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The most recent issues of this Journal were published in September 1977, November 1978, and November 1979.

DISCUSSION

Proc. Paper 15786

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

15849 BLOCK TRIANGULATION BY BUNDLES AND STEREO-UNITS

KEY WORDS: **Aerial surveys; Aerotriangulation;** Analytical techniques; **Mapping; Photogrammetry;** Research; Surveying; Triangulation

ABSTRACT: Tests were run on simulated and real block data to evaluate the comparative accuracies of bundle and independent unit block triangulation. Cases run using the ISP simulated test block were: bundles, pairs, triplets overlapping by one photograph, and triplets overlapping by two photographs with and without the perspective centers being pass points. The bundle method was superior using the data with random errors only, while the units were slightly better for the data with random plus systematic errors. Cases run using the U.S. Geological Survey, Middleburg, Va. real data test block included those run with simulated data and also quadruplets overlapping by one photograph. The horizontal accuracy results of the bundle method were essentially the same as those from units. For vertical accuracy, the bundle was slightly better in all cases except for the quadruplets, where it was slightly worse.

REFERENCE: Marks, G. Warren, Mikhail, Edward M., and McGlone, J. Christopher, "Block Triangulation by Bundles and Stereo-Units," *Journal of the Surveying and Mapping Division,* ASCE, Vol. 106, No. SU1, **Proc. Paper 15849**, November, 1980, pp. 1-11

15846 USGS DIGITAL CARTOGRAPHIC PROGRAM

KEY WORDS: **Automation; Cartography; Computer applications;** Computers; Digital data; Geography; Government agencies; **Mapping**

ABSTRACT: The U.S. Geological Survey formed a Digital Applications Team in 1977 and started development of a Digital Cartographic Applications Program. The objectives are to produce, manage, and distribute cartographic data in computer compatible form. The principal types of data are similar in content and accuracy to the categories found on the standard 1:24,000-scale 7.5-minute topographic maps. Activity is also underway to produce a national small-scale data base at 1:2,000,000 scale. The data is organized into a Digital Elevation Model (DEM) data base and a Digital Line Graph (DLG) data base and standard file formats and attribute codes have been developed. The data will become of major importance for map preparation and revision and will allow the development of geographic information systems.

REFERENCE: McEwen, Robert B., "USGS Digital Cartographic Applications Program," *Journal of the Surveying and Mapping Division,* ASCE, Vol. 106, No. SU1, **Proc. Paper 15846**, November, 1980, pp. 13-22

15814 COASTAL MAPPING HANDBOOK

KEY WORDS: Charts; Coastal plains; **Information systems; Mapping; Professional practice; Publications; Surveying**

ABSTRACT: A description is given of the Coastal Mapping Handbook distributed by the Government Printing Office. The handbook contains a complete but elementary description of the mapping process and includes examples of map products. Names and addresses of state and federal sources of technical assistance are also included in the handbook.

REFERENCE: Collins, James, "Coastal Mapping Handbook," *Journal of the Surveying and Mapping Division,* ASCE, Vol. 106, No. SU1, **Proc. Paper 15814**, November, 1980, pp. 23-25

15815 HIGH ALTITUDE PHOTOS FOR INACTIVE MINES

KEY WORDS: **Aerial photographs; Erosion; Land reclamation; Mining;** Remote sensing; Surface mining

ABSTRACT: The utility of high altitude, 1:120,000-scale, color, infrared aerial photographs for inventorying inactive surface mines and assessing their environmental conditions was demonstrates for a 200 sq mile (500 km^2) area in Pennsylvania. Some 60 surface mines that had been abandoned with little or no reclamation were detected using 1971, 1973, and 1975 photographs. Revegetation was the primary indicator. Through stereoscopic analysis of the photographs, each inactive mine was characterized by mining method, topographic features, erosion, mass wasting, revegetation, water quality, and visibility from roads or populous areas. Numerical values were assigned to these characteristics in order that a rating could be calculated for each mine. This rating reflected the mine's overall level of environmental disturbance or potential environmental hazard.

