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SPEED CONTROL OF BLDC MOTOR BY USING UNIVERSAL BRIDGE WITH FUZZY BASED TECHNIQUE

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ABSTRACT

The adaptive and non adaptive nonlinear back stepping control approach for a BLDC motor drive is discussed and analyzed. Then, the sensorless method advances are reviewed and recent developments in this area are introduced with their inherent advantages, including the analysis process of practical implementation issue and its applications. The study includes a depth overview of state-of-the-art back EMF sensing methods, which includes the Terminal Voltage Sensing (TVS), Third Harmonic Voltage Integration (THVI), Terminal Current Sensing, Back-EMF Integration and PWM strategies. The experimental results carried from prototyping platform are given to illustrate the efficiency methods and benefits of the proposed approach and the various stages of implementation of this structure in FPGA.

Keywords: BLDC Motor, PMSM Motor, Fuzzy Logic, Sliding Mode Control.

I. INTRODUCTION

The efficiency of electrical machine drives is greatly reduced at light loads, where the flux magnitude reference is held on its initial value. The non adaptive

back stepping is a rigorous and procedure design method for nonlinear feedback control.

The inherent parallelism of FPGA components offers the possibility to run several algorithms in parallel control and configure them according to the defined criteria.

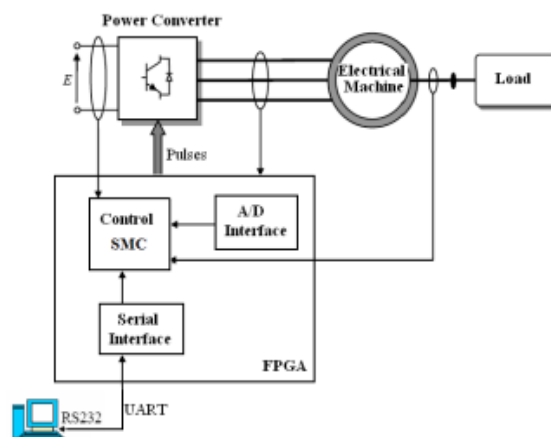


Fig 1.1 Architecture of sliding mode control

The PMSM has very large power factor & density and high efficiency. In a high performance control of PMSM, the information of rotor position and speed is very important [1].

The FPGA technology is now used by an increasing number of designers in various fields of application such as signal processing, telecommunication, video, embedded control systems, and electrical control systems. Indeed, these

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components have already been used with success in more different applications such as Pulse Width Modulation (PWM), control of induction machine drives and multi system machine control. This is because the FPGA based implementation of controllers can efficiently answer current and future challenges of this field. [2].

Considering the complexity of the diversity of the electric control devices of the machines, it is difficult to define with universal manner a general structure for such systems [3].

A fuzzy sliding mode speed controller with a load torque observer is designed it which can be effectively mitigates chattering and guarantee of robust speed control mechanism of a PMSM under model parameter and load torque variations. Furthermore, the proposed control methods consider the disturbance inputs representing this system nonlinearity or the unmodeled uncertainty [4].

A distinctive feature of this approach is that, by appropriately parameterizing and implementing the sliding mode controller, the discontinuous nature of the voltage source inverter may be directly incorporated into the design process [5].

The existing literature has proposed some methods to reduce torque and flux ripple by optimizing the duty ratio of the active vector. The novel method is superior to the existing methods in terms of simplicity and robustness. By appropriately arrange the sequences of the vectors; the commutation frequency is reduced effectively without performance degradation [6].

A multitude of flux observers have been proposed for flux estimations, but most of them fail to fare in the low speed region. Unlike conventional flux observer's, this observer's does not requires any speed adaptation mechanisms and it's immune to speed estimation error. A novel stator resistance estimation is incorporated by the sensorless drive method to compensate the effects of stator resistance variation [7].

Existing Method

The inverter which is connected to the dc supply feeds controlled power the motor. The magnitude, frequency of the inverter output voltage depends on their switching signals generated by the hysteresis controller.

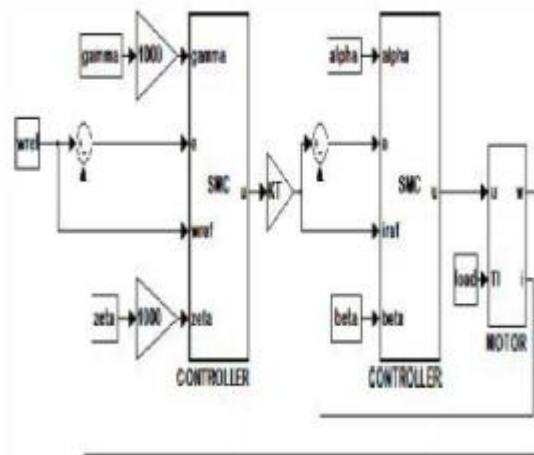


Fig 2.1 Explicit-Data Close to output flip-flop

The state of this switching signal at any instant process is determined by the rotor position, speed error, winding currents. The controller synchronizing the winding currents in the rotor positions. It also facilitates the variable speed operation of the drive and maintains the motor speed reference value even during load variations and supply fluctuations. The FPGA implementation of the predictive switching strategy could be accomplished using three independent two-level hysteresis currents' error sign (Δ is) comparators. However, this might introduce limited cycles, as only two motor currents are independent. This vector

changes whenever the control error exceeds the prescribed value, by taking into account all the dynamical changes and external disturbances enclosed by the equivalent control.

