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Independent Models with the A-7 and A-8

A new procedure of semi-analytical aerotriangulation resulted in time savings.

Introduction

During the past 10 years, semi-analytical aerotriangulation has been used extensively in various photogrammetric organizations. The main advantage of this method is the feasibility of using precision plotters instead of universal instruments. In addition, the precision obtained by this method is comparable to conventional and analytical methods. However, numerous publications have showed that this procedure still has some imperfections. For example,

- Determination of the perspective centers in each individual strip is inconvenient,
- After connection of the digitizer with the plotter, the quick-release mechanism for Wild Autographs A-7 and A-8 cannot be used during the process of the relative orientation, thus more time is required in comparison with the conventional method.

In order to overcome these objections and to conform to the uniform practices in the Washington State Highway Department, a scheme for the adoption of a practical procedure for Wild A-7 and A-8 independent-model aerotriangulation was developed as shown herein.

Abstract: *A practical procedure has been adopted using Wild Autographs A-7, A-8 for semi-analytical aerotriangulation within the Washington State Highway Department. The results obtained in the five test strips and in practical projects showed that total production time of this method of semi-analytical aerotriangulation has been reduced by as much as 40 percent in comparison to conventional procedures.*

Suggested Procedures

The suggested operational method for semi-analytical aerotriangulation is that the determination of the perspective centers can be separated from the common production procedures, and the quick-release mechanism in Wild Autographs A-7 and A-8 can be also used during the relative orientation. The detailed description of this operation is as follows:

- ★ Set the base value in plotter.
- ★ Connect the digitizer to the plotter.
- ★ Drive the X, Y wheels to *exact* X, Y drum values near left projector center, index X, Y to 250.000, 500.000 in digitizer.
- ★ Set the Z to the lowest reference line of the Z, index zero in the Z digitizer.
- ★ Check the digitizer coordinate systems, the X must increase to the right, Y must increase towards the top of the photo, Z must be positive upward.
- ★ For resetting, or after relative orientation with the quick-release mechanism, drive X, Y wheels to X, Y exact drum values near left projector center as recorded in the previous step and re-index X, Y as 250.000, 500.000 in the digitizer. According to the numerical tests, the standard deviation of resetting the previous exact X, Y, Z drum values were found to be 2 μm in the digitizers of Wild A-7 and A-8 plotters.

The perspective centers in various base settings may be predetermined by employing this operational procedures with space resection or level method. (Wood[10], Weissman[4], Hou[7].) A numerical example for predetermination of the Wild A-8 with a Wang digitizer is shown in Table 1.

TABLE 1. PREDETERMINATION OF THE PERSPECTIVE CENTER FOR WILD A-8 AUTOGRAPH WITH WANG DIGITIZER IN MM.

Base	*Exact Drum values**		*Perspective Center coordinates*			
	X	*Y*	X_c	Y_c	Z_c	*Remark*
120.00	170.00	200.00	223.210	499.870	340.042	left
			396.945	499.923	340.010	right
130.00	170.00	200.00	227.149	499.928	340.042	
			309.301	499.954	340.012	
140.00	165.00	200.00	223.262	499.915	340.042	
			416.883	499.966	340.010	
150.00	160.00	200.00	255.071	499.969	340.042	
			405.095	499.892	340.010	
160.00	160.00	200.00	250.100	499.972	340.042	
			410.065	499.898	340.010	
170.00	160.00	200.00	245.081	499.957	340.042	
			415.081	499.886	340.010	
180.00	155.00	200.00	250.135	499.977	340.042	
			430.040	499.885	340.010	
190.00	155.00	200.00	245.116	499.978	340.042	
			435.031	499.887	340.010	
200.00	150.00	200.00	250.121	499.971	340.042	
			450.012	499.884	340.010	

* With drum readings set at the exact position, index the digitizer $X=200.000$; $Y=500.000$; $Z=0.000$.

NUMERICAL TEST

Five test strips using the Wild A-7 and A-8 were triangulated by both the present conventional method and the adopted procedures of semi-analytical method, and the results were evaluated in terms of accuracies and time required for performance of these operations. The results of the test strips are shown in Table 2 and Figure 1.

As can be seen from Table 2 and Figure 1, the accuracies from the adopted procedures of semi-analytical aerotriangulation of the tested strips, as compared with the results of the analogical method, showed a negligible difference. However, the time for the performance of the operations of the adopted procedure of the semi-analytical operations was much faster than the analogical solution, which is employed in the Washington State Highway Department.

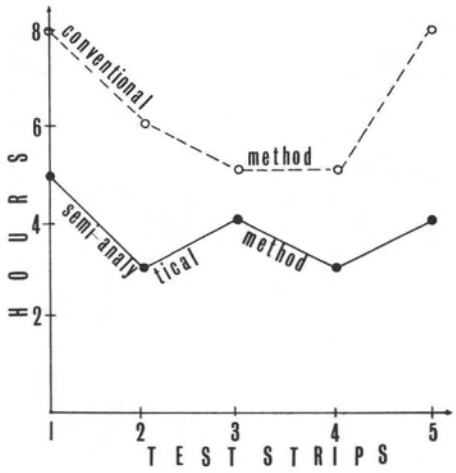

FIG. 1. Time comparison of the five test strips.

CONCLUSION

The total time for aerotriangulation operations with the adopted procedures have been reduced by as much as 40 percent in comparison to the conventional method, thus reducing total cost of photogrammetric services for any production project. The recent production job on Lower Salmon Creek, consisting of 84 models, used the adopted new procedures of semi-analytical aerotriangulation with Wild A-7 and A-8 plotters and gave very good results. A maximum production of 17 models in 8 hours is shown in the record.

ACKNOWLEDGMENT

The author expresses his thanks to all colleagues of the Photogrammetric Branch, Washington State Highways Department, for their assistance.

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TABLE 2. COMPARISON OF THE RESULTS FOR SEMI-ANALYTICAL METHOD AND ANALOGICAL METHOD.

Test strip No.	*1*		*2*		*3*		*4*		*5*	
Flight height in ft.	*1500*		*1500*		*1500*		*1500*		*1500*	
Models	*7*		*5*		*5*		*6*		*7*	
Method	*O**	*S*	*O*	*S*	*O*	*S*	*O*	*S*	*O*	*S*
Standard error in X ft										
(adjusted points)	0.14	0.09	0.09	0.01	0.06	0.05	0.14	0.39	0.06	0.07
(check points)					0.16	0.12			0.11	0.12
Standard error in Y ft										
(adjusted points)	0.09	0.05	0.11	0	0.05	0.04	0.09	0.18	0.12	0.10
(check point)					0.09	0.10			0.16	0.10
Standard error in Z ft										
(adjusted points)	0.11	0.08	0.11	0.11	0.06	0.06	0.12	0.13	0.07	0.13
(check points)					0.22	0.20			0.21	0.21
Operators	A	A	A	B	C	C	C	B	A	A
Time of Measurement (hours)	8	5	6	3	5	4	5	3	8	4
Plotters	A7	A7	A7	A8	A7	A7	A7	A8	A7	A7

* *O*=Analogical; *S*=Semi-analytical.

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