August 1988

EUROPEAN ORGANIZATION FOR EXPERIMENTAL PHOTOGRAMMETRIC RESEARCH

MAP COMPILATION AND REVISION IN DEVELOPING AREAS

TEST OF LARGE FORMAT CAMERA IMAGERY

Report by J. Rollin and I. J. Dowman

OEEPE

Official Publication N° 22

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Map Compilation and Revision in Developing Areas

Test of Large Format Camera Imagery

(with 3 Figures, 9 Tables and 3 Appendices)

Report by J. Rollin and I. J. Dowman

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Map Compilation and Revision in Developing Areas

Test of Large Format Camera Imagery

Report by J. Rollin and I. J. Dowman

ABSTRACT: Following successful acquisition of Large Format Camera (LFC) photography by the Space Shuttle Challenger in October 1984 OEEPE commissioned an evaluation to be administered by the Ordnance Survey (GB). An area of the Sudan was selected, for which ground control and colour infra-red LFC imagery at 1 : 730,000 image scale was readily available.

Eleven photogrammetric organisations throughout Europe took part in the test which involved setting one model, observing check points and producing detail and contour plots at 1 : 100,000 scale. Not all participants had sufficient resources to complete the entire test.

Many participants encountered problems transferring ground control and check points to the imagery from reduced aerial photographs supplied. The average root mean square error after absolute orientation to a maximum of ten control points was 33 m in plan and 11 m in height. Given a film resolution of 19 m per line pair at 225 km orbit this was not considered to be excessive. The average corresponding rmse for check points from six participants was 187 m in plan and 30 m height. This deterioration in fit of five or six times may be attributable to the poor resolution of the LFC colour IR imagery and/or the difficulties encountered with control point transfer. The superior fit in height compared to plan in all cases tends to support this argument.

Only major features could be interpreted with confidence in the model and topographic detail plots suffered as a consequence. Five to ten per cent of this model was obscured by cloud, shadow or valley mist. This limited the completion of contour plots and reduced plotting accuracy in these areas.

The results clearly demonstrate that this scale of colour infra-red photography has insufficient resolution and is therefore unsuitable for topographic mapping and photomapping at 1 : 100,000 scale. However, certain extraneous limitations were imposed by the test design, and it is recommended that any future test of this nature should adopt directly-identifiable topographic points as control to eliminate the need for control point transfer.

RÉSUMÉ: Suite à l'acquisition réussie de clichés spatiaux avec la Chambre photogrammétrique à grand format (LFC), lors du vol de la navette spatiale Challenger en Octobre 1984, l'OEEPE chargea l'Ordnance Survey (GB) de procéder à leur évaluation. On s'orienta vers l'étude d'une zone au Soudan, sur laquelle étaient effectivement disponibles un équipement en points connus au sol et des images infra-rouge couleurs au 1/730 000 de la LFC.

Onze organismes photogrammétriques européens participèrent à cet essai qui comporta la mise en place d'un couple, l'observation de points de vérification et la restitution de planches de planimétrie et de courbes de niveau à l'échelle du 1/100 000. Tous les participants n'eurent pas les moyens leur permettant d'effectuer l'ensemble du test.

De nombreux participants éprouvèrent des difficultés à reporter sur les images LFC les points d'appui et de vérification pris sur les photographies aériennes qui leur étaient fournies a un format réduit. L'erreur moyenne quadratique après orientation absolue sur un maximum de 10 points d'appui, était de 33 m en planimétrie et 11 m en altimétrie. Etant donné la résolution du film qui était 19 m pour une paire de traits, avec une orbite à 225 km, ces chiffres ne paraissent pas excessifs. L'erreur moyenne quadratique correspondante sur les points de vérification a atteint la valeur de 187 m en plani et 30 m en altimétrie, valeur moyenneé sur 6 participants. On peut attribuer cette dégradation d'un facteur de 5 ou 6 sur les résultats, à la mauvaise résolution de l'image IRC de la LFC et/ou aux difficultés rencontrées dans le report des points de canevas. Le meilleur résultat obtenu chaque fois en altimétrie par rapport à la planimétrie tend à confirmer cette explication.

Il n'a été possible d'interpréter avec certitude que les détails principaux du modèle, ce qui a nui directement à la qualité de la restitution de la topographie. Environ 5 a 10 % du modèle était oblitéré par des nuages, des ombres ou de la brume de vallée. Il en est résulté des manques dans la planche de courbes et une réduction de la précision dans les zones correspondantes.

Les résultats montrent clairement que les clichés IRC à cette échelle ont une résolution insuffisante pour convenir à la cartographie topographique au trait ou à la photocartographie au 1/100 000. Toutefois certaines perturbations se sont introduites dans cet essai et on recommande dans tout essai ultérieur de ce genre, d'adopter comme points d'appui des points directement identifiables par la topographie, pour éviter de recourir à des opérations de report des points de canevas.

ZUSAMMENFASSUNG: Nach der erfolgreichen Aufnahme von Satellitenbildern mit der Large Format Camera während des Fluges der Raumfähre Challenger im Oktober 1984 beauftragte die OEEPE den Ordnance Survey (GB) mit ihrer Auswertung. Es wurde ein Gebiet des Sudan ausgewählt, von dem bereits Paßpunkte und Infrarot-Farbbilder der LFC im Maßstab 1 : 730 000 vorhanden waren.

Elf photogrammetrische Organisationen in ganz Europa beteiligten sich an dem Test, der in der Aufstellung eines Modells, der Beobachtung von Kontrollpunkten und der Kartierung der Lage- und Höhensituation im Maßstab 1 : 100 000 bestand. Manche Teilnehmer konnten jedoch aufgrund unzureichender Mittel nicht den gesamten Test ausführen.

Viele Teilnehmer hatten Probleme bei der Übertragung von Paßpunkten und Kontrollpunkten aus den verkleinerten Luftbildern auf die LFC-Bilder. Der mittlere quadratische Fehler nach der absoluten Orientierung bei maximal 10 Paßpunkten betrug 33 m in der Lage und 11 m in der Höhe. Bei einer Filmauflösung von 19 m pro Linienpaar bei einer Umlaufbahn in 225 km Höhe ist dies nicht übermäßig viel. Der entsprechende mittlere quadratische Fehler für Kontrollpunkte lag bei sechs Teilnehmern im Durchschnitt bei 187 m in der Lage und 30 m in der Höhe. Diese 5 bzw. 6mal größere Abweichung kann der schlechten Auflösung der LFC-Infrarotbilder und/ oder den Schwierigkeiten bei der Paßpunktübertragung zugeschrieben werden. Das im Vergleich zur Lage bessere Höhenergebnis scheint diese Erklärung zu erhärten.

Nur die Hauptobjekte konnten mit Sicherheit im Modell identifiziert werden; dadurch litt dann die Auswertung der Topographie. Etwa 5—10 % dieses Modells waren durch Wolken, Schatten oder Talnebel verdeckt. Dies beeinträchtigte die Höhendarstellung und verringerte die Auswertegenauigkeit in diesen Gebieten.

Die Ergebnisse zeigen deutlich, daß bei diesem Maßstab die Infrarot-Farbbilder eine unzureichende Auflösung aufweisen und daher für die Herstellung von topographischen Karten und Bildkarten im Maßstab 1 : 100 000 ungeeignet sind. Jedoch ergaben sich durch die Versuchsanordnung bestimmte äußere Einschränkungen, und es wird für jeden künftigen Versuch empfohlen, daß als Paßpunkte direkt identifizierbare topographische Punkte gewählt werden, damit eine Paßpunktübertragung vermieden werden kann.

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K. Amdal	Division of Geodesy and Photogrammetry, Norwegian Institute of Technology, Trondheim, Norway.
Dr. *I. J. Dowman*	University College London, United Kingdom.

A further word of thanks must go to the Ordnance Survey staff who have contributed to the evaluation. Particular thanks are due to *Keith Murray* for his work in the compilation of this report.

1 Introduction

1.1 Mapping in Developing Countries

The deficiencies in world mapping at any scale are well documented (*Brandenberger* and *Ghosh* 1985). While many techniques are available to the cartographer a solution that provides a national map series at an acceptable cost to a developing country has yet to be established.

1.2 The OEEPE Working Party

In 1984 the OEEPE Steering Committee provided the framework to formulate a series of tests aimed at providing new mapping or revising existing mapping in developing countries utilising satellite data. A Working Party was formed and met in June 1985 to establish project proposals which included an investigation of Space Shuttle borne photographic imagery from the Itek Large Format Camera and Zeiss Metric Camera on Flight 2, and the SPOT HRV CCD linear array sensor (*Dowman, Forbes* and *Mayes* 1985).

The Steering Committee meeting of November 1985 in Lausanne approved the proposals and the Ordnance Survey (GB) was commissioned to act as pilot centre.

This is the report of the first of those tests: the Large Format Camera.

2 The Evaluation

2.1 Timescale

The Working Party set the following timescale for the test:

- December 1985 Call for participants.
- April 1986 Commence LFC Test.
- June 1986 Complete LFC Test.
- October 1986 Pilot Centre to submit Draft Report.

2.2 The Test Site

The economic application of space photography rests on its suitability for mapping large areas of land with the minimum of ground control. A longer term objective is to be able to dispense with ground control completely. This test sought to apply existing techniques to a new source of imagery. The problems associated with mapping developing countries are universally appreciated and for this test an area was chosen with an environment typical of the envisaged application. Test data was immediately available in June 1985 of an area surrounding Kassala in the Sudan.

2.3 *The Test Data*

2.3.1 The Ordnance Survey was involved in a project supplying 1 : 100,000 mapping to Sudan in the early 1980s. As a consequence the ground control supplied for that project was immediately available. The type of control point used in this test varied from instrumental stations to aerial triangulation tie-points. Figure 1 shows the test site, the coverage by LFC images and the positions of control and check points. Appendix B contains more information.

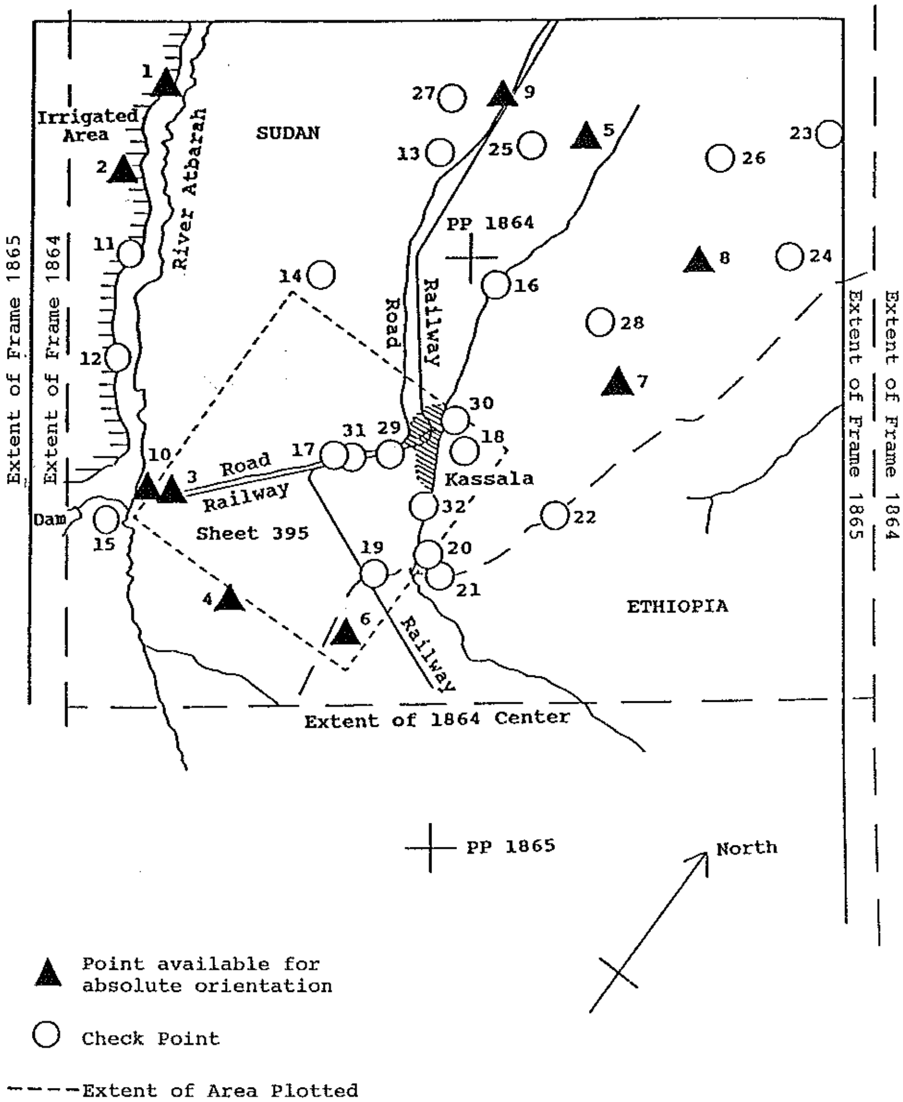


Figure 1 — The Test Site

2.3.2 Photography had been acquired during the Space Shuttle mission STS 41-G in October 1984. The Shuttle Challenger was launched on 5th October with an orbital inclination of 57 degrees and held the Itek Large Format Camera (LFC) fitted with two Attitude Reference System (ARS) cameras in the cargo bay. The magazine held six types of film spliced together in 10 sections to form a continuous 2400 frame roll (*Merkel, Salmon, Sims* and *Mollberg* 1985).

