Aerotriangulation (AT) Report

TX_LowerRioGrande_D22 - 140G0222F0295 MOD P00001

Contract: 140G0221D0010

10 cm GSD AOI

Document No. 1 | July 20, 2023

U. S. GEOLOGICAL SURVEY

Contents

Abbreviations

AT	Aerotriangulation
GSD	Ground Sample Distance
AMT	Above Mean Terrain
GNSS	Global Navigation Satellite System
IMU	Inertial Measurement Unit

1. General Project Information

Project AT Name	Lower Rio Grande 10cm		
Project Tracks	141		
GSD	10 cm | 1px equals 10 cm		
Collection AMT(s)	3400 ft		
Sensor Type	Phase 1		
Sensor Serial #s	043		
# of Collections	8		
Collection Date(s)	1/22/2023, 2/27/2023		
Ground Control Surveyor	Terrasurv		
AT Projection	UTM 14N		
AT Horizontal Datum	NAD83 2011	AT Horizontal Units	Meters
AT Vertical Datum	NAVD88 Geoid 18	AT Vertical Units	Meters

2. Ground Control

2.1 Ground Control Coordinates

Point Id	Easting (m)	Northing (m)	Ortho. Height (m)
GCP3012	562143.1	2896476	35.992
GCP3013	524172.8	2912814	46.622
GCP3014	617123.2	2883164	21.456
GCP3015	544051	2903872	40.842
GCP3016	497526	2923960	90.748
GCP3031	662613.6	2861389	7.002
GCP3032	657131.3	2861003	9.012
GCP3033	661104.2	2869105	4.784
GCP3034	681801.5	2875628	2.049
GCP3035	663055.5	2885411	3.702
GCP3036	675932.9	2882007	1.916
GCP3037	667468.1	2875286	1.83
GCP3038	677705.6	2884744	2.732
GCP3039	675601.9	2872853	8.193
GCP3040	658872.9	2864958	6.975
GCP3041	591149.8	2886989	24.136
GCP3042	648228.9	2864837	10.026
GCP3043	639723.8	2879076	12.4
GCP3044	641043.5	2873511	13.008
GCP3045	669692	2887912	3.128
GCP3046	647092.2	2874932	9.555
GCP3047	639156.6	2888616	9.701
GCP3048	621456.7	2891197	16.751
GCP3049	605522.2	2890623	22.157
GCP3050	583400.8	2885216	28.366
GCP3051	573337.6	2887024	32.079
GCP3052	592453.6	2883659	26.149
GCP3053	626321.8	2880809	16.73
GCP3054	601377.1	2885516	23.478
GCP3055	605071.2	2883307	22.147
GCP3056	487776.3	2937548	83.58
GCP3057	521502.7	2920798	80.234
GCP3058	492417.7	2930858	74.603
GCP3059	491670.6	2920836	61.293
GCP3060	499196.3	2920353	63.273
GCP3061	510597.1	2916135	53.777
GCP3062	524786.4	2920855	87.664
GCP3063	525242.6	2924236	95.458

Point Id	Easting (m)	Northing (m)	Ortho. Height (m)
GCP3064	545767.3	2910898	77.56
GCP3065	562782.6	2900314	40.377
GCP3066	528829.4	2914367	73.631
GCP3067	569107.3	2891006	33.214
GCP3068	534173	2905072	44.168
GCP3069	551701.6	2901594	38.191
GCP3070	530644.9	2910510	45.642
GCP3071	516878.7	2917978	56.769
GCP3072	506607.3	2921855	74.785
GCP3073	484469	2935218	69.387
GCP3074	488804.6	2932866	67.344
GCP3075	551980.9	2907229	50.865
GCP3076	577860.5	2886683	29.025
GCP3077	634055.4	2880963	15.116
GCP807	578592.9	2891527	31.46
GCP811	633776.1	2887213	14.757
GCP817	494575.5	2929225	88.341
GCP818	512916	2920396	68.323
GCP821	537147.2	2909276	55.221
GCP822	560829.9	2902026	45.653
GCP823	612318.1	2887220	19.481
GCP824	650657.5	2869431	8.95

