Super Twisting Control Algorithm Applied to the Brushless DC Motor (BLDCM)

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***Abstract*--This work relates to the super twisting algorithm control of brushless DC motor (BLDCM) or electronically commutated (ECM). First, we establish a dynamic model for direct current to the input of the switch that the electromagnetic torque of BLDCM is proportional to this current. This model is intended to facilitate the procedures for setting and controlling the current. In this paper a recent method called super twisting algorithm is applied to the BLDCM, in order to avoid the chattering problem and to improve control performance. High order techniques allow us to keep the main advantages of the classical sliding mode and to remove the chattering problem.**

***Index Terms*--brushless DC motor, direct current model, sliding mode, super twisting algorithm, speed control.**

I. INTRODUCTION

RECENTLY, the DC motors have been gradually replaced by the BLDC motors since the industrial applications require more powerful actuators in small sizes. Elimination of brushes and commutators also solves the problem associated with contacts and gives improved reliability and enhances life. The BLDC motor has the low inertia, large power to volume ratio, and low noise as compared with the permanent magnet DC servo motor having the same output rating [1]-[3].

In general, the BLDCM is supplied through a three-phase inverter transistor that acts as the electronic switch of the phase current, the control of the torque is then up to a current control i_d [4]. The control of the phase currents required since the reconstitution of these currents which is not easy. It is easier to directly control of the current. In most cases using a voltage inverter current controlled. As the engine torque is proportional to the DC input of the switch where the interest to influence the form of the current to optimize torque and to minimize the current [5]. The control strategy based on sliding mode technique can offer many good properties, such as the low sensitivity to the matching parameter variations and its robustness against to a large class of perturbations; many works proceed to use this technique into the control of this machine in order to improve the stability and the robustness of closed loop system [6].

However, the chattering phenomenon represents a limitation for this technique. In order to overcome this drawback, several techniques have been proposed. This work presents in section I, the model of three-phase BLDCM Section II develops the dynamic model. Section III is devoted to the sliding mode control based on the dynamic model, the super twisting algorithm control and simulation result of this machine presented in Section IV, Finally in the conclusion are set out the essential findings of this work.

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II. EQUATIONS OF ELECTRICAL AND MECHANICAL OF BLDCM

The model simplified of the BLDCM is shown in figure 1:

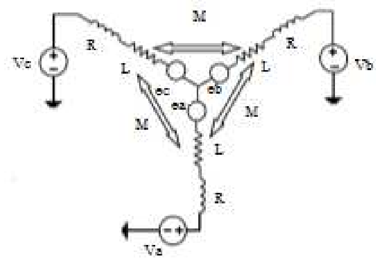

Fig. 1. The model simplified of the BLDCM

For a symmetrical winding and a balanced system (Fig. 1), the vector of voltages across the three phases of the BLDC motor is given by:

$$\begin{bmatrix} v_a \\ v_b \\ v_c \end{bmatrix} = \begin{bmatrix} R & 0 & 0 \\ 0 & R & 0 \\ 0 & 0 & R \end{bmatrix} \begin{bmatrix} i_a \\ i_b \\ i_c \end{bmatrix} + \frac{d}{dt} \begin{bmatrix} L-M & 0 & 0 \\ 0 & L-M & 0 \\ 0 & 0 & L-M \end{bmatrix} \begin{bmatrix} i_a \\ i_b \\ i_c \end{bmatrix} + \begin{bmatrix} e_a \\ e_b \\ e_c \end{bmatrix} \quad (1)$$

Where v_a, v_b and v_c are the phase voltages of the BLDCM, i_a, i_b and i_c are the phase currents, R and L are the resistance and inductance of the machine, e_a, e_b and e_c are the electromotive forces of the phases.

The electric torque is given by:

$$C_e = \frac{(e_a\, i_a \ + e_b\, i_b \ + e_c\, i_c)}{\omega_r} \quad (2)$$

Where C_e is the electromagnetic torque and ω_r is the angular velocity.

III. MODELING OF THE BLDCM

Figure 2 show the schematic diagram for controlling the BLDCM:

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