Tutorial: Generating Orthomosaic Imagery and Terrain Models Using Aerial Imageries and LiMapper

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Introduction

LiMapper is an aerial photogrammetry software which can reconstruct 3D geometry structure from overlapping images and subsequently generate a series of standard products of surveying and mapping, such as orthomosaic imagery, DEMs (Digital Elevation Model), DSMs (Digital Surface Model), and dense point clouds. LiMapper's state-of-the-art photogrammetry and computer vision algorithms fully exploit hardware resources such as multi-core CPU and high-performance GPU to provide high efficiency and robust performance. In addition, the algorithms are optimized to handle not only traditional aerial images of large frames, but also UAV-images with unstable orientations and unknown lens distortions. Furthermore, the software interface is kept simple and easy to use for both new and experienced users.

In this tutorial, you will be introduced with the detailed workflow of generating orthomosaic and terrain models using aerial imageries as input. Steps will also be taken to adding GCPs and thereby evaluate and improve the absolute accuracy of LiMapper outputs.

Software Download & Install

LiMapper software is included in the LiDAR360 Suite. Please download the latest version of LiDAR360 Suite from the GreenValley International official website, and install and activate following the User Guide: http://greenvalleyintl.com/wp-content/lidar360_en/Introduction/Install.html

Exercise 1: One-step Process Generating Orthomosaic and Terrain Models

One of the most apparent features GVI's of LiMapper is the software's smooth and efficient user experience. Complicated processing operations are streamlined by LiMapper into intuitive workflows. By following the one-step process outlined in this tutorial, users can generate orthomosaic imagery and terrain models with minimal effort using preset parameters that have been tested and proven to create high quality results. Users should note that the LiMapper is highly flexible and the only required portion of the workflow outlined in this tutorial is the step taken to create a new project.

Create New Project

1   Launch **LiMapper** > **New**.

2   Select the preset template **1_Orthomosaic**. A project template is a pre-defined workflow for a project with customized processing parameters saved. In this exercise, since our goal is to generate orthomosaic imagery and surface models, we can use the 1_Orthomosaic template.

3   Type in a **Project name** and select **Project location** directory. Click **Next**.
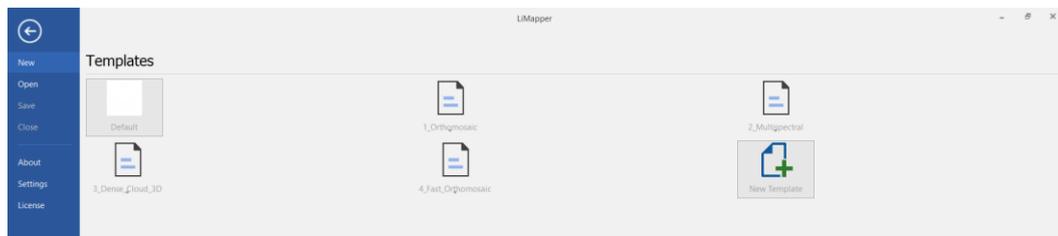
4   In **New Project Wizard**, load photos and specify photo properties.

    4.1   Select **Rig Type**. **Nadir**, **Oblique**, and **Multispectral** photos are supported in LiMapper.

    4.2   Click to browse to and import the aerial photos included in the sample data folder.

    4.3   Edit image POS data.

LiMapper uses flight trajectory or POS information to speed up
processing and to georeference output products generated from aerial
imagery. LiMapper can read coordinates (longitude, latitude, altitude)
embedded in photo EXIF, and coordinates stored in separate POS file
(.txt or .csv).

4.3.1 *If POS is embedded in photo EXIF*: Click **Edit** under **Image
Geolocation** to specify the coordinate system for the input imageries.
If external POS file need to be used, skip this step and go to next.

4.3.2 *If separate POS file is used*: Click ![icon] to import POS file. Then in
POS Editor window, click **Edit** to select **POS Coordinate System**.
Skip Lines to skip the header row if necessary. Match the columns
with these necessary inputs: **Longitude**, **Latitude**, **Altitude**. For other
columns, select **Ignore**. Click **OK** to save settings.

