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时间域航空电磁系统瞬变全时响应正演模拟

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The full-time electromagnetic modeling for time-domain airborne electromagnetic systems

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摘要

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摘要

近年来很多专家学者致力于时间域航空系统正反演的研究. 本文针对一维均匀层状介质和三维模型进行正演. 不仅计算垂直方向上的电磁响应, 还计算了同线方向上的电磁响应, 为航空电磁多分量观测提供理论依据. 通过比较航空电磁系统的脉冲响应和阶跃响应特征, 发现脉冲响应在早期时间存在奇异性, 造成计算不稳定. 然而, 阶跃响应在早期时间没有奇异性, 因而利用系统的阶跃响应可得到一种计算时间域航空电磁系统全时响应的稳定算法. 该算法具有较高的精度, 并很好地保持了磁场强度 B 和磁感应 dB/dt 关系的一致性. 该算法推广到三维地质体的时间域正演模拟亦取得很好的效果.

关键词 航空电磁, 时间域, 正演模拟, 脉冲响应, 阶跃响应

Abstract:

In recent years, many experts dedicated their research to the forward modeling and inversion of airborne EM systems. In this paper, we carry out the modeling for 1D layered media and 3D earth. We calculate not only vertical component but also the in-line component of the magnetic responses. This offers the theoretical basis for airborne EM to have multi-component survey. After comparing the impulse response and step response for airborne EM systems, we find that the impulse system response has singularity at the early time, resulting in stability problems in the EM modeling, while the step system response is non-singular, so that we can develop a stable algorithm for the calculation of the full-time EM responses for time-domain airborne systems. It is proved that the algorithm is precise and maintains well the integral/derivative relationship between the magnetic field B and the magnetic induction dB/dt . Extending the algorithm to 3D models has also obtained good results.

Keywords Airborne EM (AEM), Time-domain, Forward modeling, Impulse response, Step response

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