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PHOTOGRAMMETRY SOFTWARE. A PACKAGE FOR EVERYONE.(U)
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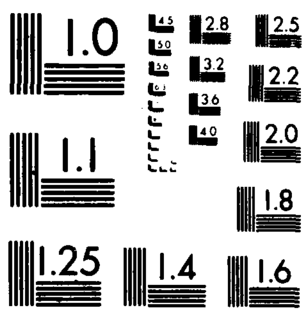

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963 A

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

An example photogrammetry software system is presented for consideration. The system is being implemented throughout Latin America by IAGS. It includes both analytical and semi-analytical adjustments. It is a simplistic yet versatile system which has proven very successful.

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PHOTOGRAMMETRY SOFTWARE
A PACKAGE FOR EVERYONE

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James Hawk is a photogrammetrist with the Defense Mapping Agency Inter American Geodetic Survey (DMA IAGS). His responsibilities include providing computer software support to the Cartographic School in the Republic of Panama and to associate Latin American mapping agencies. Mr. Hawk also has over ten years working experience with the Defense Mapping Agency Aerospace Center in St. Louis, Missouri. He received his B.S. degree in mathematics and geography from Indiana State University and his M.S. degree in photogrammetry from Purdue University. Mr. Hawk is a member and past regional officer of A.S.P.

ABSTRACT

The development of a photogrammetry software package requirés considerable study. Computer design and capacity, available photogrammetric instruments, analytical methods versus semi-analytical methods, simplicity versus comprehensiveness, user competence, and the desired final products are but a few of the elements to be weighed. An example system is presented for consideration in this paper. This system is being implemented throughout Latin America by the Inter American Geodetic Survey. The package consists of both an analytical and a semi-analytical adjustment program and the accompanying programs which tie the systems together and allow the user to go from relative orientation or comparator measurements to plotter element settings via computer. Included in the discussion is control selection and distribution, pass point selection, program execution, and analysis of results. The sample software package was assembled because it is simple and yet versatile enough to be adapted to a variety of computers and photogrammetric equipment. It is presented as a successful example of a system design, and it is hoped that this discussion and example will generate new ideas in system development.

INTRODUCTION

Photogrammetry may be defined simply as a method of extracting information about an object by studying its image. Photographs are the most familiar types of images, but devices sensitive to other parts of the electromagnetic spectrum may also be used. Regardless of the type of sensor, the image must be analyzed before the correct information is obtained. The desired results could be interpretive and require the art of photo-interpretation to identify and evaluate the image. However, the desired results could be quantitative and require measurements and mathematics to arrive at the desired goal.

The advent of the computer and its adoption to photogrammetric problems has greatly enhanced this science. Even in photo-interpretation the computer is used to recognize patterns in even the nonvisible region of the spectrum. Quantitative methods have benefited immensely from computer utilization. It is now possible to solve thousands of simultaneous equations in only a short time.

The computer software discussed in this paper was designed to help obtain quantitative results from aerial photography. The results are used to obtain dimensions and precise positions. The desire for increased accuracy has led to the development of precise equipment, systematic procedures, and rigorous computer adjustments. The most common application of the resultant information is in the preparation of topographic maps and charts of the earth's surface. Almost all of the national mapping programs in the Western Hemisphere are performed by photogrammetry.

The goal of the software system developed by IAGS is to encompass the needs of all the associate agencies. It is not burdened with copyright laws and therefore allows everyone free access. It maintains simplicity and yet allows us to obtain meaningful results from a wide variety of equipment. Technical advancement in computer hardware, photogrammetric instruments, and mathematical formulation will not allow any software system to rest. Our programs are under constant change, and we are always looking for something better. The package, however, has been installed and is being successfully used in the United States and in several Latin American countries.

SYSTEM DESIGN

The design of any photogrammetric software package must begin with the adjustment program. It is the largest and most complex part of the system, and the other programs are built around it. The wide variety of instrumentation, technology, and requirements found in the hemisphere preclude the use of a single program to accomplish this task. Thus both semi-analytical and fully analytical approaches were taken. Both applications produce accuracy and efficiency sufficient to fulfill our mapping requirements.

The purpose of the adjustment program is to enhance the ground control network that currently exists through field surveying, doppler positioning, or other techniques. Each model used in a stereoplotter requires at least two horizontal control points for scaling and three vertical control points for leveling. It would not be economical to establish all this control by ground methods. Adjustment programs must also provide a method of detecting blunders in the observations, evenly distribute small systematic errors, and determine estimates of precision for the results.

After the adjustment programs were selected, a series of auxiliary programs were acquired and written to blend the two main programs into a versatile smooth-flowing system.

These programs allow us to check observations for blunders, check data dimensions so as not to exceed the adjustment parameters, produce independent model coordinators from two dimensional comparator measurements, mathematically compute projection centers, determine stereoplotter orientation settings after the adjustment, and provide other useful information as will be discussed later in this paper.

A depiction of the overall system flow is shown in Figure 1. Raw data may enter the system from three different sources, be channeled in various directions and adjusted as desired.

THE SIMBA ADJUSTMENT SYSTEM

The Simultaneous Block Adjustment of Models (SIMBA) program was written by Randle W. Olsen of the U.S. Geological Survey in 1973. It has been adapted for use by the U.S. Forest Service and DMA IAGS. It is written in FORTRAN IV and is used to simultaneously adjust independent model units to each other and to ground control. The three-dimensional data may be generated on a stereoplotter or on a comparator providing the CRAST (Coordinate Refinement-Analytical Strip Triangulation) or a similar program is used to derive the projection centers and the third dimension. The models are adjusted by an interactive series of planimetry-height solutions. Four-parameter linear transformations are used in the horizontal solution and three-parameter linear transfromations are used in the vertical solution. This separation economizes computer time and storage without a significant compromise in accuracy as compared to more traditional seven-paramater adjustments.

Program features include:

1. Input arranged in model units with a separate control deck.

2. Internal sorting of control and tie points.

3. In-core solution of banded normal equations to minimize computer time.

4. Separate weighting for ground control and model ties.

5. Printed output arranged in model units with corresponding residuals.

6. A listing of test point coordinates and residuals which were withheld from the solution.

7. A root mean square (RMS) error summary of held control, tie points, and unheld control.

8. Absolute orientation values to include common tilt, common tip, the airbase, and exposure station elevation difference for each model.

IAGS PHOTOGRAMMETRY PROGRAM FLOWCHART

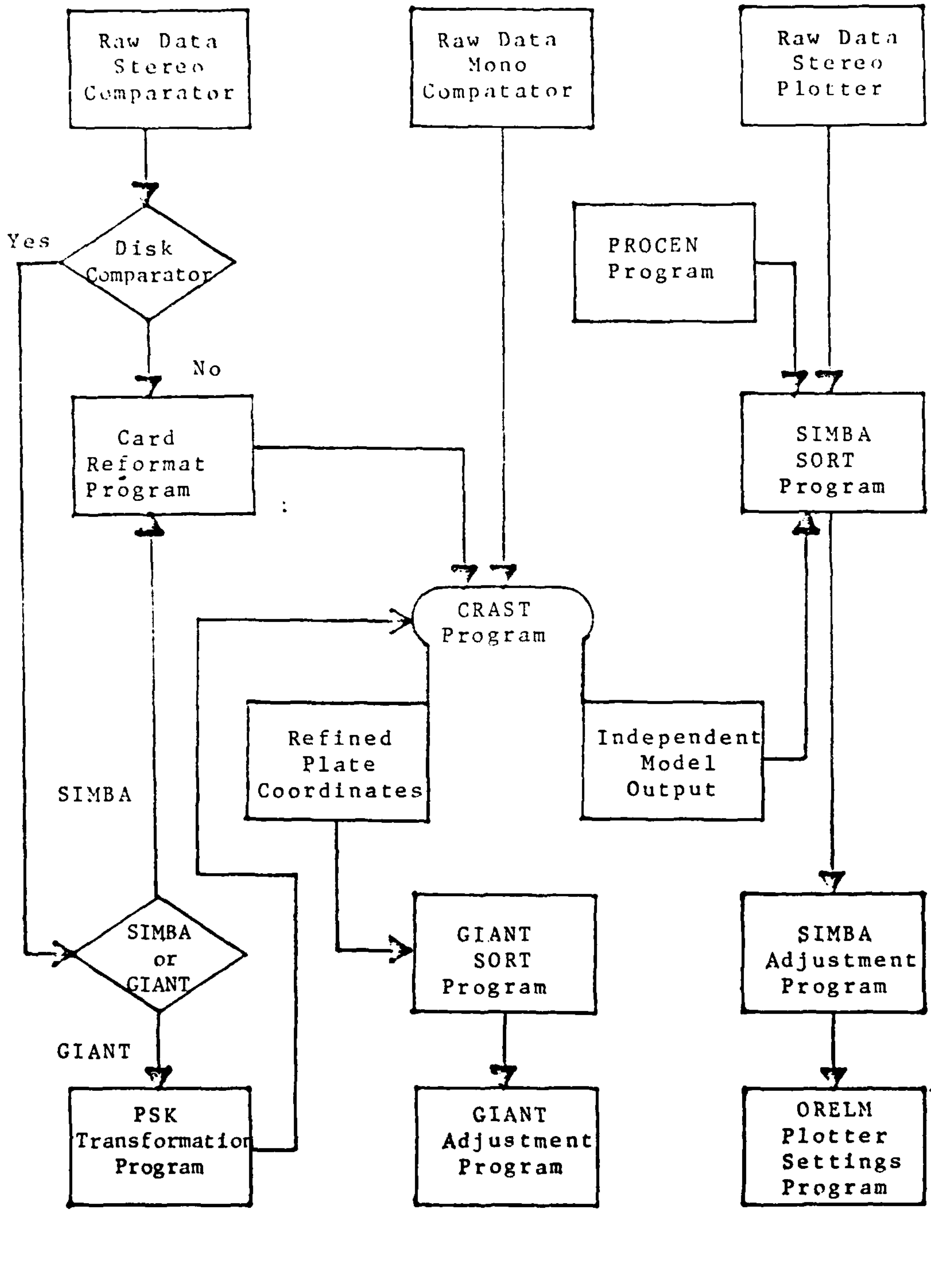


FIGURE 1

Special attention should be given to the weighting system as it affords us the opportunity to separate errors resulting from poor control from errors due to relative orientation or bad model tie points. The equation for the expression of the weight ratio is:

$$W = \frac{2 \quad Sm^2}{Sm^2 + Sc^2}$$

Where Sm = estimated unit coordinate standard deviation of the model points

Sc = estimated standard deviation of each control point

One can easily see that the value of "W" will range from zero to two. A value of one will allow equal weight to be placed on the control value and the model ties. A value close to two will constrain the control and allow the models freedom to move. Likewise a value close to zero will constrain the models and allow the control to shift.

A minimum of two horizontal control points are required for the planimetric adjustment, and three vertical control points are required for the height adjustment. If no additional control is used, there will be an absolute solution and no errors will be propagated by a least squares adjustment. Thus if only minimum control is used and constrained while the model ties are given freedom to move, the propagated error will result from poor model fit, and the tie point residuals will be exaggerated. Actual errors present in the constrained control are unimportant because they are only being used to scale and level the block solution, and we are only checking tie point residuals.