Doyle (1984) made a preliminary inspection of the frames and reported some excellent imagery. Three strips of imagery were acquired of north-eastern Africa from different orbits. The last of these covered the eastern Sudan for which control values were available. The exposures, at approximately 11.00 hours GMT, were recorded on Kodak SO-131 High Definition Aerochrome Colour Infra-Red Reversal film. Curiously frames exposed 10 minutes earlier over the UK were reported as being "out of focus" (*Doyle* 1984). It appears that whenever the exposure time was set at 23.5 milliseconds, there was a problem with the forward motion compensation which resulted in images being smeared. All film was released from the Johnson Space Centre to Eros Data Centre (EDC) in early 1985.

2.4 The Test Design

The test was designed to be objective but of short duration since the resources of the majority of participants was limited. The test involved:

— the transfer of ground control from air photos to LFC image,

— the restoration and absolute orientation of the model,

— co-ordinating 22 check points,

— the preparation of detail and contour plots at 1 : 100,000 scale.

Adjacent 1 : 100,000 map sheets were to be used as a source of map specification. Participants were required to provide computer print-outs where applicable and were encouraged to provide additional comments on all aspects of the test.

2.5 Preparation for the Test

2.5.1 Following the Working Party meeting of 25th June 1985, a suitable site was identified on microfiche and three 230 mm × 230 mm frames of the Sudan were ordered. The frame numbers were 1863-Fore, 1864-Centre, and 1865-Aft. The two adjacent models were formed with sixty per cent overlap. Unfortunately there was some confusion over the fore and aft sections of the order and it was not until November 1985 that the required frames were successfully delivered to Ordnance Survey.

2.5.2 The imagery was passed to the Photogrammetric Section at OS who were charged with transferring control and setting the models with both UTM and Geocentric co-ordinates. At each stage the operators assessed the ease and quality of transfer and setting. From these results ten points were selected for absolute orientation and the remainder left as check points.

2.5.3 The Sudan Survey Department was approached for permission to use local survey data and a 1 : 100,000 map sheet as specification for the test. This was granted.

2.5.4 A communication calling for participants was sent to all OEEPE national delegates in January 1986. Any organisation wishing to take part in the evaluation was requested to register an interest. There was a good response and when the test commenced in June 1986 there were 15 participating bodies. See Appendix A for further details.

2.5.5 Following the photogrammetric tests an order was placed with EDC in March 1986 for sufficient imagery to supply 12 participants (some users were to share photography). Model 1864–65 had been selected. The materials and copies of mission ephemeris/camera calibration data were received in late May 1986.

2.6 Distribution of Materials

The material was distributed in June 1986 and consisted of:

- Frames 1864 and 1865
- Reduced aerial photographs with controls marked
- Control point co-ordinates
- Control point descriptions
- General instructions
- Mission ephemeris/camera calibration
- Overlay showing control
- SSD 1 : 100,000 map plot
- Results sheet.

See Appendix C for more details.

2.7 Replacement of Imagery

After distribution of the data in June 1986 many participants complained of the poor resolution and grainy appearance of the copies. Examples of the poor imagery, together with an original frame, were forwarded to EDC as evidence for replacement. The entire batch was replaced in August 1986, and EDC confessed to having had "processing problems" with the previous order. A new set of diapositives was distributed to each participant in September 1986. University College London (UCL) obtained their imagery directly from EDC.

3 Results

3.1 Timescale

The timescale of the test was extended owing to the delays experienced acquiring imagery from EDC. The completion date was extended from June to December 1986 and finally to April 1987. The draft report was submitted in late April 1987.

3.2 Participants

Two new participants were added to the original list given at Appendix A, and two participants withdrew. The University of Newcastle in UK did not possess an analytical restitution instrument and therefore was unable to take part. In addition the Institute of Photogrammetry and Geodesy in Zurich withdrew owing to the poor quality of the imagery. A further participant withdrew for similar reasons but re-entered when the replacement images were supplied in September 1986. At the end of the test there had been no response from four of the participants.

3.3 Equipment and Software

The test demanded access to an analytical restitution instrument. Table 1 demonstrates the range of equipment and software used in the test.

Table 1 — Equipment and Software Used by Participants

Participant	Hardware	Software
1. RCJ, Austria	Kern DSR-1	CRISP
2. IGN, Belgium	Matra Traster 77	Standard
3. GLGI, Finland	Kern DSR-1	Std./GLGI
4. IGN, France	Matra Traster 1	Standard
5. IfAG, FRG	Zeiss Planicomp C 100	Standard
6. IT, Italy	Zeiss Planicomp	Standard
7. Eurosense, Belgium	Wild AC 1	Standard
8. SK, Norway	Wild BC 2	Standard
9. NIT, Norway	Kern DSR-11	Standard
10. UCL, England	Kern DSR-1	Standard
11. OS, GB	Kern DSR-11	Standard

3.4 Transfer of Control Points

3.4.1 The majority of participants found this aspect to be the most difficult part of the test. There was an almost universal expression of disappointment from users regarding the quality of the imagery. Although the replacement imagery was considered to be an improvement, resolution and identification problems remained a serious obstacle to a successful completion of the test. Table 2 shows the different methods adopted.

Table 2 — Method of Control Point Transfer

Participant	Method of Transfer	Comments
1. RCJ	Inspection	No transfer device
2. IGN (B)	Transf. from LFC enlargement by stereoscope	No transfer device
3. GLGI	AT computation of plate co-ords. Insufficient accuracy-test abandoned	
4. IGN (F)	Inspection	No equipment used
5. IfAG	Inspection	No equipment used
6. IT	Both transfer device and inspection unsatisfactory. Rigorous absolute orientation not attempted	
7. EUROSENSE	Transfer from LFC enlargement by stereoscope	Zeiss Seg V
8. SK	Inspection	No equipment used
9. NIT	Inspection	No equipment used
10. UCL	Inspection	No equipment used
11. OS	Wild Pug 4 used: false colour caused identification problems	

3.4.2 Few users had access to a point transfer device, so most relied on inspection at the appropriate stage. Two participants enlarged the LFC image and used a stereoscope to mark the LFC enlargement before reducing to the normal LFC size and performing a second transfer. Aerial triangulation software was applied in one case in an attempt to determine LFC plate co-ordinates, but this was unsuccessful.

3.4.3 Where a transfer device was available the poor image quality and the need to view the plate in reverse reading mode precluded the formation of a good fit in most cases. The false colour of the vegetation often resulted in identification problems when matching the panchromatic aerial image to the LFC image.

3.4.4 The majority of control points were small features e. g. isolated bushes employed in the Sudan small scale mapping and as a consequence not identifiable on the LFC image. In such cases the observer has to rely on matching surrounding features, where available.

3.5 *Inner Orientation*

3.5.1 The results of inner orientation are given in Table 3. The problems associated this aspect of the test were generally related to the poor resolution of the fiducial mark which was often feint. Research Centre Joanneum (RCJ), Austria, measured the associated cross arms in order to try to improve positioning. However, there was no significant difference in the result compared with single point measurement.

Table 3 — Results of Inner Orientation (Residuals in Micrometres)

Participant	Ph. Nos./ No. Pts.	Max. Res. L	Max. Res. R	rmsve L	rmsve R	Transformation
1. RCJ	1865-64 7 6	x : 38 y : 12	10 8	24	10	Affine
2. IGN (B)	1864-65 6 6	x : 9 y : 9	11 12	8	13	Affine
3. GLGI	Not completed to this stage					
4. IGN (F)	No details available					Conformal
5. IfAG	x scale: L/1.000174 R/1.000170 y scale: L/1.000174 R/1.000170 Loss in rect: L/0.000000 R/0.000000					Affine
6. IT	x scale: L/0.999532 R/0.999936 y scale: L/0.999334 R/0.999415 Loss in rect: L/0.00005 R/0.00016					Affine
7. EUROSENSE	1864-65 6 6	x : 12 y : 12	22 10	14	21	Affine
8. SK	1864-65 4 4	x : 15 y : 10	22 0	18	22	Affine
9. NIT	1864-65 6 7	x : 8 y : 10	12 0	9	13	Affine
10. UCL	1865-64 7 6	x : 41 y : 19	22 21	27	22	Conformal
11. OS	1865-64 7 6	x : 47 y : 2	8 2	26	7	Affine

Note:

Unfortunately manufacturers do not conform to a common statistical method of displaying the results of each orientation. To provide some uniformity in these results, the values given have been reassessed in terms of root mean square error where necessary.

3.5.2 The majority of users applied an affine transformation at this stage. There were particular problems. Statens Kartverk, Norway, for instance found inner orientation impossible to achieve for the aft image, 1865. In order to perform interpretation tests and provide detail plots, the calibration data from frame 1864 centre was applied to 1865. The consequencial distortion to the geometry was accepted by Statens Kartverk and is clearly evident in later results. The various corrections which participants made to the plate coordinates are given in Table 4. None of the participants used the focal plane reseau to correct for film distortion, which was the procedure anticipated by USGS.

Table 4 — Corrections to Plate Coordinates

Participant	Lens Distortion		Earth Curv.	Atmos. Refraction
	Radial	Tang.		
1. RCJ	No	No	No	No
2. IGN (B)	Yes	No	No	No
3. GLGI	Not completed to this stage			
4. IGN (F)	Yes	No	No	No
5. IfAG	Yes	No	Yes	No
6. IT	No details available			
7. EUROSENSE	Yes	No	No	No
8. SK	No	No	Yes	No
9. NIT	Yes	No	No	No
10. UCL	Yes	No	Yes	Yes
11. OS	Yes	No	Yes	Yes

3.6 *Relative Orientation*

Four participants employed one-step model setting programs while the remainder utilised distinct relative and absolute orientations. The average rms y parallax, with one exception, was 4.2 μm. From Table 5 it is evident that the majority of observers obtained a figure of less than 10 μm, whilst maximum residual y parallax at any setting point rarely exceeded 20 μm. The number of points used ranged from 6 to 23.

3.7 *Absolute Orientation*

The results of absolute orientation varied significantly. Only one participant employed geocentric co-ordinates and the results are presented here in geocentric form. They therefore do not directly relate to the results of other users.

Istituto di Topografia, Italy, provided only an approximate scaling owing to poor imagery and point identification to execute the interpretation and plotting aspects of the test.

Of the ten control points provided only 7 or 8 could be identified in most cases. The average rmse was 33 m [46 μm at photo scale] in plan and 11 m [15 μm] in height. These figures exclude the geocentric results from RCJ, and the results from Statens Kartverk and Eurosense. There is a 2 or 3 times improvement in fit in height with respect to plan. This is clearly seen in the results given in Table 6.

