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自适应Galerkin间接边界元方法计算三维线性静磁场问题

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摘要
基于磁荷模型的三维间接边界方法在计算静磁场问题上具有独特的优点，为提高计算精度，降低计算成本，建立了以等效磁荷为待解变量，基于Galerkin离散的三维静磁场积分方程自适应求解方法。其基本思想为：由于单元只在加权意义下满足磁场积分方程，故采用单元法线方向上磁通连续性条件满足情况作为自适应计算的判据。磁场积分方程采用Galerkin方法进行离散，避免了区域边点和角点几何奇异性对解答的影响。为进一步提高计算效率，提出了一种场量局部更新求解技术，使得每次自适应计算的规模大为降低。通过与解析计算结果和测量结果比对，数值算例证明了该文方法的正确性和有效性。

关键词 自适应剖分 三维线性静磁场 表面磁荷 局部节点更新 Galerkin方法

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An Adaptive Galerkin Approach of the Indirect Boundary Element Method for Calculating 3D Linear Magnetostatic Field

Abstract
The indirect boundary element method has some special advantages for the 3D linear magnetostatic field calculation by using the equivalent magnetic surface charge. In order to improve the accuracy of solutions and decrease the computational costs, an adaptive Galerkin approach to solve the magnetostatic integral equation is presented by using the h-type refinement technology. The basic idea of the proposed approach can be summarized as follows. The error of magnetic flux density is globally minimized in the Galerkin sense in the implementation, so the continuity error of magnetic flux density of each element can be served as a criterion to guide the adaptive refinement. The singularity of geometric corners and edges can be overcome due to the scheme of the discretization of the integral equation with Galerkin's approach. In addition, a local resolution technology is proposed, which leads to the minimal refined unknown. The numerical examples show the proposed method is efficient and accurate by comparison to the analytical solutions and the measured results.

Key words Adaptive meshing 3D magnetostatic field Magnetic surface charge Local resolution Galerkin method

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