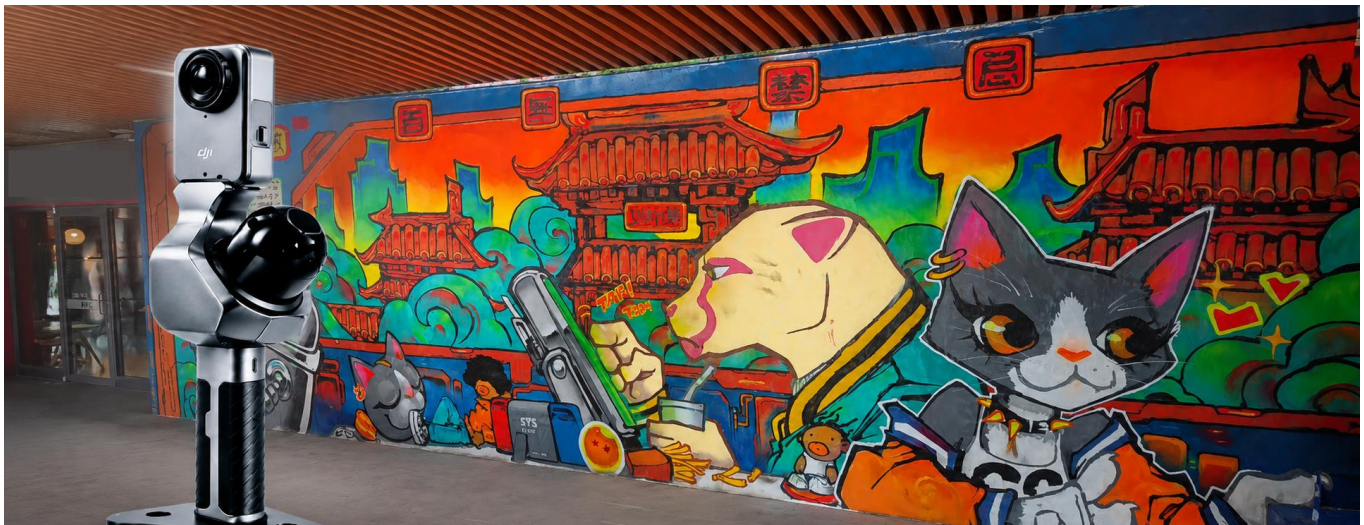


3DGS FIELD SURVEY PROCEDURE

Field Operations Guide

Field capture practices, workflows, and technical guidance for Pocket 3D



Version 1.3

Source and Editorial Note:

The technical guidance presented in this document is based on field procedures and recommendations developed and provided by the development, testing, and engineering teams at Shenzhen Feima Robotics Co., Ltd. SlamScanner.com has reorganized, edited, clarified, and supplemented the source material to provide a structured field operations guide.

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Measurement convention: metric values reproduce the source procedure. Approximate U.S. customary equivalents are added in parentheses for field convenience; they are intentionally rounded rather than survey-grade conversions.

1 Introduction:

Successful 3D Gaussian Splatting (3DGS) begins in the field. The goal is not simply to collect the largest possible dataset. The goal is to collect complete, stable, visually useful data that supports reliable SLAM reconstruction and an efficient downstream 3DGS workflow.

Complete coverage • good imagery • stable SLAM • efficient data collection

The operator should think about the final deliverable while planning and performing the survey. Missing viewpoints, blurred imagery, weak route geometry, poor loop closure, or unnecessary repeated coverage can all affect the result. More imagery can improve a difficult scene, but redundant imagery also increases storage and 3DGS training workload.