Once a good model tie solution is achieved, the full control network is used, but the weight is changed to constrain the models and give freedom of movement to the control. The control residuals thus become exaggerated, and control values incompatible with the relative model solution can quickly be noted. After all blunders have been eliminated, equal weighting is generally used in the final solution unless extenuating circumstances dictate otherwise.

The computer memory necessary to execute this adjustment is largely dependent upon the size of the normal equation coefficient matrix. If the independent models are properly aligned in the program, this matrix becomes banded along the diagonal leaving only zeros outside the band. To conserve storage, only the elements within the band above the main diagonal are stored. They are arranged in a rectangular array called "Q" in the program and are dimensioned 4 x (the bandwidth) by 4 x (the number of models). Correct sequencing of the models is therefore critical to stay within the allotted bandwidth. In a rectangular block, the bandwidth can roughly equal the number of models in the longest strip plus two. The normal equations are solved by the Gaussian elimination procedure using routines suited for symmetric and banded equations. The banded routine conserves computer core and significantly reduces execution time.

It is always difficult to recommend a control point pattern because there are so many variables, the most important of which is quality. Also, it has been my belief that a good photogrammetrist will attempt to secure as much control information as possible, and his only limiting factor will be the man in charge of expenditures. At the risk of violating this rule, a control pattern which should satisfy most needs is recommended.

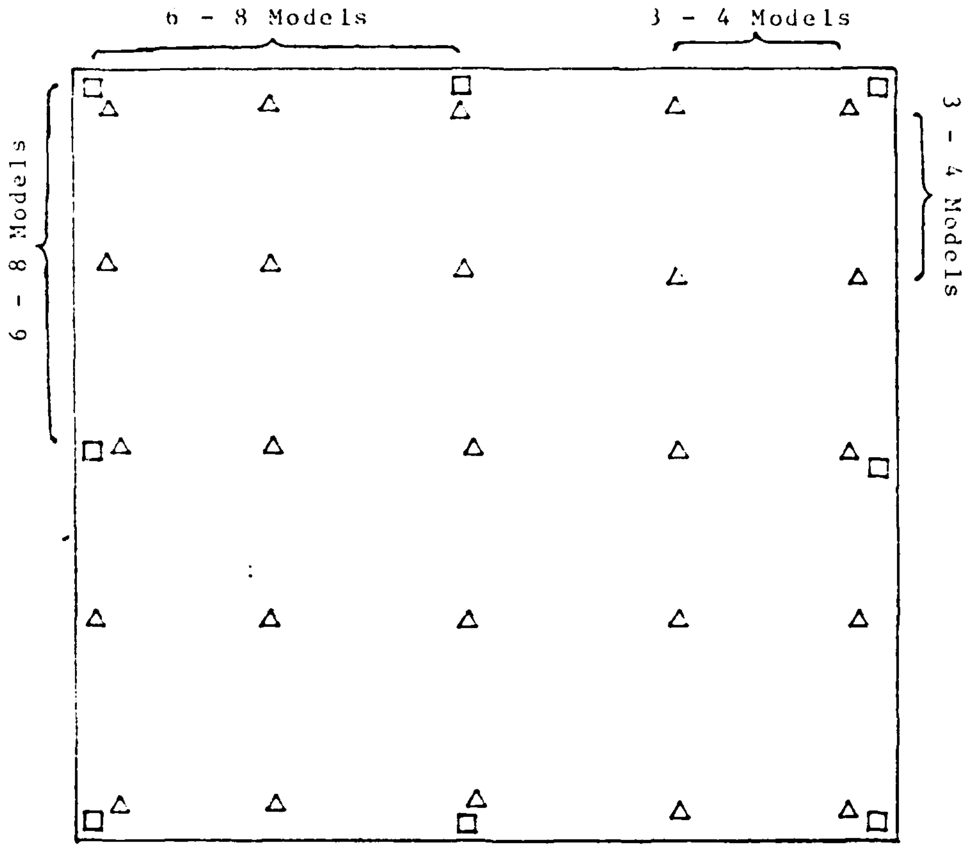
It is essential to have horizontal control in the extreme corners of the block. Any deviation from this will cause warping in the corners becoming progressively worse as the control point strays from its corner position. Other than the corners, SIMBA seems to hold horizontal position rather well. Additional horizontal control should be spaced around the edges of the block at six to eight model intervals.

Vertical control is a different matter. The adjustment acts as a blanket tacked down at the corners with a fan blowing air under it. It bulges in the middle, and when we tack down the middle, we develop two smaller bulges on each side. This progression continues geometrically until the bulges are reduced in size to an acceptable level. The general recommendation is to have a vertical control pattern at three to four photo intervals throughout the block. A sample control point pattern is shown in Figure 2.

Pass and model point selection is a matter of personal custom, but the author has developed a system which lends itself well to both the adjustment mathematics and production flow. Starting with one of the border strips in the block, pick four points in a line in all the trilap areas and at the two ends. Insure that the two points closest to the adjacent strip fall in the sidelap area and are transferred. Transfer these tie points to the second strip and send the first strip to the comparator or stereoplotter to be measured. Pick points on the second strip as before. If transferred points from the first strip happen to fall in the trilap or necessary end positions of the second strip, use them. If not, continue point selection as on strip one. It is not necessary to transfer any of the newly selected points back to the first strip. Continue in this manner until all points are selected. This method will produce from eight to ten pass points per model and is illustrated in Figure 3.

Three versions of SIMBA are currently available at DMA IAGS Headquarters in San Antonio, Texas. These versions are the standards which are then adapted to the computer and desires of individual users. The first version is the most common and has parameters of 240 models, 2200 unique points, 2500 total points, 150 control points, and a bandwidth of 25. It uses 526K bytes of storage on an IBM 370 computer. The second version of SIMBA breaks the program down into three

CONTROL POINT SELECTION

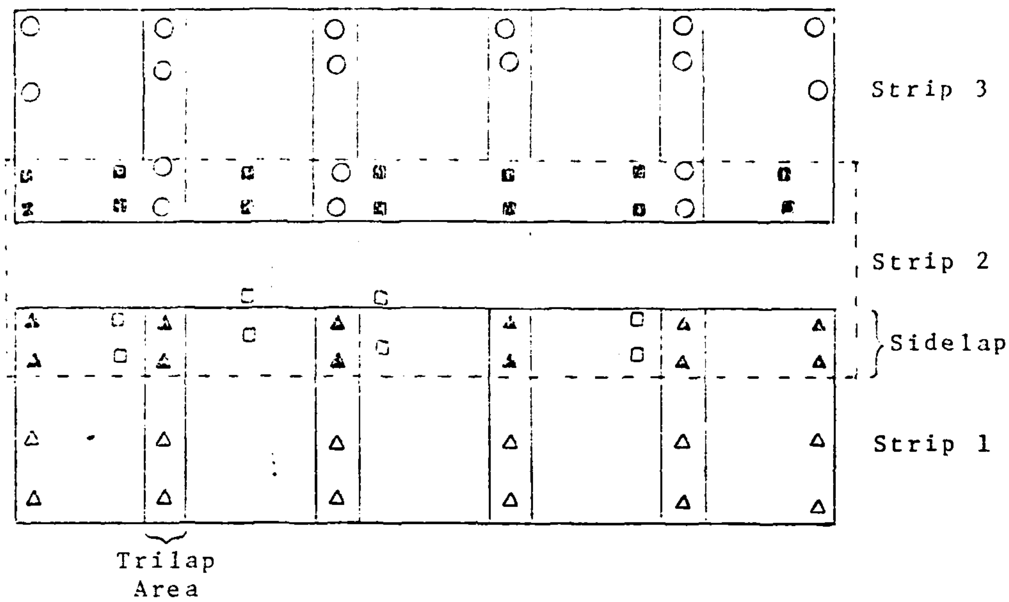


□ Horizontal Control

△ Vertical Control

FIGURE 2

PASS AND TIE POINT SELECTION



△ Points selected on Strip 1

□ Points selected on Strip 2

○ Points selected on Strip 3

Between-strip tie points are shaded.

FIGURE 3

parts which are executed separately. The first part reads the input data, organizes it, and builds a file. The second part reads that file, performs the necessary mathematics, and writes the massaged data back onto the file. The third part reads the file and prints out the desired results. This three part version is a computer core saver but sacrifices time and simplicity. Dimensioned similar to the original program, the three part version will save about 75K bytes of storage. The third version we have is another three part program with the first and third parts remaining as before. The difference in part two is that a direct access disk file is used to write and then read each row and column of the normal equation coefficient matrix. All of this reading and writing takes time but an additional reduction of 125K bytes of computer memory is realized. This version is impractical unless the computer memory is limited and computer time is of no concern.

A sample SIMBA output is shown in Appendix A.

The SIMBA adjustment requires the use of perspective centers to strengthen the vertical solution. If a stereoplotter is used for relative orientation, the coordinates for the perspective centers may be computed using either one of two available programs. The ideal solution for determining the camera perspective center is by space resection using a reseau grid. The IAGS version of John McLaurin's Perspective Center Determination Program (U. S. Geological Survey, 1969) does precisely this. A grid of known precision, usually engraved on a glass plate, is projected through a stereoplotter projector. The coordinates of from three to fifty grid intersections are then measured in model space. The bundle of rays passing through the grid intersections on the calibrated plate and the bundle extending to the same measured intersections in model space originate from the same point--the perspective center. If the latter bundle of rays is fitted to the other bundle in a least squares space-resection adjustment, accurate coordinates for the perspective center can be determined. Printed output includes:

1. Title.

2. Input data to include point numbers, number of readings on each point and grid coordinates.

3. Number of points used and computed principle distance.

4. Mean projected grid coordinates and standard deviations.

5. Parameter values after each iteration.

6. Residuals of the projected points in their coordinate system.

7. Variance-covariance matrix.

8. Standard errors.

Although this program is quite accurate and produces a wealth of information, it is time consuming to use. This, coupled with the unavailability of calibrated grid plates and stereoplotter variety encouraged IAGS to develop a simplified version. For instruments such as the Wild A-7, A-8, A-9 and A-10, the perspective centers do not vary with the relative orientation of the model since the axis of rotation for omega and phi intersect the projection cardan. The perspective centers change only if the instrument base component is changed. Thus the coordinate determinations need be made only once per strip or, in special cases, per block. However, for optical instruments such as the Zeiss C-8 and Wild B-8, the projection center varies with the relative orientation of each model since the axes of rotation for omega and phi do not intersect the projection cardan. If the perspective center is to be determined after each model relative orientation, a quick method is needed.

Instead of a reseau grid, the engraved lines and crosses on the plate carriers are measured and substituted for a grid. These intersections can be quickly measured after relative orientation of each independent model. The instrument z and the numbering sequence must remain constant for each set of recordings. The program is designed to compute perspective centers of the left and right cameras alternately. A maximum of ten points may be used, but six points are customary. The program output is limited to the x, y, and z coordinates of each projection center, but this is sufficient input for the SIMBA adjustments. An example program execution is shown in Appendix B.

