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Adaptive finite element method for solving electromagnetic field problems

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Finite element method (FEM) is a popular powerful computer oriented method of solving boundary value problems in the engineering field. The accuracy of the finite element solution can be improved by both *h*-refinement (increasing the number of triangles in the mesh domain) and *p*-refinement (free mesh with higher order *polynomial* approximation). But most of the available FEM-software give only the first-order finite element solution. Since the above refinement algorithms have complexity in programming they are simply avoided in these software. This paper produces new solutions for electromagnetic filed problems using the *hp*-.FEM. For the purpose, we have considered two numerical Examples such as AC conductor and cable system.

The first example describes a rectangular, stranded AC conductor which is surrounded by a copper sheet so that the boundary of the conductor is a flux line and the current density is a constant inside. The exact, first-order *h*-FEM and *p*-FEM solutions (second order solution) are analyzed to compare the errors produced by these methods. The *h*-refinement of the mesh is obtained by reducing the area of each the triangle from 10% to 5%. In this example, the number of known nodes (25 nodes) and unknown nodes (176 nodes) of both *p*-refinement and *h*-refinement are equal and therefore the time required for both methods to find the inversion of global matrix are almost the same. In similar way, *hp*-FEM is implemented to the Cable system and it produces 25 known nodes and 137 unknown nodes.

While analyzing the results of the above two examples we observed that *hp*-FEM provides accurate solution than the first-order. The *h*-refinement improves the first-order solution further and it almost converges to *p*-FEM solution. In this paper we have produced new highly accurate *hp*-FEM solution and for the above particular electromagnetic field problems.

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