

<http://gmv.cast.uark.edu> A Method Store for Advanced Survey and Modeling Technologies Mon, 01 Apr 2013 03:29:18 +0000 en-US hourly 1 <http://wordpress.org/?v=3.5.1> <http://gmv.cast.uark.edu/photogrammetry/software-photogrammetry/photoscan/photoscan-workflow/photoscan-building-geometry-texture-for-photogrammetry/> <http://gmv.cast.uark.edu/photogrammetry/software-photogrammetry/photoscan/photoscan-workflow/photoscan-building-geometry-texture-for-photogrammetry/#comments> Tue, 19 Mar 2013 13:53:05 +0000 caitlin <http://gmv.cast.uark.edu/?p=13141>

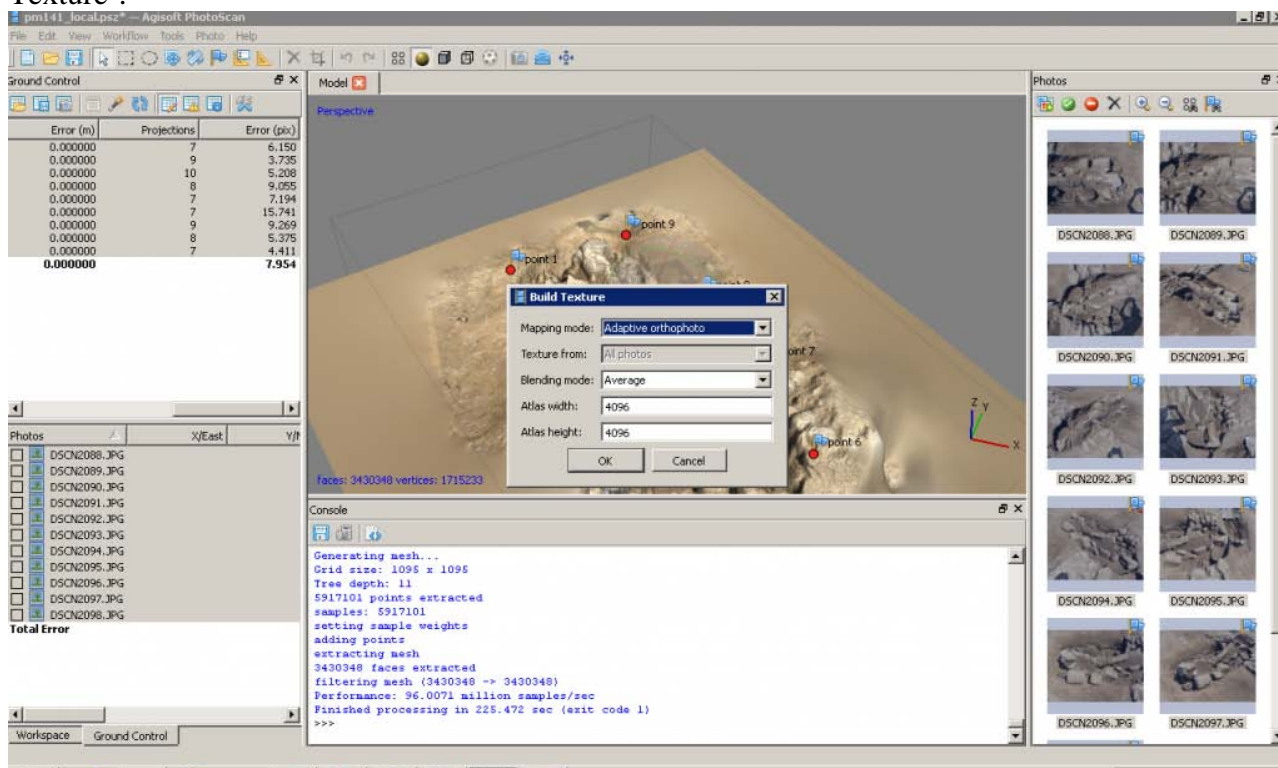
This post will show you how to build the geometry and texture for your 3D model and how to export it for use in ArcGIS.

Hint: You can click on any image to see a larger version.

Rebuild Geometry

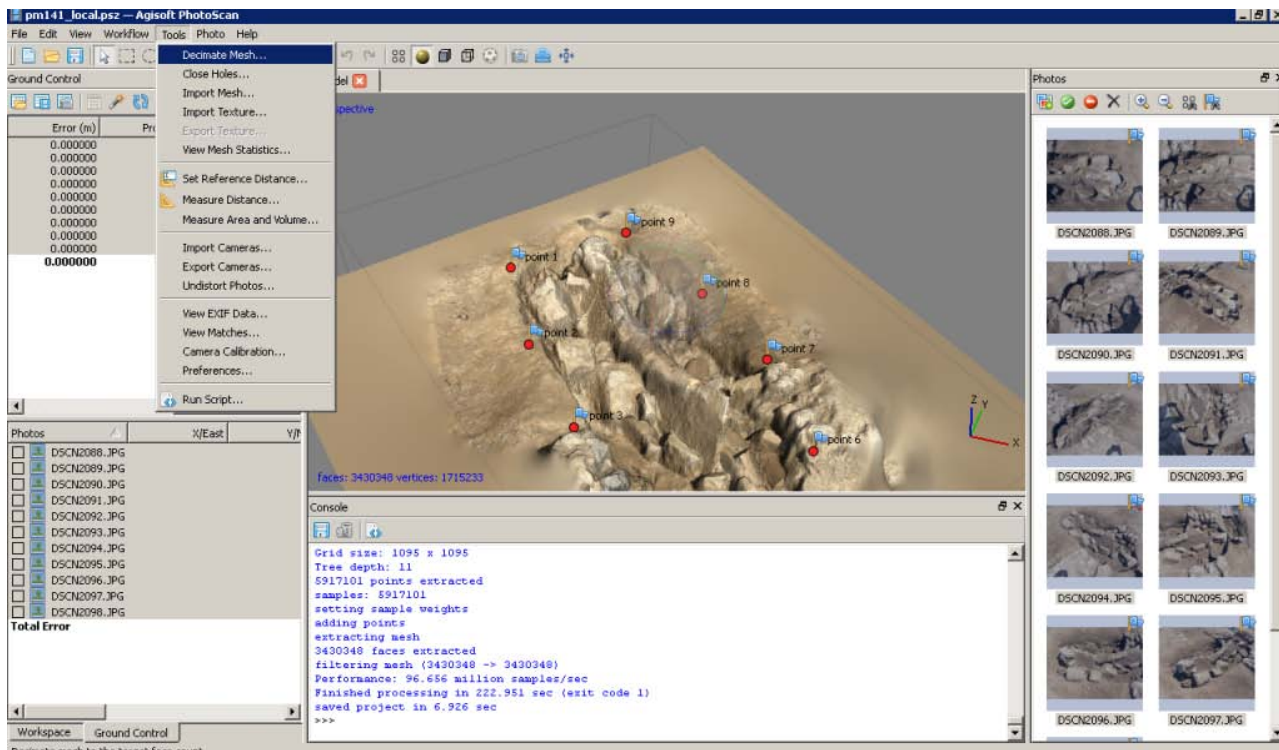
After the model is georeferenced, rebuild geometry at the desired resolution. Photoscan produces very high poly-count models, so we like to build two models, a high resolution one for archiving and measurements and a lower resolution one for import into ArcGIS for visualization and general reference. Keeping the polycount low (circa 100,000 faces) in the ArcGIS database helps conserve space and speeds up loading time on complicated scenes with multiple models. To make sure the lower poly-count model looks good, we build the textures using the high poly-count model and apply them to the lower poly-count model.

