

论文

壁画空鼓病害的探地雷达正演模拟检测

李最雄<sup>①②③④</sup>|杨涛<sup>①</sup>|汪万福<sup>②③④</sup>

- (<sup>①</sup>兰州大学土木工程与力学学院|兰州|730000)
- (<sup>②</sup>古代壁画保护国家文物局重点科研基地(敦煌研究院|敦煌|736200)
- (<sup>③</sup>敦煌研究院保护研究所|敦煌|736200)
- (<sup>④</sup>敦煌研究院文物保护技术服务中心|兰州|730000)

摘要:

通常西藏壁画地仗层的厚度不足10cm,有效去除直耦杂波是利用高频探地雷达识别壁画空鼓病害的关键,在此基础上计算空鼓的厚度。模拟制作西藏壁画地仗,在其内部预设深度和厚度各不相同的规则空鼓,通过正演模拟试验确定探地雷达的采集参数,积累数据处理的经验,并比较不同雷达天线的性能。结果表明,针对RAMAC探地雷达和Ground Vision数据采集、后处理软件,时窗深度宜为3ns左右,采样频率应不低于142GHz,效果最明显的两个滤波器是带通滤波和抽取均道。当雷达天线与细泥层地仗耦合较好时,中心频率1.6GHz和2.3GHz的雷达天线均能准确检测出深3cm左右、厚约2cm的空鼓,1.6GHz天线的极限垂直分辨率约0.5 cm。

关键词: 壁画空鼓 ■ 探地雷达 ■ 模拟检测 ■ 信号处理

FORWARD REPLICA MODELING FOR DETECTION OF DELAMINATION IN WALL PAINTINGS |WITH GROUND PENETRATING RADAR

LI Zuixiong<sup>①②③④</sup>|YANG Tao<sup>①</sup>|WANG Wanfu<sup>②③④</sup>

- (<sup>①</sup>School of Civil Engineering and Mechanics, Lanzhou University, Lanzhou|730000)
- (<sup>②</sup>Key Scientific Research Base of Conservation for Ancient Mural (Dunhuang Academy) State Administration for Cultural Heritage, Dunhuang|736200)
- (<sup>③</sup>Conservation Institute, Dunhuang Academy, Dunhuang|736200)
- (<sup>④</sup>Technical and Service Center for Protection of Cultural Relics, Dunhuang Academy, Lanzhou|730000)

Abstract:

As a rule, the thickness of wall painting plaster in Tibet is less than 10 cm. The ground penetrating radar (GPR) is applied to detection of delamination beneath wall painting plaster, It is quite a challenge task to remove directly the coupled noise waves in the radar profiling. So, size of the delamination can be determined accurately. Replica of Tibetan wall painting plaster is made and regular voids with different depths and sizes are set inside it. Then, the forward modeling detection is carried out in the replica in order to get appropriate parameters for acquisition of radar data, to find effective filters for signal processing, and to compare the performance of different antennas. Specifically to the RAMAC/GPR and its accessory software of Ground Vision, it is suggested that the depth of time window be about 3 ns and sampling frequency not less than 142 GHz, and that band pass filter and background subtraction are the two most useful filters in signal processing. When the antenna and the fine plaster are well coupled, both antennas at nominal center frequency of 1.6 GHz and 2.3 GHz are capable of detecting void located at a depth of about 3 cm and a size of around 2 cm. The vertical resolution limit of 1.6 GHz antenna is near 0.5 cm in size.

Keywords: Wall painting, Delamination, Ground penetrating radar, Modeling detection, Signal processing, Tibet

收稿日期 修回日期 网络版发布日期

DOI:

基金项目:

通讯作者:

作者简介:

作者Email:

扩展功能

本文信息

- ▶ Supporting info
- ▶ PDF(1899KB)
- ▶ [HTML全文]
- ▶ 参考文献[PDF]
- ▶ 参考文献

服务与反馈

- ▶ 把本文推荐给朋友
- ▶ 加入我的书架
- ▶ 加入引用管理器
- ▶ 引用本文
- ▶ Email Alert
- ▶ 文章反馈
- ▶ 浏览反馈信息

本文关键词相关文章

- ▶ 壁画空鼓 ■ 探地雷达 ■ 模拟检测 ■ 信号处理

本文作者相关文章

PubMed

参考文献:

本刊中的类似文章

文章评论

反馈人	<input type="text"/>	邮箱地址	<input type="text"/>
反馈标题	<input type="text"/>	验证码	<input type="text"/> 0477

Copyright by 工程地质学报