One's first experience with a large adjustment program can be frustrating if two unique points have the same point number. The block tends to fold in upon itself causing large residuals and an unsatisfactory solution. Another frequent error is the exceeding of the bandwidth parameter. This is a result of long flight lines or incorrect model sequencing in the program. SIMBA is unpredictable when this occurs and may diverge instead of reaching a solution. These and various other errors present in the data can be difficult to locate. Also, it is expensive to run large adjustments if errors are inherent in the data. For these reasons the author wrote the SIMBA SORT program (SISRT). It uses the exact same data deck (or file) as SIMBA and is quick and inexpensive to execute. The main program function is to do a point sort and list the location by strip and model of each unique point. It also computes and lists the bandwidth of each point. This allows the user to insure the SIMBA bandwidth is not violated, or if it is, which point is the culprit. A complete data deck/file listing is provided. Sample program output may be found in Appendix C.

The Numerical Model Orientation Program (ORELM) was written by Randle Olsen of the U. S. Geological Survey in 1976. The purpose of the program is to use the omega and phi elements from relative orientation, the desired model scale, and the common omega, phi, airbase, and bz for each model is computed by SIMBA to produce the input absolute orientation for a variety of stereoplotters. ORELM can be used even if the photos are measured on a comparator as the CRAST program will compute the proper input orientation angles. Specific plotters which can be oriented are: the Balplex (ER-55), Kelsh, Wild B-8, Kern PG-2 and the Wild A-8/PPOS. We are currently working to incorporate the Zeiss C-8 into this list. The projection plotters require graduated dials or auxiliary equipment to utilize this data. The use of the program eliminates the need to reorient, scale, and level before plotting. Sample output may be found in Appendix D.

THE GIANT ADJUSTMENT SYSTEM

In this analytical photogrammetric system, the physical reconstruction of model geometry is replaced with mathematics. The mathematical model is constructed to represent the relationship between the photographic images and the object space. The images are measured on a comparator and numerical methods are used to produce the position and orientation of the exposure station and the image coordinates in object space.

Analytical and semi-analytical methods are both capable of producing accurate results. Therefore, accuracy is not the justification for the extra expense of a comparator and the analytical programs. However, there are inherent advantages in an analytical system. First of all, it is much easier to bridge water or snow fields. One does not have to worry about trying to remove paralax from a model that is half water. Secondly, a large variety of photography and cameras can be accommodated. Panoramic photography, for example, does not have a simple central projection and special cameras on high flying aircraft may have a very long focal length which is impossible to duplicate on a stereo comparator. Thirdly, analytical methods permit the input of auxiliary sensors. Such sensors include stabilization systems, profile recorders, altimeters and astronomical observations. This additional information may be incorporated directly into the solution and weighed according to reliability. It should be noted that some semi-analytical programs now have this ability.

Analytical photogrammetry offers great potential. It can incorporate various distortions and deformations which are impossible to duplicate in stereoplotters. The proponents of analytical methods claim they should be able to obtain more accurate results, but in practice this has not proven to be true. The complex mathematics and equipment costs have frightened away many potential practitioners. IAGS does not recommend one method over the other, but instead has incorporated both methods into the software package.

When photogrammetric images are measured on a monoscopic or stereoscopic comparator, two dimensional coordinates are produced. The CRAST program refines these coordinates and produces either GIANT input or independent model coordinates for input into SIMBA. Mathematical refinement of the comparator measurements is necessary because the model space was not physically reconstructed. It is mathematically reconstructed, so we need to knew additional information to accurately duplicate what took place when the photos were taken. The first three items on the following list are required for program execution. The remaining items will be used if they are known and input.

1. Camera Focal Length

2. Approximate Flying Height

3. Sehut Refraction Coefficient

4. Comparator Scale Corrections in x and y

5. Comparator Non-Orthogonality

6. Initial Airbase at Photoscale

7. Radial Lens Distortion Corrections

8. Principle Point Variation from Photo Center

9. Calibrated Fiducial Coordinates

Depending on the information input and the desires of the user, the CRAST program will correct the input coordinates for the following distortions:

1. Film Distortion

2. Earth Curvature

3. Light Refraction

4. Comparator Calibration Corrections

5. Radial Lens Distortion

If the GIANT option is used, CRAST output will consist of a fit of fiducials to camera data, the refined plate coordinate listing and punched card output in the GIANT format or an optional format. If the SIMBA option is used, output will consist of independent model coordinates, y-parallax, model tie residuals and card output in the SIMBA or an optional format.

The reason for the use of this particular program is its adaptability to the lack of information which frequently is found to be the case in Latin America. For example, the program will accept the absence of calibrated fiducials and even the absence of fiducial observations. CRAST was originally written by Randle Olsen in 1973 and has been revised several times, including a revision by IAGS in 1981. Sample program output can be found in Appendix E.

The General Integrated Analytical Triangulation Program (GIANT) is designed to perform a least squares adjustment of a block of frame photographs. It was written by Atef A. Elassal in 1976 and has been adapted for use by the U. S. Geological Survey, the U. S. Forest Service and IAGS. Many variations of the program now exist and at this writing, it is currently undergoing yet another revision at IAGS.

GIANT will analytically solve for the ground coordinates of image points measured on two or more photographs. It also solves for each camera station position and orientation. Only uncorrelated observations are acceptable and may be individually weighed to reflect known precision. This system allows the mixture of horizontal and vertical control of varying accuracies. It also allows the use of known camera station parameters. The program propagates error estimates through the solution, computes the a posteriori estimate of the variance of unit weight and has an option for listing the variance-covariance matrix and standard deviation of the output parameters. These indicators are useful estimates of the solution accuracy.

An initial approximation is required of each camera station position and orientation and of each unique image point. The approximations of the image points are computed internally and gross approximations are acceptable for the camera parameters.

Program dimensions require that no strip exceeds 20 photographs or that there are fewer than ten strips in the adjustment. IAGS currently has two versions of GIANT on file with the difference being in the dimensions. The principle version has the following parameters:

1. 460 photographs

2. 450 ground control points

3. 9509 unique ground points

4. Each point may appear on up to 10 photographs.

5. Object space is expressed in space rectangular coordinates only.

The small version is similar with the dimensions reduced to 150 photographs and 150 ground control points. The large version requires 476K bytes of computer memory on the IBM 370 computer. The core capacity is reduced to 282K bytes in the smaller version.

Experience has shown that several different types of executions prove helpful in data analyzation. The idea is similar to that used in SIMBA. One must try to separate the affect of different observations in order to locate blunders. The recommended execution sequence is as follows:

1. Use the intersection-only option with no ground control. Check for large blunders.

2. Use the triangulation option with no ground control. Check for smaller errors in point marking and measuring, especially in the tie points.

3. Use the triangulation option with ground control. Weigh the image measurements tightly and allow the ground control to move. Check for ground control errors and update the exposure station parameters.

4. Use the triangulation option with full ground control. Weigh the solution realistically; check all residuals.

5. This is the final execution. Use the triangulation option, full ground control, realistic weights, and the latest estimates of the exposure station parameters. Use the error propagation option.

There are several things to watch for during the program executions. Most must be learned through experience. One important factor to remember is the bandwidth limitation. It may be controlled by careful ordering of the frame position and attitude cards. One can stack the photos in any order. The trick is to keep the frames with common points as close together as possible. The pass and control point selection procedures are the same as for SIMBA (see Figures 2 and 3). It should be noted that GIANT will not distort block corners as severely as SIMBA, so corner positioning is not as critical.

The output listing includes:

1. Camera station parameters with residuals.

2. Plate coordinates with overall standard deviation of x and y per frame.

3. Ground control coordinate listing with residuals.

4. Camera station corrections per iteration.

5. Triangulated residuals per frame for all ground points.

6. Triangulated camera station position and orientation residuals.

7. Triangulated ground point coordinates.

8. Applied ground control corrections.

9. Variance-covariance matrix and standard deviation for the camera station parameters and ground control.

Excerpts from a typical program execution may be found in Appendix F.

As with SIMBA, problems with mispunched or misnumbered data points and errors in the organization of the data deck can cause time delays and needless computer expense. A data clean-up program was written by the author in 1980 to avoid such problems. This program (GISRT) is similar to the SIMBA Sort program in that it uses the exact same input setup as GIANT and does a point by point analyzation. The output consists of the following:

1. Data deck listing.

2. Frame position and attitude card check.

3. A frame count by strip.

4. A point by point listing to include all locations encountered and bandwidth computation.

A sample of the program output may be found in Appendix G.

SUMMARY

The programs presented here are not state-of-the-art technology. They do not have the most rigorous solutions nor the most sophisticated computer manipulations. What they do have is a good combination of flexibility, mathematical rigor and computer independence. The overall package can and will be improved. It is hoped that a new adjustment program written especially for mini-computers can be incorporated into the system. The GIANT program is under revision to make it more user oriented and to add additional options. One such option would allow output in geographics. The package is presented as a model for discussion. Its greatest testimonial is that it is being extensively used and has proven successful.

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APPENDIX A

SAMPLE OUTPUT

FROM SIMBA

GROUND CONTROL LISTING FOR

PROY. ARIZONA TEST BLOCK 3 LINEAS CARTO SCHOOL BRUNO WILD A-8 DATA

YX4	340936.29	3702311.14	325.46	HOR/VER	1.	1.	1.
YX5AB	340936.82	3700755.28	316.18	HOR/VER	1.	1.	1.
YX5AH	340877.04	3699077.74	305.30	HOR/VER	1.	1.	1.
YX7A	340876.05	3697468.79	297.40	HOR/VER	1.	1.	1.
YX7B	340875.93	3697473.94	297.30	HOR/VER	1.	1.	1.
YX8AH	340883.32	3695877.31	288.20	HOR/VER	1.	1.	1.
YX9AB	340815.64	3694256.18	279.90	HOR/VER	1.	1.	1.
YX10AB	340813.39	3692639.74	266.80	HOR/VER	1.	1.	1.
YX11A	340759.52	3691029.33	255.10	HOR/VER	1.	1.	1.
ZB4	347353.39	3702180.42	346.32	HOR/VER	1.	1.	1.
ZB4B	347387.45	3702206.07	346.50	HOR/VER	1.	1.	1.
ZB5	347307.53	3700526.92	330.94	HOR/VER	1.	1.	1.
ZB6	347365.93	3698983.54	317.28	HOR/VER	1.	1.	1.
ZB7AB	348110.17	3697335.72	300.90	HOR/VER	1.	1.	1.
ZB8A	347303.54	3695753.55	288.20	HOR/VER	1.	1.	1.
ZB9AB	347282.10	3694174.99	275.00	HOR/VER	1.	1.	1.
ZB10B	347259.83	3692517.87	262.00	HOR/VER	1.	1.	1.
ZB11AB	347645.98	3690879.56	251.60	HOR/VER	1.	1.	1.
ZE4	353771.91	3702119.04	352.82	HOR/VER	1.	1.	1.
ZE5	353819.31	3700478.75	328.95	HOR/VER	1.	1.	1.
ZE5B	353918.86	3700455.03	328.40	HOR/VER	1.	1.	1.

BLOCK POINTS NPT.ID.T = .197

MODEL POINTS JMDL.JPT.Y.LL = 241

TD.,DEV. OF RELATIVE ADJ. SMX= 2. SMZ= 2.

