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SPEED DRIVE SWITCHED RELUCTANCE MOTOR USING PID FUZZY LOGIC CONTROLLER

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Abstract: This study presents the speed control and torque ripple reduction for various speeds of switched reluctance motor. The developed control system consists of hybrid PID controller which maintains a constant electromagnetic torque. This proposed system has small speed ripple and produce fast response of SRM for various speeds.
Keywords: FLC-Fuzzy logic controller, SRM-Switched reluctance motor.

Introduction

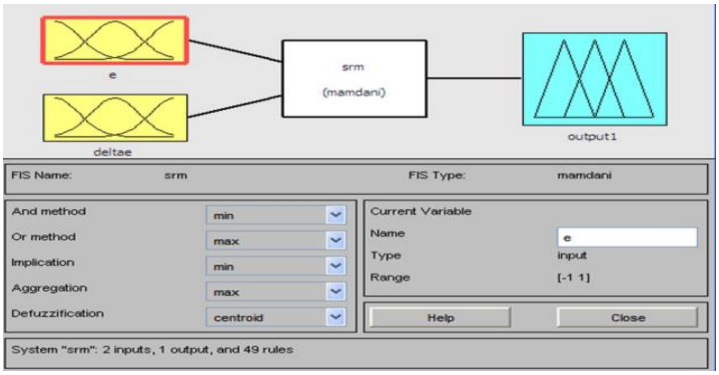
The switched reluctance motor (SRM) drives for industrial applications are of recent origin. A variable reluctance motor has been proposed for variable speed applications [1]. It has wound field coils of a dc motor for its stator windings and has no coils or magnets on its rotor. Both the stator and rotor have salient poles, hence the machine is referred to as a doubly salient machine [2, 3]. This motor includes fast response and high efficiency for various ranges of speeds. The reduction of the electromagnetic torque ripple is the most important advantage of the proposed controller.

SRM Description:

The SRM has a salient pole stator with concentrated windings and also a salient pole rotor with no magnets or coils. In this study 3 phases, 6/4 pole is used [1, 3]. The movement of the rotor, hence the production of torque and power, involves switching of currents into stator windings when there is a variation of reluctance; therefore, this variable speed motor drive is referred to as a switched reluctance motor drive[5].

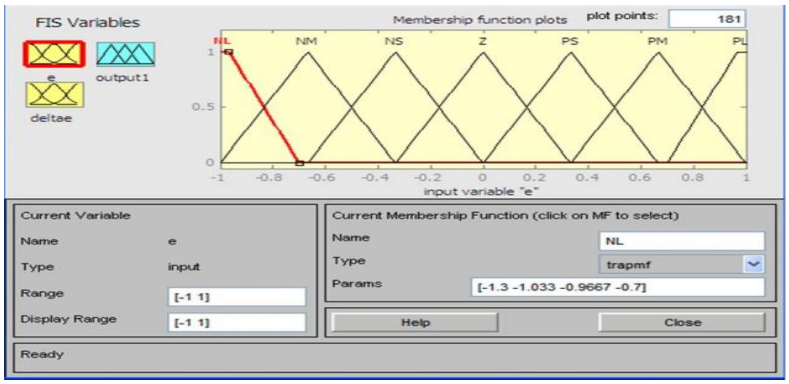
Fig 1:3 phase and 6/4 pole SRM.

FIS Editor Block:



This FIS editor block is used to change the input values such as (e) and Δe, which is given to the SRM motor. Here we use special type rule editor which includes several rules. The input value varies from (-1) to (1), and the output value is depends on the member functions.

Membership Function Block:



These membership function can be specified by 7 different rules such as negative large (NL), negative medium (NM), negative small (NS), zero (Z), positive small (PS), positive medium (PM) and positive large (PL). These member functions can be determined by means of logic functions such as AND, OR method.

Basic block diagram:

