

Gravity potential determination based on Doppler cancelling technique: simulation experiments using high-frequency-stability microwave links between satellites and ground stations

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In this report we present simulation results for determining the gravity potential (geopotential) using high-frequency-stability microwave links between satellites and ground stations. Based on gravity frequency shift principle and Doppler cancelling technique, the geopotential difference between a satellite and a ground station can be determined, and consequently the geopotential difference between different ground stations can also be determined via satellites. Suppose the relative inaccuracy of the clocks on board satellites and at ground stations is about 10^{-17} level, our simulation experiments show the following results: (1) if two ground stations are connected via one satellite, the standard deviation is around $3 \text{ m}^2/\text{s}^2$ (equivalent in height 0.3 m); and (2) if two ground stations are connected with a network of satellites up to 5, the standard deviation can be largely improved, reaching around $1 \text{ m}^2/\text{s}^2$. With quick development of time-frequency science, portable and commercial optical atomic clocks with inaccuracy of 10^{-17} or better will appear soon. Hence, our proposed approach is prospective in the near future, especially for effective real-time geopotential determination, height measurement and global height datum unification in 1 cm level. This study is supported by National 973 Project China (grant No. 2013CB733301 and 2013CB733305), NSFC (grant Nos. 41210006, 41374022, 41429401), DAAD (grant No. 57173947) and NASG Special Project Public Interest (grant No. 201512001).

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