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水平层状介质中基阶瑞利面波椭圆极化特征数值分析与研究

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A study of the elliptic polarization characteristics of fundamental mode rayleigh wave based on numerical simulation

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摘要

近年来的工程实践表明,以速度频散特性为理论基础的传统瑞利面波法的实际应用存在场地限制的瓶颈问题.为克服该困难,本文从面波的基础理论着手,在前人建立的水平层状介质中瑞利面波速度频散方程的基础上,推导了水平层状介质中瑞利面波质点位移的解析解公式.以工程中常见的几种典型的水平层状地层模型为例,结合地脉动单点谱比法(HVSR,Horizontal to Vertical Spectral Ratio),对基阶瑞利面波的椭圆极化特征进行了数值模拟研究.研究结果表明:与瑞利面波的速度频散特性类似,其椭圆极化同样具有频散特性,且椭圆极化时的质点位移水平分量与垂直分量的频谱比与地层泊松比结构有关.瑞利面波的这种椭圆极化特性展示了利用单点瑞利面波的多分量评价地层泊松比结构的理论可行性.

关键词 瑞利面波, HVSR, 椭圆极化, 频散, 泊松比

Abstract:

Field practices show that the application of Rayleigh wave method based on its velocity dispersion property is restricted by site conditions. To deal with the limitation, the paper deduces the theoretical solution of the Rayleigh wave particle displacement, based upon the theory of Rayleigh wave and its velocity dispersion equations in horizontal layer media developed by former researchers. Then, taking some typical horizontal stratum models in civil engineering as examples, and combining with the method of micro-tremor HVSR(Horizontal to Vertical Spectral Ratio)at a single surveying point, we study the elliptic polarization characters of the fundamental mode Rayleigh wave by numerical simulation. The research results show that similar to the velocity dispersion property of Rayleigh wave, its elliptic polarization has also the dispersion property, and the horizontal to vertical spectral ratio of particle displacement of the elliptic polarization is related to the Poisson ratio structures of the strata, which is of significant potential for the development of a new survey method for the Poisson ratio structures of the strata using the multiple components of Rayleigh surface wave at a single site.

Keywords Rayleigh Wave, HVSR (Horizontal to Vertical Spectral Ratio), Elliptic polarization, Dispersion, Poisson ratio

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