1.1 Core Capture Philosophy:

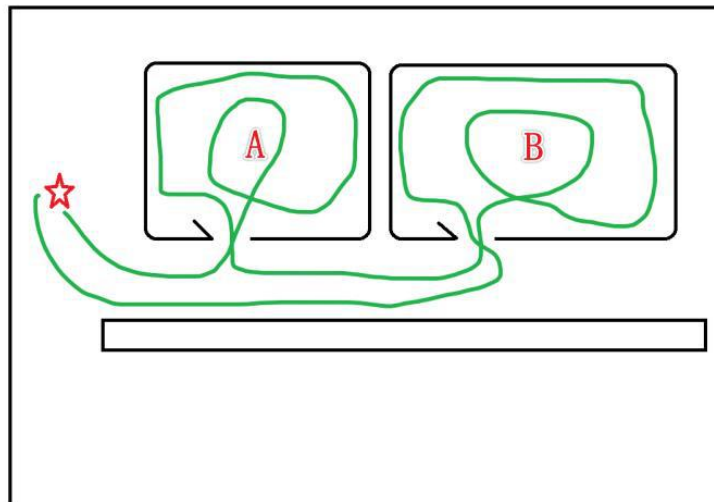
- Establish a stable, complete overall scene before concentrating on close-range detail.
- Move slowly and smoothly enough to preserve useful imagery and stable pose estimation.
- Use overlap and loop closure deliberately to control accumulated SLAM error.
- Add close-range and multi-height imagery where the final deliverable requires it.
- Collect additional data with a purpose: coverage, viewpoint diversity, detail, occlusion recovery, or loop support.

2 Planning the Capture:

For large or complex environments, plan the route before collection. Divide close-range projects into manageable sub-blocks, define how those blocks connect, and identify areas that will require additional detail capture.

2.1 Divide Close-Range Work into Logical Blocks:

For close-range acquisition, Feima recommends sub-blocks no larger than approximately 20 m × 20 m (65 ft × 65 ft). Each block should first receive overall coverage, followed by selective close-range capture of important targets. Maintain usable visibility and overlap within each block and between adjacent blocks.



Why overall coverage comes first: If close-range capture is not required for signage with small text, fine details, etc., blocking may not be necessary. When close-range work is required, first establish the surrounding environment. By performing close capture operations only, you can create heavily occluded LiDAR data sets; a broad overall coverage provides the spatial reference needed to reduce SLAM and 3DGS mapping errors and drift.

2.2 Plan Spacing and Overlap:

Except in extremely narrow spaces, use an S-shaped or serpentine route rather than a single straight traverse. Feima recommends spacing adjacent passes no more than 5 m (about 16 ft) apart. Spacing greater than 5 m (about 16 ft) may result in poor visual quality in the ground area between adjacent passes; closer spacing generally produces clearer ground texture.

2.3 Plan Loop Closure:

Use relatively small loops and shared overlap rather than one very large loop. The source procedure recommends that a single closed loop not exceed approximately 200 m (about 650 ft).

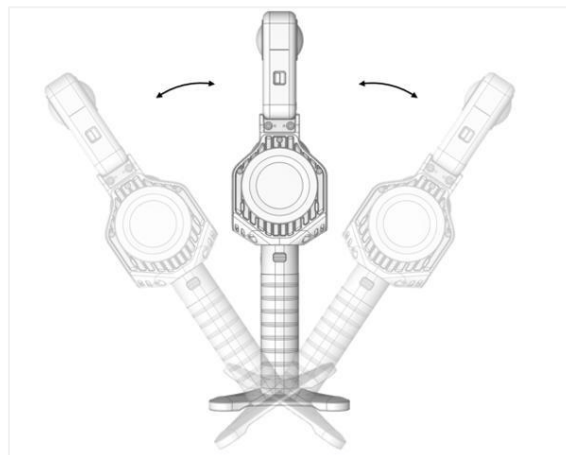
As loop size increases, accumulated SLAM error can make loop detection and matching more difficult. If loop closure fails, the resulting point cloud may exhibit misalignment or layered surfaces.

Closed-loop distance	Approx. U.S. equivalent	Guidance
≤100 m	≤330 ft	Preferred where practical.
100-200 m	330-650 ft	Acceptable; 200 m is the recommended upper limit.
200-400 m	650-1,300 ft	Add intermediate loop closure points.
>400 m	>1,300 ft	Divide the capture into sections.

3 Starting a Capture:

3.1 Startup Initialization and Device Synchronization Alignment:

With the scanner turned on and in standby mode (solid green light) and setting on a solid surface with no moving objects or obstructions in front of it, start a capture session by launching the external camera recording session. Follow this with a double-click on the scanner power button to start the scanner initialization (fast flashing green light). Initialization will take approximately 20 seconds, and the scanner will enter data collection mode (slow flashing green light). Pick up the device and perform a controlled left-right tilting motion. Feima specifies approximately 45° to each side, with one back-and-forth movement taking about 2-3 seconds. The purpose is to provide varied pose observations for time alignment between the panoramic camera and IMU.