SIMULTANEOUS BLOCK ADJUSTMENT OF MODELS

PROJ. ARIZONA TEST BLOCK 3 LINEAS CARTO SCHOOL BRUNO WILD A-8 DATA

LINEAR PLAN-HEIGHT SOLUTION

EARTH CURVATURE CORRECTION

STRIP L 23

MODEL	POINT	EAST	NORTH	ELEV	VN	VE	VZ	IDENT
95	197	339545.79	3599552.04	5144.84				
96	196	342564.32	3599397.11	5132.36	0.19	0.85	0.04	
95	1971	339841.05	3702210.94	322.42				
96	2031	339173.64	3597841.45	295.73	-0.10	-0.11	-0.07	
95	1973	339261.22	3597503.57	297.65	-0.06	0.15	0.05	
95	2041	341683.78	3597453.51	295.29	-0.04	-0.07	0.03	
96	1963	342146.78	3597403.33	295.40	-0.34	-0.10	0.39	
96	1961	342736.91	3701432.42	327.08	0.51	-0.03	0.01	
95	YA4	340935.24	3702311.14	325.49	-0.27	-0.03	0.42	HOR/VER
96	YA7A	340876.05	3697468.79	297.40	-0.05	-0.21	-0.44	HOR/VER
96	YA7C	340875.93	3697473.94	297.30	0.41	0.36	-0.30	HOR/VER
95	YA5A5	340877.04	3599077.74	395.30	-0.24	-2.77	1.53	HOR/VER
96	YA5A6	340936.82	3700755.28	310.18	1.25	-10.14	1.53	HOR/VER
95	196	342563.32	3599397.11	5132.35	-0.19	-0.85	-0.04	
95	195	345408.94	3599267.79	5125.92	0.43	1.25	0.26	
95	1961	342735.91	3701432.42	327.08	-0.51	0.03	-0.01	
95	1963	342146.78	3597403.33	295.40	0.11	0.36	-0.24	
95	2051	344083.41	3597251.34	295.37	0.38	0.21	0.11	
95	1953	344302.36	3597535.39	299.03	-0.23	-0.56	-0.16	
95	1951	345506.78	3701882.02	337.70	0.12	-0.05	0.45	
94	195	345408.94	3599267.79	5125.92	-0.43	-1.25	-0.26	
94	194	348345.05	3599155.54	5131.99	0.39	0.50	-0.41	
94	1951	345506.78	3701882.02	337.70	-0.12	0.05	-0.45	
94	1953	344302.36	3597535.39	299.03	-0.35	0.33	0.13	
94	2061	347326.67	3596966.75	297.99	0.24	-0.12	-0.24	
94	1943	348107.88	3596949.24	295.01	0.10	0.41	-0.23	
94	1941	348164.92	3701767.97	346.81	-0.14	-0.06	-0.38	
94	2848	347387.45	3702206.07	346.50	0.06	0.04	-0.19	HOR/VER

PHOY. ARIZONA TEST BLOCK 3 LINEAS CARTO SCHOOL BRUNO WILD A-8 DATA

STRIP 1 24

MODEL	POINT	EAST	NORTH	ELEV	VE	VE	VZ	IDENT
4	203	338552.53	3695125.77	5130.61				
4	204	341550.36	3695061.90	5135.05	0.10	0.89	-0.16	
4	2031	334173.64	3697861.46	255.73	0.10	0.11	0.07	
4	1973	339261.22	3697503.57	247.66	0.02	-0.16	-0.05	
4	2033	338534.42	3692385.03	252.55				
4	2341	339445.42	3693030.82	267.35	-0.59	0.16	-0.21	
4	YX33H	341815.64	3694265.13	273.99	-0.79	0.87	0.59	HOR/VER
4	YX10AH	340813.39	3692539.74	256.80	0.42	-0.21	-0.87	HOR/VER
4	2043	341915.48	3692645.25	255.61	0.73	0.01	-0.66	
4	2041	341683.78	3697453.51	295.29	0.06	-0.21	0.27	
4	337A	340875.53	3697471.94	237.33	0.33	0.13	-0.34	HOR/VER
4	YX3AH	340883.32	3695877.31	288.29	-0.35	-0.75	0.56	HOR/VER
4	YX7A	340876.05	3697468.79	297.40	0.09	-0.76	-0.58	HOR/VER
5	204	341550.36	3695061.90	5135.05	-0.10	-0.89	0.16	
5	205	344416.43	3695084.75	5121.68	0.37	0.89	1.37	
5	2041	341683.78	3697453.51	295.29	-0.05	0.25	-0.31	
5	1963	342155.78	3697403.33	295.90	0.23	-0.26	-0.15	
5	2351	342414.38	3693359.85	270.25	0.23	-0.49	0.54	
5	2043	341915.48	3692645.25	255.61	-0.38	0.38	-0.38	
5	2053	344870.01	3692578.58	255.31	0.21	0.11	-0.10	
5	2051	344083.41	3697251.34	295.39	-0.24	-0.01	0.39	
6	205	344416.43	3695084.75	5121.58	-0.37	-0.89	-0.37	
6	206	347334.27	3695099.30	5121.33	0.61	1.03	0.16	
6	2051	344083.41	3697251.34	295.39	-0.14	-0.20	-0.50	
6	1953	344902.36	3697535.39	293.03	0.56	0.23	0.03	
6	2371	344852.47	3693362.30	259.40	-0.13	-0.21	0.60	
6	2053	344870.01	3692578.58	255.31	0.14	0.26	-0.32	
6	2063	347547.96	3692107.50	250.65	0.10	-0.64	-0.17	
6	70YAB	347282.10	3694174.99	275.00	0.20	0.61	-0.17	HOR/VER
6	2061	347325.67	3696965.75	237.99	-0.13	0.09	0.55	
6	Z8BA	347303.54	3695783.55	280.20	-0.51	-0.26	0.02	HOR/VER
6	Z810B	347259.83	3692517.87	262.00	1.02	3.45	-0.31	HOR/VER

33	234	356033.43	3591010.13	5177.14	-0.77	-0.61	0.49	
33	233	355973.49	3590914.01	5197.05	0.57	1.39	-0.40	
33	2341	353415.71	3593270.73	256.58	-0.04	0.04	0.15	
33	2343	353731.24	3594568.28	271.44	0.04	-0.05	0.02	
33	2333	355731.77	3588463.99	244.34	-0.04	0.20	-1.01	
33	2331	356527.45	3593193.90	261.05	0.22	0.28	-0.19	
33	2093	356437.52	3692401.31	261.48	-0.16	-0.42	0.69	
32	233	355973.49	3590915.01	5199.05	-0.57	-1.39	0.40	
32	232	360046.86	3590759.97	5220.83	-0.17	1.02	-0.31	
32	2331	356427.45	3593193.90	251.05	0.45	-0.02	-0.00	
32	2333	355731.77	3588463.99	244.34	0.04	-0.20	1.01	
32	2323	360050.09	3588755.35	273.85	-0.15	-0.11	-0.77	
32	2321	359218.18	3593140.44	254.33	-0.10	0.24	-0.19	
32	7J9A8	360194.16	3593999.53	264.40	0.10	0.19	-0.17	HOR/VER
32	2103	359598.96	3592737.75	264.33	-1.40	-0.27	0.26	
32	7J10A	360185.88	3692240.35	264.00	4.16	-7.70	0.76	HOR/VER
32	7J114	360057.82	3690715.50	253.70	-8.22	-4.83	1.24	HOR/VER
31	232	360046.86	3590759.97	5220.83	0.17	-1.02	0.31	
31	231	352980.12	3590604.34	5205.88				
31	2321	359213.18	3593140.44	264.33	0.23	-0.15	0.00	
31	7J9A8	359194.16	3593999.53	254.40	-0.14	0.29	-0.70	HOR/VER
31	2323	360050.09	3688755.36	274.85	0.15	0.11	0.77	
31	2313	352835.22	3684740.12	247.34				
31	2311	352907.64	3693145.37	253.15				
31	2113	361774.33	3692349.18	255.09	-0.22	-0.44	0.62	
31	7J10A	360185.88	3692240.35	254.00	3.40	-8.16	0.54	HOR/VER

RMSE SUMMARY

	HELD CONTROL PTS	TIE POINTS	UNHELD CONTROL PTS
POINTS	35	58	27
EAST	0.55	0.30	3.03
NORTH	0.48	0.27	5.01
PLAN	0.73	0.42	5.85
POINTS	35	58	27
HEIGHT	0.54	0.43	0.86

PHI= INSTRUMENT GRADS DOWNWARD TOWARD RIGHT

OMEGA=INSTRUMENT GRADS DOWNWARD TOWARD BACK

MODEL	PHI	OMEGA	AIRBASE	BZ
197	0.263	-0.342	3027.2	-12.5
196	0.138	-0.254	2843.6	-5.4
195	-0.128	-1.035	2474.2	5.1
194	-0.031	-0.535	2331.1	2.7
193	-0.216	-1.175	2325.4	10.3
192	0.002	-1.159	2431.7	0.4
191	0.003	-1.318	2792.0	1.4
190	0.121	0.234	3055.3	-4.3
203	0.034	-1.447	2409.1	-1.6
204	0.294	-0.120	2555.2	-13.4
205	-0.006	-0.232	2417.9	-0.4
206	0.227	-0.555	2323.2	-11.5
207	0.494	-1.141	3126.5	-23.2
208	-0.015	-0.283	2758.3	1.5
209	-0.091	-0.950	2887.8	4.9
210	0.154	-0.795	2891.4	-7.3
239	-0.624	-1.432	2875.9	29.4
238	-0.145	0.449	2854.4	10.2
237	-0.441	0.909	2930.4	21.1
236	-0.554	0.329	2842.9	27.1
235	-0.525	2.795	3051.1	26.7
234	-0.458	-1.339	2881.5	21.9
233	-0.550	0.602	3077.1	27.8
232	0.459	0.679	2938.0	-20.9