So... Select 'Workflow' and 'Build Geometry' from the main menu as before. Then select 'Workflow' and 'Build Texture'.



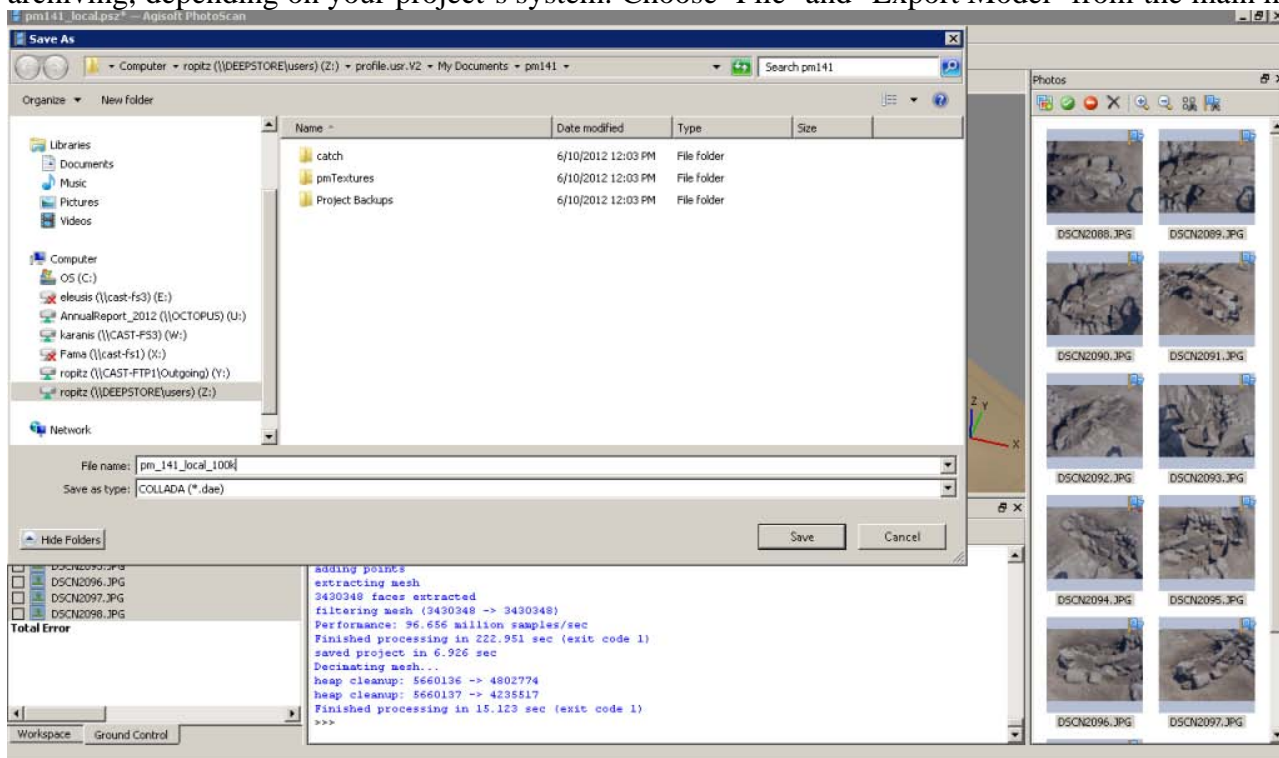
Decimate the model

Under 'Tools' in the main menu you can select 'Decimate' and set the desired poly-count for the model. The decimated model will likely have a smoother appearance when rendered based on vertex color, but will appear similar to the higher poly-count model once the texture is applied.



Export the model

Export the models and save them as collada files (.dae) for import into ArcGIS. You may select a different format for archiving, depending on your project's system. Choose 'File' and 'Export Model' from the main menu.



Continue to...

Continue to [Photoscan to ArcGIS](#)

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building-geometry-texture-for-photogrammetry/feed/ 0 http://gm.v.cast.uark.edu/photogrammetry/software-photogrammetry/photoscan/photoscan-workflow/photoscan-basic-processing-for-photogrammetry/
http://gm.v.cast.uark.edu/photogrammetry/software-photogrammetry/photoscan/photoscan-workflow/photoscan-basic-processing-for-photogrammetry/#comments Tue, 19 Mar 2013 13:35:57 +0000 caitlin http://gm.v.cast.uark.edu/?p=13131 [Continue reading →](#)]]>

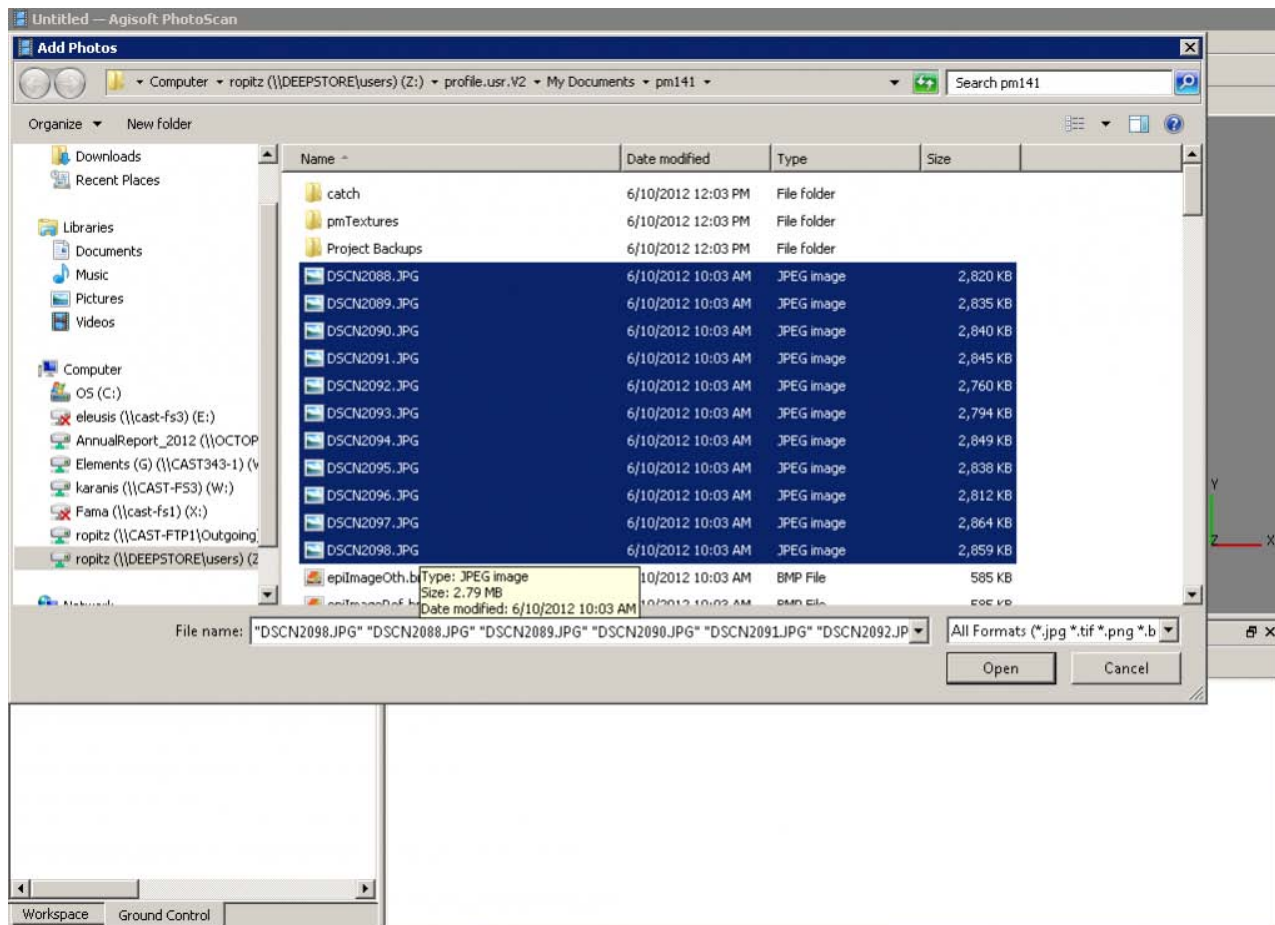
This series will show you how to create 3d models from photographs using Agisoft Photoscan and Esri ArcGIS.

