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BLDC motor torque ripple factor lowering and FOPID based motion control using DGOA algorithm

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Abstract

The Brushless Direct Current (BLDC) motor has many benefits due to characteristics like its small size and precise speed regulation. Uncertainty problems are presented by the system's slow Proportional-Integral (PI) controller response time as well as some BLDC motor operating circumstances. The proposed Fractional-Order Proportional-Integral-Derivative (FOPID) controller and Difference of Orientation Offset Gaussian (DOOG) Grasshopper Optimization Algorithm (GOA) (DGOA) function are used to mitigate torque ripples in BLDC motors and overcome these drawbacks. An adaptive parameter has been introduced to enhance the performance of the conventional GOA method, and the performance of the suggested DGOA is compared to the benchmark functions. The simulation of the driver with the suggested DGOA-FOPID results in an improvement in Torque Ripple Reduction and speed control is obtained that better torque ripple reduction and speed regulation have been achieved.

Keywords

Fractional-order proportional-integral-derivative controller, brushless direct current motor, dc-link capacitor, difference of orientation offset Gaussian grasshopper optimization algorithm

Introduction

Motivation and incitement

There are numerous ways offered for the Torque Ripple Reduction (TRR) in BLDC motors. With the use of disconnected current sensors in the motor phases, the commutation torque ripple can be significantly reduced. This method's main flaw is that unipolar PWM cannot be used to operate it. This results from the switching states of the switches in the driving circuit changing the voltage between the neutral points of the inverter and the BLDC motor.

A proper management strategy for TRR is required for small capacitor based drives in order to eliminate torque ripple without affecting motor speed. However, the effectiveness of the controller is a key aspect when using it for ripple reduction and speed control. The employed controller should be able to quickly achieve the steady-state responses.[1]

Literature review

The PI controller, which produces a sluggish response in the system and uncertainty problems in some BLDC motor operating conditions like Genetic Algorithm (GA), Particle Swarm Optimization (PSO), and Bat Algorithm (BA), is without a doubt the speed controller that is most preferred for BLDC motors. Recently, a PI controller using Optimization Algorithms (OAs) has been created to manage the torque and speed of BLDC motors. Genetic operators form the

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