Digital Aerial Photogrammetry Using Bentely Map Enterprize / Terra Soild

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GPS, IMU & Digital Camera Relationship

The relationship between a GPS, IMU and a digital camera is that they all have to work together inorder for the collection of aerial imagery to go smoothly. The GPS has the job of georeferencing the images as they come in. The IMUs job is to provide measurements of the height, pitch and roll of the aircraft. Then the digital cameras job is to actually collect the aerial imagery.

Calibration Concepts

There are three main concepts to the Calibration process and they are boresight orientation, interior orientation and Flight Planning (multiple altitudes and directions).

For the multiple altitudes it is preferred that there are three different altitudes (e.g. 500m, 1000m, 2000m). Then the multiple directions should be opposing flightlines all at the same altitude and also crossing flightlines at different altitudes.

Boresight and interior orientation is lining up the camera to make sure that the camera does not distort the image.

Ortho-Photos VS. Ortho-Mosaics

Ortho-mosaic is the automated process of generating a single image from Orthorectifing raw images and then mosaicing those images into that single image.

Orthophotos is an aerial photography or an image geometrically corrected such that the scale is uniform.

So, the difference between an Ortho-mosaic and an Ortho-photo is the mosaic is taking several images and making them into one. Then an ortho-photo is a single geometrically corrected image that you are working with.

Colour Points

Instead of using histograms to colour balance your images during the mosaicking process, A “balancing model” can be derived using hundreds of “colour points”, these points then localy colour balance the photographs to each other. These points can also be used to create a TIN, this TIN can be used to estimate the ratio between points.

Seamlines

Seamlines or cutlines as they are sometimes known as, are the seams where one image meets another image. These seamlines are usually line features or polygon features. These seamlines can be edited to make for more of a seamless transition between images.

Data Preparation Workflow

There are three main steps to prepare the data before actually getting into the process. The first process is to bring your points into TerraScan and then classify the points as model keypoints. This is done through the TerraScan main window under the classify tab – routine drop down – then select the Model Keypoints (found second from the bottom). The second process is to use the SBET file to bring in your trajectories. The first step is to bring in your SBET file through the Trajectories window. Then the second step is to Split as laser gaps, this process allows you to split the full trajectory into smaller more manageable trajectories. Then the final process that needs to be done is edit your camera log file so that it will come into TerraPhoto. This is done by bringing the text file into Microsoft Excel and editing within there, the things that need to be edited is the third column (photo ID) needs to be deleted and then the Photo name column needs to come before the rest of the information.

Calibration Workflow

The purpose of calibrating is to make sure that all the information that is collected through the camera calibration log file is connected to the images that you are working with. The requirements for the calibration process is the camera log file that collected/completed during the process of collecting the images, and then the images that go along with that camera calibration log.

The text below is just a samll example of what a Camera Calibration log looks like.

18.08.2010 15:12:12.60 inf Start of Program
18.08.2010 15:21:17.71 rel Start of Release E:\2010_230\capture\2010_230_00001
*18.08.2010 15:21:17.95 rel $EVT1,314448.335481,G,00000002*37*

18.08.2010 15:21:18.01 inf Auto-Aperture Releasesettings: Aperture 4.0 Shutter 1/1000 Iso 100 Correction 0
18.08.2010 15:21:21.34 sts LightPhase-Status 30: capture in progress
18.08.2010 15:21:22.87 rel Image 2010_230_00001 was ready
18.08.2010 15:21:22.93 sts LightPhase-Status 10: camera is ready
18.08.2010 15:23:24.76 rel Start of Release E:\2010_230\capture\2010_230_00002
*18.08.2010 15:23:25.00 rel $EVT1,314575.384443,G,00000003*3D*

Rapid & Precision Aerial Triangulation Workflows

Precision Aerial Triangulation : This technique generally produces more accurate orthophotos where seamlines are minimal and overall georeferencing is within a few pixels or better. Similar to the Rapid triangulation process this approach also requires a high quality camera calibration file but can tolerate lower quality GPS & IMU data.
The essential goal of this technique is to build on the Rapid triangulation process (which determines and refines the camera boresight angles) but then further processes the data to perform a full bundle block adjustment to refine the exterior orientations of each individual photograph.

Rapid Aerial Triangulation : This technique does not create as accurate orthophotos (seamlines may be clearly visible and general georeferencing quality is lower), but can be performed in a minimal amount of time and user-effort. However, it does require a high quality camera calibration file (covered in an upcoming guide) and reasonably good quality GPS & IMU information. The essential goal of this technique is to quickly determine the survey specific boresight angles between the camera and IMU. While this is initially determined during camera calibration, various external effects such as vibration can cause subtle changes (causing relatively large positioning errors on the ground).