Field Report

In the Issue:

Precision with TRIUMPH-LS

Produce reliable and accurate transformation parameters for a local set of known positions.

Visual Stake Out

If your goal is to set stakes, this is simply the worlds' fastest, and least fatiguing method.

Camera Features

Offset Survey, Visual Angle Measurement and more with Triumph LS

We have been testing the JAVAD equipment lately. The receiver we used is the Triumph-LS which has the receiver and data collector incorporated into one unit with a battery life of 30 hours. It utilizes all the current satellite systems, is designed to incorporate additional systems when they become available. It comes with a lifetime offer of software upgrades. The main reason we offered to test it was to see if it would produce better results under canopy than our present equipment and IT DID. It utilizes over 800 channels and 6 engines and an auto-verification system that will guarantee the results if you follow the guidelines. If fact, if you can prove you got a bad fix, they will pay you $10,000. Cameras are incorporated in the unit. The software programs have lots of useful tools and their customer service was very good. They are very open to suggestions for improvements or changes to the software and very efficient at incorporating beneficial recommendations. We are considering ordering units for all our surveyors if affordable.

One important thing we learned while testing the equipment: If you are using a VRS signal when you are working in areas with lots of tree cover and getting lots of multipath signals when trying to get fixed RTK results, you will get better results if you set up your base nearby and use the base instead of VRS (that applies to all brands). And with the JAVAD equipment you may get additional satellites.

The JAVAD equipment is also much-much less expensive that other brands, has tilt compensation, has a collapsible rover rod, has a touch screen with an alternate touch pen in case you don't want to use your fingers and the entire unit is much more compact so it takes up much less space in your vehicle.

I have always dreamed of the "black box" that would give you accurate location coordinates no matter where you are. The JAVAD equipment is the next step.

Gary Kratz
Regional Land Surveyor
US Fish and Wildlife Service

Visual Stake Out

Visual Stake Out, which we often refer to as VSO, is a J-Field exclusive, and is made possible only due to the complete integration of the wide array of sensors built into the Triumph LS. The actual uses of Visual Stake Out are as varied as the work we do. If your goal is to set stakes, this is simply the worlds' fastest, and least fatiguing method. To access VSO at any time while staking, simply press the GUIDE button.

Animated Aerial View

When you select the GUIDE button. There are three optional screen views that you may choose from by pressing the top right button. Two of which are forward facing, one being an animated synthetic landscape view, and one with live video from the forward facing camera. Also included is an animated aerial view, which is very nice for the stakeout of lines, and viewing the overall task.

This reviewing surveyors personal VSO preference is the animated synthetic landscape view. In this view, you will have arrows on the screen telling you which direction to face.

Once you are generally aimed in the correct direction, you will see a yellow line on the screen indicating the direction to walk. All that you have to do is follow it.

Animated Synthetic View

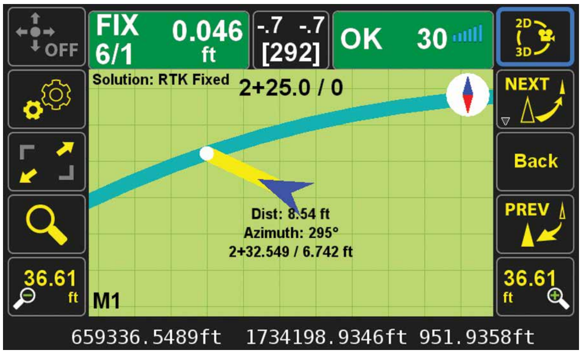
When you are approaching your destination, you will see that a simulated traffic cone is at the end of the yellow line.

