How to Capture Images for 3D Reconstruction

Presented by

COMPUTER VISION DECODED

EveryPoint®

Let's Simplify 3D Reconstruction

IT'S EASY, WE PROMISE!

Photogrammetry doesn't have to be hard. The team at **Computer Vision Decoded** and **EveryPoint** created this document to guide you through the basics of capturing images for 3D reconstruction. These techniques will work with any photogrammetry-based software package to create scenes and objects in 3D.

Here is what you will learn:

- **Camera Motions:** learn how to move around the scene while you take photos or video
- **Loop Closure:** learn how to get accurate results
- **Image Overlap**: we explain how often you need to snap a photo for 3D reconstruction to work successfully

Once you master these basics, you will be on your way to creating jaw-dropping 3D models like this one:

Camera Motions

IF YOU DO THESE WRONG, IT'S GAME OVER

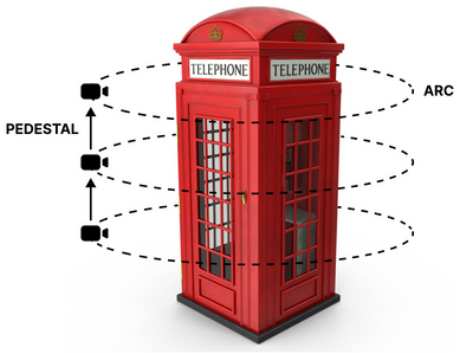
While capturing a scene with video or photographs, you will need to move through space using a set of motions that add to the overall 3D reconstruction. We group motions into three categories: **Good**, **Transition**, and **Bad** motions.

The majority of your capture approach needs to consist of good motions. Transition motions are used to connect two good motions. Bad motions should be avoided entirely while capturing as they run the risk of causing a failed 3D reconstruction.

Let's dive in to the camera motions!

DO THIS!

ARC + PEDESTAL



NOT THIS!

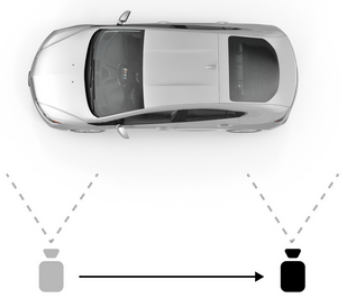
ARC + TILT

Good Camera Motions

THIS IS THE WAY

These camera motions capture a scene or object in a manner that adds to the overall results of the 3D reconstruction. A majority of camera movement during a capture session should consist of good motions.

TRUCK



This motion is characterized by moving across a scene in a straight trajectory while the camera is pointed perpendicular to your motion.

PEDESTAL

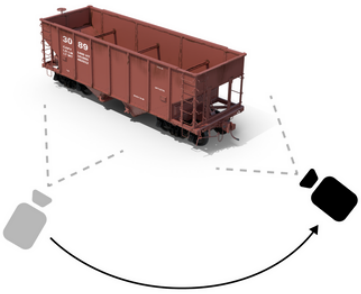
This motion is characterized by lifting or lowering a camera vertically while keeping the camera pointed in a fixed direction and angle.

This is typically used to scan lower or higher sections of an object or scene.

Good Camera Motions

THIS IS THE WAY

ARC

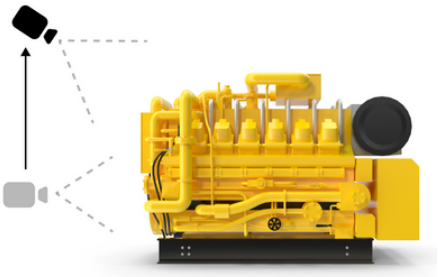


This motion is characterized by moving around an object in a curving trajectory while keeping the camera pointed at a fixed point in space.

BOOM

This motion is characterized by lifting or lowering a camera vertically while keeping the camera pointed on a fixed point or object.

This is typically used to get a different vertical angle on an object or scene.

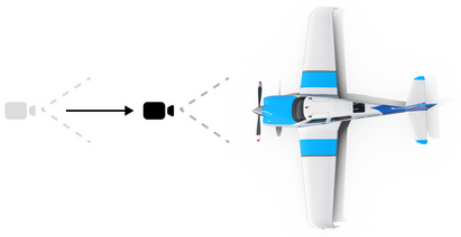


Transition Camera Motions

USE THESE TO CONNECT THE GOOD MOTIONS

The following camera motions capture a scene or object in a manner that does not add to the overall results of the 3D reconstruction. These motions are used to connect two good motions in order to gain new perspectives and angles on a scene.

PUSH IN



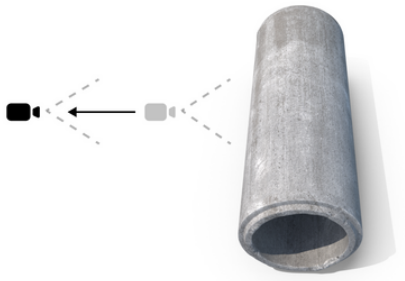
This motion is characterized by moving closer to a scene or object with the camera pointed parallel to the direction of movement.

