Building Digital Models From Imagery

Agisoft Photoscan Tutorial

Written by: Robert Ferullo

Faculty Advisor: Leslie Kanat, Ph.D.

April 7, 2018

The purpose of this paper is to demonstrate how to create a three-dimensional model of an object or landscape using Agisoft Photoscan. This tutorial will outline the proper procedure for capturing images with a drone, importing images into Photoscan, building the model, and using the model to calculate volume. Volumetric calculations yield information regarding net loss or gain of mass on a specific site.

On August 31, 2017, an independent study was designed by Dr. Leslie Kanat in order to learn how to use cost effective drones to capture images, and use those images to build digital models of an object or landscape. From these models, volume of the object may be determined. This allows users to build subsequent models, and therefore observe any changes that may have occurred over time. This would be helpful to monitor gully erosion, rockfalls, and landslides.

This project aims to illustrate the practical uses of drones in science, and show that using them is more efficient than traditional methods of data collection. The following is a step-by-step procedure that demonstrates how to capture images, build the model using a program called Agisoft Photoscan, and calculate volume.

Table of Contents

Capturing Images. 3

Using Agisoft Photoscan. 4

Calculating Volume Using Agisoft. 13

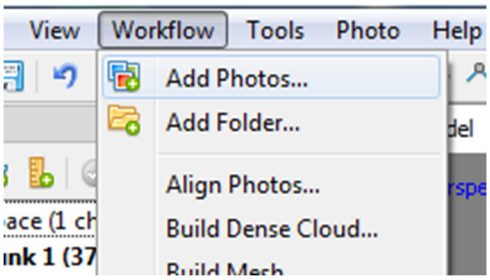
Capturing Images

1. Fly drone to desired location.
2. Point camera toward object to be modeled.
    a. Be sure to center the object and keep it entirely within camera's range.
    b. It helps to use "tripod mode" for precision.
3. Proceed to take first picture.
4. Continue taking pictures around the object.
    a. An overlap of 75% is preferable, but at least 50% is often required.
5. Do this until the drone has returned to the starting point.
6. Repeat the process head on, at a 45° angle, and at 90° (straight down).

Using Agisoft Photoscan

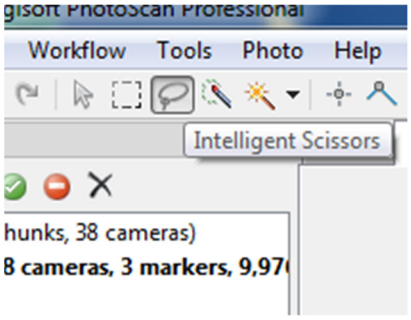
Insert Images:

1. Open Agisoft Photoscan.
2. From the *Workflow* menu, select “Add Photos.”
3. Select the desired images, and click “open.”



Create a Mask[1]

1. Double-click on an image in order to edit it.
2. Create a mask[2] with one of the following tools:
    a. Intelligent Scissors — outline an object by connecting line segments.
    b. Magic Wand — to automatically select an entire object.
    c. Paint Brush — trace an object.



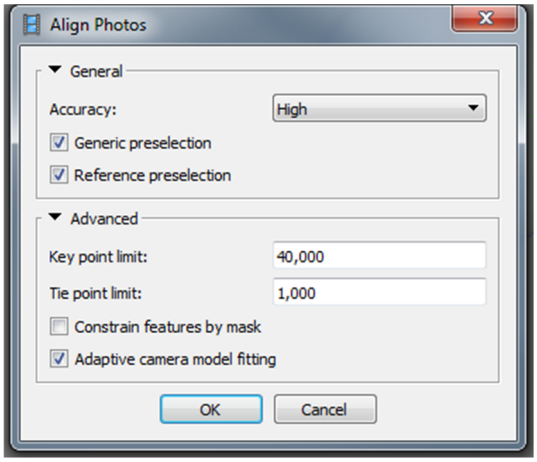
3. Repeat this process for every image that contains unwanted features. (Figure 1)

Figure 1. Before (left) and after (right) using "Intelligent Scissors." *Notice the points selected on the* "before" *image, marked by a red outline.*

[1] Masks are only to be created if an image contains elements that are not to be included in the final model. If the entire image is to be included, do not mask any features.

[2] If the element to be masked cannot be selected easily, for example, a background, it may be necessary to outline the desired features, and then *Invert Selection.*

4. From the *Workflow* menu, select "Align Photos." (approx. 4 min.)
5. The recommended parameters for aligning photos are as follows:
    a. Accuracy — high
    b. Pair preselection — disabled
    c. Key point limit — 40,000
    d. Tie point limit — 1,000
    e. Constrain features by mask - disabled, unless any image was of a moving object



6. Click "OK."

Fit the object (approx. 35 min.):

1. A box should appear around the object in “Model” view. The object may be pixelated.
2. If necessary, move the object to appropriately fit the new box using the following tools:
    a. Resize region — to make the object larger or smaller
    b. Rotate region — to turn the object

The model, while being fitted, should appear as many blue rectangles contained within a prism, as well as pixels of the model, as shown below in Figure 2.

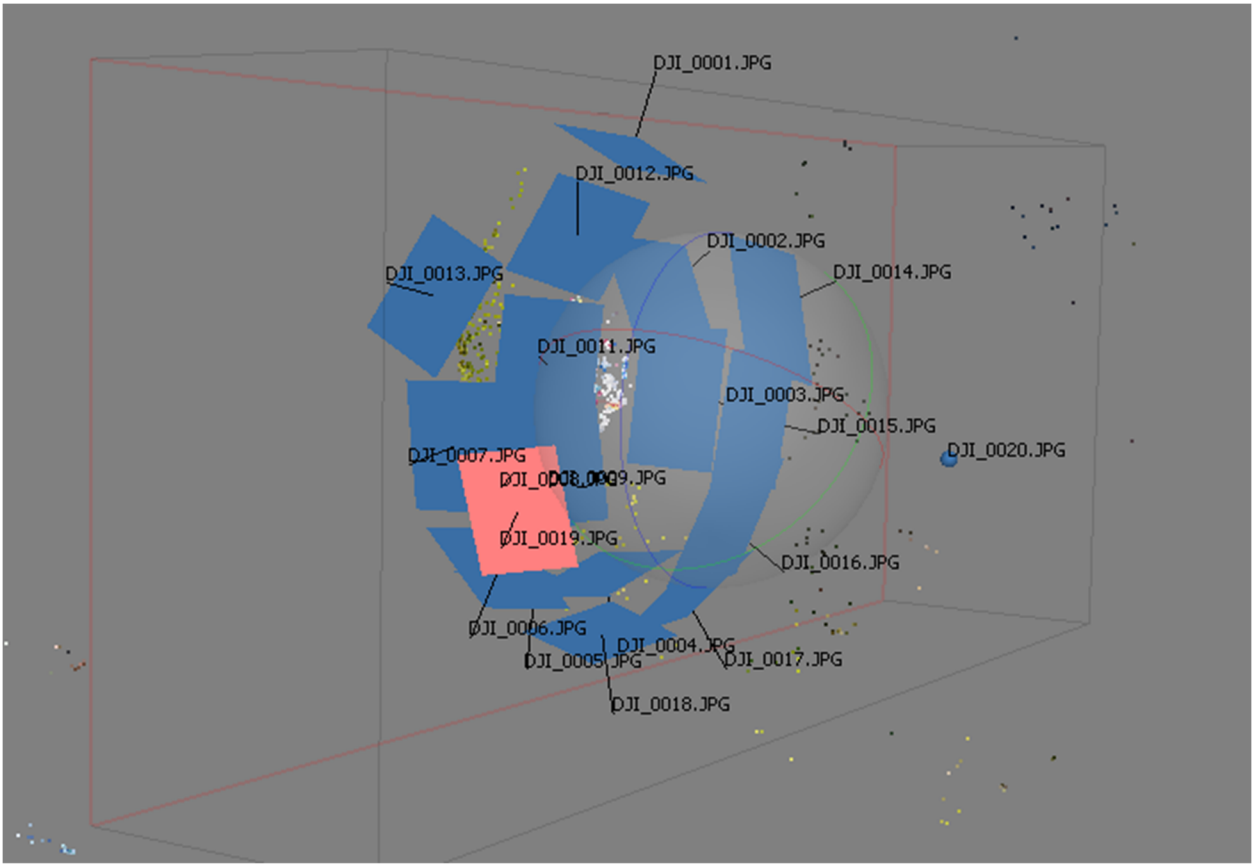
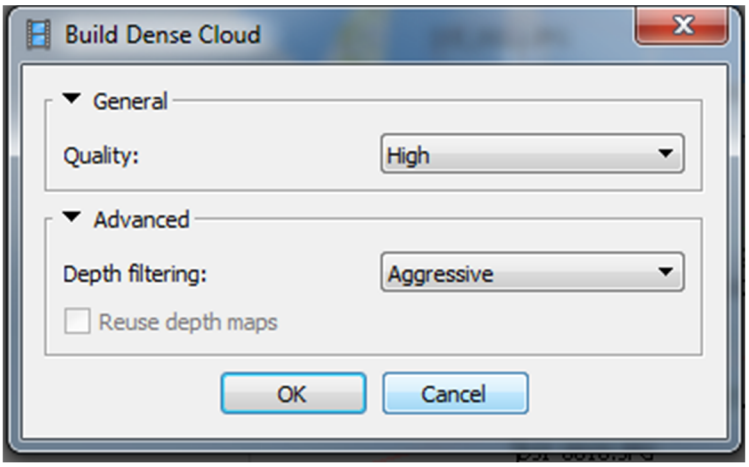


Figure 2. This is a model being fitted.

Build a Dense Cloud (approx. 13 min.):

1. From the *Workflow* menu, select "Build Dense Cloud"
2. The recommended parameters for building the dense cloud are as follows:
    a. Quality — high (This may prolong the process, but creates a clearer image).
    b. Depth filtering — mild (unless fine details are to be removed, then choose aggressive. This will eliminate additional points from the model).



