Research on Double Internal Model Control of Induction Motor Ac-Ac Frequency Conversion Speed Regulation System

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Abstract: According to the Advanced Internal Model Control Theory, a Dual Internal Model Control Structure is Proposed. Internal Model Control and Compound Cycle Control Induce the Model Design of the Expanded Speed Control System in the Outer Loop of the Frequency of Ac-Ac Variable Speed Control System. Based on the Principle of Internal Model Control and the Principle of Velocity Control System, the Regulator is Designed. the Designed Current Regulator Has Pi Structure, Flux Coupling and Regulator Have Pi or Pid Structure, But All of Them Have One Adjustable Parameter, Which is Simple in Structure and Convenient in Parameter Adjustment. the Simulation Results Show That the Output Dynamic Performance of the System is Better Than That of the Internal Model Control.

1. Introduction

Internal Model Control is Derived from Chemical Process Control. It Needs Low Model Accuracy, Good System Tracking Performance, Strong Robustness, and the Controller Needs Simple Structure, a Parameter, Clear Adjustment Direction and Convenient Online Calculation. That's Advanced Control Technology[1]. Internal Model Control is Applied to Industrial Processes with Large Time Delay, Such as Multivariable, Nonlinear, Strong Coupling and Temperature Control of Heat Exchanger. Ac Motor is a Multivariable, Nonlinear and Strong Coupling System, Which Can Be Controlled by Internal Model. in Fact, the Application of Internal Model Control in Resistance Field is More and More Popular. for Example, Limiting Current of Permanent Magnet Synchronous Motor, Voltage Regulation of Double Salient Generator, Current Control and Decoupling of Permanent Magnet Synchronous Motor. the Literature on 2-Dof Internal Model Control of Ac Servo System of Permanent Magnet Motor and Dynamic Separation of Stator Current of Induction Motor Shows That These Applications Are Successful. Internal Mode Control Has Many Advantages for Beat Frequency. in This Paper, the Internal Model Control is Extended to the Flux Multi Loop Control Induction Ac - Ac Variable Frequency Speed Control System and the External Loop Control Speed. Related Research

2. Double Internal Model Control of the System

2.1 System Structure

In the AC-AC Variable Frequency Speed Adjustment System of asynchronous motor, the speed with good dynamic characteristics is obtained. In order to realize the direction control of rotor magnetic field, the adjustment of speed and rotor flux system is often selected as the “current internal circulation, and the intersection of current, flux and speed control of the system are added. The system is a double closed-loop control system with stator current loop as inner loop and rotor flux link and speed loop as outer loop (flux link and speed loop are parallel)[2]. The current inner loop uses the current control system recorded in the literature. It is composed of “Pi current control method”, $U \times M$, $U \times T_1$ operation circuit, AC current and DC regulation link using coordinate transformation required by vector control. The indirect flux detection method based on flux sensor and speed sensorless technology is used in some structure flux and speed loops

2.2 Dual Internal Model Control Structure

The stator current control of motor mainly adopts internal model control. It can suppress the influence of motor parameters on system performance, eliminate unmeasured interference, and realize dynamic decoupling of stator current[2]. In order to give full play to the advantages of internal model control, the internal model control is extended to the closed-loop control of flux and speed of AC-AC Variable Frequency Speed Control System of induction motor. In accimc (s) is the current internal model controller, CIIMC (s) is the internal model controller of flux and speed, and G (s) is the controlled object. G (s) is the internal model of the control object, while R 1 (s) y 1 (s) is the input and output signal of the speed control system. For simplicity, it is assumed that both internal loop interference and external loop interference D1 (s) are zero.

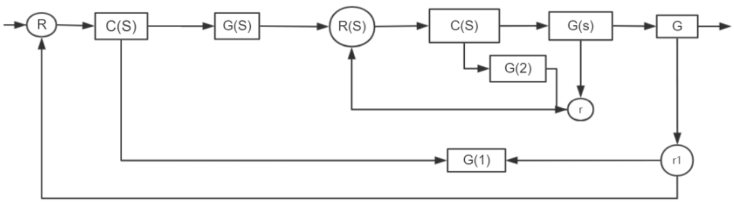

Fig.1 Double Internal Model Control Structure

3. Research on Internal Model Controller

AC-AC Variable Frequency Speed Regulating System of asynchronous motor, as shown in Figure 3, three independent single variable linear systems of current, flux and speed are separated, and their respective regulators are designed for “engineering design method”. The AC and DC current regulation loops are shown in Fig. 1, because the load current control system adopts the “Pi current control method” of AC and DC current[3]. Models the dynamic structure according to the “structural design method”. A design method of dual internal model controller for speed control system is proposed. The internal model controller of current, flux and velocity is studied and its performance is simulated.

