Session 4: Best practices

Tuesday, April 12th 16:20 - 19:00 CEST

Sessions Chairs: D. van Westrum (USA) and M. Bilker-Koivula (Finland)

16:20	- 16:35	local	**H. Wziontek, J. Glässel, A. Rülke, S. Bonvalot** *The Database AGrav as basis for the International Gravity Reference Frame*
16:40	- 16:45	remote	**Ke Baogui, Zhao Yufei** *Optimal Selection Weight Value of Gravity Network Data Based on Membership Function*
16:50	- 17:15	remote	**Derek van Westrum** *Funky Data 2.0 - Data Analysis Tips and Tricks with Micro-g LaCoste Absolute Gravimeters*
17:20	- 17:35	local	**Petr Křen, Vojtech Pálinkáš, Miloš Vaľko** *Improved measurement model for FG5/X gravimeters and essential outputs from re-processing of raw data*
17:40	- 17:45	remote	**Jaakko Mäkinen** *How to refer absolute-gravity results to the effective position without reprocessing*
17:50	- 18:20	local	**René Reudink** *Experiences in adjusting the interferometer, cleaning and adjusting the laser and other practical matters related to the FG-5 absolute gravimeter*

The Database AGrav as basis for the International Gravity Reference Frame

H. Wziontek, J. Glässel, A. Rülke, Federal Agency for Cartography and Geodesy (BKG), Germany
S. Bonvalot, Bureau Gravimetrique International (BGI), France

Since 2007, the International database for absolute gravity observations AGrav is jointly operated by BKG and BGI. After years of development, an updated web application will become operational. An overview about database and web-frontend will be given and the data exchange will be explained. User feedback and discussion is welcome.

Optimal Selection Weight Value of Gravity Network Data Based on Membership Function

Ke Baogui, Chinese Academy of Surveying and Mapping Zhao Yufei,Chinese Academy of Surveying and Mapping

In the process of gravity network adjustment, it is usually based on the value range of standardized residual error to judge whether to to reduce the weight of the observed value . In this paper, the fuzzy logic relationship between gross error and residual error is considered, and the membership function is used to optimize the weight of observational value. The results show that this data processing method based on the membership function to optimize the weight of observation can optimize the evaluation criteria of gross error and residual error, and improve the data processing accuracy of gravity network.

Funky Data 2.0 - Data Analysis Tips and Tricks with Micro-g LaCoste Absolute Gravimeters

Derek van Westrum

While there are a growing number of muQuans quantum absolute meters being deployed worldwide, the majority of absolute instruments are still Micro-g LaCoste FG5(X) or A10 instruments. Both of these use the same "g" software for acquisition and processing of the raw data. In this update to my "Funky Data" presentation of 10 or so years ago, I will do a quick review of the software and how to interpret the various signals that it monitors. I will also address some newer topics such as: the utilization of "System Response Compensation", "Bell Frequency", and some subtleties on the use of GNSS signals to control the system's time standard. In addition, I will attempt to compile a list of small "tricks" and "habits" that I've found useful over the years.

Improved measurement model for FG5/X gravimeters and essential outputs from re-processing of raw data

Petr Křen, Czech Metrology Institute, **Vojtech Pálinkáš and Miloš Vaľko**, Research Institute of Geodesy, Topography and Cartography, Geodetic Observatory Pecný, Czech Republic

We present an improvement of the measurement model of absolute gravimeters based on laser interferometry, by an enhanced description of instrumental effects. Namely, a more precise description of the demodulation of the interferometric signal is presented as well as a newly discovered and explained parasitic signal due to the dropping mechanism of FG5 and FG5X (FG5/X) gravimeters. These improvements can be easily incorporated into the measurement model allowing to obtain more accurate and more stable results for g-values. Further, by using a programming tool applied on raw data, we are discussing the appropriate choice of the prescale factor similarly as essential outputs related to the residuals, spectras, effective height etc.

How to refer absolute-gravity results to the effective position without reprocessing

Jaakko Mäkinen, Finnish Geospatial Research Institute, Masala, Finland

There is a position on the free-fall trajectory in corner-cube absolute gravimeters at which the gravity value determined is independent of the (constant) value of the vertical gradient used in the equation of motion. Referred to a point in the dropper itself (typically the start of data acquisition) this position is called the effective measurement height. Referred to the station marker it is called the effective instrumental height. The effective measurement height depends on the section of the trajectory used for the processing, defined by the fringe numbers and laser wavelength. The effective instrumental height depends, in addition, on the details of the setup and even on the height of the station marker above the mounting surface. The advantages of providing gravity data at the effective instrument height are obvious. The effective measurement height h* can be determined empirically by a simple numerical experiment: fitting the model to fringe data with two different values of the vertical gradient and then solving for h* from the two results for gravity. The h* thus determined for a given instrument appears to be rather stable as long as the choice of fringes is not changed. In many cases the absolute-gravity data disseminated is not given at the effective instrument height, and the fringe data etc. to determine it is not available either. However, for the FG5(X)-A10 family of instruments the gravity results are often exchanged in the form of the project.txt files output by the ”g” software. This is the case for the AGrav database. Then, the project.txt file contains all the necessary information to determine the effective measurement height using a simulated fringe fit and to transform the gravity value to the effective instrumental height. The simulation depends critically on the assumption that in the equation of motion the initial distance and the initial velocity of the dropped object at t=0 turn out to be negligible. The assumption seems to be largely valid: for the instruments where I have been able to calculate h* empirically to compare with the simulated h*, the difference between the two h* has been of the order of tenths of millimetre. In order to avoid error-prone manual editing it seems advantageous that the script performing the simulation also write a new version of the project.txt file with the gravity now provided at the effective instrumental height. Finally, I think it is preferable that all groups producing AG data empirically determine their effective instrumental height(s) and start using it/them. The simulation should not be considered a substitute for such a determination but rather a last-ditch remedy when the fringe data needed for it is not available to the analyst.

Experiences in adjusting the interferometer, cleaning and adjusting the laser and other practical matters related to the FG-5 absolute gravimeter

René Reudink, Delft University of Technology, Fac. Civil Engineering and Geosciences (CEG), Dep. Geoscience & Remote Sensing

Since the development of the FG-5 absolute gravimeter, this instrument has become a standard for highly accurate gravity measurements down to the µGal (10^{-8} m/s2) level. It is clear that instruments with such accuracy/sensitivity are critical in tuning. Several parameters are often influencing simultaneously to achieve the intended final accuracy. We experienced this, for example, when adjusting the interferometer of the FG-5. If you want to adjust it from scratch, there are at least 8 parameters that have to be set. Half of them are easy to operate on an individual basis with adjustment screws. The other 4 can only be adjusted after loosening a number of Allen screws. The problem with this is that these parameters can no longer be set separately from each other. That immediately makes the adjustment of the interferometer a lot more complex and time-consuming. This is why we have come up with some tools and a method to adjust the interferometer step by step. In the workshop we want to share our experience with the other participants. In addition to adjusting the interferometer, we had to do with cleaning the brewster windows in the laser and adjusting the rear mirror of the laser. We have also devised some practical tools for this to make this kind of work a bit easier. We also show some practical things such as a dust cover for the telescope, a tip to extend the life of the ferrofluidic feedthrough and a vernier to measure the two heights (which must be measured when setting up the FG-5) easily in tenths of millimeters. Furthermore we show a step-by-step manual for adjusting the digital dropper. The explanation is supported with many images. In this session everything is focused on simplicity and practicality. The tools we have come up with are quite easy to reproduce.