EPH - International Journal of Science And Engineering
ISSN (Online): 2454 2016
Volume 03 Issue 04 December 2017

DOI: https://doi.org/10.53555/eijse.v3i4.123

INTEGRATED PARAMETER CONTROL SYSTEM FOR DRIVING MOTOR MOBILE INTERNET

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Abstract:-

The brushless dc motor is a new kind of stepless variable speed motor, convenient maintenance, high efficiency and high performance is excellent, has on many occasions to replace other kinds of motors. Therefore, the further research of brushless dc motor has become a hot spot, has broad market prospects. In brushless dc motor as the research object, this paper designed a set of brushless dc motor based on TMS320F2812 DSP closed-loop variable frequency speed regulation system. On brushless dc motor speed control system of the basic composition, working principle, mathematical model and control strategy is commonly used, and on this basis of brushless dc motor double closed-loop control experiments, the results show that under the double closed loop control, brushless motor can run stable and reliable.

Keywords: - *brushless dc motor; TMS320F2812. Double closed loop control; Frequency control of motor speed*

1 INTRODUCTION

Since it was introduced in the last century brushless dc motor, brushless dc motor on the international conducted in-depth research, successively developed Cheng Fang Bo brushless motor brushless dc motor and the sine wave [1]. For more than 20 years, with the permanent magnet new material, microelectronics technology, automatic control technology and the development of power electronic technology especially high power switching devices, brushless motor got rapid progress [2].

With the development of science and technology, in variety of domains such as aerospace, defense, civilian industry, for brushless dc motor speed control system performance requirements more and more high [3]. However, because of the open loop control of the brushless dc motor, there is no feedback quantity is the introduction of the system of automatic correction ability and poor anti-interference ability or deviation on the single closed-loop speed control, if speed given mutations, the output voltage of inverter bridge is large, it may cause the motor armature current surge, the armature winding or damage of power conversion circuit. Open loop or closed loop, therefore, it is difficult to control of the brushless dc motor for effective [4].

Control system in this paper in order to solve these problems, ti (Texas Instruments) of TMS320F2812 DSP as the main controller, in the brushless dc motor speed closed-loop control, on the basis of the introduction of the current loop, on the double closed loop control. Experiments have been carried out to test for the designed control system, to examine its performance in under the action of the double closed loop frequency control of motor speed operation, the experimental results validate the control performance of the system.

2 brushless dc motor speed regulation principle

2.1 Brushless dc motor mathematical model

In order to simplify the design, we made the following assumptions: (1) the three phase windings are symmetric, air-gap magnetic field for the square wave, the stator current, rotor magnetic field distribution is symmetrical. (2) ignore the cogging, commutation process and armature reaction, etc. (3) part of the magnetic circuit of the linear motor magnet, regardless of the effect of eddy current and hysteresis losses. Criterion based on the characteristics of brushless dc motor can establish its phase voltage equation, electromagnetic torque equation and state equation and equivalent circuit of brushless dc motor (BLDCM) [5].

(1) model of the phase voltage

Three-phase brushless dc motor stator voltage balance is:

$$\begin{bmatrix} u_A \\ u_A \\ u_A \end{bmatrix} = \begin{bmatrix} R & 0 & 0 \\ 0 & R & 0 \\ 0 & 0 & R \end{bmatrix} \begin{bmatrix} i_A \\ i_B \\ i_C \end{bmatrix} + \begin{bmatrix} L-M & 0 & 0 \\ 0 & L-M & 0 \\ 0 & 0 & L-M \end{bmatrix} P \begin{bmatrix} i_A \\ i_B \\ i_C \end{bmatrix} + \begin{bmatrix} e_A \\ e_B \\ e_C \end{bmatrix} \quad (1)$$

Type (1), and as the phase voltage of the stator winding; And, for the phase current of the stator winding; And, for the stator winding electromotive force; ,, respectively is self-inductance, mutual inductance and resistance of stator winding; Is the differential operator.

According to the type (1) be able to get the equivalent circuit model of brushless dc motor is shown in figure 1.