Hint: You can click on any image to see a larger version.

Many archaeological projects now use photogrammetric modeling to record stratigraphic units and other features during the course of excavation. In [another post](#) we discussed bringing photogrammetric or laserscanning derived models into a GIS in situations where you don't have precise georeferencing information for the model. In this post we will demonstrate how to use bring a photogrammetric model for which georeferenced coordinates are available, using Agisoft's Photoscan Pro and ArcGIS.

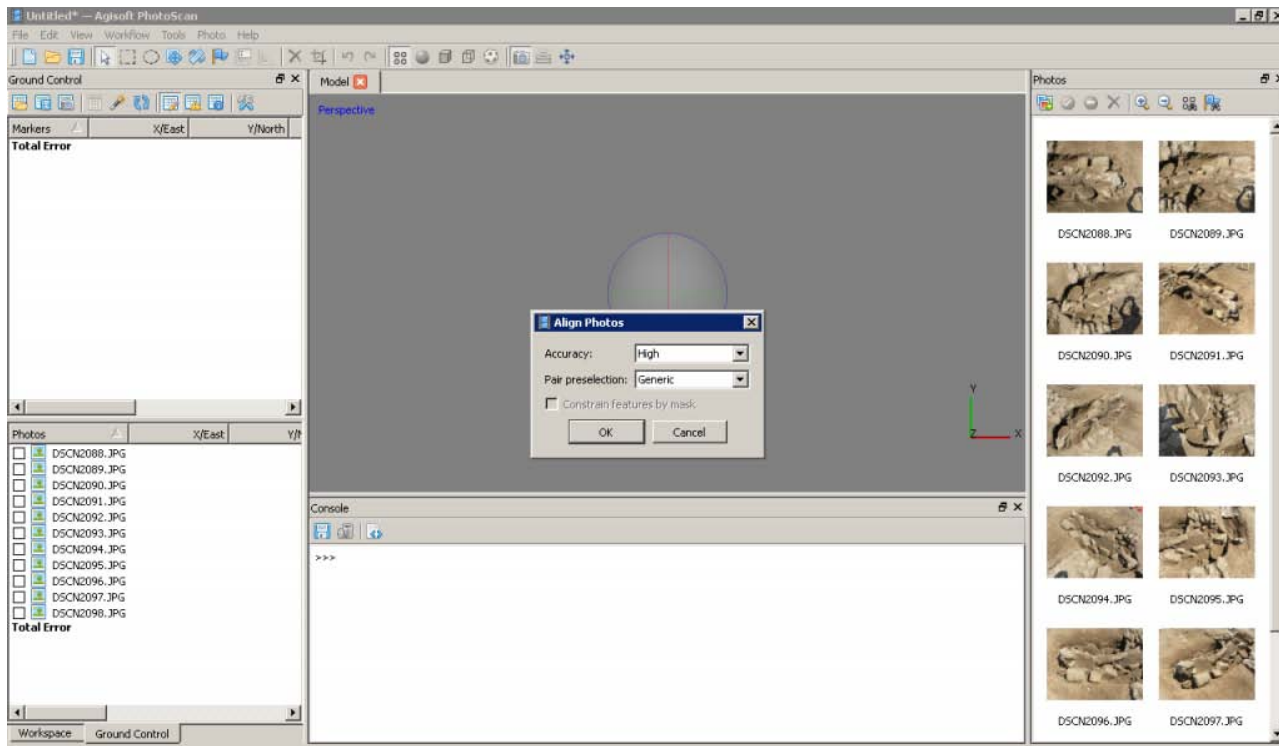
Load Photos

Begin by adding the photos used to create the model to an empty project in Photoscan.



Align Photos

Following the Photoscan Workflow, next align the images. From the menu at the top choose 'Workflow'>'Align Images'. A popup box will appear where you can input the alignment parameters. We recommend selecting 'High' for the accuracy and 'Generic' for the pair pre-selection for most convergent photogrammetry projects.