Parameter	Recommended value	Purpose
Tilt	Approximately 45° left and right	Provide diverse pose observations for time alignment.
Motion	Smooth and uniform	Complete one back-and-forth movement in approximately 2-3 seconds.

3.2 Sweep the Starting Area with a Slow 360° Rotation:

After the left-right alignment movement, sweep the starting area through a full 360° horizontal rotation. This fills the rear blind area created by the device and operator and provides complete starting-area coverage. Feima recommends a slow, constant rotation of approximately 5 seconds for the full circle.

Practical interpretation: Do not interpret 'rotate the device 360°' as simply twisting a scanner or selfie pole around its own vertical axis while the scanner remains nearly in one place. The preferred motion is a slow body turn with the device held out in front, or a small walking circle, so the scanner itself travels through a wider circular path. This produces a more observable motion for the IMU while also sweeping the scene. If using a selfie pole, rotate your body or walk the small circle rather than merely spinning the pole in your hand.

Parameter	Recommended value	Field interpretation
Coverage	360°	Complete one full sweep of the starting area.
Speed	Slow and constant	Approximately 5 seconds for the full sweep.
Motion path	Broad circular movement	Move the scanner through space; avoid an almost pure rotation about the scanner's own axis.

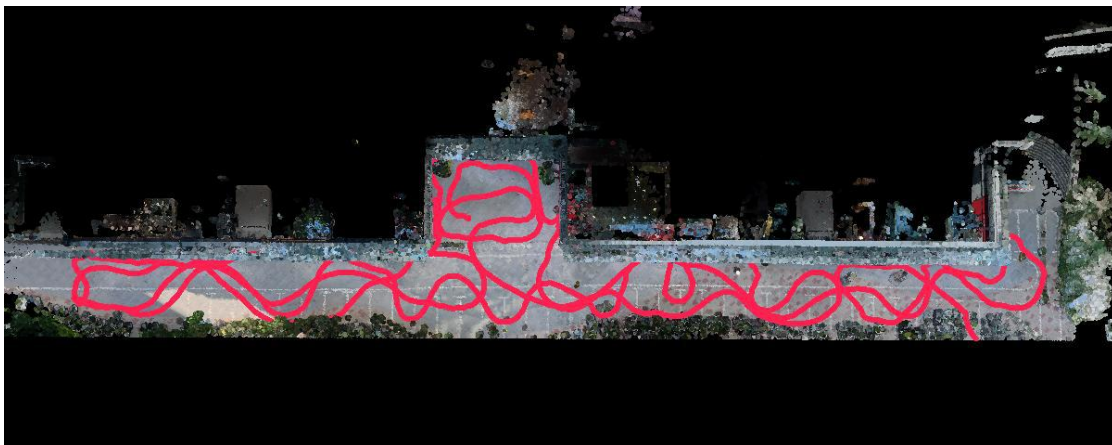
3.3 Why the 360° Starting Sweep Is Important:

The equipment itself and the operator can obstruct portions of the panoramic camera's view, creating a blind area behind the device. If the operator begins moving immediately after initialization, the starting area may not receive complete visual coverage.

The initial 360° sweep is intended to capture this otherwise obstructed area and establish complete coverage around the starting position before beginning the survey route.

4 Capturing the Overall Scene:

For large areas you should use a good overall pass to establish the spatial framework of the project. Move through each planned block using an S-shaped or serpentine route, maintaining useful overlap and avoiding unnecessarily wide spacing between adjacent passes.



4.1 Standard Overall Workflow:

Step	Action	Objective
1	Divide close-range work into manageable blocks.	Control route geometry and detail work.
2	Capture each block as a complete overall scene.	Establish the environmental point cloud and image coverage.
3	Return selectively to important targets.	Add high-quality detail where needed.
4	Close loops and maintain overlap between blocks.	Limit accumulated SLAM error and strengthen continuity.

4.2 Movement Speed and Stability:

Capture type	Metric	Approx. U.S.	Guidance
Overall scene	0.5-1 m/s	1.5-3 ft/s	Walk smoothly at a constant speed.
Fine/detail	≤0.3 m/s	≤1 ft/s	Slow movement to reduce image motion blur.
Lateral supplementary	0.3-0.5 m/s*	1-1.5 ft/s*	Move conservatively while maintaining stable orientation.