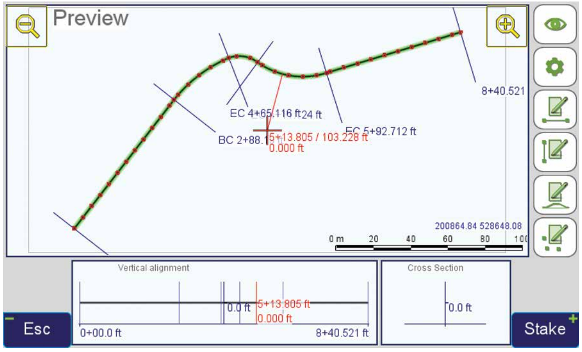
Because the screen update rate is so incredibly fast and smooth, you can simply stick your survey pole into the cone, and the cone fills the screen. Using this method will get you within about 2 tenths of a foot all day long, all without ever looking at a numerical value on a display.

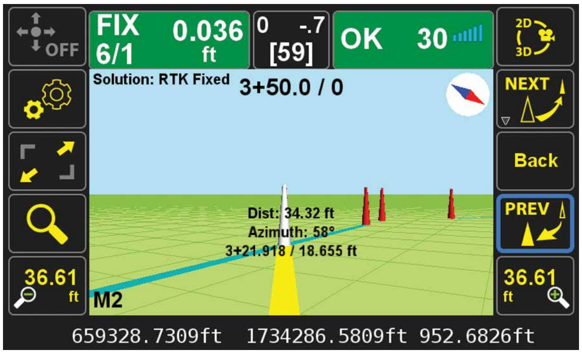
At this point, when you press the back button, you will be at the normal stakeout screen, where you have the information to make your fine adjustment.

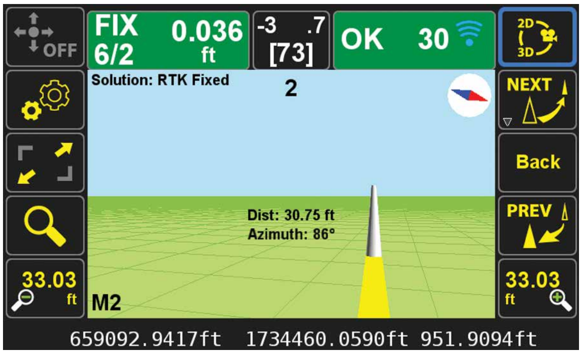
Live Video

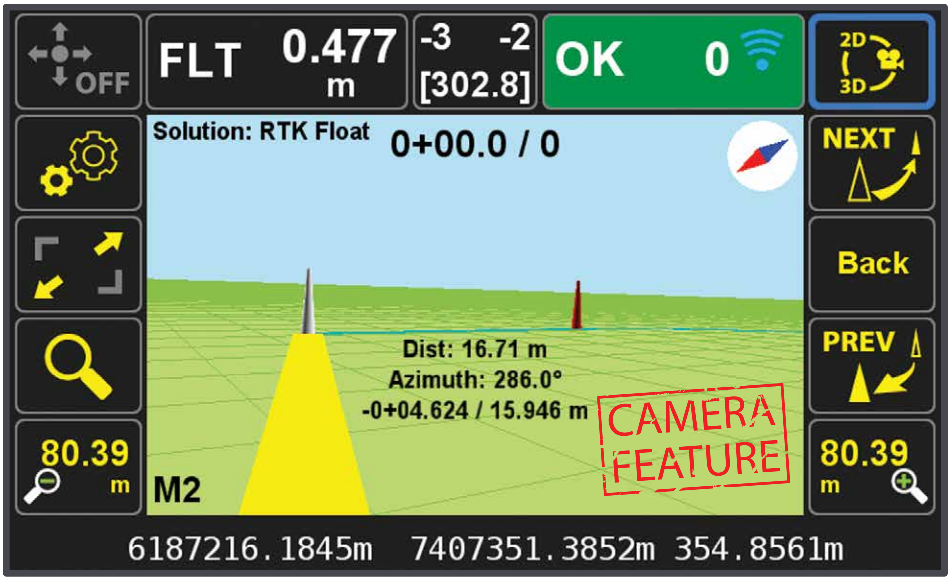
For a surveyor performing stakeout work, the surveyor is relieved of the constant monitoring of In/Out Left Right, or North and East numerical information normally provided by a data collector. This leaves much more mental energy to devote to the other aspects of the job at hand. If a surveyor is working solo, and carrying their own lath bag, hammer, and survey pole, being able to walk to the exact spot the stake goes, without ever having to actually stop and read any numbers is priceless. In addition, it is worth

