VOL.104 NO.SU1. NOV. 1978

JOURNAL OF THE SURVEYING AND MAPPING DIVISION

PROCEEDINGS OF
THE AMERICAN SOCIETY
OF CIVIL ENGINEERS

AMERICAN SOCIETY OF CIVIL ENGINEERS

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This Journal is published aperiodically by the American Society of Civil Engineers. Publications office is at 345 East 47th Street, New York, N.Y. 10017. Address all ASCE correspondence to the Editorial and General Offices at 345 East 47th Street, New York, N.Y. 10017. Allow six weeks for change of address to become effective. Subscription price to members is $4.00. Nonmember subscriptions available; prices obtainable on request. EY, SU, TC, UP, WR.

The most recent issues of this journal were published in December 1976 and September 1977.

DISCUSSION

Proc. Paper 14119

INFORMATION RETRIEVAL

The key words, abstract, and reference "cards" for each article in this Journal represent part of the ASCE participation in the EJC information retrieval plan. The retrieval data are placed herein so that each can be cut out, placed on a 3 × 5 card and given an accession number for the user's file. The accession number is then entered on key word cards so that the user can subsequently match key words to choose the articles he wishes. Details of this program were given in an August, 1962 article in CIVIL ENGINEERING, reprints of which are available on request to ASCE headquarters.

[a]Discussion period closed for this paper. Any other discussion received during this discussion period will be published in subsequent Journals.

NEW ADJUSTMENT OF NAD COMPUTER PRODUCTS

KEY WORDS: **Computer applications; Coordinates;** Geodesy; **Networks;** Surveying; Surveys; **United States**

ABSTRACT: The horizontal geodetic network of the United States comprises over 220,000 stations. Most of these stations were surveyed in the past four decades. Their inclusion into the National Network has gradually strained the accuracy of the 1927 adjustment, which led to the North American 1927 datum, and has made a new adjustment mandatory. Important topics relating to the New Adjustment (identified as North American Datum 1983) are the selection of a new datum, the effect on the coordinate system, as well as new possibilities for data dissemination resulting from advances in electronic computing.

REFERENCE: Gergen, John G., "New Adjustment of NAD-Associated Computer Products," *Journal of the Surveying and Mapping Division,* ASCE, Vol. 104, No. SU1, **Proc. Paper 14134**, November, 1978, pp. 1-6

14113 METRICATION FOR SURVEYING AND MAPPING

KEY WORDS: Aeronautical navigation charts; **Geodetic surveys;** Hydrography; **Land surveys; Mapping; Metric system; Surveying;** Topographic surveys

ABSTRACT: The key aspects of the ultimate use of the metric system by all branches of surveying and mapping are identified. The applications of the International System of Units (SI) to survey measurements are described. These are the meter (and millimeter) for lengths, heights, and depths; the square meter and hectare for areas; degree Celsius for temperature; newton for tension; and kilopascals for pressure. It is concluded that metric conversion for the surveying and mapping professions will not be difficult. The primary concern will be the acceptance by the users of the services and products of these professions.

REFERENCE: Whitten, Charles A., "Metrication for Surveying and Mapping," *Journal of the Surveying and Mapping Division,* ASCE, Vol. 104, No. SU1, **Proc. Paper 14113**, November, 1978, pp. 7-13

14112 PROJECTIVE COMPENSATION IN AEROTRIANGULATION

KEY WORDS: **Aerial surveys;** Analytical techniques; **Errors; Images;** Mapping; **Photogrammetry;** Precision; Research; Surveying; **Triangulation**

ABSTRACT: A 15-photograph block of simulated data is analyzed to evaluate the magnitude of projective compensation in aerotriangulation. Interior orientation errors in focal length and principal point coordinates as well as image errors due to image measurement (random), atmospheric refraction, lens distortion and film deformation are each simulated. When studied in the context of 6 μm random image error, the results indicate that interior orientation and systematic image errors are almost totally absorbed by changes in exterior orientation position and attitude. Previous investigations evaluating individual image error sources indicate a total image error larger than that reflected in the results of aerotriangulation tests. It is evident from this study that projective compensation, acting within the aerotriangulation adjustment process, is a significant factor contributing to this difference.

