地球物理学报 » 2012, Vol. 55 » Issue (7) :2259-2267 doi:10.6038/j.issn.0001-5733.2012.07.012

引用本文(Citation):
李振海, 罗志才, 钟波.基于3DDelaunay剖分算法的重力建模与分析. 地球物理学报, 2012,55(7): 2259-2267,doi: 10.6038/j.issn.0001-5733.2012.07.012

LI Zhen-Hai, LUO Zhi-Cai, ZHONG Bo.Gravity modeling and analyzing based on 3D Delaunay triangulation algorithm.Chinese J.Geophys. (in Chinese),2012,55(7): 2259-2267,doi: 10.6038/j.issn.0001-5733.2012.07.012

基于3DDelaunay剖分算法的重力建模与分析

李振海[1], 罗志才[1,2,3], 钟波[1,2]*

1. 武汉大学测绘学院, 武汉 430079;
2. 武汉大学地球空间环境与大地测量教育部重点实验室, 武汉 430079;
3. 武汉大学测绘遥感信息工程国家重点实验室, 武汉 430079

Gravity modeling and analyzing based on 3D Delaunay triangulation algorithm

LI Zhen-Hai[1], LUO Zhi-Cai[1,2,3], ZHONG Bo[1,2]*

1. School of Geodesy and Geomatics, Wuhan University, Wuhan 430079, China;
2. Key Laboratory of Geospace Environment and Geodesy, Ministry of Education, Wuhan University, Wuhan 430079, China;
3. State Key Laboratory of Information Engineering in Surveying, Mapping and Remote Sensing, Wuhan University, Wuhan 430079, China

摘要 地质体的重力建模是正确解释和应用重力资料的关键问题之一.针对非规则形状变密度的三度体,本文提出了基于3D Delaunay剖分算法的重力建模方法.采用3D Delaunay剖分算法将三维目标地质体分解为若干变密度四面体体元,推导了基于四面体体元的重力正演公式,建立了剩余密度值与重力异常值的线性方程组;以变密度的长方体和倾斜台阶组合体为例,比较分析了常规块体算法和3D Delaunay剖分算法应用于重力正演的有效性,并采用共轭梯度法加密度约束条件对非规则形状变密度的倾斜台阶组合体进行了密度反演.计算结果验证了本文方法的正确性和有效性.基于3D Delaunay剖分算法的重力建模可应用于存在褶皱、断层、裂缝等复杂地质体的重力正反演计算.

关键词 3D Delaunay剖分算法, 重力建模, 三度体, 重力异常

Abstract: Gravity modeling of three-dimensional geological body is one of the key problems for interpreting and applying gravity data. Aiming at three-dimensional geological body with irregular structure and varying density, we presented the gravity modeling approach based on 3D Delaunay triangulation algorithm in the paper. With 3D Delaunay triangulation, the geological body was divided into various tetrahedral vexels in optimal way, and then the gravity forward calculation formula for a tetrahedral vexel was derived, as well as the linear equations between the residual densities and the gravity anomalies. Taking a cuboid with varying density and a hybrid geological body with inclined step and varying density as examples, we compared and analyzed the validity for the forward computation of gravity anomalies using traditional cuboid vexel and 3D Delaunay triangulation algorithm respectively. Moreover, the density distribution of the hybrid geological body with inclined step and varying density was recovered by inversion using conjugate gradient algorithm with constrained density, and the inversion results were very consistent with the real geological body. Simulation results verified the correctness and validity of the gravity modeling method given in the paper. The gravity modeling based on 3D Delaunay triangulation algorithm could be applied to the gravity forward and inversion computation for the complicated and heterogeneous geological body with folds, cracks, faults and etc.

Keywords 3D Delaunay triangulation algorithm, Gravity modeling, Three-dimensional body, Gravity anomaly

Received 2011-01-24;

Fund:国家重点基础研究发展计划(973计划)(2007CB714405);国家自然科学基金(40874002);教育部新世纪优秀人才支持计划项目(NCET-07-0635);地球空间环境与大地测量教育部重点实验室开放基金(08-02-03) 联合资助.

Corresponding Authors: 罗志才,男,1966年生,教授,博导,主要研究方向为地球重力学和卫星重力探测技术及应用. E-mail: zhcluo@sgg.whu.edu.cn Email: zhcluo@sgg.whu.edu.cn

链接本文:
http://118.145.16.227/geophy/CN/10.6038/j.issn.0001-5733.2012.07.012 或 http://118.145.16.227/geophy/CN/Y2012/V55/I7/2259