

课题名称 直流无刷电机控制系统的研究与仿真

摘要

直流无刷电机包括电动机的主体和外部的驱动电路。电动机的定子绕组形式一般有三相星型接法和三角形型接法。与有刷直流电机所不同，直流无刷电机不会和机械换向一样带来的诸多问题，而且无刷直流电机调速区间更广。另外的一个优势是直流无刷电机噪声低，运转平滑，可靠性高以及转矩波动小。

随着市场需求的改变，BLDC 在当今的需求越来越大。除了在传统领域上的应用，在新能源汽车，快递无人送货小车等都在使用 BLDC。本文对纯比例（P）控制，比例-微分（PI）控制，比例-微分-积分（PID）控制算法使用 MATLAB 建立系统仿真模型并进行仿真验证和研究。

首先，本文在第一章介绍了直流无刷电机控制系统的国内外现状，简述了直流无刷电机的物理结构、工作原理、数学模型、换相策略和控制算法。然后使用 MATLAB 中 Simulink 部分自带的模型模块进行相应的设计，比较各个控制算法的优劣，并进行详细的说明。

最后，本文进行总结，并提出新的展望。

关键词：直流无刷电机；控制系统；双闭环系统；仿真模型

Abstract

The brushless DC motor includes a main body of the motor and an external drive circuit. The stator winding form of the motor generally has a three-phase star connection and a triangular connection. Unlike brushed DC motors, DC brushless motors do not suffer from the same problems as mechanical commutation, and brushless DC motors have a wider range of speeds. Another advantage is that the DC brushless motor has low noise, smooth operation, high reliability and low torque ripple.

As market demand changes, BLDC is increasingly demanding today. In addition to the application in the traditional field, BLDC is used in new energy vehicles, express delivery and unmanned delivery vehicles. In this paper, pure proportional (P) control, proportional-derivative (PI) control, proportional-derivative-integral (PID) control algorithm are used to establish a system simulation model and simulation verification and research.

Firstly, in the first chapter introduces the present situation of brushless DC motor control system, outlines the physical structure of the brushless DC motor, working principle, mathematical model, commutation strategy and control

algorithms. Then use the model module of Simulink part of MATLAB to carry out the corresponding design, compare the advantages and disadvantages of each control algorithm, and explain in detail.

Finally, this paper summarizes and proposes new prospects.

KEYWORDS:Brushless DC motor;Control system;Double closed loop system;Simulation model

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