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Four-Switch Three-Phase Inverter-Fed IM Drives at Low Speeds Using Fuzzy Logic and PI Controllers

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Abstract : The fuzzy-logic regulator (FLC) for roundabout field arranged control (IFOC) of induction motor (IM) drives fed by a four-switch three-phase (FSTP) inverter. In the proposed approach, the IM drive framework is fed by FSTP inverter rather than the conventional six-switch three-phase (SSTP) inverter for low power applications. The proposed FLC improves dynamic reactions and, it is additionally planned with decreased calculation trouble. The total IFOC conspire joining the FLC for IM drives fed by the proposed FSTP inverter. This paper presents a plan of Four-Switch Three-Phase Inverter-Fed IM Drives at Low Speeds Utilizing Fuzzy Logic and PI Controllers. Simulation is finished utilizing MATLAB/SIMULINK programming. The simulated outcomes give critical improvement in present model execution than existing model execution.

***IndexTerms* – FLC, SSTP, FSTP, IFOC, Four switch inverter, Micro grid, MATLAB, Fuzzy.**

I. INTRODUCTION

Three phase induction motors have been viewed as perhaps the most regularly utilized electric machines in modern applications because of their low expense, simple and powerful development. Three-phase inverters are viewed as a fundamental part in the variable speed AC motor drives. Already, the conventional six-switch three-phase (SSTP) inverters have been generally utilized in various modern applications.

These inverters have a few downsides in low power range applications, which include additional expense; the six switches misfortunes, and confounded control plans. In addition, they require building interface circuits to create six PWM pulses. The improvement of low-cost motor drive frameworks is an important topic, especially for a low-power range. Accordingly to, the three-phase inverter with diminished segment for driving an IM. Likewise, decreased switch check has been reached out for a rectifier–inverter framework with dynamic input current shaping. Three unique setups of IM drives fed from a four-switch inverter to implement low-cost drive frameworks for low-power range applications.

In scalar control, which depends on connections substantial in consistent state, just size and recurrence (precise speed) of voltage, current, and motion linkage space vectors are controlled. Accordingly, the scalar control doesn't follow up on space vector position during drifters. Conflictingly, in vector control, which depends on relations legitimate for dynamic states, extent and recurrence (rakish speed) yet in addition momentary places of voltage, current, and transition space vectors are controlled.

In this way, the vector control follows up on the places of the space vectors and gives their right direction both in consistent state and during drifters. As indicated by the definition above, vector control is an overall control reasoning that can be implemented from various perspectives. The most famous strategy is known as field-situated control (FOC) or vector control. Thus, the exhibition of the converter framework to a great extent relies upon the nature of the applied current control methodology. In this manner, current control of PWM converters is perhaps the main subjects of present day power gadgets. In contrast with regular open-circle voltage PWM converters, the current-controlled PWM (CC-PWM) converters have the following benefits:

1) Control of instantaneous current waveform and high accuracy;

2) Peak current protection;

3) Overload rejection;

4) Extremely good dynamics;

The motivation behind this work is to give a short survey of the accessible CC procedures for the three-phase, two level converters. Affected by any dynamic VSI voltage vector, the motor torque continues expanding or diminishing until it contacts the limit characterized by torque hysteresis bands. The torque swell is just influenced by the width of the torque hysteresis band and is practically free of the width of the transition hysteresis band. Torque swells changes relatively with change in the torque hysteresis bandwidth. Be that as it may, because of the discrete idea of the control framework, there may be still torque swells even with the zero bandwidth of the hysteresis regulator.

Then again, if the bandwidth diminishes, the VSI switching recurrence expands, which relatively builds its switching misfortunes. Thus, the bandwidth of the torque hysteresis regulator should be optimized in, for example, a way that the torque swell level and switching recurrence of the inverter are inside satisfactory limits. A too little band may bring about the determination of converse voltage vector rather than zero vectors to decrease the torque. The determination of converse voltage vector may then reason torque undershoots. Subsequently, the torque wave will get higher than those predefined by the hysteresis regulator band limits.