APPENDIX B

SAMPLE OUTPUT

FROM PROCEN

PROJECTION DETERM C-8 PANAMA SEPT. 28 1971 J.S. GARCIA

PERSPECTIVE CENTER DETERMINATION

NUMBER OF POINTS TO BE USED   6

FOCAL LENGTH IN MILLIMETERS   153.00

PHOTO	CARRIAGE	X	Y	Z
509	1	197.24	500.58	407.13
509	2	298.45	501.08	407.36

APPENDIX C

SAMPLE OUTPUT

FROM SISRT

PROV. ARIZONA TEST BLOCK 3 LINEAS CARTO SCHOOL BRUNO FILD A-8 DATA

GROUND CONTROL LISTING

Y*4	340935.23	370311.14	325.40	HOR/VER	0.	0.	0.
[illegible]	340935.32	370755.23	315.15	HOR/VER	0.	0.	0.
Y*5A4	340877.04	359077.74	305.30	HOR/VER	0.	0.	0.
Y*7A	340876.05	357766.73	247.40	HOR/VER	0.	0.	0.
Y*7*	340875.93	359747.44	297.30	HOR/VER	0.	0.	0.
Y*43B	340841.32	359587.41	241.20	HOR/VER	0.	0.	0.
Y*9**	340815.64	358426.13	274.40	HOR/VER	0.	0.	0.
Y*10A3	340813.33	[illegible]	[illegible]	HOR/VER	0.	0.	0.
Y*11A	340764.62	359124.33	255.10	HOR/VER	0.	0.	0.
Z34	347353.33	370215.42	345.32	HOR/VER	0.	0.	0.
Z*4*	347387.45	370220.07	345.50	HOR/VER	0.	0.	0.
Z55	347307.53	370520.42	333.74	HOR/VER	0.	0.	0.
Z36	347355.93	369694.54	317.20	HOR/VER	0.	0.	0.
Z*7A5	347110.17	359733.72	300.40	HOR/VER	0.	0.	0.
Z***	347393.54	359578.55	244.20	HOR/VER	0.	0.	0.
Z*9A*	347242.13	359417.47	275.00	HOR/VER	0.	0.	0.
Z*10*	347259.83	359251.47	252.00	HOR/VER	0.	0.	0.
Z*11A*	347545.95	359267.36	251.50	HOR/VER	0.	0.	0.
ZE4	353771.91	370211.04	352.42	HOR/VER	0.	0.	0.
ZE5	353413.41	370047.75	322.45	HOR/VER	0.	0.	0.
ZE5*	353918.45	370045.03	324.40	HOR/VER	0.	0.	0.
ZE5A	353794.75	359925.13	312.50	HOR/VER	0.	0.	0.
ZE63	353787.25	359490.57	312.40	HOR/VER	0.	0.	0.
ZE7**	353705.52	359749.27	245.20	HOR/VER	0.	0.	0.
ZE8A	353715.41	359505.04	282.20	HOR/VER	0.	0.	0.
ZE8*	353752.83	359528.27	231.40	HOR/VER	0.	0.	0.
ZE9*B	353750.41	359405.33	264.40	HOR/VER	0.	0.	0.
ZE10A*	353791.95	359241.31	255.31	HOR/VER	0.	0.	0.
ZJ4	360242.70	370194.92	322.55	HOR/VER	0.	0.	0.
ZJ5	360241.15	370433.47	302.71	HOR/VER	0.	0.	0.
ZJ6A3	360243.91	359774.45	295.70	HOR/VER	0.	0.	0.
ZJ73	360213.50	359715.75	243.00	HOR/VER	0.	0.	0.
ZJ74	360201.29	359719.44	284.10	HOR/VER	0.	0.	0.
ZJ8A3	360150.50	359600.54	271.40	HOR/VER	0.	0.	0.
ZJ9A3	360144.16	359399.53	254.40	HOR/VER	0.	0.	0.
ZJ10A	360145.84	359224.35	264.00	HOR/VER	0.	0.	0.
ZJ11A	360065.42	359071.50	264.70	HOR/VER	0.	0.	0.

INSTRUMENT COORDINATE LISTING

-11	1 23	0.0	0.0	0.0
95	147	100.00	500.00	340.00
95	145	243.00	502.00	340.00

96	YR50H	155.61	[illegible]	134.07
0		0.0	0.0	0.0
95	145	100.00	510.00	340.00
95	145	245.00	510.00	340.00
95	1451	103.67	625.[illegible]	[illegible]
95	1453	[illegible]	[illegible]	88.87
95	2051	[illegible]	341.11	[illegible]
95	1253	225.17	[illegible]	[illegible]
95	1451	247.47	634.[illegible]	90.46
0		0.0	0.0	0.0
94	145	100.01	510.00	340.00
94	145	245.00	500.00	340.00
94	1451	[illegible]	626.[illegible]	100.17
94	1453	77.41	[illegible]	101.85
94	2051	193.45	345.[illegible]	101.43
94	1343	237.73	345.12	101.79
94	1441	231.75	625.27	100.40
94	2445	192.40	545.[illegible]	100.14
94	745	191.50	552.10	100.77
94	745	157.61	455.57	101.45
94	744	190.75	644.27	100.17
-9		0.0	0.0	0.0
94	7H73H	237.22	415.01	101.53
0		0.0	0.0	0.0
93	146	100.00	500.00	340.00
93	143	244.00	500.00	340.00
93	1941	83.58	624.02	96.88
93	1943	91.43	346.49	97.50
93	1943	229.24	347.25	97.18
93	2071	209.33	405.44	97.11
93	1931	233.55	588.88	96.87
-8		0.0	0.0	0.0
93	7H73H	89.85	406.24	97.52
0		0.0	0.0	0.0
92	143	100.00	500.00	340.00
92	142	245.00	500.00	340.00
92	1931	85.72	588.10	95.45
92	1933	78.55	346.27	97.41
92	2041	181.42	347.84	97.11
92	7E53	224.24	327.04	97.48
92	1323	221.05	348.[illegible]	96.93
92	1321	241.44	614.67	95.93
92	754	220.10	553.46	95.05
92	755	224.23	571.16	95.45
92	7E54	224.31	431.57	95.07
-9		0.0	0.0	0.0
92	7E7AH	221.62	419.37	95.73
92	7E54	222.12	559.22	95.44

33	2331	240.17	611.23	34.35
33	2133	214.24	[illegible]	[illegible]
0		0.0	0.0	0.0
32	233	[illegible]	[illegible]	[illegible]
32	232	244.00	[illegible]	[illegible]
32	2331	[illegible]	311.21	[illegible]
32	2333	41.44	[illegible]	103.47
32	2323	[illegible]	[illegible]	101.22
32	2321	245.54	516.45	102.61
32	[illegible]	235.59	537.23	103.12
32	2103	215.54	545.48	102.73
-3		0.0	0.0	0.0
32	73103	249.43	572.80	102.22
32	23113	255.71	[illegible]	101.71
0		0.0	0.0	0.0
31	232	101.30	500.00	[illegible]
31	231	244.00	500.00	[illegible]
31	2321	123.74	[illegible]	91.32
31	73444	109.16	655.52	91.44
31	2323	117.71	[illegible]	[illegible]
31	2313	247.75	434.41	91.37
31	2311	235.93	331.27	[illegible]
31	2113	185.21	586.49	91.78
-4		0.0	0.0	0.0
31	73104	104.84	576.67	91.03
0		0.0	0.0	0.0
0		0.0	0.0	0.0

STRIP	NUMBER OF MODELS
L 23	1
L 24	[illegible]
L 25	[illegible]

TOTAL NUMBER OF MODELS 24

POINT	STRIP	MODELS		[illegible]
197	L 23	96		1
196	L 24	96	95	2
1971	L 23	95		1

[illegible]	L 23	[illegible]		
	L 24	4		9
[illegible]	L 23	[illegible]		
	L 24	[illegible]		1
[illegible]	L 23	[illegible]		1
[illegible]	L 23	[illegible]		1
[illegible]	L 23	[illegible]	[illegible]	2
2051	L 23	[illegible]		
	L 24	[illegible]	[illegible]	10
1953	L 23	[illegible]	[illegible]	
	L 24	[illegible]		10
1951	L 23	[illegible]	[illegible]	2
[illegible]	L 23	[illegible]	[illegible]	2
2051	L 23	[illegible]		
	L 24	[illegible]	7	10
1943	L 23	[illegible]	[illegible]	
	L 24	7		10
1941	L 23	[illegible]	[illegible]	2
[illegible]	L 23	[illegible]		1
[illegible]	L 23	[illegible]		1
[illegible]	L 23	[illegible]		1
[illegible]	L 23	[illegible]		1
[illegible]	L 23	[illegible]	[illegible]	
	L 24	7		10
193	L 23	[illegible]	[illegible]	2
1933	L 23	[illegible]	[illegible]	
	L 24	[illegible]		10
2071	L 23	[illegible]		

APPENDIX D

SAMPLE OUTPUT

FROM ORELM

NUMERICAL MODEL ORIENTATION -- PROGRAM NO. K470

TEST DATA FOR B-B PARAMETERS.

INPUT DATA

MODEL	QUADS				INST	PHI-1	PHI-2	OMEGA-1	OMEGA-2	C-PHI	C-OMEGA	AIRBASE	BZ
299	1	0	0	0	A-7	101.950	101.920	100.000	100.110	0.051	0.617	4712.8	-12.1
300	1	0	0	0	A-7	100.970	101.270	100.000	100.080	-0.018	0.734	4675.2	-7.6
301	1	0	0	0	A-7	100.920	100.940	100.000	100.080	0.013	0.366	4721.2	-0.8
302	1	0	0	0	A-7	100.900	100.880	100.000	99.810	0.024	0.751	4723.6	-1.8
303	1	0	0	0	A-7	100.870	100.840	100.000	99.850	0.063	0.904	4671.8	-3.5
304	1	0	0	0	A-7	100.940	100.780	100.000	99.850	0.040	1.288	4673.9	-0.3
305	1	0	0	0	A-7	100.840	100.820	100.000	99.820	0.055	0.817	4716.6	0.7
306	1	0	0	0	A-7	100.930	100.810	100.000	99.970	0.032	0.354	4701.4	2.4
307	1	0	0	0	A-7	100.900	100.870	100.000	100.420	0.041	-0.018	4690.9	1.3
308	1	0	0	0	A-7	100.900	100.870	100.000	100.320	0.051	0.067	4713.7	-2.2
309	1	0	0	0	A-7	100.870	100.840	100.000	100.440	0.115	0.032	4695.7	-9.7
766	1	0	0	0	A-7	99.540	99.450	100.000	100.830	0.061	-1.809	5031.8	0.7
767	1	0	0	0	A-7	99.430	99.560	100.000	101.080	0.072	-1.753	5055.1	-0.3
768	1	0	0	0	A-7	99.560	99.630	100.000	101.130	0.042	-1.583	5123.2	1.0

NUMERICAL MODEL ORIENTATION -- PROGRAM NO. K370

TEST DATA FOR B-B PARAMETERS.

STEREO-PLOTTER ORIENTATION ELEMENTS
TILT UNITS IN GRADS DOWNWARD TOWARD RIGHT AND BACK

MODEL	PHI-1	PHI-2	OMEGA-1	OMEGA-2	AIRBASE	dZ
299	2.001	1.971	0.617	0.727	4712.8	-12.1
300	0.952	1.252	0.734	0.814	4675.2	-7.6
301	0.933	0.953	0.366	0.446	4721.2	-0.8
302	0.924	0.904	0.751	0.561	4723.6	-1.8
303	0.933	0.903	0.994	0.754	4671.8	-3.5
304	0.940	0.820	1.288	1.138	4673.9	-0.8
305	0.895	0.875	0.217	0.637	4716.6	0.7
306	0.962	0.842	0.354	0.324	4701.4	2.4
307	0.941	0.911	-0.014	0.402	4690.9	1.3
308	0.951	0.921	0.067	0.387	4713.7	-2.2
309	0.985	0.955	0.032	0.472	4695.7	-9.7
766	-0.399	-0.489	-1.804	-0.979	5031.8	0.7
767	-0.498	-0.368	-1.753	-0.673	5055.1	-0.3
768	-0.398	-0.328	-1.583	-0.453	5123.2	1.0

NUMERICAL MODEL ORIENTATION -- PROGRAM NO. K370

TEST DATA FOR B-B PARAMETERS.