3. Click "OK."

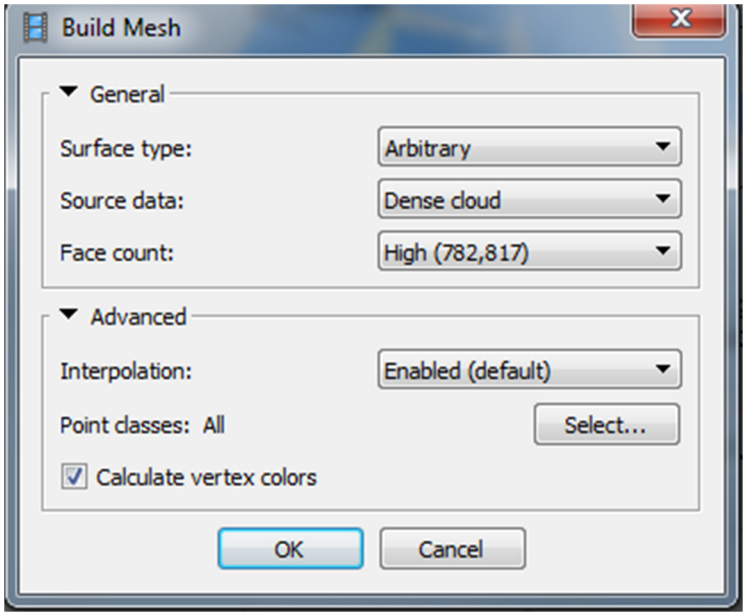
The resulting image should present many pixels dispersed throughout the plane. This may seem to be an incomplete data set, but it will be corrected in the following step.

Build a Mesh:

1. From the *Workflow* menu, select "Build Mesh"
2. The recommended parameters for building a mesh are as follows:
    a. Surface type — arbitrary
    b. Source data — dense cloud

c. Polygon (Face) count — high

d. Interpolation — Enabled

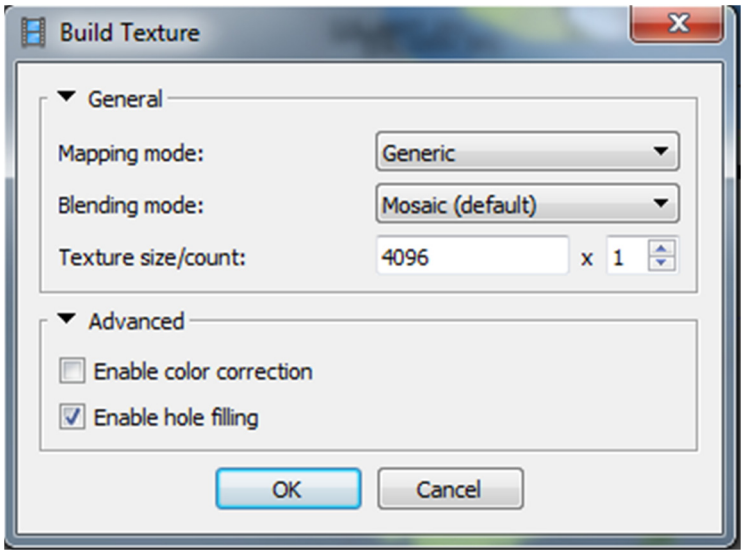


3. Click “OK.”

This step requires multiple processes that will take place automatically, including “generating” the model (approx. 8 min.,) “decimating” the model (approx. 5 min,) and “calculating vertex colors” (approx. 15 min.).

Build a Texture (this step is optional, but recommended for fine detail):

1. From the *Workflow* menu, select “Build Texture”
2. The recommended parameters for building a texture are as follows
    a. Mapping mode — generic
    b. Blending mode — mosaic
    c. Texture size/count — 4096 x 1 (This is to limit export failure due to RAM usage. If RAM size is large, for example, 64 Gigabytes, this is not an issue, and a greater texture size may be used).
    d. Color correction — disabled
    e. Hole Filling — enabled (This will help in georeferencing later).
3. Click “OK.”



Export the Model:

1. Under “File,” click “Export model.”
2. A window opens, prompting you to save your work if you have not already done so.
3. Name the model appropriately, and select a file type for the model to be exported as. All possible formats for exporting models are as follows:
    a. BMP
    b. DNG
    c. JPEG
    d. MPO
    e. OpenEXR
    f. PDF
    g. PGM, PPM
    h. PNG
    i. SEQ
    j. TIFF
4. Select an appropriate location to export the model to, and select “OK”

Calculating Volume Using Agisoft

Volume may only be calculated if an object is closed, so it is necessary to "seal off" any open parts of the model.

Close Holes:

1. From the *Tools* menu, choose *Close Holes*.
2. Make sure the slider is at the "100%" marker, as to close the entire object.
3. Click "OK"

Measure Volume:

1. From the *Tools* menu, select the *Mesh* submenu.
    a. From the *Mesh* submenu, select *Measure Area and Volume.*
2. The result will be displayed in cubic meters.