4.2.1 Walking Speed Reference:

Speed	Approx. U.S.	Practical description	What it should feel like
0.3 m/s	1 ft/s	Very slow walk	Deliberate, careful steps; appropriate for close detail capture.
0.5 m/s	1.5 ft/s	Slow walk	Comfortable but intentionally slower than normal walking.
0.5-1 m/s	1.5-3 ft/s	Slow to moderate walk	Controlled walking pace; do not hurry.
1 m/s	3 ft/s	Moderate walk	A comfortable walking pace, but still slower than a typical hurried walk.

Use the descriptions as practical field guidance rather than precise speed targets. The objective is smooth, stable movement with clear imagery - not maintaining an exact walking speed.

**The source PDF contains conflicting values for lateral supplementary capture: its dedicated ground section lists 0.5-1 m/s, while its general speed table lists 0.3-0.5 m/s. This draft uses the more conservative 0.3-0.5 m/s pending confirmation.*

Slow and steady is preferable to fast and comprehensive. Excessive speed can blur imagery and reduce visible detail in the trained model.

4.3 Smooth Transitions:

Avoid abrupt rotations and large changes in device attitude. This is especially important in low light, during close-range capture, at sharp turns, and when transitioning between environments such as outdoors and indoors. Change orientation smoothly so the system can maintain useful visual and geometric continuity.

Avoid running, jumping, rapid shaking, or other movements that produce abrupt changes in the device's position or orientation.

When approaching stairs or other changes in elevation, slow down before the transition and maintain smooth, controlled movement to minimize abrupt vertical motion and changes in device attitude.

In low-light conditions, movement should be particularly slow and stable because camera imagery is more susceptible to motion blur, which can reduce the quality of the imagery used for 3DGS training.

5 Capturing Detail:

Once the overall block has been established, return to targets that require greater visual clarity. Feima recommends a minimum target distance of approximately 0.3 m (about 1 ft) and a speed no greater than 0.3 m/s (about 1 ft/s). The operator should remain far enough away to avoid camera and LiDAR occlusion while still collecting the detail required by the deliverable.

Note: This is a bit of an extreme recommendation when absolute fine detail, or small text rendering is required. In addition, as continued work is done to support higher resolution acquisition from the external cameras is completed, this requirement will be greatly relaxed. The current camera integrations are using video frames, but the devices are capable of much higher resolutions. Field operations should be thoughtful and optimized to not overburden the build process when unnecessary. General overall data collection can produce great, generalized detail without a heavy processing load.

5.1 High-Medium-Low Plus Grid Coverage:

For signage, exhibits, distinctive architecture, and other detail-rich targets, capture from high, center, and low viewpoints and supplement these with a grid-like set of viewpoints. The purpose is to ensure the target is seen from multiple useful directions rather than relying on one frontal image.

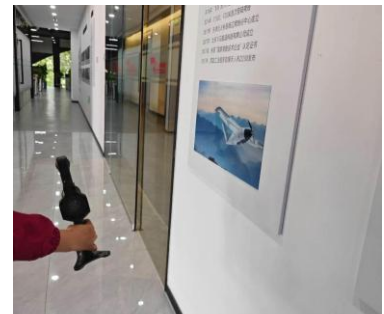
View	Method	Purpose
High	Camera slightly above the target; tilt down enough to include the target and surrounding context.	Capture upper surfaces and an elevated viewpoint.
Center	Camera approximately level with the target center.	Provide the clearest direct view.
Low	Camera slightly below the target; tilt upward while retaining surrounding context.	Capture lower surfaces and a low viewpoint.
Grid	Front plus upper-left, upper-right, lower-left, and lower-right viewpoints.	Reduce single-view blind spots.



