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# Polar transformed subdomain modeling for primary-segmented permanent magnet linear synchronous machine applied in tracked inspection robots

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Tracked inspection robots is a special robot to replace or assist of manual inspection, has great application prospects. Linear permanent magnet machine with primary-segmented is a good choice which can motion on the long distance without the use of gears. In this paper, adopting polar transformed subdomain modeling for predicting the magnetic field and forces in primary-segmented permanent magnet linear synchronous machine (PS-PMLSM).Compared with the traditional finite element method, this analytical methods can reduce the solution time, improved the efficiency. In the paper, Firstly, the PS-PMLSM is deformed into an arc-segment linear PM machine, calculating the magnetic field in Polar coordinates instead of Cartesian coordinates. In equivalent analytical model, the secondary is assumed infinite length, the back-iron is extended into a ring, the secondary are converted to rotary PMSM, the different is that PMs in analytical model is not full filled in direction of the circumference. Meanwhile, the primary iron is converted to an arc-shape stator. Comparing with the analytical model in Cartesian coordinates ,the number of subdomains in equivalent analytical model is reduced .The whole magnetic field domain is divided into four types of simple subdomains, viz. magnets, air-gap, slots, and end regions. The analytical field expression of each subdomain is obtained by the variable separation method and Fourier series method, the coefficients in the field expressions are determined by applying the boundary and interface conditions. Then, the analytical solution of each subdomain is derived, magnetic field, thrust force and the normal force are determined based on the field solutions. Finally, numerical results are validated by finite element method. The results show that the analytical model can accuracy predicting the magnetic field and forces.

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