Table 5 — Results of Relative Orientation

Participant	Type	No. Pts.	Max. Res. [μm]	rms *y* px. [μm]
1. IAGP	Min. px. diff.	14	6	2.4
2. IGN (B)	One step RO/AO	23 13 + 10 : GCP	18	3.9
3. GLGI	Not completed to this stage			
4. IGN (F)	One step RO/AO	9 9 : GCP	12	6.6
5. IfAG		6	0	0
6. IT		14	17	7
7. EUROSENSE	One step RO/AO	9 9 : GCP	40.3	25.1
8. SK	One step RO/AO	10 5 + 5 : GCP	5.8	2.9
9. NIT		16	12	6.9
10. UCL		16	10	5.4
11. OS		16	5	3.1

Table 6 — Results of Absolute Orientation

Participant	Co-ord System	No. of Points Used in AO	rmse Metres [µm]
1. RCJ	Geocentric	10 7: *XY* 10: *Z*	*X*: 15.1 *Y*: 22.7 *XY*: 27.3 *Z*: 25.3
2. IGN (B)	UTM	10 (one step) 8: plan 10: height	E: 25.3 N: 45.8 Plan: 54.3 [72] Height: 7.4 [10]
3. GLGI	Not completed to this stage		
4. IGN (F)	UTM	9 (one step) 9: plan 9: height	E: 6.5 N: 14.6 Plan: 16.0 [22] Height: 14.7 [20]
5. IfAG	UTM	6 6: plan 6: height	E: 6.1 N: 9.1 Plan: 10.9 [15] Height: 13.0 [18]
6. IT	UTM approx. scale	9 8: plan 9: height	E: --- N: --- Plan: --- ----- Height: 10.6
7. EUROSENSE	UTM	9 (one step) 9: plan 9: height	E: 273.6 N: 240.1 Plan: 364.0 [499] Height: 57.4 [79]
8. SK	UTM	5 (one step) 5: plan 5: height	E: 60.0 N: 136.7 Plan: 149.3 [205] Height: 57.5 [79]
9. NIT	UTM	8 7: plan 8: height	E: 35.4 N: 66.9 Plan: 75.7 [103] Height: 23.5 [32]
10. UCL	UTM	10 10: plan 10: height	E: 7.7 N: 8.4 Plan: 11.1 [16] Height: 6.6 [9]
11. OS	UTM	8 8: plan 8: height	E: 22.5 N: 25.3 Plan: 33.8 [46] Height: 12.3 [17]

Note:

Although the parameters of exterior orientation were provided there is little benefit in presenting these results here for comparative purposes. This is due to the differences in co-ordinate systems, manufacturers data output and matrix design.

3.8 *Check Points*

The coordinate values obtained for the check points by the participants are displayed in Tables 7 and 8. Table 7 gives the results in ground co-ordinates and at image scale with any systematic error found. The average rmse is 187 m [257 μm at photo scale] in plan and 30 m [1/7331] in height. These figures exclude the results for UCL in plan and Statens Kartverk in height. Any observation in excess of 2.5 times the rmse was disregarded as an inconsistent observation and the set was reprocessed. There is clearly a five-fold fall off in accuracy with respect to the results obtained from absolute orientation.

IGN Belgium provided results from both the old and replacement diapositives, there was approximately a 10 % improvement using the replacement images.

RCJ, Austria, obtained a good height result at the check points. Points observed in the geocentric system were transformed to the UTM system for this analysis.

Table 8 lists the points identified by participants and those points later disregarded when assessing the results.

3.9 *Plotting*

3.9.1 Five plots at 1 : 100,000 scale have been received. It is clear that a considerable amount of information can be interpreted and recorded from the imagery. Major communication routes — including roads, river bridges, railways — important water features and areas of irrigation, and places of inhabitation are all visible. Minor routes and smaller features could not be identified clearly. The false colour allowed up to five distinct classifications to be made for areas of vegetation. Some participants considered that the false colour tended to dominate in urban areas and obscure other cultural detail.

The low resolution clearly precluded identification of many features expected in a 1 : 100,000 map specification. It was generally felt that the mapping accuracy did not meet the specification required for 1 : 100,000 line maps of 30 m rmse. Figure 2 is a good example of the type of 1 : 100,000 scale revision map which can be produced. It is not intended to be a regular line map, but should instead be considered as a useful image map, particularly for relief, drainage, and areas of inhabitation.

3.9.2 Participants reported that identification was much easier when they had some prior knowledge of the features under interpretation. It is clear from their comments and the plots provided, that, given this type of imagery, extensive field verification would probably be necessary.

3.9.3 Although the imagery is very limited in the amount of interpretable detail, the false colour did allow a range of classifications to be made. Some field assessment would be required to correlate classification with crop identity.

Table 7 — Results for the Check Points

Participant	No. Pts. Id. (22 prov.) Syst. Error	Root Mean Square Error Easting	Northing	Vector	Height
1. RCJ	Id.: 16 Im. Sc. [μm] Sys:	112.7 (16) : 154 −48.8	170.1 (16) 233 −49.0	204.0 (16) 279 69.2	11.6 (13) 1/19,181 −0.7
2. IGN (B)	Id.: 21 Im. Sc. [μm] Sys:	104.4 (21) : 143 −20.1	138.3 (21) 190 −23.0	173.3 (21) 237 30.5	19.9 (19) 1/11,181 −9.0
3. GLGI	Not completed to this stage				
4. IGN (F)	Id.: 21 Im. Sc. [μm] Sys:	153.6 (18) : 210 22.8	150.3 (18) 206 −55.8	214.9 (18) 294 60.3	30.7 (16) 1/7,248 16.4
5. IfAG	Id.: 16 Im. Sc. [μm] Sys:	90.6 (13) 124 21.5	118.7 (13) 163 −20.5	149.3 (13) 205 29.7	22.5 (15) 1/9,889 10.5
6. IT	Id.: 0				
7. EUROSENSE	Test discontinued owing to poor absolute orientation				
8. SK	Id.: 3 Im. Sc. [μm] Sys:	134.7 (3) 185 −117.2	151.8 (3) 208 23.0	203.0 (3) 278 119.5	756.4 (3) 1/294 733.9
9. NIT	Id.: 0				
10. UCL	Id.: 22 Im. Sc. [μm] Sys:	584.7 (22) : 800 243.3	689.8 (22) 945 −268.2	904.3 (22) 1239 362.1	48.6 (21) 1/4,578 −28.7
11. OS	Id.: 17 Im. Sc. [μm] Sys:	80.7 (16) : 111 −31.0	161.1 (16) 221 −14.4	180.2 (16) 247 34.2	48.8 (15) 1/4,559 13.4

Notes:

Orbit height = 223,000 m
Mean ground height = 500 m
Difference = 222,500 m
Image scale = 1 : 730,000 approx.

Table 8 — Check Points Identified and Disregarded

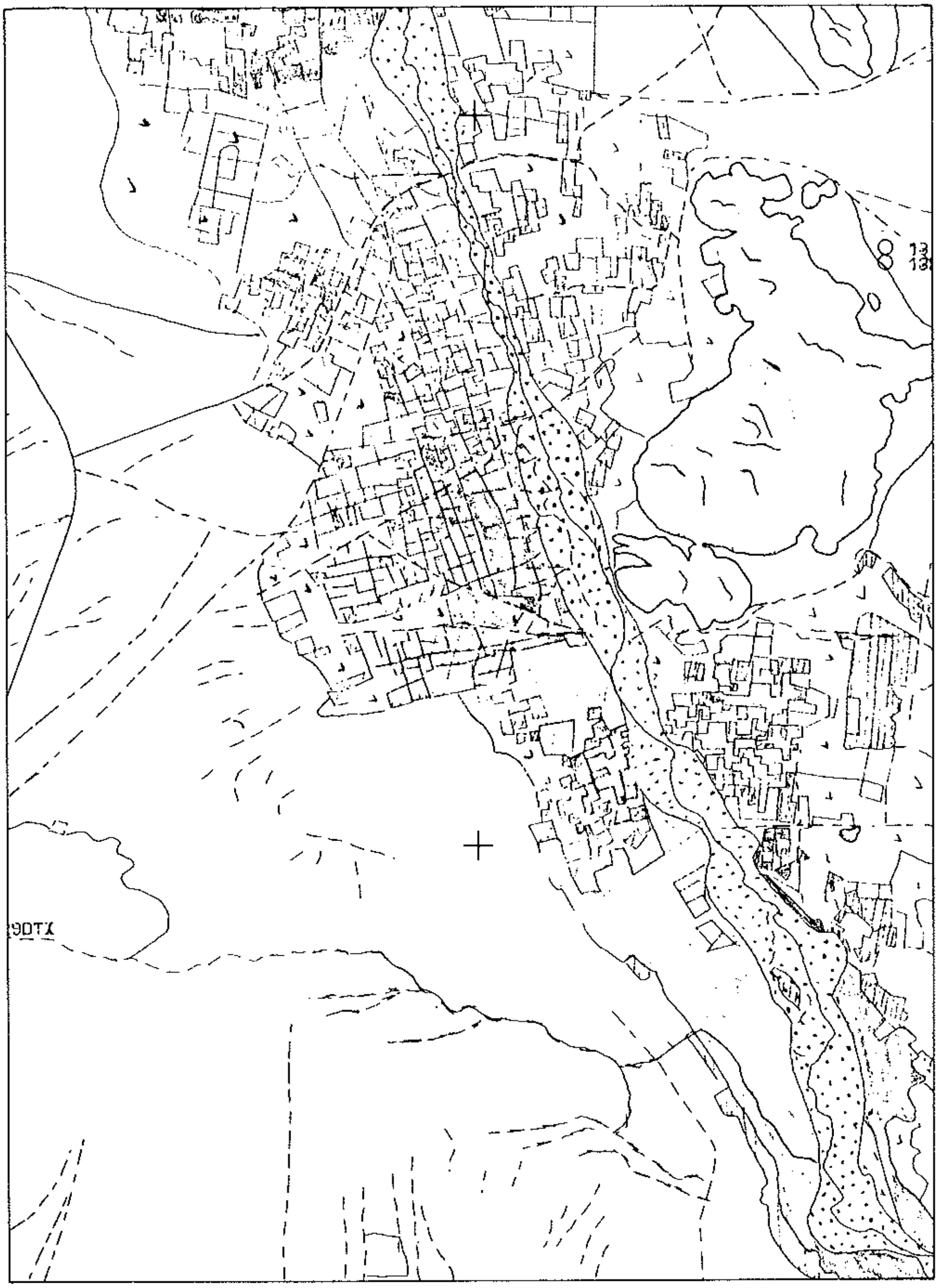
Participant	Check Point Number																					
	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
1. RCJ	X	X		X	X	X	X	X	X	X	X	X	X h		X	X		X			X	
2. IGN (B)	X	X	X	X	X	X	X	X	X	X	X	X h	X h		X	X	X	X	X	X	X	X
3. GLGI	Not completed to this stage																					
4. IGN (F)	X	X	X x	X	X	X	X	X	X	X	X	X h	X		X x	X	X	X	X	X	X x	X h
5. IfAG	X	X	X	X p	X	X	X	X	X	X	X	X h	X p			X			X p			X
6. IT	None attempted																					
7. EURO-SENSE	Test discontinued owing to poor absolute orientation																					
8. SK						X		X	X													
9. NIT	None identified																					
10. UCL	X	X	X	X	X	X	X	X	X	X	X	X	X h	X	X	X	X	X	X	X	X	X
11. OS	X	X p	X	X	X	X	X	X	X	X	X		X h	X	X	X h		X			X	

Notes:

Top row shows points identified in: X = plan and height
P = plan only
H = height only

