地球物理学报 » 2010, Vol. 53 » Issue (9) :2237-2243 DOI: 10.3969/j.issn.0001-5733.2010.09.025
应用地球物理学

引用本文:
陈 强, 魏光辉, 万浩江.雷云荷电模型量子反演[J] 地球物理学报, 2010,V53(9): 2237-2243

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2243

雷云荷电模型量子反演

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Quantum inversion of thunderstorm charged model

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摘要 雷电物理学的发展和雷电防护新理论与新技术的研究需要对雷云荷电结构进行深入探索.利用地面电场观测数据对雷云进行地球物理学反演是一个可行的研究途径.实际雷云荷电结构复杂多变,反演目标函数高度非线性,传统的反演方法往往显得利用量子反演方法可尝试解决此问题.在总结分析近年发展比较成熟的量子遗传算法(QGA)、量子退火算法(QA)和量子粒子(QPSO)的基础上,针对Amoruso和Lattarulo提出的带电圆盘雷云荷电模型建立反演模型,分别用三种改进的量子反演算法计算结果进行了反演实验,发现QA对此模型的反演准确度最高,而QGA的全局收敛速度最快.通过用QGA对一组实际观测数据的三层、四层、五层带电圆盘模型的反演,对比分析了不同模型结构对实际反演结果的影响.

关键词: 雷云荷电模型 非线性反演 量子遗传算法 量子退火算法 量子粒子群算法

Abstract: To develop the lightning physics and the new lightning protection theory and technology, inv thunderstorm charged model was done based on *E*-field data at the ground level, which is a practical wa study the thunderstorm charged structure. Traditional inversion methods always fail, for actual thunderst charged structure is extraordinarily complex and objective functions are strongly non-linear. To solve this quantum inversion methods were tried. We summed up and analyzed the quantum genetic algorithm(QGA quantum annealing algorithm (QA) and quantum particle swarm optimization (QPSO) which were develope these last few years. Inversion model was established based on charged disk thunderstorm model introdu Amoruso and Lattarulo, and then a theoretic model was inversed by three kinds of improved quantum inv methods. The results show that improved QA adapts to this model best and convergent velocity of QGA fastest. A group of *E*-field data at ground level was used to invert for three-layer, four-layer and five-lay models by improved QGA. The results show that inversion result with actual data strongly depends on th structure.

Keywords: Thunderstorm charged model Non-linear inversion Quantum genetic algorithm Quantum algorithm Quantum particle swarm optimization

Received 2009-12-18;

Fund: