2020 Mingo County Aerial Triangulation And Ground Control Report

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The Thrasher Group (TTG) has successfully completed the aerial triangulation (AT) for the countywide spring flight.

Using semi-automatic analytical aerial triangulation procedures, TTG determined the exterior orientation parameters for each exposure in the photography that covers the project area.

The results of the final adjustments are sufficient to enable TTG to photogrammetrically produce orthophotos from the photography. The AT solution ensures that the project data will meet or exceed the accuracy expectation as outlined in the contract.

Ground Control

The ground control network was designed to provide a geometrically strong horizontal and vertical control system within the project area.

Sufficiently identified ground control points (GCPS) were surveyed within the block to provide horizontal and vertical control.

Aerial Photography

Aerial photography for the project was captured between February 15, 2020 and February 22, 2020.

The photography was acquired with an approximate 60 percent overlap and an approximate 30 percent side lap. The flight altitude of the photography was approximately 7,700 feet above mean terrain.

Airborne GPS

Airborne-GPS (ABGPS) data was captured during the acquisition of the aerial photography. An appropriate GPS antenna was mounted on each aircraft used on the project, and the relationship between the antenna phase centers and the camera perspective centers was then determined through close-range survey techniques. Dual frequency, geodetic quality receivers were utilized for the data collection.

The GPS data was post-processed, and the appropriate interpolations, transformations and reductions were applied to derive the camera's spatial position referenced to the World Geodetic System of 1984 (WGS84) at each instant of exposure.

Flight

The flight plan was comprised of 52 flight lines. The designed ground sample distance per pixel was 10 centimeters.

The block consisted of a total of 2,779 images.

A fully equipped aircraft was employed for the photographic mission. In the aircraft, the instrumentation utilized in the acquisition of aerial photography and ABGPS data comprised of a Zeiss DMC II aerial camera featuring forward motion compensation, and a GPS Novatel Span Receiver with a collection rate of one half-second.

During each flight, every exposure triggered by each camera was recorded in the associated GPS data file as an external event. A time stamp for each event later allowed the interpolation of the camera position at each instant or exposure.

Aerial Triangulation

Aerial triangulation is the simultaneous space resection of image rays projected and recorded at one source, the perspective center of the aerial camera. These image rays projected from two or more overlapping images (stereo-models) intersect at the corresponding ground location to determine the three-dimensional coordinates of each point measured. This collection of image rays is fit to known ground survey control in a simultaneous three-dimensional least squares adjustment. After the completion of this adjustment, coordinates of the 'unknown' ground points are derived by the intersection of the adjusted image points.

The aerial triangulation was performed utilizing the ground control and the airborne GPS-assisted techniques. These data are then introduced along with the reduced image coordinates, as observations, into a combined three-dimensional simultaneous least squares adjustment by bundles. This approach allows a substantial reduction in the amount of ground control required for the AT solutions.

The purpose of aerial triangulation is to densify horizontal and vertical control from relatively few ground control points (GCPs). Since obtaining GCPs is a relatively significant expense in any mapping project, AT procedures are used to reduce the amount of field survey required by extending control to all stereo-models.

Internal software checks were performed to detect gross errors in the photo measurements.