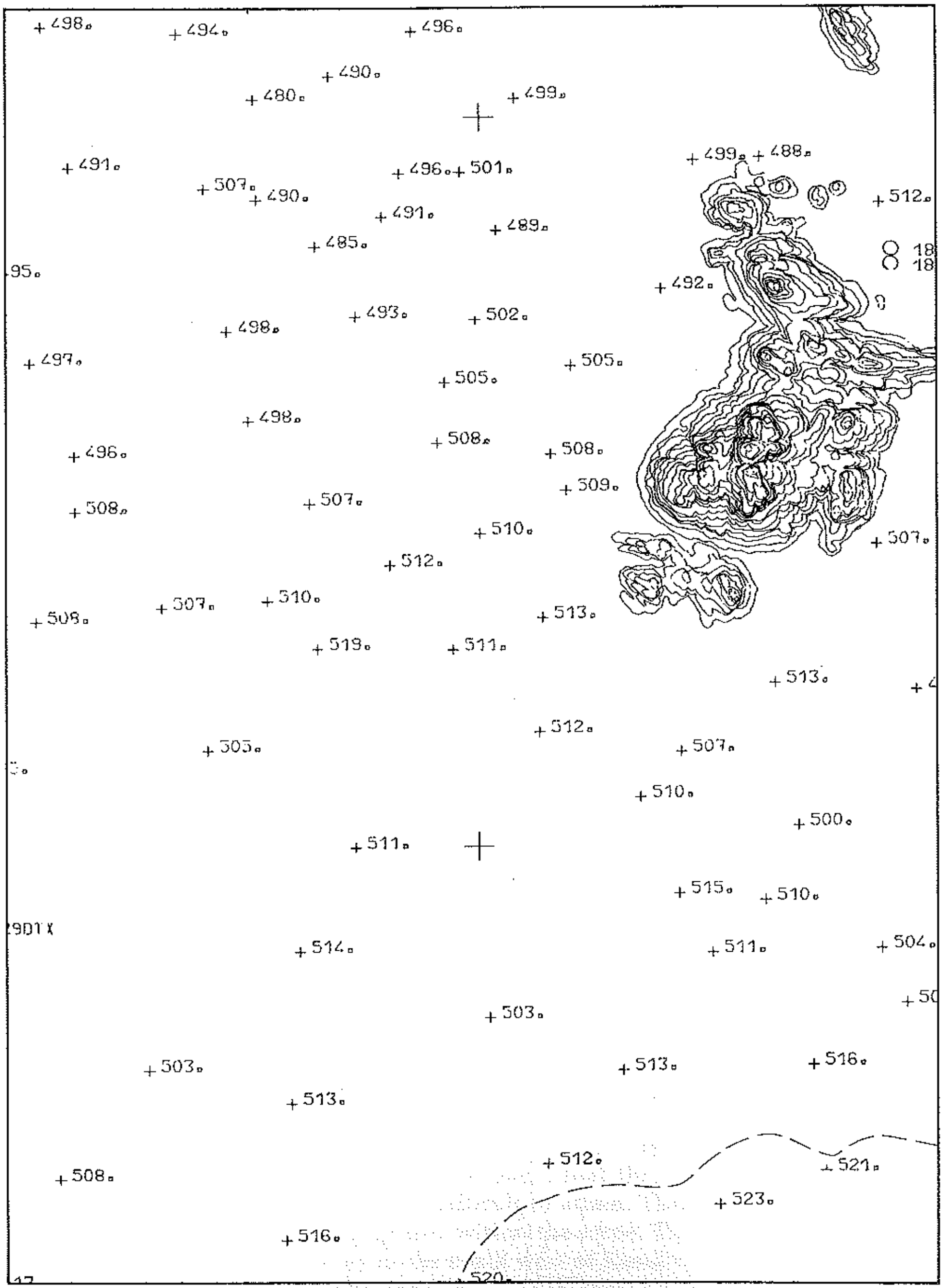
Bottom row shows points disregarded in: x = plan and height
p = plan only
h = height only

3.9.4 Most users considered that contouring would be possible with this imagery and some examples were provided. It is clear though, that the accuracy required for a 20 metres vertical interval would prove difficult to attain. There were small isolated areas of cloud with distinct dark shadows within the scene. The cloud shadows were considerably diffused in the valley to the north west of Kassala suggesting an area of mist or source of the clouds. Consistent heighting in this area was not easy, and accurate contouring would prove difficult to attain. In total approximately 5 % to 10 % of the scene was obscured by mist, cloud or shadow. Figure 3 is an example of a contour map, produced by IGN France.



Scale = 1 : 100,000

Figure 2 — Extract of a Detail Map from IGN France



Scale = 1 : 100,000 Contour interval = 40 metres

Figure 3 — Extract of a Contour Map from IGN France

3.10 Participants' Comments on Image Quality

This was the major cause of complaint among users and led to the production of a new set of diapositives. There was an unacceptable amount of residual grain and the resolution was poor. The image was also reverse reading.

The film was SO-131 Colour Infra-Red Reversal and it is understood that EDC supply all LFC material from first generation copies of the original film. This would account for the reverse reading of the film. There is always some fall off in resolution and build up of grain when copies are made. The expected film resolution was 19 metres per line pair at 225 km orbit (*Doyle* 1983). This figure would be commensurate with users finding that only major features could be identified with confidence.

EDC have not been able to explain the poor image quality except to report having had processing problems at the time of production.

3.11 Participants' Comments on Control Points

The other serious, and concurrent, obstacle to the successful completion of this test was the transfer of control points to the LFC image. The superior fit in height suggests that more could have been done with this imagery if the control points could have been clearly identified in plan. The control point sketches provided were of little use in this test.

One participant summed up the general concensus by stating "this is rather a test of the operator's skill in transferring points by estimation, than a test of the accuracy of space photographs . . . "

The transfer of control was deliberately designed into the test because the use of new satellite imagery with existing, rather than new, control was seen as a realistic situation in a developing country. However it is accepted with hindsight that this has not produced a true evaluation of LFC imagery. The preferred alternative would be to use control points directly identifiable in the imagery; for instance, recognisable features whose position could be obtained using satellite positioning systems.

3.12 Other Work with LFC Photography

Published work with Large Format Camera data is limited. There are several reports on use of the data for interpretation and thematic mapping (*Gierloff-Emden* 1986; *Dietz* 1986; *Stolz* 1987). These papers conclude that the content of LFC photographs is superior to that of Metric Camera photography, and in some cases (*Stolz*) exceeds the information given by a 1 : 50,000 scale topographic map. However, there are reservations brought about by difficulties in reliable interpretation and by the less than adequate quality of the images produced by the EROS Data Centre.

Detailed investigation of the accuracy and potential of LFC images for topographic mapping have been carried out by a number of people. Some results are given in Table 9. These may be compared with the accuracy predicted by *Doyle* (1984) of 7.5 m in plan and between 6 m and 24 m in height, depending on the base-to-height ratio. Clearly the accuracies are possible if sufficient ground control of good enough accuracy is available (*Togliatti*), and suitable adjustment methods are used (*Gruen*). It is also apparent that quality is variable, and if image quality and control are both poor results will suffer (*Trinder*).

Gruen and *Togliatti* make comments on the use of LFC photography for mapping and orthophoto production. *Gruen* compares LFC line maps with existing maps for compilation and revision; he concludes that a 1 : 100,000 scale map can be satisfactorily revised without additional information.

Work has also been carried out at IGN (France) on cartographic evaluation of LFC photographs (*Bossard et al.* 1988).

Table 9 — Accuracy Tests on LFC Photography

Ref.	Method	No. of Control Pts.	No. of Check Pts.	Root Mean Square Error			
				*X*m	*Y*m	Position (m)	*Z*m
Derenyi and *Newton* 1986	Model	6	20–30	11	9	14	15
		4	20–30	12	9	15	15
	Strip	9	88	10	11	14	15
	Block	9	95	10	11	14	16
Gruen and *Spiess* 1986	Model						
	No add. par.	12	—	—	—	9	29
	With add. par.		12	—	—	7	
	Strip	—	—	—	—	5	14
Jacobsen 1986	Bundle	53	—	10	10	14	14
Togliatti and *Moriondo* 1986	Bundle	388 plan 687 height	—	6	5	8	5
Trinder 1986	Model	15	38	20	17	26	27
		7	18	16	16	23	28

4 Conclusions

4.1 General

The full potential of this test has not been realised. Given suitable instrumentation the two variables which will affect the final plot accuracy are:

- the imagery,
- ground control.

Practical problems were encountered both with the quality of the imagery and the transfer of control. The check point results vary significantly from the absolute orientation results; this may reflect the forgiving nature of the analytical instrumentation software or be related to the identification and transfer difficulties discussed earlier. In all cases the plan errors are significantly greater than height, reflecting the problem of identification and transfer.

Users were not requested to record the time spent on the task and it is clear that many hours have been spent. This is an important factor when considering the economics of using space imagery for mapping.

4.2 Imagery

The desire to evaluate the data on a typical site was well intentioned. However the overriding objective is to test the method and clearly with a limited range of test data the scope of combining these two features was severely limited. With hindsight the colour infra-red imagery chosen for this test was not the most suitable type available for a topographic mapping project of this nature.

Topographic mapping from space requires very high resolution imagery — in the order of 3 to 5 m per line pair to produce line maps and 14 m per line pair to produce photomaps at 1 : 100,000 scale (*Doyle* 1982). The highest resolution claimed for the LFC camera at 225 km is 8.5 m per line pair using Kodak 3414 Black and White Panchromatic Negative film. This imagery is providing some encouraging results elsewhere (*Doyle* 1985, *Gruen* and *Spiess* 1986).

There is some concern that the diapositives produced for this evaluation do not represent the best that can be achieved, even from first generation copies of the original film. This is obviously a crucial factor for all types of film-based space imagery.

4.3 Ground Control

The difficulties of point transfer were greatly increased because surrounding detail was not visible. Higher resolution photography would go some way towards minimising transfer errors. Transfer may be eliminated totally by selecting points of identifiable detail, ideally post-sortie. There are many such features in this image — road junctions, stream junctions, rock outcrops — for which control could be provided efficiently using modern position-fixing equipment.

4.4 *Final Comments and Recommendations*

4.4.1 Colour Infra-Red space photography is not considered to be most suitable for topographic mapping projects where the requirement is for line or photo-mapping at 1 : 100,000 scale. However, it is useful for interpretation and can be of value in developing areas such as the Sudan. Unless there is a significant improvement in resolution of colour infra red emulsion, this type of film should not be used in this type of test in the future.

4.4.2 Ground control and check points used as control for space imagery should be identifiable in the image to avoid problems associated with point transfer to very small scale imagery (around 1 : 1,000,000). Topographic points such as road junctions, stream/river junctions, and the corners of large buildings are all suitable.

4.4.3 In future tests of this nature participants should be requested to record the time expended at each stage of the evaluation.

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Appendices

Appendix A	List of Participants
Appendix B	List of Ground Control Point Co-ordinates
Appendix C	Results of Check Point Residuals

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OEEPE TEST ON MAP COMPILATION AND REVISION IN DEVELOPING AREAS USING SATELLITE DATA

