AN AUTOMATION GRAVITY MEASUREMENTS WITH USING PDA COMPUTERS

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ABSTRACT

Preliminary processing of relative g measurements, including height, tidal, drift corrections and error analysis, was possible in the field by use of GRAW22 software. Program has been developed at the Warsaw University of Technology in nineties of previous century in OPL language to PSION microcomputer (Pachuta at all, 2001). Newer field computers, enabled more computational power and modern programming languages, allowing wider programming possibilities. New software to field operations connected with relative gravity measurements has been developed on WindowsCE platform – by GRAVANALYSER. Software can be used on different palmtops and supports every steps connected with gravimeter reading, computation of corrections and strategy of processing. In this paper short description of such software is presented. Differences between selected strategies of drift and tidal corrections computation are also presented.

1. PRESENTATION OF GRAVANALYSER SOFTWARE

Old GRAW22 software (Pachuta, 1995) permits to obtain gravity difference at span with error analysis in field. It used a simple method computation of tidal corrections (Newtonian) and only linear methods of drift elimination. New software GRAVANALYSER, developed in Visual Studio environment on mobile platform, contained every features previous application, such as:

- **different methods of gravimeter reading – optical, voltmeters, interpolation – with effort of reading analysis;**
- **computation of reference g value (interpolation from calibration table);**
- **choice of different scheme of span measurements – profile, star, repeat and different methods.**

In new application introduced some additional possibilities which can be useful in field processing of relative gravity measurements, for example:

- **nonlinear drift computation – it is possible for span with more then one repeated point and it can be useful to long span, measured several hours;**
- **more precisely tidal models based on Longman (1959) and Wenzel (1997) methods. Longman model is applying in "automatic gravimeter" i.e. Scintrex. Wenzel method (with main tidal waves coefficients) is taking mainly in absolute gravimetry. So GRAVANALYSER affords to choose such tidal model which is necessary by different gravimeter during joint measurements;**
- **to measure geodetic coordinates with use internal or external (Bluetooth) GPS receiver build into PDA, coordinates are measured with accuracy of several meters by code method without post-processing but it is enough for computation of tidal correction;**
- **possibility of re-processing registered projects with changing different parameters, i. e. scale factor, tidal and drift models; import and reprocessing OPL files (from PSION software) is also allowed;**
- **additional programs for tidal computation and support of different method of reading;**

All registered data are saved on PDA disc and results are reported in simple text file form. Figure no. 1 presents starting window of described software, Figure no. 2 presents gravimeter with PDA set.

Figure 1. Beginning window of GRAVANALYZER software.

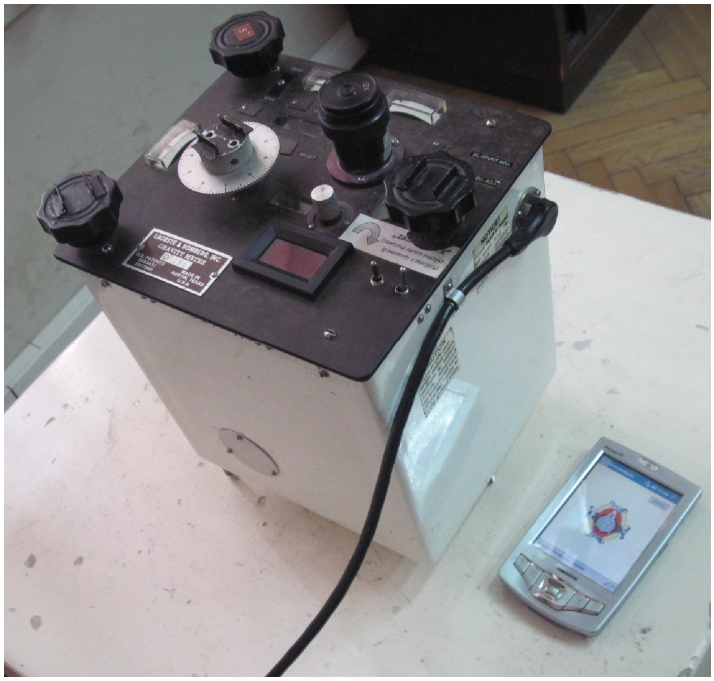

Figure 2. During survey with PDA computer.

2. ANALYSIS OF APPLICATION OF DIFFERENT TIDAL MODELS AND DRIFT COMPUTATIONS

An application of Wenzel method of tidal correction computation gives a possibility to obtain quite different and more precise results than other method. For example values of tidal correction are presented in table 1 for one long span measured in national gravimetric network. Wenzel method gives 2-3 µGals differences in comparison with Longmann and Newtonian method.

