# Advanced Speed Control of Induction Machine Based on Vector Control

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## ABSTRACT

This paper presents an advanced speed control of induction machine using fuzzy logic controller (FLC)and artificial neural network controller (ANNC). The proposed strategy is realized by application ofindirect rotor flux-oriented control (IRFOC) on squirrel cage induction machine (SCIM) fed by a Pulse- Width Modulated (PWM) inverter. The speed (PI) controller usually causes a fluctuation in the transientstate especially in terms of: rise time, settling time, overshot and steady-state error which affects themachine performances. Therefore, in order to overcome this drawback, we have proposed in this paper the use of advanced controllers based on artificial intelligence (AI) techniques. The comparative study of IRFOC with conventional proportional-integral (PI), IRFOC with (FLC) and IRFOC with (ANNC) is carried out by MATLAB/SIMULINK software. The simulation results prove the superiority of the proposed advanced controllers in terms of good performance of the reference tracking dynamics.

**Keywords:** Conventional Controllers, Fuzzy logic controller (FLC), Artificialneural network controller (ANNC).

## 1 Introduction

Induction motor (IM) is one of the most commonly used electrical machines in industry. Many control strategies were invented to achieve their optimal and reliable performance. Among them, J. Bača and al. proposes a field oriented control (FOC) with employing a feed forward neural network as an estimator [1], while A.N. Mohammed and al. have suggested an adaptive hybrid Fuzzy-PID control approach based on(IFOC) [2]. In our paper we present two different strategies based on artificial intelligence (AI) in order to improve motor's performance, the comparative study with PI regulator demonstrates conclusively the superiority of advanced controllers.

## 2 Methodology

Based on induction machine's state space representation alongside with rotor flux-oriented control (IRFOC) equations, the obtained model is simulated in MATLAB/Simulink with several tests between the three controllers during 4s for each one. The first test consisted of the application of a constant referencespeed input and a load torque of 20 N.m at a time of 2s; while in second test the load torque was appliedat a time of 1s followed by a sudden change in the reference input at 2s.

## 3 Results and Discussion

Results of the first and second test are illustrated in figures 1 and 2:


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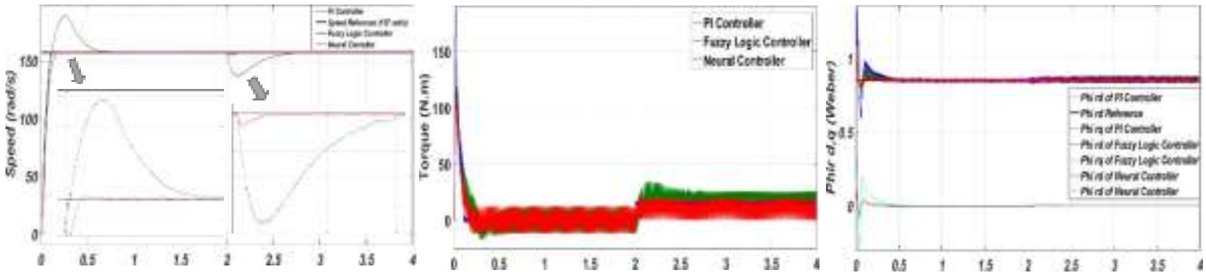


**Figure 1:** *Comparative Results for Speed, Electromagnetic Torque and Flux during 1st Test*

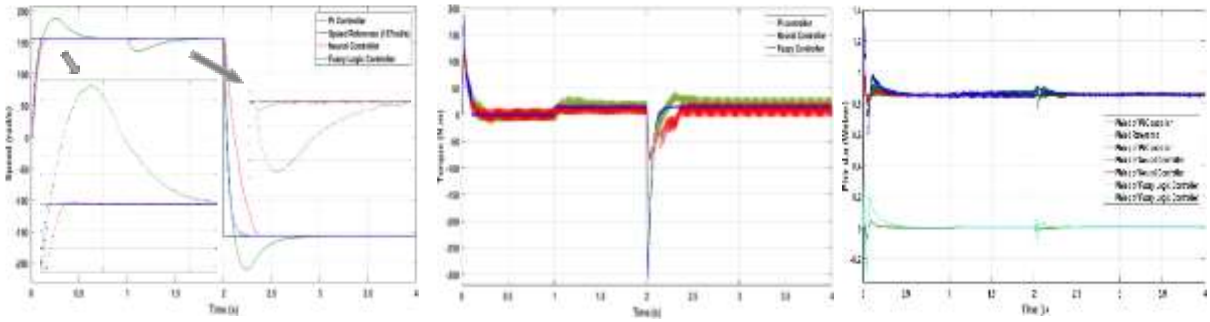

**Figure 2:** *Comparative Results for Speed, Electromagnetic Torque and Flux during 2nd Test*

According to Figures 1 and 2 of the two tests, we can see that the IRFOC strategy equipped with intelligent controllers is able to provide an acceptable tracking dynamics of the reference rotational speed with fastrise time, less settling time and no overshoot compared with the conventional IRFOC (equipped with PI controller). In addition, the two shapes of the two rotor currents and flux show that the objectives of thefield-oriented control are satisfied.

## 4 Conclusion

This paper has presented an advanced rotor speed control of induction machine based on (IRFOC) strategy using (FL) and (ANN) controllers compared with conventional PI controller. The obtained simulation results have proved the efficiency of the intelligent controllers. The simulation results also confirmed the robustness of these controllers by their quick convergence in the speed response and faster load disturbance rejection.

## 5 Declarations

### 5.1 Competing Interests

The authors reported no potential conflict of interest.

### 5.2 Additional Declarations

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## How to Cite

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