STRIP 1

PP08 PLOTTER MODEL SCALE = 1:26500.0

MODEL	BX(FT)	BX(MM)	C-PHI	PHI-1	OMEGA-1	PHI-2	OMEGA-2
299	4713	54.2	100.17	101.84	99.38	101.81	99.27
9902	4713	54.2	99.84	98.19	100.73	98.16	100.62
300	4675	53.8	100.11	100.85	99.26	101.15	99.18
3	4675	53.8	99.89	98.85	100.82	99.15	100.74
301	4721	54.3	100.02	100.93	99.63	100.95	99.55
103	4721	54.3	99.98	99.05	100.45	99.07	100.37
302	4724	54.3	100.03	100.90	99.24	100.88	99.43
203	4724	54.3	99.97	99.12	100.57	99.10	100.76
303	4672	53.7	100.05	100.89	99.09	100.86	99.24
303	4672	53.7	99.95	99.14	100.76	99.11	100.91
304	4674	53.8	100.02	100.97	98.71	100.81	98.86
403	4674	53.8	99.98	99.19	101.14	99.03	101.29
305	4717	54.2	100.00	100.91	99.18	100.89	99.36
503	4717	54.2	100.00	99.11	100.64	99.09	100.82
306	4701	54.1	99.97	101.00	99.64	100.88	99.67
603	4701	54.1	100.03	99.12	100.33	99.00	100.36
307	4691	54.0	99.99	100.95	100.01	100.93	99.59
703	4691	54.0	100.01	99.07	100.41	99.04	99.99
308	4714	54.2	100.03	100.93	99.93	100.90	99.61
803	4714	54.2	99.97	99.10	100.39	99.07	100.07
309	4695	54.0	100.14	100.55	99.96	100.83	99.52
903	4696	54.0	99.86	99.17	100.48	99.14	100.04
766	5032	57.9	100.00	99.61	101.80	99.52	100.97
6607	5032	57.9	100.00	100.48	99.03	100.39	98.20
767	5055	58.1	100.01	99.50	101.75	99.63	100.67
6707	5055	58.1	99.99	100.37	99.33	100.50	98.25
768	5123	58.9	99.99	99.52	101.58	99.59	100.45
6807	5123	58.9	100.01	100.31	99.55	100.38	98.42

APPENDIX E

SAMPLE OUTPUT

FROM CRAST

IMAGE COORDINATE REFINEMENT AND STRIP TRIANGULATION WITH ANALYTICAL ORIENTATION - USGS - NO. H252 - 3/73, MODF.4/79 RESTON IBM 370

MIDDLEBURG, VIRGINIA TEST OF H252. OLSEN I.C.R. WITH ANAL. ORIENTATION
STRIP 1

COMPARATOR CALIBRATION CORRECTIONS=
    SCALE X= 1.000000
    SCALE Y= 1.000000
    ALPHA = 0.0

SYMMETRIC RADIAL LENS DISTORTION CORRECTIONS=
    MICRONS AT 10 MM INTERVALS
    0. -6.-10.-13.-15.-16.-16.-15.-14.-12. -9. -8. -8. -8. -9.-11.

REFRACTION CORRECTION=
    SCHUT COEFFICIENT = 40.00

PRINCIPAL POINT (MICRONS)=
    X = 0.0
    Y = 0.0

FILM DISTORTION CORRECTION=
    AFFINE TRANSFORMATION TO FIDUCIALS

FIDUCIAL COORDINATES (MICRONS)=

PT	X	Y
1	-106002.0	-105999.0
2	106001.0	-105999.0
3	106020.0	105999.0
4	-105999.0	106005.0

STRIP 1

IMAGE COORDINATE REFINEMENT AND STRIP TRIANGULATION WITH ANALYTICAL ORIENTATION - USGS - NO. H252 - 3/73. MODF.4/79 RESTON IBM 370

MIDDLEBURG. VIRGINIA TEST OF H252. OLSEN I.C.R. WITH ANAL. ORIENTATION

STRIP 1

STRIP 1

	COORDINATES (MICRONS)		RESIDUALS		FILM DISTORTION		FILM DISTORTION	
	X	Y	VX	VY	DX	DY	DX	DY
PLATE 1 FIDS					SCALE=	1.00017	SCALE=1	
1	-105002.0	-105999.0	-2.6	-0.4	4.8	0.9	23.3	19.4
2	105001.0	-105999.0	2.6	0.6	4.0	-7.0	-14.5	11.6
3	106020.0	105999.0	-2.9	-0.5	-10.2	-1.7	-28.8	-20.3
4	-105999.0	106005.0	3.0	0.4	1.5	8.1	20.1	-10.5
PTS								
4000	-3739.4	98623.4						
4001	-550.7	7323.0						
4002	793.2	-82459.0						
4003	88804.4	97628.9						
4004	100459.1	666.9						
4005	92243.7	-78171.7						
50	90744.4	-33742.6						
100	53472.1	80578.1						
101	52335.5	-87416.6						
8000	910.3	79207.6						
8003	95106.1	80722.2						
PLATE 2 FIDS					SCALE=	1.00019	SCALE=1	
1	-106002.0	-105999.0	-2.9	0.3	4.1	1.6	24.4	21.9
2	106001.0	-105997.0	2.8	-0.2	4.2	-7.2	-16.1	13.1
3	106120.0	105999.0	-3.1	0.2	-10.0	-1.1	-30.3	-21.3
4	-105999.0	106005.0	3.2	-0.3	1.9	6.7	22.1	-13.6
PTS								
4000	-97289.4	97145.4						
4001	-94247.2	5229.8						
4002	-92896.6	-64875.4						
4003	-4375.5	95443.7						
4004	5455.6	-2002.7						
4005	-1390.6	-60483.1						
4006	84295.9	76297.0						
4007	87325.5	-1152.5						
4008	99923.9	-71806.1						
8000	-92901.7	77566.5						

ANALYTICAL RELATIVE ORIENTATION AND MODEL ASSEMBLY

MIDDLEBURG, VIRGINIA TEST OF R252. OLSEN I.C.R. WITH ANAL. ORIENTATION

STRIP 1

CFL=152279.9 MICRONS

STRIP 1

MOD	PT	X	Y	Z	VY	DX	DY	DZ	
									ITER= 3 SD= 11.3
1	0	200000	400000	600000					
2	0	290000	402913	599637					
102	4000	195374	495634	452329	-9				
102	4001	199367	407121	451891	-2				
102	4002	200773	319591	451506	-1				
102	4003	285870	494539	452086	19				
102	4004	297228	410648	452619	4				
102	4005	299679	324000	451955	-4				
102	8000	200880	476633	452688	19				
102	8003	293508	479361	450278	-11				
102	50	287567	357438	453051	1				
102	100	251924	479237	452128	-19				
102	101	250984	314843	451653	4				
									ITER= 3 SD= 2.2
2	0	290000	402913	599637					
3	0	381071	398512	598224					
203	4003	285868	494873	452046	-2	-2	34	-40	
203	4004	297227	400650	452630	0	-1	2	11	
203	4005	259679	324015	451987	1	0	15	32	
203	4006	372789	477734	450594	0				
203	4007	375654	401878	451675	0				
203	4008	398196	333202	452041	1				
203	8003	293508	479357	450275	3	0	-4	-3	
203	2100	324462	321653	452106	-2				
									ITER= 3 SD= 1.5
3	0	381071	398512	598224					
4	0	459925	411956	600442					
304	4006	372791	477720	450620	0	2	-14	26	
304	4007	375654	401878	451659	-1	0	0	-16	
304	4008	398195	333199	452032	0	0	-3	-9	
304	4009	457983	475597	451295	0				
304	4010	466151	408386	451944	1				

MODEL ORIENTATION ELEMENTS - AIRBASE COORDINATE SYSTEM

TILTS IN GRADS DOWNWARD TOWARD FRONT AND RIGHT

	MODEL	PHI-1	PHI-2	OMEGA-1	OMEGA-2
3 1	102	-0.257	-0.511	0.0	-0.165
3 1	203	-1.253	0.405	-0.144	0.582
3 1	304	2.979	0.669	0.865	0.638
3 1	405	-0.548	-1.514	0.811	-0.191
3 1	506	-1.769	0.238	-0.127	0.857
3 1	607	-0.445	-0.400	0.900	-0.466
3 1	708	-0.312	-0.655	-0.464	-0.164
3 1	809	-0.222	0.363	-0.151	-0.538
3 1	910	0.153	0.603	-0.529	1.863
3 1	1011	0.540	0.823	1.898	1.148
3 1	1112	0.831	0.170	1.239	1.481

APPENDIX F

SAMPLE OUTPUT

FROM GIANT

*** JOB DEFINITION OPTIONS ***

COLUMN	ADJUSTMENT OPERATION	OPTION
4	CAMERA STATION ROTATIONS	= 1
8	LIST ADJUSTED CAMERA STATION PARAMETERS	= 0
12	PUNCH ADJUSTED CAMERA STATION PARAMETERS	= 0
16	TRIANGULATION OPERATION**COMPLETE OR INTERSECTIONS	= 0
20	ERROR PROPAGATION	= 0
24	A POSTERIORI OF UNIT VARIANCE	= 0
28	SORT TRIANGULATED GROUND POINTS	= 1
32	MAXIMUM NUMBER OF ITERATIONS	= 0
42	CONVERGENCE TEST (E) - DEFAULT E=0.05	= 0.0
52	LISTING OF PLATE RESIDUALS (F) --	= 0.02

IF (F) IS EQ 0 ALL IMAGE RESIDUALS WILL BE LISTED
IF (F) IS GT 0 RESIDUALS GREATER THAN (F) WILL BE LISTED
IF (F) IS LT 0 NO RESIDUALS WILL BE LISTED

SMAZTAGS SYSTEM (USGS START)   PROYECTO- BLOQUE DE PRUEBA- ARIZONA- LINEAS 23,24,Y 25   PAGE 1

FRAME 197

PRINCIPAL DISTANCE = -152.520   ST. D. OF X = 0.020   ST. D. OF Y = 0.020

CAMERA STATION PARAMETERS

POSITION		ATTITUDE (GROUND TO PHOTO)	
X = 339554.77	ST. D. = 60000.0000	OMEGA = 0 13 56.174	ST. D. = 90 0 0.0000
Y = 3699585.70	ST. D. = 60000.0000	PHI = - 0 14 1.543	ST. D. = 90 0 0.0000
Z = 5144.14	ST. D. = 60000.0000	KAPPA = 0 2 31.744	ST. D. = 90 0 0.0000

PLATE COORDINATES

ID	X	Y	ID	X	Y	ID	X	Y	ID	X	Y
100001	3.924	6.257	100002	-7.171	-1.255	100003	-4.503	-94.422	100004	93.475	53.459
100005	92.817	-14.554	100006	50.256	-94.136	002041	56.447	-57.949	002031	-12.569	-55.565
001973	-9.807	-55.558	001963	62.241	-69.496	001961	99.609	69.851	001971	8.485	81.914
YX4	42.992	45.014	YX6A4	41.115	-16.918	YX7A	41.077	-67.532			

1

DMA/IAGS SYSTEM (USGS GIANT)   PROYECTO- BLOQUE DE PRUEBA- ARIZONA- LINEAS 23,24,Y 25   PAGE 2

FRAME 196

PRINCIPAL DISTANCE = -152.520   ST. D. OF X = 0.020   ST. D. OF Y = 0.020

CAMERA STATION PARAMETERS

POSITION				ATTITUDE (GROUND TO PHOTO)			
X =	342574.55	ST. D. =	60000.0000	OMEGA =	0 14 55.999	ST. D. =	90 0 0.0000
Y =	3644431.10	ST. D. =	60000.0000	PHI =	0 48 48.040	ST. D. =	90 0 0.0000
Z =	5127.84	ST. D. =	60000.0000	KAPPA = -	0 25 55.572	ST. D. =	90 0 0.0000

