

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 et al., 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 than 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.

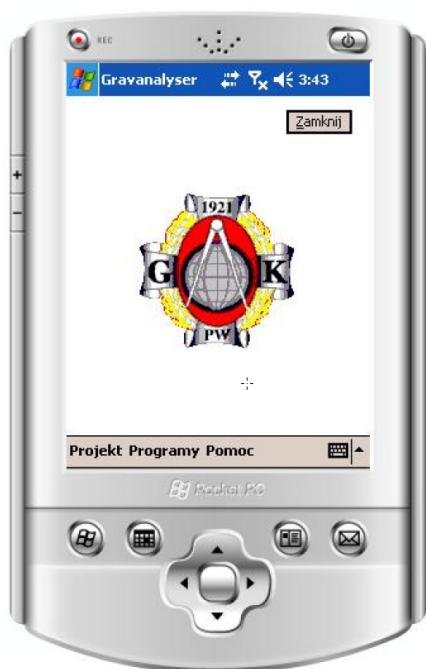


Figure 1. Beginning window of GRAVANALYSER software.



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 μ Gals 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 μ Gals, but in the effect error of measured dg can be smaller also with 1-2 μ Gals.

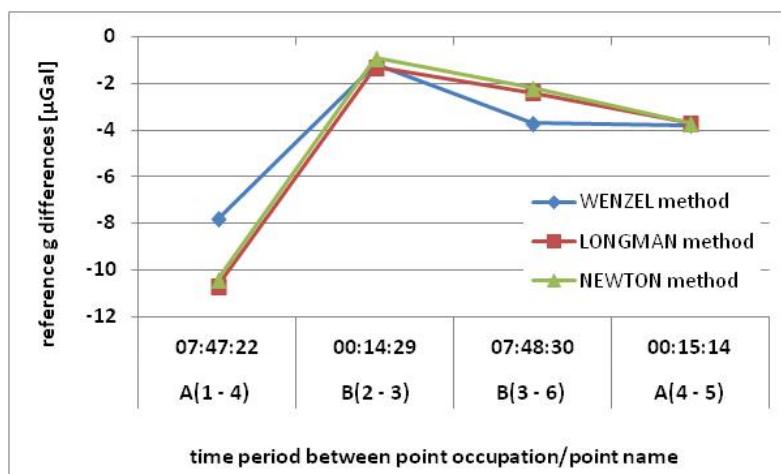


Figure 3. Reference g differences with using several methods tidal correction computation.

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.

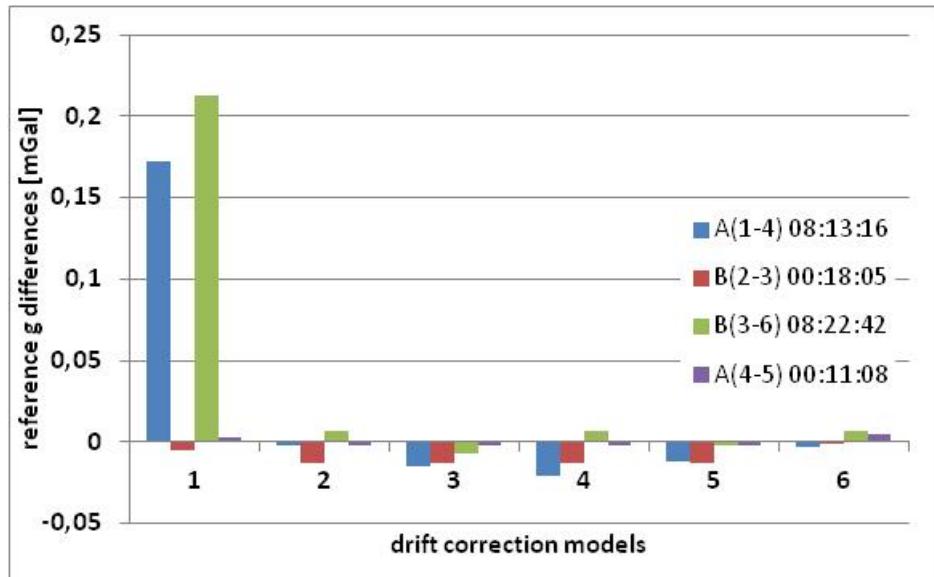


Figure 4: Comparison of differences of reference g values between repeated stations of gravimetric span (A-B-B-A-A-B method) in the context of different drift corrections. Number on horizontal axis shows differences in analyzed models: 1- mean linear, 2 - weighted (dt) linear, 3 - weighted (dt^2) linear, 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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Appendix: Screenshots of GRAVANALYSER software

