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基于结构自适应中值滤波器的随机噪声衰减方法

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Random seismic noise suppression via structure-adaptive median filter

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摘要

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摘要 本文提出一种保护断层、裂缝等地质边缘特征的结构自适应中值滤波器,用于衰减地震资料中的随机噪声.基于地震反射同相轴局部呈线型结构的假设,采用梯度结构张量估计地层倾向,分析地层结构的规则程度,在此基础上引入地震剖面中线型和横向不连续性两种结构特征的置信度量.结构自适应中值滤波器根据这两种置信度量调整滤波器窗函数的尺度和形状,根据地层倾向调整滤波器窗函数的方向,从而使得滤波操作窗能够最佳匹配信号的局部结构特征.将本文方法用于合成和实际数据的处理,并与两种常用中值滤波方法进行对比,结果表明,该方法能够更好地解决地震剖面的随机噪声衰减和有效信号保真的问题,在增强反射同相轴的横向一致性的同时有效保持了剖面内的地质边缘和细节特征,显著改善了地震资料的品质.

关键词 中值滤波, 自适应滤波, 噪声衰减, 构造保护, 梯度结构张量

Abstract: This paper presents a structure-adaptive median filter for reducing random seismic noise which preserves seismic edges and details such as faults and fractures. By considering seismic horizons as line-like structures, this filtering framework relies on the computation of the Gradient Structure Tensors, which provides dips of seismic events and the regularity of local seismic structures, based on which two confidence measures are defined for different seismic structures. The structure-adaptive median filter adjusts the shape of the filter kernel according to the two confidence measures and aligns the filtering kernel along local dips to make the filtering kernel optimally matched with different local geological features. The proposed filter has been applied to both the synthetic and real data, and compared with two widely used median filtering schemes. The processing and comparison results show that the proposed structure-adaptive median filter is more suitable to balance suppressing random seismic noise and preserving signals which preserves seismic edges and details while enhancing the coherence of seismic horizons, and improves the quality of seismic images significantly.

Keywords Median filter, Adaptive filtering, Noise suppression, Structure preserving, Gradient structure tensor

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