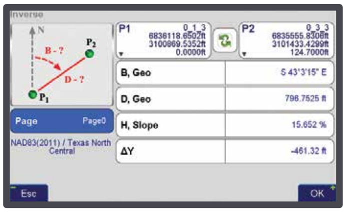


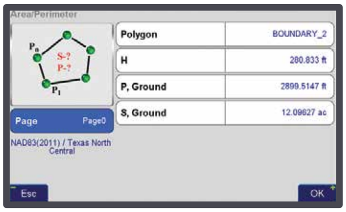


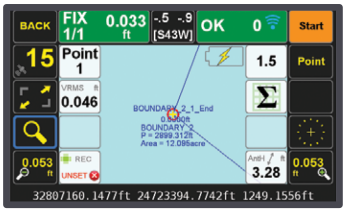


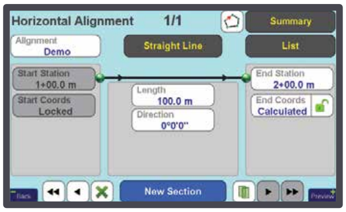












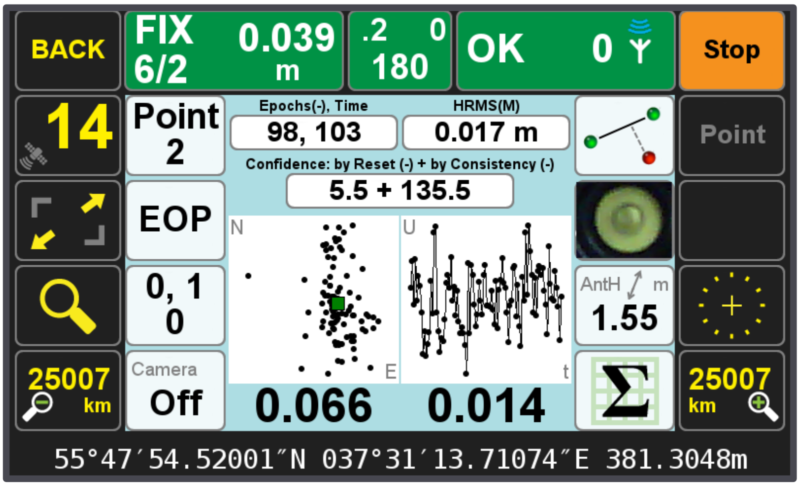
Store and Stake

Introducing GUIDE data collection in the TRIUMPH-LS. Visual Stake-out, navigation, six parallel RTK engines, over 3,000 coordinate conversions, advanced CoGo features, rich attribute tagging on a high resolution, large, bright 800x480 pixel display.
Versatile attribute tagging, feature coding and automatic photo and voice documentation.
The TRIUMPH-LS automatically updates all firmware when connected to a Wi-Fi internet connection.

View and Document your level

The downward camera of TRIUMPH-LS scans and finds the liquid bubble level mounted on the pole. Then focuses on the circular bubble automatically and shows its image on one of the eight white buttons of the Action Screen. You can:

• View the liquid bubble level on the screen.
• Document survey details including the leveling by taking automatic screen shots of the Action Screen, as shown here.
• Calibrate the electronic level of TRIUMPH-LS with the liquid bubble level for use in Lift and Tilt and automatic tilt corrections.



All these camera features are possible only in TRIUMPH-LS where camera, and GNSS antenna are co-located and all other modules integrated.