REFERENCE: Berger, Jan P., and Philipson, Warren R., "High Altitude Photos for Inactive Mines," *Journal of the Surveying and Mapping Division,* ASCE, Vol. 106, No. SU1, **Proc. Paper 15815**, November, 1980, pp. 27-34

15843 AIRBORNE HYDROLOGIC SURVEY: PLANNING

KEY WORDS: **Aerial photography; Aircraft;** Constraints; Flood control; **Hydrologic data;** Hydrology; **India; Mapping;** Surveys; **Water resources**

ABSTRACT: Aerial surveys, using camera and scanner systems, can help in collecting reliable and adequate hydrologic data over large areas in an effective time frame. Careful mission planning is an essential prerequisite to successful completion of the survey. The various considerations in regard to sensor package design and combined instrument coverage are highlighted. The solution to the problems of definition of survey area, flight planning, and path recovery in areas with inadequate or outdated topographic sheet coverage and where few details are available for precise navigation are described. This paper reflects the experience gained from the planning and execution of airborne camera or scanner missions, or both, in India. This would also have relevance in other developing countries.

REFERENCE: Thiruvengadachari, Srinivasan, and Rohini Kumar, Damal V., "Airborne Hydraulic Surveys: Mission Planning," *Journal of the Surveying and Mapping Division,* ASCE, Vol. 106, No. SU1, **Proc. Paper 15843**, November, 1980, pp. 35-39

15851 MAP CONTENT AND SYMBOLS: CHAPTER V

KEY WORDS: **Computer graphics;** Design; **Drawings (engineering); Mapping; Maps;** Planning; Plans; **Standards; Symbols**

ABSTRACT: Chapter Five, "Map Content and Symbols," of the forthcoming ASCE manual, "Manual on Map Uses, Scales, and Accuracies for Engineering and Associated Purposes," addresses the standardization of the procedures used to compile and revise maps between the scales of 20 ft/in. (1:240) and 400 ft/in. (1:4,800). Brief descriptions of the standard mapping procedures and conventions are incorporated into the chapter. Tables 1 to 8 of the chapter are concise comparisons of nine computer graphics software systems. The tables describe each system and compare the systems in terms of cost, what hardware is required, mathematical capabilities, graphic output capabilities, and what primatives are included. Tables 9 to 26 are recommended standards for the symbology to be used on larger scale engineering and associated maps.

REFERENCE: Jacober, Robert P., Jr., "Map Content and Symbols: Chapter V of Proposed Manual on Map Uses, Scales, and Accuracies for Engineering and Associated Purposes," *Journal of the Surveying and Mapping Division,* ASCE, Vol. 106, No. SU1, **Proc. Paper 15851**, November, 1980, pp. 41-72

15812 TRILATERATION ADJUSTMENT BY FINITE ELEMENTS

KEY WORDS: **Adjustment; Computer programs; Displacement;** Finite elements; Framing; **Networks; Stiffness;** Structural design; Surveying; Trusses

ABSTRACT: The finite element method is used in adjusting trilateration nets. The principle is to consider the trilateration net with distances and points as a structural framework with members and nodes. The framework must be supported for structural stability according to the nature of the problem. Redundant elements are removed and initial coordinates are calculated for the nodes. Misfits are obtained as differences between measured and calculated lengths from the initial coordinates. Stiffnesses of the members are the same as the weights of the corresponding distances. All this information is introduced as input in the computer program FINITE. The output yields the displacements of the nodes in the directions of the axes of the coordinate system. It also prints out the final forces in the members. The nodal displacements are the corrections in the northings and eastings of the net points. The forces in the members divided by the corresponding weights give the corrections in the lengths of the distances.

