

## Abstract

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**Project Code:** TRG5680067

**Project Title:** Design and Construction of Interior Permanent Magnet (IPM) Synchronous Motor

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This research presents an optimum design and construction of Interior Permanent Magnet (IPM) Synchronous Motor for harmonics reduction in the air-gap with a technique of Pulse Width Modulation (PWM). A 2-D Finite Element Analysis (FEA) is used for a nonlinear magnetic problem combined with Matlab optimization toolbox for a constrained optimization problem. Undesirable harmonic contents of the air-gap flux density can be reduced. This improves the back EMF waveform quality almost to sinusoidal waveform. Moreover, a spectral method is developed to calculate the losses in the magnet for reducing the eddy current. The prototype is manufactured by creating some grooves on the iron pole which are obtained from the PWM method and the magnets are buried as the flux concentration topology. The fundamental spectral EMF voltage of IPM motor is higher than the simulation result 14.6% and the percentage of the 5<sup>th</sup> harmonic is decreased 16.84. The tests are carried out into 2 modes; generator mode and motor mode. The open loop v/f drive is used for the control in the motor mode by 3-phase inverter.

**Keywords:** Harmonic analysis, magnetic flux density, permanent magnet synchronous motor, pulse width modulation, eddy-current losses