SORRY

MISSING PAGE

"3. To achieve these aims, the Society shall:
a) hold international Congresses at regular intervals, with lectures, communications, discussions, exhibitions and visits;
b) initiate and coordinate research in the fields of photogrammetry and remote sensing, and develop their application by creating Commissions and international Working Groups concerned more particularly with one of the aspects of photogrammetry or remote sensing;
c) ensure the wide international circulation of the records of discussions and the results of research by the publication of the International Archives of Photogrammetry and Remote Sensing, which shall form the record of Congresses and other meetings that the Society or its subordinate bodies (Technical Commissions, Working Groups, etc.) organize in accordance with the Society's policy defined by the General Assembly;
d) publish and circulate an international Review which shall be the official organ of the Society or request specialized Reviews to publish its communications;
e) stimulate the formation of a National Society of Photogrammetry and Remote Sensing in each country and promote exchanges between such Societies;
f) encourage the publication and exchange of scientific papers and journals dealing with photogrammetry and remote sensing...

"The Society may do all other things incidental or conducive to the Society's aims, provided such acts do not contravene the Statutes or By-laws of the Society, or the laws of the country in which they are done, or the general principles to which the Society subscribes."

The quoted objects do not include standardization but permit by virtue of the last quoted paragraph the development of standards. These can only be recommended procedures or specifications.

The history associated with the "Recommended Procedures for Calibrating Photogrammetric Cameras..." clearly indicates that the maintenance of ISPRS standards depends upon the personal initiative of individuals. It may be no coincidence that the "Recommended Procedures..." were amended and reaffirmed only as long as at least one of its major parents was still professionally active, which is no longer the case. If ISPRS decides to remain active in the area of recommended procedures or recommendations it appears desirable that a more formal recognition of this activity be achieved, and that review or reaffirmation of such documents becomes part of the agenda of Council and/or the General Assembly.

THE INTERNATIONAL STANDARDS ORGANIZATION (ISO)

The International Organization for Standardization (ISO) is the specialized international agency for standardization, at present comprising the national standards bodies of 89 countries. The object of ISO is to promote the development of standardization and related activities in the world with a view to facilitating international exchange of goods and services, and to developing co-operation in the sphere of intellectual, scientific, technological and economic activity. The results of ISO technical work are published as "International Standards".

International standardization started in the electrotechnical field 75 years ago. While some attempts were made in the thirties to develop International Standards in other technical fields, it was not until ISO was created that an international standards organization devoted to standardization as a whole came into existance.

Following a meeting in London in 1946, delegates from 25 countries decided to create a new international organization "the object of which would be to facilitate the international coordination and unification of industrial standards". The new organization, ISO, began to function officially on 23 February 1947.

The technical work of ISO is carried out through technical committees (TC). The decision to establish a technical committee is taken by the ISO council and its scope is approved by the ISO planning committee on behalf of the ISO council. Within this scope, the committee determines its own program of work. The technical committees may, in turn, establish sub-committees (SC) and working groups (WG) to cover different aspects of the work. Each technical committee or sub-committee has a secretariat, assigned to an ISO member body. A member body of ISO is the national body "most representative of standardization in its country". It follows that only one such body for each country is accepted for membership of ISO. For each working group, a convener is appointed by the parent committee. By the end of 1983, there were 165 technical committees, 610 sub-committees and 1391 working groups.

Sixty seven technical committees (TC) were formed in the first year of ISO's existance (1947), amongst them TC 42 (Photography). Since then another 119 TC's were formed, amongst them in 1978 TC 172 (Optics and optical instruments). When the "Recommended Procedures..." were developed, ISO was approached in regard to cooperation but declined since optical standards were then not yet a recognized ISO activity.

