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Proc. Paper 10507

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10525 ORTHOPHOTOQUADS FOR ARIZONA LAND-USE MAPS

KEY WORDS: **Aerial photography; Arizona;** Images; **Land use; Management; Mapping; Photogrammetry;** Photography; Planning; **Space surveillance (spaceborne)**

ABSTRACT: After initial evaluation of National Aeronautics and Space Administration (NASA) high altitude aerial photography in 1971, the interest in application of high altitude coverage of Arizona resulted in an agreement between NASA, U.S. Department of the Interior, and the State of Arizona, to conduct the Arizona Land-Use Experiment. Space imagery and photography, high altitude aerial photography, training of state agency personnel, orthophotoquad production, and preparation of a manual of results are principal components of the agreement. Numerous applications for the photography, orthophotoquads, and space data are under development in a coordinated program involving key state agencies. The Arizona State Land Department routinely uses the high altitude photography and plans to incorporate 1:24,000 scale orthophotoquads into a comprehensive set of maps and thematic overlays for use in its land management program. Uses by the Arizona Highway Department include updating of photogrammetrically prepared transportation planning maps and highway alinement digitization from the orthophotoquads.

REFERENCE: Winikka, Carl C., and Morse, Samuel A., Jr., "Orthophotoquads for Arizona Land-Use Mapping and Planning," *Journal of the Surveying and Mapping Division,* ASCE, Vol. 100, No. SU1, **Proc. Paper 10525**, May, 1974, pp. 1-6

10527 AEROTRIANGULATION PRECISION FOR HIGHWAYS

KEY WORDS: Accuracy; **Aerial photography;** Empirical equations; **Flight paths;** Linearity; **Photogrammetry;** Photography; Polynomials; Precision; Standard error; **Surveying; Triangulation; Wide field cameras**

ABSTRACT: The magnitude of the standard error, 0.00012 times flight height, for large-scale photography was empirically determined by analyzing data from 137 stereo models in 22 flights at heights of 1,500 ft, 3,000 ft, 6,000 ft, and 12,000 ft, taken by Wild RC-8, f=6in. camera and bridged in a Wild A-7 Autograph. The analysis shows that attainable accuracy changes in a linear form between these heights and this empirical equation may also meet the accuracy of analytical aerotriagulation for large-scale photographs.

REFERENCE: Hou, Michael C.Y., "Aerotriangulation Precision Attainable for Highway Photogrammetry," *Journal of the Surveying and Mapping Division,* ASCE, Vol. 100, No. SU1, **Proc. Paper 10527**, May, 1974, pp. 7-14

10529 SURVEYING AND MAPPING FROM ORBITAL PLATFORMS

KEY WORDS: Cartographic cameras; **Lunar photography; Mapping;** Orbits; **Photogrammetry;** Remote sensing; **Satellites (artificial); Triangulation**

ABSTRACT: The methods of triangulation and photogrammetric mapping have been successfully applied to the surveying and mapping of both the moon and the earth. The accuracy of lunar phototriangulation from orbital photography is limited only by the inaccuracy of the tracking data. Orthophoto maps of the moon at a scale of 1:2,000 with a 10-m (33-ft) contour interval have been produced from Lunar Orbiter photography. In earth applications, a world-wide geodetic control network with an rms error of ± 5 m (± 16.4 ft) in horizontal and ± 8 m (± 26.2 ft) in vertical positions has been estalished by satellite triangulation. Photographic satellite systems have been proposed for providing space photogrpahy to be used for producing small to medium scale maps of the earth. With the increasing importance of remote sensing from satellites, the surveying and mapping profession will be responsible for developing techniques for geographic positioning, thematic mapping, and digital data bank systems.

REFERENCE: Wong, Kam W., "Surveying and Mapping from Orbital Platforms," *Journal of the Surveying and Mapping Division,* ASCE, Vol. 100, No. SU1, **Proc.**

10515 PHOTOGRAMMETRIC RESIDUAL ERRORS

KEY WORDS: **Coordinates; Distortion; Errors; Mapping; Photogrammetry;** Programs; **Surveying**

ABSTRACT: A mathematical model for the photogrammetric systematic residual errors has been formulated and its solution tested using the single photo resection residuals on observations. The predicted residual errors agree within possible limits with those obtained through adjustment procedures. The method furnishes information on residual distortion parameters in addition to checking for large observational errors and blunders. The predicted residual used for refining photo coordinates shows improvement in aerial triangulation accuracy.

REFERENCE: Rampal, Kunwar K., "Analysis and Prediction of Photogrammetric Residual Errors," *Journal of the Surveying and Mapping Division,* ASCE, Vol. 100, No. SU1, **Proc. Paper 10515**, May, 1974, pp. 33-48

10528 PHOTOGRAMMETRIC CONTROL FOR ROUTE DESIGN

KEY WORDS: Accuracy; **Aerial photography;** Bridging; **Control surveys;** Instrument characteristics; **Mapping; Photogrammetry;** Polynomials; Triangulation

ABSTRACT: It is of utmost importance to select such a method and instrument for aerial triangulation which provides the required accuracy in a most economical way. Nine strips of wide and super-wide angle photographs, ranging in scale from 1:2,400 to 1:21,600, were triangulated on a Zeiss PSK stereocomparator, an OMI-Bendix analytical plotter AP-2C, and on a Wild A-10 Autograph. Various bridging distances, control configurations, and degrees of polynomials were introduced during the strip adjustment. Six models are the optimum bridging distance for the wide angle photos and three models for the super-wide angle strips. A second-degree polynomial for the planimetric adjustment and a third-degree polynomial for the heights are the most suitable. The highest accuracy is provided by the stereocomparator, followed by the analytical plotter as a close second, and then by the Autograph, , while the latter instrument shows the highest operation efficiency, followed by the analytical plotter, and then by the sterocomparator.

REFERENCE: Derenyi, Eugene E., and Maarek, Ahmed, "Photogrammetric Control Extension for Route Design," *Journal of the Surveying and Mapping Division,* ASCE, Vol. 100, No. SU1, **Proc. Paper 10528**, May, 1974, pp. 49-61

10524 POSITIONING—BY MULTILATERATION

KEY WORDS: **Aerial surveys;** Airborne equipment; Control surveys; **Geodesy;** Geodetic surveys; Helicopters; Photogrammetric surveys; **Photogrammetry; Surveying**

ABSTRACT: Systems of equations are derived and computational routines are outlined that can be used to determine the geodetic coordinates and elevation of a point by three-dimensional multilateration using slope distances only. The geodetic coordinates and elevation of a point are computed using slope distances (only) that have been measured from three or more points having known geodetic coordinates and elevations to the point of unknown position. By an alternate method, the position of a point is also determined using as few as two slope distances if, in addition, the elevation of the point is known. Least squares methods are employed and precision evaluation estimators are computed.

REFERENCE: Ball, William E., Jr., "Three-Dimensional Positioning—by Multilateration," *Journal of the Surveying and Mapping Division,* ASCE, Vol. 100, No. SU1, **Proc. Paper 10524**, May, 1974, pp. 63-78

ENGLISH-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 customary (English) and SI (International System) units, the list below 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 & Materials. Copies of this publication (ASTM E-380-1972) 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
gallons (gal)	liter (dm^3)	3.8
acre-feet (acre-ft)	cubic meters (m^3)	1233.
gallons per minute (gpm)	cubic meters/minute (m^3/min)	0.0038
newtons per square meter (N/m^2)	pascals (Pa)	1.00