

10 QUESTIONS ON USING A CAMERA FOR MEASURING & MODELING

HOW PHOTOGRAMMETRY SOFTWARE WILL CHANGE THE WAY YOU WORK



PHOTOMODELER

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INTRODUCTION TO PHOTOGRAMMETRY

A FASTER, EASIER METHOD OF MEASURING & MODELING

Every day architects, engineers, geologists, law enforcement officers, and surveyors the world over create measurements, drawings and 3D models of real-world objects using a digital camera and a software program for photogrammetry. The technique of photogrammetry has been used in aerial map-making since the late 1800's.

Today's photogrammetry, driven by advances in both camera and computer technology, is used for modeling and measuring small to large objects and areas using either aerial or ground-based photographs. This paper deals with the diverse general use of modern photogrammetry and image-based modeling, rather than traditional map making.



PHOTOGRAMMETRY OFFERS A LARGE NUMBER OF BENEFITS INCLUDING:

- ▶ **Accuracy.** Photogrammetry is as accurate, if not more so, than many measuring and modeling methods.
- ▶ **Speed.** From start to finish, photogrammetry projects move faster.
- ▶ **Cost savings.** When all costs are considered, photogrammetry projects tend to be less expensive.
- ▶ **Comfort.** Photogrammetry requires you to spend less time in the field.
- ▶ **Flexibility.** No project is too large or too small for photogrammetry.

This guide is designed to help professionals considering the use of photogrammetry by answering the questions that most often come to mind. As you'll see in the following sections, photogrammetry has much to offer in the way of accurate measurements and modeling with a low entry cost and short learning curve.

Photogrammetry will change the way you handle measuring and modeling projects.

Let's jump right in.

1

HOW ACCURATE IS PHOTOGRAMMETRY?

First let's look at what we mean by "accuracy". Simply put, accuracy is the quality of being correct. The accuracy of any measurement device or technique is properly assessed by comparing its results to that of a known standard.

Professional photogrammetry is highly accurate. It is quite capable of meeting or exceeding the accuracy of hardware-based devices with similar functional purposes, such as laser scanners and total stations. Photogrammetry can generate:

- ▶ **Point clouds** with similar accuracy to laser scanner / LIDAR
- ▶ **Discrete points** and features more accurately than total station and GPS, especially as subject size decreases

You can use photogrammetry as a quick method to get results that are "good enough" for a specific purpose; or you can employ more structured project procedures to achieve the highest possible levels of accuracy.

With the quality and resolution of cameras always increasing, photogrammetry will continue to provide you with a method to achieve higher levels of accuracy in the future.

2

HOW HARD IS IT TO LEARN PHOTOGRAMMETRY AND GET MY FIRST RESULTS?

Photogrammetry is not a difficult technique to learn. New users are often able to start creating their own data within one day; although, as with most sophisticated software, there is always more to learn for those who are keen to refine or learn new techniques. Anyone with prior experience using CAD or 3D software will find many familiar elements.

There is a wealth of established resources available to help you learn, both from photogrammetry software vendors and from online communities of photogrammetry users. Professional solutions typically come with formal documentation and provide other learning resources such as videos on YouTube.



3

WHAT CAMERAS ARE BEST FOR PHOTOGRAMMETRY?

It is possible to get good photogrammetry quality with a smart-phone or a simple \$200 point-and-shoot camera. Many people use these types of cameras and are pleased with the results.

While it is certainly not the only factor that will determine project quality, camera equipment does have an effect on results, and getting a camera with higher resolution and a lens well suited to photogrammetry is one way to improve the quality of your work. In fact, it's been said that one of the great benefits of photogrammetry mapping over laser mapping is the ability to quickly improve resolution by simply by changing cameras.

If you want great photogrammetry results and higher accuracy, you can expect to spend \$1000 to \$2000 as a starting point for a digital SLR camera and a fixed focal length (or prime) lens.

For the latest information on cameras and photogrammetry visit this [About Cameras](#) webpage.

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HOW DO I TAKE PHOTOS?