14180 PRECISION SURVEYING — RADIO ...

KEY WORDS: Astronomy; **Baselines;** Earthquakes; **Geodetic surveys; Interferometers;** Motion; Polar regions; **Radio interferometers;** Telescopes; Tides; Troposphere

ABSTRACT: The application of Very long baseline Interferometry (VLBI) to surveying is reviewed. An examination of the error budget for the VLBI observing system in use by the GSFC/HO/MIT VLBI team is presented, and methods for decreasing the effects of the various errors sources are reviewed. Results from recent VLBI experiments are presented. These results show millimeter level repeatability on a baseline 1.4-km in length and 10-cm level repeatability on a 4,000-km baseline from Massachusetts to California. Results for polar motion and UT1 determined from VLBI observations are presented and compared with determinations from the Bureau International de l'Heure, the primary international service for polar motion, and with the determinations from the Doppler Satellite System. The Doppler and VLBI determinations are seen to exhibit a common trend not seen in the BIH values.

REFERENCE: Ryan, James W., Clark, Thomas A., Coates, Robert, Corey, Brian E., Cotton, William D., Counselman, Charles C., III, Hinteregger, Hans F., Knight, Curtis A., Ma, Chopo, Robertson, Douglas S., Rogers, Alan E.E., Shapiro, Irwin I., Whitney, Alan R., and Wittels, Jill J., "Precision Surveying Using Radio Interferometry," *Journal of the Surveying and Mapping Division,* ASCE, Vol. 104, No. SU1, **Proc. Paper 14180**, November, 1978, pp. 25-34

14136 AN OLD TRICK RECALLED

KEY WORDS: Altitude; Azimuth; **Benefit cost analysis; Compensation;** Computer programs; **Errors; Land surveys; Observation;** Orientation; Random error; **Refraction; Solar system;** Surveys; Theodolites; Trajectories

ABSTRACT: Adopting practices that reliably orient land descriptions with respect to a time invariant meridian is seen as a necessity for land surveyors. As land values increase, the importance of precisely retracing originally intended boundaries increases. Orienting land surveys to an absolute meridian with improved reliability will permit future retracement with minimal effort and evidence. The solar altitude method of azimuth determination is suggested as a convenient technique that meets these requirements. Procedural improvements that enhance accuracy, convenience, and economy for this technique are presented. Computerized data reduction is emphasized. Error sources are evaluated through statistical inferences from experimental data. Anomalous atmospheric refraction is shown to generate systematic errors that are the most serious offenders in the solar altitude error regime.

REFERENCE: Smith, Donald W., "An Old Trick Recalled," *Journal of the Surveying and Mapping Division,* ASCE, Vol. 104, No. SU1, **Proc. Paper 14136**, November, 1978, pp. 35-49

14157 SYSTEM CALIBRATION OF METRIC CAMERAS

KEY WORDS: **Calibration; Cameras; Geodesy; Geodetic surveys; Mapping;** Photogrammetry; Topography

ABSTRACT: A strong correlation is known to exist between the exposure station coordinates and the elements of camera calibration under conditions of flat terrain. It has been shown in this paper how this correlation can be minimized and the elements of camera calibration recovered through a system's approach and simulating geometrical conditions necessary to break the correlation using photo and ground data pertaining to a flat terrain. The method proposed in this paper was tested using Casa Grande Test Range (Arizona) data. Equations have been derived to give a new mathematical model and a different approach as compared to the existing methods. Test results show significant improvement not only for the exterior orientation elements but also demonstrates the possibility of recovering the camera calibration elements.

REFERENCE: Rampal, Kunwar K., "System Calibration of Metric Cameras," *Journal of the Surveying and Mapping Division,* ASCE, Vol. 104, No. SU1, **Proc. Paper 14157**, November, 1978, pp. 51-62

14129 THREE-DIMENSIONAL DENSIFICATION FOR CONTROL

KEY WORDS: Adjustment; **Computation; Control surveys;** Control systems; **Densification; Geodesy;** Least squares method; **Surveying**

ABSTRACT: In recent years local engineers and surveyors have often asked for precisely determined control points at a spacing of 2-km to 3-km. To fulfill this demand, a study is being conducted at the Univ. of Illinois at Urbana so as to densify the existing first-order geodetic control. Considered for this study are various configurations and electronic instrumentation that will provide a method for rapid field work, thus reducing the total project cost tremendously without reducing the desired high accuracy. Results of a new configuration, called the Central-Point Configuration, are more accurate than desired, both for horizontal and vertical control. This study will be of importance to all states and counties that need to establish a densified control net of higher accuracy with limited funds.

