

Analytical Aerial Triangulation for Highway Location and Design

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ABRIDGMENT

•THIS IS A SUMMARY REPORT on a study conducted by the University of Illinois in cooperation with the Illinois Division of Highways and the U.S. Department of Transportation, Federal Highway Administration, Bureau of Public Roads (IHR-804). The report is available through the Clearinghouse for Federal Scientific and Technical Information, Springfield, Virginia 22151, PB 186 495.

The investigation reported here pertains to the application of analytical aerial triangulation for aerial surveying to accomplish highway location and design. Three basic approaches distinguished by the number of photographs used as a unit in the relative orientation phase (2-photo, 3-photo, and simultaneous solutions) were compared through the analysis of both fictitious and real data. The 3-photo (triplet) analytical aerial triangulation approach was recommended as the one most suitable for the implementation of analytical photogrammetry to the highway location and design task. This approach can provide the results needed for the determination of supplemental photogrammetric control, with feasible requirements for analyst data handling and with an optimum facility for observational blunder detection.

The monocular and stereoscopic approaches to analytical photogrammetry were also compared in this project. The results indicated that both approaches yield essentially the same order of accuracy, and this led to the recommendation of the monocular observational system for operational utilization, inasmuch as such a system would be significantly lower in price than a stereoscopic observational system.

Experimentations with various densities and distributions of ground control demonstrated the extremely important influence these 2 parameters have on the results of aerial triangulation projects. The use of a minimum of 3 control points at both ends of the bridged strip or substrip was strongly recommended. These control points should be positioned in a triangular fashion such that 2 points are placed along a line approximately perpendicular to the strip axis at one side of the stereoscopic model and the third point near the centerline of the strip near the opposite side of the stereoscopic model.

To meet accuracy requirements of map compilation products, a bridging distance of not more than 6 stereoscopic models was recommended. For strips longer than 6 models, the control should be placed at equal intervals along the strip, with the maximum interval between control points being 6 stereoscopic models in length. The analysis and adjustment of such continuous strips may be accomplished in either of 2 ways: (a) Each substrip is to be treated separately; or (b) the continuous strip is treated as a whole, and the adjustment is based on all available control provided at the ends of each substrip. On the basis of the investigators' previous experience in this matter, the separate substrip approach was recommended.

Results of the investigation indicated the extreme care with which photographic points are to be transferred, particularly in the monocular approach.

For optimum operation utilization, the electronic computer programs for the monocular 3-photo solution were developed and assembled into a single systems computer programming package, with emphasis placed on the inclusion of program and operator checks within the system to ensure minimization of operator data handling blunders.

The investigation indicated the suitability of analytic aerial triangulation for highway location and design, and pointed out a number of areas where further research is highly recommended, including the design of photographic targets (panels), and the development of design criteria for aerial triangulation projects involving large-scale photography.