Don’t need Total Station

I was attempting to demonstrate that all could be done entirely with the TRIUMPH-LS with photogrammetry and give results that are sufficiently accurate for cadastral land surveying.

Continue reading Shawn Billings article (pages 3-6)

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Real 5-Hz Base Station Transmission

All RTK base stations (including RTNs) transmit data once per second. We are introducing The BEAST MODE RTK, real 5-Hz Base Station Transmission. Here are testimonials:

Well this just about has to be the most amazing single improvement I have observed.

I am most assuredly getting faster fixes under tree cover. And the ability to collect 5 times as many honest epochs in the same time period is wonderful.

My quick little test doing 3 epoch, lift to start topography actually made me laugh because it is so fast.

The only thing users need to know is that if they must use the RTK Delay setting of None for the allowable correction age, otherwise they will only see 1Hz updates. As Javad told us, extrapolate is a sin we should avoid.

I have a feeling that we are now seeing fixes, that are actually occurring 5 times as fast under tree cover. In my “bad spot” under a tree, I am making it through 10 resets in less than 10 seconds. This is simply amazing.

John Evers, PLS

In a test I just did under a tree, I would reset the RTK engines and use a stopwatch to time how long it took 2 engines to fix.

With 1 Hz it was averaging over 30 seconds and with 5 Hz it is in few seconds.

Mine is up and running fine. This thing is so fast now it is hard to believe!

Matthew D. Sibole, PLS

Be aware that increasing the transmission rate increases the battery usage of the radio and will also increase the heat generated inside it. For 2 Hz corrections you should use D8PSK or D16QAM modulation. D16QAM has the most bandwidth and is required for 5 Hz transmissions but may reduce the range of the radio some. If you are using a 35 watt radio the fan should be used with 5 Hz corrections if the output power is more than 4 watts.

Matt Johnson, PLS

Complete the Job with One Complete Tool

This is my photogrammetry test from yesterday. After taking some baby steps Saturday and Monday, I felt I was ready to try a real job. We already did the job a few weeks ago, and it is close to home, so it was a good place to test. Originally we did 80% of this job with the Triumph-LS and 20% total station. What I was attempting to demonstrate was that this could have been done entirely with the Triumph-LS with photogrammetry and give results that are sufficiently accurate for cadastral land surveying.

The 3.705 acre project site. It is a gas station and convenience store. There is the main building (approximately 180'x50'), the gas pumps with canopy, the storage building in the back and a large pylon sign. All of which must be located for the survey.

In performing the photogrammetry survey, I divided this job into six sub-projects (or scenes):

- Canopy (6 photos)
- East Side (12 photos)
- North End (6 photos)
- Sign (9 photos)
- South End (5 photos)
- West Side (10 photos)

By dividing the job up this way, I was able to limit the number of photos in each Camera Offset Survey Project to less than 12. Not only is this a practical limitation for J-Field processor, it also limits the number of photos the user must keep up with at one time. I began each scene by considering the points I wanted to collect remotely by photogrammetry and determining how to capture them with good geometry. Once I had a general idea of where I wanted my photos to be taken, I then set targets (rolls of survey ribbon) in several places that would be visible to at least a few of the images I'd collect for the scene. I then collected control points by normal RTK survey methods. Once I had my control for the scene collected, I would then begin collecting images in Camera Offset. Ideally I attempt to have each point of interest captured in 5 photos that spray from the point with at least 90° of dispersion (preferably wider). It's important to remember that photogrammetry is 3D which requires specific points be identified. While I may not be interested in the elevation of a building corner, I need to specifically target a consistent point on the building corner for the results to work properly. When taking the images, I make sure that the image includes the point on the building corner that I am locating, not just the corner itself. I also attempt to vary the distance from the scene and the height of the camera as I capture images. While collecting the Sign scene, I didn't have a good place to establish a control point, but I noticed a pipe post that was in most of my photos, so I located it after I collected the photos to be used as a control point. Control points don't need to be artificial targets, but they need to be able to be resolved 3 Dimensionally, from any angle. Because the pipe is cylindrical it is a good target horizontally.

