OREGON GNSS USERS GROUP
MEETING MINUTES

Date: June 14, 2019

Location: Deschutes National Forest Office, Bend, Oregon

Board Members Present: Casey Varnum, Chair
Randy Oberg, Chair-Elect
John Minor, Treasurer
Chris Munson, Secretary

Called to Order: 9:00 am
Adjourned: 3:30 pm
Contact Hours: 5.0 hours

Introduction & Business Meeting

- Welcome by meeting host, Bill Ham of US Forest Service. General housekeeping notes. Chris Munson will send out meeting minutes later with request for evaluation of the meeting and topics.
- Treasurer's Report by John Minor. Currently have around $9,800 in our bank account.
- Overview of today's agenda by Casey Varnum, Chair.

News in the GNSS Community by Casey Varnum of the Oregon Department of Transportation

- NGS Updates
    - GEOID18 available later this year. Derived from GRAV-D flights, GPS on Benchmarks data, improved modelling. Last hybrid geoid before 2022. Per Randy Oberg of ODOT, there is no effect on the ORGN as they use ellipsoid heights only.
    - Multiyear CORS Solution 2 now complete. New coordinates and velocities computed. Used 1100 weeks of data from 1996-2016, 3050 CORS stations, 25 TB of data. Average change of 5 mm horizontal. North America is rotating counterclockwise around a Euler pole centered in the Pacific Ocean off of South America.
- GNSS User Technology Update
    - Broadcom GNSS chip released last May, uses GPS and Galileo, 30 cm stated accuracy, intended for consumer navigation.
    - Adding Galileo to cellphone chips increases accuracy by up to 4.5 meters.
    - E6 signal from Galileo being dumbed own to about 20 cm accuracy to avoid competing with commercial providers (Omnistar, Trimble RTX).
    - Maritime industry predicting fully autonomous transoceanic shipping by 2035.
    - 100,000 GNSS trackers on chickens, mostly in China, tracking health.
    - Reach RS2, $1899 for dual frequency GNSS receiver. Comes with app to be used with user's BYOD device, very user intensive compared to Trimble and Leica user software.
    - IMU's can extend accuracy of GNSS after signal loss.
    - Items to consider when buying new GNSS equipment: Constellations supported, frequencies supported, firmware update frequency, stated accuracy.

- Expressions of accuracy:
  - FGDC: 2 sigma, or ~95% confidence. Typically used by surveyors.
  - RMSE: 1 sigma, or ~68% confidence. Used by equipment manufacturers.

Remote Sensing Power Hour by Chris Glantz and Jon Rawlings of the Oregon Department of Transportation

- Active sensors send and receive: lidar, sonar, radar, etc.
- Passive sensors receive only: photographs, thermal imaging, etc.
- Remote sensing uses GNSS static, RTK, and PPK observations for ground control, geopositioning of aerial images, constraint marks, confidence points.
- ODOT mobile scanner in use for several years now. Components include:
  - Lidar, ~150 foot range, phase-based, 200 Hz.
  - IMU/INS, 100-2000 Hz, higher rate equals ability to drive faster.
  - Cameras.
  - GNSS receiver (1-10 Hz, usually 1 Hz).
  - DMI—Distance Measurement Indicator. Measures tire rotation, not used by ODOT very often.
  - Interface/Storage (computer).
- Premarks set ~500 feet along road, RTK'd and levelled. These constrain and correct the solution.
- Lidar accuracy is based on distance to target. Vertical accuracy is better than horizontal accuracy.
- For aerial drones, GNSS is used for direct geopositioning, then post-processed later.
- Mobile lidar is being used on every project in ODOT Region 1 (Portland area). I-5/Rose Quarter and OR 35/Hood River are two examples.
- Limitations: Good at overhead utilities, signs, trees, ADA ramps. Poor with hedges, parked cars, thick ground vegetation.
- Remote sensing much safer in urban and tight areas compared to traditional methods. Rarely does ODOT close lanes anymore for surveying.
- Project overview: 82nd Avenue
  - Use of static scanning reduces field crew time immensely, with huge amounts of data for designers. Also use static scan data to constrain mobile scan data.
  - Geoterra flew corridor for utility locate markings. Saved huge amount of field time, with estimated 50% total cost reduction.
  - Inverted scanner, using inverted tripod & Leica static scanner, used for inside of manholes and vaults.

Break (15 minutes)

Surveying for Gold/Story of the Bohemia Mining District by Mark Armstrong of the National Geodetic Survey (retired) and Jim Colton of OBEC

- Mark Armstrong received a US Forest Service contract for surveying patented mining claims in the Bohemia Mining District.
- Bohemia is approximately 35 miles southeast of Cottage Grove in the Umpqua National Forest, and was founded in 1867.
- Ore contained gold, silver, lead, zinc, and copper.

