Performance analysis & Torque Ripples minimization of BLDC motor using controller

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ABSTRACT

A motor converts the supplied DC electrical energy into mechanical energy. Brushless DC (BLDC) motor feature high efficiency and excellent controllability, and are widely used in many applications. The BLDC motor has power-saving advantages relative to other motor types. The reason of popularity is due to its simpler speed control with enhanced performance by the use of electronic commutation. This paper presents a simulation study of Speed Control of BLDC motor for performance analysis and comparison using intelligent controller (ANFIS) with conventional controller (PI, PID). The further study will be used for minimizing the ripples [1]in Torque and Speed along with admissible current control. The simulation study and analysis of results will form the basis of the conclusion.

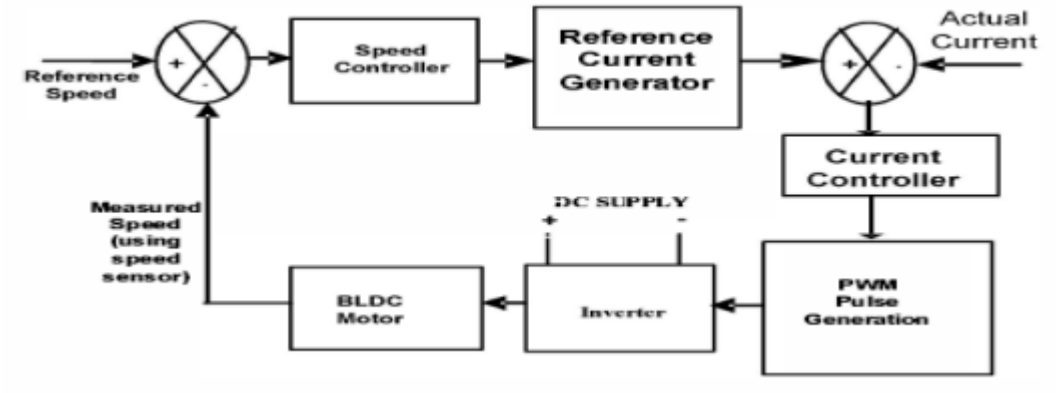
Keywords: Brushless DC motor (BLDC motor), Electronic commutation, Speed Control, ANFIS (intelligent controller), PI, PID (Conventional Controller), Torque Ripples.

INTRODUCTION

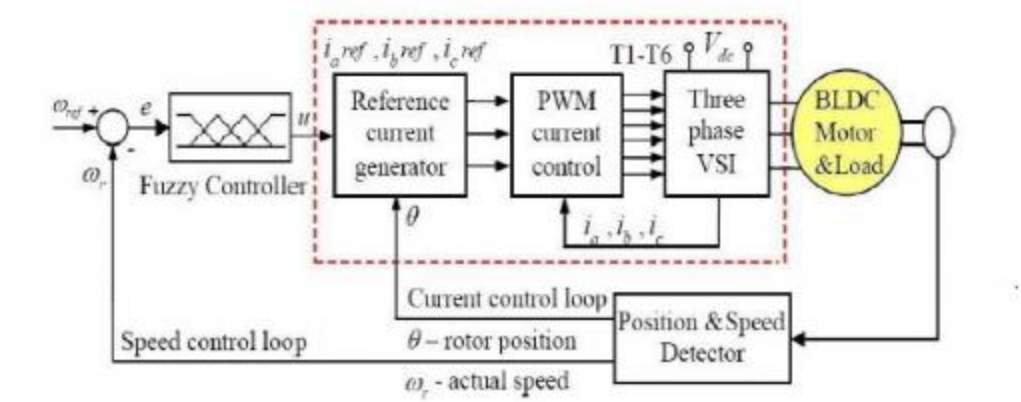
The permanent magnet brushless DC (BLDC) motor is the ideal choice for applications requiring high reliability and high efficiency. The BLDC motor is considered to be a high-performance engine and is capable of delivering large amounts of torque over a wide range of speeds. BLDC motors are the derivatives of the most commonly used DC motor and having the same torque and speed curve characteristic[2]. A BLDC motor requires an inverter and a rotor position sensor to perform a switching process because a permanent magnet synchronous motor does not have a brush and a commentator on DC motors. BLDC motor has better performance, reduced acoustic noise and more convenient features. These BLDC motors are suitable for applications such as automotive, medical equipment, transport, HVAC, electronics, computer, motion control and many industrial tools. ANFIS controller provides feasibility and ease of access to controllers in terms of linguistic variables. Schemas based Adaptive Neuro-Fuzzy [3][4]Controller Based on Emotional Learning Algorithm designed for speed control [2] of brushless (BLDC) drives have been implemented. Modeling and simulation analysis for BLDC motor provides a good foundation and method for system design and intelligent control strategy verification. Performance is observed with the Conventional Speed Controller and the ANFIS Speed Controller, and a comparison is made to know which gives the best results. The drive system depends on the position and the current sensors for the control.[5]

