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基于WNAD方法的非一致网格算法及其弹性波场模拟

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Non-uniform grid algorithm based on the WNAD method and elastic wave-field simulations

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摘要 加权近似解析离散化(WNAD) 方法是近年发展的一种在粗网格步长条件下能有效压制数值频散的数值模拟技术. 在地
际应用中, 不是所有情况都适合使用空间大网格步长. 为适应波场模拟的实际需要, 本文给出了求解波动方程的非一致网格
算法. 这种方法在低速区、介质复杂区域使用细网格, 在其他区域采用粗网格计算. 在网格过渡区域, 根据近似解析离散化
采用了新的插值公式, 使用较少的网格点得到较高的插值精度. 数值算例表明, 非一致网格上的WNAD方法能够有效压制数
著减少计算内存需求量和计算时间, 进一步提高了地震波场的数值模拟效率.

关键词： 波场模拟 非一致网格 加权的近似解析离散化方法 数值频散

Abstract： Weighted nearly-analytical discrete (WNAD) method is a new numerical technology develope
recent years, which can effectively suppress the numerical dispersion when a coarse grid is used. Howev
a large spatial step is not always suitable for any seismic exploration cases. In order to meet the actual
requirement of seismic wave-field simulations, we suggest a non-uniform grid algorithm based on the WN
method to solve the wave equations in this paper. This algorithm uses a fine spatial grid in special compu
domains such as the low-velocity areas and complicated media, and adopts a coarse spatial grid in the r
computational domains. Based on the characteristics of the WNAD method, this non-uniform grid algorith
new interpolation formula to connect the fine grids and the coarse grids in the transition zone, thus obta
interpolation accuracy through using fewer grids. Numerical results show that the non-uniform grid algori
suppress effectively the numerical dispersion, and reduce the storage spaces and computational costs, r
in further increasing the computational efficiency of seismic wave-field simulations.

Keywords： Wave-field simulation Non-uniform grid Weighted nearly-analytic discrete method Nume
dispersion

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