SLIDING MODE CONTROLLER

The sliding mode controller modelling approach involves two different stages. The first stage considers the modelling of switching functions, which provides the desirable system performance in the sliding mode. The second stage consists of modelling a control law, which will ensures the sliding mode, and thus the

Most BLDC motors have three Hall sensors inside the stator on the non driving end of the motor. Whenever rotor magnetic poles pass through near the

Hall sensors they give a high or low signal indicating the N or S pole is passing near the sensors.

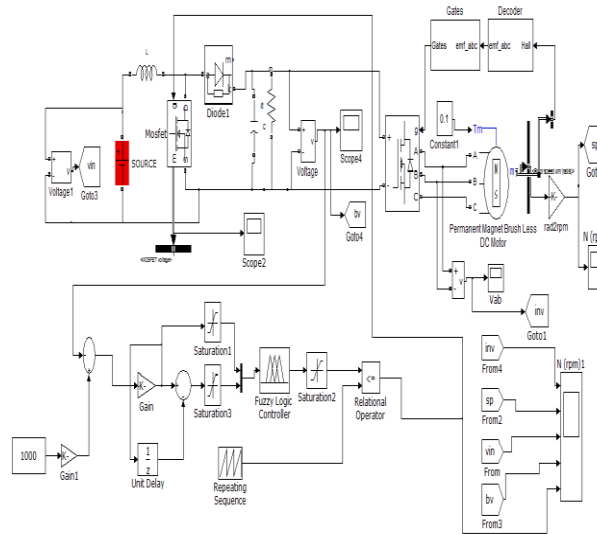


Fig 3.3 Circuit Diagram

Fuzzy Controller

Fuzzy Logic is based on fuzzy set and fuzzy logic membership functions are used to represent the fuzzy set and in this paper, triangular membership function is used. The error in speed and the rate of change of speed error are considered as the input linguistic variables and the quadrature axis current is considered as the output linguistic variable. The error

change is the difference in error from one sample period to next. If they current error is a small positive number vehicle speed is slower than commanded the controller needs to slightly increase the throttle angle in order to speed up the vehicle appropriately. If both of us current error and error change are positive, the vehicle is going too slowly and decelerating.

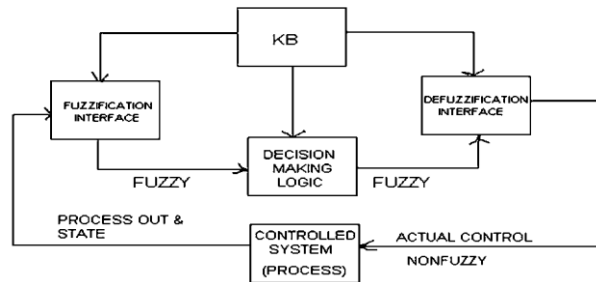


Fig 3.4 Fuzzy Logic Diagram

Simulation Result

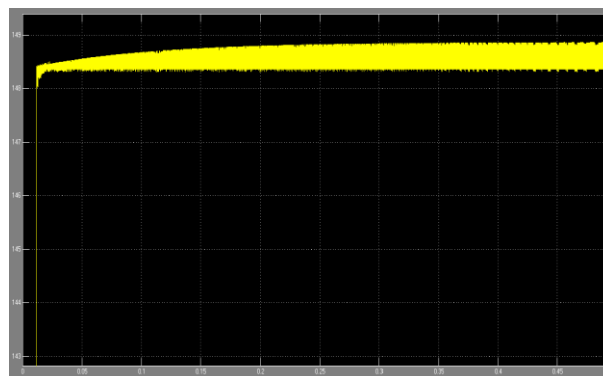


Fig 4.1 Simulation Result

The output voltage waveform is when the motor starts the actual speed to reference speed. The output voltage varies between the speeds of motor. The input voltage will be constant. The output varies 148 to

149v the level of 1000set speed. After comes set of speed control voltage is constant level of the speed as shown in below figure.

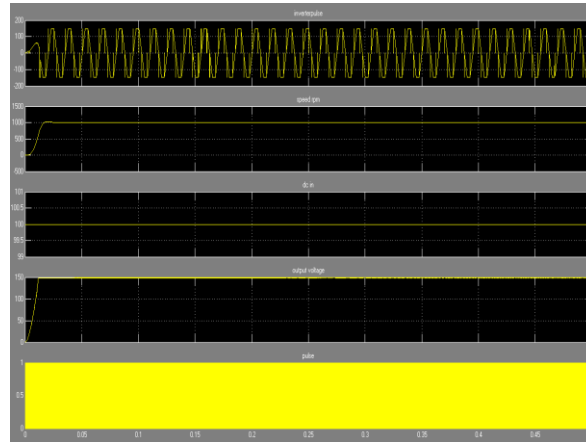


Fig 4.2 Simulation with Input and Output

The PWM control blocks converts an analog input level into a variable duty cycle switch drive signal. If they high output is commanded, the switch is mainly held on most of the period. The switches are usually both on and off once during each cycle of the switching frequency, but many designs are capable of holding a 100% on duty cycle.

CONCLUSION

It is also detailed the speed control basic circuit of voltage source inverter, which control its output waveform. The output waveform frequency is lab view of MATLAB tool software simulate the basically independent of trapezoidal inverter pulse wave levels. The SM controller is simulated under transient conditions and a comparative study of the results with that of fuzzy controller has been presented and proved that SM controller has better performance in all aspects. In sliding mode control, there is a problem with chattering effect due to the presence of switching imperfections, switching time delays and discontinuity in control. In my future work, I plan to replace the discontinuous control functions such as signal and saturation functions with a continuous sigmoid function and compare the effect of chattering.

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