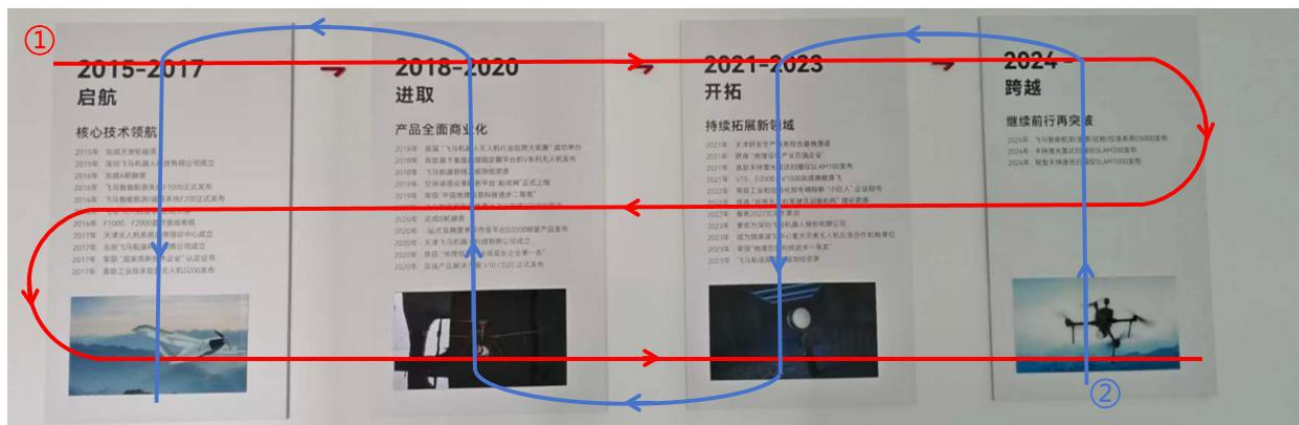
High Angle



Center Angle



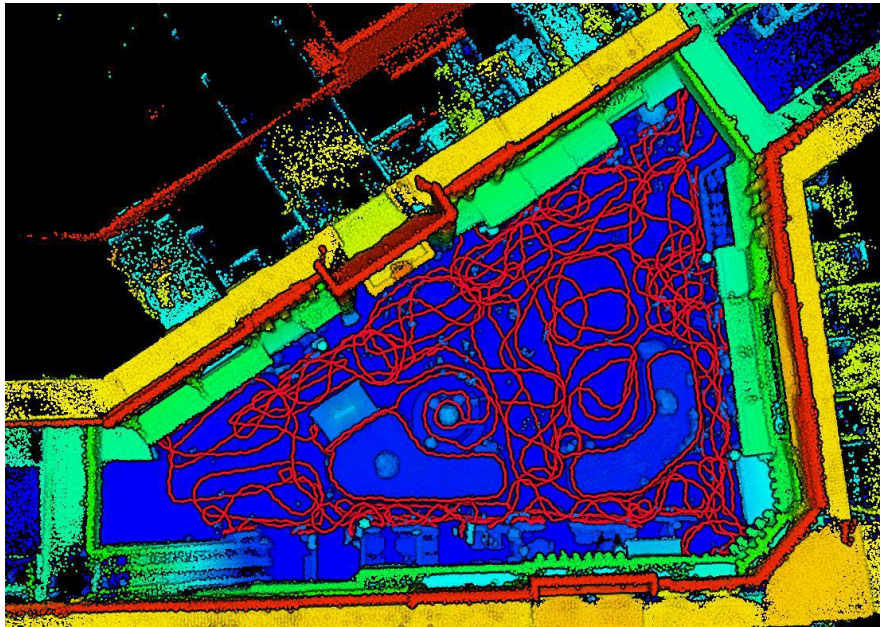
Low Angle



Move slowly during close-range capture. **IMPORTANT NOTE:** With a dual-lens panoramic camera, orient one lens toward the target while keeping the operator's body from blocking the opposite lens.

5.2 High-Density Multi-View Capture:

For scenes with substantial occlusion, or where visual quality is a priority, Feima recommends additional routes and varied scanner heights. This can improve viewpoint diversity and coverage, but it should be used intentionally because it also increases the imagery that must be processed downstream.



6 Managing Capture Size and Processing Workload:

3DGS projects have a downstream processing cost that can be much greater than point-cloud processing alone. A long capture can generate tens of gigabytes of imagery and a large number of panoramas. Point-cloud generation, panorama creation, and colorization may be completed in a few hours on a large project, while 3DGS training can continue for many additional hours. It is not at all unheard of to have 3DGS build times in excess of 24 hours. Given sufficient time the processes do finalize but it can be a challenge in a productive environment.

The objective is sufficient, purposeful coverage - not maximum capture.

6.1 Plan the Field Capture As a Processing Dataset:

Before starting a large capture, decide whether the final deliverable truly needs to be one continuous 3DGS scene. Natural boundaries such as rooms, floors, wings, courtyards, or distinct exterior areas can often become logical processing units, provided the project requirements allow it.

Various software ecosystems are emerging for editing, consuming, viewing, and sharing 3DGS content. Therefore, smaller, coordinated Splat deliverables may be a best practice approach.