The two TC's singled out above have a number of WG's of interest to photogrammetrists such as

TC42 / WG 3 Sensitometry
TC42 / WG 5 Physical properties and image permanence of photographic materials
TC42 / WG 6 Photographic chemicals and processing
TC42 / WG12 Lens quality characteristics
TC172 / SC1 / WG 1 General optical test methods

Recent activities within ISO WG's include for example the following items of interest to photogrammetrists:
- Black-and-white aerial camera films - Designation of ISO speed and average gradient (TC 42)
- Optical transfer function (TC42 and TC 172) with the sub-items definitions, principles of measurement, and applications
- Veiling glare index of photographic objectives - Method of test (TC42 and TC 172)
- Photographic lenses - Determination of image distortion (TC42 and TC172).

ISPRS-RECOMMENDED PROCEDURES/SPECIFICATIONS AND ISO STANDARDS

The ISPRS "Recommended Procedures for Calibrating Photogrammetric Cameras and for Related Optical Tests" contain a significant amount of technical information which already is or will be in the near future addressed by ISO standards. This suggests that the procedures could be rewritten based on ISO standards. The emphasis could then be placed on matters specifically of photogrammetric concern and not covered adequately by ISO standards. This solution would provide an ISO basis which is subject to periodic review and which enjoys (with possible exceptions) the support of the major manufacturers of photogrammetric equipment and the standard organizations in their respective countries. ISPRS could contribute to such standards where desirable either by participation in the ISO study group meetings or through national standard organizations (e.g. the home country of the president of Commission I).

Such a reorientation and the extensive revision of the "Recommended Procedures..." therefrom would provide an opportunity for additions to the procedures in regard to their present scope. It would in particular be possible to add in regard to definitions and to the reporting of calibration results.

Within an ISO WG the suggestion was made not long ago to seek input from the photogrammetric community (in regard to image distortion of photogrammetric cameras). This fact should suffice to encourage ISPRS to seek a liaison with ISO in matters of common concern. It is also conceivable that a joint sponsorship of ISO/ISPRS standards may be possible. Such joint sponsorship would bring about more standardization of test methods, greater reliability of test results, and international recognition of the recommended procedures.

NOTES ON THE "RECOMMENDED PROCEDURES FOR CALIBRATING PHOTOGRAMMETRIC CAMERAS..."

Since the review of section 2 (Calibration) in [Tayman and Ziemann 1982] suggestions have been received for further modification of this section and for the review of other sections [Hakkarainen 1984, Ratzenberger and Mackwardt 1984]. These will now be summarized below for the respective paragraphs of the present document

1.10. The recommendation "...the same sensitive material is used in actual practice..." appears problematic in view of the fact that a wide spectrum of photographic materials which differ considerably in their properties and involve different processing procedures, are now available. The situation is further complicated by the development of aerial cameras with build-in forward motion compensation.

1.13.3. The unit "Lines per millimeter" and its unambiguous definition are to be welcomed, in view of the growing frequency of "lp/mm" in the literature which has caused some confusion among workers in the field.

2.2.8. Decentring distortion (Proposal for addition).

When a lens is mounted, the optical axes of the lens elements usually deviate somewhat from the common optical axis. This is producing so-called decentring distortion. Tensions between lens elements and the camera cone can cause similar effects. Changes of refractive index and polishing errors can additionally cause small irregularities in the distortion.

The decentring distortion does not depend on the size of mean radial distortion. It has two components, radial and tangential. The radial component has its maximum value in a diameter line going through the PPA, usually in the direction of the movement line of the lens element, and it is zero in the diameter line perpendicular to it. The tangential component is zero in the diameter line where the radial asymmetry is largest, and largest in the diameter line not having any radial asymmetry. The tangential component can be expected to increase nearly parabolically with the field angle.

If the lens has decentring distortion and if the PPA is used as origin in the determination of radial distortion the corresponding semi-diagonals have different distortions. The differences between the rotationally symmetrical radial lens distortion and the radial distortion of each semi-diagonal is the asymmetry of 1st order in this direction, i.e. radial component of decentring distortion. This component has different signs for corresponding semi-diagonals.

A useful indicator for the radial component of the decentring distortion is the distance between the PPA and PBS. This distance is equals to the first order asymmetry for $r = f_c$. It must be less than 20 µm in a well-adjusted aerial camera. It is recommended to choose as tolerance for the principal points the requirements that PPA, PBS and FC fall within a circle with a diameter of less than 20 µm.