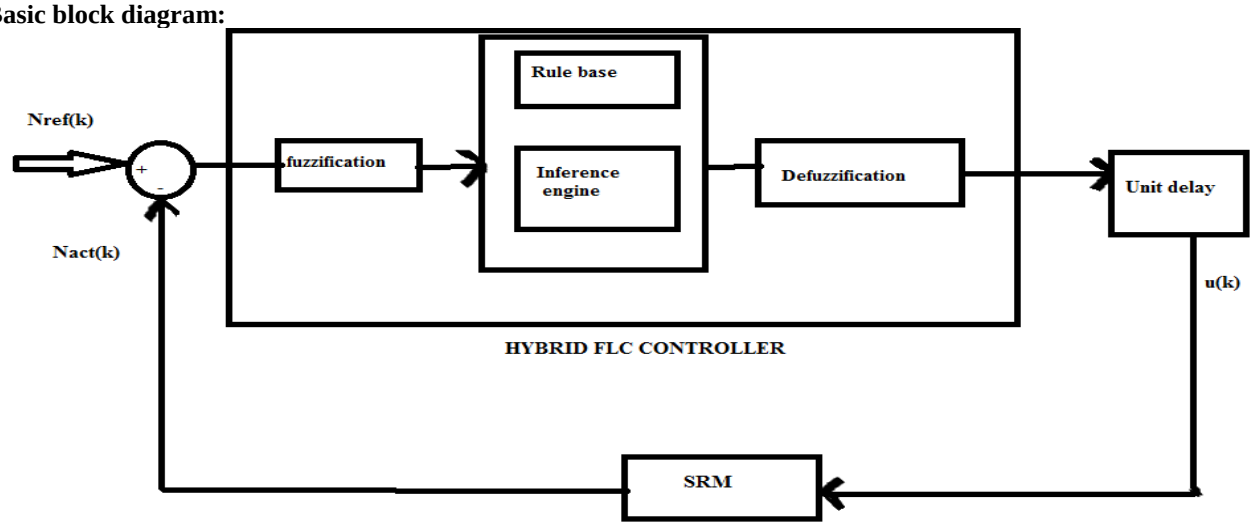


Fig 2: Basic block for FLC

This block includes the comparator, converter, PID controller and motor. During no load condition the reference speed is compared with the motor speed and it allows the motor to run at constant speed. To increase the speed value of motor the torque has to be reduced. The 3 phase input value is given to the motor and several output can be measured such as flux, torque, speed and current value of the given motor.

Simulation Results:

The simulation of given SRM motor can be done in 2 ways, such as

1. Without PID FLC and
2. with PID FLC.

Without PID FLC:

In this method the PID controller is directly connected with the converter in which the current value gets increased and change in motor speed is reduced. The different value of output is mentioned below.

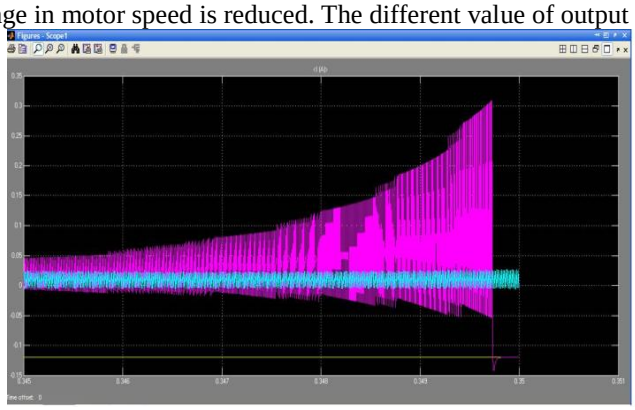


Fig3: Output Current.

Fig3 shows the simulated output value of 3 phase current with respect to time period[t].It shows the increase of current value in the motor without PID FLC circuit.

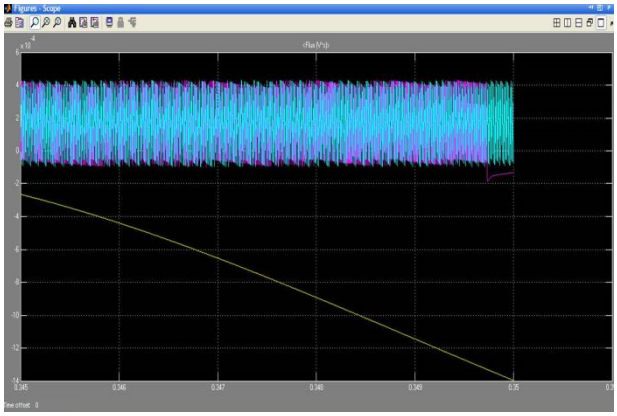


Fig4: Flux output voltage.

Fig4 denotes the value flux produced inside the motor when 3 phase supply voltage is given as an input value. This will increase the torque and decrease the speed when flux value is high.

With PID Fuzzy Logic Controller:

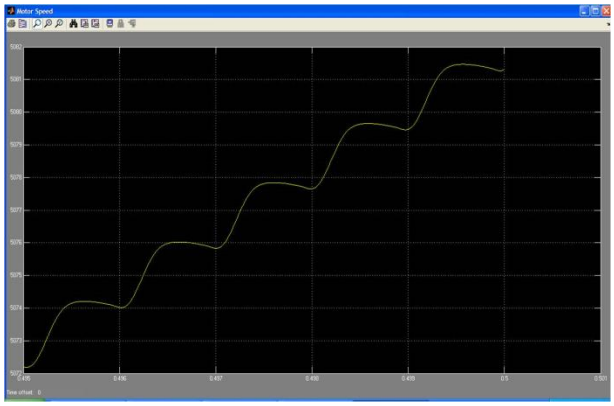


Fig 5: Motor speed output.