Table 1. Results of computation of tidal correction by different method for long gravimetric span

Point	Time	Reference g	Wenzel method	Longman method	Newtonian method
	[h:m:s]	[mGal]	[mGal]	[mGal]	[mGal]
A	07:10:09	255.4196	-0.0263	-0.0264	-0.0268
B	10:36:56	189.0267	-0.0738	-0.0763	-0.0765
B	10:51:26	189.0268	-0.0750	-0.0777	-0.0779
A	14:57:32	255.4602	-0.0763	-0.0793	-0.0793
A	15:12:47	255.4559	-0.0758	-0.0787	-0.0787
B	18:39:57	189.0074	-0.0578	-0.0592	-0.0591

For the same span the reference gravity on every repeated stations has been computed. For WENZEL method "closures" are quite often smallest then different methods. The differences are more than 1-2 µGals, but in the effect error of measured dg can be smaller also with 1-2 µGals.

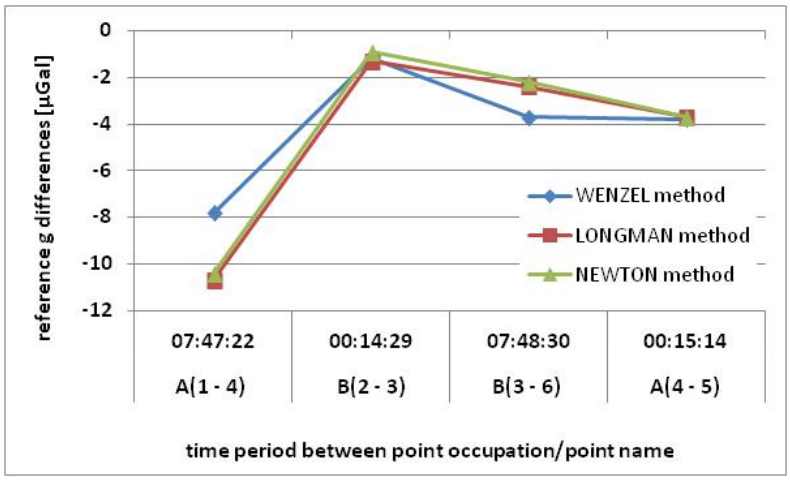

Figure 3. Reference g differences with using several methods tidal correction computation.

In presented software are build several methods of drift elimination: - mean linear, - linear weighted in proportion to time period, - linear weighted in proportion to power of time period, - non linear models based on reference g and differences of reference g and model of simultaneity adjustment observations in span with regarding non linear drift coefficient (Ożarowska, 2005). Comparison of these methods, for example span, is presented in Figure no. 4.

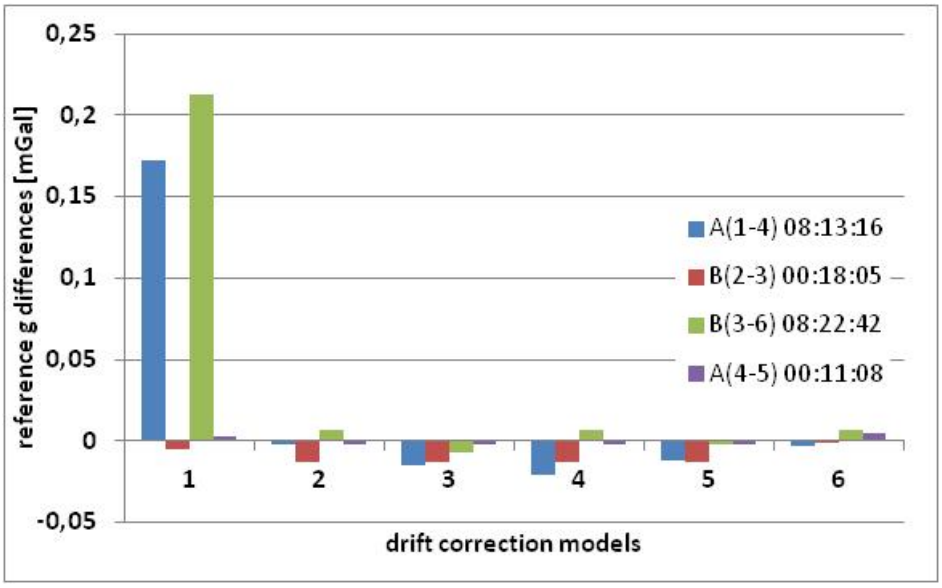

Figure 4: Comparison of differences of reference g values between repeated stations of gravimetric span (A-B-B-A-A-B method) in the context of different drift corrections. Number on horizontal axis shows differences in analyzed models: 1- mean linear, 2 - weighted (dt) linear, 3 - weighted (dt^2) linear, 4 - linear with adjustment, 5 – non-linear with adjustment, 6 - non-linear with adjustment and reduction.

