PHOTOGRAMMETRY

Preparing to Photograph: Camera Settings & Surrounding Conditions (04.02)

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ASOR TUTORIALS FOR CULTURAL HERITAGE DOCUMENTATION

ASOR and its partners have developed a series of tutorials and training modules aimed to help cultural heritage specialists perform surveys and condition assessments through open source tools and software, including QGIS, KoboToolbox, LibreCAD, and RealityCapture.

These modules provide step-by-step tutorials on how to download, install, and effectively use applications and software during data collection, analysis, and output. All tutorials can be found on ASOR's website: https://www.asor.org/chi/chi-tutorials.

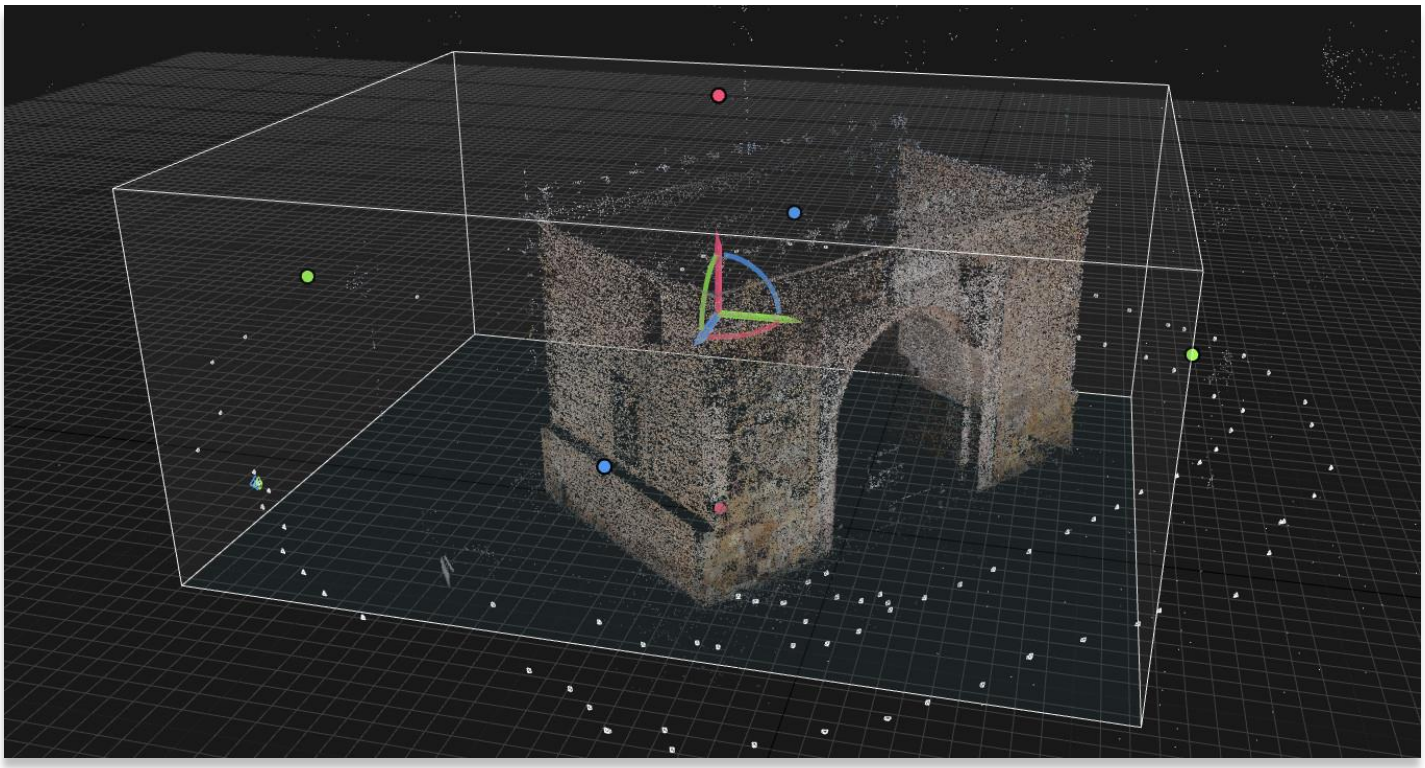
WHAT IS PHOTOGRAMMETRY?

Photogrammetry is the use of two dimensional (2D) images to provide measurement data. Measurement data includes positions of objects and relationships between objects. Photogrammetry uses a procedure referred to as "Structure from Motion" (SfM) to solve feature positions within a defined coordinate system.

