An Overview of OPUS and Utilizing the System

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BIOGRAPHY

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ABSTRACT

There are various tools used to survey land and determine accurate positions. In this lab, students aim to learn about the benefits of using an online system called OPUS. This advanced system provided by the national geodetic survey website can help improve raw data for GPS users. The online system is easy and free to use for everyone.

OPUS used PAGES and RSGPS to process raw data uploaded by GPS users. These software compute the averages of the nearby CORs to provide the most accurate position. There will be small errors resulting from bad timing of data collection or obstructions, but OPUS is able to provide the error in root mean square differences so the users can take the error into account.

INTRODUCTION

OPUS is an online positioning user service system provided by the National Oceanic and Atmospheric Administration. Its enhancement over the years has allowed users to access the data easily. Using the raw data uploaded by users, the system is able to compute highly accurate coordinates from the National Spatial Reference System(NSRS). Basically anyone can collect data using a survey-grade GPS receiver and utilize OPUS to obtain NSRS coordinates within minutes to hours depending on the load of the original data. It is important for surveyors to utilize OPUS because traditional methods of computing coordinates are not as accurate or consistent. The NSRS allows users to possess the same data points throughout the United States provided by their major network of permanent survey marks. This ensures that the final data collected by users will always remain consistent regardless of their collection methods.

METHODS.

As mentioned, OPUS is an easy-to-use system that anyone can access. Users simply must collect their raw data that meet the minimum requirements and upload them to OPUS. Once the file is sent, users will typically receive their results back within minutes or hours. Data files are required to have dual-frequency GPS full wavelength carrier phase observables and include static data only. Data must also reach the minimum time length from anywhere between 15 minutes to 2 days. Files must include both P2 and P1 or C1 observables if they are under two hours. OPUS accept data in RINEX 2 and 3 formats as well as many other raw data formats. Once users have the data file chosen on OPUS, they will only have to inform the system of the antenna type used during the process of data collection. Since different types of antennas are used in surveying, choosing the correct type helps to ensure that OPUS applies the right calibration model to eliminate height measurement errors. Once users report the antenna's type and height, they can select additional options to customize their NSRS results. After this is done, users will provide OPUS with an email address to receive the computed data.

Once provided with the raw data file, students uploaded them onto OPUS as well as selecting the Trimble R8 GNSS None as the antenna type and two meters as the height. Once the results are delivered to students' emails, they identified the previous GPS base stations and excluded these from the second trial. Two different software are used by OPUS to process raw data depending on the duration of the data. Files that are over two hour long can be processed using PAGES while shorter files are processed by RSGPS. The second software is what OPUS used in this lab. (ngs.noaa.gov, 2019)

Figure 1.0 Top View of the Oceanography Building

RESULTS

Two sets of data were collected at the end of the lab. The first data file was the computed results from the raw data provided. The second file was more customized since five base stations were excluded. Students conducted the second trial with the missing base stations in order to prove that OPUS is able to be used survey marks set by the NOAA to provide consistent coordinates. Since the uploaded data duration is between two hours to 48 hours, OPUS used the PAGES software to process them and report the average of three independent solutions, each computed by one of three nearby CORs (continuously operating reference station).

Table 1. Normalized RMS

Data Report	**RMS**
1	NORMALIZED RMS: 0.381
2	NORMALIZED RMS: 0.392

CONCLUSION

After finishing the lab, students are able to judge from the reported data that OPUS is beneficial in providing highly accurate data. Although base stations are placed everywhere, the closer stations allow a more accurate position. This is shown through a smaller RMS (root mean square) difference from the first report. The second report was restricted to using base stations farther from the location, therefore it reported a slightly higher RMS
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REFERENCES

ngs.noaa.gov
Reading Assignments

FILE: 43243000.17o OP1569878677031

NGS OPUS-RS SOLUTION REPORT
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USER: tramnguyen741@tamu.edu DATE: September 30, 2019
RINEX FILE: 4324300q.17o TIME: 21:24:41 UTC

SOFTWARE: rsgps 1.38 RS83.prl 1.99.3 START: 2017/10/27 16:48:35
EPHEMERIS: igs19725.eph [precise] STOP: 2017/10/27 17:48:30
NAV FILE: brdc3000.17n OBS USED: 3186 / 6210 : 51%
ANT NAME: TRMR8_GNSS NONE QUALITY IND. 18.25/ 29.38
ARP HEIGHT: 2.0 NORMALIZED RMS: 0.381

REF FRAME: NAD_83(2011)(EPOCH:2010.0000) ITRF2014 (EPOCH:2017.82115)

X:	-606777.160(m)	0.011(m)	-606777.978(m)	0.011(m)
Y:	-5460287.208(m)	0.032(m)	-5460285.747(m)	0.032(m)
Z:	3229318.263(m)	0.021(m)	3229318.075(m)	0.021(m)

LAT:	30 36 55.61579	0.004(m)	30 36 55.63303	0.004(m)
E LON:	263 39 32.37746	0.013(m)	263 39 32.34089	0.013(m)
W LON:	96 20 27.62254	0.013(m)	96 20 27.65911	0.013(m)
EL HGT:	83.226(m)	0.037(m)	81.959(m)	0.037(m)
ORTHO HGT:	109.916(m)	0.049(m)	[NAVD88 (Computed using GEOID18)]	