REFERENCE: Danial, Naguib F., and krauthammer, Theodor, "Trilateration Adjustment by Finite Elements," *Journal of the Surveying and Mapping Division,* ASCE, Vol. 106, No. SU1, **Proc. Paper 15812**, November, 1980, pp. 73-93

15818 MAPPING MASSACHUSETTS WETLANDS

KEY WORDS: Contracts; **Legislation; Mapping; Massachusetts; Orthophotos;** Professional practice; Regulations; **Wetlands**

ABSTRACT: Government mapping programs have often been cost ineffective because of the repetition of incompatible and redundant mapping efforts at the conclusion of which the resultant maps are often not available for reuse or are not applicable to other purposes. These conclusions are drawn from a critical review of a mapping program which has evolved into the development of a wetlands restriction program for the Commonwealth of Massachusetts, mandated by statute and administered by a state agency. The subject mapping program has evolved from a process of annotation directly on contact prints of aerial photographs to the production of ground-controlled orthophoto maps prepared to National Map Accuracy Standards, but the purposes of the programs have not yet been achieved. The program is at a standstill while the subject of litigation in the courts of Massachusetts and of thorough review by the Massachusetts Attorney General.

REFERENCE: Foster, Robert W., "Mapping Massachusetts Wetlands," *Journal of the Surveying and Mapping Division,* ASCE, Vol. 106, No. SU1, **Proc. Paper 15818,** November, 1980, pp. 95-104

15826 GEOGRAPHIC INFORMATION SYSTEMS

KEY WORDS: **Computer applications; Computers; Data handling;** Geodetic coordinates; **Geography;** Grid systems; Impact; **Information systems; Model studies;** Polygons; Technology; **Terrain models;** Topography; Topology

ABSTRACT: The impetus for the development of GIS technologies is derived primarily from the fact that traditional manual techniques for the derivation, organization, storage and use of spatial data are no longer sufficient to meet the demands and expectations placed on such activities. The GIS technology is a service technology used to assist spatial data management, evaluations and analyses. There are three basic approaches currently developed that organize spatial data in a format such that the computer can perform previously time-consuming analytical and display processes. These are: (1)the rectangular grid approach; (2)the fine or coarse polygon approach; and (3)the triangulated irregular network approach. There is a wide range of applications that can be supported by GIS. These can be reasonably divided into two groups: those that depend on qualitative analysis and those that depend on quantitative analysis. The GIS design requirements are much more demanding to support quantitative analyses.

REFERENCE: Gates, William E., and Heil, Richard J., "Geographic Information Systems," *Journal of the Surveying and Mapping Division,* ASCE, Vol. 106, No. SU1, **Proc. Paper 15826**, November, 1980, pp. 105-117

15833 GEOGRAPHIC INFORMATION ...

KEY WORDS: **Automation; Cartography; Color perception; Computer graphics;** Data analysis; Digital techniques; **Geography; Information systems;** Interactions; Mapping

ABSTRACT: The paper defines the background and current use of Geographic Information Systems (GIS). Specifically, it describes and illustrates a computer based interactive graphics GIS developed at Harvard University, called The ODYSSEY Project.

REFERENCE: Teicholz, Eric, "Geographic Information Systems: The ODYSSEY Project," *Journal of the Surveying and Mapping Division,* ASCE, Vol. 106, No. SU1, **Proc. Paper 15833**, November, 1980, pp. 119-135

15837 RATE OF CHANGE IN ASTRONOMICAL SURVEYING

KEY WORDS: **Astronomical photography; Astronomy;** Azimuth; Calculations; **Mapping;** Programming

ABSTRACT: A method is described whereby longitude, latitude and azimuth can be obtained by taking sights on the sun at short timed intervals. Both rate of change of altitude with time and rate of change of bearing with altitude can be used to calculate the observer's position and the direction of the meridian. A calculator can be programmed with monthly data from the *Star Almanac for Land Surveyors* to correct for refraction and carry out the necessary calculations from the raw observations. No previous knowledge of position is required.