Select **Default** when Vertical Coordinate System is **ellipsoid height**.
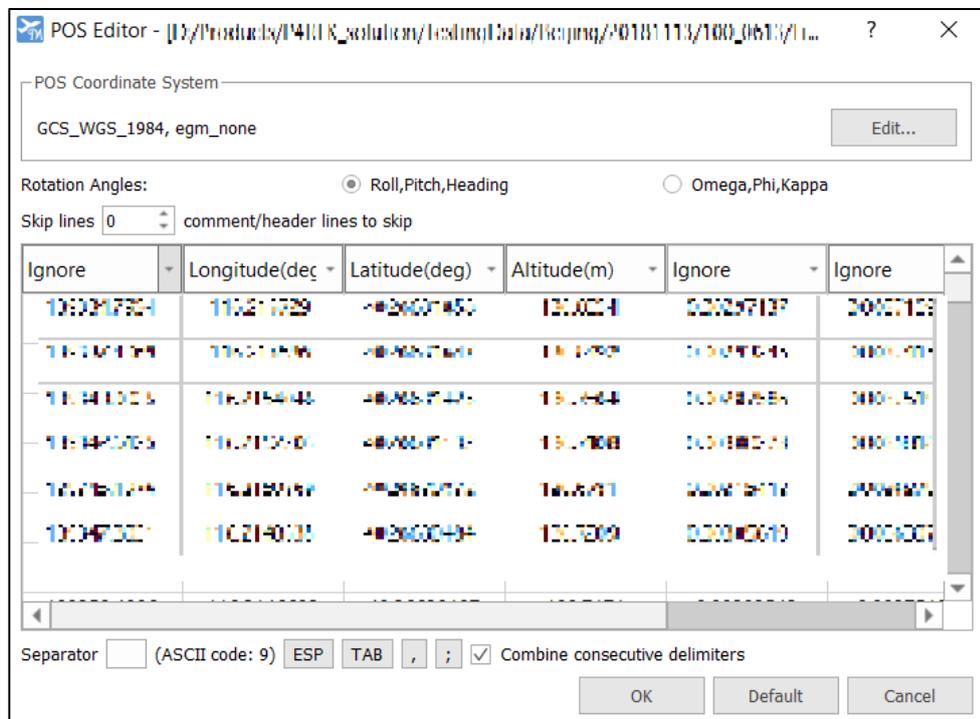
4.4 Click **Next**.

5 Select **Output Coordinate System**. The default **Horizontal Coordinate System**
is the auto detected UTM zone for the project area, and the default **Vertical**

Coordinate System would be the same as the input Vertical Coordinate System. Click **Finish**.
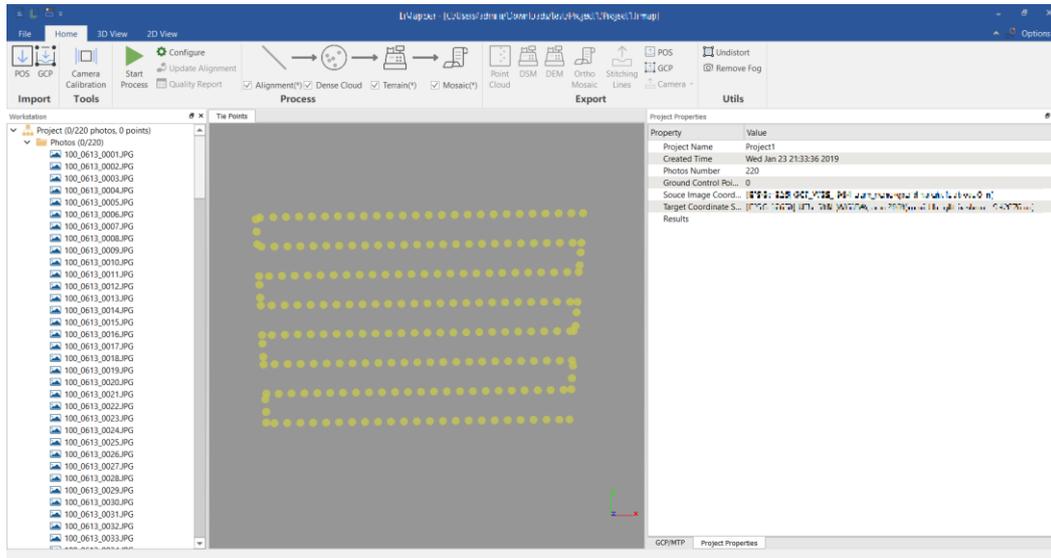
List of imported photos shown in Project panel, locations of imported photos displayed in map viewer, and project properties shown in Property panel.