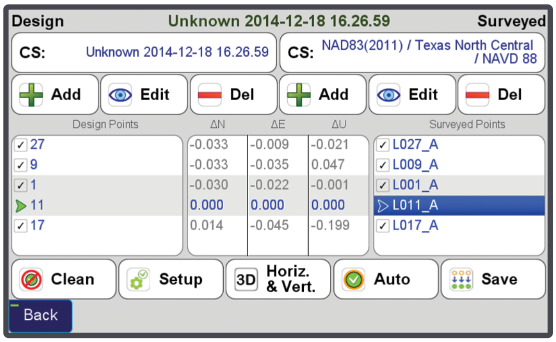
Precision with TRIUMPH-LS

Our friend from JAVAD GNSS, Michael Glutting, recently related that a surveyor in Minnesota asked how he could use his Triumph-LS and corrections from the MnCORS real time network to accurately work within his projects previously established with HARN. The MnDOT provides mount points for various adjustments of NAD83, however, a surveyor can quickly produce reliable, highly accurate transformation parameters for a local set of known positions as this paper describes.

In 2000, Stanger Surveying of Tyler, Texas, established a GPS control network consisting of 30 monuments for my hometown of Kilgore, Texas, over an area measuring about 7 miles square (50 square miles). Even after 15 years, the network proves to be incredibly accurate and was well constructed with ties to two different HARN PACS (High Accuracy Reference Network Primary Airport Control Stations) and multiple repeat and braced vectors. This network predated the modern proliferation of CORS stations, and so there is no precise relation to the CORS and therefore no precise relationship to NAD83_2011. This means that there is some unknown translation from the Kilgore GPS Control Network of 2000 and NAD83_2011. Because of this, we must resolve these transformation values by observation.

To do this, we conducted two field campaigns. In both sessions, I placed a JAVAD GNSS receiver on a stable monument, POST, located at our office. The first session, I used a Triumph-1, and for the second, I used a Triumph-2, both broadcasting corrections over the Internet via TCP. The NAD83_2011 position of POST has been accurately determined by hundreds of hours of data from several different GPS receivers processed through OPUS.

In the first session, my father, J.D., and I observed five different monuments from the Kilgore network with the Triumph-LS for 90-120 seconds each. These points were the primary control Stanger established from the HARN PACS. After observing those five points I performed a preliminary localization.



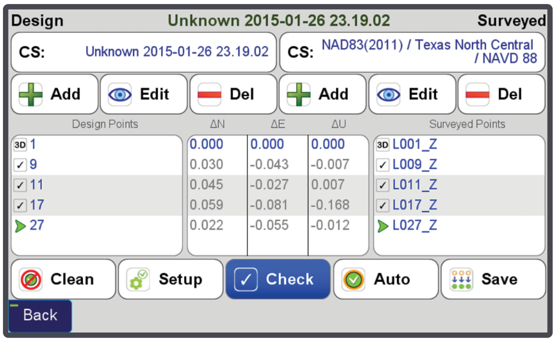
In this preliminary localization, I fixed only one point (point L011_A). Three of the remaining four show very low residuals, however point L017_A, with its noticeably higher vertical residual suggests this point has been displaced since it was established in 2000, or that there is an error in the observation itself - only a repeat occupation will tell.

During the second session, we observed the five points again and used the average tool in J-Field to perform a weighted average of the two points. The second observations showed excellent agreement with the first observations. This chart shows the difference in the repeat observations for each of the five stations:

