

# STAR\*NET VERSION 8.1

## GETS HIGH MARKS FROM INITIAL USERS FOR VASTLY IMPROVED FUNCTIONALITY

By Robert Galvin

For most surveying projects, speed, efficiency and accuracy of measurements are paramount. Since time truly is money in the surveying business, you, of course, want to reduce random error inherent in survey measurements. The best way to confidently accomplish this objective is through a least squares adjustment. It's a versatile and helpful method. Least squares adjustment can be applied to something as simple as a resection or a more complicated situation such as a 3-dimensional network. This method can accomplish several key steps: solve resections, adjust a network, adjust traverses, hunt down blunders in the

data you're observing, blend GPS vectors, and total station work, and differential leveling data into one project. The desired result is to get adjusted coordinates that are more reliable and accurate compared to those obtained from simple intersection and traverse adjusted coordinates that are more reliable and accurate compared to those obtained from simple intersection and traverse adjustments.

While not the only software program available to accomplish least squares adjustment, MicroSurvey STAR\*NET has become one of the most popular and routinely used packages for this important method. Keep in mind that Least Squares adjustment is a processing tool in surveying, really. In other words, it's a way to process all of your measurements simultaneously

to achieve the best, most precise results. STAR\*NET, which MicroSurvey acquired from Starplus Software in 2010 and has since offered has offered through numerous upgraded and improved versions, is well adapted to help its users perform least squares adjustment with confidence. Striving to make the software even better, MicroSurvey has just unveiled version 8 along with a massively updated version 8.1. Different users will have different reasons to upgrade to this improved software package. But the new version seems to have something for everyone, suggests Brian Sloman, MicroSurvey's Desktop Products Manager. "In fact, nearly all of the new features built into it came directly from requests in MicroSurvey's Request Forum," Sloman said.



## NEW NETWORK PLOT MANAGER

A main feature of STAR\*NET 8.1 is a new Network Plot Manager to control your observations. The network plot can be customized in an intuitive grid view that allows users to control the visibility, color, linetype and size of each network element to graphically differentiate conventional, GPS, and leveling observations. Directional linetypes indicate the direction and number of observations between each network station. And, users can now use their mouse to smoothly zoom and pan within the network plot.

Michael Durnin, Survey Manager and Technical Manager with Murphy Surveyors, global consulting surveyors with offices throughout the UK and Ireland, and a STAR\*NET user for 15 years, considers the new Network Plot Manager a valuable capability. "It's very useful, and completely changes the approach and analysis I take with my network plots because I can more easily distinguish the types of observations in my networks and check for completeness and redundancy more easily."

## ERRORS CAUGHT MORE ACCURATELY

Establishing network control and checking it is, of course, a fundamental task on all projects. But now, STAR\*NET has made this capability more versatile and powerful. "It's the basis of our quality (in surveying projects) and

the part of the fundamentals from which our precision on surveys is quoted," Durnin explains. "All measurements are propagated from your control, so having a robust solution on which we (Murphy Surveyors) can rely is the bedrock of our methodologies and protocols and how we achieve precise results. Least squares adjustment gives us this solution, allowing us to catch errors accurately and with confidence," Durnin added.

Rail/control network projects have become a specialty of Murphy Surveyors, and so STAR\*NET already has proven its mettle when used for this application. For example, in 2012, Network Rail, the authority responsible for the UK's railway network, opened what then was the landmark new London Blackfriars station to provide better interchange between national rail and London Underground services. The project's aim also was to make London's Bankside and South Bank areas more accessible to passengers. The project, whose surveying was performed by Murphy Surveyors, was part of the Thameslink Program, a 5.5 billion British pounds effort to improve travel running north to south through London.

During redevelopment of the Blackfriars station, Murphy Surveyors performed a laser scan survey to verify the positions of existing signage throughout the ticket halls to the north and south of the station and in the platform areas. Network Rail used the data to study the visibility of signage and to identify other areas of the station that could be improved. The data also was valuable for use alongside an existing design model so that a visual simulation of the passenger's travel experience could be accomplished.