SfM refers to a set of algorithms from computer vision sciences that assist photogrammetry by automatically detecting and matching features (points) across multiple images, then triangulating positions.

The resulting calculations create point clouds that can be converted into surfaces or meshes. This process, known as spatial interpolation, creates continuous data layers (surfaces) from non-continuous data (points) that result in orthorectified photographs, 3D models of objects, and 3D surfaces of landscapes, facades, and architectural features.

This ASOR Tutorial (04.02) will provide an outline of camera settings, environmental conditions, and photo-taking strategies that are conducive to successful photogrammetry projects.



LIGHTING & ENVIRONMENTAL CONDITIONS

1. Flat and diffuse light works best. Shadows may appear on the 3D model or orthophoto in harsh or bright light. Shadows make it more difficult for the photogrammetry computer software to create accurate point clouds and find similar points when comparing multiple images.
2. If taking photos outside, aim to shoot during an overcast day or early in the morning before harsh shadows appear.

CAMERA SETTINGS

DSLR Cameras are preferred, however phone and tablet cameras are adequate for creating 3D models and surfaces using photogrammetry.

Lens: use a fixed-length prime lens if possible. Generally, these should be wide-angle, but not fish-eyed. You will want everything in the photo to be in focus rather than zooming in on specific places within the frame.

Aperture: set to a constant **f-stop (depth of field)**. Camera lenses are sharpest at an intermediate f-stop (between f/8 to f/11).

ISO: Typically a low ISO will produce better results. A lower ISO value means less sensitivity to light, while a higher ISO means more sensitivity. Aim for the 200-300 range. Your photos may appear dark initially, but can brighten later using photo editing software (such as GIMP or Adobe Photoshop). A lower ISO will help avoid bright or "washed out" images that may miss details needed for your model.

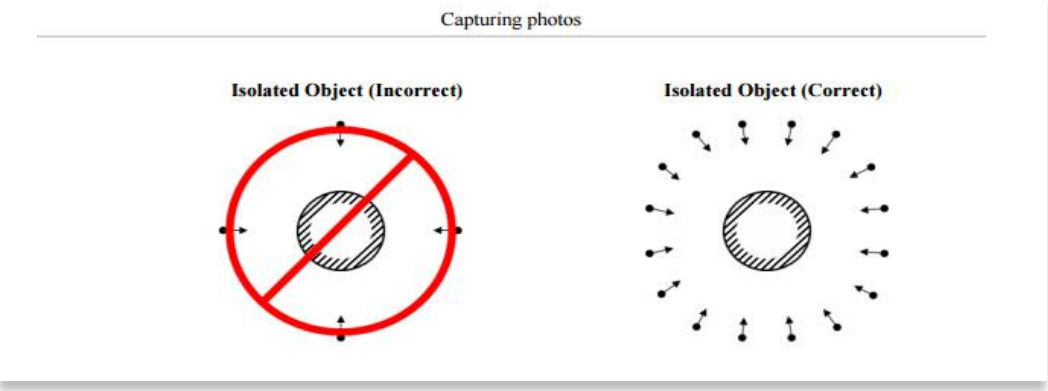
PHOTO-TAKING STRATEGIES

A good, systematic strategy for taking the images in the field or in a studio is much more important than the choice of camera itself.

a. More images will produce a more accurate model. The amount of photos you take should be balanced with processing time on your computer. More images will increase processing time (oftentimes significantly).

