

Precision Assessment of Multi-Gravimeter Observations and Intercomparisons at the National Gravity Reference Station in Taiwan

Miao-Hsiang Peng¹, Cheinway Hwang²

¹ Center for Measurement Standards, Industrial Technology Research Institute, 321, Sec. 2, Kuang Fu Rd., Hsinchu 300, Taiwan

² Department of Civil Engineering, National Yang Ming Chiao Tung University, 1001 Ta Hsueh Rd., Hsinchu 300, Taiwan

Abstract

A gravity station has been established in Hsinchu, Taiwan, and operated as a national-level gravity reference station. The primary objectives of the station are to maintain the national measurement standard, establish a precise gravity standard, and support geoscientific research. The long-term stability and metrological traceability of the station are essential for the maintenance and dissemination of the national gravity reference.

In this study, the national gravity reference station serves as the core of an integrated observation and intercomparison framework combining FG5 and A10 absolute gravimeters, a superconducting gravimeter (SG), and a CG-6 relative gravimeter. The framework establishes a complementary measurement chain consisting of absolute, continuous, and relative gravity observations, and is used to evaluate the consistency, repeatability, and measurement uncertainty of gravimeters based on different measurement principles.

For the multi-instrument intercomparison, observations obtained from the newly acquired A10 absolute gravimeter at the station are cross-validated against those from the existing FG5 absolute gravimeter. Long-term, high-temporal-resolution observations from the SG are further employed to examine the temporal consistency

of the absolute gravity measurements. In addition, CG-6 relative gravity measurements are conducted for gravity transfer and co-location observations to evaluate the relative precision of transferring gravity values from the national gravity reference station to external gravity stations. Data processing and quality assessment take into account major influencing factors. These procedures provide a basis for evaluating the precision and consistency of the multi-gravimeter observations and their associated measurement uncertainties.

By combining gravity observations obtained from different measurement principles and temporal scales, the proposed framework enhances the reliability of long-term maintenance of the national gravity reference and provides an integrated methodology for gravity reference maintenance, gravity value transfer, and geoscientific applications.

Keywords: national gravity reference, absolute gravimeter, superconducting gravimeter, measurement uncertainty, metrological traceability