## LEVEL LOOP TOLERANCE CHECK ADDED

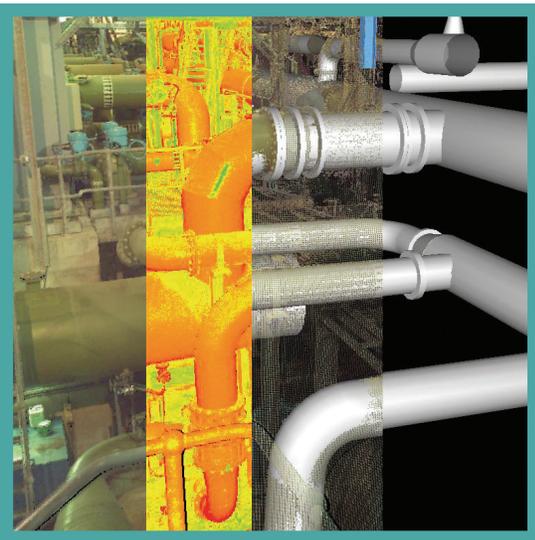
Murphy Surveyors performed a closed loop traverse to extend the existing control network within Blackfriars Station. A survey traverse was performed down the stairs into the northern and southern ticket halls of the stations and back up alternate routes and onto the station platform. This enabled Murphy Surveyors to create the needed closed loop. Additional cross-bracing measurements were also made to strengthen the network. These measurements were processed with STAR\*NET, after which each newly installed railway station was given a level loop tolerance check to ensure accuracy. The leveling data was fed into STAR\*NET so it could be included in the adjustment (in the new STAR\*NET version 8.1, a new Level Loop Tolerance Check allows users to instantly verify the vertical closure of level loops or traverses).

## MORE STREAMLINED WORKFLOW

For the Blackfriars Station survey, Murphy Surveyors used a Leica G200 HDS laser scanner at numerous locations to capture sufficient data. Also used was a Nodal Ninja bracketing system and a single-lens reflex camera to color the scans. Murphy Surveyors delivered the scanned data with light intensity and DWG TrueView as required by Network Rail and as part of a full survey report that also contained witness diagrams, traverse adjustments, etc.

Projects like Blackfriars Station are now easier





to measure using STAR\*NET 8.1 because the software gives consistent measurements over the lifecycle of a project from field to finish, which could take from months to years. “During construction of a project, points are destroyed and replaced,” Durnin explained. “STAR\*NET allows us to keep the network consistent and homogenous. For construction with a BIM, the ability to retain the spatial data capture and stake out consistent course of the project is key.” For example, Durnin added, a network of stations that are all linked to the original control and from which the design is based is crucial. “Maintaining consistency in the control network and monitoring the quality of measurements during stake-out or as-built survey (i.e., TPS, GNSS, or HDS) is key to successful survey results and a streamlined workflow that reduces risk,” Durnin said. Least squares adjustment produces this kind of result.

Examples of some other projects that Murphy Surveys has completed include:

- \* DLR (Docklands Light Railway) London – complete network re-establishment.
- \* RPA (Railway Procurement Agency) Dublin – LUAS, METRO and BXU control Networks.
- \* Internal and external measured building surveys, 2D AutoCAD plans, elevations and cross sections, and 3D As-Built Building information Models (BIMS) in AutoDesk Revit format.

## ‘PRISM’ INLINE COMMAND

Another advantage of STAR\*NET 8.1 comes in the form of a new “PRISM” inline command enabling users to apply a correction for measurements that were collected

with an incorrect prism offset setting. Durnin notes that this feature is helpful for workflows on survey projects such as scanning roads. “The PRISM inline functions are a huge help, particularly when mistakes are made and you need to know where they are and when they occur immediately,” Durnin said. “PRISM will help correct these mistakes right in the field.”