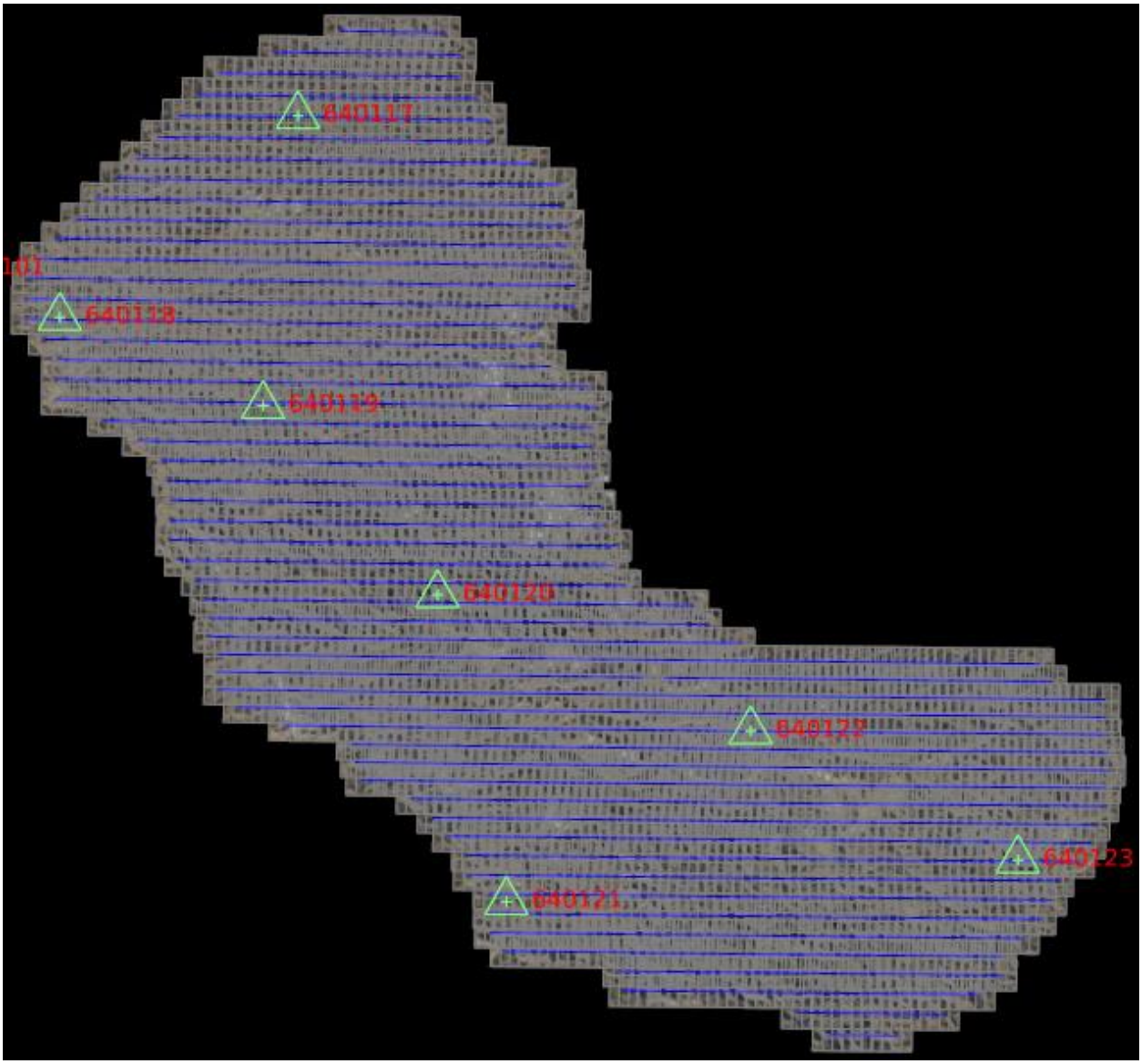
Bundle Adjustment

The surveyed control, along with the reduced image coordinates, served as input into the 'combined' block adjustment. Three–dimensional, simultaneous least squares adjustments by bundles, were undertaken using Match-AT bundle adjustment software. This bundle block adjustment software has proven to be a very rigorous and stable platform.

Seven control points were used to constrain the AT solution. The sigma naught is a significant indicator of the quality of the adjustment. The sigma value derived by the block adjustment is the root mean square of all photo measurement residuals for the entire block. The lower the sigma naught, the less tension within the AT solution. The sigma naught for this adjustment was 1.3 microns. The residuals of the control points from measured position to surveyed position are as follows:

Residual point x y z (ft.)

