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Analytical subdomain model for Double-Stator Permanent Magnet Synchronous Machine

Abstract

This paper presents an analytical subdomain model for predicting the magnetic field distributions in three-phase double-stator permanent magnet synchronous machine (DS-PMSM) during open-circuit and on-load conditions. The model is initially derived based on Laplace's and Poisson's equations in polar coordinates by separation of variables technique in four subdomains, i.e., outer airgap, outer magnet, inner magnet and inner airgap. The field solutions in each subdomain are obtained by applying the appropriate boundary conditions and interface conditions. Finite element analysis (FEA) is later deployed to validate the analytical results in DS-PMSM having different number of slots between outer and inner stators with a non-overlapping winding arrangement. The analyzed electromagnetic performances are slotless airgap flux density waveform, back-emf waveform and output torque waveform. The results show that the proposed analytical model can accurately predict the magnetic field distributions in DS-PMSM.

Keywords

Analytical subdomain model; Double-stator; Permanent magnet; Synchronous machine