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# 利用解析法有效快速估计将来GRACE Follow-On地球重力场的精度

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# Efficient and rapid estimation of the accuracy of future GRACE gravitational field using the analytic method

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摘要

本文首次利用解析法有效快速估计了将来GRACE（Gravity Recovery and Climate Experiment） Follow-On地球重
第一，基于功率谱原理分别建立了新的GRACE Follow-On卫星激光干涉星间测量系统星间速度、GPS接收机轨道位置和
及加速度计非保守力误差影响累计大地水准面的单独和联合解析误差模型. 第二，利用提出的GRACE卫星关键载荷匹配精
国喷气推进实验室（JPL）公布的GRACE Level 1B实测精度指标的一致性，以及估计的GRACE累计大地水准面精度和德
学研究中心（GFZ）公布的EIGEN-GRACE02S地球重力场模型实测精度的符合性，验证了本文建立的解析误差模型是可靠
论证了GRACE Follow-On卫星不同关键载荷匹配精度指标和轨道高度对地球重力场精度的影响. 在360阶处，利用轨
km、星间距离50 km、星间速度误差$1\times10^{-9}$m/s、轨道位置误差$3\times10^{-5}$m、轨道速度误差$3\times10^{-8}$m/s和非保守力
$^{13}$m/s$^2$，基于联合解析误差模型估计累计大地水准面的精度为$1.231\times10^{-1}$ m. 本文的研究不仅为当前GRACE和
Follow-On地球重力场精度的有效快速确定提供了理论基础和计算保证，同时对国际将来GRAIL（Gravity Recovery an
Laboratory）月球卫星重力测量计划的成功实施具有重要的参考意义.

关键词： GRACE Follow-On 解析法 误差模型 卫星跟踪卫星模式 地球重力场

Abstract:

The accuracy of Earth's gravitational field from the Gravity Recovery and Climate Experiment (GRACE)
satellite mission is efficiently and rapidly estimated for the first time based on the analytic method. F
new single and combined analytic error models of cumulative geoid height influenced by four erro
including the intersatellite range-rate of interferometric laser ranging system, orbital position and veloc
receiver and nonconservative force of accelerometer from GRACE Follow-On satellites are established
power spectrum principle, respectively. Secondly, the dependability of analytic error model is validated
to the consistency of the matching accuracy indexes of GRACE key payloads from the single analytic err
and the GRACE Level 1B provided by the American Jet Propulsion Laboratory (JPL), and the conformity
cumulative geoid height errors from the combined analytic error model and the Earth's gravitational fi
EIGEN-GRACE02S released by the German GeoForschungsZentrum Potsdam (GFZ). Finally, the infl
different matching accuracy indexes of key payloads and orbital altitudes from GRACE Follow-On satelli
accuracies of Earth's gravitational field are demonstrated contrastively. At the 360 degree, cumula
height error is $1.231\times10^{-1}$ m using combined analytic error model based on orbital altitude 250 km, in
range 50 km, intersatellite range-rate error $1\times10^{-9}$ m/s, orbital position error $3\times10^{-5}$ m, orbital velo
$3\times10^{-8}$ m/s and nonconservative force error $3\times10^{-13}$ m/s$^2$. This work not only can provide the t
foundation and calculational guarantee for the efficient and rapid determination of the accuracies o
GRACE and future GRACE Follow-On Earth's gravitational field, but also has some reference significar
successful execution of the future Gravity Recovery and Interior Laboratory (GRAIL) lunar satelli
exploration mission.

Keywords: GRACE Follow-On Analytic method Error model Satellite-to-satellite tracking model Ea
gravitational field

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