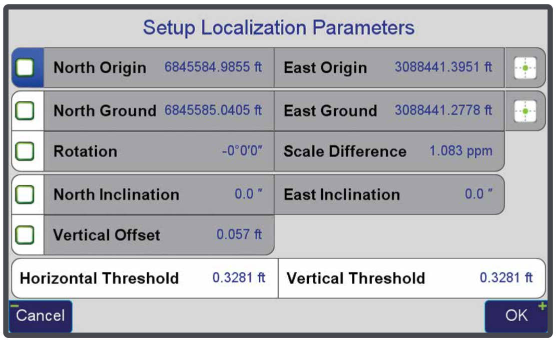
STATIONB	ase-Rover Vector Length (usft)	Δ 2D (usft)	Δ UP (usft)
L001	37342.30	.097	-0.029
L009	23155.70	.048-	0.139
L011	13559.4	0.049-	0.005
L017	24184.6	0.036	0.033
L027	2285.90	.032	-0.005

With the five control points averaged, I began the localization process again. First I performed a minimally constrained localization holding only point L001. Notice that point L017 still appears to be an outlier.

Next, I constrained horizontally to L001, L009, L011 and L027 while still only fixing point L001 vertically. The residuals predictably decrease among the points fixed.

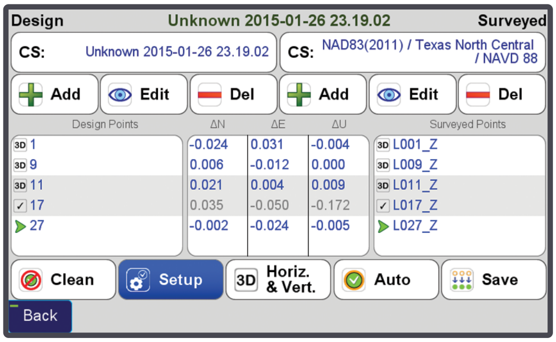


With the residuals indicating a good fit, I turn my attention to the parameters of the localization.

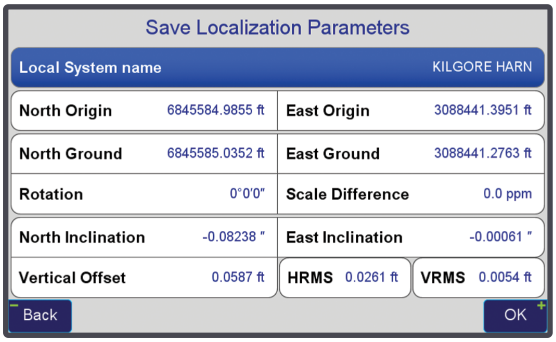


From these parameters, several observations can be made immediately. Because both surveys relied upon the same definition of North, it is expected that there would be little, or no rotation. Furthermore, because both surveys relied upon the same definition of the foot, US Survey foot measured along the same grid surface, Texas Coordinate System of 1983, North Central Zone, there should be little difference in the scale factor. The rotation determined is less than half of one arc second and the scale factor being applied to best fit my survey to Stanger's original work is only 1 part-per-million, revealing very good relative agreement between the surveys.

Finally, I am ready to perform a fully constrained localization, holding all four points (still disregarding the displaced monument L017) both horizontal and vertical.



I set both the rotation and scale to zero as I do not want to redefine North nor the US Survey Foot. Now that more than one point is involved vertically, a tilted plane is calculated. Because the Stanger survey was based on Geoid96 and today's survey is based on Geoid12A, I left the tilt values intact. In this case the inclination values are so small as to be practically insignificant.



The final results indicate that the translation between the Kilgore GPS Control Network of 2000 and NAD83_2011, epoch 2010, (usft) is N: -0.0497 E: +0.1188 U: -0.0587. From this point forward, I can use this new localization system to survey in coordinates related to the Kilgore GPS Control Network of 2000 with a reference station broadcasting NAD83_2011 corrections, or I can transform coordinates from surveys related to the Kilgore GPS Control Network of 2000 to NAD83_2011.

The final step in this exercise is to use this transformation to test on known points. In order to do this, we observed five additional points from the Kilgore network that were not used in the localization. Each point was observed for 120 seconds with the Triumph-LS with corrections from the Triumph-2 onPOST. The chart below depicts the difference in coordinates determined from the LS using the localization and the original Kilgore GPS Control Network of 2000 coordinates.