PHASE I - TEST OF LARGE FORMAT CAMERA

CO-ORDINATE LIST

PT NO	PT TYPE	UTM CO-ORDINATES EASTINGS	NORTHINGS	HT	3D CARTESIAN CO-ORDINATES X	Y	Z	
Control points								
1	BM	133029.89	1734804.82	434.20	4996482.869	3574171.034	1711141.657	BM 10168
2	GP	134527.02	1715515.28	441.70	4999641.339	3578649.157	1692610.366	ET 8322 pp1
3	GP	180023.20	1667746.00	475.70	4982722.611	3623346.973	1647233.191	G 403 pp2
4	GP	202087.20	1655521.40	501.70	4972146.800	3643119.031	1635718.714	PE 425/1 pp1
5	GH	211486.99	1773000.34	435.10	4942118.165	3630881.603	1748950.438	E 337/2
6	GP	226252.90	1664037.00	567.60	4956111.897	3661178.266	1644236.576	ET 8331 pp1
7	AT	244315.44	1735211.70	597.84	4930683.984	3663798.931	1713044.595	B 136
8	GP	244502.00	1762809.20	546.20	4924686.976	3659185.097	1739576.139	ET 8323 pp1
9	BM	192078.87	1770555.28	426.50	4954151.677	3615696.149	1746349.297	BM 11178
10	BM	175336.33	1665745.81	438.10	4985863.177	3619874.311	1645232.138	BM 10581
Check points								
11	AT	145234.04	1702521.02	450.87	4996069.373	3589495.808	1680263.695	8/47
12	BM	155158.10	1683703.08	460.30	4994113.197	3600648.490	1662278.959	BM 12455
13	AT	188074.50	1755253.10	428.35	4959788.072	3615117.424	1731593.705	11/28
14	AT	180221.19	1720398.02	454.84	4971783.973	3614744.611	1697969.930	C 134
15	GP	172196.00	1656406.00	437.00	4989594.169	3618863.536	1636177.451	G 401 pp1
16	AT	211429.40	1738686.82	463.98	4949468.631	3636758.232	1715972.567	13/26
17	AT	204736.99	1692187.21	492.20	4963128.549	3639220.636	1671119.652	C 85
18	GH	225685.04	1708034.73	514.50	4947418.532	3653411.744	1686645.396	E 395/1
19	GP	224126.50	1678295.20	914.30	4954760.272	3657332.042	1658062.070	ABU GAMBAL
20	GP	231287.50	1686813.70	740.71	4948616.582	3661569.039	1666313.253	ET 8340 pp1
21	RH	234934.48	1684978.05	715.00	4946793.811	3664781.332	1664576.248	IBRAHIM TAU
22	RH	247565.73	1707595.88	959.00	4934776.342	3671272.229	1686581.345	TUKURET
23	AT	252558.19	1801469.67	494.80	4911480.083	3658848.177	1776779.104	16/13
24	AT	259111.80	1776190.84	557.28	4913068.355	3668555.857	1752595.154	C 166
25	GP	202545.00	1765447.00	437.00	4949048.691	3625006.480	1741581.555	G 415 pp1
26	GP	235646.00	1784244.00	641.00	4925455.587	3648420.350	1760095.626	G 416
27	GP	183429.00	1763399.00	430.00	4960801.769	3609972.304	1739359.272	PE 366/1
28	GP	234612.40	1744562.20	533.60	4934466.759	3654394.847	1721916.537	G 413 pp2
29	GP	213145.40	1698905.30	507.50	4956764.431	3644868.366	1677700.204	PE 28 pp2
30	GP	220931.55	1712990.15	500.80	4949213.929	3648758.402	1691360.368	PE 12
31	GP	206669.60	1693241.20	502.70	4961773.082	3640605.065	1672161.917	G 407 pp1
32	GP	224679.14	1693541.70	528.20	4951015.723	3655031.369	1672670.197	PE 17

Appendix C

This Appendix contains:

List of geocentric co-ordinates transformed to UTM, from Research Centre Joanneum, Austria.

Residuals at Check points for participants observing check points.

OUTPUT FROM THE GEODETIC SUITE

DATE 24-APR-87 TIME 08:36:04

RESEARCH CENTRE, JOANNEUM, AUSTRIA

CARTESIAN COORDINATES

STATION	X	Y	Z
11	4996126.0000	3589467.0000	1680181.0000
12	4994181.0000	3600440.0000	1662523.0000
14	4971857.0000	3614622.0000	1698002.0000
15	4989729.0000	3618716.0000	1636088.0000
16	4949496.0000	3636799.0000	1715827.0000
17	4963186.0000	3639196.0000	1671066.0000
18	4947413.0000	3653506.0000	1686487.0000
19	4954797.0000	3657326.0000	1657946.0000
20	4948596.0000	3661635.0000	1666167.0000
21	4946709.0000	3664886.0000	1664491.0000
22	4934983.0000	3671276.0000	1686364.0000
23	4911510.0000	3658685.0000	1777201.0000
25	4949099.0000	3624970.0000	1741524.0000
26	4925430.0000	3648356.0000	1760033.0000
28	4934447.0000	3654509.0000	1721785.0000
31	4961861.0000	3640522.0000	1672061.0000
1	4996482.8690	3574171.0340	1711141.6570
5	4942118.1650	3630881.6030	1748950.4380
6	4956111.8970	3661178.2660	1644236.5760
8	4924686.9760	3659185.0970	1739576.1390

REFERENCE ELLIPSOID

SEMI-MAJOR AXIS = 6378249.1450
SEMI-MINOR AXIS = 6356514.8695
1/(FLATTENING) = 293.46500000
ECCENTRICITY = 0.082483400044

TRANSVERSE MERCATOR PROJECTION

TRUE ORIGIN
LATITUDE N 0 0 0.0000 LONGITUDE E 39 0 0.0000

FALSE COORDINATES OF ORIGIN
EASTINGS 500000.0000 NORTHINGS 10000000.0000

CENTRAL SCALE FACTOR = 0.9996000000

GEODETIC COORDINATES

STATION	LATITUDE				LONGITUDE			
11	N	15	22	32.1471	E	35	41	43.2894
12	N	15	12	36.5334	E	35	47	19.8677
14	N	15	32	33.7621	E	36	1	3.9708
15	N	14	57	45.9665	E	35	57	3.0973
16	N	15	42	35.7698	E	36	18	27.9513
17	N	15	17	24.1888	E	36	15	1.0125
18	N	15	26	4.3723	E	36	26	40.8478
19	N	15	9	58.2679	E	36	25	56.8541
20	N	15	14	37.0605	E	36	29	56.4065
21	N	15	13	40.8770	E	36	32	1.5704
22	N	15	25	55.3610	E	36	38	47.8378
23	N	16	17	12.1870	E	36	40	59.4668
25	N	15	57	5.0079	E	36	13	15.3490
26	N	16	7	30.3426	E	36	31	40.8868
28	N	15	45	56.4285	E	36	31	26.6869
31	N	15	17	57.8530	E	36	16	3.1128
1	N	15	39	57.7585	E	35	34	39.2078
5	N	16	1	16.3713	E	36	18	14.4995
6	N	15	2	19.2873	E	36	27	14.4654
8	N	15	55	58.1123	E	36	36	48.3063

PLANE COORDINATES

STATION	EASTINGS	NORTHINGS
11	145176.2044	11702434.3288
12	154952.8688	11683959.4366
14	180079.4560	11720434.4200
15	171995.9860	11656316.4267
16	211444.1092	11738533.8981
17	204682.3601	11692127.7308
18	225762.2005	11707867.3255
19	224098.4224	11678176.6542
20	231351.0976	11686665.8305
21	235068.1958	11684895.7819
22	247442.6046	11707342.9223
23	252414.2532	11801897.0242
25	202485.0010	11765387.1884
26	235608.9841	11784200.6102
28	234714.2731	11744420.2037
31	206549.2610	11693139.5680
1	133029.8857	11734804.8250
5	211486.9892	11773000.3415
6	226252.8986	11664037.0000
8	244502.0002	11762809.1997

HEIGHTS

STATION	HEIGHT
11	457.0783
12	459.7376
14	450.8751
15	435.6682
16	469.0327
17	508.6905
18	522.0254
19	908.9903
20	724.1451
21	686.9739
22	1063.1590
23	542.5631
25	439.4797
26	567.0591
28	547.9614
31	497.0463
1	434.2000
5	435.0996
6	567.6006
8	546.1998

END OF OUTPUT

BLOCK : AUS:RCJ:UTM:DSR:***

Total number of points 16
Total number of plan points .. 16
Total number of height points 13

RESULTS : CO-ORDINATES (GROUND & COMPUTED)

Part 1 Input data from file RMSDAT1

		GROUND CO-ORDINATES			COMPUTED CO-ORDINATES		
No.	Id.	Easting	Northing	Height	Easting	Northing	Height
1	11	145234.040	1702521.020	450.870	145176.200	1702434.330	457.080
2	12	155158.100	1683703.080	460.300	154952.870	1683959.440	459.740
3	14	180221.190	1720398.020	454.840	180079.460	1720434.420	450.880
4	15	172196.000	1656406.000	437.000	171995.990	1656316.430	435.670
5	16	211429.400	1738686.820	463.980	211444.110	1738533.900	469.030
6	17	204736.990	1692187.210	492.200	204682.360	1692127.730	508.690
7	18	225685.040	1708034.730	514.500	225762.200	1707867.330	522.030
8	19	224126.500	1678295.200	914.300	224098.420	1678176.650	908.990
9	20	231287.500	1686813.700	740.710	231351.100	1686665.830	724.150
10	21	234934.480	1684978.050	715.000	235068.200	1684895.780	686.970
11	22	247565.730	1707595.880	959.000	247442.600	1707342.920	1063.160
12	23	252558.190	1801469.670	494.800	252414.250	1801897.020	542.560
13	25	202545.000	1765447.000	437.000	202485.000	1765387.190	439.480
14	26	235646.000	1784244.000	641.000	235608.980	1784200.610	567.060
15	28	234612.400	1744562.200	533.600	234714.270	1744420.200	547.960
16	31	206669.600	1693241.200	502.700	206549.260	1693139.570	497.050

S = Suspended Point

BLOCK : AUS:RCJ:UTM:DSR:***

Total number of points 16
Total number of plan points .. 16
Total number of height points 13

DIMENSIONAL and VECTOR RESIDUALS

Part 2 Data from file RMSDAT2

No.	Id.	vx	vy	vector(p)	vz	vect/rmsv	vz/rmsz
1	11	-57.840	-86.690	104.214	6.210	0.511	0.536
2	12	-205.230	256.360	328.390	-0.560	1.610	-0.048
3	14	-141.730	36.400	146.330	-3.960	0.717	-0.342
4	15	-200.010	-89.570	219.150	-1.330	1.074	-0.115
5	16	14.710	-152.920	153.626	5.050	0.753	0.436
6	17	-54.630	-59.480	80.761	16.490	0.396	1.424
7	18	77.160	-167.400	184.327	7.530	0.904	0.650
8	19	-28.080	-118.550	121.830	-5.310	0.597	-0.459
9	20	63.600	-147.870	160.967	-16.560	0.789	-1.430
10	21	133.720	-82.270	157.001	-28.030	0.770	-2.421
11	22	-123.130	-252.960	281.336	104.160*S*	1.379	8.996
12	23	-143.940	427.350	450.940	47.760*S*	2.210	4.125
13	25	-60.000	-59.810	84.719	2.480	0.415	0.214
14	26	-37.020	-43.390	57.037	-73.940*S*	0.280	-6.386
15	28	101.870	-142.000	174.761	14.360	0.857	1.240
16	31	-120.340	-101.630	157.513	-5.650	0.772	-0.488

RMSX:	RMSY:	RMSV:	RMSZ:	Max v:	Max z:
112.676	170.071	204.010	11.579	Not Av	Not Av

Detected SYSTEMATIC ERRORS:

SysX	SysY	SysVECT	SysZ
-48.806	-49.027	69.178	-0.714

S = Suspended Point

BLOCK : BGM:IGN:UTM:MAT:***

Total number of points 21
Total number of plan points .. 21
Total number of height points 19

RESULTS : CO-ORDINATES (GROUND & COMPUTED)

Part 1 Input data from file RMSDAT1

		GROUND CO-ORDINATES			COMPUTED CO-ORDINATES		
No.	Id.	Easting	Northing	Height	Easting	Northing	Height
1	11	145234.040	1702521.020	450.870	145171.000	1702508.000	447.000
2	12	155158.100	1683703.080	460.300	154987.000	1684002.000	446.000
3	13	188074.500	1755253.100	428.350	188176.000	1755256.000	407.000
4	14	180221.190	1720398.020	454.840	180240.000	1720423.000	451.000
5	15	172196.000	1656406.000	437.000	172246.000	1656360.000	431.000
6	16	211429.400	1738686.820	463.980	211409.000	1738696.000	446.000
7	17	204736.990	1692187.210	492.200	204734.000	1692173.000	509.000
8	18	225685.040	1708034.730	514.500	225679.000	1707925.000	509.000
9	19	224126.500	1678295.200	914.300	224073.000	1678178.000	946.000
10	20	231287.500	1686813.700	740.710	231260.000	1686816.000	694.000
11	21	234934.480	1684978.050	715.000	235016.000	1684873.000	688.000
12	22	247565.730	1707595.880	959.000	247461.000	1707376.000	1164.000
13	23	252558.190	1801469.670	494.800	252429.000	1801220.000	555.000
14	25	202545.000	1765447.000	437.000	202439.000	1765371.000	428.000
15	26	235646.000	1784244.000	641.000	235552.000	1784209.000	652.000
16	27	183429.000	1763399.000	430.000	183233.000	1763433.000	416.000
17	28	234612.400	1744562.200	533.600	234489.000	1744638.000	494.000
18	29	213145.400	1698905.300	507.500	213141.000	1698856.000	507.000
19	30	220931.550	1712990.150	500.800	221152.000	1713332.000	494.000
20	31	206669.600	1693241.200	502.700	206776.000	1693113.000	504.000
21	32	224679.140	1693541.700	528.200	224781.000	1693432.000	513.000