Use this to get closer in for details.

PULL OUT

This motion is characterized by moving further away from a scene or object with the camera pointed parallel to the direction of movement.

Use this to get wider, establishing shots of the scene or object.

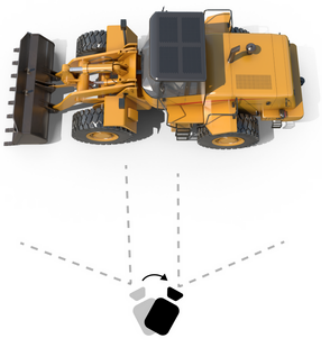


Bad Camera Motions

A SHORTCUT TO DISAPPOINTING RESULTS

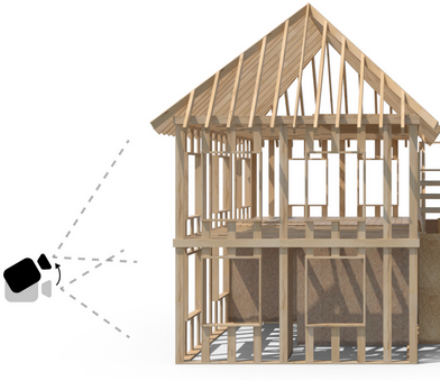
These camera motions capture a scene or an object in a manner that negatively impacts the results of the 3D reconstruction. Avoid these motions at all costs! You've been warned.

PAN



This motion is characterized by swiveling the camera horizontally from a fixed position.

TILT



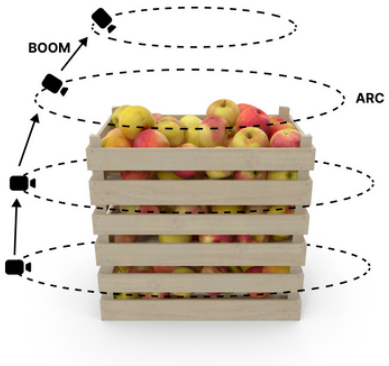
This motion is characterized by swiveling the camera vertically from a fixed position.

Connecting Motions

MOST CAPTURES REQUIRE A COMBO OF MOTIONS

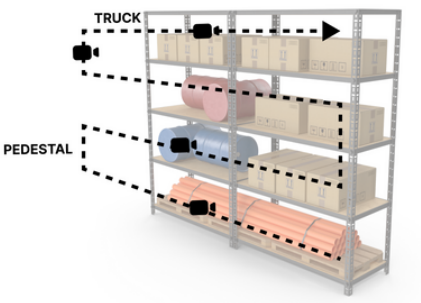
In the following section, we show you how to connect motions to capture objects and scene primitives. These are just a few examples. Get creative with your motions when capturing images!

ARC + BOOM



This is a great strategy for capturing a single small object. Move in a circle and capture an image every few degrees in an arc. Boom up in small increments. You can also use a turntable to move the object, and boom the camera between rotations.

TRUCK + PEDESTAL

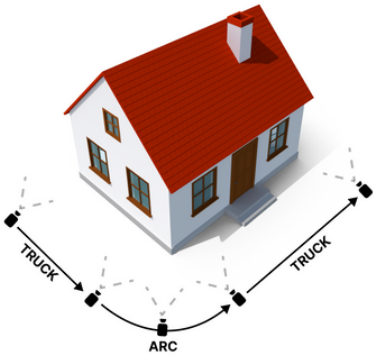


This is the perfect combo for capturing large building facades. The key to success is hitting 70% overlap image-to-image. It is better to capture more often than not enough! For tall structures, use a drone or monopole.

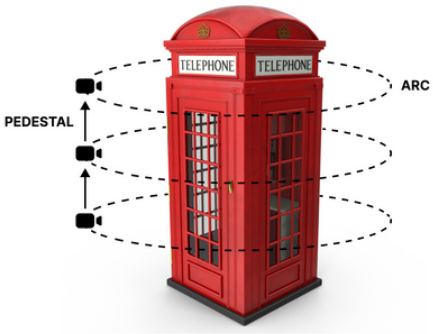
Connecting Motions

TRUCK + ARC

It doesn't get much easier than this. The key is to pick a point on the building to arc around to ensure you do not introduce a panning motion.