Select Output Products

In the **Process** ribbon, a streamlined workflow has been created and will run in sequence to perform a **Photo Alignment**, process a **Dense Cloud**, and generate **Terrain** models and a **Mosaic** map, once user clicks **Start Process**. Before running the automated process, user can customize processing and output parameters.

6   Under **Home**, click **Configure** ⚙ in **Process** ribbon.

7   Accept default parameters for **Align Photos** and **Build Dense Cloud**.

8   Click **Build DEM/DSM**. Select/unselect **Build DSM/Build DEM** to control what terrain models are generated. Change the **Resolution** if needed.

> **DEM**: Digital Elevation Model; **DSM**: Digital Surface Model

9   Click **Build Orthomosaic**. Select a mode to generate Orthomosaic imagery. Change **Resolution** if needed.

> The default mode **Pixel-level mosaic based on surface model** has the best performance and fast processing speed under most circumstances. Navigate through the modes and read their descriptions to select one that is appropriate for your surveying environment.

10   Click **OK**.

Start Process

11   Click **Start Process** to run the streamlined process.

Export Products

12   When the LiMapper workflow has finished, the Dense Points, Orthomosaic map, and DEM/DSM can be exported to .ply file and .tiff file. In **Export** ribbon, click the product to export, and navigate through the export wizard.

13   The POS of images, GCPs, and photos after distortion correction can also be exported using options included in the **Export** ribbon.
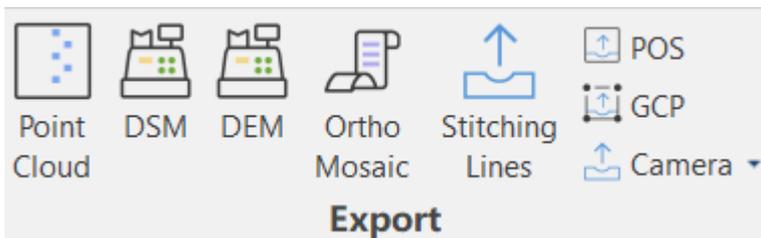
Exercise 2: Using GCPs, MTPs, and Check Points

The quality and absolute accuracy of photo alignment can be improved by using Ground Control Points (GCPs). Data output qualities can also be improved in areas where matching key points were difficult for LiMapper to identify and automated methods failed to be register images correctly using Manual Tie Points (MTPs). The software also allows users to evaluate photo registrations and alignments using imported survey Check Points and generate a project quality control report.

In this exercise, we will use Control Points to improve absolute accuracy, and Check Point to evaluate accuracy. In the following text, GCPs will be used to refer to a combination of GCPs, MTPs, and Check Points.

> If GCPs will be used in the project, in the one-step process above, you may uncheck **Dense Cloud**, **Terrain**, and **Mosaic** in **Process**, because only **Alignment** process is necessary for adding GCPs. In addition, when updating alignment after adding GCPs, the dense cloud, terrain, and orthomosaic imagery products will be removed.
>
> Therefore, if GCPs are used in the project, the recommended workflow is: Alignment > Add GCPs > Generate Quality Report > Process Dense Cloud, Terrain, and Mosaic.

Add GCPs

1 If GCP/MTP window does not show up in the panel on the right side, click **Options** on the top right > **Windows** > **GCP/MTP**.

