NGS Geodetic Tool Kit, Part I

Gary M. Young

The National Geodetic Survey (NGS) Geodetic Tool Kit is a unique NGS product in that it represents a change in the way NGS does business with its customers. Historically NGS has been a provider of geodetic data and software. Now, instead of users having to download the software and run it on their local computer, users upload their data (through Web-based forms) and run the programs on NGS computers with the Tool Kit. This saves the user from downloading the software and all the associated files, installing everything in the proper directory, and compiling the code if necessary.

With the arrival of the Online Positioning User Service (OPUS) system, as part of the Tool Kit, NGS is now encouraging its customers to upload their GPS data (via the Internet) to NGS and process the data using NGS OPUS software on an NGS computer. Additional applications will follow.

The newest addition to the Tool Kit, U.S. National Grid (USNG) conversion software, converts between geodetic latitude and longitude, USNG, and Universal Transverse Mercator (UTM) coordinates. The USNG system is an alpha-numeric overlay of the UTM coordinate system, providing an easy-to-use geo-address to identify and determine locations via a USNG gridded map and/or a USNG-enabled GPS system.

The NGS Tool Kit has proven to be very popular. It averages 1,000 hits each month. The Tool Kit currently incorporates 17 separate computer programs. New programs are being added at a rate of about three programs per year. Tool Kit computations include computing the geodetic position for a point from a user-supplied input file of GPS observations (OPUS), transforming between datums, e.g., between NAD 27 and NAD 83 and between NGVD 29 and NAVD 88 (NADCON and VERTCON, respectively), converting between coordinate systems, e.g., from geodetic latitude/longitude to the State Plane Coordinate System (GPPCGP and SPC83), computing the effects of crustal motion on geodetic observations to convert them to a new epoch (HTDP), converting

between geodetic latitude/ longitude to UTM to USNG, etc.

The purpose of this lead article is to provide a general overview of the Tool Kit. Future articles will be published in *Professional Surveyor* over the next several months, describing individual tools in the Tool Kit.

NGS looks to its users and constituency to provide suggestions for additional tools. Please note that the Tool Kit provides an interface to programs NGS has been using for internal processing over the years. None of the programs in the Tool Kit was written only to be included in the Tool Kit. We are receptive to users comments on how we can improve the quality of the tools and the clarity of the software documentation.

The NGS Geodetic Tool Kit is available on-line at *www.ngs.noaa.gov/TOOLS/*

Please send comments or suggestions to NGS via e-mail: *info_center@ngs.noaa.gov* or call: 301-713-3242.

Gary M. Young *was a Geodesist on the staff of the Spatial Reference System Division, National Geodetic Survey (NGS). He retired from Federal service in January 2003 after 37 years with NGS.*

Letter received by NOAA's National Geodetic Survey on November 15, 2002:
I would like to let you know how much of an integral part your OPUS program played on a recent aerial photo project. Back in April of this year our department received funding approval to acquire digital orthophotography of the county. It was my task to "survey in" a network of control panel points for the project. Along with a Survey Tech II, we had two trucks and two Trimble 4800 GPS receivers allotted to us to use every day. We also had access to one of our road survey crew's Trimble 4800s (when they weren't using it!) and we could "borrow" one of our mapping technicians if we really needed to.

We had to survey in 26 control points (mostly PLSS corners) for the project. Fifteen coordinates would be delivered to the contractor and eleven (check coordinates) would be held back to compare the contractor's final results to and verify the accuracy of the data we were to receive from them. After getting the Xs painted on all of the control points, we had approximately two weeks to finish the survey. Due to the contractor's specification that the control was not to be done using RTK GPS methods, we had to GPS the positions using static methods. I had post- processed GPS data in the past and knew that not having properly trained personnel running the GPS receivers and logging the correct data of each session of the network could result in a lot of headaches when

post-processing the data. Having the limited use of the third receiver basically ruled out attempting a traditional GPS network survey.

I had heard of the OPUS program about a year ago at some of our MNDOT Surveying and Engineering seminars from some of the NGS advisors. On occasion, when the survey crew was doing a RTK survey and the base receiver was set up on a control point for a few hours, I would download the data and send it in to OPUS to see how it compared. It worked very well. After reading more about the OPUS program on your website I decided to use OPUS to do the survey. I e-mailed OPUS to verify some antenna height issues I had, and received a very helpful e-mail in return. We were going to run four-hour sessions on each point to be sure we had enough data to obtain a good result, both horizontally and vertically. There were a few skeptics when I proposed how we should do this job and how long we should run each session. But my supervisors, the County Surveyor and the Public Works Director, are very open-minded about using new innovations and techniques. It took a little more than a week (with some overtime) to get all 26 points GPS'ed and post-processed. It worked very well because people could run their sessions independently of others. Also, I had very little of my own time involved in the post-processing. Each day I would try to download some of the data, and by the next morning I had the results (most of the time I would get some results back before I was able to submit the data for other sessions). After getting the "final" coordinates on all of the points, we encountered some unforeseen (snow-related) delays. I was able to wait until the precise ephemeris data was available, then resubmitted the GPS data and came up with a new, more accurate, set of "final" coordinates. I was hoping to see results of at least <.03m horizontally and <.06m vertically. These precisions were met and easily exceeded! We have recently received the data back on the check points from the contractor. The accuracy of the aerial solutions well exceeded our original goals.

Now, whenever we start a survey we try to set our control using the OPUS program. I felt like I needed to thank someone for making this such an enjoyable and seemingly effortless project. The Geodetic Tool Kit is a great help to me and I appreciate the time and effort put into the programs. Thanks again.

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