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МАТЕМАТИКЕ

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Room 310

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FEM modeling of magnetic fields in nonlinear magnetostatics problems with high aspect ratio geometries in terms of scalar potential

Finite element method (FEM) modeling of magnetic fields in terms of vector potential (A-formulation) when applied to nonlinear magnetostatics problems with high aspect ratio geometries may lead to enormously large number of parameters, the so-called degrees of freedom (DOF) and, as a consequence, to significant usage of the computational resources (memory, time). This stems from the fact that the high aspect ratio geometries require the finer meshing for the convergence of the iterations from one hand side, and the engineering design – the higher accuracy of about of 1 Gauss (10^{-4} Tesla) for its practical realization in some regions from the other. To cope with the problem and save the computational resources, an optimization of the modeling has become necessary for both the meshing (using, for instance, symmetry and swept) and the solving (for example, by stepping and solvers combining). However, the most radical reduction can be achieved by making use of the scalar instead of the vector potential (V-formulation). In order to define this quantity uniquely as a single-valued function, it is sufficient to make the problem domain (ferromagnetic region) simply connected by creating the cut-surfaces bounded by the current loops and enforce the potential jump to be equal to the net current. In this way, the V-formulation of magnetostatics becomes fully consistent, while the usage of one unknown per node instead of three makes it very attractive for 3D modeling as will be demonstrated in the talk.