Dynamic Modeling of Permanent Magnet Machines under Healthy and Unhealthy conditions Using Conformal Mappings

In this PhD thesis, an Improved Conformal Mapping (ICM) method is introduced for modeling and analysis of a typical Surface Mounted Permanent Magnet (SMPM) motor under healthy condition and rotor eccentricity. The ICM method can consider accurately the influence of stator slotting, armature reaction, stator winding distribution, magnetic saturation, and the variation of PM operating points in its different parts due to the magnetic induction.

In this PhD thesis, the analytical and numerical conformal mappings, such as the Schwarz-Christoffel (SC) mapping and two logarithmic conformal mappings, are used to calculate the air gap magnetic field due to the permanent magnets and the armature winding. A new form of bilinear mapping is also presented for mapping of an eccentric slotless model of typical SMPM motor to its concentric model. The slotted air gap flux density is then calculated through multiplying the slotless air gap flux density by the complex conjugate of the air gap complex relative permeance while considering the rotor eccentricity. All electromagnetic quantities, such as the flux-linkage, the Back-EMF, and the electromagnetic torque, can be calculated while having the air gap magnetic field distribution under healthy condition and rotor eccentricity.

In this PhD thesis, the capabilities of CM method are also used for the parametric analysis and in optimization problems. This developed method (ICM method) is verified by comparing its results with the corresponding results obtained through FEM and FPM.