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Experimental Evaluation and Numerical Simulation of a HTS Linear Synchronous Motor for High Speed Railway

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A HTS linear synchronous motor prototype that could be used as the traction system of high speed railway was demonstrated in our laboratory. The stator was made of traditional ferromagnetic yoke and three-phase copper windings. To control the three-phase travelling magnetic field of the stator, a frequency-variable convertor was applied to the system. Different from the permanent magnet mover of traditional synchronous motor, the secondary was assembled by YBCO-coated conductor which has powerful ampacity to create high-intensity magnetic field. The YBCO coils were electrically connected in series and were injected dc currents to behave as magnets. To take a comprehensive study of the developed HTS linear synchronous motor, a finite-element model was established to simulate its thrust and normal force which are the key factors for traction. To validate the simulation model, we have developed a three-dimensional force-measuring system. A three-dimensional force sensor was used to observe the thrust and normal force of the HTS linear synchronous motor under different conditions. As the key parameters, the trust and the normal force of the linear synchronous motor play an important role in the traction system because the speed and the load-ability are the key factors for railways. In this paper, the combination of the finite element method (FEM) and experiments presents the mechanical properties of the HTS linear synchronous motor prototype and provides some references for optimizing.

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