MAPPINGMATTERS

YOUR QUESTIONS ANSWERED

The layman's perspective on technical theory and practical applications of mapping and GIS

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QUESTION:

Question: I am a college student working on my bachelor degree in Spatial Science (Surveying).

I am interested in photogrammetry and my study is on drone-based surveys. I have the following questions on the new "ASPRS Positional Accuracy Standards for Digital Geospatial Data:"

1. In sections 7.7 and 7.8, when it talks about checkpoint and ground control accuracy being 1/2 RMSEmap, is RMSEmap the desired/intended accuracy class?
2. With GCPs having three times the accuracy of the geospatial data set being tested, does that mean the GCP accuracy will be three times more accurate than the desired/intended accuracy class?
3. Do you use Table D.1 to calculate all the statistics and then use the results to determine the ASPRS accuracy class? Is that the typical workflow? Is there a sample report you can supply?
4. Are there guidelines on what you should aim for regarding the additional statistics discussed on the standards, such as max, min, skew, kurtosis and mean absolute?
5. Can you clarify what it means when you can state 'tested to meet' versus 'produced to meet?'
6. Can you direct me to a document regarding planning and best practice guidelines?
7. Do the vegetated area ground control points simply go on the bare ground between vegetation?
8. How do you assess seamline mismatch?
9. If an orthophoto fails a column in Table B.3 (e.g. the RMSEr is okay, but the accuracy at 95% CI exceeds the limit), do you select the accuracy class where your project meets or exceeds all standards in a single row?
10. I note that many drone-based surveys seem to have a mean error much higher than 25% of the RMSE. What does this information tell you about the quality of the project, and how can you correct it?
11. I also noticed that nearly every drone software company reports accuracy as a function of GSD, e.g. heights within three times the GSD. How are these related, and is GSD really related to accuracy in any way? I did a project with a GSD of 1 cm, but I achieved 11 mm RMSE heights and mean of 3 mm.
12. Can you direct me to where I can read more about rigorous total propagated uncertainty regarding photogrammetry?

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Dr. Abdullah: Due to the length of this list of good questions, I will address them over the span of several articles.

PART I

Question 1—*In section 7.8 of the standards, when it talks about ground control accuracy being ½ RMSEmap, is RMSEmap the desired/intended accuracy class?*

Answer: Yes, it is. The standards, in section 7.8 impose the following relationship between the accuracy of the ground control points and the derived product or map:

- Accuracy of ground control designed for planimetric data (orthoimagery and/or digital planimetric map) production **only**:
  - $RMSE_x$ or $RMSE_y$ = 1/4 * $RMSE_{x(Map)}$ or $RMSE_{y(Map)}$,
  - $RMSE_z$ = 1/2 * $RMSE_{x(Map)}$ or $RMSE_{y(Map)}$
- Accuracy of ground control designed for elevation data, or planimetric data and elevation data production:
  - RMSEx, RMSEy or RMSEz = 1/4 * $RMSE_{x(Map)}$, $RMSE_{y(Map)}$ or $RMSE_{z(DEM)}$

Therefore, if your photogrammetric processing is solely for producing 2D planimetric data,

> **"The independent source of higher accuracy for checkpoints shall be at least three times more accurate than the required accuracy of the geospatial data set being tested."**

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such as orthoimagery and/or 2D vector maps with a horizontal accuracy class of 30 cm, your ground control points need to be surveyed with:

- Horizontal accuracy of RMSEx or RMSEy = 7.5 cm
- Vertical accuracy of RMSEz = 15 cm

However, if you plan to produce any elevation data, such as point clouds, contours or 3D vector maps, your ground control points need to be surveyed with:

- Horizontal accuracy of RMSEx or RMSEy = 7.5 cm
- Vertical accuracy of RMSEz = 15 cm

Question 2—*In section 7.9 of the standards, when it talks about checkpoints being three times the accuracy of the geospatial data set being tested, does that mean the GCP accuracy will be three times more accurate than the desired/intended accuracy class?*

Answer: Yes, it does. The standards in section 7.9 state the following:

"The independent source of higher accuracy for checkpoints shall be at least three times more accurate than the required accuracy of the geospatial data set being tested." Therefore, if you are testing products that must meet a vertical accuracy class of 10 cm, your checkpoints should be surveyed to a vertical accuracy of $RMSE_{z = 3.33\ cm}$.

Question 3—*Do you use Table D.1 to calculate all the statistics and then use the results to determine the ASPRS accuracy class? Is that the typical workflow? Is there a sample report you can supply to me?*

Answer: Table D.1 in the standards represents the methodology reported in the "National Standard for Spatial Data Accuracy (NSSDA)" testing guidelines. While you can use any organization to compute the statistical terms needed to calculate the accuracy figures (according to ASPRS standards), Table D.1 is particularly helpful.

> **"'PRODUCED TO MEET' statement is usually provided by data producers or providers when accuracy is not verified by an independent set of checkpoints."**

Question 4—*Are there guidelines on what you should aim for regarding the additional statistics discussed in the standards, such as max, min, skew, kurtosis and mean absolute?*

Answer: No, not at this moment. However, textbooks and manuals on statistics can be consulted to derive desirable values based on the limits of RMSE and bias set by the standards. I will add your question to the list of issues catalogued for future enhancements to the standards.

Question 5—*Can you clarify what it means when you can state, 'tested to meet' versus 'produced to meet?'*

> **"'TESTED TO MEET' statement is usually provided by data users or their consultants when accuracy is verified using an independent set of checkpoints."**

Answer: Formal testing statements were provided to users in section 7.12 of the standards. There are two types of statements for reporting product accuracy:

1) **'PRODUCED TO MEET'**: This statement is usually provided by data producers or providers when accuracy is not verified by an independent set of checkpoints. The producers report their achieved accuracy based on confidence in their workflows and by the data fit to the control they used to calibrate the products.
2) **'TESTED TO MEET':** This statement is usually provided by data users or their consultants when accuracy is verified using an independent set of checkpoints. For product accuracy to be independently validated according to ASPRS standards, the test must satisfy the following conditions:
   a. Independent checkpoints are ground control points that are not used in the calibration process during product generation. Check points can also be derived from existing datasets with known accuracy.
   b. Checkpoints should be more accurate than the tested products. According to the standards, checkpoints should be at least three times more accurate than the tested product.
   c. To make it a valid statistical sample, regardless of the project size, there should be at least 20 well-distributed checkpoints used in the accuracy assessment.

Question 6—*Can you direct me to a document regarding planning and best practice guidelines??*

Answer: Unfortunately, no such document exists at ASPRS for UAS-related activities. I co-instruct several workshops during the ASPRS annual conferences that you may find useful. In those workshops, we explore best practices based on past project experience and technical guidelines developed over the years from our standard mapping practices. However, I am working with the ASPRS UAS subcommittee to encourage them to develop such a document that we can include as an addendum in a future version of the standards.

(to be continued)

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