3. AT Software and Procedures

Software Name	Catalyst Ortho Engine	Version and Build	2222.0.7 2022-07-27

3.1 AT Description

- The main purpose of AT is the reconstruction or adjustment of exterior orientation parameters (EOPs), which consist of sensor positions and attitudes; XYZ and Omega, Phi, Kappa. When using a frame sensor, each individual frame features its own exterior orientation, which is observed with the GNSS/IMU SBET. Although this so-called a-priori solution can be used for direct geo-referencing of the imagery, the EOP can be improved by including ground control and tie-points, that fix adjacent frames into the AT bundle adjustment. The AT can also help determine IMU misalignments and datum shifts. Such an AT solution is essential for high-resolution applications that assume high ground point accuracy. The software provides newly designed analysis tools and automatically interacts with Automatic Point Matching (APM) and targets image point measurements where necessary to improve the AT accuracy.
- Block data - block, image, and/or take footprints; trajectory - as well as AT-related information, such as, ground control points, check-points, and tie-point locations can be viewed and assessed after loading.
- An AT adjustment is based on a set of control parameters. An initialization bundle adjustment is performed incorporating the EOPs, ground control points, tie-points and optional check-points. Further bundle adjustments may be iteratively launched if initial results require tuning. This may involve manual point measurement adjustments or the addition of tie-points to improve the results within a AT loop. The final results are presented in terms of:
  - Adjustment statistics (overall quality measures),
  - Information on individual ground points (residuals, reliability, blunders), and
  - Adjusted EOPs / trajectory (SBET) quality.

4. AT Results

4.1 Block Adjustment Results

Control RMS-X:	0.055	Meters
Control RMS-Y:	0.066	Meters
Control RMS-Z:	0.137	Meters
TiePoint RMS-X:	0.018	Meters
TiePoint RMS-Y:	0.018	Meters
TiePoint RMS-Z:	0.008	Meters
Control Max-X:	0.147	Meters
Control Max-Y:	-0.157	Meters
Control Max-Z:	-0.408	Meters

4.2 Ground Control Residuals

Point ID	Res X	Res Y	Res Z
GCP3013	-0.077	-0.009	0.05
GCP3014	-0.065	-0.062	-0.034
GCP3015	-0.068	0	-0.048
GCP3016	0.147	-0.003	-0.269
GCP3031	0.074	0.006	-0.154
GCP3033	0.012	0.065	0.135
GCP3035	0.023	0.101	-0.086
GCP3036	-0.09	-0.077	-0.013
GCP3037	0.023	0.06	-0.122
GCP3038	-0.005	-0.015	-0.07
GCP3040	-0.058	-0.049	-0.098
GCP3041	0.061	-0.005	-0.038
GCP3042	0.018	0.011	-0.058
GCP3043	-0.055	0.027	0.08
GCP3044	-0.006	0.002	-0.212
GCP3048	0.054	-0.038	0.193
GCP3050	0.001	-0.006	-0.1
GCP3051	-0.026	-0.021	0.107
GCP3052	-0.011	-0.026	0.058
GCP3053	-0.02	0.108	0.179
GCP3054	0.027	-0.012	-0.155
GCP3055	-0.006	-0.033	0.001
GCP3057	0.087	-0.025	-0.213

Point ID	Res X	Res Y	Res Z
GCP3058	0.043	0.064	-0.026
GCP3061	-0.094	0.002	-0.106
GCP3062	-0.078	-0.106	0.152
GCP3063	-0.021	-0.157	0.078
GCP3064	0.096	0.083	0.143
GCP3065	-0.015	-0.105	0.331
GCP3066	-0.04	0.097	0.177
GCP3069	-0.007	0.015	-0.05
GCP3070	-0.027	0.013	0.08
GCP3072	0.074	0.134	0.02
GCP3073	-0.113	-0.049	-0.198
GCP3074	0.007	0.124	0.053
GCP3075	0.036	0.003	0.321
GCP3077	-0.066	0.032	0.111
GCP811	0.092	-0.03	-0.031
GCP818	-0.021	-0.029	-0.408
GCP821	0.011	-0.064	0.053
GCP822	0.041	0.004	0.2
GCP823	0.045	-0.03	-0.033

5. AT Approval

Project AT Name	Lower Rio Grande 10cm
GSD	10cm
Accuracy Standard	ASPRS

6. Contact Information

6.1 Project Manager

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