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GRACE星体和SuperSTAR加速度计的质心调整精度对地球重力场精度的影响

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Influence of the adjusted accuracy of center of mass between GRACE satellite and SuperSTAR accelerometer on the accuracy of Earth′ s gravitational field

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摘要 本文利用改进的能量守恒法开展了GRACE星体和星载加速度计检验质量的不同质心调整精度影响地球重力场精度的模拟研究论证. 结果表明：第一，在120阶处，当质心调整精度设计为0 m，恢复累计大地水准面精度为17.616 cm；当质心调整精度分别设计为5×10^{-5} m、1×10^{-4} m和5×10^{-4} m时，恢复精度各自降低至18.106 cm、19.033 cm和27.329 cm. 第二，以德国GFZ公布的EIGEN-GRACE02S地球重力场模型的实测累计大地水准面精度为标准，当质心调整精度设计为$(5\sim10)\times10^{-5}$ m时，其和K波段星间测量系统、GPS接收机、SuperSTAR加速度计、恒星敏感器等GRACE核心载荷的精度指标相匹配，对地球重力场恢复精度的影响较小，因此建议我国将来研制的首颗重力卫星的星体和星载加速度计检验质量的质心调整精度设计为$(5\sim10)\times10^{-5}$ m较优.

关键词 GRACE, 加速度计, 质心调整精度, 地球重力场, 能量守恒法

Abstract: In this paper, the demonstration of simulation study on the accuracy of Earth′ s gravitational field influenced by the different adjusted accuracy of center of mass between GRACE satellite and SuperSTAR accelerometer proof mass is carried out using the improved energy conservation principle. The results show: Firstly, at degree 120, cumulative geoid height error is at the level of 17.616 cm with the adjusted accuracy of center of mass designed as 0 m, and errors come to 18.106 cm, 19.033 cm and 27.329 cm with the adjusted accuracy designed as 5×10^{-5} m, 1×10^{-4} m and 5×10^{-4} m, respectively. Secondly, under standard of measured cumulative geoid height error from the Earth′ s gravitational field model EIGEN-GRACE02S publicized by German GFZ, the adjusted accuracy of center of mass designed as $(5\sim10)\times10^{-5}$ m is matched with the accuracy of GRACE key payloads including K-band ranging system, GPS receiver, SuperSTAR accelerometer and Star camera assembly, and does not influence the accuracy of Earth′ s gravitational field. Therefore, we propose that the optimal adjusted accuracy of center of mass between GRACE satellite and SuperSTAR accelerometer proof mass is designed as $(5\sim10)\times10^{-5}$ m in the future first gravity satellite in China.

Keywords GRACE, Accelerometer, Adjusted accuracy of center of mass, Earth′ s gravitational field, Energy conservation principle

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