Report

Submitted by: Saloni
Date: 19-05-2021

Aerial triangulation

- With aerial triangulation in aerial photogrammetry we might be able to calculate 3-dimensional coordinates for object elements on almost any object.
- We need at least some points with known position that are visible in at least some of the photographs.
- These points we call ground control points, or any control points, the control points have to be a part of the aerial triangulation.
- This method is that we measure several unknown point clearly visible in the aerial triangulation in a stereo instrument.
- These new points together with the ground control points and the exposures positions for the camera are put together in a big computation.
- The result we get out of this is the coordinates in the reference system for all the new measured points.

Inputs for Aerial Triangulation

- Index map of Aerial photos
- Digital Aerial image data
- Results and Descriptions of Ground control Points
- 3D-airborne position data File of Aerial photo
- Elements of Aerial Camera

Benefits of Aerial Triangulation

- Minimizing delays and hardships due to adverse weather condition
- Access to much of the property within the project area is not required.
- Field surveying in difficult area, such as Marshes, Extreme slope, hazardous rock formation, etc. can be minimized.

Aerial Triangulation is classified into three categories.

1. **Analogue Aerial Triangulation**
    - This method uses a "first order stereo" plotter to carry out relative and approximate absolute orientation of the first model and cantilever extension.
    - The strip or block adjustment is then performed using the resulting strip coordinates.
2. **Semi Analytical Aerial Triangulation**
    - Relative orientation of each individual model is performed using a precision plotter (e.g., Wild A10).
    - The resulting model coordinates are introduced in a rigorous simultaneous independent model block adjustment.
    - Independent models can also be linked together analytically to form strips which are then used for strip adjustment or block adjustment with strips.
3. **Analytical Aerial Triangulation**
    - The inputs for the analytical aerial triangulation are the images coordinates measured by a comparator (in stereo mode or mono mode plus point transfer device).
    - A bundle block adjustment is then performed by using all image coordinates measured in all photographs.
    - An analytical plotter in comparator mode can also be used to measure the image coordinates.
    - Analytical Aerial Triangulation tends to be more accurate than Analogue or semi analytical analogue aerial triangulation.
4. **Digital Aerial Triangulation**
    - This method uses a photogrammetric workstation which can display digital images.
    - Selection and transfer of tie points and measurement tasks that are performed manually in analytical triangulation are automated using image matching techniques.
    - The procedure is fully automatic, but allows interactive guidance and interference.

Block Adjustment

- Block adjustment is a technique used in photogrammetry. It is used in mosaicking satellite images or aerial photographs for an area or a project—which is called a block.
- Block adjustment is the process of computing adjustment (or transformation) based on internal relationship between overlap images, ground control points (GCPs), a camera model, a DEM, and applying the adjustment to the images within a block.
- It consists of the following three key parts:
  Tie points- Minimizes the misalignment between images
  GCPs- Geo-references the images to the ground
  Triangulation- Computes the transformation by minimizing and distributing the errors among images and control points.

- **Bundle Blocks Adjustment**
  A bundle of rays that originates from an object point and passes through the projective centre to the image points forms the basic computational unit of aerial triangulation. Bundle block adjustment means the simultaneous least squares adjustment of all bundles from all exposure stations, which implicitly includes the simultaneous recovery of the exterior orientation elements of all photographs and the positions of the object points.

Structure-from-Motion

Structure from motion (SfM) is the process of estimating the 3-D structure of a scene from a set of 2-D images. SfM is used in many applications, such as 3-D scanning, augmented reality, and visual simultaneous localization and mapping (vSLAM).

• Detect 2D features in every input image.
• Match 2D features between images.
• Construct 2D tracks from the matches.
• Solve for the SfM model from the 2D tracks.
• Refine the SfM model using bundle adjustment

Advantages

- Photos from many angles and distances can be used, with no a priori knowledge of locations or pose
- Enables “unstructured” image acquisition from the ground, legacy air-photosets, or unmanned platforms
- Requires only a cheap camera
- Coloured points & orthophoto for texture mapping
- Back-solves for camera parameters; warping
- Artefacts are a common problem but easily mitigated

Multi-view stereo

Multi-view stereo (MVS) is the general term given to a group of techniques that use stereo correspondence as their main cue and use more than two images. Different applications may use different implementations of each of the main blocks, but the overall approach is always similar:

• Collect images,
• Compute camera parameters for each image,
• Reconstruct the 3D geometry of the scene from the set of images and corresponding camera parameters.
• Optionally reconstruct the materials of the scene.

Multiple View Geometry

Multiple view geometry is the subject where relations between coordinates of feature points in different views are studied. It is an important tool for understanding the image formation process for several cameras and for designing reconstruction algorithms.

Point Cloud

A point cloud is a type of geometry that is useful for storing large amounts of data, typically gathered from LIDAR applications. The use of LIDAR allows for fast and accurate collection of data, such as for forestry canopy measurements, or landscape modelling.

GDAL

GDAL stands for "Geospatial Data Abstraction Library": A translator library for raster and vector geospatial data formats that is released under an X/MIT style Open Source license by the Open Source Geospatial Foundation. As a library, it presents a single raster abstract data model and single vector abstract data model to the calling application for all supported formats. It also comes with a variety of useful command line utilities for data translation and processing.

PDAL - Point Data Abstraction Library

PDAL is Point Data Abstraction Library. It is a C/C++ open source library and applications for translating and processing point cloud data. In addition to the library code, PDAL provides a suite of command-line applications that users can conveniently use to process, filter, translate, and query point cloud data. PDAL's weak points is that it doesn't provide a friendly GUI interface