Waijung Blockset-STM32F4 Environment for Real Time Induction Motor Speed Control

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***Abstract*— Induction motors of wound rotor or squirrel cage type are widely used in industry application due to their low cost and robustness. Nevertheless, for a long time, these types of motors were used especially in variable speed drives. During the two last decades, due to the great progress in microelectronic control systems and power converters they became also an important in controlled constant speed drives. This paper presents a solution to control an AC induction motor (IM) using Waijung Blockset and STM32F4 DISCOVRY that enable cost-effective design, reducing the system components and increase efficiency. The aim of this work is to keep a constant speed at variable mechanical torque .Thus a closed loop speed control for an induction motor with scalar control technique is presented. Verification of the proposed controller is provided by experimental tests. The experimental results show the effectiveness of the speed controller with a wide range of load.**

Keywords—Induction Motor; Scalar Control; STM32F4; Waijung Blocset; Speed control.

I. Introduction

The motor control is a competitive field; the variable speed drives must address several design constraints including cost reduction, power consumption reduction, and reduced electromagnetic interference radiation. In order to meet these challenges, advanced control algorithms are necessary. Embedded control technology allows both a high level of performance and system cost reduction to be achieved [1]. According to market analysis, the majority of industrial motor applications use AC induction motors (IM). The reasons for this are higher robustness, higher reliability, lower prices and higher efficiency on comparison with other motor types [2]. However, the use of induction motors is challenging because of its complex mathematical model, its nonlinear behavior during saturation and the electrical parameter oscillation that depends mainly on the temperature. These factors make the control of induction motor complex and demand high performance control algorithms such as “vector control” and a powerful microcontroller [3].

The control methods of IM are mainly classified into scalar based and vectors based controllers. Vector control algorithms are based on mathematical model valid for dynamic states, and allow the control of the instantaneous position of the current, voltage and flux vectors for both steady states and transients regions [4, 5]. This guarantee a good dynamic response and a high performance control. But these types of control methods require a complex algorithms and much computational efforts [6].

The simplicity of the controller is a major concern. Thus the scalar control presents a good alternative when accuracy of the speed response is not mandatory, especially in applications such as heating, ventilation and air conditioning [7, 8]. This method based on the relation valid for steady states, only the magnitude of voltage and flux are controlled. Therefore this approach belongs to low-performance control algorithms for IM [11].

Scalar control is the term used to describe a simpler form of motor control, using non-vector controlled drive schemes [9, 10]. An AC IM can be led to steady state by simple voltage or speed controlled schemes. Although its transient behavior is not ideal, a scalar system leads to a satisfactory steady state response [12].

This work presents an efficient implementation of a closed loop speed controller. The control system was developed for a space vector modulation-voltage source inverter and the three-phase IM, in order to adjust the speed with scalar control technique. The test bench used for validation is built around a STM32F4 DISCOVRY and Waijung Blockset to implement the speed control and the modulation scheme. Waijung is a Simulink Blockset that can be used to easily and automatically generate C code from Matlab/Simulink simulation models for many kinds of microcontrollers (Targets) [13]. The performance of the proposed controller is verified by a series of experiments. These consist of step variation of load torque and speed references.

This paper is structured as follow. Section II develops the scalar control for induction motor. Section III presents some simulation results. Experimental results for different scenario are shown in Section IV. Finally, conclusions are contained in Section V.

II. Scalar Control

In many industrial applications, the needs to good dynamic properties are not necessary. This is especially where no fast speed variation is required and where there are not instantaneous load torque variations [14, 15]. The scalar control focuses only on the steady state dynamic. This technique is based on the assumption that the flux magnitude is constant in the steady-state operation. The speed of IM is controlled by adjusting magnitude of stator voltages and

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