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Utilizing Fuzzy an Effective Approach for Enhancing the Performance of BLDCM

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***Abstract* - Because of its high power density and simplicity of control to reach the appropriate level of performance, the BLDC drive is widely employed in a variety of industries. For the motor to operate at its best, an appropriate speed control is needed. In permanent magnet motors, speed control is often accomplished using the traditional proportional integral (PI) controller. PI controllers are simple to use and have a straightforward control structure, however they have issues with non-linearities and load conditions and other complex situations. Yet, an exact linear mathematical model is necessary for PI controllers. In this work, a fuzzy is suggested as a way to alleviate the torque ripple in Motor drives. To limit ripple and enhance the dynamic response of drive system, fuzzy logic is used. In comparison to the PI control, the FLC enhances the speed response quality and lessens torque output ripple.**

Keywords: torque ripple, fuzzy modeling, and BLDC motor.

1. Introduction

One type of small-scale motor utilised in small electric gadgets like CD players, hard drives, and even tiny electric cars is the brushless DC motor. Permanent magnets are installed on the rotor of it. It is not necessary to excite the field further. For applications requiring position & speed control drive, this motor is well known and widely used. The main benefits of this drive over others with similar ratings are its better ratio of delivered torque to weight, quick response time, precise position control, decreased moment of inertia, low maintenance requirements, etc. Modern brushless motors are built very similarly to ac motors, often known as permanent magnet synchronous motors. A poly phase ac motor's windings are identical to those of the stator, as well as the rotor is made of a permanent magnet or magnets.

In contrast to ac synchronous motors, brushless dc motors have some mechanism for detecting the position of the rotor (or magnetic poles) in order to generate signals.

2. Literature Survey

I) Several strategies have been proposed to reduce the ripple in Drive systems in order to solve this problem. These techniques include using both passive and active filters, control algorithms, and Pulse Width Modulation techniques. These methods are intended to diminish its ripple effect and enhance the effectiveness and longevity of the motor.1, 3.

II) Fuzzy set theory is used by the control algorithm FLC to connect inputs and outputs. It is especially helpful when there may be ambiguous or uncertain input and output data. In situations where accurate control is crucial, FLC can be used to reduce its ripple effect in bldc Drive systems, improving efficiency and stability 6.

III) The results showed that, in contrast to a traditional PI controller, the proposed technique was successful in reducing ripple current by as much as 40% 7.

IV) In order to assess the torque ripple and produce switching signal for the motor, the authors was using a fuzzy torque observer. The study's findings showed that, when compared to a conventional PI controller, the proposed FLC-based technique considerably decreased the torque ripple with up to 70%. 4,5.

V) Several more methods have been suggested to eliminate the ripple of BLDC motors in addition to FLC. For instance, Sun et al. (2015) suggested an active power filter in order to lessen the ripple in a BLDC motor's DC bus voltage 4.

VI) In conclusion, the research points to FLC as a promising method for lowering the disturbance in BLDC motors. To optimize the Fuzzy controller parameters and confirm the results using results of the experiment, additional study is necessary.

3. Proposed Methodology

Fuzzy Logic Controller Development: To start, an FLC will be created to reduce the ripple with in Bldc. The FLC will be made to manage its current or torque delivery depending on the application. The FLC will use input variables like current or torque distortion and changes in current / torque distortion and provide a control signal to lessen the ripple.

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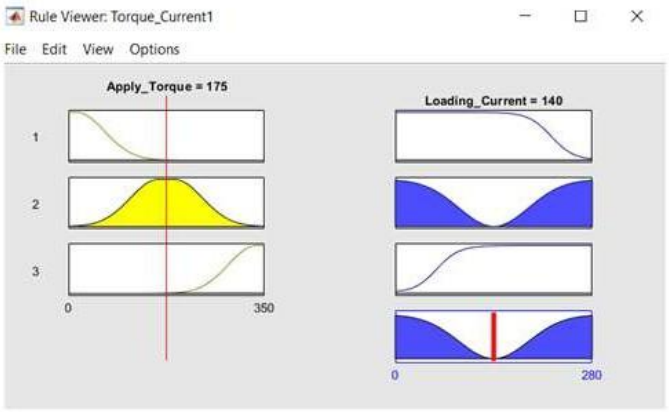

Figure 1: Rule for control by fuzzy methodology

The next step will be to use MATLAB software to simulate the BLDC motor fitted with the FLC. The motor will be subjected to a load throughout the simulation in order to assess how well the FLC reduces output ripple in terms of current or torque. The model will be run multiple times with different input and FLC values in order to enhance the FLC design.

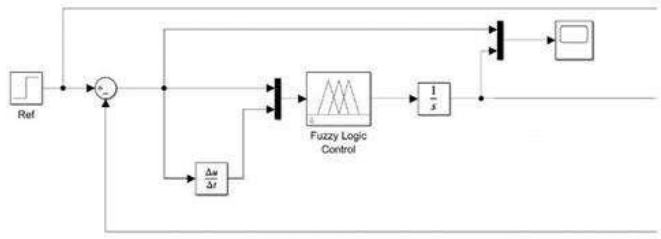

Figure 2: Fuzzy methodology

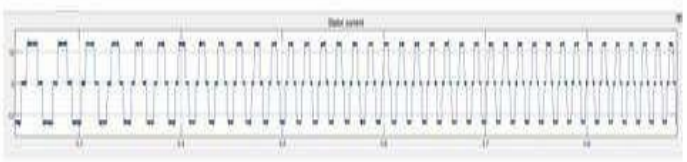

Figure 3: BLDCM output current by fuzzy system

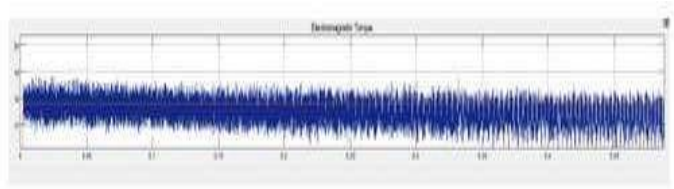

Figure 4: Electromagnetic Torque by fuzzy methodology

As a whole, the suggested process entails creating a mathematical model of the BLDC motor, creating a fuzzy logic controller for it, simulating its motor in MATLAB, & comparing the outcomes with traditional controllers. The method is intended to verify the suggested FLC's efficacy in decreasing ripple in Bldc and to tune its settings for particular applications.

4. Conclusion

In order to reduce the BLDC motors' output current as well as torque ripple, a novel technique is presented in this research study that makes use of MATLAB simulation by fuzzy logic control.

5. Future Scope

Future study could look into improving the FLC design and looking into the use of additional complex control techniques, like neural networks and adaptive control.

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