	UTM COORDINATES (UTM (Zone 14))	STATE PLANE COORDINATES (SPC (4203 TX C))
Northing (Y) [meters]	3389998.852	3112045.447
Easting (X) [meters]	754900.944	1082686.908
Convergence [degrees]	1.35488611	2.05628333
Point Scale	1.00040161	0.99990429
Combined Factor	1.00038854	0.99989122

US NATIONAL GRID DESIGNATOR: 14RQU5490089998(NAD 83)

BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE(m)
DO8865	TXCK CROCKETT CORS ARP	N311921.457	W0952609.241	116721.5

DH3608 TXHE HEMPSTEAD CORS ARP N300556.472 W0960348.544 63162.6
DG9111 LCSM SMITHVILLE COOP CORS ARP N300030.431 W0970731.758 101099.8
DO8863 TXC2 CAMERON CORS ARP N305235.392 W0965820.397 67024.6
DN4508 TXLV LIVINGSTON CORS ARP N304442.692 W0945518.194 136754.1
DH3604 TXCN CONROE CORS ARP N302056.205 W0952628.336 91307.6
DL9812 TXCM COLUMBUS TXDOT CORS ARP N294210.221 W0963438.333 103696.7
DO8873 TXMX MEXIA CORS ARP N313542.418 W0963127.718 110016.8
DN5858 TXPI PALESTINE CORS ARP N314328.159 W0953541.697 142050.4

NEAREST NGS PUBLISHED CONTROL POINT
BM0028 A AND M COLLEGE N303600055. W0962000027. 7.0

This position and the above vector components were computed without any knowledge by the National Geodetic Survey regarding the equipment or field operating procedures used.

FILE: 43243000.17o OP1569879964633

NGS OPUS-RS SOLUTION REPORT
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All computed coordinate accuracies are listed as 1-sigma RMS values.

USER: tramnguyen741@tamu.edu DATE: September 30, 2019
RINEX FILE: 4324300q.17o TIME: 21:43:02 UTC

SOFTWARE: rsgps 1.38 RS80.prl 1.99.3 START: 2017/10/27 16:48:35
EPHEMERIS: igs19725.eph [precise] STOP: 2017/10/27 17:48:30
NAV FILE: brdc3000.17n OBS USED: 2079 / 5724 : 36%
ANT NAME: TRMR8_GNSS NONE QUALITY IND. 11.59/ 19.72
ARP HEIGHT: 2.0 NORMALIZED RMS: 0.392

REF FRAME: NAD_83(2011)(EPOCH:2010.0000) ITRF2014 (EPOCH:2017.82115)

X:	-606777.155(m)	0.010(m)	-606777.973(m)	0.010(m)
Y:	-5460287.243(m)	0.026(m)	-5460285.782(m)	0.026(m)
Z:	3229318.281(m)	0.019(m)	3229318.093(m)	0.019(m)

LAT:	30 36 55.61572	0.005(m)	30 36 55.63296	0.005(m)
E LON:	263 39 32.37782	0.011(m)	263 39 32.34121	0.011(m)
W LON:	96 20 27.62218	0.011(m)	96 20 27.65879	0.011(m)

EL HGT: 83.265(m) 0.031(m) 81.997(m) 0.031(m)
ORTHO HGT: 109.955(m) 0.044(m) [NAVD88 (Computed using GEOID18)]

	UTM COORDINATES UTM (Zone 14)	STATE PLANE COORDINATES SPC (4203 TX C)
Northing (Y) [meters]	3389998.850	3112045.446
Easting (X) [meters]	754900.954	1082686.918
Convergence [degrees]	1.35488611	2.05628333
Point Scale	1.00040161	0.99990429
Combined Factor	1.00038853	0.99989122

US NATIONAL GRID DESIGNATOR: 14RQU5490089998(NAD 83)

BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE(m)
DN5858	TXPI PALESTINE CORS ARP	N314328.159	W0953541.697	142050.4
DH3604	TXCN CONROE CORS ARP	N302056.205	W0952628.336	91307.6
DM7149	TXLE LEAKEY CORS ARP	N294421.565	W0994540.470	343392.5
DE8099	OKLW LAWTON CORS ARP	N343421.987	W0982435.689	479781.5
DN5860	TXRU RUSK CORS ARP	N314705.631	W0950734.188	173824.0
DE5999	ADKS ADDICKS 1795 CORS ARP	N294727.471	W0953511.043	116760.0
DJ7864	TXHO HONDO CORS ARP	N292037.892	W0990803.985	304174.4
DF7479	TXWF WICHITA FALLS RRP CORS ARP	N335114.109	W0983019.962	412928.7
DH3610	TXLF LUFKIN CORS ARP	N312122.843	W0944305.912	175411.8

NEAREST NGS PUBLISHED CONTROL POINT

BM0028	A AND M COLLEGE	N303600055.	W0962000027.	7.0

This position and the above vector components were computed without any knowledge by the National Geodetic Survey regarding the equipment or field operating procedures used.