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煤矿井下槽波三维数值模拟及频散分析

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3-D numerical simulation and dispersion analysis of in-seam wave in underground coal mine

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摘要 采用交错网格高阶有限差分法编制了地震波场三维正演模拟软件,设计了基于镜像法原理处理煤矿井下近水平和起伏巷道特殊空间的算法;模拟了煤矿井下含巷道和不含巷道情况下煤层中传播的地震波场,并分析其频散特征.结果发现:由于巷道的影响,巷道壁上产生很强的巷道振型槽波,煤层中则出现了以Love型为主的槽波,据此分析了实际槽波记录的形成机理,研究结果对今后煤矿井下巷道地震超前探测和工作面弹性波透视等具有重要的理论意义和实际价值.

关键词 煤矿, 槽波, 三维数值模拟, 巷道, 交错网格高阶有限差分, 频散

Abstract：The staggered-grid high-order finite difference method is used in developing of a 3-D seismic wavefield forward modeling software. Based on the principle of image method, the algorithm is designed to process the special spaces of subhorizontal and undulate roadway in underground coal mine. The seismic wave fields of 3-D coal seam models with and without roadway are simulated and dispersion characteristics are analyzed. It is found that strong roadway-type waves appear in the roadway wall and in-seam waves mainly of Love type appear in the coal seam. According to the simulation, we have analyzed the forming mechanism of practical in-seam wave records. The result has important theoretical significance and actual value for future seismic roadway probing ahead and coal working face perspective of elastic wave in underground coal mine.

Keywords Coal mine, In-seam wave, 3-D numerical simulation, Roadway, Staggered-grid high-order finite difference, Dispersion

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