SurvCE: Localizations
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Embarrassing Fact: I have a 250,000+ sheet paper map collection.

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What is a localization?

Localization, also called ‘Site Calibration’ is a mathematical way to make your projected points align with:

- An actual projected system realization (like State Plane)
- A local 10,000, 10,000 like Ground coordinate system
- A low-distortion projection
- A specially designed system
- A previously measured coordinate system (perhaps record)
Localization Examples

1. An earlier survey started with 5000.00, 5000.00 in one corner and worked around a parcel with some arbitrary non-geodetic/non-grid basis of bearings.

2. You are following an old survey that was performed with chain and compass.

3. You are following an old survey that was performed with a Total Station.

4. An earlier survey was performed in pseudo-NAD27 based coordinate system.

5. Your network is aligned with NAD83 2011 2010.0 but you are following a previous survey that was NAD83 CORS96 2003.0 based.

6. You would like to survey with Ground coordinates aligned to Geodetic North at the parcel’s South East corner.

7. You are working in a mine coordinate system which has been purposely distorted and rotated to obfuscate the underground works.
Horizontal localization consists of an underlying geographic projection, a scale factor, a rotation and a translation. A least-square adjustment may be used to ‘best –match’ an existing system, or a single point may be used to translate a system to match actual datum.

Vertical Localization typically consists of GEOID for GPS work to relate ellipsoidal heights to orthometric elevations and Vertical Control Points which adjusts the plane up or down to match a bench mark. While a ‘tilted-plane’ calibration can be used in SurvCE, do NOT do it.
General Rules

- If you are working on a job that has an underlying projection, ALWAYS match the underlying projection. Example: A DOT Job Specifies UT Central Zone; but you localize to 3-points using a Transverse Mercator projection center on the job center. (We will cover this in more detail later.)

- ALWAYS use an appropriate GEOID. Even if you are only interested in horizontal distances!

- Don’t blow the units: U S Survey Feet vs. International Feet. Don’t use a localization to paint over the use of incorrect footage units.
SurvCE Screens that affect the coordinate system
When making New Job
After making a New Job
Edit Projection List
Equip: Localization: GPS
Equip: Localization: Points
Reprocess the Raw File?
How do you Un-Localize a Job?
Equip: Localization: System
Localization Method:
- Multi Point Method: Plane Similarity
- One Point Azimuth: State Plane Grid

Geoid File: None
Geoid Interpolation Method: Quadratic

Use Grid to Ground:
Equip: Localization: Points
No Localization: Summary

- No Grid to Ground Scale Factor
- No Control Points
- No 7-parameter frame translation
- Don’t mess with (change the defaults of) the built-in coordinate systems
- Disable Base Translation
Getting Local Coordinates into a Job

- You could add them one at a time:
Import DXF/DWG/LandXML/SHP/DTM Files (The Best Way?)
A part of the Southeast Quarter of Section 23, Township 6 North, Range 1 East, Salt Lake Base and Meridian, U.S. Survey: Beginning at the East quarter corner of this Section 23, thence South 89°36' 25" West 1446.81 feet along the quarter section line, thence South 6°59' 51" East 565.86 feet, thence South 4°54' 27" West 66.0 feet; thence Easterly along a curve to the left with a radius of 206.57 ft., an arc distance of 110 feet, a chord bearing of N. 79° 39' 08" E and a chord length of 108.70 feet to the True point of Beginning.

Thence Easterly along a curve to the left with a radius of 206.57 feet, an arc distance of 50.3 feet, a chord bearing of N. 57° 20' 25" E and a chord length of 50.13 feet; thence Northeasterly along a curve to the left with a radius of 2683.29 feet, an arc distance of 100 feet, a chord bearing of N. 49° 23' 04" E and a chord length of 99.99 feet; thence South 46° 54' 35" East 225.64 feet to the Northerly line of Snow Basic Road; thence South 43° 05' 25" west 92.25 feet; thence Southerly along a curve to the left with a radius of 164.61 feet, an arc distance of 263.10 feet, a chord bearing of S. 02° 41' 56" E and a chord length of 235.98 feet, along said South line to the center of an existing road, thence two courses along the center of said road as follows: South 41° 30' 42" West 58.98 feet and South 11° 46' 15" West 211.33 feet; thence North 86° 17' 37" West 152.24 feet; thence North 0° 17' 53" East 606.33 feet to the place of beginning.
Demo Import into a New Job
Import Text Files

[Image of the Import Ascii window]

- File Type: User Defined
- Enter/Select Format: P,Y,X,Z,D
- P-Pt ID, Y-North, X-East, Z-Elv, D-Desc, S-Skip
- Header Lines: 0
- Add to Pt ID's: 2000
- Pt's to Import: ALL
- Pt Protect
Local Coordinates in Control Files
Directly Entering a Metes and Bounds Description

- From the Map View, type ‘T’, then a bearing code (1-NE, 2-SE, 3-SW, 4-NW ...), angle, distance, desc, PID.

