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新一代GRACE重力卫星反演地球重力场的预期精度

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Expected accuracy of the global gravity field for next GRACE satellite gravity mission

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摘要 基于低低卫卫跟踪模式,本文主要探讨利用动力学法融合精密轨道数据和星间测距或距离变率数据求解地球重力场的基本原理与方法,该方法既可对两颗低低跟踪卫星的初始状态误差进行有效校正,也可充分利用低轨卫星轨道所包含的低频重力场信息.为探讨适合我国国情的低低跟踪模式下的重力卫星指标,本文以不同星载设备精度指标的组合进行模拟计算,模拟结果显示:(1)把GRACE卫星的星间距离变率指标提高一个量级,其余指标保持与GRACE卫星设计指标一致时,可使地球重力场的精度获得同量级的提高;(2)若星间距离变率为1.0×10^{-8} m·s^{-1},轨道高度为300 km,加速度计精度为3.0×10^{-10} m·s^{-2},轨道精度为0.03 m, 星间距离100 km,与利用GRACE的设计指标反演出的重力场精度相比,可提高约121倍,并建议我国未来低低跟踪重力卫星计划参考此指标.

关键词 数据融合, 星间距离, 距离变率, 新一代重力卫星, 预期精度

Abstract: For the technology of low-low satellite to satellite tracking, this paper focuses on a method which combines the precise orbit data with range data or range rate data to recover the global gravity field. It not only can calibrate the initial position error of the two satellites, but also make good use of the low frequency gravity information from the mission. Several simulation scenarios are discussed in this paper. The results are as follows. (1) If the precision of range rate measurement is improved by a factor of ten, the accuracy of global gravity field will be 10.6 times better; (2) The accuracy of the global gravity field will be higher than that of GRACE by a factor of about 121 if we use the following accuracy indexes: the accuracy of range rate, altitude, acceleration, orbit position and the distance between the two satellites is 1.0?10^{-8}m穖$^{-1}$, 300 km, 3.0?10^{-10}m穖$^{-2}$, 0.03 m, and 100 km, respectively. Therefore, we recommend the payloads mentioned above for Chinese future satellite gravity mission.

Keywords Data combination, Range, Range rate, Future satellite gravity mission, Expected accuracy

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