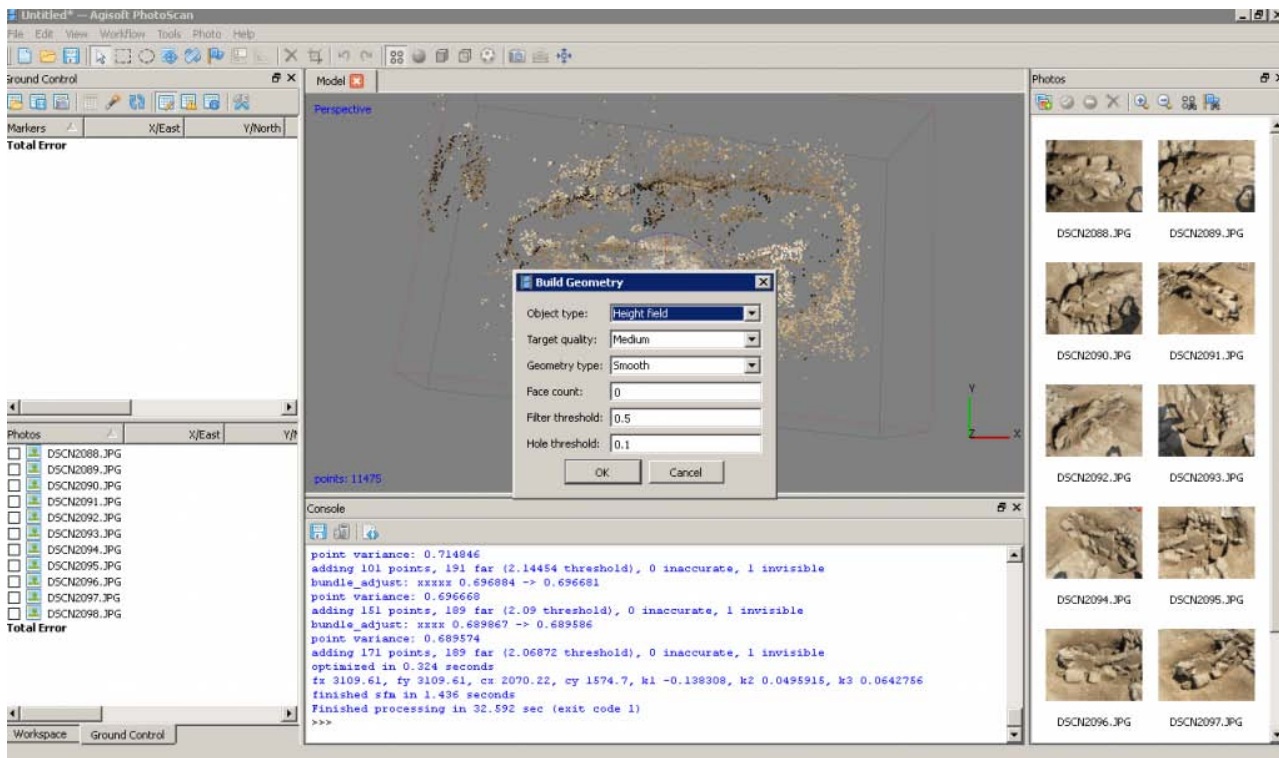


A choice

At this point there are two approaches to adding the georeferenced points to the project. You can place the points directly on each image and then perform the bundle adjustment, or you can build geometry and then place the points on the 3d model, which will automatically place points on each image, after which you can adjust their positions. We normally follow the second approach, especially for projects where there are a large number of photos.

Build Geometry

Under 'Workflow' in the main menu, select 'Build Geometry'. At this point we don't need to build an uber-high resolution model, because this version of the model is just going to be used to place the markers for the georeferenced points. A higher resolution model can be built later in the process if desired. Therefore either 'Low' or 'Medium' are good choices for the model resolution, and all other parameters may be left as the defaults. Here we have selected 'Medium' as the resolution.



Get the georeferenced points

When the photos for this model were taken, targets were placed around the feature (highly technical coca-cola bottle caps!) and surveyed using a total station. These surveyed targets are used to georeference the entire model. In this project all surveyed and georeferenced points are stored in an ArcGIS geodatabase. The points for this model are selected using a definition query and exported from ArcGIS.

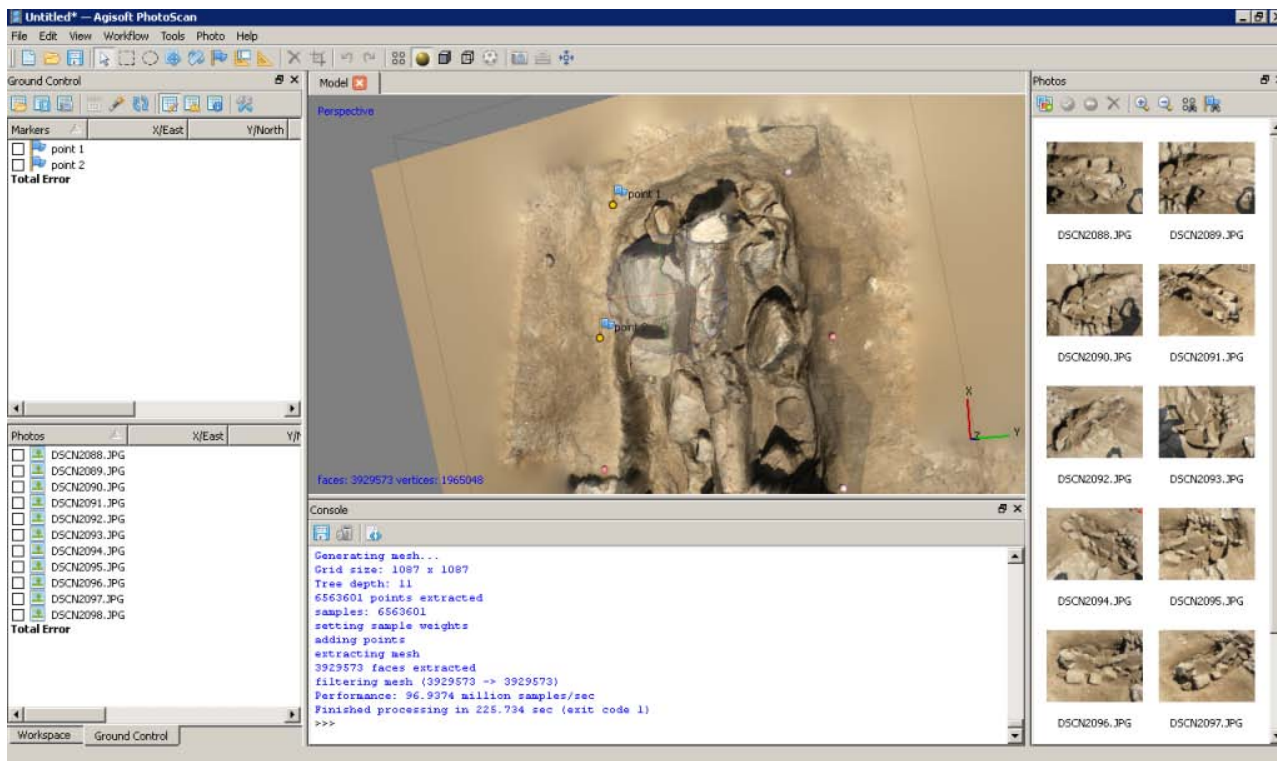
The screenshot shows the ArcMap interface with a georeferenced aerial image. The Layers panel on the left shows several layers, including 'PM' (Place Markers) and three 'gabii' clip layers. The main map area displays the aerial image with several green point markers placed on surveyed targets. A scale bar is visible in the bottom right corner of the map area.

The Table window at the bottom displays the following data:

OBJECTID*	Date_	Point_number	SU_number*	DESCRIPTIO	NORTHING	EASTING	ELEVATION	PM_NUMBER	SHAPE*	POIN
7813	08/07/2010	<Null>	1147	pm141	4639829.3622	2330801.9658	63.5725	141	Point Z	23308
7814	08/07/2010	<Null>	1147	pm141	4639828.8117	2330802.3306	63.5416	141	Point Z	23308
7815	08/07/2010	<Null>	1147	pm141	4639828.3307	2330802.7924	63.5572	141	Point Z	23308
7816	08/07/2010	<Null>	1147	pm141	4639827.9891	2330803.3229	63.5296	141	Point Z	23308
7817	08/07/2010	<Null>	1147	pm141	4639827.9778	2330803.8141	63.4182	141	Point Z	23308

Add the georeferenced points

On the left you have two tabbed menus, 'Workspace' and 'Ground Control'. Switch to the the 'Ground Control' menu. Using the 'Place Markers' tool from the top menu, place a point on each surveyed target. Enter the corresponding coordinates from the surveyed points through the 'Ground Control' menu. *Be careful to check that the northing, easting and height fields map correctly when importing points into Photoscan, as they may be in a different order than in ArcGIS.*