S = Suspended Point

BLOCK : BGM:IGN:UTM:MAT:***

Total number of points 21
Total number of plan points .. 21
Total number of height points 19

DIMENSIONAL and VECTOR RESIDUALS

Part 2 Data from file RMSDAT2

No.	Id.	vx	vy	vector(p)	vz	vect/rmsv	vz/rmsz
1	11	-63.040	-13.020	64.370	-3.870	0.371	-0.194
2	12	-171.100	298.920	344.425	-14.300	1.988	-0.719
3	13	101.500	2.900	101.541	-21.350	0.586	-1.073
4	14	18.810	24.980	31.270	-3.840	0.180	-0.193
5	15	50.000	-46.000	67.941	-6.000	0.392	-0.302
6	16	-20.400	9.180	22.370	-17.980	0.129	-0.904
7	17	-2.990	-14.210	14.521	16.800	0.084	0.844
8	18	-6.040	-109.730	109.896	-5.500	0.634	-0.276
9	19	-53.500	-117.200	128.834	31.700	0.744	1.593
10	20	-27.500	2.300	27.596	-46.710	0.159	-2.347
11	21	81.520	-105.050	132.970	-27.000	0.767	-1.357
12	22	-104.730	-219.880	243.548	205.000*S*	1.406	10.302
13	23	-129.190	-249.670	281.114	60.200*S*	1.622	3.025
14	25	-106.000	-76.000	130.430	-9.000	0.753	-0.452
15	26	-94.000	-35.000	100.305	11.000	0.579	0.553
16	27	-196.000	34.000	198.927	-14.000	1.148	-0.704
17	28	-123.400	75.800	144.821	-39.600	0.836	-1.990
18	29	-4.400	-49.300	49.496	-0.500	0.286	-0.025
19	30	220.450	341.850	406.767	-6.800	2.347	-0.342
20	31	106.400	-128.200	166.602	1.300	0.961	0.065
21	32	101.860	-109.700	149.698	-15.200	0.864	-0.764

RMSX:	RMSY:	RMSV:	RMSZ:	Max v:	Max z:
104.385	138.310	173.279	19.898	Not Av	Not Av

Detected SYSTEMATIC ERRORS:

SysX	SysY	SysVECT	SysZ
-20.083	-23.001	30.535	-8.992

S = Suspended Point

BLOCK : FRA:IGN:UTM:MAT:***

Total number of points 21
Total number of plan points .. 18
Total number of height points 16

RESULTS : CO-ORDINATES (GROUND & COMPUTED)

Part 1 Input data from file RMSDAT1

		GROUND CO-ORDINATES			COMPUTED CO-ORDINATES		
No.	Id.	Easting	Northing	Height	Easting	Northing	Height
1	11	145234.040	1702521.020	450.870	145644.700	1702677.000	464.500
2	12	155158.100	1683703.080	460.300	155115.200	1683701.000	456.400
3	13	188074.500	1755253.100	428.350	191059.800	1760307.000	463.000
4	14	180221.190	1720398.020	454.840	180072.100	1720303.000	519.700
5	15	172196.000	1656406.000	437.000	172199.700	1656497.000	446.800
6	16	211429.400	1738686.820	463.980	211467.800	1738491.000	466.700
7	17	204736.990	1692187.210	492.200	204698.400	1692138.000	506.400
8	18	225685.040	1708034.730	514.500	225598.000	1708167.000	489.500
9	19	224126.500	1678295.200	914.300	224030.900	1678180.000	908.700
10	20	231287.500	1686813.700	740.710	231281.700	1686730.000	762.400
11	21	234934.480	1684978.050	715.000	235004.200	1684896.000	683.700
12	22	247565.730	1707595.880	959.000	247448.700	1707371.000	1149.200
13	23	252558.190	1801469.670	494.800	252439.100	1801067.000	548.300
14	25	202545.000	1765447.000	437.000	200356.500	1769677.000	507.900
15	26	235646.000	1784244.000	641.000	235587.900	1784148.000	684.400
16	27	183429.000	1763399.000	430.000	183307.000	1763594.000	448.300
17	28	234612.400	1744562.200	533.600	234790.300	1744512.000	553.500
18	29	213145.400	1698905.300	507.500	213184.900	1698908.000	558.600
19	31	206669.600	1693241.200	502.700	220707.700	1713251.000	489.500
20	32	224679.140	1693541.700	528.200	224937.900	1693459.000	542.500
21	24	259111.800	1776190.840	557.280	259358.600	1776089.000	673.400

S = Suspended Point

BLOCK : FRA:IGN:UTM:MAT:***

Total number of points 21
Total number of plan points .. 18
Total number of height points 16

DIMENSIONAL and VECTOR RESIDUALS

Part 2 Data from file RMSDAT2

No.	Id.	vx	vy	vector(p)	vz	vect/rmsv	vz/rmsz
1	11	410.660	155.980	439.285	13.630	2.044	0.444
2	12	-42.900	-2.080	42.950	-3.900	0.200	-0.127
3	13	2985.300	5053.900	5869.746*S*	34.650*S*	27.316	1.127
4	14	-149.090	-95.020	176.795	64.860	0.823	2.110
5	15	3.700	91.000	91.075	9.800	0.424	0.319
6	16	38.400	-195.820	199.549	2.720	0.929	0.089
7	17	-38.590	-49.210	62.536	14.200	0.291	0.462
8	18	-87.040	132.270	158.339	-25.000	0.737	-0.813
9	19	-95.600	-115.200	149.701	-5.600	0.697	-0.182
10	20	-5.800	-83.700	83.901	21.690	0.390	0.706
11	21	69.720	-82.050	107.671	-31.300	0.501	-1.018
12	22	-117.030	-224.880	253.509	190.200*S*	1.180	6.189
13	23	-119.090	-402.670	419.911	53.500	1.954	1.741
14	25	-2188.500	4230.000	4762.608*S*	70.900*S*	22.164	2.307
15	26	-58.100	-96.000	112.212	43.400	0.522	1.412
16	27	-122.000	195.000	230.020	18.300	1.070	0.595
17	28	177.900	-50.200	184.847	19.900	0.860	0.648
18	29	39.500	2.700	39.592	51.100	0.184	1.663
19	31	14038.100	20009.800	24443.002*S*	-13.200*S*	113.752	-0.430
20	32	258.760	-82.700	271.654	14.300	1.264	0.465
21	24	246.800	-101.840	266.986	116.120*S*	1.242	3.778

RMSX:	RMSY:	RMSV:	RMSZ:	Max v:	Max z:
153.571	150.298	214.880	30.733	Not Av	Not Av

Detected SYSTEMATIC ERRORS:

SysX	SysY	SysVECT	SysZ
22.789	-55.801	60.275	16.350

S = Suspended Point

BLOCK : FRG:IAG:UTM:ZPC:***

Total number of points 16
Total number of plan points .. 13
Total number of height points 15

RESULTS : CO-ORDINATES (GROUND & COMPUTED)

Part 1 Input data from file RMSDAT1

		GROUND CO-ORDINATES			COMPUTED CO-ORDINATES		
No.	Id.	Easting	Northing	Height	Easting	Northing	Height
1	11	145234.040	1702521.020	450.870	145253.220	1702528.960	480.100
2	12	155158.100	1683703.080	460.300	155181.100	1683713.120	505.500
3	13	188074.500	1755253.100	428.350	188067.120	1755250.080	405.840
4	14	180221.190	1720398.020	454.840	180997.880	1720298.880	467.030
5	15	172196.000	1656406.000	437.000	172026.000	1656710.800	432.810
6	16	211429.400	1738686.820	463.980	211436.640	1738702.880	500.630
7	17	204736.990	1692187.210	492.200	204741.520	1692153.760	516.310
8	18	225685.040	1708043.730	514.500	225765.040	1708023.040	531.720
9	19	224126.500	1678295.200	914.300	224052.400	1678157.440	953.510
10	20	231287.500	1686813.700	740.710	231320.640	1686721.260	727.310
11	21	234934.480	1684978.050	715.000	235033.560	1684902.880	713.700
12	22	247565.730	1707595.880	959.000	247604.560	1707361.120	1033.010
13	23	252558.190	1801469.670	494.800	252194.440	1800961.440	493.010
14	25	202545.000	1765447.000	437.000	202541.720	1765438.560	430.330
15	29	213145.400	1698905.300	507.500	213045.640	1699421.440	506.550
16	32	224679.140	1693541.700	528.200	224908.200	1693541.760	532.610

S = Suspended Point

BLOCK = FRG:IAG:UTM:ZPC:***

Total number of points 16
Total number of plan points .. 13
Total number of height points 15

DIMENSIONAL and VECTOR RESIDUALS

Part 2 Data from file RMSDAT2

No.	Id.	vx	vy	vector(p)	vz	vect/rmsv	vz/rmsz
1	11	19.180	7.940	20.758	29.230	0.139	1.300
2	12	23.000	10.040	25.096	45.200	0.168	2.011
3	13	-7.380	-3.020	7.974	-22.510	0.053	-1.001
4	14	776.690	-99.140	782.992*S*	12.190	5.243	0.542
5	15	-170.000	304.800	349.003	-4.190	2.337	-0.186
6	16	7.240	16.060	17.617	36.650	0.118	1.631
7	17	4.530	-33.450	33.756	24.110	0.226	1.073
8	18	80.000	-20.690	82.632	17.220	0.553	0.766
9	19	-74.100	-137.760	156.425	39.210	1.047	1.744
10	20	33.140	-92.440	98.201	-13.400	0.658	-0.596
11	21	99.080	-75.170	124.368	-1.300	0.833	-0.058
12	22	38.830	-234.760	237.949	74.010*S*	1.593	3.293
13	23	-363.750	-508.230	624.989*S*	-1.790	4.185	-0.080
14	25	-3.280	-8.440	9.055	-6.670	0.061	-0.297
15	29	-99.760	516.140	525.693*S*	-0.950	3.520	-0.042
16	32	229.060	0.060	229.060	4.410	1.534	0.196

RMSX:	RMSY:	RMSV:	RMSZ:	Max v:	Max z:
90.604	118.723	149.346	22.477	Not Av	Not Av

Detected SYSTEMATIC ERRORS:

SysX	SysY	SysVECT	SysZ
21.485	-20.525	29.713	10.494

S = Suspended Point

BLOCK : NWY:SKV:UTM:BC2:***

Total number of points 3
Total number of plan points .. 3
Total number of height points 3

RESULTS : CO-ORDINATES (GROUND & COMPUTED)

Part 1 Input data from file RMSDAT1

		GROUND CO-ORDINATES			COMPUTED CO-ORDINATES		
No.	Id.	Easting	Northing	Height	Easting	Northing	Height
1	17	204736.990	1692187.210	492.200	204711.365	1692019.759	1047.866
2	19	224126.500	1678295.200	914.300	223945.799	1678494.571	1900.385
3	20	231287.500	1686813.700	740.710	231142.084	1686850.864	1400.633

S = Suspended Point

BLOCK : NWY:SKV:UTM:BC2:***

Total number of points 3
Total number of plan points .. 3
Total number of height points 3

DIMENSIONAL and VECTOR RESIDUALS

Part 2

Data from file RMSDAT2

No.	Id.	vx	vy	vector(p)	vz	vect/rmsv	vz/rmsz
1	17	-25.625	-167.451	169.401	555.666	0.834	0.735
2	19	-180.701	199.371	269.075	986.085	1.326	1.304
3	20	-145.416	37.164	150.090	659.923	0.739	0.872

RMSX:	RMSY:	RMSV:	RMSZ:	Max v:	Max z:
134.728	151.844	202.998	756.445	Not Av	Not Av

Detected SYSTEMATIC ERRORS:

