

### 探地雷达小波域三维波动方程偏移

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**摘要** 阐述了矩阵多分辨分析理论中的标准形式与非标准形式, 并以Hilbert算子为例, 说明了算子多分辨表示的压缩效果, 为小波域偏移算法奠定了理论基础. 从三维雷达波动方程出发, 利用爆炸反射原理和浮动坐标变换, 推导出三维探地雷达波动方程差分格式, 并通过方程分裂算法及小波多分辨算法, 在小波域求解波场外推矩阵, 进而得到探地雷达小波域三维波动方程偏移算法, 在此基础上, 开发了探地雷达小波域偏移处理程序, 并把该程序应用于三个球体空洞的3-D正演结果及实际的雷达数据中, 通过对比偏移处理前后的雷达资料, 得知该三维偏移算法能使3-D正演剖面中的反射波归位、绕射波收敛, 极大地提高了雷达剖面的分辨率, 有利于探地雷达资料的地质解释.

**关键词** [探地雷达](#), [小波域](#), [波动方程](#), [偏移](#)

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### The migration of GPR three dimension wave equation in wavelets domain

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**Abstract** This paper elaborated on the standard and nonstandard forms of matrix multi resolution analysis theory in detail, and taking Hilbert operator as an example, explained the compression result of operator with multi-resolution form. It laid a good theoretical foundation for migration algorithm of wavelets domain. Then, setting out from the three-dimension radar wave equation, and making use of the bursting reflection theory and floating coordinate transform, we have deduced the finite difference format of GPR three-dimension wave equation. Through equation splitting and multi-resolution wavelets theory, and solving the extrapolate matrix of wave field in the wavelets domain, we have also got the migration algorithm of GPR three-dimension wave equation in wavelets domain. Based on this, the authors developed the migration program of GPR three-dimension wave equation, and applied this program to three-dimensional forward modeling result of three spheric caverns and practical GPR data. Through comparing the radar data before and after the migration processing, it is known that this three-dimension migration algorithm could make the reflection wave return to original position, and make the diffraction wave converge in the three-dimension sections. The lateral resolution of radar sections could be highly enhanced, and the migration algorithm could make the radar three-dimension detection more reliable and precise, which is propitious to the geology explanation of GPR data.

**Key words** [Ground penetrating radar](#) [Wavelets domain](#) [Wave equation](#) [Migration](#)

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