II. METHODOLOGY

The methodology is based on the following sub-modules-

- Input Source
- Rectifier
- Inverter
- Fuzzy Logic Controller
- PI Controller
- Current Sensing Controller

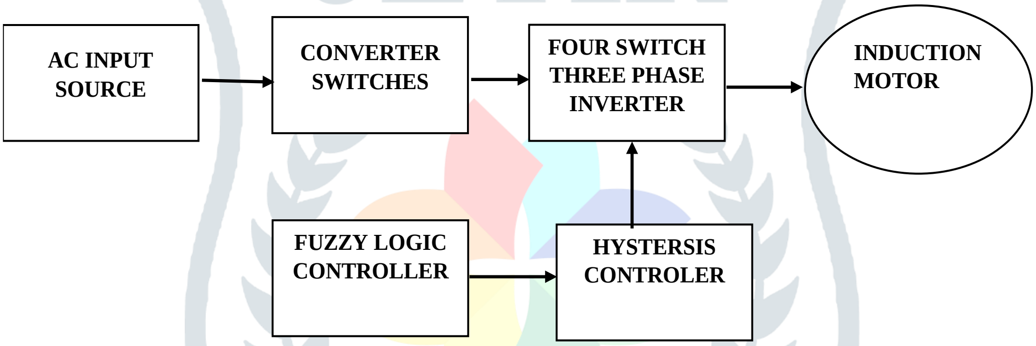

Figure 1: Flow Chart

Alternating current (AC), is an electric current wherein the flow of electric charge intermittently turns around course, though in direct current (DC, likewise dc), the flow of electric charge is just one way. Rectifier take various structures, including vacuum tube diodes, mercury-circular segment valves, copper and selenium oxide rectifiers, semiconductor diodes, silicon-controlled rectifiers and other silicon-based semiconductor switches.

A power inverter, or inverter, is an electronic device or circuitry that changes direct current (DC) to alternating current (AC). The input voltage, yield voltage and recurrence, and by and large power handling rely upon the plan of the particular gadget or hardware. A fuzzy control framework is a control framework dependent on fuzzy logic, a numerical framework that breaks down simple input esteems regarding logical factors that take on persistent qualities somewhere in the range of 0 and 1, rather than traditional or advanced logic, which works on discrete upsides of one or the other 1 or 0 (valid or bogus, separately), probably are aware in a corresponding and basic regulator yield is straightforwardly relative to the summation of relative of blunder and mix of the mistake signal, composing this numerically.

III. SIMULATION AND RESULTS

The implementation of the present model is done over MATLAB software. The power gui toolbox helps us to use the functions available in MATLAB Library for various design and analysis.

