

# ACCURACY ANALYST

## Compute Horizontal Accuracy Assessment Metrics for Orthoimagery Products

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Accuracy Analyst is a standalone software product that provides a standardized assessment methodology for calculating the horizontal accuracy of orthorectified imagery. The product simplifies the horizontal accuracy assessment process so many desktop geographic information system (GIS) users will be able to compute their own horizontal accuracy assessments, regardless of their imagery contractor or data provider. This is important because often horizontal accuracy assessments are compiled and delivered by imagery vendors to prove they've met or exceeded the accuracy specified within a contract. Because high-resolution imagery projects typically cost thousands of dollars, many imagery consumers acquire the data and then use the imagery without independently confirming its stated accuracy. Such accuracy assessments are critical when imagery is leveraged for base mapping and feature extraction by GIS technicians.

The product's output indicates the off-set error calculated by RMSE, CE90 and CE95 (see "Useful Definitions" at right) within the image tile(s) as compared to on-the-ground, Global Positioning System (GPS)-based ground control point (GCP) observations. With Accuracy Analyst, imagery consumers can conduct a defensible horizontal accuracy assessment and possibly spend less money by doing the work themselves.

In addition, imagery vendors may use Accuracy Analyst to provide an easily understood, comprehensive assessment of data accuracy to enhance customer acceptance of purchased data. Also, any service company that conducts imagery data validation will find Accuracy Analyst a useful tool for enabling efficient and standardized assessment workflows.

### Practical Applications

Orthoimagery typically is acquired for use in mapping, planimetric measurement and/or feature extraction (e.g., digitizing).

Imagery consumers juggle several variables related to acquisition and delivery options related to orthoimagery instruments and collection procedures, including color selection, delivery formats, cloud cover and leaf-on conditions. However, the resulting horizontal accuracy—and ground resolution—usually tops the list of import criteria. Often the horizontal accuracy is written into

contracting specifications and may determine final acceptance and/or rejection of final product delivery and payment. Therefore, the ability for clients to independently confirm the horizontal accuracy of delivered imagery products is an important aspect of the transaction and aids in the accuracy assessment of any map features derived from the base imagery products.

With Accuracy Analyst, users can compile in-house accuracy assessments of base mapping image products and make better decisions regarding the use of existing orthoimagery products. Collecting high-precision, survey-grade GPS or traditionally

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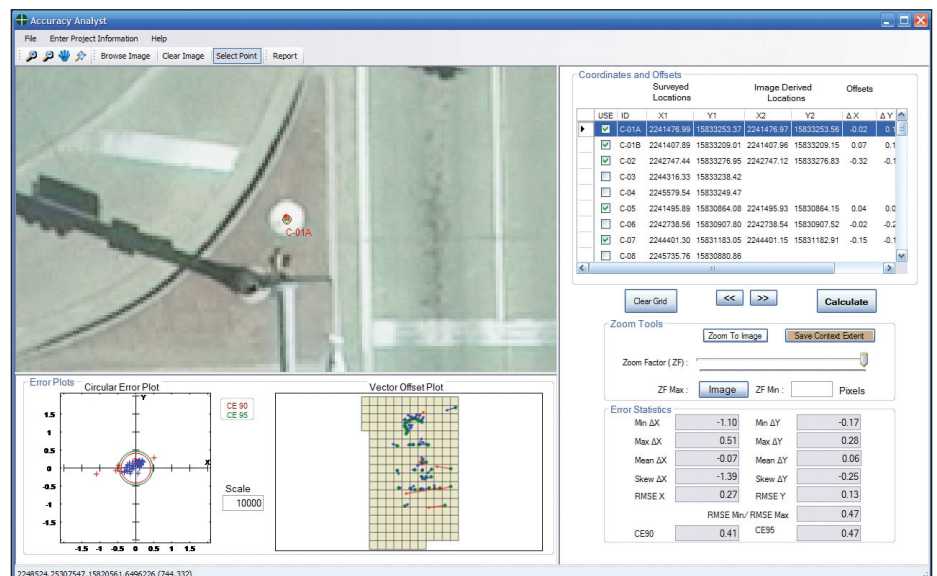
surveyed control points are a required input into any Accuracy Analyst assessment, and those surveyed GCP locations must be clearly visible within the images being tested. The Federal Geographic Data Committee's National Standards for Spatial Data Accuracy (NSSDA) recommend users collect at least 20 photo-identifiable control points per accuracy assessment that are "well distributed" across the entire study area. The cost of collecting the control points is an additional expense Accuracy Analyst users should anticipate.

### Software Use and Documentation

Accuracy Analyst automates much of the work required for a horizontal accuracy

**In short, Accuracy Analyst generates a complete accuracy assessment report with a click of a button.**

assessment, but users should be familiar with the process. New users should be familiar with the NSSDA guidelines and the U.S. National Map Accuracy Standards. Although these national mapping and data accuracy standards have been around for years, Accuracy Analyst is the first software product that compiles horizontal accuracy assessments for orthoimagery. The user documentation and downloadable example datasets provided for Accuracy Analyst are geared toward new users, providing useful information on proper procedures for conducting a horizontal accuracy assessment.