Most photogrammetry projects require two or more photos of the scene or object from different angles. A project might be just a few photos up to hundreds. The exact number of images required often depends on the shape of the object.

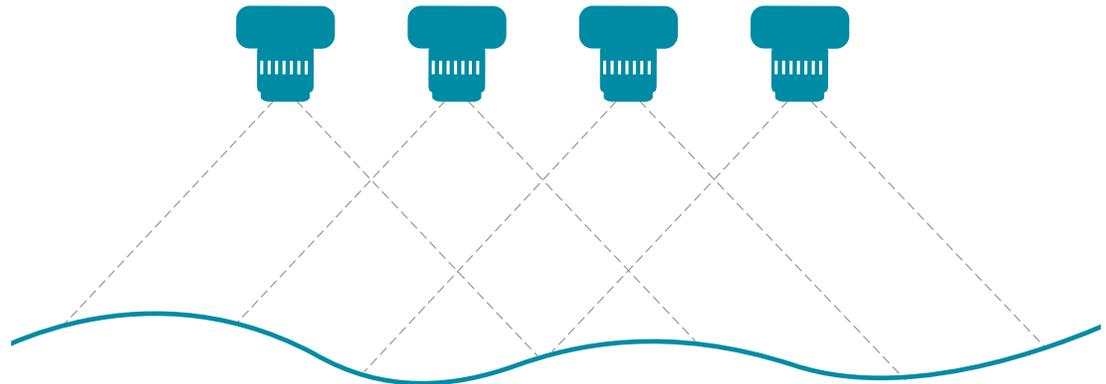
For example, if your subject matter is a wall, you can capture a section of the wall with only two photographs because you can get the wall in full view from two different camera positions in two photos. On the other hand, a 360-degree view of the outside of a house will take more photos because you can't capture all four walls in just two photographs.

You can improve the accuracy and quality of a project by taking more photographs than the minimum number. The photographs are usually taken by a single camera, but there are situations where photographs from different cameras can be mixed together in the same project. This is especially useful for dynamic projects in which the subject's shape or position is changing as multiple cameras can be synchronized to help track the changes over time.

There are a few configurations of camera position based on the type of project. The most common photogrammetry camera configurations are parallel and triangulated. Let's look at the difference.

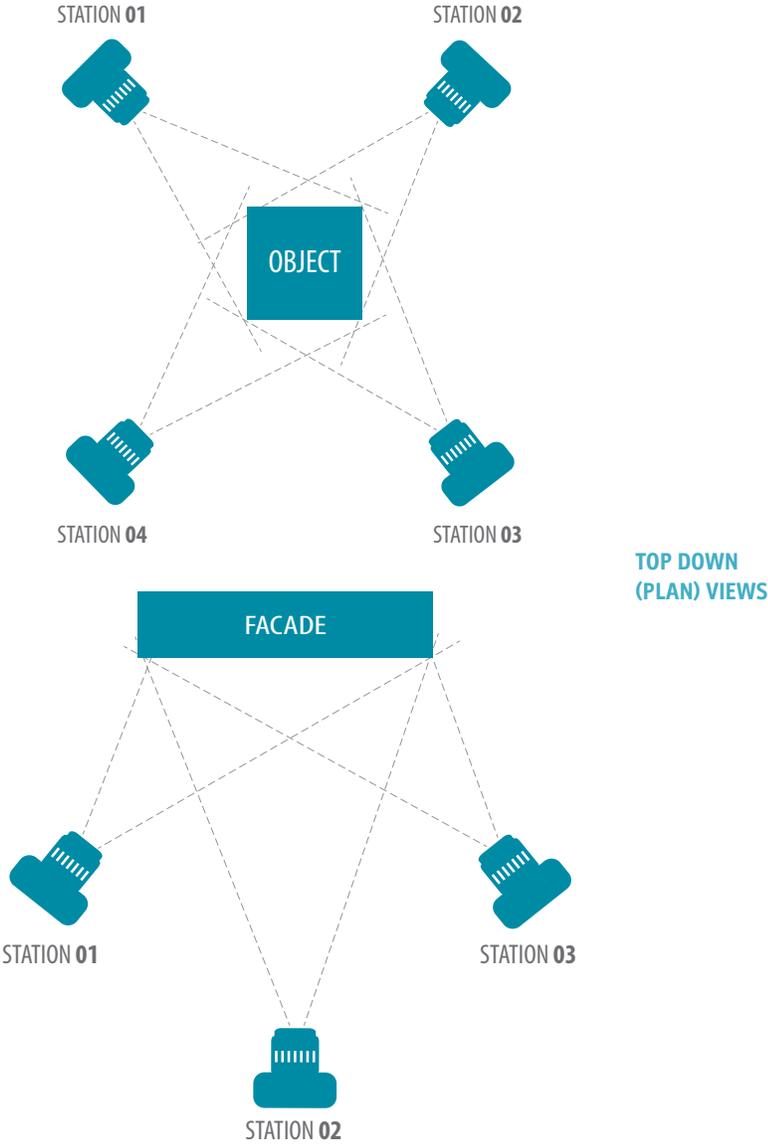
PHOTOS FOR DSM

In a parallel configuration, the paths from the camera to the subject matter are in alignment with one another. This is also sometimes called “stereo pairs”. The photo positions are close to each other and the angles are small. This type of setup is best suited to Dense Surface Modeling (DSM) projects, where the goal is to create a dense point cloud similar to a laser scanner.



PHOTOS FOR REGULAR

In a triangulated configuration, the paths from the camera to the subject matter converge at the same point on the subject. The photo positions are farther apart and the angles can be larger. This type of setup is best suited to targeted and manually marked projects to create CAD-models with discrete features such as point locations, lines, edges, curves, and more.



5

HOW MUCH TIME DOES IT TAKE TO COMPLETE A PROJECT AND HOW AUTOMATED IS IT?

Every photogrammetric measuring or modeling project has two parts - data capture and software processing. With photogrammetry, the data capture portion of a project – especially in the field – is extremely quick when compared to other methods. This involves taking photographs (and usually taking a scale distance measurement). Most of the work is done back at a computer with the software.

Software processing time varies. Some projects can be completed in a few minutes; others take hours when the number of photographs is very large. Processing for the longer tasks is usually automated and you can go on to something else.

The level to which the processing step can be automated depends on the type of project you are running.

DSM (dense surface modeling) point clouds can be highly automated. Projects where it is possible to place or project high contrast circular targets on object surfaces can also be highly automated. A few clicks of your mouse are usually all that's needed.

CAD wire-frame models involve a greater level of interaction and input from you to match up common physical features of interest between multiple photographs as seen from different camera positions.

Regardless of the type of project, the ease of data collection and automated processing means photogrammetry offers many opportunities to save time compared to other methods. And you'll be doing the bulk of your work in a comfortable environment at a time of your choosing, instead of performing most of it in the inconvenient, sometimes dangerous or uncomfortable environments of the field.

In many types of projects, photographs are already collected as part of the documentation. Using these photographs as the foundation of the measurement process yields greater efficiency by combining two tasks into one.

In some situations photogrammetry doesn't just save time – it actually makes a challenging measurement task possible. For example, measuring distant objects that are located in dangerous areas, or reverse engineering an accident scene from by-stander photographs.



6

CAN I EXPORT PHOTOGRAMMETRY FILES TO OTHER APPLICATIONS?

Yes. It's very common to use photogrammetry as part of a comprehensive workflow that also involves other software applications for further analysis, enhancement or presentation. Photogrammetry users often export files to be used with CAD packages, GIS systems, visualization software, and motion film and gaming development.

Some photogrammetry software even allows for scripting or automating workflows together with other software packages.

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WHAT TYPES OF OBJECTS ARE BEST FOR PHOTOGRAMMETRY?

There are techniques and methods for using photogrammetry to model almost anything. There is no size restriction and you can use any subject matter you can take photographs of.

Methods for automatically generating DSM point clouds work best with object surfaces that have a random texture appearance – such as cloth, brick walls, or rock formations.

CAD or wire-frame style models are most easily acquired from objects that have an abundance of sharp corners and edges and well-defined features – such as a building.

Objects that have more smooth, uniform and highly curved surfaces can even be modeled or measured through the use of projected or applied targets or texture.

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CAN I USE EXISTING OR KNOWN MEASUREMENTS TO IMPROVE MY PHOTOGRAMMETRY PROJECT?

You may already have survey data from your subject, usually in the form of known 3D XYZ point positions, and want to use photogrammetry to find other unknown dimensions. Professional photogrammetry solutions have the capability to use this type of known information (sometimes called control data) to enhance the results.

If the goal of your project is to provide a model or measurements in real-world units, you'll need a scale reference measurement. This scale measurement can be acquired using simple tools such as a tape measure, or for projects requiring higher accuracy, more sophisticated methods can be employed to collect the scale measurement. Professional photogrammetry solutions will also allow for multiple scale measurements to be used in a project, and will additionally provide feedback on precision estimates.

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HOW MUCH WILL IT COST?

Photogrammetry solutions are usually less expensive than other professional options and offer far more versatility for the cost.

The two most important items you need for photogrammetry are;

1. Camera. You can use a camera you already have, or start with inexpensive consumer cameras and work your way up - if needed - to higher quality camera equipment costing \$1000 and up.
2. Photogrammetry software. Professional solutions start from about \$1000.

Other hardware-based measurement devices cost quite a bit more than a camera. For example, laser scanners cost \$25,000 and up and total stations run \$8,000 and up. Both often require very expensive complementary software to efficiently handle the resulting data, and typically more training.

Even greater potential cost savings are available for those with multiple field teams. Providing field personnel with a camera to capture images they can send to a software operator is far less expensive than duplicating laser scanners or total stations across each field team.

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HOW DO I GET STARTED?

Providers of professional photogrammetry software, such as [PhotoModeler](#), have web sites with comprehensive information about photogrammetry in general and about their own product suite. Once you have a specific project in mind, they can usually give you a quick assessment based on a description of your project and what type of information you need for results or output.

Professional software providers will also have resources to help you to learn more about how to use the software for your projects, such as an online knowledge base, video tutorials, case studies and research papers, demo software downloads, and more.



CONCLUSION

Photogrammetry is a widely used, efficient and cost-effective method of creating measurements, drawings and 3D models of real-world objects and scenes. Using a digital camera and a piece of specialized software, you can increase the accuracy of your projects with minimal cost and very little time.

Photogrammetry has the potential to change the way you work because of its capabilities, accessibility, ease-of-use, accuracy, and low cost.



RESOURCES

TYPES OF PHOTOGRAMMETRY

See photogrammetry.com to read further descriptions of Close Range Photogrammetry and Aerial Photogrammetry, and to find further resources.

ASSOCIATIONS

- ▶ [ASPRS](#) - American Society for Photogrammetry and Remote Sensing
- ▶ [ISPRS](#) - International Society for Photogrammetry and Remote Sensing
- ▶ [CIPA](#) - Committee for Documentation of Cultural Heritage

BOOKS & JOURNALS

- ▶ The Manual of Photogrammetry, 4th Ed., American Society of Photogrammetry and Remote Sensing.
- ▶ Non-Topographic Photogrammetry, 2nd Ed., American Society of Photogrammetry and Remote Sensing.
- ▶ Introduction to Modern Photogrammetry, E. Mikhail, J. Bethel, J. McGlone, John Wiley & Sons.
- ▶ The Photogrammetric Record journal, Wiley.

FIND OUT HOW PHOTOGRAMMETRY CAN CHANGE THE WAY YOU WORK

- ▣ ASK A QUESTION OF A PHOTOGRAMMETRY EXPERT
- ▣ WATCH THE PHOTODELER INTRODUCTION VIDEO
- ▣ FOLLOW THE LEADING PHOTOGRAMMETRY PRODUCT
PHOTODELER ↴



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