1.SPEED CONTROL SCHEME FOR BLDC MOTOR DRIVE SYSTEM:

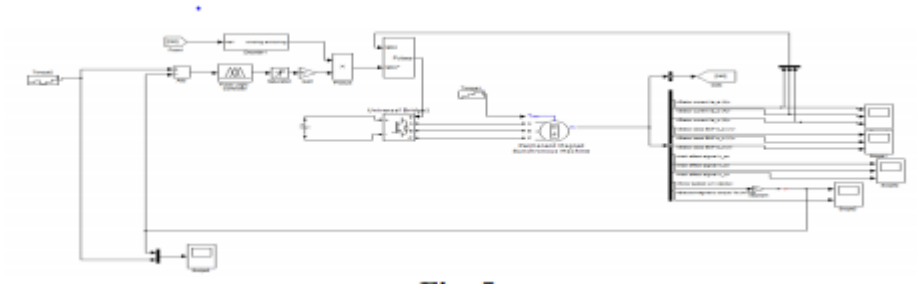
In a typical arrangement, motor speed **controlling** using pulse-width modulation (PWM) which converts the input DC voltage into a modulated driving voltage. The use of PWM allows the start-up current to be limited and offers precise **control** over speed and torque



3. ANFIS Speed Controller- ANFIS Controller does not require a mathematical model of the system and it works on a structure prepared from the knowledge base. In ANFIS Speed controller the inputs used are the speed error and rate of change of speed error.



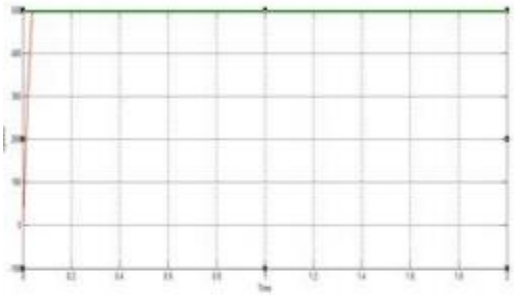
4. **Implementation of Simulation Model in MATLAB/ SIMULINK:** According to the mathematical model mentioned above, the complete motor drive is simulated in the MATLAB / SIMULINK environment[6]. This system uses a double-loop control system, where the outer loop is the speed loop with the PI controller and the inner loop is the current loop with the hysteresis controller. The entire drive is divided into several functional blocks, including the BLDCM body block, the speed PI controller block, the current hysteresis controller block, the current reference block, the inverter block and the commutation logic block. The simulation model of the BLDCM drive is implemented by the logical combination of these blocks.



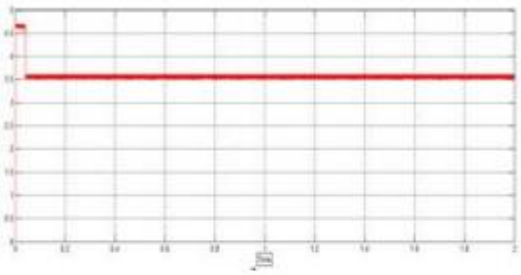
Simulation Results:

Modeling and simulation of a 3 phase, 4 poles, and 6.2 Nm PMBLDC motor is carried out using MATLABI

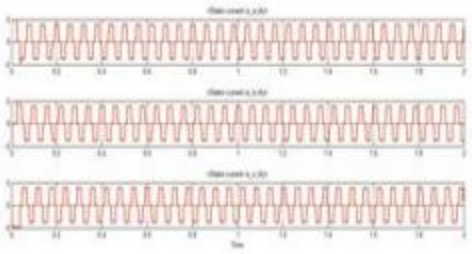
SIMULINK. The performance characteristics are presented. The purpose of the simulation is to evaluate the performance of the PMBLDC drive system when Conventional speed controller is used and comparing its performance when ANFIS speed controller is used. By using ANFIS controller the speed is improved and current as well as Torque come in admissible value and ripples is also minimized.



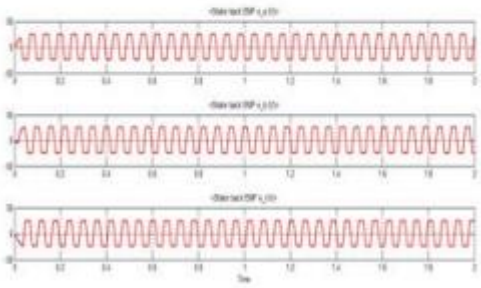
Speed



Torque



Current



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