Finite Element Analysis of Superconductive Tape By Using T-Ω Formulation

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Abstract

This paper deals with a numerical modelling technique based on finite elements method for computing magnetic field and current density distributions in High Temperature Superconducting (HTS) tapes. The model is developed using the $ T-\Omega $ formulation for which the degree of freedom (DOF) and the CPU time decreased considerably in AC losses analysis, and it is also observe that $ T-\Omega $ formulation gives better convergence results with iteration methods than the other formulations. This formulation takes great advantage of the combination of discretizing method named second order hybrid edge/nodal element. Edge variables which are curl conforming are used to discretize the electric vector potential also easier for handling non-linearities while node variables are used to discretize the magnetic scalar potential. The classical power law is used to describe the resistivity of the superconductors. The method has been implemented in COMSOL Multiphysics® for a two-dimensional geometry of superconductor for various transport currents.

Reference

N. Amemiya and Y. Ohta, \Mode of magnetic flux penetration into high Tc superconductors with various cross-sectional shape and their AC loss characteristics," Physica C: Superconductivity, vol. 357, pp. 1134-1143, 2001.
2. O. Bro, Edge element formulations of eddy current problems," Computer methods in applied mechanics and engineering, vol. 169, no. 3, pp. 391-405, 1999.
3. T. Kang, T. Chen, H. Zhang, and K. I. Kim, Improved T-Ω nodal finite element schemes for eddy current problems," Applied Mathematics and Computation, vol. 218, no. 2, pp. 287-302, 2011.

Figures used in the abstract

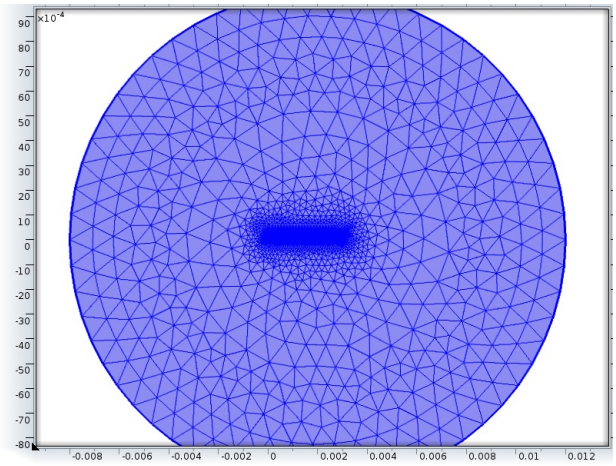

Figure 1: Geometry of finite element model for HTS tape's cross-sectional.

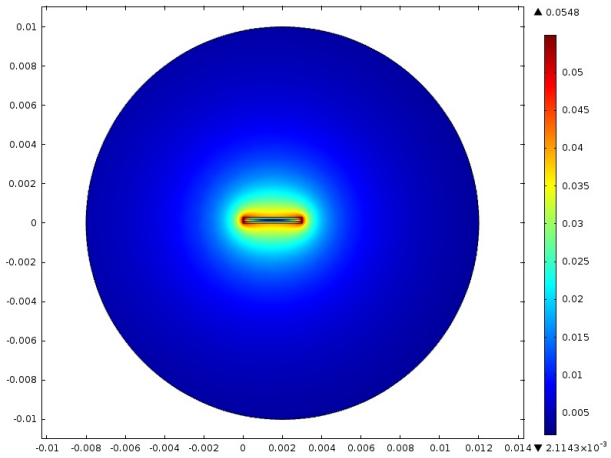

Figure 2: 2D three layer HTS tape model magnetic vector potential z component.

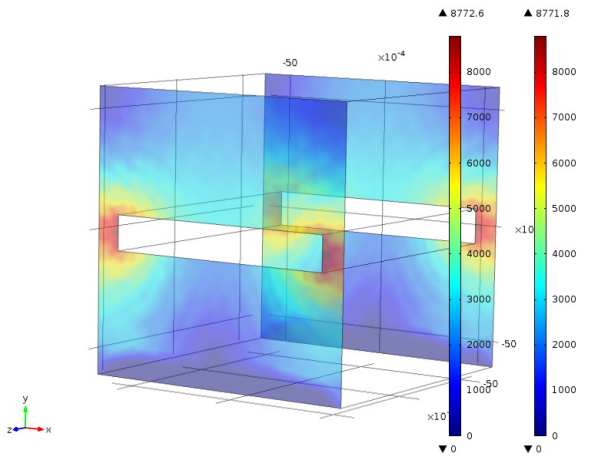

Figure 3: 2D one layer HTS tape model magnetic flux density.

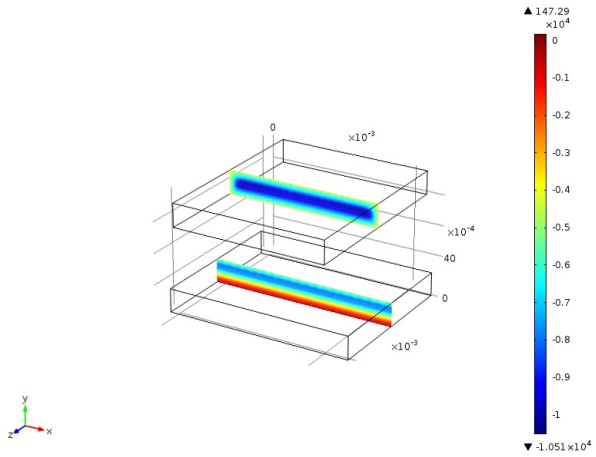

Figure 4: 2D two layer HTS tape model magnetic flux density.