SysX	SysY	SysVECT	SysZ
-117.247	23.028	119.487	733.891

S = Suspended Point

BLOCK : UK.:OS.:UTM:DSR:***

Total number of points 17
Total number of plan points .. 16
Total number of height points 15

RESULTS : CO-ORDINATES (GROUND & COMPUTED)

Part 1 Input data from file RMSDAT1

		GROUND CO-ORDINATES			COMPUTED CO-ORDINATES		
No.	Id.	Easting	Northing	Height	Easting	Northing	Height
1	11	145234.040	1702521.020	450.870	145246.000	1702868.000	487.000
2	12	155158.100	1683703.080	460.300	153448.000	1635779.000	494.000
3	13	188074.500	1755253.100	428.350	188179.000	1755160.000	435.000
4	14	180221.190	1720398.020	454.840	180118.000	1720187.000	484.000
5	15	172196.000	1656406.000	437.000	172096.000	1656486.000	452.000
6	16	211429.400	1738686.820	463.980	211433.000	1738647.000	460.000
7	17	204736.990	1692187.210	492.200	204712.000	1692165.000	543.000
8	18	225685.040	1708034.730	514.500	225655.000	1708029.000	567.000
9	19	224126.500	1678295.200	914.300	223987.000	1678171.000	894.000
10	20	231287.500	1686813.700	740.710	231178.000	1686739.000	697.000
11	21	234934.480	1684978.050	715.000	234971.000	1684937.000	637.000
12	23	252558.190	1801469.670	494.800	252410.000	1801769.000	672.000
13	24	259111.800	1776190.840	557.280	259157.000	1776342.000	608.000
14	25	202545.000	1765447.000	437.000	202476.000	1765405.000	375.000
15	26	235646.000	1784244.000	641.000	235589.000	1783957.000	494.000
16	28	234612.400	1744562.200	533.600	234617.000	1744481.000	563.000
17	31	206669.600	1693241.200	502.700	206748.000	1693155.000	608.000

S = Suspended Point

BLOCK : UK.:OS.:UTM:DSR:***

Total number of points 17
Total number of plan points .. 16
Total number of height points 15

DIMENSIONAL and VECTOR RESIDUALS

Part 2 Data from file RMSDAT2

No.	Id.	vx	vy	vector(p)	vz	vect/rmsv	vz/rmsz
1	11	11.960	346.980	347.186	36.130	1.927	0.741
2	12	-1710.100	2075.920	2689.588*S*	33.700	14.925	0.691
3	13	104.500	-93.100	139.957	6.650	0.777	0.136
4	14	-103.190	-211.020	234.899	29.160	1.303	0.598
5	15	-100.000	80.000	128.062	15.000	0.711	0.308
6	16	3.600	-39.820	39.982	-3.980	0.222	-0.082
7	17	-24.990	-22.210	33.433	50.800	0.186	1.041
8	18	-30.040	-5.730	30.582	52.500	0.170	1.076
9	19	-139.500	-124.200	186.778	-20.300	1.036	-0.416
10	20	-109.500	-74.700	132.553	-43.710	0.736	-0.896
11	21	36.520	-41.050	54.944	-78.000	0.305	-1.599
12	23	-148.190	299.330	334.004	177.200*S*	1.853	3.633
13	24	45.200	151.160	157.773	50.720	0.875	1.040
14	25	-69.000	-42.000	80.777	-62.000	0.448	-1.271
15	26	-57.000	-287.000	292.606	-147.000*S*	1.624	-3.014
16	28	4.600	-81.200	81.330	29.400	0.451	0.603
17	31	78.400	-86.200	116.521	105.300	0.647	2.159

RMSX:	RMSY:	RMSV:	RMSZ:	Max v:	Max z:
80.706	161.129	180.211	48.778	Not Av	Not Av

Detected SYSTEMATIC ERRORS:

SysX	SysY	SysVECT	SysZ
-31.039	-14.423	34.226	13.425

S = Suspended Point

LIST OF THE OEEPE PUBLICATIONS

State — August 1988

A. Official publications

1 *Trombetti, C.:* „Activité de la Commission A de l'OEEPE de 1960 à 1964" — *Cunietti, M.:* „Activité de la Commission B de l'OEEPE pendant la période septembre 1960—janvier 1964" — *Förstner, R.:* „Rapport sur les travaux et les résultats de la Commission C de l'OEEPE (1960—1964)" — *Neumaier, K.:* „Rapport de la Commission E pour Lisbonne" — *Weele, A.J. v. d.:* „Report of Commission F." — Frankfurt a. M. 1964, 50 pages with 7 tables and 9 annexes.

2 *Neumaier, K.:* „Essais d'interprétation de »Bedford« et de »Waterbury«. Rapport commun établi par les Centres de la Commission E de l'OEEPE ayant participé aux tests" — „The Interpretation Tests of »Bedford« and »Waterbury«. Common Report Established by all Participating Centres of Commission E of OEEPE" — „Essais de restitution »Bloc Suisse«. Rapport commun établi par les Centres de la Commission E de l'OEEPE ayant participé aux tests" — „Test »Schweizer Block«. Joint Report of all Centres of Commission E of OEEPE." — Frankfurt a. M. 1966, 60 pages with 44 annexes.

3 *Cunietti, M.:* „Emploi des blocs de bandes pour la cartographie à grande échelle — Résultats des recherches expérimentales organisées par la Commission B de l'O.E.E.P.E. au cours de la période 1959—1966" — „Use of Strips Connected to Blocks for Large Scale Mapping — Results of Experimental Research Organized by Commission B of the O.E.E.P.E. from 1959 through 1966." — Frankfurt a. M. 1968, 157 pages with 50 figures and 24 tables.

4 *Förstner, R.:* „Sur la précision de mesures photogrammétriques de coordonnées en terrain montagneux. Rapport sur les résultats de l'essai de Reichenbach de la Commission C de l'OEEPE" — „The Accuracy of Photogrammetric Co-ordinate Measurements in Mountainous Terrain. Report on the Results of the Reichenbach Test Commission C of the OEEPE." — Frankfurt a. M. 1968, Part I: 145 pages with 9 figures; Part II: 23 pages with 65 tables.

5 *Trombetti, C.:* „Les recherches expérimentales exécutées sur de longues bandes par la Commission A de l'OEEPE." — Frankfurt a. M. 1972, 41 pages with 1 figure, 2 tables, 96 annexes and 19 plates.

6 *Neumaier, K.:* „Essai d'interprétation. Rapports des Centres de la Commission E de l'OEEPE." — Frankfurt a. M. 1972, 38 pages with 12 tables and 5 annexes.

7 *Wiser, P.:* „Etude expérimentale de l'aérotriangulation semi-analytique. Rapport sur l'essai »Gramastetten«." — Frankfurt a. M. 1972, 36 pages with 6 figures and 8 tables.

8 „Proceedings of the OEEPE Symposium on Experimental Research on Accuracy of Aerial Triangulation (Results of Oberschwaben Tests)"
Ackermann, F.: „On Statistical Investigation into the Accuracy of Aerial Triangulation. The Test Project Oberschwaben" — „Recherches statistiques sur la précision de l'aérotriangulation. Le champ d'essai Oberschwaben" — *Belzner, H.:* „The Planning. Establishing and Flying of the Test Field Oberschwaben" — *Stark, E.:* Testblock Oberschwaben, Programme I. Results of Strip Adjustments" — *Ackermann, F.:* „Testblock Oberschwaben, Program I. Results of Block-Adjustment by Independent Models" — *Ebner, H.:* Comparison of Different Methods of Block Adjustment" — *Wiser, P.:* „Propositions pour le traitement des erreurs non-accidentelles" — *Camps, F.:* „Résultats obtenus dans le cadre du project Oberschwaben 2A" — *Cunietti, M.; Vanossi, A.:* „Etude statistique expérimentale des erreurs d'enchaînement des photogrammes" — *Kupfer, G.:* „Image Geometry as Obtained from Rheidt Test Area Photography" — *Förstner, R.:* „The Signal-Field of Baustetten. A Short Report" — *Visser, J.; Leberl, F.; Kure, J.:* „OEEPE Oberschwaben Reseau Investigations" — *Bauer, H.:* „Compensation of Systematic Errors by Analytical Block Adjustment with Common Image Deformation Parameters." — Frankfurt a. M. 1973, 350 pages with 119 figures, 68 tables and 1 annex.

9 *Beck, W.:* „The Production of Topographic Maps at 1 : 10,000 by Photogrammetric Methods. — With statistical evaluations, reproductions, style sheet and sample fragments by Landesvermessungsamt Baden-Württemberg, Stuttgart." — Frankfurt a. M. 1976, 89 pages with 10 figures, 20 tables and 20 annexes.

10 „Résultats complémentaires de l'essai d'«Oberriet» de la Commission C de l'OEEPE — Further Results of the Photogrammetric Tests of «Oberriet» of the Commission C of the OEEPE"
Hārry, H.: „Mesure de points de terrain non signalisés dans le champ d'essai d'«Oberriet» — Measurements of Non-Signalized Points in the Test Field «Oberriet» (Abstract)" — *Stickler, A.; Waldhäusl, P.:* „Restitution graphique des points et des lignes non signalisés et leur comparaison avec des résultats de mesures sur le terrain dans le champ d'essai d'«Oberriet» — Graphical Plotting of Non-Signalized Points and Lines, and Comparison with Terrestrial Surveys in the Test Field «Oberriet»" — *Förstner, R.:* „Résultats complémentaires des transformations de coordonnées de l'essai d'«Oberriet» de la Commission C de l'OEEPE — Further Results from Co-ordinate Transformations of the Test «Oberriet» of Commission C of the OEEPE" — *Schürer, K.:* „Comparaison des distances d'«Oberriet» — Comparison of Distances of «Oberriet» (Abstract)." — Frankfurt a. M. 1975, 158 pages with 22 figures and 26 tables.

11 „25 années de l'OEEPE"
Verlaine, R.: „25 années d'activité de l'OEEPE" — „25 Years of OEEPE (Summary)" — *Baarda, W.:* „Mathematical Models." — Frankfurt a. M. 1979, 104 pages with 22 figures.

12 *Spiess, E.:* „Revision of 1 : 25,000 Topographic Maps by Photogrammetric Methods." — Frankfurt a. M. 1985, 228 pages with 102 figures and 30 tables.

13 *Timmerman, J.; Roos, P. A.; Schürer, K.; Förstner, R.:* On the Accuracy of Photogrammetric Measurements of Buildings – Report on the Results of the Test "Dordrecht", Carried out by Commission C of the OEEPE. – Frankfurt a. M. 1982, 144 pages with 14 figures and 36 tables.

14 *Thompson, C. N.:* Test of Digitising Methods. – Frankfurt a. M. 1984, 120 pages with 38 figures and 18 tables.

15 *Jaakkola, M.; Brindöpke, W.; Kölbl, O.; Noukka, P.:* Optimal Emulsions for Large-Scale Mapping – Test of "Steinwedel" – Commission C of the OEEPE 1981–84. – Frankfurt a. M. 1985, 102 pages with 53 figures.

16 *Waldhäusl, P.:* Results of the Vienna Test of OEEPE Commission C. – *Kölbl, O.:* Photogrammetric Versus Terrestrial Town Survey. – Frankfurt a. M. 1986, 57 pages with 16 figures, 10 tables and 7 annexes.

17 *Commission E of the OEEPE:* Influences of Reproduction Techniques on the Identification of Topographic Details on Orthophotomaps. – Frankfurt a. M. 1986, 138 pages with 51 figures, 25 tables and 6 appendices.

18 *Förstner, W.:* Final Report on the Joint Test on Gross Error Detection of OEEPE and ISP WG III/1. – Frankfurt a. M. 1986, 97 pages with 27 tables and 20 figures.

19 *Dowman, I. J.; Ducher, G.:* Spacelab Metric Camera Experiment – Test of Image Accuracy. – Frankfurt a. M. 1987, 112 pages with 13 figures, 25 tables and 7 appendices.

20 *Eichhorn, G.:* Summary of Replies to Questionnaire on Land Information Systems – Commission V – Land Information Systems. – Frankfurt a. M. 1988, 129 pages with 49 tables and 1 annex.