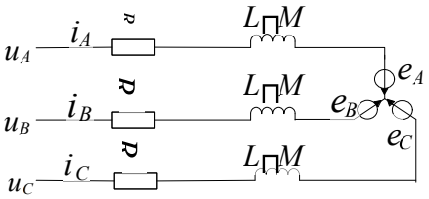

Fig. 1 Three-phase model equivalent circuit of BLDCM

(2) electromagnetic torque equation of Brushless DC motor The electromagnetic torque of Brushless DC motor is generated by the interaction between the current on the stator winding and the magnetic field generated by the rotor:

$$T_e = \frac{e_A i_A + e_B i_B + e_C i_C}{\omega} \quad (2)$$

Among them, for the angular velocity of brushless dc motor (rad/s). Can be seen from the type (2) the size of the electromagnetic torque is proportional to the flux and current amplitude, as long as the control of the inverter output current amplitude can control the electromagnetic torque of the motor.

2.2 Brushless DC motor speed control principle

(1) The principle of variable frequency speed regulation In the case of a star connected three-phase brushless DC motor, only two phase stator windings are energized at any time under ideal conditions:

$$u_s = 2e + iR = 2K_e n + iR \qquad (3)$$

Can get the expression of the speed:

$$n = \frac{u_s - iR}{2K_e} \qquad (4)$$

Type (4) : for in two mutually the average voltage on the electric winding; For the motor instead electromotive force; For the motor phase current; As the motor speed; For circuit equivalent resistance, including two-phase motor winding resistance and pressure drop of the equivalent resistance; The potential coefficient for the motor.

By type (4) it can be seen that the brushless dc motor speed adjusting can change both the average voltage on the phase winding. In this paper, by adjusting the inverter PWM signal's duty ratios of the main switching devices to adjust the average voltage, and then change the frequency of stator winding current, so as to realize the speed control of brushless dc motor.

(2) Double closed loop speed regulation the common speed current double closed-loop control system can achieve good control performance, can be achieved within a certain range of speed or constant speed steady speed control. The principle diagram is shown in Figure 2. It needs to have the speed feedback and current feedback, so usually need to set the speed sensor and the current sensor. The working principle of the system: first of all, the speed of the given value and feedback value, get the speed value, the speed regulator PI regulation, output current loop as the given value, and the current feedback value is compared, difference of current through the current regulator for necessary amplification and correction, the adjusted signal phase in PWM transform circuit The pulse width should be PWM, then the rotor position signal generating the PWM control signal is required. The PWM control signal is sent to the base set (or gate, gate) driving circuit, driving the three-phase inverter bridge circuit, the power switching device accordingly, through the appropriate PWM duty cycle to drive the motor winding [6].

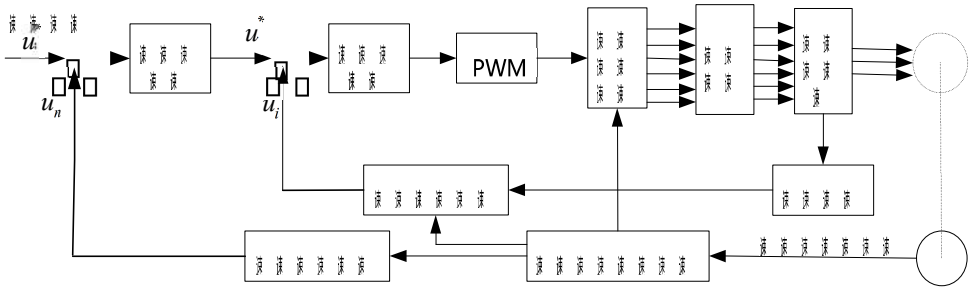

Fig.2 Speed, electric current double closed-loop control system diagram

3 control system hardware and software design

3.1 hardware design

Based on the hardware diagram of DSP brushless DC motor speed control system as shown in Figure 3, the main control circuit, power conversion circuit, driver circuit, detection circuit and protection circuit. The control circuit, TMS320F2812 circuit with DSP as the core, its function is: to measure the speed and current feedback value, complete the speed loop and the current loop controller operation, generating PWM signal to control the motor, IGBT control switch; power change circuit part is composed of six IGBT built, it is under the control of the PWM signal, the working voltage of the motor according to the three-phase windings to make. Motor; position signal and current detection circuit of the main motor feedback signal, and sent to DSP; the protection circuit is mainly used to prevent IGBT due to over-current, short-circuit or other accidents are burned, overvoltage and undervoltage protection, over-current protection, over temperature protection.