Figure 5 shows the simulated output of 3 phase motor when combined with PID Fuzzy logic controller where the input value is given by means of 3 different converters. The speed of motor increase graudually and maintain constant at particular value. The speed can be varied with time[t]. Where time period is 0.5 seconds.

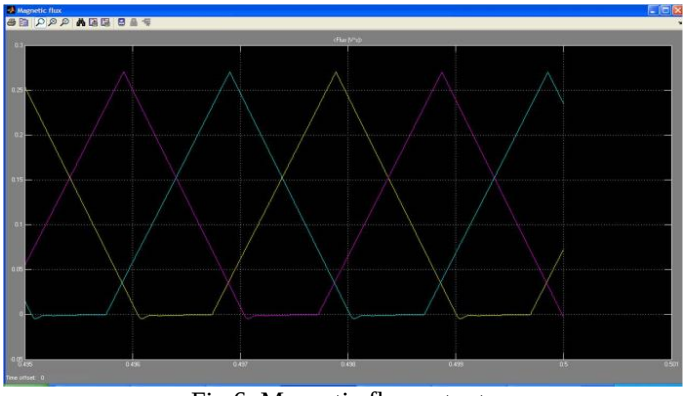


Fig 6: Magnetic flux output.

Figure 6 shows the magenitc flux value of the motor, the three different phases are obtained and the torque has to be maitain same for all phases. The flux induced inside the motor is depends on the turn ON and turn OFF angle.

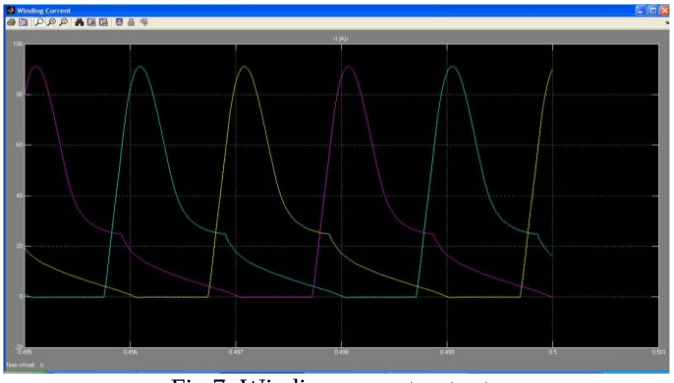
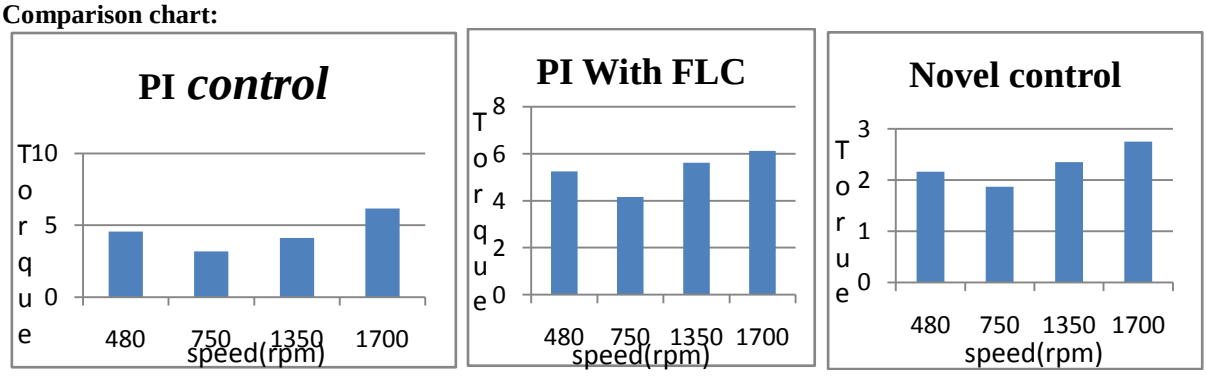


Fig 7: Winding current output.

From figure 7 the output denotes the value of current flows through the winding of the motor with respect to time. For 3 phase motor the current induced inside motor is get decreased and speed value is increased to certain period of time and maintain as a contant value in which the performace of motor is kept high.

Comparison chart:



Hence the above graphs gave the clear value of output of the motor when compared with other conventional controller. In this proposed controller, the torque value is reduced and speed of motor gets increased.

Conclusion:

A major issue in this research was high ripple content, less steady state error and fast response capability of SRM drive. The proposed controller is used to overcome the issue and to reduce torque ripple content of SRM drive for various speeds. The simulated results are obtained using fuzzy logic controller and hardware to be implemented.

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