Study of the Effect of Field Current (Iq Current Axis) on Torque Three Phase Induction Motor Using Field Oriented Control

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Abstract. 3-phase induction motors as electric drives are very popular due to their lower prices, sturdy construction and maintenance-free. Induction motors also have non-linear characteristics so that they are difficult to regulate. In this study the vector method is used as a field setting on an induction motor, this method can make the coupled system a decoupled system. The test results show that the value of the field current (iqs) given to the Field Oriented Control (FOC) system affects the torque and rotation of the rotor. the greater the value of the field current (iqs), the smaller the torque value so that the rotor speed on the motor increases. Under the condition that the motor is loaded with 5 N and iqs 1 A, the electromagnetic torque value is 14.05 Nm, while at the 5 N and iqs 5 A load conditions, the electromagnetic torque value is 13.63 Nm.

Keywords: Induction motors, Non-linear, Field oriented control, Decoupled, Torque.

1 Introduction

The induction motor is the most widely used electric motor. The name comes from the fact that this motor works based on the induction of the stator magnetic field to the rotor, where the rotor current of this motor is not obtained from a particular source, but is an induced current due to the relative difference between the rotations of the rotor. and the rotating magnetic field generated by the stator current. Induction motors have several advantages including relatively cheap prices, simple and strong construction and good working characteristics, while the weakness of the induction motor itself is that it cannot maintain a constant speed when load changes occur[1].

Several methods were developed, namely the vector control method and then developed into several other methods such as Field Oriented Control (FOC) and Direct Torque Control (DTC)[2]. Both of these methods can be used as speed regulation for 3-phase induction motors, each with its own advantages and disadvantages. In this study, we will discuss the effect of the

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field current (iq current axis) on the torque of a three-phase induction motor using the FOC method. FOC is a setting based on the field setting or induction motor flux which will affect the rotational speed of the motor. It is assumed that the greater the flux value, the greater the field current generated so that it affects the rotation of the rotor which causes the motor speed to decrease.

2 Research Methods

2.1 Block Diagram FOC

Field Oriented Control is a method of setting the field on an induction motor, where the coupled system is converted into a decoupled system. With this system the gain current and motor load current can be controlled separately, thus flux and torque can also be adjusted independently separated.

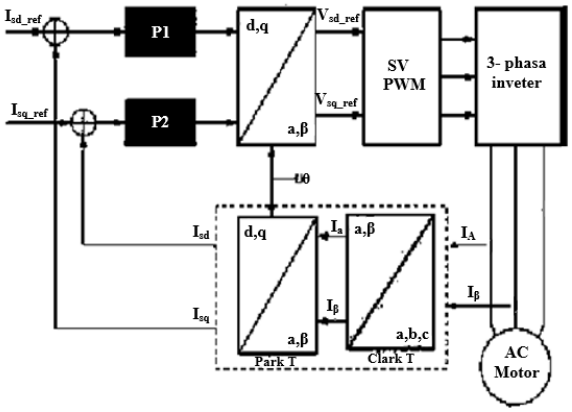

Fig. 1. Foc diagram block.

2.2 Three-Phase Induction Motor Modeling

Model The induction motor used in this modeling is a type of rotor cage (Squirrel-cage) induction motor. Which of these induction motors can be known the magnitude of the voltage or current of each phase. The resulting output consists of an electrical system, namely the value of the stator flux, electromagnetic torque and a mechanical system, namely the rotational speed of the rotor.

Table 1. Specifications of Three Phase Induction Motor

No	Parameter	Value	Unit
1	Voltage	560	Volt
2	Frequency	50	Hz
3	Speed	3000	Rpm
4	Pole	4	-
5	Stator resistance	4.1250	Ohm

6	Rotor prisoner	2.4860	Ohm
7	Stator and rotor inductance	0.0156	H
8	Magnetic inductance	0.2848	H
9	Moment of inertia	0.1390	J
10	Stator and Rotor Reactance	4.8915	Ohm
11	Motorcycle magnetic reactance	89.4726	Ohm

2.3 Research Flowchart

At this stage, explain the flowchart in the first stage, namely problem identification, which is the initial stage carried out in research so that it is known what problem will be raised. In writing this thesis the problem that is taken is the study of the influence of the field current (iq current axis) on the torque of a three-phase induction motor using FOC. Literature study is collecting some literature related to this research including scientific journals, reference books and other sources. Three-phase induction motor modeling in this study is to model and look for a three-phase induction motor model. Determine the parameters of the three-phase induction motor, in this step determine the parameters of the three-phase induction motor used in this study. The use of the FOC method is a field regulation method for induction motors, with this system the gain current and motor load current can be controlled separately, thus flux and torque can also be set separately. Analysis and conclusions At this stage analyze and then conclude the results of the study. If the performance analysis of the motor has not met the goals, it needs to be studied further so that the goals that have been set can be achieved. The conclusion is based on the results of the analysis that has been done. conclusion to confirm that the proposed idea has succeeded in solving the problem and research objectives.

