DQ09

Design and Control of a New Hybrid Magnetic Levitation Using Permanent and Electro Magnets

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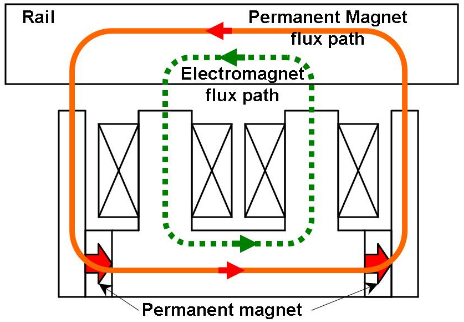
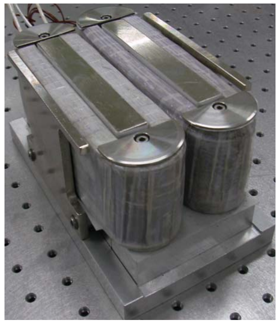
Electromagnetically levitated and guided systems are commonly used in the field of people transport vehicles, tool machines and conveyor system because of its silent and non-contacted behavior. Hybrid magnets, the use of permanent and electro magnets for levitation, are good solution to reduce its control power loss but still have some limits on stable dynamic operating range because the permanent magnet in series with electromagnet increases reluctance of magnetic path [1-3].

A new scheme of levitation magnet, permanent magnets in parallel with electromagnets are proposed as in figure 1. In this scheme, the permanent magnets circuit acts as a bias force generator which compensates the vehicle mass and the electromagnet circuit acts as a dynamic force generator which stabilizes the system under disturbances. Design of this hybrid magnet and control results on magnetically levitated vehicle with 100kg is presented in order to prove stable operation and low power consumption.



(a) Parallel circuit structure



(b) Model for test

Fig. 1. Proposed Hybrid Levitation Magnet.

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DQ10

Investigation of Auxiliary Poles Design Criteria on the Reduction of the End Effect of Detent Force for PMLSM

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The detent force that is caused by the attraction between the permanent magnet (PM) and the iron core in permanent magnet linear synchronous motor (PMLSM) can be divided into two components: the slot effect and the end effect [1, 2]. The end effect of detent force results from the finite iron core length of the mover is predominant in comparison with the slot effect. In this paper we propose a novel method to reduce this end effect utilizing the auxiliary poles.

Fig. 1 shows the PMLSM model with a 9-slot/8-pole fractional-slot pitch structure. This not only reduces the back EMF harmonics, but also suppresses the detent force [3]. The auxiliary poles are fixed on both sides of the iron core and the connection material is chosen as aluminum alloy for its low magnetic permeability. The original position of the auxiliary poles is set on x=29.25 [mm], which will prevent the flux in the mover core passing through the auxiliary poles. Fig. 2 shows the detent force according to the mover displacement and the auxiliary poles position simulated by 3D finite element method (FEM). The peak value of the detent force can be reduced to less than 10 [N].

The detent force, normal force, and thrust characteristics will be also analyzed according to the variation of the position, width, shape, and overhang length of the auxiliary poles to obtain the design criteria. The validity of this proposed method will be confirmed by some numerical calculations and experimental results.

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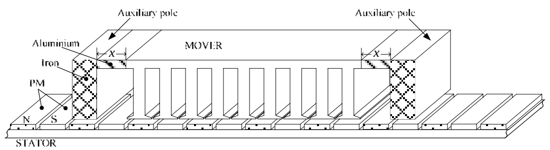

Fig. 1. PMLSM structure fixed with auxiliary poles.

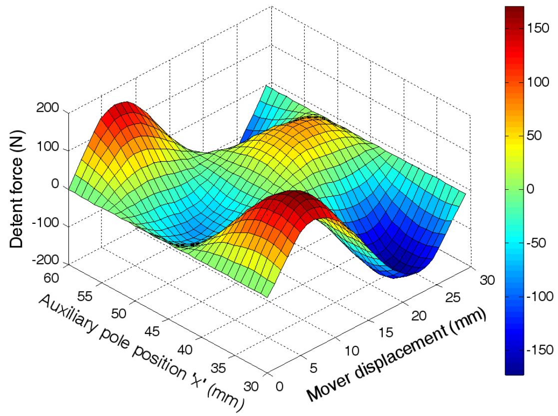

Fig. 2. Detent force in terms of mover displacement and auxiliary pole position.

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