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非抽样离散小波变换叠前地震数据重建方法

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Pre-stack seismic data reconstruction based on the undecimated wavelet transform

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摘要

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摘要 叠前地震数据包含了丰富的地层信息,但在实际勘探中由于受采集条件等影响,叠前地震数据地震道缺失现象严重。针对规则采样不规则道缺失的插值恢复问题,一些传统的插值方法无能为力或者插值效果不佳,而近年来发展起来的非抽样离散小波变换(UDWT),具有很好的稀疏表示能力,比傅里叶变换能更加稀疏地表示地震数据;根据压缩感知理论,即使不满足Nyquist采样定理的要求,利用极少的观测数据,也可能较好地恢复缺失的地震数据。本文提出一种基于UDWT的地震数据插值方法,对地震数据做插值和规则化处理,可以提高叠前地震数据的完整性,理论模型和实际资料的重建效果验证了方法的有效性和实用性。

关键词: 非抽样离散小波变换 压缩感知 地震数据重建 地震数据规则化 叠前地震数据

Abstract: Due to seismic data acquisition conditions, seismic trace missing often occurs. This is a serious problem in pre-stack data processing. Some conventional interpolation methods do not work or have very poor results to reconstruct non-uniform seismic missing traces. The undecimated discrete wavelet transform (UDWT) developed in recent years can effectively capture the singularity in seismic data with robust sparse representation capability. This approach can achieve better results than the Fourier transform. According to the compression sensing theory, the transform can reconstruct seismic missing data just using little acquired data even if the Nyquist sampling theorem is not satisfied. We develop a seismic data interpolation method based on UDWT for seismic missing trace reconstruction to ensure the integrity of seismic data for pre-stack data processing. Tests on theoretical model and real data have verified the validity of this method.

Keywords: undecimated wavelet transform compression sensing seismic data reconstruction seismic data regularization pre-stack seismic data

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