ARC + PEDESTAL



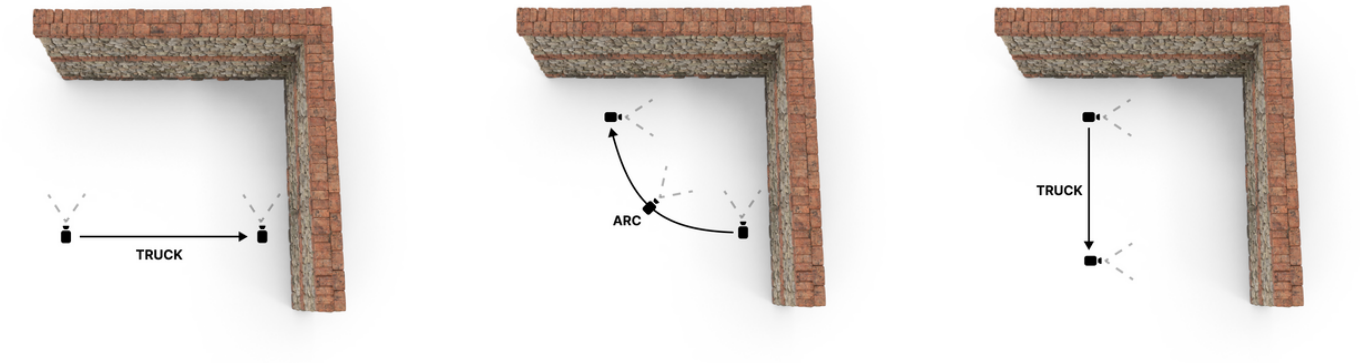
For objects that you can completely walk around, we recommend 2+ loops around the object with different elevations. Keeping the camera perpendicular will result in greater detail and better textures.

ARC + TILT

Multiple loops around an object while tilting the camera between each loop will result in skewed textures. Oscillating the camera up and down while walking around an object also runs the risk of a failed 3D reconstruction.

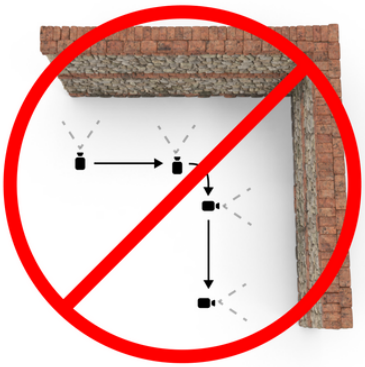
Connecting Motions

TRUCK + ARC



Capturing corners are tricky. We suggest a 3-movement approach. Truck across one wall until you can walk no further. Move in a wide arc to the perpendicular wall while keeping the corner as your camera's main focus. Walk out of the corner in your new orientation and continue to truck along the second wall.

TRUCK + PAN



Never put yourself in a corner! This is a common mistake when scanning the interior of a room or a concave area of a building exterior. The panning motion in the corner will ruin your results!

Loop Closure

START CAPTURING LIKE A PRO

Using the information you learned above about camera motion, the last major key to successful camera movement is implementing loop closures into your capture strategy.

What is a loop closure? This is when you capture images in a loop to correct for errors in you camera positions.

As you capture images around a scene, the 3D reconstruction software calculates the pose (position and orientation) of each image in relation to the others. It then uses these poses to triangulate object and scene surfaces. The software is not perfect and error can accumulate across your image set.

Moving in loops around a scene and coming back to known, previous positions helps the software fix errors in the results.

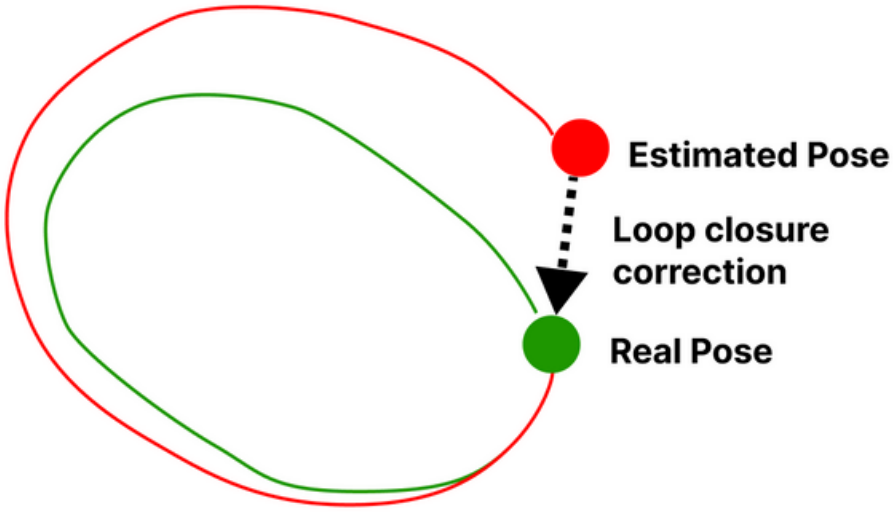


Image Overlap

IT'S BETTER TO CAPTURE MORE THAN LESS!