If the vertical angle though is too severe, the height may be difficult to distinguish. That was not the case with this pipe.

While I was collecting them in the field, I gave the Camera Points (the points collected at the camera location) names that related to the scene. For instance CANOPY1, CANOPY2, CANOPY3, etc. and E1, E2, E3, etc. Control Points were named CP1, CP2, etc., regardless of what scene they may have appeared in. Tie Points (points selected from the photos) were also named based on the scene, I included a T in the name to distinguish them from the Camera Points (e.g. ET1, ET2, ET3).

I ended up with:

- Canopy (19 points)
- East Side (33 points)
- North End (18 points)
- Sign (12 points)
- South End (14 points)
- West Side (12 photos)

I am a neophyte with photogrammetry. I realize that in most cases regarding positioning, the less adjustment the better as adjustments may mask a problem. Thus far, I have kept Adjust Focal Length and Use Control Points checked with Adjust Principal Point unchecked and Adjust Image Coordinates unchecked. A few times I would select the wrong control point while registering points in the image. This would cause J-Field to take a very long time to process as it continued to iteratively attempt adjustments to make the wrong point work in the solution. I found that it is a good idea to uncheck Use Control Points for adjustment (minimally constrained) and see what the residuals are for the control point before proceeding. Then if the residuals are reasonable, include them in the final adjustment for the scene. Thus far, it seems that the error estimates are reliable. If a point is showing error estimates that are disproportionate to the other points in the scene, it is likely due to the point being poorly identified on the image or having a weak geometry establishing it. Here are some examples of adjustment results of the six scenes:

Adjustment accuracy report, South End

Adjustment accuracy report, North End

Adjustment accuracy report, Canopy

Adjustment accuracy report, Sign

Adjustment accuracy report, West Side

Keeping up with so many points in a scene, I found it helpful to keep a scratch pad handy. I drew a rough sketch of the scene and as I created points, I would note it on the sketch. Then as I registered the points in other images I could look on my sketch and quickly recall which point belonged to which feature.

The results from the adjustment appear to be fantastic. Far superior to my expectations. So how did they compare to the RTK/total station survey from a few weeks ago?
Horizontal Residuals (vertical in parenthesis):

0.19' NNWC Building - NT6
0.06' NWC Concrete (0.10' Height) - NT5
0.08' NEC Building (from North End scene) - NT18
0.09' NEC Building (from East Side scene) - ET26
0.22' NEC Concrete (0.02' Height) - ET27
0.06' NEC North Awning - ET25
0.10' SEC North Awning - ET22
0.07' NEC Center Awning - ET19
0.21' SEC Center Awning - ET9
0.19' NEC South Awning - ET6
0.25' SEC South Awning - ET3
0.10' SEC Building (from South End scene) - S1
0.25' SEC Building (from East Side scene) - ET2
0.29' SEC Concrete (0.05' Height) - ET1
0.06' SWC Concrete (0.04' Height) - S14
0.07' SWC Building - S13
0.11' SWC South Building extrusion - W9
0.07' NWC South Building extrusion - W10
0.19' SWC Center Building extrusion - W7
0.14' NWC Center Building extrusion - W6
0.11' SWC North Building extrusion - NT2
0.09' NWC North Building extrusion - NT4
0.02' SWC South Storage Building - W1
0.00' SEC South Storage Building - W2
0.13' NEC South Storage Building - W3
0.05' SEC North Storage Building - W4
0.04' SWC Canopy - CT18
0.06' SEC Canopy - CT20
0.04' NWC Sign - SIT4
0.04' NEC Sign - SIT5

(I realize from making this report that I messed up my point naming scheme. Point W1, for example, should have been WT1 and S1 should have been ST1).

If my math is correct, the average horizontal residual is 0.106'. It should be noted that is a comparison of coordinates from the job we did a few weeks ago RTK/Total Station and the job done RTK/photogrammetry. The RTK used the same control point, 8200' away. When viewing these residuals, remember that this includes differences in positions with RTK between the two jobs as well as errors in the total station ties that were made. Thus not all of the residuals can be attributed to photogrammetry.