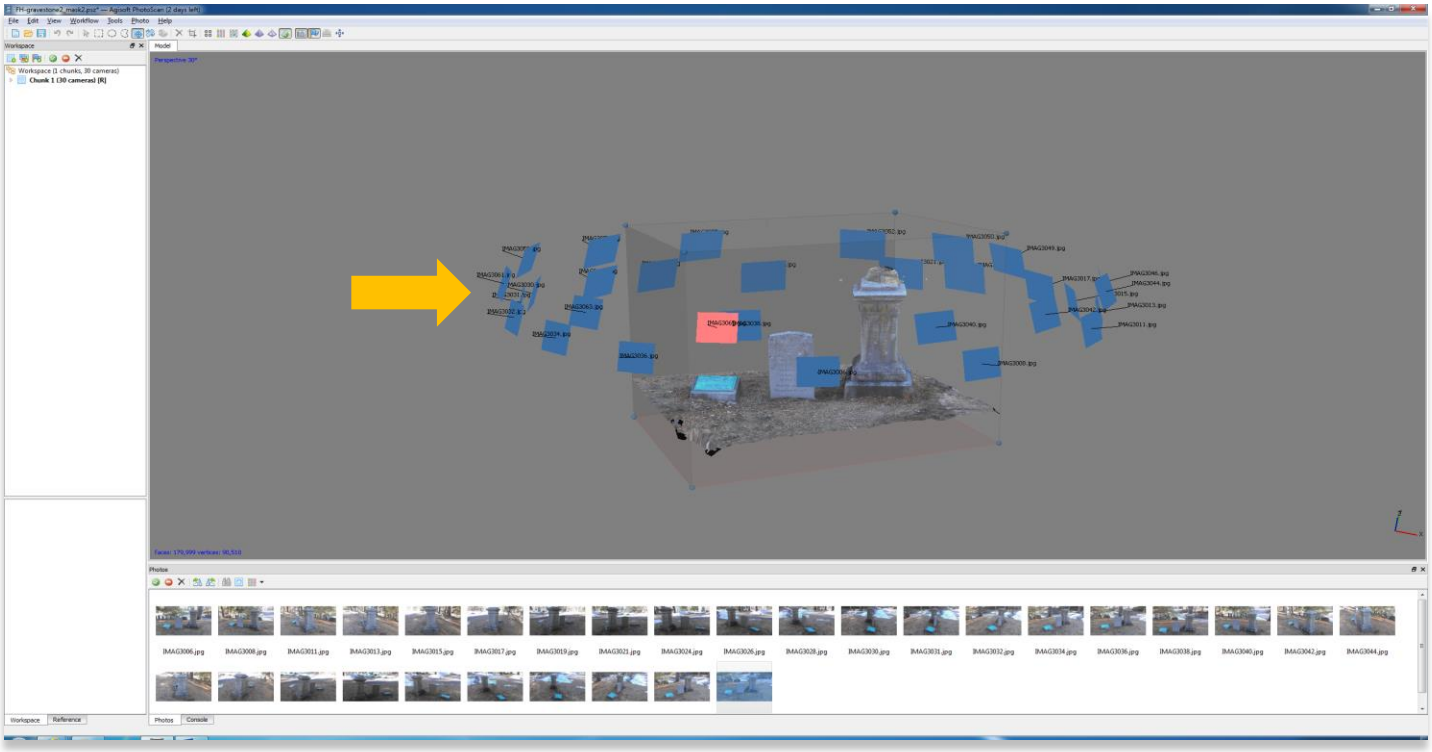
b. Images should be taken in a regular pattern with a minimum of 80% overlap between frames and 30% overlap between passes or moving to a different distance from the object. A pass is one full rotation around a 3D object or moving in a line along one axis (used to capture a single wall of a monument). You often will need to make 2-3 passes at different heights in order to successfully capture photos for your model.

A SINGLE PASS AROUND AN OBJECT



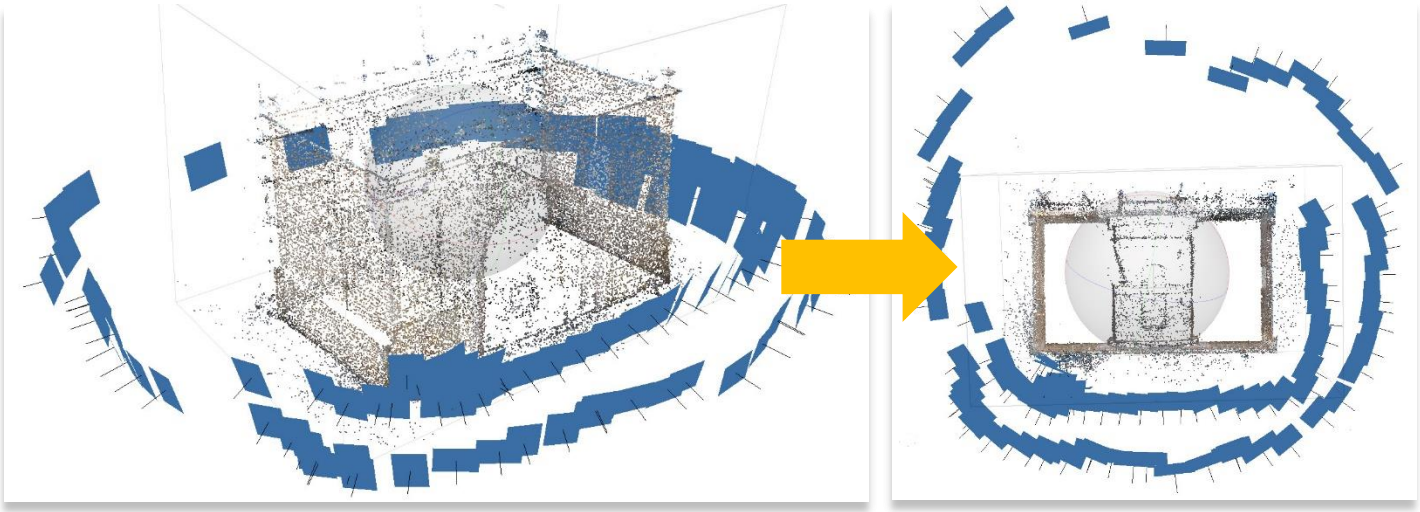
DOUBLE PASS AROUND AN 3D OBJECT/MONUMENT (BEST METHOD WHEN POSSIBLE)

