任意层导电板上方线圈阻抗的级数计算模型

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摘　要：

为解决积分法求解层叠导电结构上方通电线圈阻抗困难、费时的问题，采用一种基于Maxwell方程组、矢量磁位和空间解域截取的级数展开快速计算方法，将有限层导电结构检测模型拓展到任意层，并导出级数形式的通电线圈阻抗变化表达式；通过设定适当的解域截取半径和级数求和项数，并对复杂项预先计算，可以在保证计算精度的同时提高计算速度。在多种线圈激励频率下，分别采用级数展开法与有限元仿真法，对单层导电平板上方线圈的阻抗变化进行了比较计算，两种方法的计算结果非常吻合，验证了级数展开计算模型的正确性，可应用于涡流法缺陷定量检测的正向模型中。

关键词：涡流检测；线圈阻抗计算；级数展开；有限元仿真；任意层导电板

The Series Expansions Calculation Model for the Impedance of Coil above Arbitrary Layer Conductive Plates

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Abstract:

In the impedance calculation of the coil above multilayer conductive plates, time consuming and implementation difficult are the main problems. A means based on the system of Maxwell equations, the magnetic vector potential and truncated region eigenfunction expansion was proposed，and the conductors were extended to an arbitrary number of layers, the expression for the impedance change of the coil was derived in the form of series. When outer boundary length and the number of summation terms were selected properly, and some terms were precomputed, the computation time can be reduced considerably and at the same time preserve the computational accuracy. The impedance change of the coil over a conducting half space was calculated at different frequencies with series approach and finite element method respectively, the results agreed very well and confirmed the suitability of the proposed series expansion calculation model and its application prospect in forward model of eddy current testing for defect quantitative measurement.

Keywords: eddy current testing; coil impedance calculation; series expansions; finite element simulation; arbitrary layer conductive plates

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