REFERENCE: Saxena, Narendra K., and Vonderohe, Alan P., "Three-Dimensional Densification for Local Control," *Journal of the Surveying and Mapping Division,* ASCE, Vol. 104, No. SU1, **Proc. Paper 14129**, November, 1978, pp. 63-77

14132 DOPPLER SATELLITE SURVEYING SYSTEM

KEY WORDS: Accuracy; **Aerial surveys;** Artificial satellites; Control surveys; **Doppler systems;** Field tests; **Geodesy; Geodetic surveys; History;** Positional field; **Research;** Satellites

ABSTRACT: The Doppler Satellite System has become an indispensable tool for the surveyor. Because of its portability, all weather capabilities, reasonable cost, and accuracies at the sub-meter level, the Doppler satellite surveying technique is increasingly being used by surveyors around the world to meet control requirements for a variety of applications. The National Geodetic Survey which has utilized Doppler positioning since 1973 has found that with improved tracking instrumentation, field operating procedures, and refinements in the data reduction programs, positional rms errors are now less than 50 cm for 40-pass solutions and 10-cm to 25-cm for differential positions. While studies are continuing to determine the limiting accuracy of the present Doppler system, improved Doppler satellite surveying using the Global Positioning System (GPS) is being researched. Preliminary studies indicate this system may be more practical and cost effective in meeting the needs of the worldwide surveying community by giving better than 10-cm accuracy within a day's observations.

REFERENCE: Hothem, Larry D., Strange, William E., and White, Madeline, "Doppler Satellite Surveying System," *Journal of the Surveying and Mapping Division,* ASCE, Vol. 104, No. SU1, **Proc. Paper 14132**, November, 1978, pp. 79-91

14145 CLIPP, RESPA, AND CADASTRE

KEY WORDS: **Cadastral surveys;** Information systems; **Insurance;** Land; **Land titles;** Properties; **Surveys**

ABSTRACT: A review of past efforts and opinions related to the improvement of an outdated land record system is given. Conflicts between legal and engineering profession in the approach to the problem are highlighted. A new uniform and comprehensive land record system — a Cadastre — administered on the county level, is recommended. Because the land parcel is the base unit of such system, precise and permanent determination of location and boundaries is urged. Also, it is suggested that the system will function best under the leadership and direction of well educated survey engineers.

REFERENCE: Greulich, Gunther, "CLIPP, RESPA, and Cadastre," *Journal of the Surveying and Mapping Division,* ASCE, Vol. 104, No. SU1, **Proc. Paper 14145**, November, 1978, pp. 93-102

U.S. Customary-SI Conversion Factors

In accordance with the October, 1970 action of the ASCE Board of Direction, which stated that all publications of the Society should list all measurements in both U.S. Customary and SI (International System) units, the following list contains conversion factors to enable readers to compute the SI unit values of measurements. A complete guide to the SI system and its use has been published by the American Society for Testing and Materials. Copies of this publication (ASTM E-380) can be purchased from ASCE at a price of 75¢ each; orders must be prepaid.

All authors of *Journal* papers are being asked to prepare their papers in this dual-unit format. Until this practice affects the majority of papers published, we will continue to print this table of conversion factors:

To convert	To	Multiply by
inches (in.)	millimeters (mm)	25.40
inches (in.)	centimeters (cm)	2.540
inches (in.)	meters (m)	0.0254
feet (ft)	meters (m)	0.305
miles (miles)	kilometers (km)	1.61
yards (yd)	meters (m)	0.91
square inches (sq in.)	square centimeters (cm^2)	6.45
square feet (sq ft)	square meters (m^2)	0.093
square yards (sq yd)	square meters (m^2)	0.836
acres (acre)	square meters (m^2)	4047
square miles (sq miles)	square kilometers (km^2)	2.59
cubic inches (cu in.)	cubic centimeters (cm^3)	16.4
cubic feet (cu ft)	cubic meters (m^3)	0.028
cubic yards (cu yd)	cubic meters (m^3)	0.765
pounds (lb)	kilograms (kg)	0.453
tons (ton)	kilograms (kg)	907.2
one pound force (lbf)	newtons (N)	4.45
one kilogram force (kgf)	newtons (N)	9.81
pounds per square foot (psf)	newtons per square meter (N/m^2)	47.9
pounds per square inch (psi)	kilonewtons per square meter (kN/m^2)	6.9
gallons (gal)	cubic meters (m^3)	0.0038
acre-feet (acre-ft)	cubic meters (m^3)	1233
gallons per minute (gal/min)	cubic meters per minute (m^3/min)	0.0038
newtons per square meter (N/m^2)	pascals (Pa)	1.00