# Photogrammetry

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Photogrammetry can be defined as the art, science, and technology of obtaining reliable information about physical objects and the environment through the process of recording, measuring, and interpreting photographic images and patterns of electromagnetic radiant energy and other phenomena.

In most instances, the use of photogrammetry is more efficient, less labor-intensive, and more cost-effective than field collection. The major components necessary for a photogrammetric project (aerial photography and ground control survey) can be obtained with relative ease in places that would normally be hard to access.

The most important consideration when determining project requirements is deciding the level of accuracy necessary for the final product. Accuracy, photographic scale, and project size are directly related. Typically, the higher the level of accuracy required, the larger the scale of photography necessary, which in turn increases the magnitude of the job. Once the accuracy requirement is determined, the process of designing a project to achieve the desired results can begin.

## Project Design

The flight line diagram is an integral part of the photogrammetric process. Many elements need to be considered to ensure that proper project design is met. These elements include the size of the area, scale of the photography, terrain (mountains or rolling hills), vegetation cover (desert or forest), accessibility (rivers, cliffs, or ownership), sun angle (latitude, longitude, or time of year), and film type (black and white, natural color, or color infrared). The most important goals of a flight line diagram are to guarantee that the photos have complete stereoscopic coverage (photos taken with sufficient overlap to permit three-dimensional [3-D] viewing) at the proper scale and to ensure that the proper amount of survey ground control is specified and properly located.

## Types of Aerial Photography

Traditional aerial photography is film based. Once the film has been exposed, it needs to be developed through the photographic process. The industry has started to migrate to the digital world in recent years and, thus, there is no film to be dealt with. The image is captured in a digital form.

Aerial photography film is typically a 9-inch × 9-inch format and is available in black and white, natural color, or color infrared forms depending on the project requirements.

Each aerial camera has its own Camera Calibration Report. This is a report generated with the results of a series of tests developed to reveal the geometric characteristics of the camera and lens. The photogrammetrist uses this information in subsequent calculations to remove distortions, which ensures a quality product.

Presently, several systems are able to capture aerial images digitally. The frame digital sensor is similar to a film camera in that it captures single frames. A push broom sensor continuously collects data and then divides the data into frames. Digital images can also be captured in panchromatic, multispectral, and infrared modes; this is advantageous in that the images are captured simultaneously and do not require additional flights. Digital sensors also offer capabilities that allow the photogrammetrist to enhance portions of the image to compensate for adverse conditions such as shadows or high-contrast areas. This allows data collection in areas that might be obscured on film.

## Survey

Another vitally important part of this process is the ground control survey. The survey is the link between the ground and the photography. The survey gives the map its identity as far as projection, coordinates, and accuracy are concerned. A high level of accuracy (geodetic quality) is of the utmost importance when gathering the survey (horizontal and vertical) data.

Aerotriangulation is a mathematical process (least squares bundle adjustment) that uses the survey data to tie the photos together and distributes adjusted coordinate values throughout the entire project. Correct spacing and location of ground control survey points will determine the area that can be mapped.

## Instruments

A stereoplotter is an instrument used in photogrammetry to compile spatial data by using stereoscopic models (the area coincident on consecutive frames) and ground coordinates. The more traditional, analytical stereoplotter utilizes diapositives (film transparencies) of the photography. The diapositives are placed on glass platens in the carriage of the stereoplotter and the photos are oriented. Information is supplied to the computer–plotter and a series of mathematical calculations and optical observations allow the photogrammetrist, through sophisticated optics, to view the photography in a 3-D environment.

Photogrammetry is evolving into a digital environment referred to as softcopy photogrammetry. Softcopy photogrammetry employs the same photogrammetry principles while utilizing digital files of the imagery. These files can be supplied directly from a digital sensor or by scanning aerial film. Film scanning is performed with an extremely accurate (micron accuracy-level) scanner. The result is a digital representation of the film. The digital files are displayed on a computer monitor in a way that enables the operator, equipped with a pair of specially designed glasses, to view the digital files in a 3-D environment.

Either approach (analytical stereoplotter or softcopy photogrammetry) allows the photogrammetrist, with the aid of sophisticated software, to interpret the imagery and collect the data necessary for producing a reliable map.

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