3 Result and discussion

Testing the Simulation Results of Three Phase Induction Motor Using the FOC method with varying iqs values and 5 Nm torque load

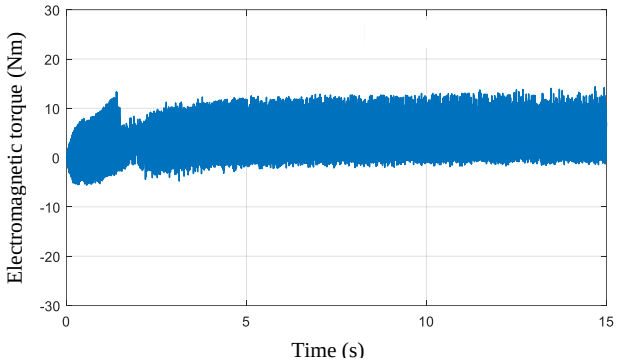

Fig. 2. Torque response with a load of 5 iqs 1

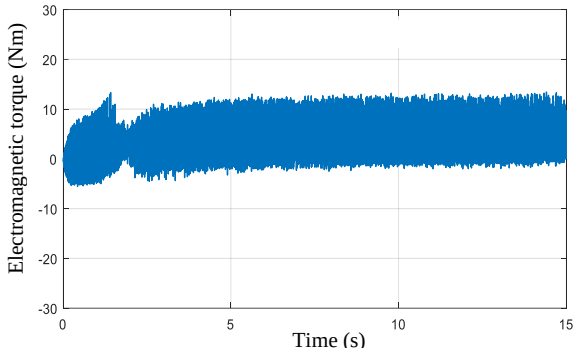

Fig. 3. Torque response with a load of 5 iqs 2

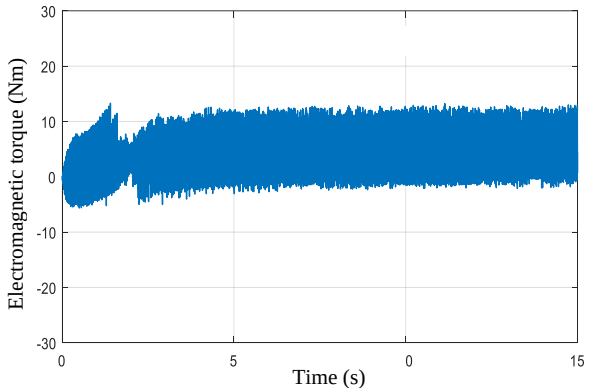

Fig. 4. Torque response with a load of 5 iqs 3

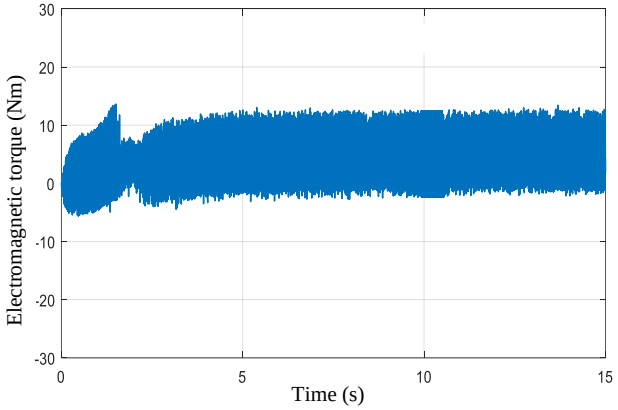

Fig. 5. Torque response with a load of 5 iqs 4

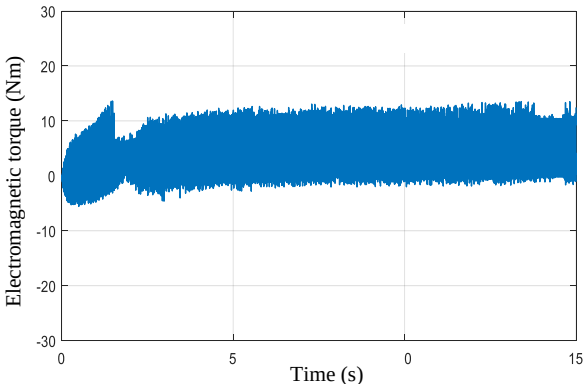

Fig. 6. Torque response with a load of 5 iqs 5

At this stage, a three-phase induction motor simulation test using the FOC method with Iqs varies by 1-5 A and a load of 5 Nm obtains electromagnetic torque. It is known that when Given Iqs of 1 A at 1.38 the value starts to increase by 13.34 Nm then starts to steady state at 2.5 at 14.05 Nm as shown in **Figure 2**. When given Iqs of 2 A at time 1.48, an increase in value of 13.45 Nm begins to occur and then starts to steady state at time 2.2 of 13.37 Nm as shown in **Figure 3**. When an Iqs of 3 A is given at 1.41, the value increases by 13.35 Nm and then starts to steady state at 1.99 at 13.05 Nm as shown in **Figure 4**. When the Iqs of 4 A is given at 1.40, the value increases by 13.28 Nm and then starts to steady state at 1.87 at 13.22 Nm, as shown in **Figure 5**. When given Iqs of 5 A at time 1.46, an increase in value of 13.63 Nm begins to occur, then starts to steady state at time 1.85 of 13.02 Nm as shown in **Figure 6**.

4 Conclusion

Based on the simulation results, it can be seen that this research uses a three-phase induction motor, the value of the field current (iqs) given to the FOC system affects the torque and rotation of the rotor. the greater the value of the field current (iqs), the smaller the torque value so that the rotor speed on the motor increases. Where at load conditions 5 and iqs 1 A obtained a torque value of 14.05 Nm while at load conditions 5 and iqs 5 A obtained a torque value of 13.63 Nm. The suggestions from this research are expected to develop a better control system and this research can be implemented in a system that uses a three-phase induction motor.

References

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