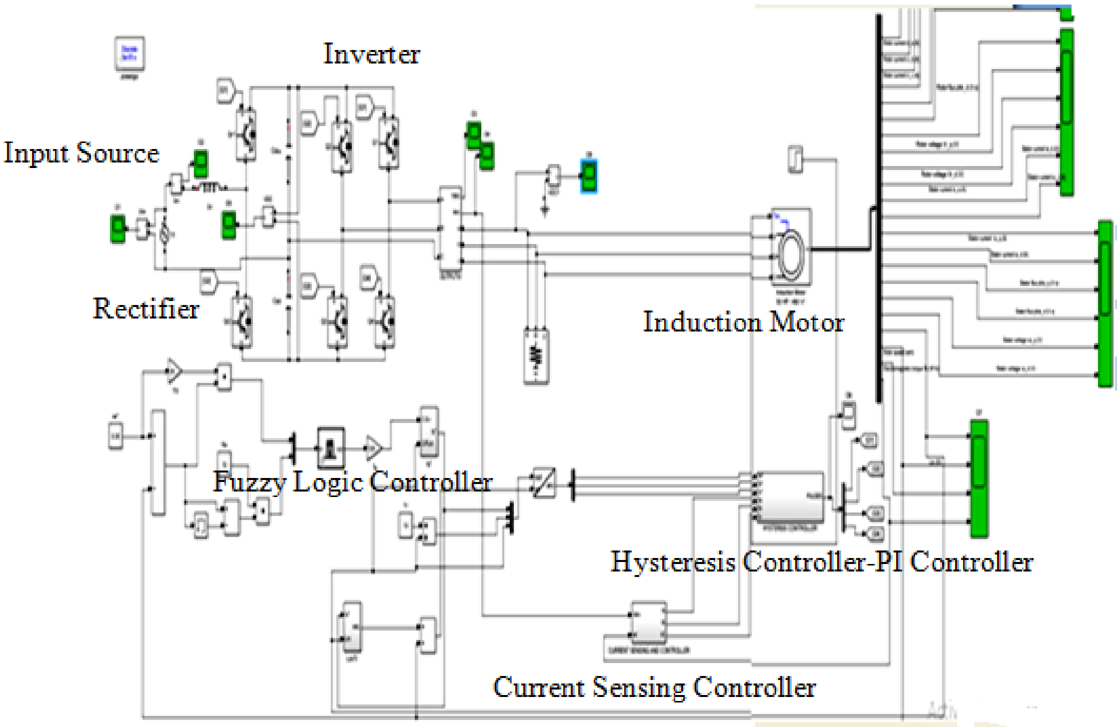

Figure 2: Three Phase Four Switch Inverter

A standard three stage voltage source inverter uses three legs with a couple of correlative power switches per stage. A diminished switch count voltage source inverter involves just two legs with four switches as displayed in Fig. 2.

The circuit comprises of 4 switches S1, S3, S4, S6, and two split capacitors Cdc1 and Cdc2. The dc voltage source Vdc is thought to be framed by the sustainable power sources. The power circuit is the three stage four switch inverter. Two stages "a" and "b" are associated with the two legs of the inverter, while the third stage "c" is associated with the middle mark of the dc interface capacitors, Cdc1 and Cdc2. The 4 power switches are signified by the parallel factors, where the paired "1" compares to an ON state and the double "0" relates to an OFF state. The conditions of the upper switches (S1, S3) and lower switches (S4, S6) of a leg are correlative that is S4 =1− S1 and S6 =1− S3.