6.2 Add Imagery Only When it has a Job to do:

- Establish complete overall coverage and stable SLAM first.
- Add a pass when it provides a needed viewpoint, fills an occlusion, supports loop closure, improves ground coverage, or captures required detail.
- Avoid repeated transit through already well-covered areas unless it serves a reconstruction purpose.
- Use high-density multi-route capture selectively; it can improve difficult scenes but can also multiply downstream image volume.
- At natural boundaries, consider ending the current capture and beginning a new logical dataset.

6.3 Field Decision Protocol:

Decision point	Question
Before capture	What is the deliverable, and which areas actually require 3DGS-quality coverage?
Planning	Can the project be divided into logical scenes or processing units?
During capture	Is this pass adding coverage, viewpoint diversity, detail, ground visibility, or loop support?
Detail work	Does this target justify slower, denser, multi-height imagery?
Natural boundary	Is there a technical reason to keep one continuous dataset, or would a new capture be more manageable downstream?

Production recommendation: record capture duration, source-data size, panorama count, 3DGS input size, GPU/hardware used, and training time. Real project data can then be used to develop practical dataset-size limits for your workflow.

7 Special Capture Situations:

7.1 Ground Walking-Path Coverage:

The rear-mounted panoramic camera can have its view of the ground along the operator's walking path blocked by the device itself. The operator generally cannot verify these missing views in real time. Instead, anticipate where the device and operator are likely to have occluded the ground and include a planned supplementary pass in areas where continuous ground appearance matters.

Without this supplementary coverage, the ground along the walking trajectory may be poorly represented in the trained 3DGS model.

For the supplementary pass, while keeping the device vertically oriented, you can rotate it from 45° to 90° sideways, so one camera lens has a more forward vs. sideways orientation and this allows the camera to view the ground and route from a different orientation (see the pano image below). Traveling generally parallel to the original path. A slight upward or downward tilt of approximately $\pm 15^\circ$ may further vary ground coverage.

Field planning note: Do not wait to 'see a gap' in back in the office. Visualize the strip of ground that may have been hidden beneath or immediately behind the scanner during the primary pass and plan the lateral pass to view that strip from the side. If using a lawn mower fashioned collection path, then your subsequent parallel passes will collect the ground where you had previously walked, so this extra going capture is only really necessary where a single pass has been made.



7.2 Corridors, Doorways, and Narrow Spaces:

In corridors and other narrow elongated spaces, Feima recommends turning the device from 45-90° sideways so the camera/lens orientation looks along the direction of travel. This places more useful three-dimensional features within the sensor field of view and can reduce mapping difficulty. Where the corridor width permits, continue to use a gentle serpentine path rather than simply walking a straight line down the center. This provides additional lateral variation and views of the corridor from different positions while maintaining the sideways camera orientation. You do need to also think about the LiDAR field of view so a pass in each direction or swinging the device gently from side to side may also be necessary.

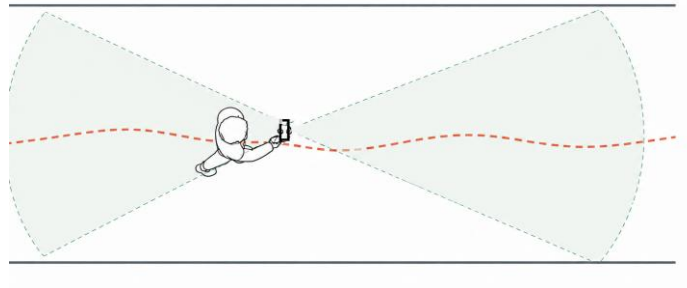


Figure 10. Feima corridor-orientation schematic.

7.3 Doorways and Room Transitions:

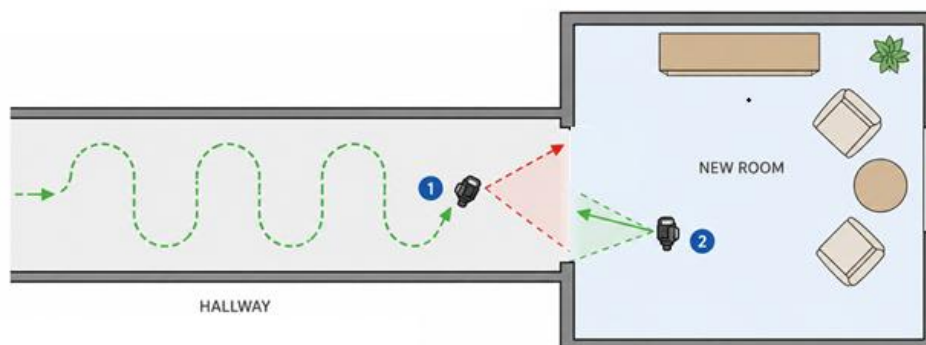
Doorways can create a challenging transition because the scanner passes through a narrow opening between two spaces that may contain substantially different visual and geometric information. The objective is to maintain useful visual overlap between the space being exited and the space being entered.

