V induction motor. The mathematical replica of the induction motor was analyzed in terms of stator voltage and torque equation. The definite torque and the modify of toque of the motor were functional to the ANFIS and the electromagnetic torque was strong-minded from the output of interfering system.

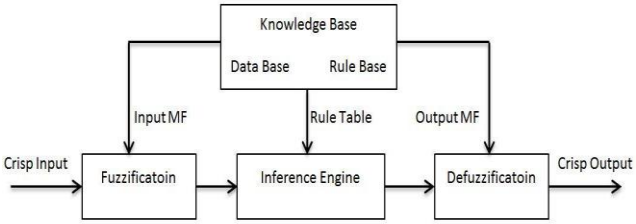

Figure 2 : structure of fuzzy logic controller.

The output of ANFIS was rehabilitated into stator voltage and the stator voltage was functional to SVM. From the output of SVM, the control signal was produce to control the speed of the motor close to reference speed. The presentation speed and the torque are analyzed and the analyzed performance are compare with fuzzy controller. From the relative analysis, the proposed ANFIS speed control method is enhanced than fuzzy control technique.

We proposed novel method for induction motor speed control using fusion pid-fuzzy logic controller.

II. RELATED WORK

Three-stage affectation motor are the most widely recognized and every now and again experienced machines in industry. Since it has Simple configuration, high energy to weight proportion and simple to keep up. V/f control of incitement engine has extensive applications in industry. The control technique comprises of keeping consistent the voltage-recurrence proportion of the incitement engine supply source. D. Chandra Sekhar in at al[1] in this paper fundamental spotlight on lessening the swing levels of the flux and torque, for that enhancing the dynamic execution. For the controller the PWM beat era puts a noteworthy part to control the rate with decreased flux and torque vacillation. The distinctive affectation engine control procedures, for example, DTC with space vector heartbeat width regulation (SVPWM) strategy, counterfeit consciousness systems and so on., were being developed as of now. In this paper

proposes the ANFIS based Hybrid field arranged pace controller. They have proposed ANFIS based DTC are vigorous and quick torque reaction, no prerequisites for direction change, necessities for PWM beat era and current controllers. The present paper worries with the usage of Fuzzy and ANFIS systems to enhance the velocity/torque attributes of the affectation engine.

Vaibhav B. Magdum[2] illuminated the fundamental idea driving direct torque control. He additionally clarifies the field introduction control and guide discretion in versatile engine model square. Data on the subordinate control obstructs outside the essential DTC.

ALNASIR Z. A. [3] presents the outline of an immediate torque control demonstrate and tried utilizing MATLAB/SIMULINK bundle. Recreation results delineate the legitimacy and high precision of the proposed model .

Bhoopendra Singh in at al[4] another torque swell diminishment plan is proposed with an altered turn upward table. This table including a huge no. of combined non-zero dynamic voltage vector to conquer the confinement of the customary procedure and obligation proportion control exchanging system.

Mustafa A. Al-Refai. In at al[5]The DTC standard is based upon the decoupling of torque and stator flux. Direct torque control system workers hysteresis comparator which creates high swells in torque and exchanging recurrence is variable. The proposed DTC-SVM plan decreases torque swells and safeguards the DTC transient benefits. The SVM system is used to acquire the required voltage space vector which remunerates the flux and torque blunders, at every cycle period .

Subhankar et al.[6] examined about PID controller based shut circle framework which makes a squirrel confine incitement engine running under consistent volt/hertz proportion. In this study engine is demonstrated by exchange capacity in light of inductance lattices or L-networks of the engine. The engine displays to keep running in the client characterized or summon speed.

Dazhi et al.[7] examined around a neural system versatile PID controller for velocity sensor less field-situated control of impelling engine. By measuring the stage voltages and streams in Induction Motor (IM) drive, the multi-step prescient control, neural systems based rotor flux parts and speed recognizable proof strategy for IM are utilized.

