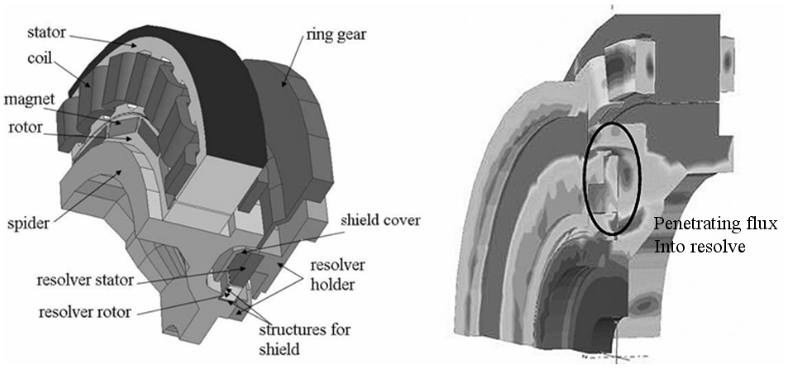
DQ01

Magnetic Shield Design between Permanent Magnet Motor and Sensor for a Hybrid Electric Vehicle

Ki-Chan Kim* and Ju Lee
Dept. of Electrical Engineering, Hanyang University, Seoul, 133-791, South Korea
*Corresponding author: Ki-Chan Kim, e-mail: channykim@hanyang.ac.kr

Nowadays interior permanent magnet synchronous motor (IPMSM) is usually applicable to hybrid electric vehicle (HEV) as an auxiliary power source. It is necessary to use a position sensor in order to perform a torque control as well as speed control of IPMSM without sensorless control algorithm. The operational temperature of HEV is too high to use an encoder as a position sensor. A resolver detecting the position of rotor by magnetic mechanism is used generally in HEV [1]. The IPMSM for HEV is usually designed to have a compact size as well as high power density. Leakage flux from permanent magnet and armature coil is apt to affect main flux in a magnetic core of resolver. Therefore, the leakage flux is the main reason of malfunction of resolver. The relevant magnetic shield design between a resolver and an IPMSM is required in order to operate HEV stably. In the paper, the magnetic shield design by both 3D FEM and analytical method with an IPMSM module including several surrounding mechanical parts is proposed [2]. The penetrating flux into resolver is calculated by using magnetic equivalent circuit considering shield structure and is analyzed with 3D FEM like Fig. 1. Finally an IPMSM model with effective magnetic shield is suggested and also experimented for the verification of proposed method.



(a) IPMSM module for shield analysis (b) Analysis results by 3D FEM

Fig. 1. IPMSM model for shield design and its effect by magnetic flux.

REFERENCES
[1] M. Ehsani *et al*., Modern Electric Hybrid Electric, and Fuel Cell Vehicles, Fundamentals, Theory, and Design, CRC Press (2005).
[2] K. Yamazaki, IEEE Trans. MAG. 36, 1881 (2000).

DQ02

Vibration and Sound Radiation Analysis of the BLDC Axial-Gap Type Motor Using FEM

Sang-Ho Lee[1], Taeckjin Lee[2], Junhong Park[2]*, and Jung-Pyo Hong[1]
[1]Department of Automotive Engineering, Hanyang University, Haengdang-dong, Seongdong-gu, Seoul, Korea
[2]Department of Mechanical Engineering, Hanyang University, Haengdang-dong, Seongdong-gu, Seoul, Korea
*Corresponding author: Junhong Park, e-mail:parkj@hanyang.ac.kr

For the Axial-gap type motor, the magnetic force between the rotor and the stator is affected by the geometries and number of magnets and coils. The vibration and noise of the axial-gap motor are usually generated due to structural resonance of the motor, air inside the motor and the magnetic force between the rotor and the stator [1, 2]. In this paper, the vibration and the noise generation characteristics of the axial-gap type motor are analyzed. Experimental modal analysis was performed to understand the vibration characteristics of the motor. The noise generation was measured in an anechoic room and its dependence on the rotating speeds was analyzed.

The vibration and the noise of the motor were especially related to its modal characteristics at specific frequencies. The natural modes had strong impact on the generated noise even when the aeroacoustic noise from the rotating fan existed. Finite element analysis (FEA) was performed to investigate the vibration characteristics of the motor. For acoustic structure interaction analysis, acoustic elements were used inside the motor which were used to investigate effects of air cavity inside the motor. The prediction well reproduced the modal characteristics which contribute to noise generation.

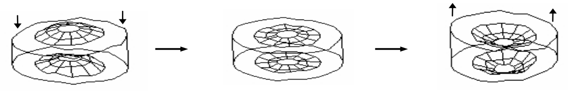


Fig. 1. Mode shape of BLDC Axial-gap type motor at 2nd resonance frequency (391 Hz).

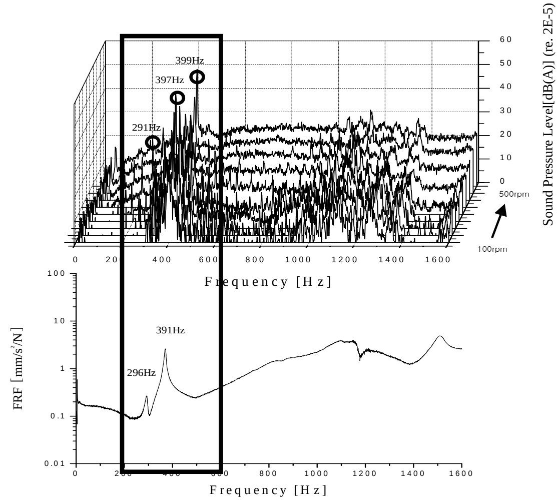


Fig. 2. Vibration response measured using impact tests and comparison to radiated sound during operation.

REFERENCES
[1] H.-S. Ko, IEEE Trans. MAG. 40, 3482 (2004).
[2] H.-J. Lee, S.-U. Chung, S.-M. Hwang, J. Mech. Sci. Technol. 22, 708 (2008).