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计算粗糙地面下方埋藏目标复合散射的E-PILE+BMIA/CAG算法

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摘要：

为快速获取电大尺寸随机粗糙面下方埋藏目标的电磁散射特性，基于层内波传播展开法（propagation-inside-layer-expansion, PILE）和带状矩阵迭代及规范网格法（banded matrix iterative approach canonical grid, BMIA/CAG），提出了结合带状矩阵迭代及规范网格法的扩展层内波传播展开法（E-PILE+BMIA/CAG）。数值计算过程中，以高斯随机粗糙面模拟实际地表面，并引入锥形入射波以减小人为截断粗糙面所引起的计算误差。为验证算法的有效性和收敛性，计算了一维介质粗糙面下方埋藏无限长二维介质圆柱目标的散射特性，研究了目标与粗糙面之间的相互作用，并与已有算法结果进行比较。最后计算了大入射角情况时地面下方埋藏目标的复合散射特性。该研究成果对于目标探测等领域具有一定的理论指导价值。

关键词： 埋藏目标 复合散射 层内波传播展开法 带状矩阵迭代及规范网格法

E-PILE+BMIA/CAG method for calculating electromagnetic scattering from buried objects below rough surface

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Abstract:

In order to calculate quickly the composite electromagnetic scattering from buried objects below a large dimensional rough surface, the E-PILE+BMIA/CAG method is presented by combining the extended propagation-inside-layer expansion (PILE) and banded matrix iterative approach canonical grid (BMIA/CAG). The actual ground surface is simulated by a random surface with Gauss spectrum, and the tapered incident wave is chosen to reduce the truncation error. The composite scattering from an infinite length 2-D cylinder buried under the 1-D randomly rough surface with lossy media is calculated by using E-PILE+BMIA/CAG. The validity and convergence of this method are verified by comparing the result with that of the existing method. The coupling effect between the surface and the object and the roughness is studied. Finally, the scattering pattern of buried targets below a rough surface is studied. The numerical results provide a guide in the application of the ground penetrating radar.

Keywords: buried target composite scattering propagation-inside-layer expansion (PILE) banded matrix iterative approach canonical grid (BMIA/CAG)

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