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Mon-Af-Po1.21-10 [97]: Design of 8p12s IPMSM for Minimization of Electromagnetic Noise and Vibration

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The vibration occurring in an electric motor can be largely divided into mechanical vibration due to nonaligned bearings and shafts, and electromagnetic vibration by the electromagnetic force. For existing industrial electric motors, the mechanical vibration associated with the life of the motor was the most important concern. However, in recent years, electric motors—such as the ones used for electric cars and hybrid cars—have high-torque density by using the rare-earth permanent magnet. Thus, the relative importance of electromagnetic noise and vibration is increasing. Electromagnetic vibration and noise affect people emotionally, so it has become very important to reduce vibration when designing a motor.
The electromagnetic vibration can be predicted by analyzing radial force as a vibration source when designing the electromagnetic field of an electric motor. Thus, analyzing the spatial and time harmonics of the radial force enables us to find the harmonic that most influences the vibration. In this study, the optimum design of a 8pole 12-slot IPMSM for vibration reduction was performed. The optimum design was created by analyzing the radial force and finding the design variables that affect vibration. Additionally, to verify the validity of the design results, the results were compared using an electromagnetic-vibro coupled analysis.
In this study, an analysis was made to identify the shape parameters that affect the magnetic flux density of rotor and slot relative permeance in a permanent magnet motor. Using these parameters, optimal design was performed to minimize the vibration velocity in a 8pole 12slot IPMSM initial model. As a result, vibration velocity was reduced by 5.5%. In addition, electromagnetic field-vibration interaction analysis was performed, and thus the results of the optimum design were verified.

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