

MULTI-MATERIAL TOPOLOGY OPTIMIZATION OF ELECTRIC MACHINES UNDER MAXIMUM TEMPERATURE, STRESS AND DEMAGNETIZATION CONSTRAINTS

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Abstract

Electric machines play a major role in combatting climate change. As a consequence, the use of topology optimization methods for determining their optimal design has become increasingly popular over the past years. Beside electromagnetic performance, also thermal aspects play a more and more important role due to a desired increase in power density and a recent trend to high speed machines.

In this talk, we employ a multi-material level set algorithm based on the mathematical concept of topological derivatives to the design optimization of electric machines. More precisely, we aim at finding the optimal material distribution consisting of ferromagnetic material, air and permanent magnets in order to maximize the torque produced by the machine. We impose constraints on both the maximum temperature due to energy losses in the machine and the maximum mechanical stresses due to the centrifugal force. In addition, by imposing constraints on the magnetic fields, we aim to find designs which are insensitive with respect to demagnetization of the magnets when the machine is operated at higher input current.