From a quick look at the adjustment results, it does appear that the re-projection error estimate can indicate lower accuracy even if the linear error estimate appears to be small, as some of the higher residuals shown above also have higher RE, px error estimates.

The total time spent last night registering the 100+ points I created from the photos took about 4 hours. As I mentioned earlier, the time in the field was just under 1.5 hours. As I get more proficient, I expect I will be able to reduce processing and field time somewhat. This was only my third attempt at this! This likely wasn't as efficient as a total station survey for the points I actually needed. The total station setups (there were four) required an equivalent amount of time in the field with no post processing required. But I ended up with a lot more data than I had with the total station. Because I pick as many precise points that are common to several photos as I can, I end up with extra information, such as the location of windows and the height of the roof or the elevation of the door threshold. Also, because it is vital to get good coverage of the scene with photos, I am guaranteed to have great photo documentation in my archived file.

There are many instances in commercial industrial environments where sites are very open, but there are no places to set up an total station. For this survey, I mounted the Triumph-LS to a surveyor's extendable prism pole and bipod, which can be set up almost anywhere. I was collecting for 20 epochs at 5Hz, so the time per point was very small. In high traffic environments, this means I could get the data (photo) very quickly and move, then determine the actual position(s) I am interested in at some later time through post processing. Even the quickest total station setup generally takes me 15 minutes. The real limitation to this is the required geometry. If you have mobility around your scene, this is not difficult to achieve. However, if the points you are interested in are obscured from all but only a few directions, or a single direction, photogrammetry may not be the right tool. I can't quite say I'm ready to sell my total station, but with a bit more practice, I think I'll be able to produce results that are almost as good and in some environments much safer and more efficient.

One of the things that impresses me, is that I am getting these kind of results on my third attempt. I've only read about photogrammetry in the past and have no practical experience with it. This speaks well for the interface as well as the processing algorithms. Yes I agree the desktop software would be more convenient; having said that, it is truly remarkable that I was able to generate every bit of this from the LS without any outside hardware or software required.

Regarding scale, the building is 180' long and 50' wide, just to give some perspective, and of course the entire site is much larger.

Shawn Billings, PLS

TRIUMPH-LS users, please update to the latest version of TRIUMPH-LS software set (released today) to benefit from all these features. Set the TRIUMPH-2 or TRIUMPH-1 at base to 0.2 Sec transmission rate. TRIUMPH-LS will do the rest.

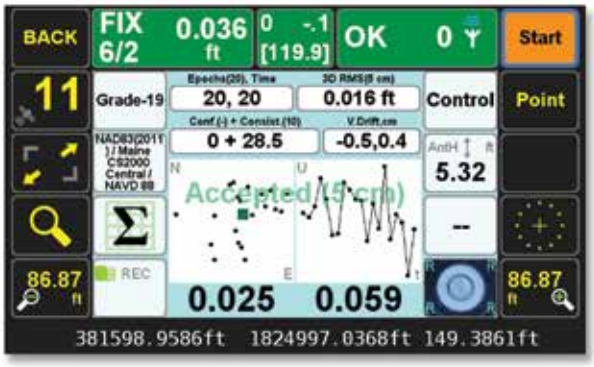
Javad,

Today was incredible. We had a chance to test the Beast….

Stopping to take a shot I would fix and know the position of the line in seconds. This is truly a big deal for me since we are constantly staking line in heavy multi path environment. The LS is truly becoming a receiver to beat. Javad if I were to thank you for anything it would be for the Beast Thank you.

Doug Carter, PLS

Double Bubble



Survey results can be documented with the on-screen image of the vial.

The vials can be viewed on the TRIUMPH-LS screen via the bottom camera.

The internal electronic levels can be calibrated with the mounted vials.

A 40 min vial for fast set up. Next to it is an 8 min vial for precision set up. All in a small package.