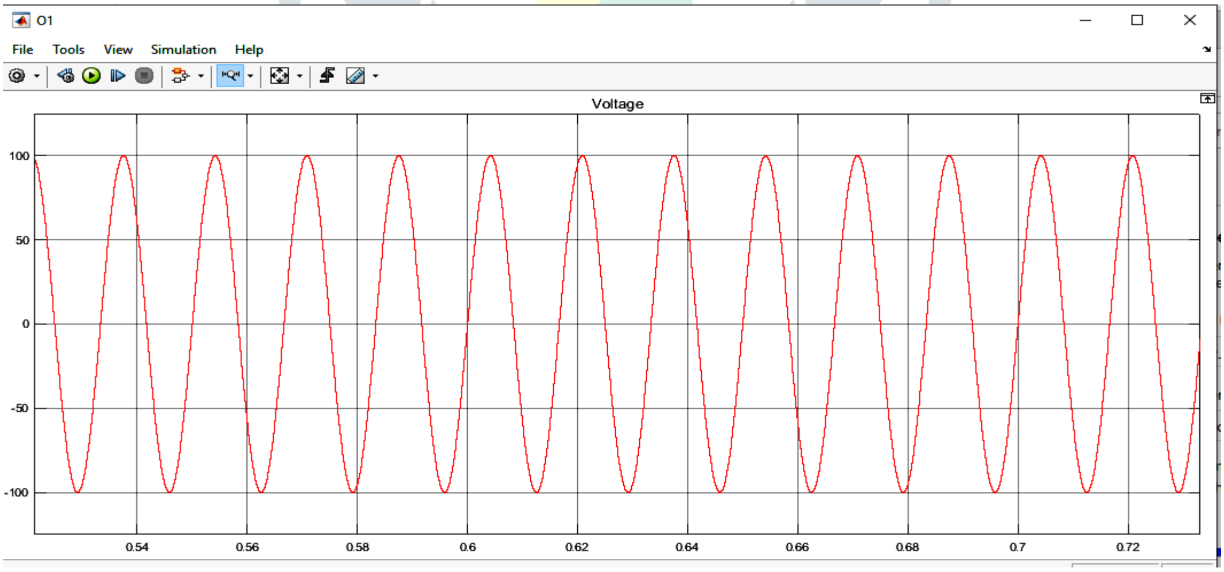

Figure 3: AC output voltage

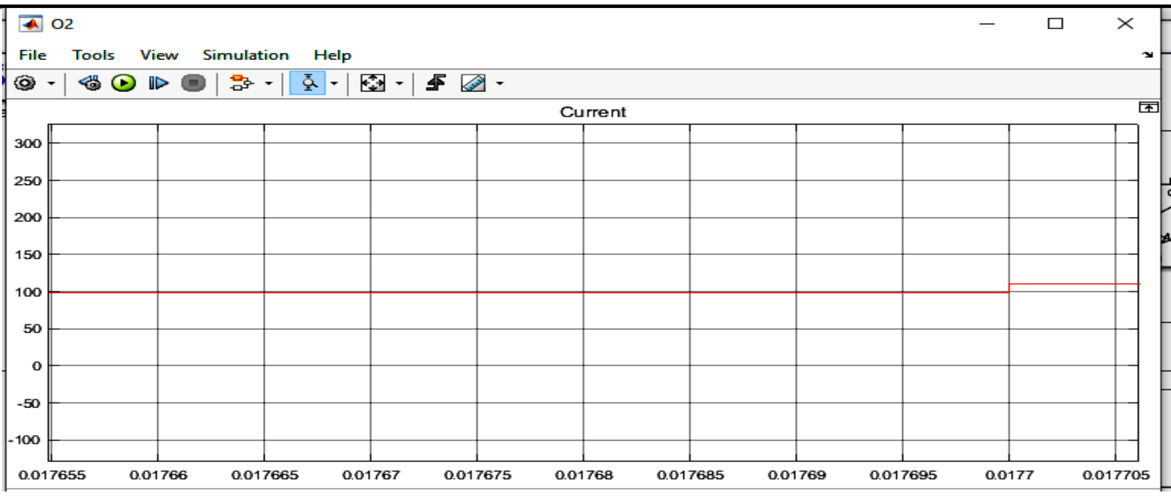

Figure 4: AC current

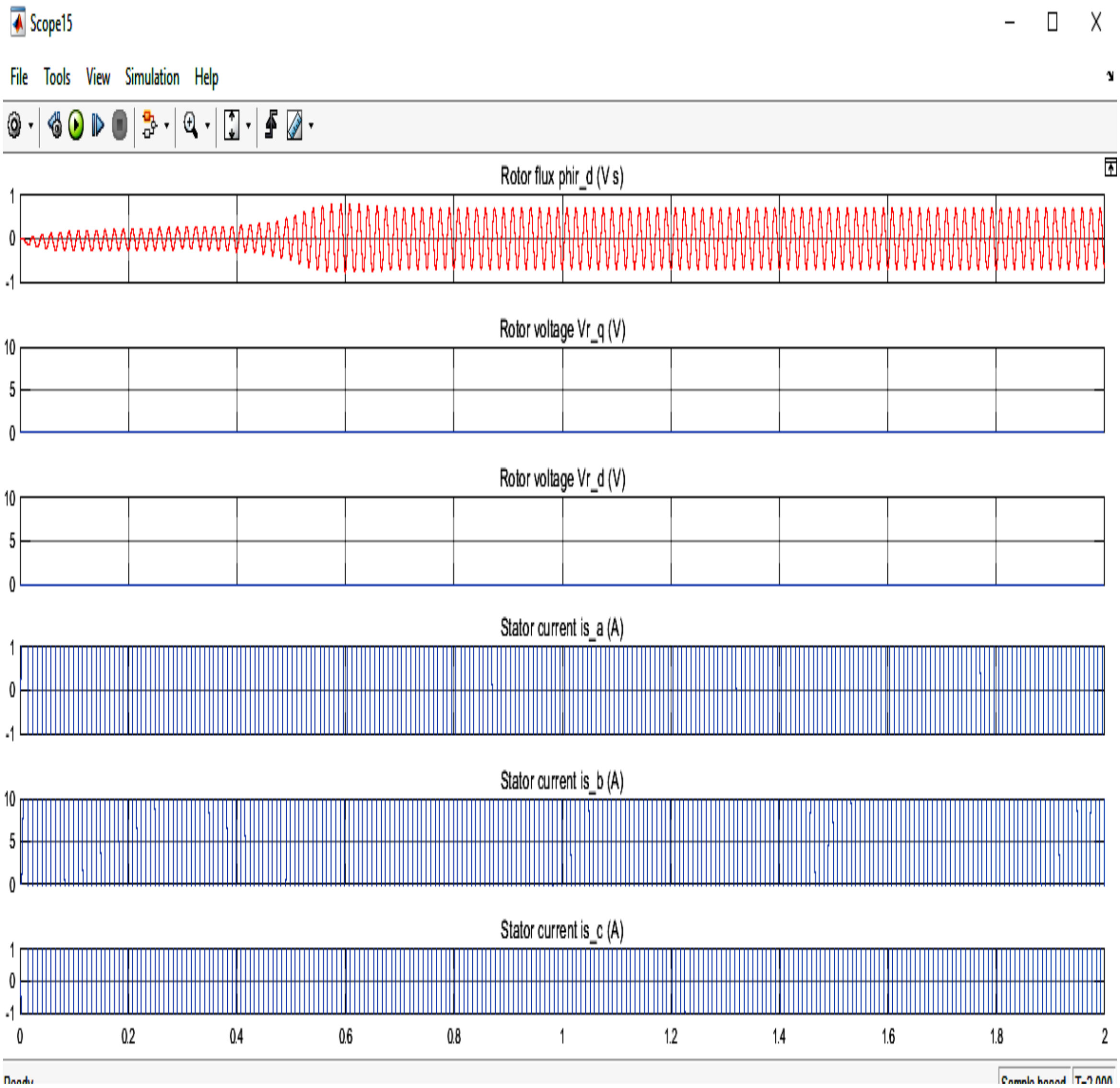

Figure 5: Rotor voltage and Stator Output Current

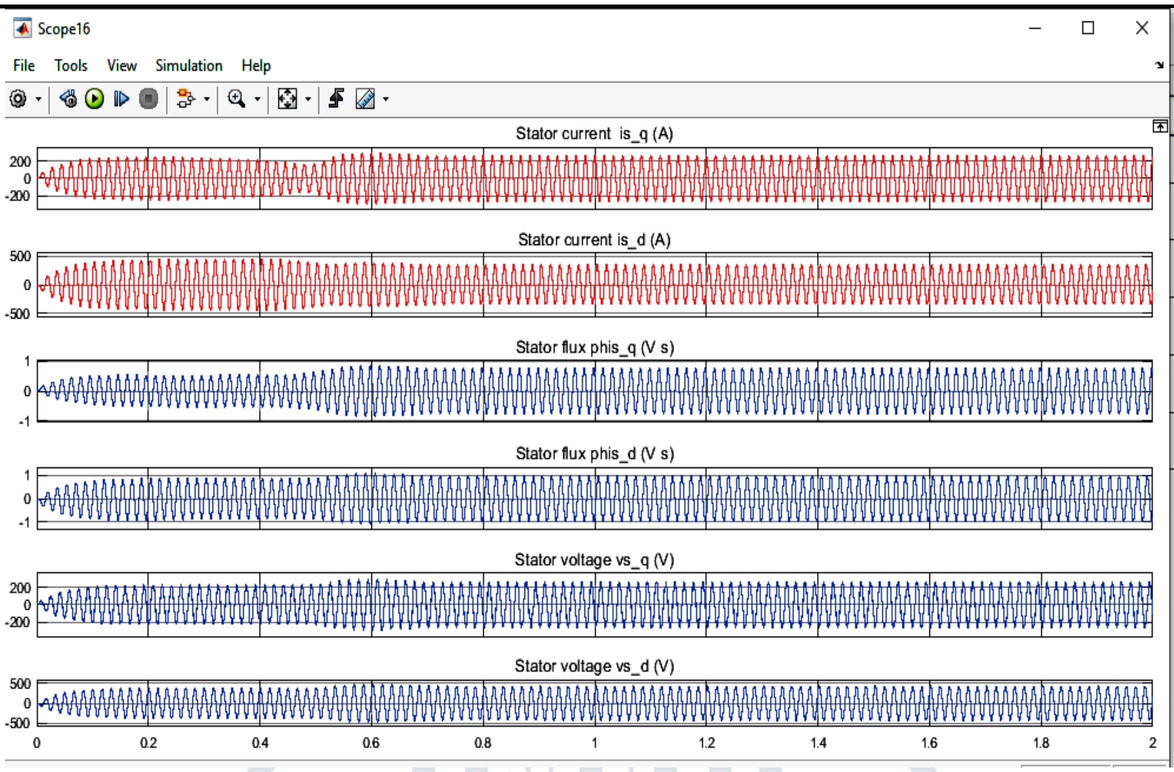

Figure 6: Stator Output

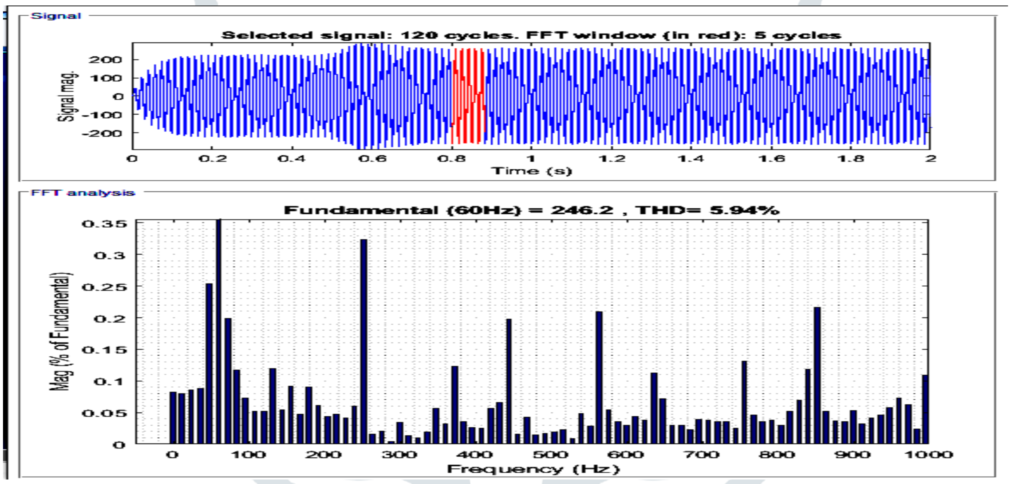

Figure 7: FFT Analysis

Table 1: Result Comparison

Sr No.	Parameter	Previous Model	Present Model
1	THD	20%	6.11 %
2	Rotor Speed	100	200
3	Voltage	380V	390V
4	Flex	0.8pu	1pu

Table 1 is showing the present model results with compare of the previous model results. Simulated result shows that the present model optimized significant better results than previous model.

IV. CONCLUSION

The present implementation is robustness design. The powerful speed reaction of the IM drive at low speeds is improved utilizing the FLC which is planned with low calculation weight to be fitting for ongoing applications. The legitimacy of the present FLC has been simulated at different speed reference following and burden torque unsettling influences, especially at low speeds.

Simulation is performed using MATLAB software. It is clear from the simulation results; the present model is giving the significant improved results then the previous work.

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