PLATE COORDINATES

ID	X	Y	ID	X	Y	ID	X	Y	ID	X	Y
100001	-88.974	111.234	100002	-97.135	3.970	100003	-95.570	-93.507	100004	[illegible]	[illegible]
100005	0.654	-4.530	100006	-11.345	-88.452	100007	83.824	91.076	100008	87.533	-5.290
100329	88.561	-33.740	002031	-103.909	-50.263	002041	-25.407	-92.190	002051	50.562	[illegible]
001953	75.724	-59.335	001963	-9.564	-63.720	001973	-101.170	-60.839	001971	-84.355	[illegible]
001961	6.730	76.230	001951	95.365	79.518	YX4	-50.158	90.697	YX6A8	-51.165	-11.252
YX7A	-50.780	-51.797									

ANAZTAGS SYSTEM (USGS GIANT)   PROYECTO- BLOQUE DE PRUEBA- ARIZONA- LINEAS 23,24,Y 25

FRAME 231

PRINCIPAL DISTANCE = -152.520   ST. D. OF X = 0.020   ST. D. OF Y = 0.020

CAMERA STATION PARAMETERS

P O S I T I O N		A T T I T U D E (GROUND TO PHOTO)	
X = 352974.52	ST. D. = 60000.0000	OMEGA = 0 0 8.635	ST. D. = 90 0 0.0000
Y = 3641504.08	ST. D. = 60000.0000	PHI = 0 18 54.607	ST. D. = 90 0 0.0000
Z = [illegible]	ST. D. = 60000.0000	KAPPA = - 0 35 11.225	ST. D. = 90 0 0.0000

PLATE COORDINATES

ID	X	Y	ID	X	Y	ID	X	Y	ID	X	Y
300022	-[illegible].734	[illegible]	300023	-[illegible].442	10.[illegible]	XYX3	-89.409	-73.234	300025	-[illegible].113	[illegible].319
300025	-2.437	2.036	300027	-2.556	-73.095	002313	-3.081	-58.072	002323	-49.109	-[illegible].276
002321	-52.047	75.925	002311	-2.327	78.200	002113	-36.994	53.217	002103	-105.691	64.268
7J9AB	-66.042	103.310	7J13A	-85.571	49.003						

G R O U N D   C O N T R O L   D A T A

	X =	340435.29	ST. D. =	1.0000	
YX4	Y =	3702311.14	ST. D. =	1.0000	TYPE = 0
	Z =	325.46	ST. D. =	1.0000	
	X =	340736.42	ST. D. =	1.0000	
Y35AH	Y =	3700755.29	ST. D. =	1.0000	TYPE = 7
	Z =	316.18	ST. D. =	1.0000	
	X =	340477.04	ST. D. =	1.0000	
Y46AH	Y =	3699077.74	ST. D. =	1.0000	TYPE = 7
	Z =	305.30	ST. D. =	1.0000	
	X =	347153.39	ST. D. =	1.0000	
Z44	Y =	3702100.42	ST. D. =	1.0000	TYPE = 0
	Z =	346.32	ST. D. =	1.0000	
	X =	347307.53	ST. D. =	1.0000	
Z45	Y =	3700526.92	ST. D. =	1.0000	TYPE = 0
	Z =	330.44	ST. D. =	1.0000	
	X =	347355.43	ST. D. =	1.0000	
Z46	Y =	3698383.54	ST. D. =	1.0000	TYPE = 0
	Z =	317.28	ST. D. =	1.0000	
	X =	348110.17	ST. D. =	1.0000	
Z87AH	Y =	3697335.72	ST. D. =	1.0000	TYPE = 7
	Z =	300.90	ST. D. =	1.0000	
	X =	353819.31	ST. D. =	1.0000	
ZF5	Y =	3700478.75	ST. D. =	1.0000	TYPE = 0
	Z =	328.95	ST. D. =	1.0000	

G R O U N D   C O N T R O L   D A T A

	X =	3500[illegible]	ST. D. =	1.0000		
XYX3	Y =	3688231.77	ST. D. =	1.0000	TYPE = 0	
	Z =	276.69	ST. D. =	1.0000		
	X =	0.0	ST. D. =	1.0000		
XYX4	Y =	0.0	ST. D. =	1.0000	TYPE = 3	
	Z =	254.77	ST. D. =	1.0000		
	X =	0.0	ST. D. =	1.0000		
	Y =	0.0	ST. D. =	1.0000	TYPE = 0	
	Z =	0.0	ST. D. =	1.0000		

E R R O R   W A R N I N G S

POINTS NOT PHOTOGRAPHED

YA5A1	Z44	Z65	Z65
Z67A4	Z66A	Z37A	YX7A
Z6AB	Z511A	Z611AB	YX11A
XYYJ			

PASS POINTS APPEARING ON 1 PHOTO

002033	300007	002373	300021
002333			

END OF PHASE1

C A M E R A   S T A T I O N S   C O R R E C T I O N S

ITERATION 1

197	POSITION	-11.9	-5.1	-2.8	ATTITUDE	0.000804706	-0.001964529	-0.000537352
196	POSITION	-19.5	-5.5	3.7	ATTITUDE	0.000455551	-0.001911164	-0.000432732
195	POSITION	-2.7	-5.1	7.3	ATTITUDE	0.000386853	-0.000849867	0.000143571
194	POSITION	8.3	-7.4	8.3	ATTITUDE	0.000869689	0.000414834	0.000315221
193	POSITION	13.2	-11.7	4.1	ATTITUDE	0.001444558	0.001552793	-0.000567933
192	POSITION	14.9	-4.2	-1.4	ATTITUDE	-0.000064527	0.001583430	-0.001067227
191	POSITION	10.5	2.9	-5.0	ATTITUDE	-0.001405914	0.000410017	-0.000537948
190	POSITION	3.3	-2.8	-5.3	ATTITUDE	-0.000737573	-0.000100358	-0.000127639
189	POSITION	1.4	-3.1	-5.0	ATTITUDE	-0.000735448	-0.000092378	-0.000075388
203	POSITION	-5.4	-12.5	-3.9	ATTITUDE	0.002231654	0.000474300	-0.001839409
204	POSITION	-32.5	-9.2	0.3	ATTITUDE	0.000395813	-0.003909279	-0.003520778
205	POSITION	-7.2	14.0	11.9	ATTITUDE	-0.004291500	-0.001064552	-0.001006769
206	POSITION	14.5	-14.3	7.3	ATTITUDE	0.000524585	0.000977925	0.001684165
207	POSITION	13.9	-9.3	2.3	ATTITUDE	0.000257677	0.001756042	0.001245045
208	POSITION	11.5	-3.3	-1.0	ATTITUDE	-0.000116846	0.000554814	0.000355565
210	POSITION	7.0	-0.1	-1.3	ATTITUDE	-0.000544354	0.000085256	-0.000011513
212	POSITION	3.3	3.3	-1.4	ATTITUDE	-0.000679191	-0.000218536	-0.000109025
211	POSITION	-0.1	1.5	-0.7	ATTITUDE	-0.000796457	-0.000445154	-0.000022501
237	POSITION	33.9	-144.5	-36.7	ATTITUDE	0.020135796	-0.000489650	0.011005150
236	POSITION	9.3	-41.5	-19.6	ATTITUDE	0.006067932	-0.001778023	0.003594863
235	POSITION	7.2	-32.5	-15.7	ATTITUDE	0.007325941	-0.001058101	0.001114097
234	POSITION	5.3	-25.3	-11.7	ATTITUDE	0.005174497	-0.000553338	0.000233896
233	POSITION	4.4	-5.8	-2.9	ATTITUDE	0.001275719	-0.000100939	-0.000179958
232	POSITION	1.5	-5.4	-2.3	ATTITUDE	0.001061160	-0.000155479	-0.000331652
231	POSITION	-9.4	-5.1	-1.8	ATTITUDE	0.000891086	-0.000165122	-0.000370903

WEIGHTED SUM OF SQUARES = 53550.6

ITERATION 2

197	POSITION	-0.1	-0.0	-0.1	ATTITUDE	0.000003531	-0.000023501	0.000001595
196	POSITION	-0.1	-0.0	-0.0	ATTITUDE	0.000003799	-0.000016478	-0.000001693
195	POSITION	-0.1	-0.1	0.0	ATTITUDE	0.000011250	0.000000291	-0.000006087
194	POSITION	-0.1	-0.0	0.0	ATTITUDE	0.000001104	0.000007269	-0.000007625
193	POSITION	-0.1	-0.0	-0.0	ATTITUDE	-0.000003862	0.000000584	-0.000002392
192	POSITION	-0.1	-0.0	0.0	ATTITUDE	0.000003507	0.000000025	0.000001773
191	POSITION	-0.0	-0.0	0.0	ATTITUDE	-0.000000895	-0.000000722	0.000002438
190	POSITION	0.0	-0.0	0.0	ATTITUDE	0.000001423	0.000001528	0.000004028
189	POSITION	0.0	-0.0	0.0	ATTITUDE	0.000000958	0.000002828	0.000004539
213	POSITION	-0.3	0.1	-0.2	ATTITUDE	-0.000001440	-0.000058698	-0.000009719
214	POSITION	-0.2	0.3	-0.1	ATTITUDE	-0.000030584	-0.000034955	-0.000005620
215	POSITION	-0.0	0.0	-0.1	ATTITUDE	0.000015208	0.000015163	-0.000015129
216	POSITION	-0.1	0.1	0.1	ATTITUDE	-0.000026245	0.000007209	-0.000023663

147	POSITION	-0.0	-0.0	-0.0	ATTITUDE	0.000000012	-0.000000125	0.000000003
146	POSITION	-0.0	-0.0	-0.0	ATTITUDE	0.000000029	-0.000000113	0.000000000
145	POSITION	-0.0	0.0	0.0	ATTITUDE	-0.000000018	-0.000000028	-0.000000001
144	POSITION	0.0	0.0	0.0	ATTITUDE	-0.000000011	0.000000033	-0.000000037
143	POSITION	0.0	-0.0	0.0	ATTITUDE	0.000000045	0.000000050	-0.000000016
142	POSITION	0.0	-0.0	-0.0	ATTITUDE	0.000000022	0.000000019	-0.000000016
141	POSITION	-0.0	-0.0	-0.0	ATTITUDE	0.000000015	-0.000000012	0.000000003
140	POSITION	-0.0	-0.0	-0.0	ATTITUDE	0.000000015	-0.000000014	0.000000001
139	POSITION	-0.0	-0.0	0.0	ATTITUDE	0.000000011	-0.000000018	-0.000000004
203	POSITION	-0.0	0.0	-0.0	ATTITUDE	-0.000000037	-0.000000157	-0.000000032
204	POSITION	-0.0	0.0	-0.0	ATTITUDE	-0.000000091	-0.000000184	-0.000000028
205	POSITION	-0.0	0.0	0.0	ATTITUDE	-0.000000138	-0.000000212	-0.000000032
206	POSITION	0.0	0.0	0.0	ATTITUDE	-0.000000135	0.000000020	-0.000000031
207	POSITION	0.0	0.0	0.0	ATTITUDE	-0.000000179	0.000000354	0.000000021
208	POSITION	0.0	-0.0	-0.0	ATTITUDE	0.000000020	0.000000014	0.000000012
209	POSITION	-0.0	0.0	-0.0	ATTITUDE	-0.000000013	-0.000000024	0.000000005
210	POSITION	-0.0	-0.0	-0.0	ATTITUDE	0.000000003	-0.000000019	0.000000003
211	POSITION	-0.0	-0.0	-0.0	ATTITUDE	-0.000000004	-0.000000015	0.000000002
237	POSITION	0.0	-0.0	0.0	ATTITUDE	0.000000071	0.000001755	0.000000240
236	POSITION	0.0	-0.0	0.0	ATTITUDE	0.000000232	0.000000348	0.000000103
235	POSITION	0.0	-0.0	-0.0	ATTITUDE	0.000000336	0.000000117	0.000000065
234	POSITION	-0.0	-0.0	-0.0	ATTITUDE	0.000000264	-0.000000039	-0.000000007
233	POSITION	-0.0	0.0	-0.0	ATTITUDE	-0.000000007	-0.000000004	-0.000000015
232	POSITION	-0.0	0.0	-0.0	ATTITUDE	-0.000000011	0.000000011	-0.000000003
231	POSITION	-0.0	0.0	-0.0	ATTITUDE	-0.000000003	0.000000010	0.000000004

