Evaluation of INS/GNSS Integration for Gravimetry with UAV

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The airborne gravimetry system based on Inertial Navigation System and Global Navigation Satellite System (INS/GNSS) integration has been successfully developed to observe the gravity field and estimate the gravity disturbance, which is defined as the difference between the actual gravity and the normal gravity, with the accuracies of approximately 3–4 mGal for vertical component. This technique is more cost-effective than terrestrial gravimeters, and provides higher resolution than satellite missions. Therefore, it currently contributes to geodetic applications and Earth sciences. However, the present airborne gravimetry systems have some shortcomings. It is expensive to rent an aircraft for surveying, and strict rules and regulations exist for acquiring permission to conduct a flight mission. The availability and flexibility of conducting small area surveys or spatial information collection are limited. In addition, detecting short wavelength gravity signals has become a challenge because higher altitude would cause a decrease in the gravity magnitude. Generally speaking, decreasing the altitude of the system is an easy and direct way to overcome these problems.
This research integrates a navigation-grade INS and GNSS for gravimetry based on the use of Unmanned Aerial Vehicle (UAV). The advantages include its high maneuverability and operational flexibility, and it is an intermediate system between the aerial and terrestrial survey in terms of coverage and resolution. The preliminary results show that the internal accuracies of horizontal and vertical gravity disturbance at crossover points are approximately 6–11 mGal and 4 mGal, respectively, with a 0.5-km resolution. As expected, the accuracy in down component is higher than that in horizontal components because the orientation errors could cause large error in horizontal components. The capability of INS/GNSS integration for gravimetry with UAV from determining and de-noising processing has been evaluated in this research.

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