21 *Kölbl, O.:* Proceedings of the Workshop on Cadastral Renovation – Ecole polytechnique fédérale, Lausanne, 9–11 September, 1987. – Frankfurt a. M. 1988, 337 pages with figures, tables and appendices.

B. Special publications

— Special Publications O.E.E.P.E. — Number I

Solaini, L.; Trombetti, C.: Relation sur les travaux préliminaires de la Commission A (Triangulation aérienne aux petites et aux moyennes échelles) de l'Organisation Européenne d'Etudes Photogrammétriques Expérimentales (O.E.E.P.E.). I^{ère} Partie: Programme et organisation du travail. — *Solaini, L.; Belfiore, P.:* Travaux préliminaires de la Commission B de l'Organisation Européenne d'Etudes Photogrammétriques Expérimentales (O.E.E.P.E.) (Triangulations aériennes aux grandes échelles). — *Solaini, L.; Trombetti, C.; Belfiore, P.:* Rapport sur les travaux expérimentaux de triangulation aérienne exécutés par l'Organisation Européenne d'Etudes Photogrammétriques Expérimentales (Commission A et B). — *Lehmann, G.:* Compte rendu des travaux de la Commission C de l'O.E.E.P.E. effectués jusqu'à présent. — *Gotthardt, E.:* O.E.E.P.E. Commission C. Compte-rendu de la restitution à la Technischen Hochschule, Stuttgart, des vols d'essai du groupe I du terrain d'Oberriet. — *Brucklacher, W.:* Compte-rendu du centre «Zeiss-Aerotopograph» sur les restitutions pour la Commission C de l'O.E.E.P.E. (Restitution de la bande de vol, groupe I, vol. No. 5). — *Förstner, R.:* O.E.E.P.E. Commission C. Rapport sur la restitution effectuée dans l'Institut für Angewandte Geodäsie, Francfort sur le Main. Terrain d'essai d'Oberriet les vols No. 1 et 3 (groupe I). — I.T.C., Delft: Commission C, O.E.E.P.E. Déroulement chronologique des observations. — Photogrammetria XII (1955—1956) 3, Amsterdam 1956, pp. 79—199 with 12 figures and 11 tables.

— Publications spéciales de l'O.E.E.P.E. — Numéro II

Solaini, L.; Trombetti, C.: Relations sur les travaux préliminaires de la Commission A (Triangulation aérienne aux petites et aux moyennes échelles) de l'Organisation Européenne d'Etudes Photogrammétriques Expérimentales (O.E.E.P.E.). 2^{e} partie. Prises de vues et points de contrôle. — *Gotthardt, E.:* Rapport sur les premiers résultats de l'essai d'«Oberriet» de la Commission C de l'O.E.E.P.E. — Photogrammetria XV (1958—1959) 3, Amsterdam 1959, pp. 77—148 with 15 figures and 12 tables.

— *Trombetti, C.:* Travaux de prises de vues et préparation sur le terrain effectuées dans le 1958 sur le nouveau polygone italien pour la Commission A de l'OEEPE. — Florence 1959, 16 pages with 109 tables.

— *Trombetti, C.; Fondelli, M.:* Aérotriangulation analogique solaire. — Firence 1961, 111 pages, with 14 figures and 43 tables.

— Publications spéciales de l'O.E.E.P.E. — Numéro III

Solaini, L.; Trombetti, C.: Rapport sur les résultats des travaux d'enchaînement et de compensation exécutés pour la Commission A de l'O. E. E. P. E. jusqu'au mois de Janvier 1960. Tome 1: Tableaux et texte. Tome 2: Atlas. — Photogrammetria XVII (1960—1961) 4, Amsterdam 1961, pp. 119—326 with 69 figures and 18 tables.

- „OEEPE — Sonderveröffentlichung Nr. 1"

  Gigas, E.: „Beitrag zur Geschichte der Europäischen Organisation für photogrammetrische experimentelle Untersuchungen" — *N. N.:* „Vereinbarung über die Gründung einer Europäischen Organisation für photogrammetrische experimentelle Untersuchungen" — „Zusatzprotokoll" — *Gigas, E.:* „Der Sechserausschuß" — *Brucklacher, W.:* „Kurzbericht über die Arbeiten in der Kommission A der OEEPE" — *Cunietti, M.:* „Kurzbericht des Präsidenten der Kommission B über die gegenwärtigen Versuche und Untersuchungen" — *Förstner, R.:* „Kurzbericht über die Arbeiten in der Kommission B der OEEPE" — „Kurzbericht über die Arbeiten in der Kommission C der OEEPE" — *Belzner, H.:* „Kurzbericht über die Arbeiten in der Kommission E der OEEPE" — *Schwidefsky, K.:* „Kurzbericht über die Arbeiten in der Kommission F der OEEPE" — *Meier, H.-K.:* „Kurzbericht über die Tätigkeit der Untergruppe „Numerische Verfahren" in der Kommission F der OEEPE" — *Belzner, H.:* „Versuchsfelder für internationale Versuchs- und Forschungsarbeiten." — Nachr. Kt.- u. Vermesss.-wes., R. V, Nr. 2, Frankfurt a. M. 1962, 41 pages with 3 tables and 7 annexes.

- *Rinner, K.:* Analytisch-photogrammetrische Triangulation eines Teststreifens der OEEPE. — Österr. Z. Vermess.-wes., OEEPE-Sonderveröff. Nr. 1, Wien 1962, 31 pages.

- *Neumaier, K.; Kasper, H.:* Untersuchungen zur Aerotriangulation von Überweitwinkelaufnahmen. — Österr. Z. Vermess.-wes., OEEPE-Sonderveröff. Nr. 2, Wien 1965, 4 pages with 4 annexes.

- „OEEPE — Sonderveröffentlichung Nr. 2"

  Gotthardt, E.: „Erfahrungen mit analytischer Einpassung von Bildstreifen." — Nachr. Kt.- u. Vermess.-wes., R. V, Nr. 12, Frankfurt a. M. 1965, 14 pages with 2 figures and 7 tables.

- „OEEPE — Sonderveröffentlichung Nr. 3"

  Neumaier, K.: „Versuch »Bedford« und »Waterbury«. Gemeinsamer Bericht aller Zentren der Kommission E der OEEPE" — „Versuch »Schweizer Block«. Gemeinsamer Bericht aller Zentren der Kommission E der OEEPE." — Nachr. Kt.- u. Vermess.-wes., R. V, Nr. 13, Frankfurt a. M. 1966, 30 pages with 44 annexes.

- *Stickler, A.; Waldhäusl, P.:* Interpretation der vorläufigen Ergebnisse der Versuche der Kommission C der OEEPE aus der Sicht des Zentrums Wien. — Österr. Z. Vermess.-wes., OEEPE-Sonderveröff. (Publ. Spéc.) Nr. 3, Wien 1967, 4 pages with 2 figures and 9 tables.

- „OEEPE — Sonderveröffentlichung Nr. 4"

  Schürer, K.: „Die Höhenmeßgenauigkeit einfacher photogrammetrischer Kartiergeräte. Bemerkungen zum Versuch »Schweizer Block« der Kommission E der OEEPE." — Nachr. Kt.- u. Vermess.-wes., Sonderhefte, Frankfurt a. M., 1968, 25 pages with 7 figures and 3 tables.

- „OEEPE — Sonderveröffentlichung Nr. 5“

  Förstner, R.: „Über die Genauigkeit der photogrammetrischen Koordinatenmessung in bergigem Gelände. Bericht über die Ergebnisse des Versuchs Reichenbach der Kommission C der OEEPE.“ — Nachr. Kt.- u. Vermess.-wes., Sonderhefte, Frankfurt a. M. 1969, Part I: 74 pages with 9 figures; Part II: 65 tables.

- „OEEPE — Sonderveröffentlichung Nr. 6“

  Knorr, H.: „Die Europäische Organisation für experimentelle photogrammetrische Untersuchungen — OEEPE — in den Jahren 1962 bis 1970.“ — Nachr. Kt.- u. Vermess.-wes., Sonderhefte, Frankfurt a. M. 1971, 44 pages with 1 figure and 3 tables.

- „OEEPE — Sonderveröffentlichung Nr. D-7“

  Förstner, R.: „Das Versuchsfeld Reichenbach der OEEPE.“ — Nachr. Kt.- u. Vermess.-wes., Sonderhefte, Frankfurt a. M. 1972, 191 pages with 49 figures and 38 tables.

- „OEEPE — Sonderveröffentlichung Nr. D-8“

  Neumaier, K.: „Interpretationsversuch. Berichte der Zentren der Kommission E der OEEPE.“ — Nachr. Kt.- u. Vermess.-wes., Sonderhefte, Frankfurt a. M. 1972, 33 pages with 12 tables and 5 annexes.

- „OEEPE — Sonderveröffentlichung Nr. D-9“

  Beck, W.: „Herstellung topographischer Karten 1 : 10 000 auf photogrammetrischem Weg. Mit statistischen Auswertungen, Reproduktionen, Musterblatt und Kartenmustern des Landesvermessungsamts Baden-Württemberg, Stuttgart.“ — Nachr. Kt.- u. Vermess.-wes., Sonderhefte, Frankfurt a. M. 1976, 65 pages with 10 figures, 20 tables and 20 annexes.

- „OEEPE — Sonderveröffentlichung Nr. D-10“

  Weitere Ergebnisse des Meßversuchs „Oberriet“ der Kommission C der OEEPE. *Hårry, H.:* „Messungen an nicht signalisierten Geländepunkten im Versuchsfeld «Oberriet»“ — *Stickler, A.; Waldhäusl, P.:* „Graphische Auswertung nicht signalisierter Punkte und Linien und deren Vergleich mit Feldmessungsergebnissen im Versuchsfeld «Oberriet»“ — *Förstner, R.:* „Weitere Ergebnisse aus Koordinatentransformationen des Versuchs «Oberriet» der Kommission C der OEEPE“ — *Schürer, K.:* „Streckenvergleich «Oberriet».“ — Nachr. Kt.- u. Vermess.-wes., Sonderhefte, Frankfurt a. M. 1975, 116 pages with 22 figures and 26 tables.

- „OEEPE — Sonderveröffentlichung Nr. D-11“

  Schulz, B.-S.: „Vorschlag einer Methode zur analytischen Behandlung von Reseauaufnahmen.“ — Nachr. Kt.- u. Vermess.-wes., Sonderhefte, Frankfurt a. M. 1976, 34 pages with 16 tables.

„OEEPE — Sonderveröffentlichung Nr. D–12"

Verlaine, R.: „25 Jahre OEEPE." — Nachr. Kt.- u. Vermess.-wes., Sonderhefte, Frankfurt a. M. 1980, 53 pages.

„OEEPE — Sonderveröffentlichung Nr. D–13"

Haug, G.: „Bestimmung und Korrektur systematischer Bild- und Modelldeformationen in der Aerotriangulation am Beispiel des Testfeldes „Oberschwaben." — Nachr. Kt.- u. Vermess.-wes., Sonderhefte, Frankfurt a. M. 1980, 136 pages with 25 figures and 51 tables.

„OEEPE — Sonderveröffentlichung Nr. D—14"

Spiess, E.: „Fortführung der Topographischen Karte 1 : 25 000 mittels Photogrammetrie" (in Vorbereitung).

„OEEPE — Sonderveröffentlichung Nr. D—15"

Timmerman, J.; Roos, P. A.; Schürer, K.; Förstner, R.: „Über die Genauigkeit der photogrammetrischen Gebäudevermessung. Bericht über die Ergebnisse des Versuchs Dordrecht der Kommission C der OEEPE." — Nachr. Kt.- u. Vermess.-wes., Sonderhefte, Frankfurt a. M. 1983, 131 pages with 14 figures and 36 tables.

„OEEPE — Sonderveröffentlichung Nr. D—16"

Kommission E der OEEPE: „Einflüsse der Reproduktionstechnik auf die Erkennbarkeit von Details in Orthophotokarten." — Nachr. Kt.- u. Vermess.-wes., Sonderhefte, Frankfurt a. M. 1986, 130 pages with 51 figures, 25 tables and 6 annexes.

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