2 Click **Import GCP** in the GCP/MTP window.
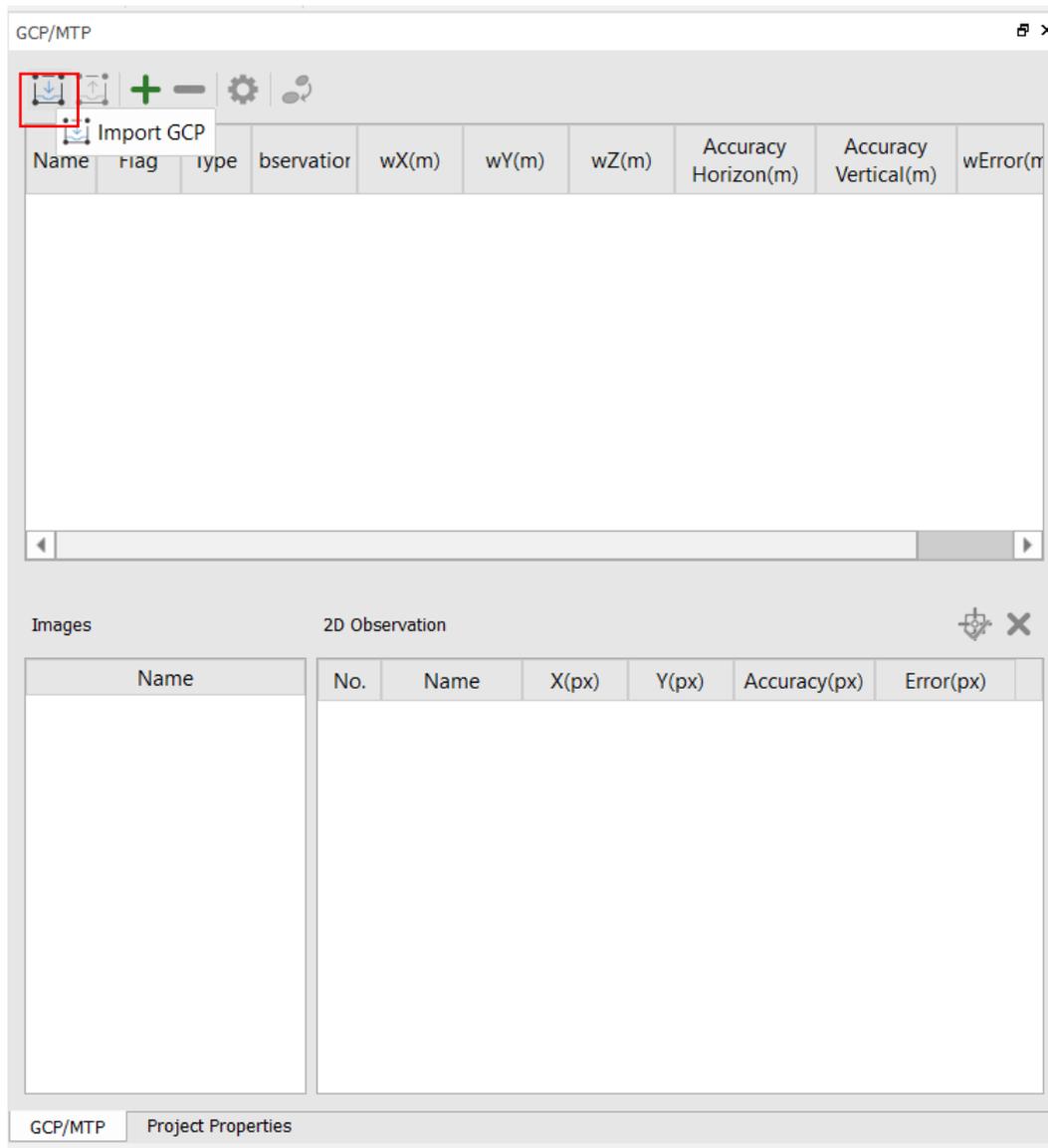
3   Browse to the GCPs table and click Open.

4   In **GCP Editor**, **Edit Coordinate System** of the GCPs, and skip the header lines.

5   Under **Flag**, mark the point as **Ctrl Point** (Control Point) or **Check Point**, based on whether the point will be used as control point or check point for accuracy evaluation.

> To select multiple, use Ctrl or Shift, or Ctrl + A to select all, and change Flag for selected rows at once.

6   Click **OK**.

7   In GCP/MTP window, select a row of GCP, the predicted images where this selected point can be found are listed in the bottom left **Images** window.

> Corresponding images will only be predicted if **Alignment** process has been run.

8   Double-click at the first image in **Images** window. The image will display in the map view.

9   A predicted location of the GCP is also marked on the image. The predicted location is usually near the true location of the GCP. Therefore, zoom to the predicted location and find the GCP. **Click** on the GCP.

10   In the **2D Observation** window, click **Add 2D Observation** to add the marked GCP to the table.

11   Mark at least 4 GCPs for one image.

12   Follow the same method to add 2D observations for other images.

Generate Quality Report

13   After finish adding GCPs, click **Update Alignment** to update alignment using GCPs.

14   In Process ribbon, click **Quality Report** .

15   In the **Quality Report** window, click **OK** to generate report for the default items. The generated result is placed in the project folder > 1_Report.

More resources

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For technical articles, user stories, and other product information, please visit our official website https://greenvalleyintl.com/.