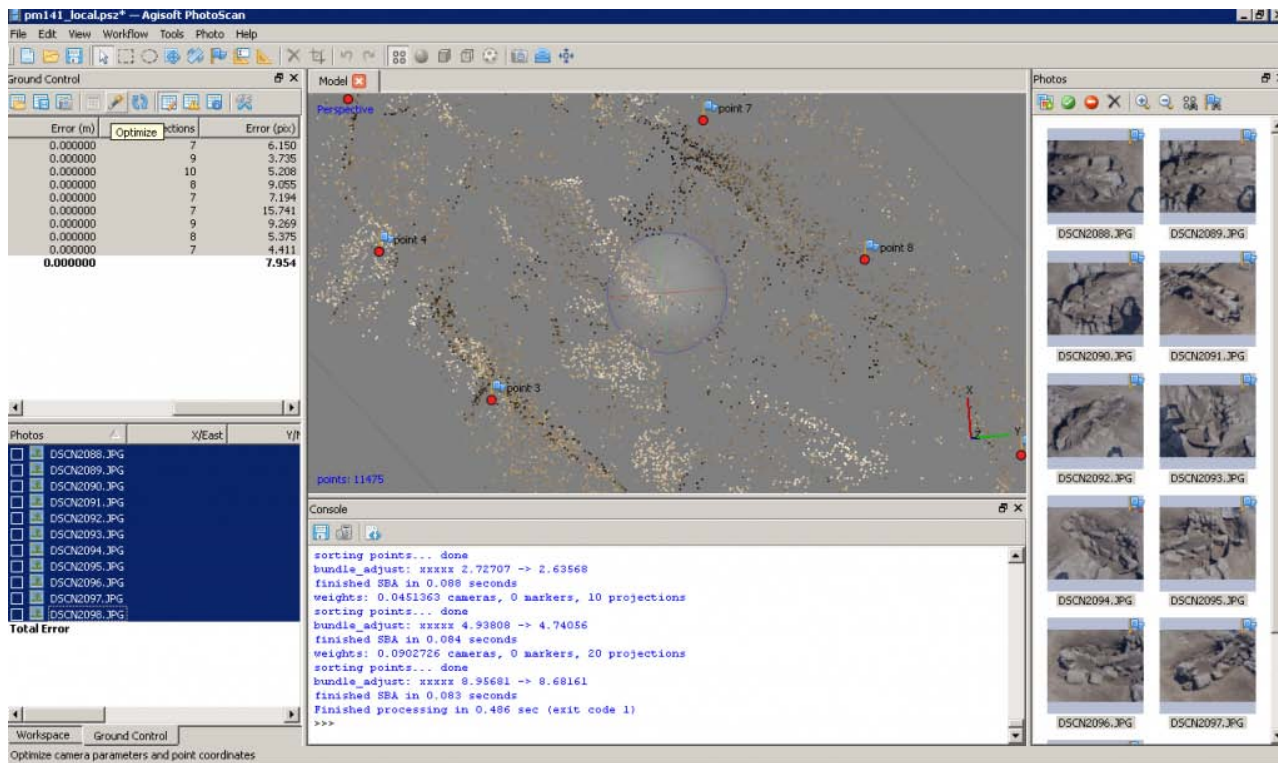


Local coordinates and projections

In practice we have found that many 3d modelling programs don't like it if the model is too far from the world's origin. This means that while Photoscan provides the tools for you to store your model in a real world coordinate system, and this works nicely for producing models as DEMs, you will need to use a local coordinate system if you want to produce models as .obj, .dae, .x3d or other modeling formats and work with them in editing programs like Rapidform or Meshlab. If your surveyed coordinates involve large numbers e.g. UTM coordinates, we suggest creating a local grid by splicing the coordinates so they only have 3-4 pre decimal digits.

Bundle Adjust – Another Choice

After all the points have been placed select all of them (checks on). If you believe the accuracy of the model is at least three time greater than the accuracy of the ground control survey you may select 'update' and the model will be block shifted to the ground control coordinates. If you believe the accuracy of the ground control survey is near to or greater than the accuracy of the model, you should include these points in your bundle adjustment to increase the overall accuracy of the model. To do this select 'optimize' from the 'Ground Control' menu after you have added the points. After the process runs, you can check the errors on each point. They should be less than 20 pixels. If the errors are high, you can attempt to improve the solution by turning off the surveyed points with the highest error, removing poorly referenced photos from the project, or adjusting the location of the surveyed points in individual images. After adjustments are made select 'update' and then 'optimize' again to reprocess the model.



Continue to...

Continue to [PhotoScan – Building Geometry & Texture for Photogrammetry](#)

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<http://gmv.cast.uark.edu/photogrammetry/software-photogrammetry/photoscan/photoscan-workflow/epson-scanner-with-silverfast-software/#comments> Wed, 13 Feb 2013 20:27:22 +0000 adam <http://gmv.cast.uark.edu/?p=12342>

This document will guide you through using the Epson 10000XL Flatbed Scanner and SilverFast plugin to scan film for many applications including use in photogrammetry and archival storage.

Hint: You can click on any image to see a larger version.

GETTING STARTED

Transparency Unit – The EPSON 10000 XL scanner should have the transparency unit attached. If it is not attached, the user needs to turn off the power of the scanner, remove the regular cover, and attach the transparency unit. The transparency guide is not needed for scanning film.



Epson 10000XL Flatbed Scanner

- 1 - **Put on white gloves** when handling film to avoid fingerprints rubbing onto film.
- 2 - **Take film out of canister** and find the glossy side, which will need to be face down for scanning.
- 3 - **Unroll film to find flight direction markings**, which are usually at the beginning of the roll. If there are none, then use your own judgment on flight direction so film data is correctly oriented.
- 4 - **Put film on roller** that allows film to feed through scanner with the glossy side down and with the data correctly oriented; switch spindles if necessary. This can be changed if the user later discovers that the film is incorrectly oriented.
- 5 - **Push bars of rollers together** to a distance with the film right between them and then tighten the knobs of the rollers.

PLACING FILM

- 6 - **Open Adobe Photoshop** program and click on file, import, and select the Silverfast program.
- 7 - **Roll the handle on the roller to feed film onto scanner.** Film should be scanned at the top of the scanner. Rollers can be adjusted as necessary and scanner can be moved so the film is rolled across the top.
- 8 - **When scanning portions of film that are not on the edge of the roll**, attach the end of the film to the opening on the spindle of opposite roller.
- 9 - **Once film is attached to spindle**, use this roller to unroll and feed film through the scanner.

GENERAL SETTINGS

- 10 - **After Silverfast opens, click on Pre-Scan** button at lower left corner for visualization of imagery. This provides an initial preview. Settings need to be changed as listed in the following step.
- 11 - **Select the general tab and set the following settings:**

- 1 - **Scan mode**-normal
- 2 - **Original**- reflective
- 3 - **Pos/neg**- positive

4 - **Frame-set-** save

SCAN QUALITY

12 - Select the frame tab to control quality of scanning procedures and set the following settings:

1 – **Scan type** – 16-8 bit grayscale

2 – **Filter** – GANE, to maximize dust and grain removal settings

3 – **Setting** – save

4 – **Image type** – standard

5 – **Name** – untitled, user can add a title when saving image

6 – **Original-** this setting displays the width and height of area being scanned and can be changed by typing in values or clicking and dragging on box in preview window.