As you approach a doorway, slow down or pause briefly before passing through. Rotate the device approximately 90° so that one of the external panoramic camera lenses has a clear view through the doorway and into the space being entered. Move slowly through the doorway while maintaining this view.

After entering the new space, continue moving smoothly and, where practical, turn the device or your body so that the panoramic camera obtains a clear view back through the doorway into the space just exited. Avoid abrupt changes in device orientation during the transition.

This technique is especially important when moving between spaces with significantly different visual conditions, such as entering a darker room from a brightly illuminated area or transitioning between exterior and interior environments.

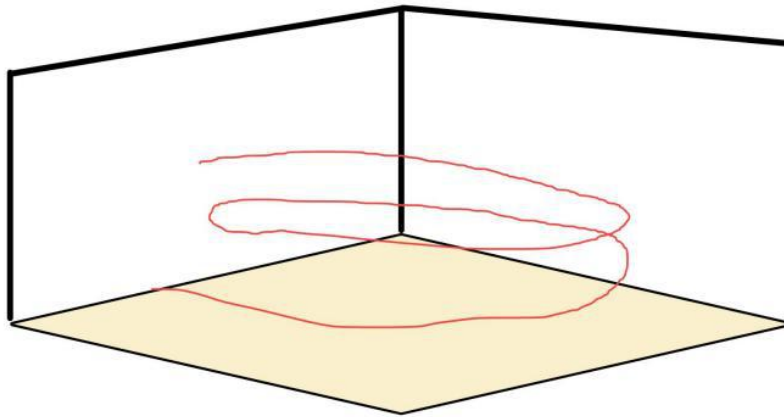
Field principle: Treat a doorway as an overlap zone. The camera should see into the new space before the scanner enters it and should obtain a useful view back into the previous space after passing through.



7.4 Sculptures and Freestanding Objects:

For three-dimensional objects, combine a surround-view path with multiple capture heights so the lower, middle, upper, and top surfaces are observed.

Pass	Position	Purpose
Lower surround	Near the lower portion of the object; complete a 360° circuit.	Capture lower geometry and side coverage.
Middle surround	Approximately one-third of the object height.	Capture central details.
Upper surround	Approximately two-thirds of the object height.	Capture upper structure.
Top supplementary	Approximately 45° above where practical.	Fill top-surface coverage.



For reflective materials such as metal or polished stone, vary the viewing angle to reduce harsh highlights. During surround capture, keep the camera directed toward the subject.

8 Common Problems and How to Avoid Them:

Problem	Likely field cause	Corrective practice
Blurred or unclear detail	Walking, turning, or tilting too quickly	Reduce speed and keep motion smooth.
Texture discontinuity	Abrupt turns or abrupt environmental transition	Change device orientation gradually through the transition.
SLAM drift / layered point cloud	Weak geometry, long route, or poor loop closure	Use blocks, overlap, and shorter closed loops.
Missing ground appearance	Camera/device occlusion along walking path	Plan a lateral supplementary pass; visualize potential gaps while in the field
Poor fine detail	Insufficient proximity or viewpoint diversity	Use slow, close, high-center-low and grid coverage.
Excessive 3DGS processing time	Large or redundant imagery set	Plan logical datasets and use dense capture selectively.
Reflections / blown highlights	Unfavorable angle to reflective surface	Change viewpoint and avoid direct highlights.

8.1 Stable Movement and Image Quality:

Stable movement is important not only for SLAM positioning, but also for the quality of the imagery used to build the 3DGS model. The panoramic cameras continuously collect images while the operator is moving. Excessive walking speed, abrupt turns, shaking, or sudden changes in device attitude can introduce motion blur and reduce the amount of clear visual detail available for processing.

