CONTROL OF AC INDUCTION MOTOR USING MICROPROCESSOR

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Abstract

Three-phase AC motors are widely used in the industry. For commercial equipment, operators must not interfere with the control structure due to the closed nature of the system. Therefore, the author proposes a solution to build a standardized hardware system that can interfere with the microprocessor’s control structure. The advantage of this solution is that it is inexpensive and allows us to install different algorithms.

Keyword: IM, V/f Control, PWM

1. INTRODUCTION

The vector control method for the stator current that uses coordinate transformations is analyzed into two components: torque control and magnetic flux control [1,2,4-8]. Three-phase motor control can be divided into scalar control and vector control [1-8]. The scalar control is simple to implement, but the dynamic quality of the system is not achieved as the vector control [3,9,10]. Therefore, the quality of control will be improved. However, the control structure of this method is complex and requires the computing power of the microcontroller to be strong enough. There have been some popular control methods implemented in industry: V/f control [3,9,10,11-16], FOC control [17-30], direct or non-direct control magnetic flux (DFOC, IFOC) [31-39], and flux attenuation control [40-45]. The two most common methods used in practical industry are the V/f control method and the FOC control method.

2. CONTROL STRUCTURE

The V/f control law for motor torque is as follows:

\[ M_r = \frac{L_m}{J_m} (\psi_r i_{\beta} - \psi_p i_{\alpha}) \]  (1)

For the control method based on the rotor flux, derived from the three-phase asynchronous motor model on the dq coordinate system [1], we have:

\[
\begin{align*}
\frac{di_{\alpha}}{dt} &= -\frac{1}{T_{rd}} i_{\alpha} + \omega_r L_{rd} i_{\beta} + \frac{1}{L_{rd}} u_{\alpha} \\quad (2) \\
\frac{di_{\beta}}{dt} &= -\omega_r L_{rd} i_{\alpha} - \frac{1}{T_{rd}} i_{\beta} + \frac{1}{L_{rd}} u_{\beta} - \frac{\psi_p}{L_{rd}}
\end{align*}
\]

According to [1], the FOC control law for flux and motor torque is as follows:

\[ M_r = \frac{3}{2} z_p L_m^2 \psi_p' i_{\alpha} \]  (3)

The V/f control structure that has been proposed is guaranteed by an amplifier stage with angular velocity input signal \( \omega \). The control structure deployed on the microcontroller is described as shown in Fig. 1. The speed controller adjusts the motor’s sliding speed to stabilize the speed.

![Figure 1 V/f control law](image-url)
The structure of the hardware system is described in Fig. 2. The output of the controller is the control signal sent to the engine. The method uses an integrator, the rotation angle value of the voltage vector is calculated. The product of the torque constant with the angular velocity is the voltage applied to the motor.

3. CONCLUSIONS

With the open structure of the microprocessor, the intervention of control structure and algorithm setting becomes more convenient. In future works, the author will implement different algorithms to test control quality on the hardware system using the built-in real-time microcontrollers platform. This ensures the implementation of applications in practice and the implementation of different algorithms.

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REFERENCES


tolerant control of induction machine drives based on EKF. IET Electric Power Applications.


