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DEVELOPMENT OF LOW COST FIELD EXCITATION FLUX SWITCHING MACHINE WITH SINGLE DIRECTION OF DC FIELD CURRENT

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Abstract

Researches on flux switching machines (FSMs), especially permanent magnet FSMs (PMFSMs) have been dramatically increased lately due to its high magnetic field excitation suitable for high torque condition, high efficiency and robust rotor structure suitable for high speed applications. However, a large amount of permanent magnet (PM) volume in PMFSMs such as NdFeB creates a problem of high manufacturing cost in order to avoid the PM from demagnetized. In addition, the cost of PM itself is very expensive which is more than double when compared with the price in the last two years. Moreover the working environment with high temperature may limit its applications due to ease of demagnetization, while the flux weakening operation at high speed region is relatively difficult due to fixed PM excitation. In order to solve the problems and to reduce the machine cost, one of possible solutions is to replace the PM excitation by the DC excitation. In this research, a new topology of low-cost field excitation FSM (FEFSM) which use DC field current as their only mmf sources as well as with controllable flux capability is introduced. The DC field current is arranged in single direction alternately with the armature coil around the stator teeth to ease the manufacturing. Initially, the coil arrangement tests are examined to confirm the operating principle of the machine and to identify the zero rotor position. Furthermore, the flux linkage, the induced voltage and torque characteristics at several current density conditions are analyzed. As conclusion, the proposed low-cost FEFSM has successfully achieved similar performances of PMFSM under similar restrictions and specifications.