640117	0.004	-0.134	-0.122
640118	-0.200	0.247	0.098
640119	-0.139	0.326	-0.161
640120	0.120	-0.157	-0.135
640121	-0.068	0.231	-0.005
640122	0.067	-0.210	0.089
640123	0.210	-0.279	0.232



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GNSS CONTROL POINT LOCATION SHEET

Horizontal Datum: NAD 83	Vertical Datum: NAVD88
Projection: SPC WV South	Geoid: G12BUS
Precisions (ft): Hz Prec 0.025 Vt Prec 0.128	Method: GPS Static
Date: 03-04-2020	
Location: Breeden, Mingo Co, WV	

Point 640117 - ACP 117

Detailed Description:

040-10259 BM5730 SPRING FLIGHT

Northing (ft):	342505.040
Easting (ft):	1602223.705
Elevation (ft):	806.718

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GNSS CONTROL POINT LOCATION SHEET

Horizontal Datum: NAD 83	Vertical Datum: NAVD88
Projection: SPC WV South	Geoid: G12BUS
Precisions (ft): Hz Prec 0.020 Vt Prec 0.032	Method: GPS VRS
Date: 03-04-2020	
Location: Kermit, Mingo Co, WV	

Point 640118 - ACP 118

Detailed Description:
040-10259 BM5730 SPRING FLIGHT

Northing (ft): 308320.177	
Easting (ft): 1561823.644	
Elevation (ft): 627.834	

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GNSS CONTROL POINT LOCATION SHEET

Horizontal Datum: NAD 83	Vertical Datum: NAVD88
Projection: SPC WV South	Geoid: G12BUS
Precisions (ft): Hz Prec 0.015 Vt Prec 0.037	Method: GPS VRS
Date: 03-04-2020	
Location: Lenore, Mingo Co, WV	

Point 640119 - ACP 119

Northing (ft): 293352.151	
Easting (ft): 1596308.747	
Elevation (ft): 641.654	

Detailed Description:

040-10259 BM5730 SPRING FLIGHT

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GNSS CONTROL POINT LOCATION SHEET

Horizontal Datum: NAD 83	Vertical Datum: NAVD88
Projection: SPC WV South	Geoid: G12BUS
Precisions (ft): Hz Prec 0.014 Vt Prec 0.035	Method: GPS VRS
Date: 03-04-2020	
Location: Delbatron, Mingo Co, WV	

Point 640120 - ACP 120

Detailed Description:
040-10259 BM5730 SPRING FLIGHT

Northing (ft): 261308.976	
Easting (ft): 1625880.635	
Elevation (ft): 746.286	

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GNSS CONTROL POINT LOCATION SHEET

Horizontal Datum: NAD 83	Vertical Datum: NAVD88
Projection: SPC WV South	Geoid: G12BUS
Precisions (ft): Hz Prec 0.023 Vt Prec 0.046	Method: GPS VRS
Date: 03-04-2020	
Location: Freeburn, Mingo Co, WV	

Point 640121 - ACP 121

Detailed Description:

040-10259 BM5730 SPRING FLIGHT

Northing (ft): 209278.488	
Easting (ft): 1637585.549	
Elevation (ft): 729.359	

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GNSS CONTROL POINT LOCATION SHEET

Horizontal Datum: NAD 83	Vertical Datum: NAVD88
Projection: SPC WV South	Geoid: G12BUS
Precisions (ft): Hz Prec 0.020 Vt Prec 0.030	Method: GPS VRS
Date: 03-04-2020	
Location: Mountain View, Mingo Co, WV	

Point 640122 - ACP 122

Detailed Description:
040-10259 BM5730 SPRING FLIGHT

Northing (ft): 238213.116	
Easting (ft): 1678990.786	
Elevation (ft): 1756.674	

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GNSS CONTROL POINT LOCATION SHEET

Horizontal Datum: NAD 83	Vertical Datum: NAVD88
Projection: SPC WV South	Geoid: G12BUS
Precisions (ft): Hz Prec 0.022 Vt Prec 0.042	Method: GPS VRS
Date: 03-04-2020	
Location: Justice, Mingo Co, WV	

Point 640123 - ACP 123

Detailed Description:
040-10259 BM5730 SPRING FLIGHT

Northing (ft): 216328.704	
Easting (ft): 1724353.524	
Elevation (ft): 880.044