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Mon-Af-Po1.21-07 [94]: Experimental Verification and Semi-3D Analysis Techniques of BLDC Motor with Permanent Magnet Overhang and Housing-Integrated Rotor Core

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Brushless direct current (BLDC) motors have the advantage of power density and low maintenance cost compared to DC motors. DC motors are increasingly being replaced with BLDC motors due to low cost of driving devices and the development of control technology. In particular, outer rotor type BLDC motors have higher power density than inner rotor type BLDC motors since permanent magnets (PMs) can be used more in the former. In this type of BLDC motors, housing-integrated rotor core structure can reduce the radial size by decreasing the thickness of the rotor core due to its three-dimensional (3D) flux path. And BLDC motors with this 3D structure requires 3D analysis for an accurate prediction of their electromagnetic characteristic. Meanwhile, overhang structure is commonly used in ferrite magnets to enhance the effective air-gap magnetic flux; this 3D structure also requires 3D analysis. However, 3D analysis is time consuming, and hence, inefficient for motor design. Therefore, in this paper, we proposes semi-3D analysis techniques using two-dimensional (2D) finite element analysis (FEA), considering the 3D structures of PM overhang and housing-integrated rotor core. First, the PM overhang structure was corrected to a 2D analysis model by equating the amount of magnetic energy to the volume of the PM. In addition, to take 3D flux path of a housing-integrated rotor core structure into account, this structure was corrected to a 2D analysis model by the cross-sectional area in a tangential direction from the definition of the magnetic flux density. Finally, semi-3D analysis techniques taking into account the 3D structures of BLDC motors were performed using 2D FEA and validated by experiments. Detailed discussions and results will be presented in the final paper.

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