Ustun and Demirtas[8] broke down around another system for the ideal tuning of corresponding fundamental controller coefficients in the disconnected from the net control of a prompting engine.

III. PROPOSED METHODOLOGY

The major objective of this work is to intend a control technique to make available optimal dynamic response of squirrel cage induction motor. This will be accomplish by include fuzzy logic with conservative controllers and exploitation of vector control system .in this research we learn of a variety of hybrid system controllers such as (PI-, PD-, and PID-fuzzy) are analyzed and evaluate along with conservative PI controller in terms of several presentation measurements such as settling time (ts) ,rise time (tr), overshoot (Mp),) and steady state error at different load conditions. The conservative PI controllers are fixed-gain controllers i.e., the comparative and integral gains are constant. So, this category of controllers will not recompense properly, if the parameter changes and it does not regulate with changes in surroundings. The answer of the PI-controller is too sluggish due to its sluggish response to comparatively prompt variation in the state which will consequence additional settling time. In totting up to verdict the increase constants connected to system is extremely complicated. consequently the fuzzy control algorithm(FCA) is accomplished of getting better the system performance as compare with the classical technique. The two FLC contribution variables are the electromagnetic torque (T) and modify of electromagnetic torque (ΔT). The process of a fuzzy logic controller depends on the silhouette of membership functions for rule base. In this paper a FLC method is proposed for speed control of an induction motor. The FLC have compensation to be vigorous and comparatively straightforward to intend. The irrespective of system precise model we can intelligent to intend fuzzy logic controller. The fuzzy rule base technique is complete during three stages. They are Fuzzification, supposition engine and defuzzification.

Fuzzification : The fuzzy membership function values are allocate to the linguistic variables with five fuzzy subsets. In this paper the electromagnetic torque (T) and modify in electromagnetic torque (ΔT) are certain as input variables of the system. In this paper the FLC is intended in Sugeno model. The input membership functions the gbellmf type of enrollment capacities are specific to control the framework. The scope of each participation reason for taking so as to exist is captivating torque and alter in torque. Derivation motor This stage basically comprise of fluffy

standard base. In this principle base assessment is finished. In this stage first the inputs are fuzzified and this fuzzified inputs are nourished through deduction motor and lead base is connected. At that point fluffy yield sets are recognized.

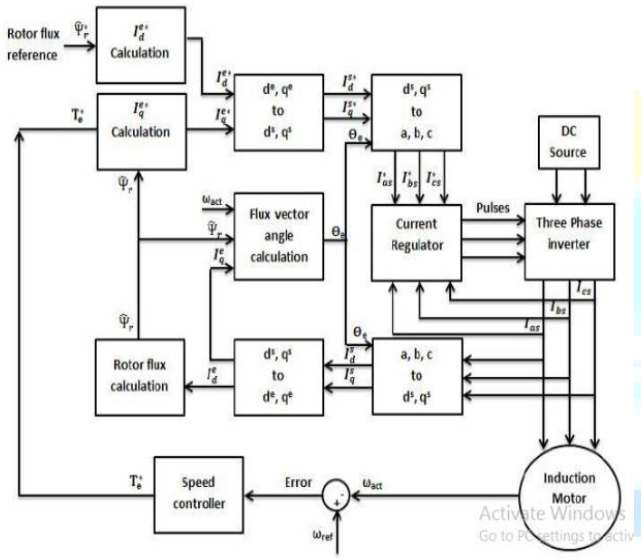

Figure 3. We proposed novel method for induction motor speed control using fusion pid-fuzzy logic controller.

Defuzzification : After recognizable proof of fluffy yield sets the defuzzification is required on the grounds that to get the controlled torque. The centroid defuzzification strategy is utilized defuzzification as a part of the proposed procedure. The yield enrollment capacities params values and the fluffy principles. The controlled torque which is the yield of the fluffy rationale controller is changed over into stator voltage. This is postures through the SVM, this will produces the terminating heartbeats to the inverter to control he speed of the incitement engine which firmly identified with the reference speed.