REFERENCE: Rish, Raphael F., "Rate of Change Methods in Astronomical Surveying," *Journal of the Surveying and Mapping Division,* ASCE, Vol. 106, No. SU1, **Proc. Paper 15837**, November, 1980, pp. 137-141

15853 NEW MANUAL ON MAP USES, SCALES, ACCURACIES

KEY WORDS: Accuracy; Bibliographies; **Contours; Engineering;** Government agencies; **Graphs (charts); Land use;** Mapping; **Maps;** Metric system; **Publications; Scale (ratio);** Specifications; **Surveying;** Surveys; **Symbols;** Topography

ABSTRACT: A Manual on Map Uses, Scales, and Accuracies for Engineering and Associated Purposes, in preparation by a Task Committee of the Committee on Cartographic Surveying, of the Surveying and Mapping Division of the ASCE, is nearing completion. This preparation is part of the long-range objective of the parent committee to aid engineers in obtaining maps which best fulfill their requirements. For a wide range of engineering and associated purposes, the proposed manual will: (1)Provide a means of determining appropriate scales and contour intervals, based on present and past practice; (2)present a functional method for defining map accuracies according to need; (3)furnish guidelines on the map's content and symbols required to depict graphically the details essential to its purpose; and (4)supply information on the availability of existing maps suitable for the intended purpose. This paper will present a brief report on the development of the manual, its purpose, and highlights of its content.

REFERENCE: Feldscher, Carl B., "A New Manual on Map Uses, Scales, and Accuracies," *Journal of the Surveying and Mapping Division,* ASCE, Vol. 106, No. SU1, **Proc. Paper 15853**, November, 1980, pp. 143-148

15856 MANUAL ON MAP AVAILABILITY — CHAPT. VI

KEY WORDS: **Cartography;** Engineering; Government agencies; **Highway planning; Mapping; Maps;** Plans; Railroads

ABSTRACT: During the planning and design of engineering works, various uses of maps are required due to the varied levels of required information. Various agencies of the U.S. Government produce a multitude of maps, each with a specific usage intended. Lesser known, are some of the map products produced by agencies of state governments, i.e., general highway maps, geologic mapping, etc. Also available to the map user are the by-products of mapping such as aerial photography, diapositives, copy negatives, feature (and color) separates, and digital information. Hydrographic surveys are the basis of nautical chart information and copies of these surveys may be obtained on request. Highway plan sheets and railroad valuation maps provide valuable data regarding these modes of transportation. Maps useful to the petroleum industry include structure maps, base maps, and lease maps.

REFERENCE: Brown, Robert L., "Proposed Manual on Selection of Map Uses, Scales, and Accuracies for Engineering and Associated Purposes: Map Availability—Chapter VI," *Journal of the Surveying and Mapping Division,* ASCE, Vol. 106, No. SU1, **Proc. Paper 15856**, November, 1980, pp. 149-177

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 $3.00 each; orders must be prepaid.

All authors of *Journal* papers are being asked to prepare their papers in this dual-unit format. To provide preliminary assistance to authors, the following list of conversion factors and guides are recommended by the ASCE Committee on Metrication.

To convert	To	Multiply by
inches (in.)	millimeters (mm)	25.4
feet (ft)	meters (m)	0.305
yards (yd)	meters (m)	0.914
miles (miles)	kilometers (km)	1.61
square inches (sq in.)	square millimeters (mm^2)	645
square feet (sq ft)	square meters (m^2)	0.093
square yards (sq yd)	square meters (m^2)	0.836
square miles (sq miles)	square kilometers (km^2)	2.59
acres (acre)	hectares (ha)	0.405
cubic inches (cu in.)	cubic millimeters (mm^3)	16,400
cubic feet (cu ft)	cubic meters (m^3)	0.028
cubic yards (cu yd)	cubic meters (m^3)	0.765
pounds (lb) mass	kilograms (kg)	0.453
tons (ton) mass	kilograms (kg)	907
pound force (lbf)	newtons (N)	4.45
kilogram force (kgf)	newtons (N)	9.81
pounds per square foot (psf)	pascals (Pa)	47.9
pounds per square inch (psi)	kilopascals (kPa)	6.89
U.S. gallons (gal)	liters (L)	3.79
acre-feet (acre-ft)	cubic meters (m^3)	1,233