BINGO 6.6

Product Information

Bundle Triangulation for Aerial Photogrammetry and Close Range Applications

1. Overview

Software package for combined adjustment of photogrammetric and geodetic measurements including additional conditions. Areas of application are standard aero triangulation including GPS/INS positioning, UAV, oblique and close range photogrammetry, triangulation with blocks of satellite models, as well as three dimensional adjustment of geodetic networks. The photo orientation data computed in BINGO can be used directly for stereo model setup and can be loaded into nearly all available photogrammetric systems.

BINGO is distinguished by several unique processing options, excellent data editing, high processing speed, a rigorous mathematical model, highest run certainty, an easy to operate user interface and extensive data checks. They all facilitate correct application by the user especially for complex observation material.

Particular outstanding features in BINGO are:
Computation of *standard deviations* for all unknowns including confidence ellipsoids for all points, *free network adjustment*, trouble shooting using *data snooping* according to Baarda and in particular the rigorous *variance component estimation* to check input data for correct weighting.

Important is as well the problem-free and fast computation of large blocks with millions of unknowns on normal personal computers.
The BINGO software package includes many programs and modules for data conversion, error detection and six programs for graphical presentation any analysis.

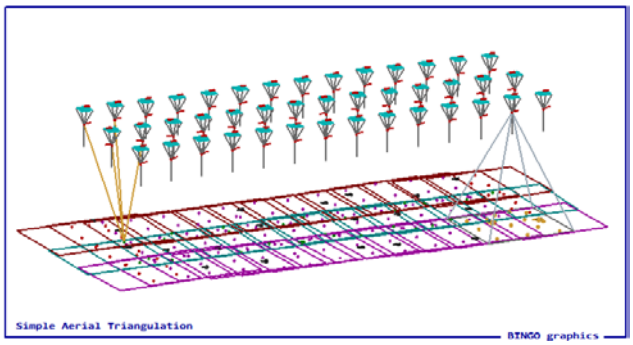
2. RELAX

RELAX performs automatic computation of initial approximation data for all photos and points in a block without additional information and without interaction by the user. Just a few global parameters allow control of photograph ties and set limits for removing incorrect measurements.

Even for large blocks with many thousands of photographs, the initial approximation orientation data can be determined without knowledge of the block configuration in just a few minutes.

3. BINGO

BINGO performs a combined least squares adjustment with all available data and prepares files for different graphical presentations.



3.1 Permitted input data

- Image measurements from satellite, aerial, oblique or terrestrial photographs in any combination.
- Survey measurements like distances, sets of directions, zenith angles, azimuths, coordinate differences, control points and independent check points.
- Geodetic conditions such as horizontal planes (e.g. sea horizon), local altitude networks, perpendicular lines and vertical planes parallel to the coordinate axes.
- Photogrammetric conditions for recording with stereo cameras and exposures from known camera station points.
- Antenna or projection centre coordinates from a GPS receiver be introduced to strengthen the block. A rigorous mathematical model is included to correct GPS positions. Alternatively shift and drift parameters can be applied.
- Direct angle observations of photo orientations from an IMU can be included. The alignment of the IMU to

the camera will be simultaneously calibrated in the bundle triangulation.

- Camera data: Interior orientation including distortion curve as well as data from eccentric camera positions in terrestrial photos with known camera station points or aerial photos with airborne GPS and IMU misalignment corrections.

3.2 Adjustment

The least squares method is used for the adjustment. To achieve the best processing times possible, the entire process of adjustment has been optimised, i.e. memory techniques, solution algorithms and dividing matrices into partial blocks are optimally adapted to each other.

3.3 Results

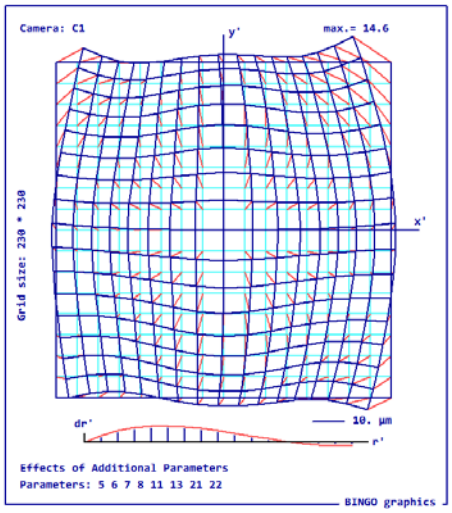
BINGO supplies adjusted point coordinates, photo orientation data and camera data as well as the standard deviations for all these values. In addition, residuals of control and check points and the parameters of confidence ellipsoids of all adjusted points are available in a special file.

3.4 Outstanding features

Free network adjustment -Two methods of free network adjustment have been implemented:

1. The usual free network adjustment with minimum trace and minimum solution vector or with partial minimised trace and partial minimised solution vector, as well as

2. A special automatic recognition and removal of rank defects. It does not matter whether the reason for these rank defects is missing datum information or weak or ill-conditioned block configuration. Thus an adjustment system can be solved in every case. Recognised defects are listed at the end.



Simultaneous calibration – BINGO includes thirty *additional parameters* for removal of systematic image deformations. These parameters are tested and reduced to the required and sufficient number in an automatic selection process according to three different criteria.

Camera constants and principal point positions can also be adjusted. Thus a complete camera calibration is possible. For some aerial survey cameras like UltraCam, DMC and DigiCam BINGO includes special calibration parameter sets.

For semi-metric cameras this calibration is on high importance.

Error detection – Residuals, standard deviations and reliability values are computed for all measurements. This allows error elimination by the rigorous data snooping according to Baarda. Errors in photo measurements can be eliminated attended or unattended in an automatic process. Other suspicious data will be clearly marked for easy recognition.

Variance component estimation - Weighting errors are recognised using variance component estimation. This is in particular of high importance when data of different types have to be processed. Aaccurate weighting of the individual observation groups is of great importance for a correct adjustment result.

Further features - If the geometry of a network is given, a simulation computation is possible without concrete data for judging the achievable accuracy and the inner reliability of the network.
Before starting the adjustment BINGO executes intensive checks of all input data and provides detailed information of data errors or problems with clear text output.
Despite the high flexibility and multiple application possibilities offered by BINGO, data input and program use is easy to handle.

4. Availability and capacity

The standard version under Windows 7/8 32/64bit is designed for processing unlimited numbers of photographs, points and unknowns. A normal aerial project with about 2000 photos can take e.g. one to two minutes for processing.

5. Interfaces

Interfaces are available for all known digital photogrammetric stations and systems, enabling optimum interaction with BINGO.

6. Options available for BINGO

The BINGO Software package is protected by *Hardware Key* with selectable security options. A *Network Option* enables BINGO processing via Intranet or Internet. For multiprocessor use is a 64-bit BingoM64 option available which is considerably faster.

GIP, Dr. Kruck & Co. GbR
Platanenweg 24
D-73430 Aalen, Germany
Tel.: +49-7361-931434
Fax: +49-7361-931435
www.bingo-atm.de
info@bingo-atm.de