When the average values of radial distortion of different diameters are different, a lens has asymmetry of 2nd order. It also exists when the PBS is used as origin. The average value of each diagonal must not deviate from the overall rotationally symmetrical radial lens distortion by more than 4 µm.

5.3. It appears to be more logical to relate the deviation vectors measured at any filter position to the deviation vector at the centre of the filter, as this is done for example with tangential distortion.

In addition to the proceeding specific comments, the following suggestions were received in regard to the calibration of photogrammetric cameras with a goniometer [Hakkarainen 1984]:

1. Instrument

Vertical and horizontal goniometers can both be used for calibration. The goniometer must be constructed such that a very stable instrument results. Goniometer measurements shall produce distortion values with an accuracy better than ±3µm. The accuracy of angular measurements should be better than ± 1" (sexagesimal). The angle measuring instrument must be calibrated.

2. Grid

The glass grid plate used to provide points in the image plane shall be plano-parallel and at least 15 mm thick. The deviation from parallelity should not exceed 1" (sexagesimal), and local uneveness should not exceed 1 µm. The grid must be calibrated to ±1 µm.

The following grid configuration is recommended. Diagonal lines passing through the grid centre are necessary. Additional diameter lines (at least those bisecting the angles between the diagonals) should not pass through the centre point but be interrupted such that a line does not approach the centre point closer than 100 µm. All lines should be chrome vaporized and have short perpendicular lines at 10mm intervals commencing at the grid centre. Additional markings at odd radial distances may be required dependent upon the fiducial mark arrangement of different camera types. The width of all line elements should be at least 20µm.

NOTE: Phase shift phenomenon and pseudo-resolution cause in almost all (especially in older wide-angle) cameras a shift of the centre of gravity of the intensity profile of images. These phenomena occur primarily for field angles greater than 35° on radially oriented lines and only rarely in tangentially oriented lines. It is therefore recommended that diagonally oriented crosses be used, as just suggested. This solution is better than a rectangular grid aligned to the format sides where the shift would affect both cross bars in all points not located on diameters not parallel to the format sides.

3. Illumination

The illumination should closely resemble the photographic daylight.

Recommended is further the use of a minus blue filter to minimize the effect of flare in the measuring instrument. Spectral distribution of illumination must be reported in calibration reports or certificates.

4. Measurements

The PPA is the most suitable reference point because it can be accurately realized in the image plane. All points should be observed twice to minimize the effect of the angle measuring instrument, using the two possible directions of movement through the image plane. The grid must be rotated 90° between these two series of measurements to reduce the effect of grid errors.

At least the radial distortion along the diagonals should be measured. It is recommended however to also measure the distortion for the diameters bisecting the angles between the diagonals. All readings for the diagonals of a camera must be taken during the same day.

5. The radial lens distortion must either be reported with the PPA as origin or the distance PPA-PBS must be given in the calibration report.

6. It is recommended to determine symmetrical components of the tangential distortion at least in the diagonals and in the diameters bisepting the angle between the diagonals.

7. The temperature of the calibration laboratory must be constant during the duration of the measurements within ± 1°C. The temperature should be between 19 and 23°C and should be reported.

CONCLUSION

This paper is a follow-up to [Tayman and Ziemann 1982] which gave a detailed technical review of the section on calibration of the ISPRS "Recommended Procedures for Calibrating Photogrammetric Cameras and for Related Optical Tests". The current paper moves away from a strictly technical discussion - although it also reports proposals for a revision - to a more general discussion about the role of ISPRS in standardization and proposes a cooperation between ISPRS and the International Standards Organization. This cooperation can consist of a use of ISO standards in the development of ISPRS-recommended procedures and specifications, of a participation in the development of relevant ISO standards and possibly also - this remains to be explored - in the cooperation of ISPRS and ISO in the development of joint standards. It is hoped that this paper will result in an active discussion between photogrammetrists.

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