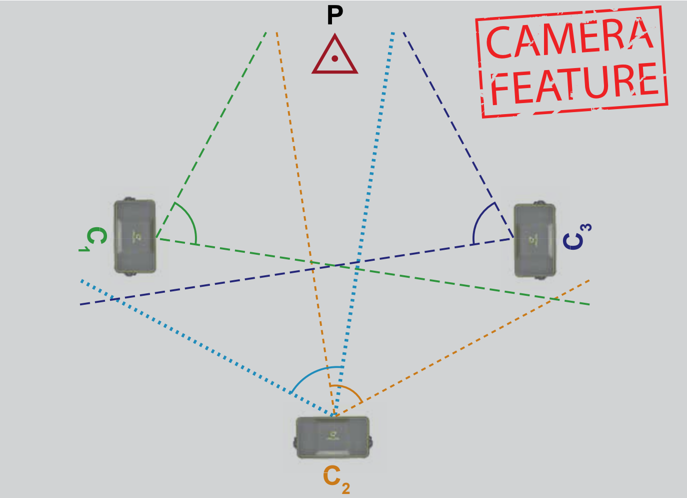
These residuals can be attributed to several different sources: original survey error, current survey error, displacement over 15 years, as well as errors in the localization/transformation being used. However these results, together with the residuals from the localization, indicate that the localization, as determined, will allow me to reproduce the Kilgore GPS Control Network of 2000 coordinates within a centimeter, anywhere within the network. The total time required to perform this exercise was 4.5 hours in the field (including redundant observations) and 30 minutes of calculations, which were all made within the Triumph-LS.

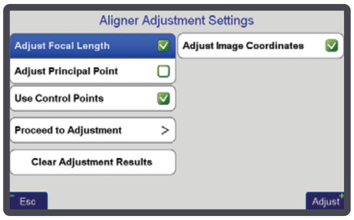
Shawn Billings, PLS

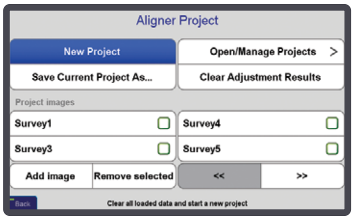
StationB	ase-Rover Vector Length (usft)	2D Residual (usft)	Up Residual (usft)
L007	15363.30	.036	-0.006
L0121	4416.1	0.030	0.101
L0191	2900.90	.025	0.001
L021	7553.00	.048	0.121
L025	11238.80	.011	0.048

Offset Survey with built in camera

You can survey points with internal TRIUMPH-LS camera with accuracy of about 2 cm. Take pictures from at least three points. Leave a flag on points that you take pictures from, otherwise accuracy will be about 10 cm.





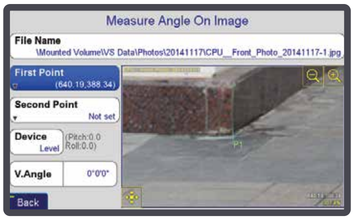


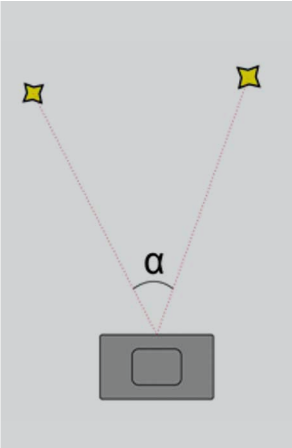
Visual Angle Measurement with Triumph LS

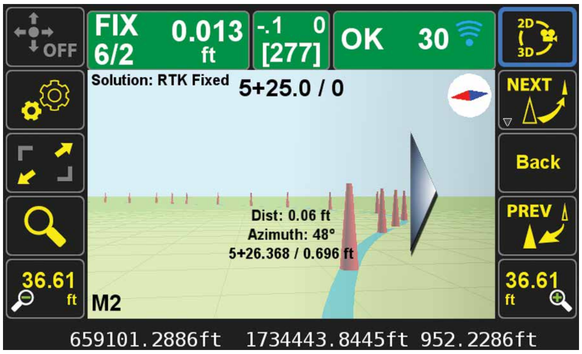
The new Visual Angle Measurement function of the TRIUMPH-LS allows measuring angles between points by using photos taken by the TRIUMPH-LS camera and use in CoGo tasks with the Accuracy of about 10 angular minutes.