7 – **Scale** – 100

8 – **Q-factor** – 2.5, maximizes quality of scan

9 – **Screen** – 480 lpi

10 – **Scanning resolution** is below screen and q-factor, but unlabeled, set to 1200 dpi

11 – **Click pre-scan again** for new preview of imagery. Re-size window to include only the area of film that contains data.

SCANNING

13 - If desired, check additional options by clicking on options button at right corner to open extra options menu. These options do not need to be changed from default settings.

14 - If desired, check additional options located on top row of SilverFast menu, such as histogram and gradation curve adjustment – alter as the user sees fit. The auto-adjust tool is also located on this row and can improve scanned imagery if needed.

15 - Click on **Scan** button at bottom of tab to begin scanning imagery.

16 - **Saving** : Scanned imagery is loaded into Adobe Photoshop. The user needs to name the file and save it to a folder of your choice as a .tiff file.

FINISHING SCANS / GENERAL TIPS

17 - Continue rolling film as needed to scan imagery and repeat scanning process.

18 - When finished scanning, use the roller on the original spindle to roll the film back.

TIPS

For clear scans : When scanning aerial photography, the user needs to either place sheets of paper behind the film or put the cover back over the transparency unit glass portion. It is also possible that this process could improve scanning results of other series as well.

Distortion : Each roll of film tightens as the user rolls the film through the scanner and attaches it to the roller on the opposite side. Occasionally, this results in the film becoming very tight and resists laying down flat on the scanner bed. When this happens, the portions of the scanned image on the edge of the scanner bed become distorted. Unrolling some of the film on the receiving roller relieves some of the tightness, but does not totally eliminate distortion from the image. The best way to eliminate the distortion is to select not to scan the area that is distorted during the pre-scan.

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This document will guide you through using the Epson 10000XL Flatbed Scanner to scan photographs and other media for many applications including use in photogrammetry and archival storage.

Hint: You can click on any image to see a larger version.

GETTING STARTED

A current version of EPSON Scan Utility software can be freely downloaded from the Epson website and used to scan a variety of media, including transparent film and photographic prints.



Epson 10000XL Flatbed Scanner

To get started, make sure the scanner is connected to the computer and turn both the scanner and computer on. Log in to the computer and start the EPSON Scan software.

- 1. Mode** – In the EPSON Scan dialog (Figure 1), change the “Mode” to “Professional Mode.”
- 2. Media** – If scanning transparent film media, choose “Film” in the “Document Type” drop-down menu. If scanning paper, prints, or other reflective type media choose “Reflective.”

SETTINGS

- 3. The “Document Source”** should always be set to “Document Table.”

4. In the “Image Type” drop-down menu, choose the appropriate setting for the media you’re scanning.

-When scanning transparent film media we recommend using a 16-bit Grayscale (for B&W film) or 24-bit Color (for color natural or false color film).



Figure 1: Settings for scanning with EPSON Scan software

5. Choose a resolution that is appropriate for the media you’re scanning.

- When scanning transparent film media we recommend using a minimum resolution of 1200 dpi

- For high quality film, we recommend using 2400 or 3200 dpi in order to capture all of the available detail contained within the film

- When scanning print or paper media, a scanning resolution of 300-350 dpi should capture all of the available detail contained within the print.

6. Un-check the “Thumbnail” check box. All other settings in the EPSON Scan dialog will depend on the media you’re scanning, or on your personal preference.

SCANNING



Figure 2: Transparent Film on Scan Bed

7. Placement – Carefully place the media face down in the upper left corner of the scan bed (Figure 2). We recommend using clean gloves when handling transparent film or print media.

8. Click the “Preview” button at the bottom of the dialog and the scanner will begin scanning.



Figure 3: EPSON Scan software Preview

9. Once the preview scan is complete, the “Preview” dialog should appear (Figure 3). Use the Marquee tools to select the area of the media you would like to include in your scan. Be sure not to crop an image you plan on using for photogrammetry, and to include any visible fiducial marks.

10. Begin Scan – In the “EPSON Scan” dialog window, click “Scan” to start the scanning process.

SAVING YOUR FILE

11. In the “File Save Settings” dialog, choose a location, format, and name for output file.

NOTE: *For best practice (and especially projects considering archival), we recommend scanning to the TIFF (.tif) file format.*

12. Time - Depending on the size of your media and the resolution you chose, the scanning process could take up to 1-2 hours.

]]> <http://gmv.cast.uark.edu/photogrammetry/software-photogrammetry/photoscan/photoscan-workflow/basic-operation-of-the-epson-10000xl-flatbed-scanner-with-epson-scan-utility-software/feed/0>

This page will show you how pre-process digital images for use in Close-Range Photogrammetry (CRP).

Hint: You can click on any image to see a larger version.

A BASIC INTRODUCTION

Why is pre-processing necessary?

For most close-range photogrammetry projects digital images will need to be captured in a RAW format, preserving the maximum pixel information which is important for archival purposes. Therefore it will likely be necessary to do some pre-processing in order to convert RAW images into a file format accepted by the photogrammetry software being used for the project.

If a color chart or gray card was used during image capture, it may also be useful to perform a white balance on the image set. There are a number of tools/software packages available for this purpose, but below we will describe a potential workflow using Adobe products for batch processing.

Overall steps of this workflow:

- Â Batch convert RAW to DNG (Adobe DNG Converter)
- Â Batch white balance (Camera Raw)
- Â Batch image adjustments (Camera Raw)
- Â Batch save to JPEG (or TIFF) format (Camera Raw)

BATCH CONVERT RAW DATA

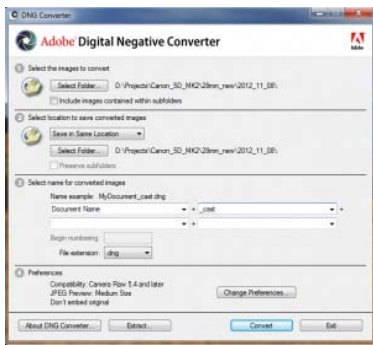
Batch RAW to DNG with Adobe Digital Negative (DNG) Converter Software

As an open extension of the TIFF/EP standard with support for EXIF, IPTC and XMP metadata, the Adobe DNG format is rapidly becoming accepted as a standards for storing raw image data (primarily from digital photography).

For more information about file formats for archival, see the [Archaeological Data Service \(ADS\) Guides to Good Practice](#).

Steps to Batch Convert:

1. Download and install Adobe DNG Converter. As of the date this workflow was published, version 7.2 of Adobe DNG Converter is a free tool available for download on the Adobe website.



Adobe DNG Converter is a free tool available for download on the Adobe website.

2. This tool converts an entire folder (aka batch) of images at one time. Use the tool interface to select the appropriate input folder containing the RAW images.
3. If needed, use the interface to design a naming scheme to be used for the new file names.
4. Set preferences for compatibility (e.g. Camera Raw 5.4 and later) and JPEG Preview (e.g. medium size). As an option, you can embed the original RAW file inside the new DNG files. This will, of course, increase the file size of the new DNG file.
5. Click **Convert** to start the process. Wait for this to finish.

BATCH WHITE BALANCE – 1

Batch white balance, image processing, and exporting with Adobe – Part 1: Adobe Bridge

It is considered best practice to (correctly) use a quality color chart or gray card when capturing digital images for any CRP project. **Performing a white balance for each image set (or each lighting condition) can dramatically enhance the appearance of a final product** (i.e. ortho-mosaic). This particular workflow uses Adobe Bridge and the Adobe Camera Raw tool, but a similar process can be done in other (free) software as well.



