RESULTS ON ON-LINE ANALYTICAL AERIAL TRIANGULATION
USING A DICOMETER COMPLED TO A PC MICROCOMPUTER

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Abstract

The main on-line analytical aerial triangulation stages, using a Dicometer - P.C. microcomputer system is briefly presented. Practical results of an aerial triangulation block containing four strips and eight photographs each, having pre-marked control points and being measured by two human operators independently have been also given.

Key Words: Aerotriangulation, Image Processing, Map Revision, Photogrammetry, Real-Time.

On-line analytical aerial triangulation has been designed and implemented considering a main component: Dicometer and a PC computer. The system concept is that the basic element, i.e. Dicometer, is compled to a PC computer directly from either HARD or SOFT point of view, thus eliminating H-Coordimeter from the standard configuration. In this variant, the measuring equipment - Dicometer - is now a peripheric computer standard, with a serial input through COM_1 and COM_2.

Aerial triangulation data measuring and acquisition can be carried out in two variants:

- in variant 1, photograph pairs are measured in their succession on the strip; thus, besides data validation, model coordinate computations and adjacent model connection checkings are also made. This is the stage for strip adjustment using independent models. Measuring data are also preserved in this variant.
- in variant 2, photograph pairs within a strip could be measured in any arbitrary order, making only the measurement validations, relative photograph orientation including. During this variant, block adjustment on strip independent models begins along with model sortings on the strip. Computations are carrying on as in variant I.

In both variants, measurements could be interrupted or taken again, after a photograph pair has been measured. Block adjustment on independent models contained in more strips is computed based on independent models computed on strips using one of the two variants. Working Dicometer + PC station general view is shown in Figure 1 diagram, where the broken line shows the proper on-line operation.

After establishing strips with independent models, block adjustment on strip or block of strips is carried out based on control points.

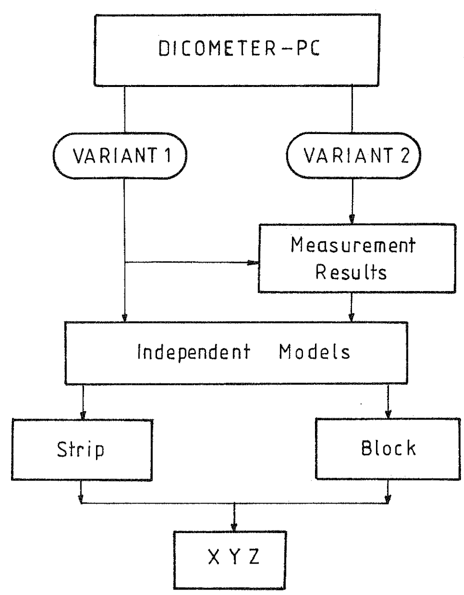

Fig. 1
On-line working Dicometer-PC station

To test the new on-line aerial triangulation technology a 1:6,000 scale photogrammetric flight containing four strips and eight photographs each, having pre-marked control points over a photogrammetric test field has been used. Some of the pre-marked control points were used for adjustment, the others in checkings.Non-premarked control points having a standard location within a model have been also chosen.

The main goal of these tests was to check the solution in discovering measurement gross errors and human operator's influence on measurement accuracy.

To this aim in view, the block of photographs have been measured by two human operators independently. Measurement gross error discovery is based on the robust/stout adjustment method, on changing the measured size weights, i.e. model point coordinates, considering our example.

Weight change follows solution (Li, 1987):

$$p^{(\nu+1)} = \begin{cases} 1 & \text{if } W_i^{1/2} \leq K \\ (\sigma_0^2 \cdot r_i)/v_i^2 & \text{if } W_i^{1/2} > K \end{cases}$$

where :

$W_i = V_i^2 / (\sigma_0^2 \cdot r_i)$

ν = number of iterations

σ_0 = [Vpv] / (n-u)

r_i = a part of redundancy associated with V_i correction

W_i = normalized corrections

K = acceptience limit of a measurement having value 1 if $\nu \leq 3$ and 3,29 if $\nu > 3$.

Precisions of the test findings are presented in Tables I and II, such as :

- The following mean square error of the two human operators are given in Table 1:

  σ = mean square of the mean errors considering the 7 model relative orientation in each strip, their mean on the block respectively.

  σ_0 = mean square error of the unit weight on each strip, block respectively.

  σ_e = mean square errors computed in the points tying the models,among models and strips, respectively.

  σ_r = mean square errors in the control points.

- Correction distributions on various K-intervals both for each processed strip and a block, considering the two human operators are presented in Table II.

Result Accuracies

Table I (1,2)

	Human operator 1			
	σ	σ_0	σ_e	σ_r
B_1	10,5	12,7	12,7	11,0
B_2	8,8	11,3	10,5	11,5
B_3	9,9	14,3	12,5	15,0
B_4	10,5	15,3	13,4	15,2
Block	9,95	20,3	23,1	16,2

	Human operator 2			
	σ	σ_0	σ_e	σ_r
B_1	13,0	15,2	16,2	12,2
B_2	13,5	19,3	20,8	14,7
B_3	14,3	15,5	17,2	9,7
B_4	15,5	22,8	25,3	14,5
Block	14,1	25,5	31,2	17,0

W_i-Correction,Grouping on Intervals

Table II (1,2)

	Human operator 1			
	$K \leq 1$	$1 < K \leq 2$	$2 < K \leq 3,29$	$K > 3,29$
B_1	95	43	10	0
B_2	143	34	11	1
B_3	122	31	10	5
B_4	115	30	13	7
TOTAL	475	138	43	14
Block	187	96	45	23

	Human operator 2			
	$K \leq 1$	$1 < K \leq 2$	$2 < K \leq 3,29$	$K > 3,29$
B_1	88	43	12	5
B_2	104	58	16	11
B_3	120	34	10	4
B_4	98	40	15	12
TOTAL	410	175	53	32
Block	178	96	38	39

Analysing data from the two tables, we can draw the following conclusions :

- Human operator 1 has got a better accuracy for all four strips. Human operator 2 and 1 ratio is 1.42.
- Analysing correction distributions on the four strips, human operator's 1 correction distributions both on strips and a block are better, too.
- Number of gross errors, non-accepted is 14 as against 32 considering human operator 1 and 2 respectively, thus, proving his better quality once again.
- Human operator's 1 gross errors are ranging between 31.6 - 41.6 for strips and 31.6 - 95.0 for a block as against operator's 2 ones ranging between 32.0 - 101.0 for strips and 51.6 - 141.6 for a block, thus, establishing the true interval they belong to, considering a 1:6,000 scale.
- As regards human operator 2, his tie points among strips has not been measured properly.
- The last, but not the least considering both human operators: measurements rejected represented coordinates of the points among strips; these errors could belong either to the human operators or to the other operators having prepared aerial triangulation points in TRANSMARK.

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