Accuracy Analyst provides quick access to each GCP location with simple point-and-click navigation between GCPs and easy image point digitization. Instant feedback is provided via the dynamic Circular Error and Vector Offset plots.

## User Input Requirements

Accuracy Analyst requires a modest amount of setup and user input to get started. New users can refer to a general checklist of data requirements to serve as a guide for their first accuracy assessment project. Accuracy Analyst requires users to have a polygon index

## Useful Definitions

**CE90** (Circular Error of 90 percent): A CE90 value is the minimum diameter of the horizontal circle that can be centered on all photo-identifiable ground control points (GCPs) and also contain 90 percent of their respective twin counterparts acquired in an independent geodetic survey. CE95 (Circular Error of 95 percent) is more rigorous and allows for only 1 GCP outlier for every 20 GCP sets.

**RMSE** (Root Mean Squared Error): An RMSE value is a single summary statistic that describes the square root of the mean horizontal distance between all photo-identifiable GCPs and their respective twin counterparts acquired in an independent geodetic survey.

file of their imagery—sometimes referred to as an “image catalog” by GIS users. Image catalogs often are supplied by imagery vendors when they deliver their products. Accuracy Analyst requires the index to be provided as an ESRI Shapefile, so users should request this index file as a contract deliverable for their image acquisitions.

In addition, users must know their data coordinate system, as the aforementioned GCP coordinates must be within the same mapping unit and projection/coordinate system as the delivered imagery. This is typically a State Plane Coordinate System for local government mapping applications in the United States, but many statewide acquisitions are delivered in the Universal Transverse Mercator (UTM) projection/coordinate system. Regardless of the coordinate system of the delivered imagery, be sure the surveyed GCP coordinates are precisely located upon easily photo-identified points within the delivered imagery and that the x, y coordinates are delivered within the same projection/coordinate/datum/unit as the delivered imagery.

These GCP or “real-world” coordinate locations should be collected as much as three times the accuracy of the specified accuracy of the final imagery products and recorded with the appropriate coordinate precision to support such accuracy. Accuracy Analyst expects each GCP location to be identified with a user-defined unique “ID” and include the x, y coordinates, as well as any field notes that may help Accuracy Analyst users “heads-up” digitize the corresponding position on the imagery.

Accuracy Analyst users can load these control points into the software by typing them individually or in bulk as a comma separated file (.csv) in which the left-hand column represents a unique ID for each GCP, followed by the x, y coordinates.

After an imagery index file (.shp) and GCP file (.csv) are acquired, the next step is to open the Accuracy Analyst application and create a new Project file (.aap). After providing a project file name and brief metadata, users import the imagery index file (.shp) and load the GCPs (may be typed individually or imported via a .csv file) for the accuracy assessment. The imagery index files must contain an attribute with the name of each image or else your individual images can't be located. Accuracy Analyst reads the most common raster image formats, including .tiff, .img, .sid, .jpeg and .jpg. For better performance, users should store the imagery on the same computer. Including the .rd and/or the .ovr files for each image will improve the imagery's display performance, but they aren't required.

## Accuracy Analyst Workflow

The product's usefulness and efficiency quickly becomes apparent after a project is set up and the two required datasets are imported (.shp and .csv files). Notice that I haven't mentioned anything about the imagery, because Accuracy Analyst will load only the area of each image that intersects a control point. This means Accuracy Analyst's image display is fast, and users will save hours of work by eliminating the need to wait for an entire high-resolution image to load before they locate and digitize the corresponding GCP point on corresponding images. The time savings alone is reason enough to justify Accuracy Analyst's purchase.

Accuracy Analyst's software layout streamlines the coordinate acquisition workflow, too, so users can quickly move through their list of surveyed GCP locations (see upper right corner of accompanying product screen shot) and locate, then heads-up digitize, the appropriate “on image” location that corresponds to its twin GCP position. After all of the image control positions are digitized for each of the GCPs, the user “calculates” the error results, which are quantified by the RMSE, CE90 and CE95 accuracy assessment statistics for the project imagery. Additionally, a circular error and offset vector error plot are generated and presented within the application. These error plots are interactive and provide color-coded graphics that depict the error distribution, as well as the direction of image offset from each control point. The points are color coded based on whether they're within the CE90 or CE95 specifications.

After the accuracy statistics are calculated, Accuracy Analyst users can review their collection of GCP positions and use the graphic

display of the error plots to help decide if they should remove “outliers” from their assessment or add additional GCPs to refine their accuracy assessment. As these changes are made, Accuracy Analyst recalculates RMSE, CE90 and CE95 to provide instant results.

Finally, when users have completed their work, they can select “Generate Report,” and a snap-shot, multipage report of their accuracy assessment data, input, output and results is produced in a single portable document format (.pdf) file. The reports are time/date stamped and contain all relevant information regarding the accuracy assessment. The report includes snapshots of each control point's location and corresponding digitized image location.

In short, Accuracy Analyst generates a complete accuracy assessment report with a click of a button. The time-stamped reports can be re-generated at any time, and each report run reflects the current status and result computed at that moment within the Accuracy Analyst project. The product's report generator will save users hours of project documentation time and should easily justify the product's purchase. [E]

## Because Accuracy Matters



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**Accuracy Analyst Release Date:  
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