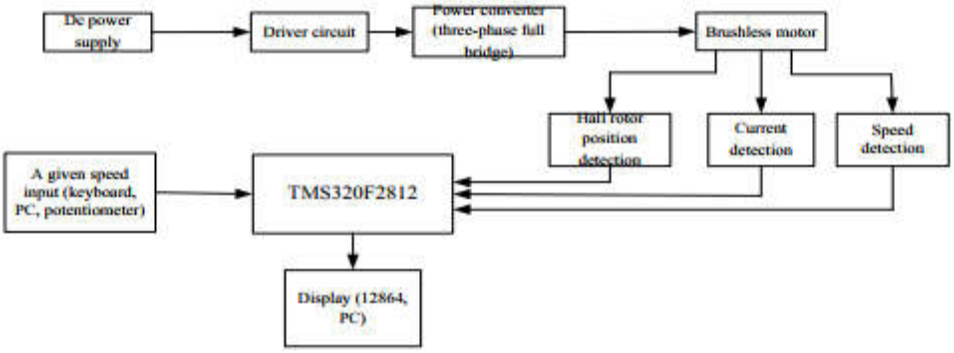

Fig. 3 Control system hardware diagram of BLDCM

3.2 Software design

The program is written by TI's CC Studio v3.3 software. In the software, the main program function is by calling the subroutine, the program cycle operation, to achieve the required control requirements. The parameters in the system settings, input parameters, speed calculation, PID algorithm, are realized by calling the subroutine and interrupt program. The main program flow chart is shown in Figure 4.

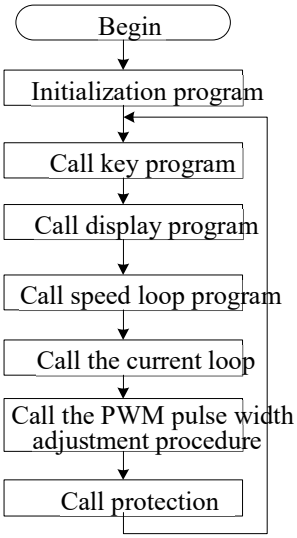

Fig.4 Flowchart of main program

4 Experimental results and analysis

This paper carries out an experiment on the control system. We need to brushless motor speed were measured by Visual Basic 2010 software of the host computer, change the speed of the given input continuously in the PC real-time PWM value, duty ratio and speed curve of the PC as shown in Figure 5.

Fig.5 Display of the upper computer

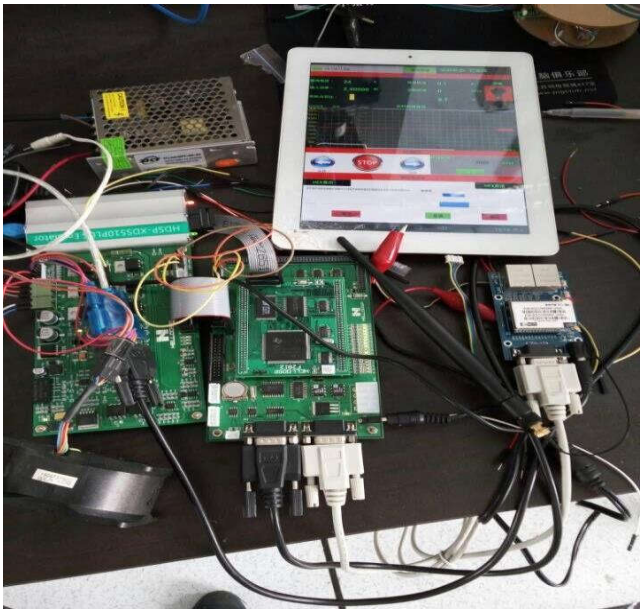

Fig.6 Visual illustration

In the experiment, the PC given speed is 3600n/min, the actual speed is 3612n/min; the PC given speed is 3000n/min, the actual speed is 2978n/min; the PC given speed is 2000n/min, the actual speed is 1979n/min; the PC given speed is 1000n/min, the actual speed is 1020n/min; the PC given speed for 500n/min the actual speed is 484n/min, this can get in, allow a certain error under the condition of Brushless DC motor Speed and current double closed loop control, can make the response speed follow a given speed quickly, with a given speed is basically consistent, indicating that the brushless motor closed loop control has achieved good results.

5 Conclusion

This paper takes TMS320F2812 DSP as the core controller of brushless motor basic principle of frequency conversion and the hardware design of control system, and has carried on the current loop and speed loop of the double loop control experiment, the experimental results were analyzed. The results show that the control system is stable, fast response, wide speed range.

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