- Gold was discovered in 1858 in Sharps Creek. Mining began in 1859.
- Bohemia named after James "Bohemia" Johnson. Staked claims beginning in 1864.
- Bohemia Trail from Oakland was constructed in 1864 and was approximately 50 miles long.
- US Geological Survey ran level lines in 1934.
- Lode mining began in earnest in 1871.
- First stamp mill was hauled up by oxen in 1872.
- Claim size is 600' x 1500' and follows ore vein. A location certificate is first filed for a claim. After that an application for patent is made. Survey of the patent is done by a Deputy Mineral Surveyor under instructions from the Surveyor General.
- First mineral patent survey in Bohemia was done in 1891.
- Must tie a claim corner of the patent to a section or quarter corner within 2 miles. If none is present, a U.S. Mineral Monument may be set.
- Four U.S. Mineral Monuments were set in Bohemia. Jim and Mark recovered USMM #621 along with a bearing tree. Reset with USGS brass disk and new bearing trees.
- Jim & Mark visited Helena Mine in 2018 with permission from owners.
- Large history behind US Deputy Mineral Surveyor Briggs and many other deputy mineral surveyors.
- Three lookouts have been constructed on Fairview Peak since 1919. US Air Force levelled a portion of the mountain for a radar installation in the Cold War.

Lunch (1 hour)

PPP and RTK Algorithm Development by Brian Weaver of the University of Nottingham

- TREASURE Fellow funded by MSCA.
- Precise Point Positioning (PPP):
    - Advantages: Absolute global centimeter level positioning with 1st order ionosphere free solution.
    - Disadvantages: Lengthy convergence times. External network information is required.
- Galileo scheduled to be fully operational in 2020 with 30 satellites. As of February 11, 2019, 26 satellites are in orbit, 24 of which are healthy. Two more are in testing and two more on top of that are not available due to a launch failure. Galileo uses five frequencies.
- PPP experiment:
    - Evaluate 4 performance scenarios with severe ionospheric activity: GPS, GPS+GLO, GPS+GAL, GPS+GLO+GAL.
    - GPS satellites most visible at test site (Brazil). More Galileo satellites visible than Glonass.
    - Time to convergence order: GPS only was first, GPS+GLO was last.
    - GPS only was the worst performer with regard to accuracy in high iono conditions. GPS+GLO+GAL was best, followed by GPS+GAL (2nd) and GPS+GLO (3rd).
- Highest ionospheric scintillation occurs in the equatorial areas and poles, least in the mid-latitudes (continental USA).

OSU GNSS Research Update by Jihye Park of Oregon State University.

- Research with NGS: Working on multi-GNSS PPP software with NGS to be done September 2019—will use GPS, Glonass, Galileo, and Beidou.

- GNSS-based tide gauge system:
    - Traditional tide gauges are expensive to install and maintain.
    - GNSS-R tide gauge uses multipath reflection from water surface to determine tide level.
    - Experiment selected 4 GNSS stations collocated with tide gauges.
    - GNSS tide gauges allow for consistency, all based on a single reference frame, rather than local tide station datums.
    - Case Study #1: Hurricane Harvey storm. GNSS-R closely correlated to tide gauge.
    - Case Study #2: Alaska using PBO station. High ionospheric disturbance, poor satellite geometry due to closeness to North Pole.
    - Summary: Near real-time estimation of tides, cost effective, complementary to traditional tide gauges.
- GNSS-based hurricane tracking model:
    - Precipitable water vapor (PWV) difficult to measure.
    - Several existing methods to measure PWV, all have limitations.
    - Can use thousands of existing GNSS stations to measure PWV using tropospheric delay.
    - Measured PWV during Hurricane Matthew with 5 GNSS stations. PWV used to predict hurricane path.
    - Further studies occurring to verify model against past hurricane data.

Break (15 minutes)

ORGN Update by Randy Oberg and Eric Zimmerman of the Oregon Department of Transportation

- Stations have been added in SE Oregon.
- Coastal stations are being upgraded with new batteries and cell connections in support of early warning systems.
- Taking over Marion County stations, upgrading to GLONASS.
- Informally taken over La Pine station from Deschutes County. In negotiations to take over station at City of Bend.
- ORGN upgrading spider software with Galileo capability after biennium budget is approved. Upgrade hopefully complete by July 2019. Will discontinue MAX corrector at that time, will only use iMAX corrector with RTCM 3.2 protocol.
- 112 stations/40 ODOT owned/14 redundant/5 planned.
- Different ports for different correctors (GPS only, GPS+GLO, single base)
- 5 second RINEX data available on website for all stations. Other formats, custom rates available upon request.
- Over 1000 rover accounts. Agricultural and private sector accounts increasing their total share.
- ORGN FAQ's:
    - MAX vs. iMAX correctors: iMAX computed at master station, smaller package. MAX computed at rover, larger package. iMAX possibly better in spotty cell coverage areas due to smaller size?
    - Can go 12 km outside network and still get correctors.
    - Can go 45 km from master station and still get correctors.
    - Rover may change master stations during a session because spider software automatically picks the master station on what it believes to be the best solution.
        - Choosing the Ag corrector will keep the same master station during the length of the session.

        - Can also set most receiver units to use a certain master station, but this can be dangerous if you forget to reset and then change geographic location significantly.
    - Solutions for using the ORGN in poor or non-existent cell coverage:
        - Intuicom repeaters.
        - Free laptop software (GNSS Internet Radio program) used in conjunction with radios.
    - OCRS is not the ORGN. OCRS does not need the ORGN.
    - You can use a local Wi-Fi connection for correctors, don't need a cell phone—just an internet connection.
- NATRF2022 changeover:
    - ORGN will change station coordinates within 6 months of adoption by NGS, similar to changeover to NAD83(2011) from NAD83(CORS96).
    - NGS will add OCRS to OPUS with NATRF2022, but will not accept overlapping zones.

Adjourned at 3:30 pm

Respectfully submitted,

Chris Munson, Secretary
Oregon GNSS Users Group