USER TESTS OF THE OPTECH LYNX MOBILE MAPPING SYSTEM, DATA QC TO GROUND SURVEY CONTROL

Clay A. Wygant, P.S., Scan Systems Manager
WHPacific, Inc
6501 Americas Parkway NE, Suite 400
Albuquerque, NM 87110
cwygant@whpacific.com

ABSTRACT

WHPacific is a Native American and Native Alaskan owned A&E firm and a subsidiary of the NANA Corporation with corporate headquartered in Anchorage Alaska. The thrust of our presentation is how a midsized A&E firm has developed systems to insure quality and timely data acquisition utilizing the LYNX Mobile Mapping system.

INTRODUCTION

Optech's LYNX Mobile Mapping system, designed as a hybrid LiDAR mapping tool, at WHPacific has been applied to a variety of applications relating to survey data acquisition. Defining systematic processes to guarantee accuracy of collected data has been paramount. WHPacific has taken a "surveyors" approach to establishing reliable methods to verify accuracy and precision standards.

THE SYSTEM

LYNX, a hybrid ground based LiDAR, is an innovative array of tightly coupled components working to create an accurate 3 dimensional model. The LYNX platform is built of four main components: the laser sensor, the IMU (inertial measurement unit), duel GPS receivers (separated by a minimum of 2 meters, one antenna/receiver dedicated to navigational relationship, the second, post-processed duel frequency) and the DMI (distance measurement instrument, attached to a rear wheel hub measures the velocity of the vehicle). The components are connected to a CPU where data is stored to an internal hard disk and removable SCSI drive. The vehicle navigator, through the interaction of two programs on the laptop, can view mission statistics such as GPS coverage, satellite health, location and use in solution.

APPLICATION

WHPacific has applied the LYNX system to a variety of projects and tested its repeatability under varying conditions:

1) Mapping Interstate Highway corridors during high and low traffic period, daylight hours and night,
2) Secondary (2 lane) paved, dirt/gravel surfaced roadway
3) Large scale site topographic models
4) Shoreline/riparian mapping studies from a river jet boat
5) Cross country with an adapted ATV.

Testing in urban canyons, buildings and roadway overpasses, terrain with extensive canopy, open sky airport facilities and relatively open sky Interstate Highway system all have specific challenges and some limitations where errors are possible.

CONDITIONS

Best case working conditions for the LYNX system are airport facilities. Barring any GPS wave interference the physical obstructions are relatively nonexistent. GPS is the weak link of the system and by design airfields are overhead obstruction free. From field experience a typical RTK survey in motion, collecting data at a time or distance interval, is accurate within +/- 0.06 foot. The LYNX system is not RTK (Real Time Kinematic) but rather post-processed GPS data collected en-route as part of the integrated system and separately at a remote GPS base station location. The base station is set over a marker with known values (x,y,z) and all data is post-processed to that base coordinate. The extent mapped from each base station is determined by the accuracy standard being adhered to. Design type projects require quality data and a good example for this type data collection would be a five (5) mile diameter, 2.5 mile radius from the base. In a corridor setting a method would be to set multiple base locations at approximately 5 mile intervals with GPS receivers and process specific files from the associating base unit. This obviously takes pre-trip planning. With base location and route knowledge, given good to moderate GPS conditions (7-10 SV visible at both the base unit and roving LYNX, areas of potential GPS outage reviewed for best approach, time and speed) we have achieved +/-0.03 feet. Ideal speed of the roving vehicle varies with the specific project scope. Optimum speed for design topography data gathering is between 25 and 45 mph. Higher speeds have been used.

DATA REVIEW

The primary methods used to review mobile scan data is through field gathered RTK GPS confidence data. Many methods can be employed at this point however the ease of use, distance coverage, proven reliability and relative accuracy make RTK GPS methods acceptable and preferable in many cases. Mobile scanning does not lend itself to the same field data review methods commonly used with today's static scanning community. In static scanning the typically scenario is to place physical targets, mounted on survey grade stakeout rods throughout the project area. An extremely high resolution "scan" of these targets is performed such that field derived coordinates of the target points can be transferred from scan to scan. Targets, common to several related scans, are used later in the process to "register" overlapping scanned areas to each other creating larger areas with a quantity of reliable detailed data. The Mobile Hybrid LiDAR's characteristics are not suitable to this method. We have found "Photo ID Points", often painted on the surface, to be the best method of confirming the control the project is based on. Vertical ID points are most prevalent, many easily identifiable objects on the mapping plain are available with relatively flat surfaces, top of catch basins and drop inlets, corners of unique pavement stripes are two examples. Horizontal ID points are more difficult. Even though the LYNX Mobile Scanner is creating 100,000 laser pulses per second and rotating at 1000 rpm the spacing of the gathered points can be too broad for selecting specific pinpoint objects. Methods of painting small targets on the pavement surface in multiple straight sided, right angled figures rotating the angle of which by 45 degree increments to determine best scan viewing. This has proven an effective course of action, a way of visually viewing the horizontal control in the scan and extracting an exact location. This simple procedure is relayed throughout the corridor mapping gathering recognizable feature data for comparison to field gathered RTK GPS data points. Airport runway asphalt surfaces are excellent areas to study the reliability of Mobile Scan Data. The GPS horizon is unobstructed, many well painted targets exist, the surface, although undulating is consistent and the length is adequate for distance analysis. Our results over 8500 feet of runway show absolute vertical error within the +/- 0.03 feet/0.01 meter range. Horizontal error is similar however slightly less. This horizontal error may partially exist in the confidence data gathering method. Regardless both horizontal and vertical error sets are at the threshold of reliable accuracies using RTK GPS. There is an effort to utilize survey instruments that can achieve greater accuracy in measurement in this field checking analysis however I believe the inherent background noise in the Mobile Scanning System is something near that of RTK GPS and therefore the error may shift somewhat but the confidence of the checking method would need to be scrutinized.

ALTERNATIVE METHODS OF CONFIDENCE CHECKS

An alternative and somewhat unstudied method of gathering control data is through the utilization of static scanned data as control for mobile scans in areas where access is unsafe or not possible. An example of this approach is Interstate 5 in Downtown Seattle. The Interstate threads itself through a series of closely crossing

overpasses and under the Civic Center creating virtually a ¾ mile tunnel. GPS satellite lock is non-existent within this corridor but with proper control it is possible to reliably adjust the data for design use. Washington DOT as well as other urban municipalities would benefit from this approach.

CONCLUSION

To date there has been relatively little real world application of this hybrid technology and only one LYNX Mobile Mapping System exists in the US business community, that system is owned and operated by WHPacific, Inc. The opportunity to apply this technology is being realized every day. In future I see partnering with others in this community of topographic data acquisition to create a wider range of products for our customer base. The ideas described herein are field tested methods. Robust controlled testing has not been applied for this comparison.