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# Comparison between T-A formulation and uniform current assumption for the critical current calculation of high temperature superconductor ReBCO coils

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High temperature superconductor (HTS) coils have been applied in high field magnet applications, such as nuclear magnetic resonance (NMR) and maglev trains. The accurate calculation on the critical current of HTS coils is key for the magnet design and optimization. In practical applications, HTS tapes are also often wound into different shaped coils, such as racetrack coil for motors and 'D'shape coils, which requires 3D model to calculate their critical current. This paper studies and compares critical current of special shaped HTS coils, including circular, racetrack and 'D'shape. The critical current of each coil is calculated by two methods: a critical state model based on T-A formulation with E-J power law, and a magnetic field model based on uniform current assumption. The key idea of T-A model is to separate the calculation of current from the magnetic fields, T-model gives the current distribution to A-model, in turn A-model gives the magnetic fields distribution to T-model. While in magnetic field method, current is distributed uniformly in each turn, so the calculation time is greatly shortened. The influence of coil shape and tape parameters are studied, the results of these two methods are also compared and discussed. This paper aims to provide a simple and fast modeling method for the critical current estimation with enough accuracy for HTS coils.

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