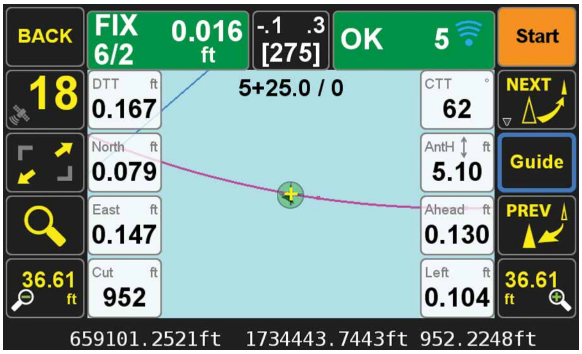
To measure an angle:

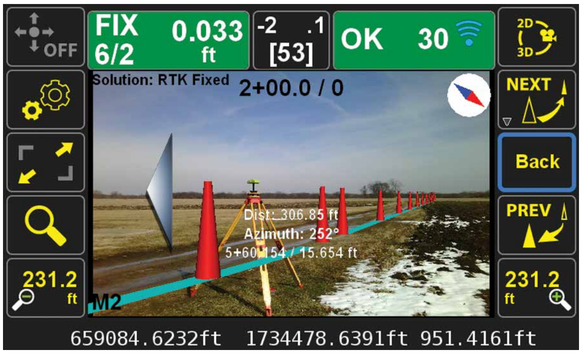
- just take an image containing both objects of interest and open it in the Measure Angle screen
- select first and second point (using zoom to focus on necessary features)
- The angle between points is immediately displayed on the screen.

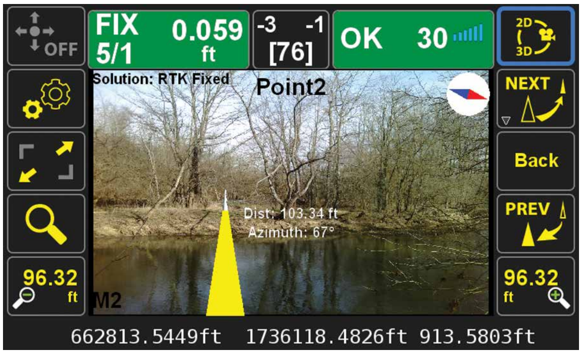


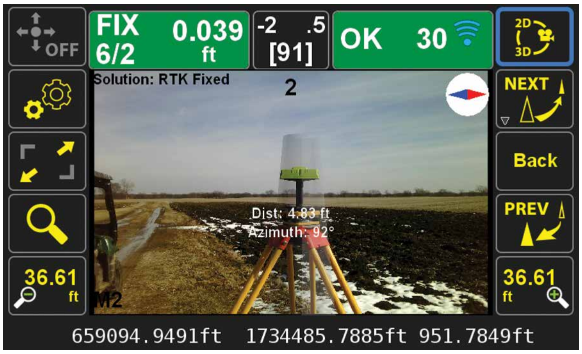












noting that if you are looking down at a data collector screen, reading numbers to navigate to your point, you will find the VSO method to be much safer when you find yourself surrounded by construction equipment, and you can actually keep your head up.

