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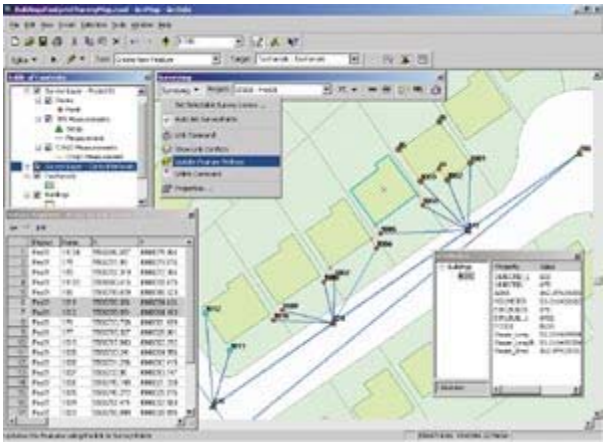
Survey Analyst: A Dream Coming True

By Bruce Joffe, GIS Consultants

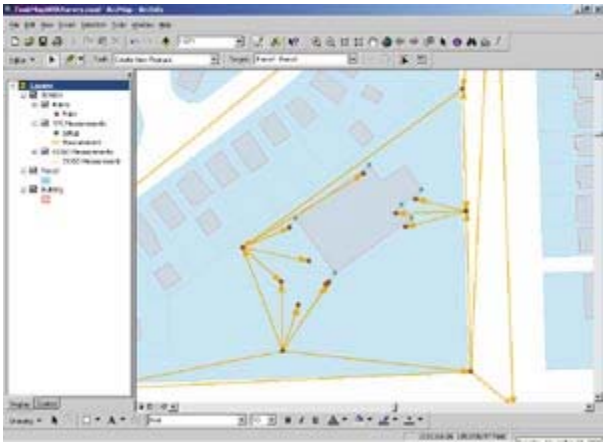


With ArcGIS Survey Analyst, building features can be snapped to surveyed locations.

Since the early 1980s, geographic information theorists (such as Ken Dueker, Harlan Onsrud, and others on the National Research Council's Committee on Geodesy) have called for a multipurpose cadastre system for GIS data. In this schema, highly accurate survey control would be the basis of cadastral mapping, which in turn would control other layers of GIS-mapped features. The key to this idea was to link these various map features together, along with appropriate computational methods, to propagate control feature changes through the linked features.

The second and equally important quest (called for by Andrew Frank, T.B. Buyong, Nancy von Meyer, Paul Durgin, and others) has been for a measurement-based survey database. With this schema, original survey measurements and computations would be retained in the GIS database so that changes to control-point measurements could be repropagated through the network of related points.

Together, these two long sought-after capabilities have comprised the dream, or "holy grail," of survey automation and integration with GIS. With ArcGIS Survey Analyst, the quest is over: these tools are now available to surveyors and GIS analysts alike. As a result, a government agency's GIS map base can now be built as a measurement-based multipurpose cadastre, and existing GIS map bases can gradually be transformed into this much desired data model. Moreover, this technology enables surveyors to fully integrate their survey work, computations, and expertise into the construction and maintenance of a fully functional enterprise GIS.

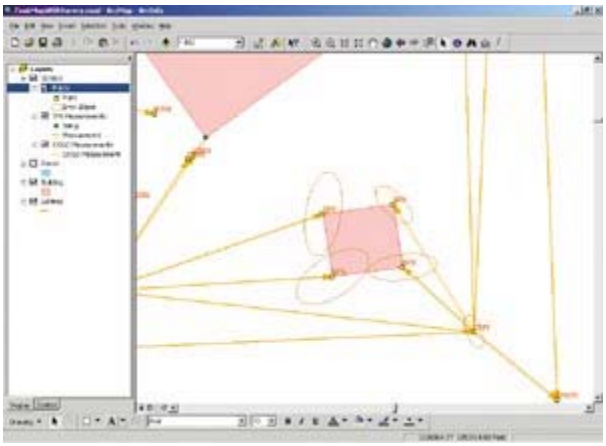


ArcGIS Survey Analyst links GIS features to survey points in the survey layer.

To appreciate the importance of this technical innovation, consider the way COGO technology is currently used by surveyors to create maps. Surveyed measurements (such as bearings and distances) are keyed into the COGO software (or, alternatively, measurements from tools such as the total station are automatically imported into the COGO software), which then computes coordinates for the measured points. The COGO outputs are point coordinates, adjusted to reduce errors with various computational algorithms such as least squares. These output points are not the measured locations but a derivation that best reduces the inevitable errors. These point coordinates may then be imported into GIS map layers.

If one of the control points from which the measurements were made is updated in the future, COGO would adjust these derived point coordinates again to create a computed best fit. Since the original measurements are not saved for future repropagation, successive adjustments may actually degrade the reliability of all the mapped points.

ArcGIS Survey Analyst stores the original measurements in the database so that future updates to controlling points can repropagate through the traverse network. ArcGIS Survey Analyst also stores the computations used to generate the resulting mapped points so that the exact same computations could be used to repropagate the network of points. The result: successive update measurements can actually make the entire network of mapped points more accurate.



Error ellipse (spatial quality information) can be displayed for survey points in ArcGIS Survey Analyst.

Why is this capability important? Transforming an entire digital map set from the NAD27 coordinate datum to NAD83 is a huge modification for which the measurement-based database would create more accurate results than COGO's best-fit algorithms. And, every few years, geodetic control points are updated as new "epochs" (adjustments) are published, which affects the survey control of parcel survey measurements. The need to update related mapped features continues with each new control epoch.

ArcGIS Survey Analyst software's second innovation is its ability to link survey-created points with corresponding mapped features that derive from those points. When a surveyor's data is entered into ArcGIS Survey Analyst, it is automatically formatted and stored in the ArcGIS geodatabase schema, thus making the data accessible to related mapped feature layers. The survey measurement points can control the location of such dependent features as building footprints, edge of pavement, property corners, manholes, or fire hydrants. When given the command to do so by an authorized user, the revised survey measurements can automatically adjust the other mapped features. The dependent map features are said to be "survey aware." Users and maintainers of those layers can see the controlling, surveyed points, but cannot change them without explicit permission.

ArcGIS Survey Analyst software's third improvement is its surveyor-friendly interface. The software can receive several types of data entry according to a surveyor's particular data flow method and preference. Field measurements can be entered into one of several predefined (or user-created) entry screens. Alternatively, data can be automatically input from various field data collection devices. A notable example of data flow-based entry is the assignment of a project to each set of survey data. Points from several different projects can be viewed in a current project and used to control the location of current project points. Yet, each project's points are locked to protect against unauthorized change.

The geodatabase also captures and includes related information collected in survey notes and assigns it to the mapped points. This enables future surveyors or analysts to evaluate the reliability and relationship of each point to the others. As dependent points are propagated and mapped from control points and measurements, the apparent error of each point is calculated and displayed as an error ellipse. This gives the surveyor or GIS analyst a visual cue to the reliability of each point.

These capabilities—capturing survey measurements, notes, and computations and using them to propagate or repropagate a network of related mapped points and features—enable surveyors to easily incorporate their work products into GIS databases that serve all departments and applications in an agency.

Furthermore, ArcGIS Survey Analyst is a fully integrated part of ArcGIS; therefore, all geodatabase, ArcCatalog, and ArcMap capabilities are available.

For more information, contact Bruce Joffe, GIS Consultants, Oakland, California (tel.: 510-238-9771, e-mail: mailto:GIS.Consultants@joffe.com), or visit **www.esri.com/surveyanalyst** or **www.esri.com/surveying** on the Web.