CLOSING REMARKS

Dr. Qassim Abdullah, Woolpert, Inc.

ASPRS Positional Accuracy Standards
Understanding the New “ASPRS Positional Accuracy Standards for Digital Geospatial Data” and its Applicability to UAS-based Products

Dr. Qassim Abdullah, Woolpert, Inc.

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Motivation Behind the New Standard

- New **aerial cameras** vary widely in their **design and sophistication**. For these reasons, existing accuracy measures based on **map scale, film scale, GSD, c-factor and scanning resolution** are no longer applicable to current geospatial mapping practices.

- Legacy map accuracy standards were designed to deal with **plotted or drawn maps** as the only medium to represent geospatial data.

- More recent advances in mapping technologies can now **produce better quality and higher accuracy** geospatial products and maps.
New Standard Highlights

- It is all **Metric**!
- Unlimited **Horizontal Accuracy** Classes:

Horizontal Accuracy Standards for Geospatial Data

<table>
<thead>
<tr>
<th>Horizontal Accuracy Class</th>
<th>RMSE$_x$ and RMSE$_y$ (cm)</th>
<th>RMSE$_r$ (cm)</th>
<th>Horizontal Accuracy at 95% Confidence Level (cm)</th>
<th>Orthoimagery Mosaic Seamline Mismatch (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>X-cm</td>
<td>≤X</td>
<td>≤1.41*X</td>
<td>≤2.45*X</td>
<td>≤2*X</td>
</tr>
</tbody>
</table>
Accuracy for Aerial Triangulation and Ground Control

**AT** Should be **Twice as accurate** as the Map

**Ground Control** Should be **Twice as accurate** as the **AT**

OR,

**Ground Control** Should be **Four Times as accurate** as the Map
Examples on Aerial Triangulation and Ground Control Accuracy

Aerial Triangulation and Ground Control Accuracy Requirements,
Orthoimagery and/or Planimetric Data Only

<table>
<thead>
<tr>
<th>Product Accuracy (RMSE&lt;sub&gt;x&lt;/sub&gt;, RMSE&lt;sub&gt;y&lt;/sub&gt;) (cm)</th>
<th>A/T Accuracy</th>
<th>Ground Control Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RMSE&lt;sub&gt;x&lt;/sub&gt; and RMSE&lt;sub&gt;y&lt;/sub&gt; (cm)</td>
<td>RMSE&lt;sub&gt;z&lt;/sub&gt; (cm)</td>
</tr>
<tr>
<td>50.00</td>
<td>25.0 (or ½ RMSE&lt;sub&gt;x,y&lt;/sub&gt;)</td>
<td>50 (or 1 RMSE&lt;sub&gt;x,y&lt;/sub&gt;)</td>
</tr>
</tbody>
</table>

Aerial Triangulation and Ground Control Accuracy Requirements,
Orthoimagery and/or Planimetric Data and Elevation Data

<table>
<thead>
<tr>
<th>Product Accuracy (RMSE&lt;sub&gt;x&lt;/sub&gt;, RMSE&lt;sub&gt;y&lt;/sub&gt;, or RMSE&lt;sub&gt;z&lt;/sub&gt;) (cm)</th>
<th>A/T Accuracy</th>
<th>Ground Control Accuracy</th>
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<tbody>
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</tr>
</tbody>
</table>
How Will We Embrace the New Standard?

• Here is How:
  – With the **old standard**, using large/medium format metric cameras we provided **Class 1 horizontal accuracy** to be:

  \[ \text{RMSE}_x = \text{RMSE}_y = 2 \times \text{Pixel} \]
  (Orthoimagery Mosaic Seamline Mismatch = Not defined)

  – With the **new standard**, we can provide any accuracy, let it be:

  \[ \text{RMSE}_x = \text{RMSE}_y = 1 \frac{1}{2} \times \text{Pixel or better} \]
  (Orthoimagery Mosaic Seamline Mismatch = 3 \times \text{Pixel})
New Standards Highlights

– Unlimited **Vertical Accuracy** Classes:

**Vertical Accuracy Standards for Digital Elevation Data**

<table>
<thead>
<tr>
<th>Vertical Accuracy Class</th>
<th>Absolute Accuracy</th>
<th>Relative Accuracy (where applicable)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RMSE$_z$ Non-Vegetated (cm)</td>
<td>NVA at 95% Confidence Level (cm)</td>
</tr>
<tr>
<td>X-cm</td>
<td>$\leq X$</td>
<td>$\leq 1.96* X$</td>
</tr>
</tbody>
</table>

– NVA = Non-vegetated **Vertical Accuracy** based on RMSE

– VVA = Vegetated **Vertical Accuracy** based on 95th percentile because errors are not normally distributed as required for RMSE
How We Will Embrace the New Standard?

• Here is How:
  – With the old standard, using large/medium format metric cameras we provided **Class 1 Vertical Accuracy** to be:

\[ \text{RMSE}_z = 1.33 \times \text{Pixel} \text{ or (1/3 of C.I.)} \]

  – With the new standard, we can provide products accurate to:

\[ \text{RMSE}_z = 1 \times \text{Pixel} \text{ or better} \]

  (10 cm imagery to support QL2 Lidar)
The New Standard and the UAS Products

Your UAS GSD = 2 cm
Target Horizontal Accuracy $\text{RMSE}_{x,y} = 1.5 \times \text{GSD} = 3.0 \text{ cm}$
Target Horizontal Accuracy $\text{RMSE}_{z} = 1.5 \times \text{GSD} = 2.0 \text{ cm}$

This implies:
Ground Control Accurate to:
$\text{RMSE}_{x,y} = \frac{1}{4} \times 3.0 \text{ cm or } 0.75 \text{ cm or better}$
$\text{RMSE}_{z} = \frac{1}{4} \times 2.0 \text{ cm or } 0.50 \text{ cm or better}$
Can We Use 1.5 x Pixel for the UAS Products?

The problem?
- GCP accuracy of 0.50 cm to 0.75 cm is not possible with standard GPS survey techniques
- Costs of each GCP could exceed $1500.00

The Solution?
- Relax the accuracy requirements when you use UAS.
  - Target ortho absolute accuracy of 7.5 cm to 10.0 cm at best which requires a ground control accuracy of 2.5 cm, still expensive but doable.
Thank You!

Qassim.abdullah@woolpert.com
mapping_matters@asprs.org