If you are staking out an alignment, the alignment will be depicted as a light blue line on the ground, and any endpoints, and interval points which have been specified will be depicted by the familiar traffic cones. The point you are currently staking will be depicted with a silver colored cone, and the points not yet staked will be depicted as orange traffic cones. This is as close to cheating as any surveyor should ever get

When you are performing boundary work, VSO can be one of your best friends. It will point right to what you are looking for. This is where the video overlay can be very useful, it will answer the questions of which side of the tree would be the best to start clearing with a machete, and is the point we are looking for on the other side of the stream?

Stake Numerical Indicators Surrounding Map View

I have also found that the video overlay of GUIDE is also a useful method of verifying the internal compass calibration. As an example, when you stake out the point number of your base station, you should find it hiding right behind a traffic cone.

When you are within 10 feet of the target point, the traffic cone becomes transparent.

This is a feature that must be seen, and used to be believed. Until you do, please just trust me.

Javad Ashjaee (left), John Evers and Shawn Billings.

John Evers
Professional Surveyor, Ohio 7869

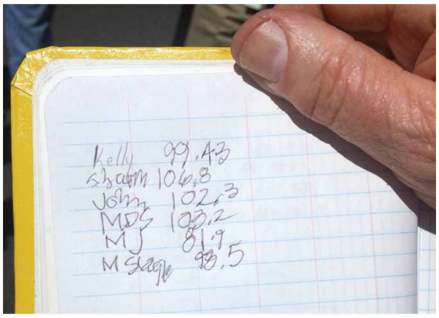
Semitransparent Cone Symbol Over a Point

John Nailed It!

During a week of advanced training for Javad's 5PLS Support Team in San Jose, California, which covered topics such as Live Support over RAMS (Remote Access and Monitoring Server) for Triumph-LS users, Localizations, Linework Collection, Import and Export, Staking, Base/Rover Setup, DPOS processing, and exploration of many other features and future software enhancements, the team took a brief time out for a competition any surveyor would appreciate - a pacing contest.

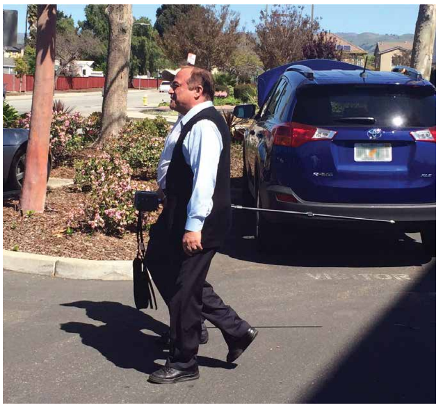
Inverse between start and finish lines.

Michael Glutting used a Triumph-LS, receiving corrections from an Internet base mounted to the Javad facility's roof, to precisely determine a distance between two marks in the parking lot. The result was 102.31 US Survey Feet.



Yep, that's a real field book with hand written data!

Each member of the team then evaluated the baseline, and made careful effort to count their strides as they paced, one at a time, across the parking lot. Each submitted their measurement to the official record keeper, Kelly Bellis.



Doug Carter attempts to avoid detection by concealing himself behind an innocent pedestrian in this photographic evidence of his illegal use of pacing enhancements.

Unfortunately one contestant was disqualified for violating the International Federation of Pacing Official Rules and Guidelines by attempting to use pacing enhancements during the competition.

Once the dust had settled, the results were tabulated and compared to the precisely determined baseline distance. The winner, with an impressive 102.3 feet, was John Evers, Professional Surveyor from Ohio. John's submission varied only one hundredth of a foot from the RTK derived distance - a ratio of error of more than 1:10,000.

Runner-up Matt Sibole of Kentucky, submitted a very respectable distance of 103.2 feet - a difference of 0.89 foot.

At the conclusion of the event, the team celebrated the diverse skills required to be a surveyor - including the use of advanced, modern measuring technologies tempered with ancient techniques requiring nothing more than an even stride. Congratulations, John!

Story by Shawn Billings. Photographs by Nedda Ashjaee.

Matt Sibole in motion while Doug Carter and Matt Slagle discuss pacing strategies in the distance.