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Wed-Mo-Po3.13-01 [109]: Comparative Study of Permanent Magnet Assisted Linear Switched Reluctance Motor and Linear Flux Switching Permanent Magnet Motor for Railway Transportation

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Compared with conventional rotary machines, linear motors have no mechanical transmission device and, therefore, offer higher transmission efficiency, lower noise and easier to maintain. Hence, they have attracted a lot of attention in urban rail transit recently. Among them, linear induction motor (LIM) merits the advantages of simple structure, and has been applied in some countries. However, LIM suffers low efficiency and power factor, which is difficult to improve furtherly. Accordingly, more and more researches focus on the linear structures of other kinds of motors, such as linear flux switching permanent magnet (LFSPM) motor, linear switched reluctance (LSR) motor, etc. There are many similarities between the LFSPM motor and LSR motor such as similar primary iron and robust secondary. However, what is the difference between the electromagnetic characteristics and operation mechanism of the two motors in rail transit system? No quantitative comparison has been conducted between LFSPM motor and LSR motor in the identical volume until now. As we know, in contrast to LFSPM motor, no permanent magnet is a major obstacle of thrust improvement for LSR motor. On this basis, the magnetic circuits of the permanent magnets are introduced to LSR motor so that the magnetic saturation in primary poles is weaken. In this paper, a permanent magnet assisted linear switched reluctance (PMA-LSR) motor is proposed, investigated, and quantitatively compared with LFSPM for the urban railway transit system. First, the topology, operation principle, and electromagnetic performance of the LFSPM motor have been investigated and validated using finite element method (FEM). Then, the PMA-LSR motor for railway transit is designed and optimized. Finally, the electromagnetic performance of LFSPM and PMA-LSR motor have been compared and summarized through FEM in the following respects: working mechanism, thrust, thrust ripple, normal force, power factor, efficiency, magnetic field distributions, cost of materials, etc. The analysis results will provide design reference for the practical application and selection of two kinds of motors in urban rail transit traction system.

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