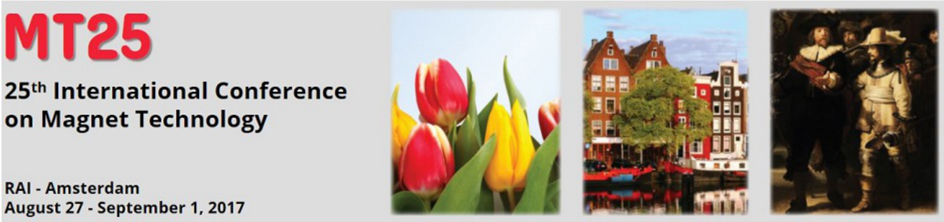

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Electromagnetic Performances and Noise Analysis of IPMSM according to the Control Method under Flux-Weakening Region

Monday, 28 August 2017 13:15 (1h 45m)

In this research, we designed Interior Permanent Magnet Synchronous Motor (IPMSM) type traction motor for 130kW Electrical Vehicle (EV). In addition, we analyzed its electromagnetic characteristics related to Permanent Magnet (PM) such as eddy current loss of PM, demagnetization, electromagnetic force especially radial magnetic force, and performed the noise analysis using the noise map in accordance with input control method, both SVPWM and six-step control under high speed and flux-weakening region. IPMSM has broad applications in domestic, automotive and marine field, and motor vehicle electrical system due to its high efficiency, power density and environmental issues. In the case of IPMSM, a voltage saturation problem is a major drawback in the high-speed region (over base speed) due to a back-electromotive force and the limited inverter voltage. The EV traction motor system requires various operating points and wide driving speed region to substitute role of the planet gear system. To satisfy its performance specification, the flux-weakening control is inevitable for IPMSM, generally. In terms of the flux-weakening control, the magnetic flux cannot be directly controlled because it occurs from PMs. Therefore, the stator current of d-axis, which is the direction of magnetic flux, must flow to generate magnetic flux in the direction opposite to the one of the PM to reduce the effective magnetic flux magnitude of the air-gap. It allows IPMSM to operate wide operating region under the limited input voltage condition. In the flux-weakening region, however, high speed and the magnetic flux from d-axis current bring about more harmonic components in air-gap flux density, ideally regarded as sinusoidal wave. We analyzed these harmonic components effect on PM eddy current loss, demagnetization, and radial force which leads to noise and vibration depending on the input control method by the coupled analysis of finite element analysis, FFT, and Simulink.

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