WEIGHTED SUM OF SQUARES = 1011.2

T R I A N G U L A T E D   G R O U N D   P O I N T S   R E S I D U A L S

100001		197	196				
100002		197	196				
100003		197	195				
100004		197	196	195			
100005		196	197	195			
100006		197	196	195			
002041		195	197	203	204	205	
002031		197	204	196	203		
001973		197	196				
001963		203	195	204	197	196	205
001951		195	197	196			
001971		197	196				
YA4	***	196	197				

T R I A N G U L A T E D G R O U N D P O I N T S R E S I D U A L S

300025	231	232
300026	231	232
300027	231	232
002313	231	232

WEIGHTED SUM OF SQUARES = 943.0 DEGREES OF FREEDOM = 5[illegible]

APPENDIX G

SAMPLE OUTPUT

FROM GISRT

PROYECTO- BLOQUE DE [illegible] LINEAS 23,24,Y 25

CAMERA SYSTEM CARD LISTING

RCM -152.520

FRAME ID AND IMAGE COORDINATE LISTING

197	-152.520	0.020	0.020		1
100001	3.929	[illegible].267		197	
100002	-7.171	-1.[illegible]		197	
100003	-4.548	-[illegible].422		197	
100004	93.378	93.489		197	
100005	92.819	-14.554		197	
100006	42.256	-[illegible].135		197	
002061	65.447	-57.640		197	
002031	-12.5[illegible]	-[illegible].865		197	
001973	-9.817	-55.558		197	
001953	92.241	-59.496		197	
001961	94.509	69.553		197	
001971	3.637	81.914		197	
YX6	42.942	45.014		197	
YX[illegible]	41.119	-1[illegible]		197	
YX7A	41.077	-67.532		197	
****	0.0	0.0		197	
196	-152.520	0.020	0.020		1
100001	-53.979	101.234		196	
100002	-49.135	3.970		196	
100003	-93.570	-84.507		196	
100004	0.354	90.169		196	
100005	2.554	-8.538		196	
100006	-11.345	-80.452		196	
100007	83.823	31.076		196	
100008	87.533	-5.296		196	
100009	44.551	-30.740		196	
002031	-103.904	-56.243		196	
002041	-25.937	-62.196		196	
002051	50.626	-68.379		196	
001953	76.729	-59.336		196	
001963	-9.564	-53.720		196	
001973	-101.170	-[illegible]		196	
001971	-83.345	45.969		196	
001961	6.739	75.530		196	

001943	87.015	-75.765		195	
001933	-13.255	[illegible]		195	
001963	-101.340	-82.337		195	
002051	-41.215	-50.257		195	
002061	82.154	-75.416		195	
001941	57.235	77.352		195	
001951	2.443	80.127		195	
001961	[illegible]	77.651		195	
7848	52.374	90.425		195	
245	82.745	-11.040		195	
78785	85.449	-53.659		195	
••••	0.0	0.0		195	
194	-152.520	0.020	0.020		1
100007	-103.355	[illegible]		194	
100008	-94.711	[illegible]		194	
100009	-98.704	-43.915		194	
100010	-6.421	93.367		194	
100011	-5.295	[illegible]		194	
100012	-4.149	-85.536		194	
100013	[illegible]	95.555		194	
100014	82.459	-5.045		194	
100015	93.757	-35.438		194	
002071	56.455	-51.180		194	
002051	-43.270	-71.487		194	
001953	-110.426	-54.536		194	
001943	[illegible]	-72.154		194	
001933	78.755	-73.266		194	
001931	55.219	53.092		194	
001941	-5.021	80.591		194	
001951	-92.074	83.314		194	
7848	-32.707	94.137		194	
245	-12.581	-7.777		194	
78788	-8.411	-60.070		194	
••••	0.0	0.0		194	
193	-152.520	0.020	0.020		1
100010	-92.813	95.926		193	
100011	-94.255	-4.882		193	
100012	-101.407	-42.369		193	
100013	-7.832	87.517		193	
100014	-9.495	-3.857		193	
100015	0.752	-83.557		193	
100016	97.038	85.033		193	
100018	77.057	-45.012		193	
002041	59.555	-71.745		193	
002071	-25.770	-58.888		193	
001943	-101.415	-53.558		193	

FRAME POSITION AND ATTITUDE CARDS

197	339554.750	3690595.000	5144.035	0.	0.	0.
197	1452.174	-1461.243	231.745	0.	0.	0.
196	342574.525	3699401.000	5127.844	0.	0.	0.
196	1455.499	4544.339	-2555.572	0.	0.	0.
195	345438.500	3699270.000	5114.692	0.	0.	0.
195	5531.512	1102.092	-2090.773	0.	0.	0.
194	348373.645	3699160.000	5123.945	0.	0.	0.
194	4343.945	-5910.459	-3409.945	0.	0.	0.
193	351243.063	3699044.000	5131.645	0.	0.	0.
193	5725.451	315.341	750.534	0.	0.	0.
192	354217.434	3698872.000	5147.141	0.	0.	0.
192	10501.581	144.447	-5520.035	0.	0.	0.
191	357111.563	3698565.000	5150.644	0.	0.	0.
191	11541.471	2527.423	-4352.612	0.	0.	0.
190	359419.375	3698575.000	5150.828	0.	0.	0.
190	-1211.543	-443.576	-4443.148	0.	0.	0.
189	352478.813	3698563.000	5144.345	0.	0.	0.
189	2411.224	3455.424	-3334.424	0.	0.	0.
203	335554.375	3695140.000	5137.504	0.	0.	0.
203	11012.824	541.135	-15215.922	0.	0.	0.
204	341532.063	3695067.000	5133.375	0.	0.	0.
204	610.021	4452.537	-1451.614	0.	0.	0.
205	344422.475	3695065.000	5108.495	0.	0.	0.
205	2415.504	605.535	-3933.432	0.	0.	0.
206	347321.000	3695115.000	5111.906	0.	0.	0.
206	4910.172	-343.457	-21348.453	0.	0.	0.
207	350255.813	3695037.000	5109.918	0.	0.	0.
207	11512.243	4051.023	-13023.926	0.	0.	0.
208	353271.375	3694455.000	5065.245	0.	0.	0.
208	2107.032	4504.941	-11924.251	0.	0.	0.
209	355031.434	3694482.000	5087.121	0.	0.	0.
209	5424.063	-3157.752	-352.859	0.	0.	0.
210	359421.813	3694775.000	5091.347	0.	0.	0.
210	4549.544	-435.518	-5551.401	0.	0.	0.
211	361616.751	3694694.000	5080.184	0.	0.	0.
211	553.543	644.570	-312.908	0.	0.	0.
237	345127.313	3690865.000	5144.925	0.	0.	0.
237	-15734.078	115.571	-15254.752	0.	0.	0.
236	348145.813	3690803.000	5145.137	0.	0.	0.
236	-1665.441	-3331.068	-2553.071	0.	0.	0.
235	351042.250	3690509.000	5168.734	0.	0.	0.
235	-24902.024	-5814.324	-5413.766	0.	0.	0.

7J6	360242.648	3701364.000	322.550	0.	0.	0.	0
7J7A	350213.500	3637167.000	263.500	0.	0.	0.	0
7J5	360241.125	3700633.000	304.710	0.	0.	0.	7
7J4A3	360150.500	3625500.000	271.400	0.	0.	0.	7
YX4A4	340815.625	3542266.000	274.400	0.	0.	0.	0
YX10A4	340813.375	3542639.000	256.500	0.	0.	0.	0
YXMA4	340883.313	3545577.000	244.200	0.	0.	0.	0
YX7A	340576.000	3547668.000	297.400	0.	0.	0.	0
7H4A4	347242.063	3644174.000	275.000	0.	0.	0.	7
7H103	347254.813	3542517.000	262.000	0.	0.	0.	7
7E10A4	353701.938	3642418.000	255.900	0.	0.	0.	0
7E9A4	353752.875	3636050.000	264.400	0.	0.	0.	7
7J7A	350201.250	3637191.000	266.100	0.	0.	0.	0
7J9A4	350146.125	3643429.000	254.400	0.	0.	0.	0
7J10A	350185.875	3632240.000	264.000	0.	0.	0.	7
YX7A	340875.875	3637473.000	237.300	0.	0.	0.	0
7H6A	347357.438	3702206.000	345.500	0.	0.	0.	0
7HHA	347303.500	3645783.000	244.200	0.	0.	0.	0
7EHA	353715.875	3645555.000	282.200	0.	0.	0.	0
7EHA	353752.813	3645626.000	261.400	0.	0.	0.	7
7J11A	350069.813	3640715.000	258.700	0.	0.	0.	7
7H11A4	347645.438	3640474.000	251.500	0.	0.	0.	0
YX11A	340764.563	3691029.000	255.100	0.	0.	0.	0
XYX0	341492.563	3644756.000	241.500	0.	0.	0.	7
002381	342414.538	3643350.000	270.100	0.	0.	0.	4
XYX1	345041.563	3647447.000	240.800	0.	0.	0.	4
XYX2	0.0	0.0	244.540	0.	0.	0.	3
XYX3	350031.000	3648241.000	275.500	0.	0.	0.	0
XYX4	0.0	0.0	254.770	0.	0.	0.	3
	0.0	0.0	0.0	0.	0.	0.	0

STRIP	NUMBER OF FRAMES
1	[illegible]
2	[illegible]
3	7

TOTAL NUMBER OF FRAMES 25

CONTROL POINT	STRIP	FRAMES		BANDWIDTH
100001	1	197	196	2
100002	1	197	196	2

	100004	1	197	196	195	3
	100005	1	197	196	195	3
	100006	1	197	196	195	3
	002041	1	197	196		12
		2	213	204	205	
	002031	1	197	196		11
		2	203	204		
	001974	1	197	196		2
	001963	1	197	196	195	12
		2	203	204	205	
	001961	1	197	196	195	3
	001971	1	197	196		2
0	Y*4	1	197	196		2
7	Y*5A8	1	197	196		2
0	Y*7	1	197	196		12
		2	203	204	205	
	100007	1	196	195	194	3
	100008	1	196	195	194	3
	100003	1	196	195	194	3
	002051	1	196	195		12
		2	204	205	206	
	001953	1	196	195	194	12
		2	204	205	206	
	001951	1	196	195	194	3
	100010	1	195	194	193	3
	100011	1	195	194	193	3

END

DATE
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