

Position and Speed Control of Brushless DC Motors using Sensorless Techniques: A Review

Ms. Poonam M. Yadav, Prof. Mr. Gadgune S. Y.

Affiliation: Dr. Babasaheb Ambedkar Technological University, Lonate,
Electrical Engineering, Padmabhooshan Vasantraodada Patil Institute of Technology,
Budhgaon.

Abstract- In this paper, different methods define the position and speed control fundamentals of BLDC motors using sensors and the control improvements applying sensorless techniques including limitations and suggestions. The proposed Position and Speed Control method improve the performance and reliability of BLDC motor drivers because the conventional control and sensing techniques have been improved through sensorless technology. For realization of Sensorless operation, zero crossing of back emf is detected. In order to generate the proper firing pulses for commutation of inverter circuit and to remove the noise from the back emf signals, low pass filters are used.

Keywords:- BLDC, back-EMF, sensorless, position, speed, estimator, Hall-effect sensors

I. INTRODUCTION

Permanent Magnet Brushless DC (PMBLDC) Motors are the latest choice of researchers due to their high efficiency, silent operation, compact size, high reliability and low maintenance requirements. These motors are preferred for numerous applications; however, most of them require sensorless control of these motors. The operation of P.M.B.L.D.C. motors requires rotor-position sensing for controlling the winding currents. The sensorless control would need estimation of rotor position from the voltage and current signals, which are easily sensed.

The use of permanent magnets (PMs) in electrical machines in place of electromagnetic excitation results in many advantages such as no excitation losses, simplified construction, improved efficiency, fast dynamic, and high torque or power per unit volume. The PM excitation in electrical machines was used for the first time in the early 19th century, but was not adopted due to the poor quality of P.M materials. In 1932, the invention of Alnico revived the use of PM excitation systems, however it has been limited to small and fractional horse powered commutator machines.[1]

In the 20th century, squirrel cage induction motors have been the most popular electric motors, due to its rugged construction. Advancements in power electronics and digital signal processors have added more features to these motor drives to make them more prevalent in industrial applications. However squirrel cage induction motors suffer from poor power factor and efficiency as compared to synchronous motors. On the other hand, synchronous motors and dc commutator motors have limitations such as speed, noise problems, wear and EMI due to the use of commutator and brushes. These problems have led to the development of

permanent magnet brushless or commutatorless synchronous motors which have P.M excitation on the rotor.

Therefore, permanent magnet brushless (PMBL) motors can be considered a kind of three phase synchronous motor, having permanent magnets on the rotor, replacing the mechanical commutator and brushes. Commutation is accomplished by electronic switches, which supply current to the motor windings in synchronization with the rotor position.

The popularity of PMBL motors are increasing day by day due to the availability of high energy density and cost effective rare earth PM materials like Samarium Cobalt (Sm-Co) and Neodymium-Iron-Boron (Nd-Fe-B) which enhance the performance of P.M.B.L.D.C.M. drives and reduce the size and losses in these motors. The advancements in geometries and design innovations have made possible the use of PMBL motors in many of domestic, commercial and industrial applications. PMBL machines are best suited for position control and medium sized industrial drives due to their excellent dynamic capability, reduced losses and high torque/weight ratio.[1]

PMBL motors find applications in different fields such as domestic appliances, automobiles, transportation, aerospace equipment, power tools, toys, vision and sound equipment and healthcare equipment ranging from microwatt to megawatts. Advanced control algorithms and ultra-fast processors have made P.M.B.L.D.C. motors suitable for position control in machine tools, robotics and high precision servos, speed control and torque control in various industrial drives and process control applications. With the advancement in power electronics it is possible to design PMBL generators for power generation on board ships, aircraft, hybrid electric cars, while providing reduced generator weight, size and a high payload capacity for the complete vehicle.[25]

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