Absolute Calibration of Spring Type Gravity Meters by the Moving Mass Device of the Mátyáshegy Gravity and Geodynamic Observatory, Budapest

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Abstract

The paper presents the characteristics and the metrological limits of the absolute calibration of spring type gravimeters by using a cylindrical test mass moved vertically around the gravimeter by a lifting device operated in the Mátyáshegy Observatory. The movement of the 3000 kg mass generates a sinusoid-like signal having a peak-to-peak amplitude of 1102 nm/s^2. The careful determination of the geometrical and physical parameters of the test mass combined with the analytical modeling of its gravitational effect and the related uncertainties provides an accuracy of 3 nm/s^2 in absolute sense. The overall accuracy, however, is influenced by several factors investigated in detail. The conclusions are based on more than 400 experiments with 5 LCR G and, as a unique case, a Scintrex CG-5 instrument too.

Two processing methods were developed. *Max-Min* determines the difference between the observed minimum and maximum effects and relates it to the theoretical value. *Full-Fit* fits the observations to the full calibrating signal by L2 norm adjustment providing the scale factor and other parameters.

The observations corrected for the disturbing effects still contain a systematic constituent with amplitude of (10 – 20) nm/s^2 for each LCR instrument. It resembles the second time derivative of the calibrating signal that may indicate the non-uniform elastic response of the spring sensors to increasing and decreasing gravity. The overall dispersion of the random and non-random residuals provided by *Full-Fit* method is typically 10 nm/s^2. The a posteriori accuracies of the individual scale factors provide, however, measurement accuracy of 2 nm/s^2.