Adobe Bridge – Open in Camera Raw

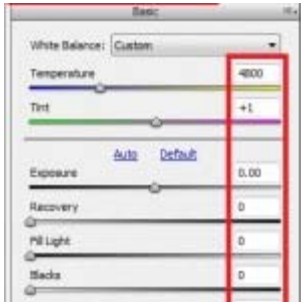
1. Open Adobe Bridge and navigate to the folder containing the digital images (DNG files).
2. Select the appropriate images (including images with color chart/gray card).

3. Use the 'File' menu to select 'Open in Camera Raw'

BATCH WHITE BALANCE – 2

Batch white balance, image processing, and exporting with Adobe – Part 2 : Camera Raw tool

4. Camera Raw will open and all of the selected images will appear on the left side of the window. Select the image with the color chart/gray card you would like to use for white balancing and other adjustments. Do all adjustments to this one image. We will apply the same changes to all images in the following slide 'Batch Image Adjustment'.



Adobe Camera Raw –
Image Processing
Settings

5. **By default, Camera Raw may attempt to apply a number of image processing settings that you should remove.** This can be done using the interface on the right hand side of the screen. Check that all settings (with the exception of Temperature and Tint, which are set by the white balance tool in the next step) are set to zero. Be sure to check under each of the tabs.

6. Select the 'Color Sampler Tool' found in tool bar at the top of the window and:

A. If using a color chart, add a color sample inside the black and white squares. After adding these you should see the RGB pixel values for each sample.

B. If using a gray card, add a color sample inside the gray portion of the card.

7. Select the 'White Balance Tool' from the tool bar at the top of the window and click on the gray portion of the chart (or card) to apply a white balance. At the same time, notice how the RGB values of the color sample(s) change. The RGB values should not differ by more than five or six (e.g. the white sample could be R: 50, G: 50, B: 51). If they differ by too much there could be a problem with the white balance. Try clicking a slightly different spot in the gray portion of the chart.

8. If other adjustments need to be made (i.e. exposure, brightness, contrast) make them now.

BATCH IMAGE ADJUSTMENTS

Applying adjustments to all

Once the white balance and adjustments have been made to this one image, we can apply the same to all the other images open in Camera Raw.

To do this, click **â€œSelect Allâ€œ** in the top left corner of the window **â€œ** then click **â€œSynchronize.â€œ** Wait for this to finish.

BATCH SAVE TO JPEG OR TIFF

Saving

Once the Synchronization is complete, click the **â€œSave Imagesâ€œ** in the bottom left corner of the window (make sure all images are still selected). The **â€œSave Optionsâ€œ** dialog allows you to choose a folder for the images to be saved to, a naming scheme, a file extension and format, and a quality/compression. Choose the settings you prefer and click **â€œSave.â€œ**

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CONTINUE TO...

Continue to [PhotoScan – Basic Processing for Photogrammetry](#)

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Thu, 19 Jul 2012 16:01:26 +0000 adam <http://gmv.cast.uark.edu/?p=10761> [Continue reading →](#)]]>



Computer requirements for software can change quickly. We recommend you visit the [PhotoScan Wiki](#) and especially the [Tips and Tricks](#) page for more, up-to-date information on this topic.

Basic Requirements

Because of the wide range of potential images used, the minimum computer requirements for using PhotoScan will depend heavily on the number and size of the images being processed. According to the PhotoScan Help Files, system requirements are:

Operating System:

Windows XP or later (32 or 64 bit) / Mac OS X Snow Leopard or later / Debian/Ubuntu (64 bit)

Processor:

Minimum Intel Core 2 Duo / Recommended Core i7

RAM:

Minimum of 2GB of RAM / Recommended 12GB

Typical Machine/Project setup

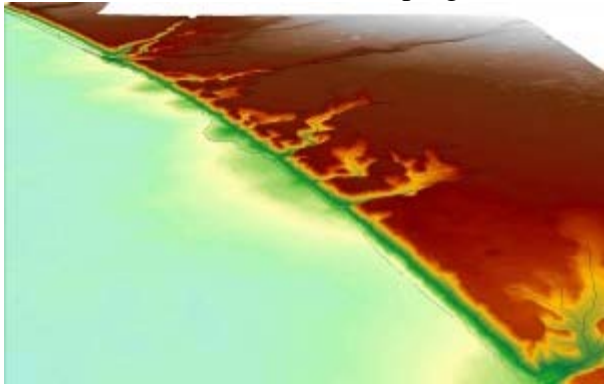
A typical desktop at CAST now has Windows 7 64 bit, Core i7 3.4 GHz processor, 8-12GB of RAM, and an NVidia Quadro or GTX series graphics card. We also have a number of larger machines with dual quad-core processors and ca. 28GB of RAM. It has been our experience that projects involving up to 15-20 images from a Canon 5D Mark II (21.1 megapixel) can be processed (with PhotoScan settings set for maximum resolution) on a machine with the typical setup (8-12GB RAM). Projects involving more than 20 images require the bigger machines (28GB RAM).

According to PhotoScan, a machine with 12GB of RAM can potentially process 200-300 images in the 10 megapixel range. For projects involving multiple (more than 2-3) medium format images (e.g. modern aerial imagery or historic aerial photography scanned at 1200dpi or higher) will likely require a well-built machine with a significant amount of RAM (i.e. 56 to 128GB).

OpenCL

PhotoScan and PhotoScan Pro use OpenCL for portions of the meshing process. OpenCL allows the user to deactivate one or more CPU cores and activate one or more GPU cores using the "Preferences" dialog found through the "Tools" menu. It has been our experience that some video cards will appear in the OpenCL Devices list even though they are not properly supported by OpenCL. Check the PhotoScan Help to find a list of support GPU model video cards. NVidia Quadro graphics cards are not on this list (as of July 2012).

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3D View of DEM Overlaid With 3D Breaklines

Close Range Photogrammetry:

Typical deliverables created as the end result of a CRP project could include 2D vector graphics (planimetric or elevation type CAD drawings), dense point clouds, 3D polylines, facetized models (mesh) of an object or surface, and raster graphics such as rectified or fully orthorectified images. Each deliverable created should include appropriate metadata for each of the above mentioned steps, as well as metadata for the additional processing performed to create the final file.

Because the diversity of possible end products and software packages associated with photogrammetry, it is difficult to specify the metadata required. We recommend using the ADS Guides to Good Practice to identify the appropriate metadata for your specific file. Below is a list of ADS Guides and the file types they should be used for:

2D CAD drawings and 3D vectors: http://guides.archaeologydataservice.ac.uk/g2gp/Cad_Toc

3D point clouds and facetized models (mesh):

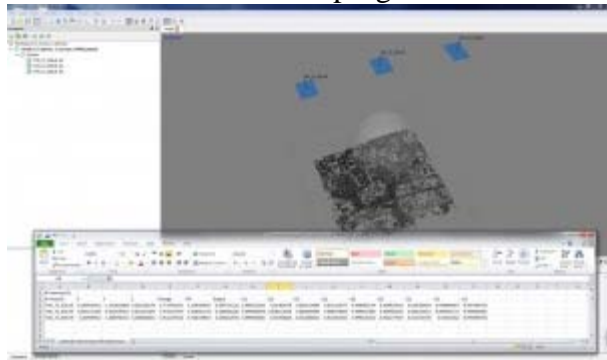
http://guides.archaeologydataservice.ac.uk/g2gp/LaserScan_Toc

Raster images: http://guides.archaeologydataservice.ac.uk/g2gp/RasterImg_Toc

Low Altitude & Aerial Photogrammetry:

A discussion and comparison of file export formats is currently being developed. Please check back soon! And in the meantime, please see the [ADS Guides to Good Practice regarding Aerial Survey](#) for detailed information regarding documentation and standards.