DEMO...
From COGO: Manual Traverse

- **Occupy Pt ID:** 1
- **Desc:** NE Corner
- **Bearing NE:** N45°30'00"E
- **Elev. Diff:** 0.0000
- **Horz. Dist:** 461.2300

**Options:**
- **El/Off**
- **TR Mode**

**Controls:**
- **Calculate**
- **Store**
What happens if you use the Wrong Base Projection?

Your data collector’s project projection should match the project projection.
Use the correct projection

If a job of significant size (> ½ mile) is designed in Utah South NAD83, don't do a site calibration using a Transverse Mercator base projection.

And don’t trust your data collector to ‘do the right thing’ without your intervention, most don’t.
Consider a 6.2 mile vector across a project. Assume the project is designed in UTS NAD83.
Compute the midpoint from SPC coordinates
Compute the midpoint from UTM coordinates
Convert the UTM midpoint to SPC, then inverse

<table>
<thead>
<tr>
<th></th>
<th>(US Feet UTS NAD83)</th>
<th>(Meters Z 12)</th>
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<tbody>
<tr>
<td></td>
<td>SPX</td>
<td>SPY</td>
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<tr>
<td>NE Corner</td>
<td>1121972.0770</td>
<td>10056132.8700</td>
</tr>
<tr>
<td>SE Corner</td>
<td>1096411.6560</td>
<td>10030908.7480</td>
</tr>
<tr>
<td>SPC Midpoint NE SW</td>
<td>1109191.8665</td>
<td>10043520.8090</td>
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<tr>
<td>UTM Midpoint NE SW</td>
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<td></td>
</tr>
<tr>
<td><strong>Compute SPC &lt;&lt;&lt; From UTM</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>dXY</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>0.2593</strong></td>
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</tbody>
</table>
Whoops!

0.259 foot bust! There are two lines which intersect only at the endpoints and diverge as you move to the midpoint.
Making an even finer point, in this example between the NE and SE points there is a straight line in Utah South NAD83 State Plane projection and there is a straight line in UTM space between the same two points. These lines touch each other only at the end points. The distance between the midpoints of these two lines is a ¼ foot!

Many surveyors don’t realize the danger in crossing base projections and will do a two or three-point localization (with a miss-matched projection). In this example they might choose to localize at the NE, SW and a third point close to the center. The localization math will do a best case fit, distributing the projection mis-match error between the two endpoints and nearly holding the center point.

The unaware surveyor will see residuals of 0.16’ on the localization points and assume that the residuals are a result of GPS measurement instability.
Match the underlying projection!

So if the project is SPC Projected, use a matching base projection!
Don’t Blame Your GPS or TURN!

- If you use the wrong underlying projection in your site calibration/localization, then you will have significant projection errors.
- These errors will be BUILT IN to the system into your data collector.
- Don’t blame these errors on GPS measurement uncertainty.
- Don’t blame these errors on TURN.
- By matching the underlying projection, you can expect site wide errors less than 0.02’!
Survey two points, inverse distance and bearing
Repeat with Grid to Ground
Repeat with Grid to Ground and Single Point (10000,10000) and Geodetic BOB
Modify to align system to East line of section
Export to Google Earth (even with Local Coordinates!)
Describe the advanced options for scale factors
Repeat with Grid to Ground, Single Point, drop all but 5 digits
Repeat with Low Distortion Projection based at Section Center
:: Show the resulting change in scale factor over this small job
Demo #2 Time!

- Import Huntsville description, at ground
- Localize to E point
- Navigate to N point, store and reloc
- Navigate to NW point, store and reloc
- Navigate to SE point, store and reloc
- Investigate residuals
- Stake SW, Stake E

- Show how we can still export KML to GE
Demo #3: OPUS Adjustment of Base

- Setup autonomous base in section center
- Store position, and section corner
- Use OPUS result to adjust job
Storing Your Base Position

- Click on Antenna, check base antenna type, check base HI
- Then click on Store to save the base position in your job.
- You can also retrieve the Base Ground Mark from the .REF file or the .RW5 file
Elevation Localization

- Always load the GEOID that matches your desired realization.
- Never use more than 1 affine point with vertical turned ON

- If you think you can use more than one affine point, then…
  - Make sure the job is fully surrounded by points that form a well defined plane.
What happens when you don’t use a GEOID file in your GPS and you just set your base with an orthometric height?
The rover you sold me reports a height that is 0.7’ too low. Can I fix it with a tilted plane vertical calibration?

<table>
<thead>
<tr>
<th>CORRECT</th>
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<tbody>
<tr>
<td>Enter Ortho Height at Base</td>
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<tr>
<td>Data Collector reduces to ellipsoid</td>
<td>80.369</td>
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<tr>
<td></td>
<td>2904.994</td>
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<tr>
<td>Rover computes ellipsoid</td>
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<tr>
<td>Data Collector computes orthometric</td>
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<tr>
<td></td>
<td>2758.947</td>
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<td>0.706</td>
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<table>
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<td>Enter Ortho Height at Base as Ellipsoid</td>
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<tr>
<td>Rover Computes Height</td>
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<tr>
<td>Error</td>
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</table>
I will be available the rest of today and most of Wednesday and can work through any special examples with you if needed.
Thank You!

Final slides posted on:
ashgps.wordpress.com