* Blue rectangles represent locations where photos were taken

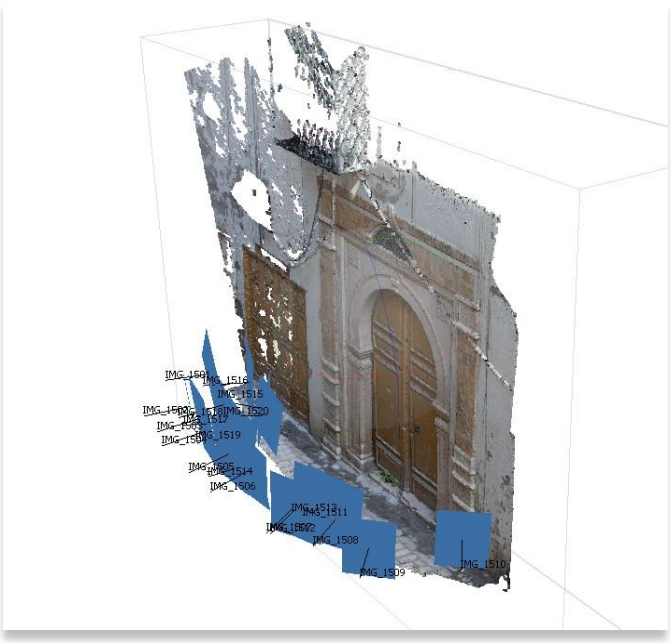


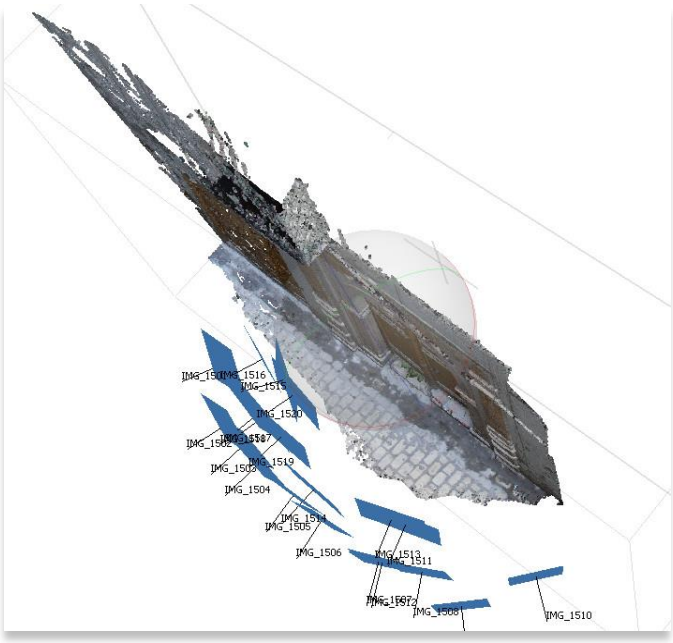
MULTIPLE PASSES OF ARCHITECTURE FROM DIFFERENT HORIZONTAL DISTANCES (NOT VERTICAL)

* Blue rectangles represent locations where photos were taken



If taking photos from different heights isn't possible, you can change your horizontal distance from the object. This method is highly effective for documenting architecture, however it may produce models whose resolution is slightly worse than using the vertical pass method.





The focus of the model below is the door and archway. You will notice that these aspects of the model do not have holes, which means that the photographer successfully covered this area when shooting. The areas with holes can be cleaned up and deleted later while processing the model using photogrammetry software.

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