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Capability improvement design method considering eddy current loss reduction of axial-flux permanent magnet coupling with Halbach array structure using 3-D FEM.

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Permanent magnet couplings (PMCs) transmit torque without any mechanical contact. In particular, the axial flux magnet coupling (AFPMC) has the advantage of a compact and flat construction. Furthermore, it can achieve a high torque-to-weight ratio. Owing to the structural characteristics of AFPMC, its analysis requires the three-dimensional finite element method (3-D FEM). Analyzing magnetic torque of AFPMCs with a Halbach array is very important because the operation area of the PMCs is restricted to the maximum allowable torque. By accurately predicting the maximum torque value, the product can be minimized and reduces unnecessary production costs. We will discuss design techniques based on 3D FEM to design AFPMC for high performance. Therefore, the magnetic torque characteristics are predicted according to the design parameters such as the thickness of the iron core, inner PM radius to -outer PM radius ratio, PM thickness, and the number of poles. In order to verify the design results of AFPMC using 3D FEM analysis, we will compare with the result of maximum torque measurement experiment of actual manufactured model. Furthermore, the AFPMC is required an analysis of the eddy current loss. The eddy current may be generated inside the permanent magnet when the torque transmitted to the permanent magnet coupling fluctuates or slip occurs beyond the maximum permissible torque of the permanent magnet coupling. The eddy current induced in the PM lead to losses. When an eddy current is generated in the PM, it is possible to increase the temperature of the PM, which is partly responsible for degradation of PM performance. Therefore, it is important to design a shape that can reduce the eddy current loss. Finally, we will propose some design methods to reduce eddy current loss, which causes maximum torque reduction and is partly responsible for degrading of the permanent magnet performance.

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