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Tue-Af-Po2.21-06 [70]: Coupled Magnetic Field analysis and optimization of Double Stator Linear Rotary PM Machine

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As the complexity of modern industrial drive systems, the two degree of freedom (2-DOF) movement is needed in many industry drive applications. In this paper, a double stator linear rotary permanent magnet machine (DSLRPMM) which features linear and/or rotary movements is investigated. The motor is constituted of two stators and a hollow mover with permanent magnets (PMs) affixed on its surfaces.
In the DSLRPMM, the linear and rotary magnetic fields are coupled in the mover core. In general, the mover core are designed as thickness as possible to avoid the magnetic field coupling. Yet, the increase of the mover mass may cause the decrease of torque/inertia ratio, thrust/inertia ratio, bearing support strength, etc.. Thus, this paper forces on the coupled magnetic field of the DSLRPMM, and the two optimized topologies of the DSLRPMM is proposed. Based on the finite element method (FEM), the electromagnetic characteristics and optimization of the DSLRPMM are investigated. The main works are listed as follows.
Firstly, the characteristics of the coupled magnetic field in the different operation conditions is studied based on the 3D FEM, and the relation between the magnetic field coupling degree and the electromagnetic characteristics including the torque, force, core loss, and etc. are also discussed. Then, two topologies of the DSLRPMM are proposed, and the electromagnetic characteristics are investigated. The magnetic field coupling of the two topologies are also studied. In order to reduce the influences of the coupled magnetic field, the electromagnetic parameters are optimized based on the multi-objective optimization method under the same constraints and goals. Lastly, the results are compared and discussed, and those will validate the effective of the DSLRPMM topologies. Moreover, the experiments will be also done to affirm the validity of the results that obtained from the simulation analysis.

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