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多次各向异性散射模式对S波能量密度包络曲线的影响

景月岭^{1,2,4}, YuehuaZeng³, 林泉^{1,2}, GendaChen⁴, 李建波^{1,2*}

1. 大连理工大学海岸与近海工程国家重点实验室, 辽宁大连 116024;
2. 大连理工大学建设工程学部工程抗震研究所, 辽宁大连 116024;
3. U. S. Geological Survey, Golden, CO 80401, USA;
4. Department of Civil, Architectural, and Environmental Engineering, Missouri University of Science and Technology, MO 65409, USA

The effect of multiple anisotropic scattering pattern on S wave energy density envelope

JING Yue-Ling^{1,2,4}, ZENG Yuehua³, LIN Gao^{1,2}, CHEN Genda⁴, LI Jian-Bo^{1,2*}

1. The State Key Laboratory of Coastal and Offshore Engineering, Dalian University of Technology, Dalian 116024, China;
2. Earthquake Engineering Research Division, Dalian University of Technology, Liaoning Dalian 116024, China;
3. U. S. Geological Survey, Golden, CO 80401, USA;
4. Depart of Civil, Architectural, and Environmental Engineering, Missouri University of Science and Technology, MO 65409, USA

摘要

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摘要 在多次各向异性散射理论的基础上,本文重新推导了方向性散射系数的球函数展开式.引入特征时间的概念,来定义震源处初始地震波脉冲宽度,并在地震波能量密度积分方程中引入任意给定频率的初始脉冲能量谱密度的解析表达.通过离散波数方法求解了修正的地震波能量密度积分方程.基于积分方程的数值解,研究了不同散射模式对S波能量密度包络曲线的影响.计算结果表明:随着震源距的增加,在S波到时之后,多次各向异性散射模式与多次各向同性散射模式合成的能量密度包络差异逐渐增大.其中通过多次前散射模式,我们可以得到不同震源距的尾波能量密度包络的同一衰减趋势,以及S波能量密度包络随着震源距的增加而出现的展宽现象.最后,利用美国内华达州Wells地震余震的台站记录验证了多次前散射模式的实用性与有效性.

关键词 多次各向异性散射, S波能量密度包络, 方向性散射系数, 包络展宽, 尾波, 同一衰减, 能量传输理论

Abstract: Based on the multiple anisotropic scattering theory, we reevaluate the spherical harmonic series expansion of directional scattering coefficient. A characteristic source time is introduced to define the initial impulse width of energy density at the source. We use an analytical expression of the initial spectral energy intensity in the integral equation of seismic wave energy density at any given frequency. The modified integral equation is solved by a discrete wave number method. Based on this solution, we investigate the effect of scattering pattern on S wave energy density envelope. And the numerical simulation shows that after the S arrival time the difference of the energy density envelope between the multiple anisotropic scattering pattern and the isotropic scattering pattern increases with distances. Using forward anisotropic scattering pattern, we successfully reproduce the common decay of the seismic coda wave energy density envelopes at different hypocentral distances. For the same pattern, the S wave energy density envelope broadens with increasing hypocentral distance. Finally, we verify the forward anisotropic scattering pattern with the observation from the aftershock of the 2008 Wells, Nevada earthquake in USA.

Keywords Multiple anisotropic scattering, S wave energy density envelope, Directional scattering coefficient, Envelope broadening, Coda wave, Common decay, Energy transport theory

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