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Speed control of PMBLDC motor using DTC

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Abstract-The application of direct torque control (DTC) to brushless ac drives has been investigated extensively. This paper describes its application to brushless dc drives, and highlights the essential differences in its implementation, as regards torque estimation and the representation of the inverter voltage space vectors. Simulated and experimental results are presented, and it is shown that, compared with conventional current control, DTC results in reduced torque ripple and a faster dynamic response.

Keywords : Brushless dc (BLDC) drives, direct torque control (DTC), permanent-magnet motor.

I. NECESSITY OF PM BLDC MOTOR

Brushless dc motors are rapidly gaining popularity in the appliance, automotive, aerospace, consumer, medical and industrial automation industries. As a result of the absence of mechanical commutators and brushes and the permanent magnet rotor, brushless dc motors have many advantages over the brush dc and induction motor . Some of the advantages of brushless dc motors are:

1) High power density, low inertia and high torque to inertia ratio and high dynamic response due to the small size, low weight and high flux density neodymium-iron-boron permanent magnet rotor.
2) High efficiency due to the low rotor losses as a result of the absence of current carrying conductors on the rotor and reduced friction and windage losses in the rotor.
3) Long operating life and high reliability due to the absence of brushes and metallic commutators.
4) Clean operation due to the absence of brushes, resulting in no brush dust during operation and allowing for clean room applications.
5) Low audible noise operation due to the absence of brushes, commutators and smooth low air resistance rotor.
6) Low thermal resistance since most of the machine losses occur in the stationary stator, thereby allowing heat dissipation by the process of direct conduction. In addition, since the rotor losses are small, heat transfer to machine tools and work pieces when these motors are utilized in machine tools is minimal, thereby reducing the effects of heat on the machining operation.

The rotor position signal of BLDCM is usual provided by position sensor. But the existence of position sensor makes the configuration more complex, influences the reliance of motor operation and increases the cost of the motor. Nevertheless, in some specialized fields, it is not convenient to use position sensor, such as if there are high temperature, frozen and erosion materials, it defines the application of BLDCM. In this paper, the rotor position is detected via detecting the three phase terminal voltages. This kind of method don't use position sensor, reduced the system cost and the volume of the motor, especially improved the characteristics of the system.

Conventional DC motors are highly efficient and their characteristics make them suitable for use as servomotors [1]. However, their only drawback is that they need a commutator and brushes which are subject to wear and require maintenance. When the functions of commutator and brushes were implemented by solid- state switches, maintenance free motors were realized.