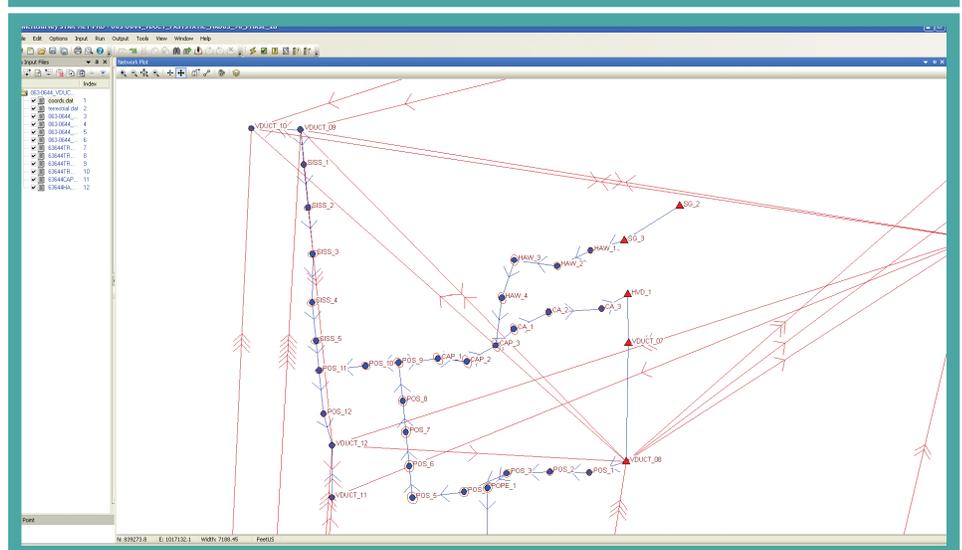
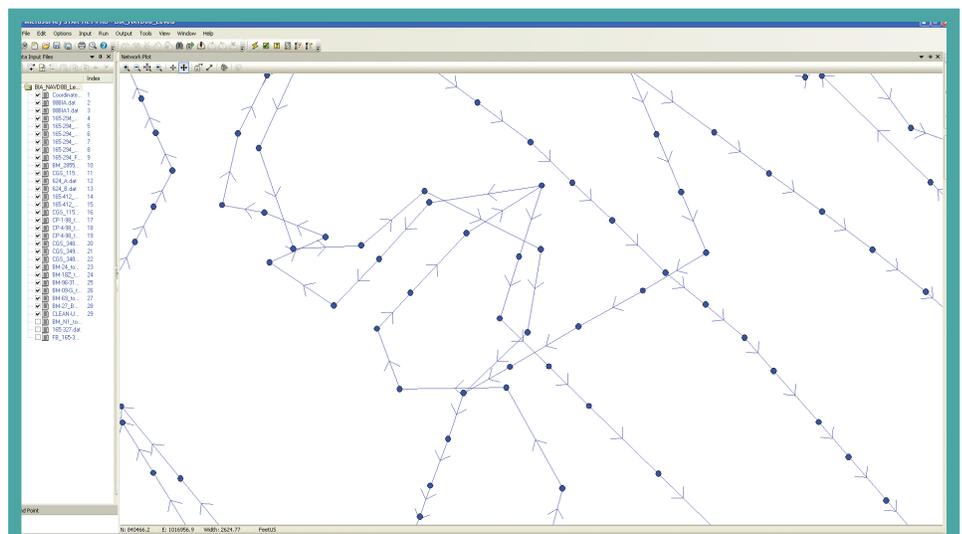
As referenced above, the least squares adjustment method is particularly useful for large-scale construction projects with extended timeframes. This is why one Northeast U.S. department of transportation relies upon this method to ensure accuracy of its control networks. Some examples of projects that this DOT has completed include:

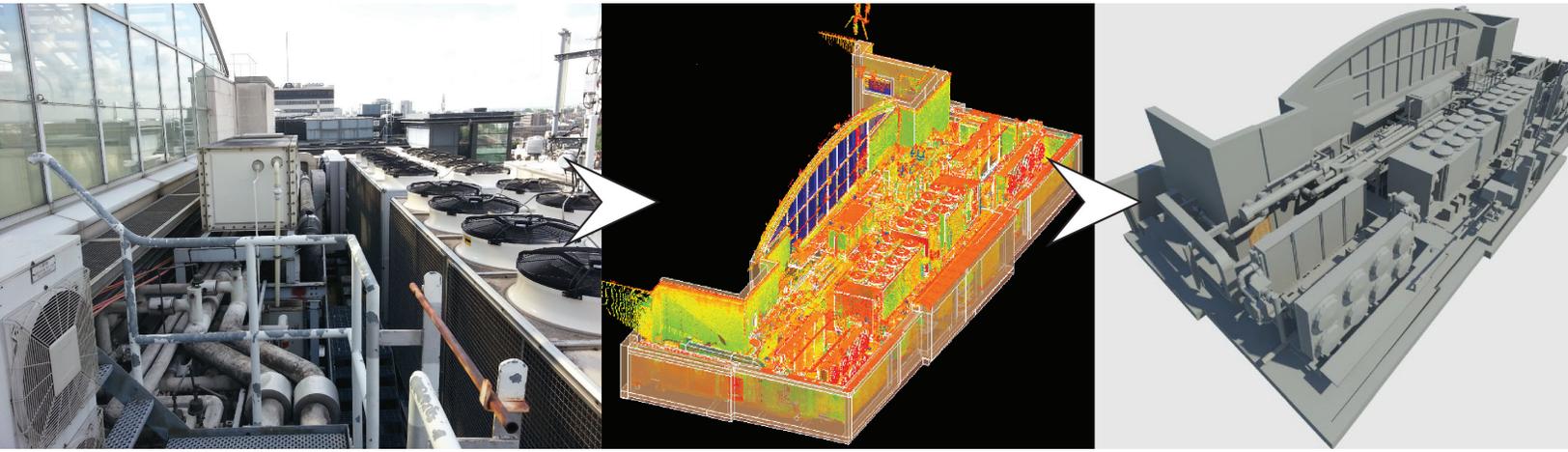
- \* A High-Speed Rail Project.
- \* A Viaduct Project.
- \* A Fastrak Busway.