3.1 Internal Model Controller of Current, Flux and Speed

3.1.1 Design Principle of Internal Model Controller

At present, the internal model controller is usually designed in two stages. First, a stable ideal controller is designed without considering the robustness and constraints of the system. Secondly, the low-pass filter L (s) is added to stabilize the system by adjusting the structure and parameters of L(s), so that the system can obtain the desired dynamic quality and robust performance. The specific steps are the initial filter design. The function of the filter is to ensure the stability, robustness and the possibility of realization of the internal model controller. L(s) includes functions capable of implementing elements and filters. The simplest form of the filter i s the first-order system of the inductive motor's EIF L(s) = coren/ (s + core) n. The internal model of the second controller design of the filter L (s), l (s) = core I / (s + core) can be selected. G (s) has a non minimum phase system, so this is G(s) = G + G (s) - L(s) can be decomposed, G(s) is the right zero of G (s) in half of the plane, and G -L(s) is the minimum phase system of the controlled object. Generally, in order to ensure that the internal model controller CIMC (s) is appropriate, the filter n must be larger, and the value of parameter λ is directly related to the performance of the closed-loop system. The smaller the λ value is, the slower the closed-loop output response is. Thirdly, the design of equivalent feedback controller. In order to compare with the design method, the internal model controller is equivalent to the feedback controller by using the correlation formula.

3.1.2 Design Principles of Current, Flux Chain and Speed Controller

“According to the internal model control principle of the current speed and flux controller design method, from the initial design of the current loop, flux and speed loop to the order of the initial and external loops of the internal loop, the” design design method “is adopted for the” chain design “and” speed loop “. The designed current loop is equivalent to the link between flux and speed loop. The flux and velocity controllers are designed[5]. Flux and rate controllers have the same design method. When designing the closed-loop, the internal model is designed according to the following steps and the closed-loop controller. When the model matches the object (g (s) = g (s)), get the internal pattern G - 1 (s) from the internal pattern g (s). Design the internal model controller CIMC (s). If necessary, the internal model can be set according to(s)] $F(s) = CIMC(s)/[G(s) \times CIMC(s)]$.

3.1.3 Research on Current, Flux and Speed Control

The AC current controller designed by “Pi current control method” is only a proportional controller, and the design method of DC current controller is flexible and diverse. The internal model control and internal model control generate the DC current controller design method. In the current regulator in the PI regulator, its possible adjustment function f(s), the adjustment parameters have a core I, and the regulator parameters are easy to adjust.

3.2 Research on Flux and Velocity Internal Model Controller of Other Structures

In the above design of flux and speed controller based on internal model control method, in order to get PI structure controller, $\lambda_J = \lambda_{\frac{I}{2}}$ and $\lambda_n = \frac{\lambda_I}{3}$ are selected. In a simple controller, the method depends on the adjustment of parameters, and λ_J and λ_n cannot be adjusted. Another configuration of the flux and speed controller will be described. The structure of the designed controller is relatively complex, but it does not depend on the parameter adjustment. There is only one adjustable parameter. Simply adjust.

4. Simulation Analysis of Controller Performance

The performance of current control, flux control and speed controller can be compared by computer simulation experiment[6]. As the current loop is relatively simple, the analysis method of the magnetic loop is the same as that of the speed loop, mainly analyzing the dynamic response performance of the speed loop.

4.1 Simulation Analysis of Dynamic Performance of Speed Cycle Output

4.1.1 Dynamic Simulation of Speed Ether ring Output

D shows a dynamic structure of a speed loop based on the “engineering method”. When AC-AC inverter and some other small time constants (feedback filter, trigger input filter, etc.) are considered together, $TS = 3MS$, equivalent time constant of DC current loop TEQ, $DI = 4TS = 12MS$ are taken. Set the time constant of mutual inductance $LM = 93.91HM$ logarithm of Marta pole NP = 2, winding inductance MH $LR = LM + LRE = 71.31$, $windingtr = LR / RR = 87.43$ as rotor.

4.1.2 Output Cycle Output Dynamic Performance Simulation

According to the internal model control method, the PI structure uses the dynamic structure diagram of the speed regulator of the speed loop, which is shown in Figure 4, and is modeled in the Simulink[7]. According to the parameters used in the model, the KM, t 'm value and the engineering design method are the same. In the electric flow loop, 500 cores I, use the internal model control method, PI speed controller structure, and its integration time constant $fin = 9$, and the scale factor KPN= λ_I /3 = 240. The input signal waveform of the speed loop is the same as figure 5a, and the dynamic response curve of the speed loop output

4.2 Dynamic Performance Simulation of Speed Ad Cycle Output 2

The speed controller designed by internal model control mode adopts PID structure, and the dynamic structure diagram of speed loop is shown in Figure 6. According to figure 6, Simulink can be used for modeling and simulation. The PID structure of speed controller, when used, the selected controller parameter is core[8]. The input signal waveform of the speed loop is the same as that in Fig. 5a, and the output dynamic response curve has a more dynamic performance than the speed dynamic performance designed by the engineering design scheme shown in Fig. 5D; the comparison between Fig. 5C and Fig. 5D shows that the internal speed control method is also used to design the speed loop. When the speed controller adopts PID structure, the performance is better than PI controller, but the structure is more complex[9]. The specific selection of internal model controller with PI or PID structure depends on the technical requirements.

5. Conclusion

Internal model control has many advantages, mainly used in the stator current control of AC motor. The dual internal mode control of the AC - AC variable frequency speed control system of the proposed induction motor further improves the performance of the speed control system and imitates the design method of the regulator. Based on the principle of internal model control, the regulator design method is obtained, and the current speed adjustment method of design is introduced. In the computer simulation test, after using the internal model control, the output dynamic performance of the system is designed according to the engineering design method.

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