]]> <http://gmv.cast.uark.edu/photogrammetry/software-photogrammetry/photomodeler/metadata-photomodeler/file-exports-and-deliverables-documentation-for-close-range-photogrammetry/feed/> 0
<http://gmv.cast.uark.edu/photogrammetry/software-photogrammetry/photomodeler/metadata-photomodeler/image-processing-and-block-triangulation-documentation-for-close-range-photogrammetry/>
<http://gmv.cast.uark.edu/photogrammetry/software-photogrammetry/photomodeler/metadata-photomodeler/image-processing-and-block-triangulation-documentation-for-close-range-photogrammetry/#comments> Thu, 19 Jul 2012 15:48:49 +0000 adam <http://gmv.cast.uark.edu/?p=10749> [Continue reading →](#)]]>



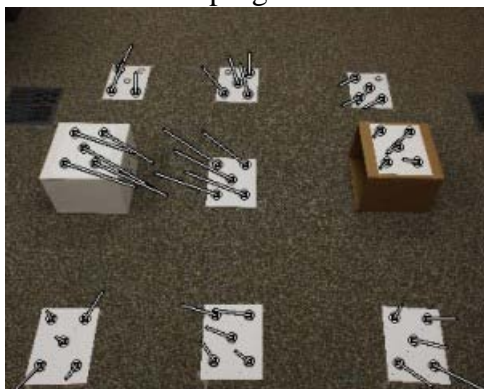
Aligned Images in PhotoScan

In order to extract three dimensional points from two dimensional images, it is necessary to perform a triangulation with at least two images (a stereo pair). When more than two images are used in a triangulation, we refer to the group of images as a “block”. To perform a triangulation, we must measure a sufficient number of tie, control, and/or check points throughout the block. Constraints may also be placed on certain sets of points to enforce angular, linear, and/or planar properties. Once a triangulation is successful, image exterior orientation parameters (along with estimate for accuracy) should be available to the user. These are important pieces of information for downstream deliverables and should be documented. The table below describes the appropriate documentation for this process. Download a printable form in PDF format [here](#) or in a spreadsheet (.xlsx) format [here](#).

Entry	Description
For each block:	
Name and version of the software	Include all details of the software name, manufacturer, version, and build used for image processing and file format conversions.
Description of image processing	Describe and image processing and/or file format conversions performed and the settings used.
Name and version of the software	Include all details of the software name, manufacturer, version, and build used for triangulation.

RMSE values	Root Mean Square Error (RMSE) for control and check point measurements, indicating whether the RMSE is for control points only, check points only, or all points.
Constraints on object points	List of constraints used during processing.
For each point:	
Point ID	ID or name used for the point.
Point type	Tie, Control, or Check point.
XYZ priori and a priori	If available, provide the XYZ coordinates before and after bundle adjustment (control and check points only).
Covariance matrix a priori	If available, provide the covariance matrix.
Image coordinates and residuals	A list of images on which the point is indicated. For each image on the list, provide the uv coordinates and residual.
For each image:	
Exterior orientation	List exterior orientation parameters for each image.

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<http://gmv.cast.uark.edu/photogrammetry/hardware-photogrammetry/canon-5d-mark-ii/metadata-forms-canon-5d-mark-ii/camera-calibration-documentation-for-close-range-photogrammetry/>
<http://gmv.cast.uark.edu/photogrammetry/hardware-photogrammetry/canon-5d-mark-ii/metadata-forms-canon-5d-mark-ii/camera-calibration-documentation-for-close-range-photogrammetry/#comments> Thu, 19 Jul 2012 15:37:51 +0000 adam <http://gmv.cast.uark.edu/?p=10743> [Continue reading →](#)]]>



Camera Calibration Photo

Each camera (referring to a camera and lens combination) used in a close-range photogrammetry project should be calibrated and a calibration file should be saved with the project data. Some close-range photogrammetry software does not require this information before processing the image block; however, it will provide most of this information after processing. The tables below describe what is appropriate to document for this process. Download a printable form in PDF format [here](#) or in a spreadsheet (.xlsx) format [here](#).

For each camera/lens calibration:

Element	Description
Camera/Lens name	Name used to identify this camera/lens combination (e.g. CAST5DmkII-2_28mm).
Date of calibration	Date that the calibration was performed.
Camera calibration file name	The exact file name for the camera calibration.
Camera specifics	Specific make and model of the camera and lens used.
Array dimensions in pixels	Width and height of digital array measured in pixels.
Array dimensions in mm	Width and height of digital array measured in millimeters.

Focal length	As indicated by camera calibration.
Principal Point	As indicated by camera calibration.
Lens distortions (K1, K2, P1 and P2 parameters)	Radial and decentering distortion parameters as measured by the camera calibration.
Affine distortions	Affine distortion parameters as measured by the camera calibration (if measured).
Calibration Quality Values	Quality values such as overall RMS, maximum residual, and photo coverage (%) from the calibration process.
Calibration adjustment report	A report on the quality of the camera calibration including the correlation between exterior and interior parameters.

For each calibration image (if performing a camera calibration with a target):

Entry	Description
Image file names	File names for calibration images.
Calibration target description	Include target dimensions, creator and description.

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<http://gmv.cast.uark.edu/photogrammetry/hardware-photogrammetry/canon-5d-mark-ii/metadata-forms-canon-5d-mark-ii/image-acquisition-documentation-for-close-range-photogrammetry/>
<http://gmv.cast.uark.edu/photogrammetry/hardware-photogrammetry/canon-5d-mark-ii/metadata-forms-canon-5d-mark-ii/image-acquisition-documentation-for-close-range-photogrammetry/#comments> Thu, 19 Jul 2012 15:27:55 +0000 adam <http://gmv.cast.uark.edu/?p=10734> [Continue reading →](#)]]>



Nikon D70

Organization and documentation during image collection in the field is especially important. The table below describes the appropriate documentation for this process. Download a printable form in PDF format [here](#) or in a spreadsheet (.xlsx) format [here](#).

For each group of images:

Entry	Description
Project name	The project name or name for the dataset.
Number of images	Total number of images.
File name for planimetric sketch or map	File name and extension. Should include outline of subject and surrounding objects (if any), indicated location and orientation of each image (using a ∞ symbol to indicate orientation), and other special comments and/or observations.
Camera calibration file	Reference to the camera calibration file if available.
Additional notes	Any additional notes the surveyor feels applicable. Could list images containing control and/or scaling references.
For each image:	

Image file name	File name and extension.
Textural description of location and orientation	Should describe general location (e.g. north side) and camera to subject orientation (e.g. view to south).
Format conversions (if any)	List of format conversions performed on the digital images and the software used.

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