This effect can become more pronounced during close-range capture and in low-light conditions, where image quality is particularly sensitive to movement. Blurred or inconsistent imagery may still allow the project to process, but fine details and textures in the resulting 3DGS model can appear soft, smeared, or poorly defined.

The operator should therefore think of smooth movement as part of the image-acquisition process. Walk at a controlled pace, make turns progressively, and avoid sudden changes in scanner position or orientation.

***Field principle: Stable capture produces better training imagery.** Smooth, deliberate movement helps preserve image sharpness and visual continuity, giving the 3DGS process better source imagery from which to reconstruct the scene.*

9 Field Best-Practice Summary

The preceding sections address individual capture techniques, special field conditions, and common problems. Taken together, they establish a practical set of best practices for planning and executing a 3DGS field survey. The following sequence summarizes those practices as a typical field workflow.

1. **Plan the capture.** Define the deliverable, identify areas that require 3DGS-quality imagery, divide close-range work into logical blocks, and plan routes, overlap, and loop closures.
2. **Initialize deliberately.** Complete the required alignment movement and starting 360° sweep before beginning the survey route.
3. **Establish the overall scene first.** Use smooth S-shaped or serpentine routes to build broad, overlapping coverage before concentrating on close-range detail.
4. **Maintain stable, controlled movement.** Walk at an appropriate pace, make turns progressively, and avoid running, jumping, abrupt shaking, or sudden changes in device attitude. Slow down further in low light, on stairs, and during difficult transitions.
5. **Maintain useful overlap and route geometry.** Keep adjacent passes reasonably close, use smaller closed loops, and avoid long unconstrained routes that can increase accumulated SLAM error.
6. **Add detail intentionally.** Return to important targets for slower, closer, multi-view capture only where the final deliverable requires additional visual detail.
7. **Adapt to special conditions.** Use the appropriate technique for doorways, corridors, ground walking-path coverage, reflective surfaces, freestanding objects, and other situations that require additional viewpoints or changes in scanner orientation.
8. **Control dataset growth.** Add imagery when it serves a purpose; coverage, viewpoint diversity, detail, ground visibility, or loop support. At natural project boundaries, consider whether a new capture would create a more manageable downstream 3DGS dataset.
9. **Verify before leaving the site.** Review the capture mentally and confirm that critical areas, transitions, likely ground-occlusion zones, loop closures, and required detail targets have been addressed.

Best-practice principle: Collect complete, stable, purposeful data. More capture is useful only when it adds information that improves coverage, reconstruction, or the final deliverable.

10 Field Quick Reference

Task	Method	Metric	Approx. U.S.	Purpose
Alignment motion	Tilt left/right	45°; 2-3 sec	Same	Support camera/IMU time alignment.
Starting sweep	Broad 360° body turn / small circle	~5 sec	Same	Cover starting area and rear blind zone.
Close-range block	Overall first, then detail	≤20 m × 20 m	≤65 ft × 65 ft	Keep close-range work spatially controlled.
Overall route	S-shaped / serpentine	0.5-1 m/s	1.5-3 ft/s	Build broad scene coverage.
Pass spacing	Adjacent S-route legs	≤5 m	≤16 ft	Improve ground/visual coverage.
Detail	Slow multi-view capture	≤0.3 m/s; ≥0.3 m	≤1 ft/s; ≥1 ft	Preserve fine detail and viewpoint diversity.
Ground supplement	90° lateral orientation	0.3-0.5 m/s*	1-1.5 ft/s*	View ground hidden during primary pass.
Corridor	Side orientation, lens along corridor	Slow/stable	Slow/stable	Improve useful scene geometry.
Loop control	Close within each block	≤200 m	≤650 ft	Limit accumulated error.
Dataset control	Use logical project boundaries	Project dependent	Project dependent	Keep 3DGS processing manageable.

**Conservative value used pending clarification of the conflicting lateral-pass speeds in the source PDF.*

10.1 Operator reminders

- Overall first; detail second.
- Move the scanner through space during the 360° starting sweep - do not simply spin a pole in place.
- Slow, smooth motion protects imagery and pose quality.
- Use S-shaped coverage and keep adjacent passes reasonably close.
- Plan for likely ground occlusion rather than finding out later.
- Close loops deliberately and avoid very long unconstrained routes.
- Use dense multi-view capture where it adds value, not everywhere.
- Think about the downstream 3DGS dataset while collecting in the field.