Now that you know how to move around a scene and capture images, you need to know how often you need to push the shutter button on that camera. If you do not have enough photos of a scene or object, the 3D reconstruction engine won't know how to make sense of it.

A rule of thumb: aim for 2/3^{rds} scene overlap between images. Here is what it looks like in your camera:

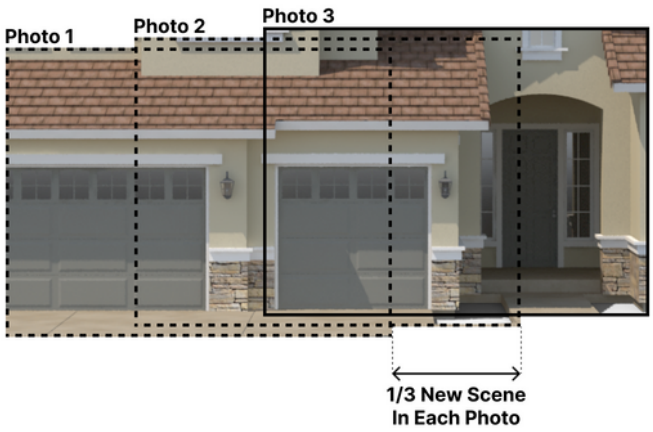
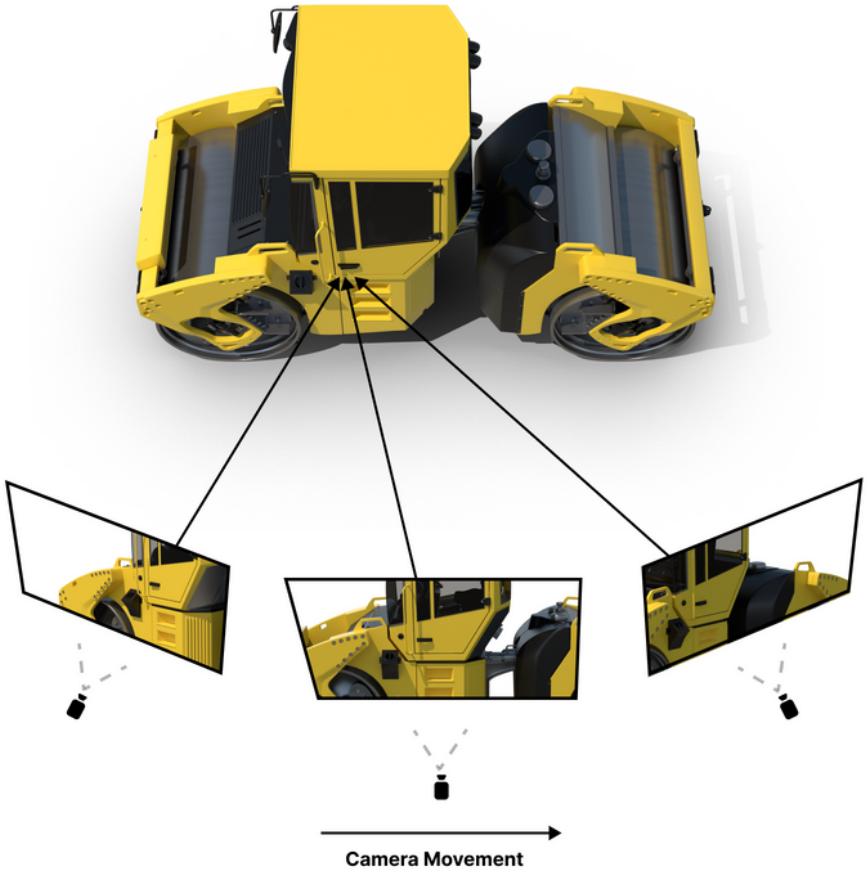


Image Overlap

IT'S BETTER TO CAPTURE MORE THAN LESS!

When it comes to arcing around an object, you want to see features in 3 or more images before you rotate too far.



If you want to ace rotations, aim for 100+ images in a full arc around an object.

Image Overlap

IT'S BETTER TO CAPTURE MORE THAN LESS!

Deciding when to snap each photo can be a daunting task for a novice user. Thankfully **EveryPoint** enabled apps to intelligently extract images from video to ensure perfect overlap every time.

Simply use one of the several apps listed below, start a capture session, and follow the basic camera movements described above. EveryPoint's image processing engine will take care of the rest.

Scanamaze

Recon-3D

Point Precise

Show Off Your New Skills

"PRACTICE"
-ALLEN IVERSON

You are one step away from becoming a 3D reconstruction master. All it takes is practice! Go out and practice what you learned.

Try one of the three listed apps and share your best scans on LinkedIn or Twitter and use **#EveryPoint** in the post. We just might showcase your scan on our social media channels.

Here are just a few scans from people using EveryPoint-enabled apps for inspiration: