GPS DATA PROCESSING WORKS IN THE SPACE RESEARCH CENTRE.

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ABSTRACT. The main task of this work was the software development for the processing of GPS observations. In the paper results of GPS pseudo-range and carrier beat phase observations are presented.

1. INTRODUCTION

Most of GPS receivers make two types of observations, namely carrier beat phase and pseudo-range. Both observations are a function of a topocentric range to satellite and differ with internal precision. Carrier beat phase and pseudo range have precision of submilimeter level and a few meters, respectively. In the GPS geodetic applications the phase measurements are mainly used. Pseudo-ranges combined with phase measurements can be used for relative kinematic positioning. Approximate geocentric coordinates and clock corrections, which can be obtained from pseudo-range single point positioning, are necessary for the processing of carrier phase relative positioning.

In 1988 we had not our own data, so for analyses of pseudo-ranges we used observations from Schwarzwald campaign carried out by Geodetic Institute of Stuttgart University using WM101 receivers. In the present time pseudo-range software is used for the processing of other observations including Polish campaigns.

In March 1989 the first GPS measurements in Poland were performed along the geodynamic traverse Józefosław-Borowiec which consisted of 11 short (~ 30 km)

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ВИТИЕ СПУТНИКОВЫХ МЕТОДОВ ОПРЕДЕЛЕНИЯ ПОЗИЦИИ

Войтех Пахельски

водит главные итоги, полученные за срок 1986-90 г. в еории радио-позиционных методов и методов уравнивания, мых для геодезической обработки наблюдений Допплера и GPS.

baselines. Five WM102 receivers were used in the campaign. Three of them were from the Department of Geodesy of the Royal Institute of Technology in Stockholm and two from Geodetic Institute of Stuttgart University. The end sites of the traverse were occupied during four days, the short baselines were measured in one day sessions. In addition the small test network in Borowiec with baselines from 168 to 310 m was measured once during the campaign. Data were analysed by three software packages: POPS, the software based on SLSO program made available by Dr.B.WRemondi and modified by D.Łapucha (Łapucha, 1989); PUMA program made available by Dr. W. Pachelski and further developed by A. Stomma. Changes made by A.Stomma are particularly described in (Stomma, 1989), (Stomma et al., 1990).

2. AN ANALYSIS OF ALGORITHMS AND ACCURACY OF THE GPS POINT POSITION DETERMINATION USING PSEUDO - RANGE OBSERVATIONS.

A mathematical model of single point positioning of pseudo-range observations is given in (Łapucha, Stomma, 1989). Two ways of implementation of receiver clock

Table 1. Repeatability of coordinates with different models of clock error.(m_p- point position error, m_0- standard deviation of unit weight)

Variant	day	X	Y	Z	m_p	m_0
		[meters]				
2-nd degree polynomial	1	4170892.9	629855.8	4769126.0	3.4	11.9
	2	919.5	857.5	141.3	2.1	8.6
	3	904.0	848.6	131.0	4.6	18.3
4-th degree polynomial	1	4170897.1	629856.6	4769129.3	2.8	9.7
	2	917.1	857.3	139.4	1.3	5.1
	3	907.6	851.6	133.1	1.4	5.6

error were analysed; with polynomial representation and separate clock unk... for each epoch. In the second case sequential adjustment was used. Pseudo-... data collected during three days for one station with similar three-hour vi... window were analysed.

Repeatability of coordinates show that model with separate clock unkno... each epoch is the best one. Comparison of above solution for different days to estimate the real accuracy of about 10 meters.

3. RESULTS OF THE FIRST GPS CAMPAIGN IN POLAND

The main task of this work was to test and develop available software packa... GPS phase observations processing. Since there was a possibility to deco... L1 measurements, modified SLSQ and PUMAS results were from L1 fre... The preliminary version of program for cycle slipes detection and repair... stations separated up to ~ 30-40 km was written. It is based on poly... approximation of raw phase data differenced between epochs and tri... ferenced data. Using this program L1 cycle slips from the first Polish GPS ca... were detected and corrected.

First results with phase observations using POPS and modified SLSQ are pu... in (Zdunek et al., 1989).

Then a particular attention was paid to program PUMAS, which was n... before with a large data set. Introduced important changes in PUMAS... scribed in (Stomma,1989). Results of POPS, modified SLSQ and PUMAS a... in (Stomma et al.,1990). Taken into account version of PUMAS was ba... changed formula of observational equation as it was given in above paper.M... SLSQ and PUMAS were used on the same data set. Ambiguity resolution... programs was not performed. For 11 short baselines accordance in heigh... ences between POPS L1 and SLSQ is 6-33 mm, ~ 18 mm in average an... systematic character. Analogical discrepancies for POPS L1 and PUM... worse than previously, 6-87 mm, ~ 39 mm in average. For 7 from 11 ba... modified SLSQ and PUMAS show good agreement in distances up to 15 m... other differences are 15 mm, 18 mm, 28 mm, 46 mm. All distances from F... and SLSQ are shorter than from POPS L1. Shortening is in average equal...

from POPS L1 frequency are shorter than from L1/L2 combination in average ~ 1 ppm.

For test network discrepancies between all programs and ground measurements in distances are not greater than 6 mm and in height differences not worse than 23 mm.

Differences of POPS L1/L2 4-day results of Józefosław-Borowiec baseline (271.5 km) and their mean value are 16-51 mm and 102-122 mm for distance and height difference, respectively.

Comparison with available ground distance measurements for 4 baselines (26.9-46.9 km) gives for POPS L1/L2, POPS L1, modified SLSQ, PUMAS discrepancies 2-20 mm, 11-71 mm, 66-200 mm, 55-218 mm, respectively.

4. CONCLUSIONS

Program for pseudo-range observations processing, written by D. Łapucha is tested and ready to use.

Further development of other programs is necessary and this work is now being in progress.

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ГПС ИССЛЕДОВАНИЯ В ЦЕНТРЕ КОСМИЧЕСКИХ ИСЛЕДОВАНИ...

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РЕЗЮМЕ. Главной задачей этой работы является развитие для обработки наблюдений ГПС. В работе представляются ре... из псевдо-расстояний и фазовых наблюдений.