## AGENCY FINDS MULTIPLE USES FOR STAR\*NET 8.1

According to a surveyor in this DOT’s Bureau of Engineering and Construction District 1-Surveys & Plans, “We’re marrying terrestrial data, elevation data, GPS, and RTK data all within one project under one archive—and adjusting simultaneously. GPS data importing, finalized residual, multiple coding formats, exporting, layers and color coding are the most popular features in STAR\*NET that I use daily. Also, I have created individual project templates for different types of work,” the spokesman added. “It’s amazing how quickly the entire process moves along once you’ve standardized procedures.”

All GPS data collected for any of the DOT’s surveys comes in through Trimble data collectors and is imported into Trimble Business Center. From there, the data is exported to the Trimble Exchange format and imported into STAR\*NET and then processed. The DOT performs the





majority of its survey evaluations in STAR\*NET. "I use STAR\*NET for all of my GPS vector evaluations, RTK, terrestrial input, and residual evaluations," the surveyor said. "I find the Error Propagation report especially useful as my final check," he continued. "Version 8.1's Leveling Routine is the biggest improvement in this software for our DOT."

Similar to Durnin of Murphy Surveys, the Northeast DOT is impressed with STAR\*NET 8.1's level loop tolerance checking feature. In fact, this is a feature that the DOT expressly requested. The leveling routine in 8.1 now checks against the national vertical surveying standards as the DOT's surveyor had requested. He noted that the leveling routine performs closure checks for every level run/loop that the program encounters, with each individual loop report giving pass/fail criteria. "I'm not aware of any other leveling routine that can perform a simultaneous least squares adjustment of a multi-loop level run that includes junction points," the surveyor said. "So, that's the most significant improvement (in STAR\*NET 8.1)—that the leveling routine is now fully functional, evaluating and reporting against the national vertical standard as it should."

Bridge projects were prevalent on the DOT's agenda this year. The surveyor estimates between 25 and 30 bridge surveys have been completed using STAR\*NET during the last year. "RTK, static, and terrestrial data sets were all adjusted using STAR\*NET," he said.

Handicapped cross-walk ramp improvements kept our DOT busy as well. "We used STAR\*NET to adjust our cellular RTK and static GPS collection sets for the upgrading of 124 handicap cross-walk ramps all over the state," the surveyor said.

### TESTED VERSION 8.1/ VERSION 6 REVERSE COMPATIBILITY

The surveyor assessed reverse compatibility with the new STAR\*NET 8.1 using previously completed DOT projects—adjusted with the least squares adjustment software's Version 6. "The geoid models must be placed in a new location, and State Plane formats have been modified, but everything upgrades fairly seamlessly from our older Version 6 projects," the surveyor confirmed.

### SIMULTANEOUS LEVEL LOOPS RUN TOGETHER ON VIADUCT PROJECT

As for types of projects to which the DOT applies least squares adjustment, one involved a viaduct project where multiple level loops were run conventionally—loop built upon loop, built upon loop. "It turned out there was an error in a particular level loop because something had shifted vertically, and there was no way (prior to STAR\*NET 8.1) to properly adjust because the loops could not be run together simultaneously," the surveyor explained. "STAR\*NET gave us

this option. STAR\*NET readjusted the loops simultaneously, including common junction points, and all loops passed as expected."

### VECTOR ARROWS, LAYERING ARE BIG ADVANTAGES

With the DOT projects it's very possible to have 25 to 30 GPS points in a network, with terrestrial data connecting a good portion of these points, and level runs running throughout, the surveyor noted. It was always difficult to visualize these combined items. "STAR\*NET has vector arrows which will specify how many times a GPS vector has been collected, and it also shows the direction of that vector, which is another advantage," he said. In addition, he continued, "Being able to turn layers on and off, with the addition of individual layer colors, allows me to better visualize how the different types of observations are connected."

What the Northeast DOT's surveyor likes about STAR\*NET is knowing that the program will yield consistently good results, which is why the DOT has used the software from Version 6 up to 8.1. "What's different about Version 8.1 for the surveyor? " A huge plus for me is the addition of the GPS vector arrows, which will allow me to assess the strength and redundancy of my GPS networks at a glance," he said. "The ability to depict GPS and terrestrial data in different colors, and on different layers, will make visualization and evaluation much simpler."