Starting window and create of new project



Setup of new project windows

The image shows two setup windows for a new project. The left window is titled 'Dane wejściowe - Główne (1/4)' and contains fields for 'Obiekt' (Object), 'Nazwa' (Name), 'Obserwator' (Observer), and 'Sekretarz' (Secretary). It also includes a date input field with a calendar icon showing '2007 6 10' and a text area for 'Uwagi' (Notes). The right window is titled 'Dane wejściowe - Instrument (2/4)' and contains fields for 'Typ instrumentu' (Instrument type) with 'LaCoste and Romberg' selected, 'Instrument' (Instrument), 'Dopuszczalny błąd odczytu grawimetrem' (Allowable error of gravimeter reading) with a value of '0 uGal', 'Stała grawimetru' (Gravimeter constant), 'Współczynnik zmiany skali' (Scale change factor), and 'Stała woltomierza' (Voltmeter constant). Both windows have tabs for 'Główne', 'Instrument', 'Poprawki', and 'Pomiar', and buttons for 'OK', 'Anuluj' (Cancel), 'Pomoc' (Help), and a calendar icon.

The image shows two setup windows for a new project. The left window is titled 'Dane wejściowe - Poprawki (3/4)' and contains fields for 'Pływnawa' (Flowing) with options 'Wenzel'a and 'Longmana', 'Uproszczona' and 'Brak'; 'Współczynnik sztywności Ziemi' (Rigidity coefficient of the Earth) with a dropdown menu; 'Współrzędne na punktach' (Coordinates on points) with options 'różne' (different) and 'te same' (the same); 'Uwzględnianie wpływu ciśnienia' (Taking into account the effect of pressure) with options 'Iak' (Yes) and 'Nie' (No); and 'Dryft' (Drift) with a dropdown menu. The right window is titled 'Dane wejściowe - Pomiar (4/4)' and contains fields for 'Metoda odczytu' (Reading method) with options 'Zerowania' (Zeroing), 'Interpolacyjna' (Interpolation), 'Quasizerowana' (Quasizeroing), 'Automatyczna' (Automatic), and 'Pływy' (Flowing); and 'Schemat' (Diagram) with options 'ABBA', 'ABBAAB', 'ABAB', 'A123...A', and 'A123...B'. Both windows have tabs for 'Główne', 'Instrument', 'Poprawki', and 'Pomiar', and buttons for 'OK', 'Anuluj' (Cancel), 'Pomoc' (Help), and a calendar icon.

Measurement windows (different methods)

Met. zerowania (Method of zeroing):
 Nazwa punktu: []
 Odczyty z grawimetu:
 1. [0] dz. 2. [0] dz.
 Wysokość instr. nad punktem: [0] cm
 Współrzędne:
 [] z GPS Szer. [0] ° [0] ' [0] "
 START Dług. [0] ° [0] ' [0] "
 STOP Wysokość [0] m
 Gradient rzeczywisty [0,30855] mGal/m Cisnienie [1013,25] hPa

Met. interpolacyjna (Method of interpolation):
 Nazwa punktu: []
 Odczyty z grawimetu i woltomierz:
 automat 1. [0] dz. [0] mV
 START 2. [0] dz. [0] mV
 STOP 3. [0] dz. [0] mV
 Wysokość instr. nad punktem: [0] cm
 Współrzędne:
 [] z GPS Szer. [0] ° [0] ' [0] "
 START Dług. [0] ° [0] ' [0] "
 STOP Wysokość [0] m
 Gradient rzeczywisty [0,30855] mGal/m Cisnienie [0] hPa

Met. quasizerowania (Quasizeroing method):
 Nazwa punktu: []
 Odczyty z grawimetu i woltomierz:
 automat 1. [0] dz. [0] mV
 START 2. [0] dz. [0] mV
 STOP 2. [0] dz. [0] mV
 Wysokość instr. nad punktem: [0] cm
 Współrzędne:
 [] z GPS Szer. [0] ° [0] ' [0] "
 START Dług. [0] ° [0] ' [0] "
 STOP Wysokość [0] m
 Gradient rzeczywisty [0,30855] mGal/m Cisnienie [1013,25] hPa

Post-processing window and additional procedure for tidal computation

Postprocessing Instrument: LCR-G-42

Instrument:
 Stała grawimetru: [1]
 Współczynnik zmiany skali: [1]

Poprawki:
 Poprawka pływowa:
 Wenzel'a Longmana Uproszczona Brak
 Współczynnik sztywności Ziemi: 1.20
 Uwzględnianie wpływu ciśnienia:
 Tak Nie
 Dryft: liniowy ważony dt

Plik OK Anuluj

Poprawki pływowe

Metoda:
 Wenzel'a Longmana Uproszczona

Współczynnik sztywności Ziemi: []

Szerokość geograficzna - Wysokość:
 [0] ° [0] ' [0] " [0] m

Długość geograficzna - Interwał:
 [0] ° [0] ' [0] " [0] s

Data - początek:
 rok [0] mies. [0] dzień [0] godz. [0] min. [0] sek. [0]

Data - koniec:
 rok [0] mies. [0] dzień [0] godz. [0] min. [0] sek. [0]

Plik Oblicz Zamknij