Actuation engines, especially the squirrel confine prompting engines (SCIM) have been generally utilized as a part of industry application, for example, half breed vehicles, paper and material plants, apply autonomy, and wind era frameworks due to their few innate preferences, for example, their straightforward development, heartiness, dependability, minimal effort, and low support needs. Without legitimate controlling, it is for all intents and purposes difficult to

accomplish the sought undertaking for any mechanical application. Open circle control of instigation engine (IM) with variable recurrence and

variable voltage abundancy give an agreeable variable rate engine for relentless torque operation and without stringent prerequisites on velocity regulation. Be that as it may, for superior drive necessities including quick element reaction, precise pace, and exact torque control of impelling engine is a testing issue because of their exceedingly coupled nonlinear structure and a considerable lot of the parameters shift with the working conditions, for example, load torque, reference speed set point, rotor resistance, and engine temperature . To accomplish ideal proficiency of affectation engines, a few control procedures have been created to control the impelling engine, for example, scalar control, vector or field situated control, direct torque control. Scalar control is one of the first control strategies of incitement engines. In this technique the proportion of both the sufficiency and recurrence of the supply voltage is kept consistent keeping in mind the end goal to keep up a steady air hole flux and thus give greatest torque. Scalar control drives are anything but difficult to actualize yet does not yield palatable results for elite applications in light of intrinsic coupling impacts in the middle of torque and flux give lazy reaction and framework is effortlessly inclined to insecurity. This issue can be fathomed by field arranged control or coordinate torque control. In the greater part of mechanical drive control applications, the standard technique to control affectation engine depends on the field arranged or vector control guideline with a specific end goal to accomplish the best element conduct. In this system the decoupling between the flux and torque permits the prompting engine to be controlled in a comparative technique to that in the control of independently left dc engines. Subsequently it can be utilized for elite applications [6]. Throughout the years, the routine control, for example, the corresponding in addition to essential (PI), and relative in addition to necessary in addition to subsidiary (PID) controllers have been utilized together with vector control strategies to better control the rate of actuation engines. In any case, it must brought up that routine controllers have significant disadvantage, for example, execution affectability to varieties in framework's parameters, and the way that when utilizing altered additions the controller may not give the required velocity

execution under varieties in the engine parameters and working conditions. With a specific end goal to beat these difficulties, Fuzzy Logic controller (FLC) has been utilized for engine speed control [7]. The fundamental favorable position of fluffy rationale controller when contrasted with the customary controller is that no scientific model is required for the controller outline. Fluffy rationale has been effectively used to control sick known or complex frameworks where exact displaying is troublesome or inconceivable. It has been exhibited that dynamic execution of electric drives and in addition strength adopting so as to regard parameter varieties can be enhanced the nonlinear pace control methods as in the ones fluffy control gives. As of late, half breed control procedures taking into account mix of two or more control techniques are proposed to upgrade controller's execution. Our proposed strategy consolidate customary controller with fluffy rationale controller and vector control method to exploit the best qualities of both controllers and dispose of the disadvantages of routine controller, for example, swaying, overshoot, and undershoot and the downside of FLC, for example, consistent state mistake.

IV. CONCLUSION

In This paper has effectively novel system for actuation motor speed control utilizing combination pid-fluffy rationale controller for controlling a three-stage squirrel confine affectation motor. Hybridization of fluffy rationale and routine controllers is utilized as a solitary controller. Moreover, the backhanded field situated control is used in the proposed novel framework to settle the prompting engine coupling impacts issue that makes the framework reaction drowsy and effortlessly inclined to shakiness. The show and power of the sum total of what controllers have been assessed under reasonable working conditions. Besides, a relative investigation of the distinctive control plans has been finished utilizing the execution noteworthy measures, for example, rise time (tr), top overshoot (Mp), settling time (ts), and consistent state mistake (Ess).

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