DQ05

Excitation Voltage Estimation of Superconducting Synchronous Machine via 3D Magnetic Energy Calculation

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The superconducting synchronous motor or generator mostly has high permeability iron only around outer yoke portion. Therefore, if excitation voltage (Back E.M.F) is calculated from 2 dimensional magnetic field distributions, it can be largely different from actual value due to additional voltage originated from end coils. In order to calculate the excitation voltage more accurately, 3 dimensional magnetic field calculation is necessary for including the end coil effect from large air-gap structure. The excitation voltage can be calculated by stator (armature) coil linkage flux originated from rotor (field) coil excitation, but it is difficult to calculate the flux linkage exactly because of complicated structure of the stator coil. This paper shows a method to calculate the excitation voltage from 3 dimensional magnetic energy that can be calculated directly from volume integration of magnetic flux density and field intensity scalar product through a Finite Element Analysis tool.

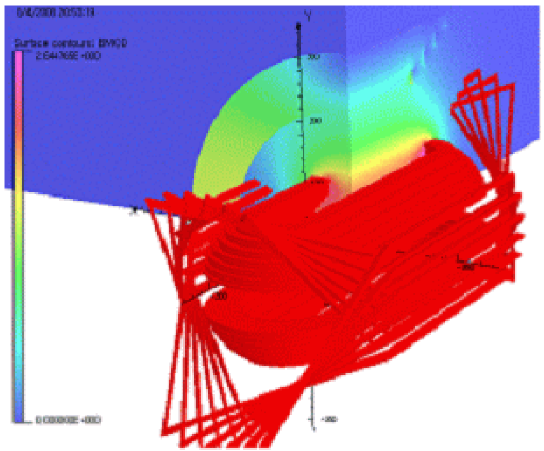

Fig. 1. 3D Magnetic energy calculation model of a superconducting synchronous machine.

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DQ06

Modeling of an Active Halbach Magnet Array for an EDS Maglev System

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In this paper, an Active Halbach Magnet Array (AHMA) is proposed to control the magnetic field intensity of an EDS Maglev system. The Maglev system employs special arrays of high-field permanent magnets, Halbach arrays, on the levitating cradle that is moving above a track consisting of a close-packed array of shorted coils [1]. The magnetic field control capability is crucial to EDS Maglev system in order to compensate its relatively under-damped motion in response to perturbations at low speeds [2]. The insufficient magnetic stiffness results in an instability at the natural oscillation frequency of the levitated vehicle. The proposed AHMA can control magnetic field intensity by the active current control of coils in the array that provides us control capability of damping forces in EDS Maglev system. First, this paper introduces the Halbach array configuration and its characteristics. Then, characteristic analyses based on the modeled AHMA are provided in order to compare the equivalent Halbach array. Fig 1 shows an array of permanent magnets with magnetic field orientations. Fig 2. shows that AHMA contains a set of coils wound around a ferromagnetic materials and the magnetic field generated model based on active coil configuration. The analysis results show that the proposed AHMA can ensure stable EDS Maglev system. The optimized AHMA has almost identical physical properties of the equivalent Halbach permanent magnet array such as horizontal length, vertical length, array magnet wavelength and thickness of the array block. Since the active Halbach magnet array is more practical in terms of the fabrication than the passive Halbach magnet array, the advantage that it can be actively driven to provide a dynamic damping force makes it an overall better option to select the Halbach array of an EDS Maglev system.

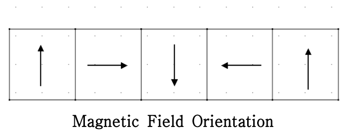

Fig. 1. Halbach magnetic array.

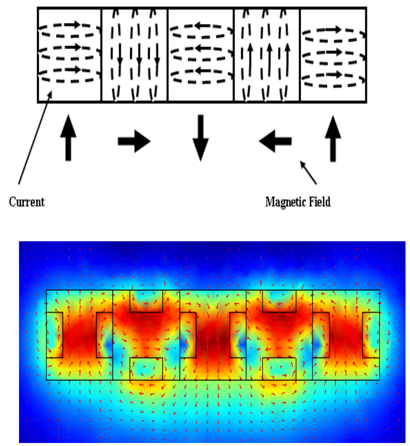

Fig. 2. Active halbach magnetic array.

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