In presented and in every computed examples mean drift was absolutely disparaged as method of drift computation. More complicated models (non-linear) was a little bit better than simple method weighted drift computation. But linear model turns out be accepted and gives only parts of microGals differences in long spans.

Presented software makes it possible to carry out every computational procedures in the field. It contains every modern method of tidal and drift computations. From user's point of view it is also simple to choose operation and manage files between PDA and PC computer. As appendix there are presented few exampled screenshots (in Polish language).

REFERENCES

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Ożarowska M. (2005). *"Analiza wpływu nieliniowego modelu dryftu na wyniki pomiarów grawimetrycznych"* praca dyplomowa niepublikowana, Warszawa, 2005.

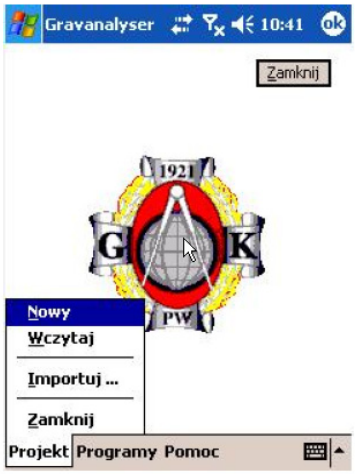
Pachuta A (1995). "*Metody automatyzacji względnych pomiarów grawimetrycznych"*. Konferencja Komitetu Geodezji PAN na temat: Problemy automatyzacji w geodezji inżynieryjnej. Warszawa 16-17.03.1995.

Pachuta A., Barlik M., Olszak T., Walo J (2003). "*Automation of the determination of gravity differences and vertical gravity gradient for measurements in hydrotechnical objects"* Reports on Geodesy No. 4 (67), Warsaw, 2003. Institute of Geodesy and Geodetic Astronomy, Warsaw University of Technology.

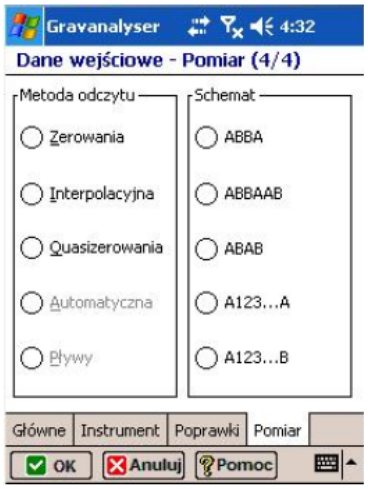
Wenzel H., (1997): *Analysis of earth tide observations.* Lecture Notes in Earth Sciences, Volume 66/1997, Springer Berlin/Heidelberg.

Appendix: Screenshots of GRAVANALYSER software

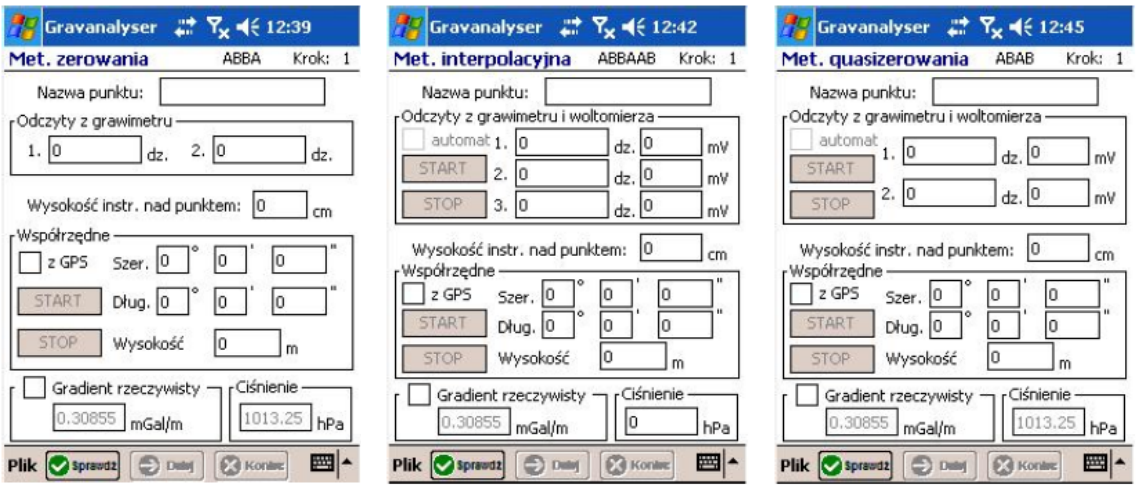
Starting window and create of new project



Setup of new project windows



Measurement windows (different methods)



Post-processing window and additional procedure for tidal computation