

ABSTRACT

Optimal Shape Design of Rotor Slot in Induction Motor Considering Operating Characteristics

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Induction motors are widely used in various industrial applications due to their simplicity and low cost and have a significant portion of the electric machines in domestic and overseas. Because of the operating characteristics of induction motors are various for many applications, the NEMA(National Electrical Manufacturers Association) tried to classify the motor characteristic mainly in four designs and explain their applications.

Operating characteristics of induction motor are critically affected by shape of rotor slot, so studies about the geometry of rotor slot for improve the power or efficiency are performed. However, former studies are optimized the shape of rotor slot by the geometry based variables then the optimal shape is dependent on initial design.

To overcome this limitation, topology optimization, which finds optimal material distributions within a given design domain subject to certain criteria, particularly the level set method has an advantage that can represent the clear boundary so has been applied to the electro-magnetic problems.

But level set based shape optimization method is not applied to rotor slot of induction motor, the little shape change can affect the torque, current and efficiency thus in this paper, level set based shape optimization validated in former studies is adopted to find out various operating characteristics.

To find out various operating characteristics, rated torque, starting torque, starting current, efficiency and material usage of rotor slot which are referred by NEMA Standard are selected for performance indicator. Optimization problems are formulated by the operating characteristics to maximize the rated torque under the starting torque or maximize the starting torque under the rated torque and constraints of starting current, efficiency and material usage are added.

The FLUX 2D example which is verified by finite element method and experiment is selected to validate the optimization method. The optimal shape of rotor slot has same rated power, efficiency, starting current and material usage but starting torque is increased. Also, by the different formulation of the optimization problem for each operating characteristics, optimal shape of rotor slots which have different operating characteristics are obtained.