Lixel Scanning Guideline

1. General Scanning Precautions

•   Avoid rapid body rotations or sudden stops, as these may cause the scanner to experience violent acceleration and shaking. This will affect the accuracy and effectiveness of point cloud mapping to a certain extent.

•   Hold the scanner in an upright position during collection and avoid leaning the device forward, backward, or sideways. (Especially when carrying an RTK module, this will affect the reception of RTK signals.)

•   During scanning, avoid placing the scanner within 1 meter of surrounding objects, and avoid blocking 50% of the LiDAR field of view at any time.

•   Outdoor scenes such as roads and streets have many dynamic objects, such as pedestrians and vehicular traffic. When scanning, avoid aiming the LiDAR at dynamic objects. If conditions permit, and there are too many moving objects on one side, aim the LiDAR to the other side to avoid including them in the Field of View.

•   When scanning indoor scenes involving multiple rooms or floors, please open all the doors in advance. When passing through a door, scan slowly and stand sideways under the door frame for a period of time to ensure that features on both sides of the door can be scanned and successfully joined together. If the door is not opened in advance, turn around and back up to the door, with your body between the lidar scanner and the closed door. You do not want the closed door to be included in the lidar Field of View. With your back against the door, open it and stand sideways under the door frame for a few seconds. Finally, enter the room slowly and proceed to scan normally.

## 2. Scanning Starting Phase (Scanner Initialization)

•   It is recommended to use the control point base (the latest steel base) rather than the tripod.

•   To avoid shaking, place the scanner on a flat surface for static start-up. You can hold the device (at the battery and the base) firmly with your hands to ensure a stable start-up process. While the device is initializing, clear the surrounding space so that no obstructions (including people) are blocking the Field of View. After initialization, wait for at least 15 seconds after the point cloud appears on the mobile phone interface. [If you use the latest version 1.1.1 or above of the APP, please initialize successfully according to the APP prompt.] Then, slowly pick it up and start scanning.

•   During initialization, the laser radar should be aimed at areas with at least some features (such as trees and buildings). Avoid initializing in empty environments such as open plains, reflective environments near glass curtains, or environments full of

dynamic objects to ensure that the lidar Field of View contains enough features.

3. Scanning Route Planning Suggestion: whole structure first, details afterwards

Simple, small areas with rich features can be scanned without a predetermined route. However, for larger, more complex scenes with unclear features, extra attention needs to be paid to scanning route planning. Reasonable route planning can achieve better results.

The principle of route planning is to first scan the general structure of the entire survey area (see the green triangle in the recommended route figure), and then scan in small loops until you have covered the whole survey area. See the example below:
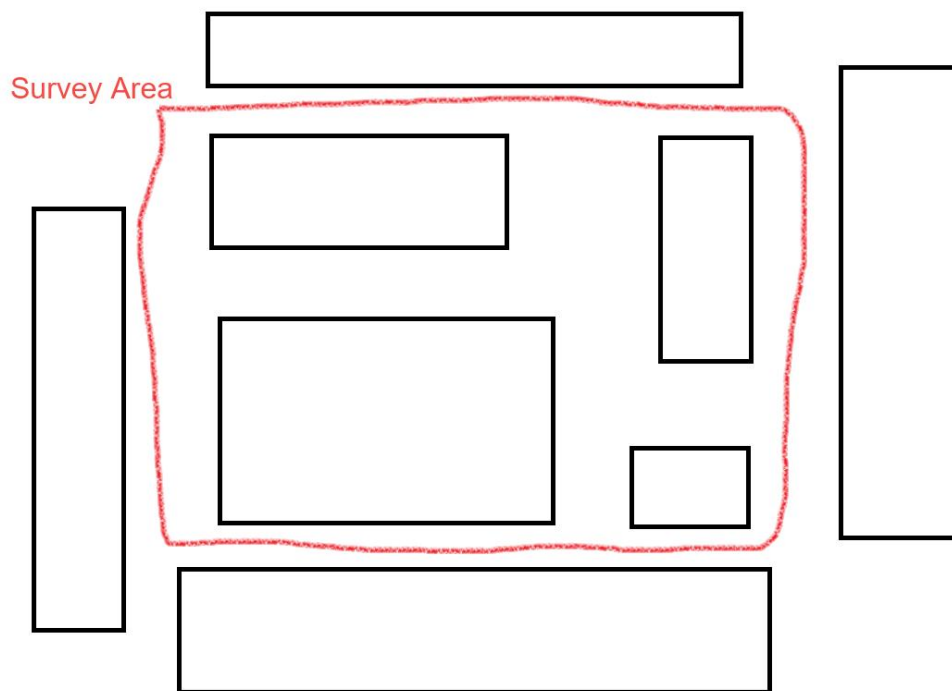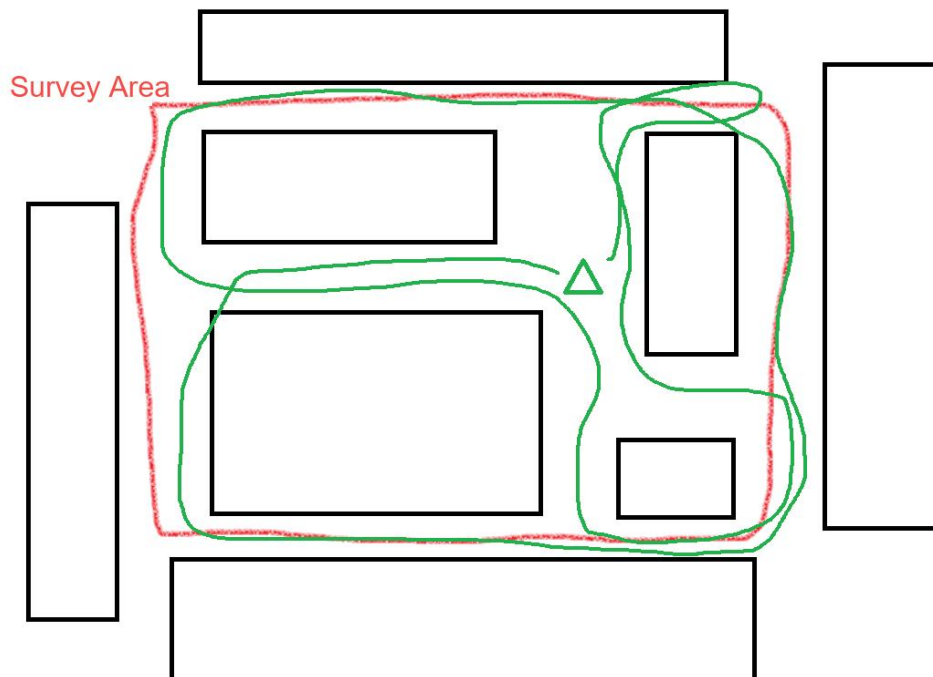

Route not recommended:

Survey Area
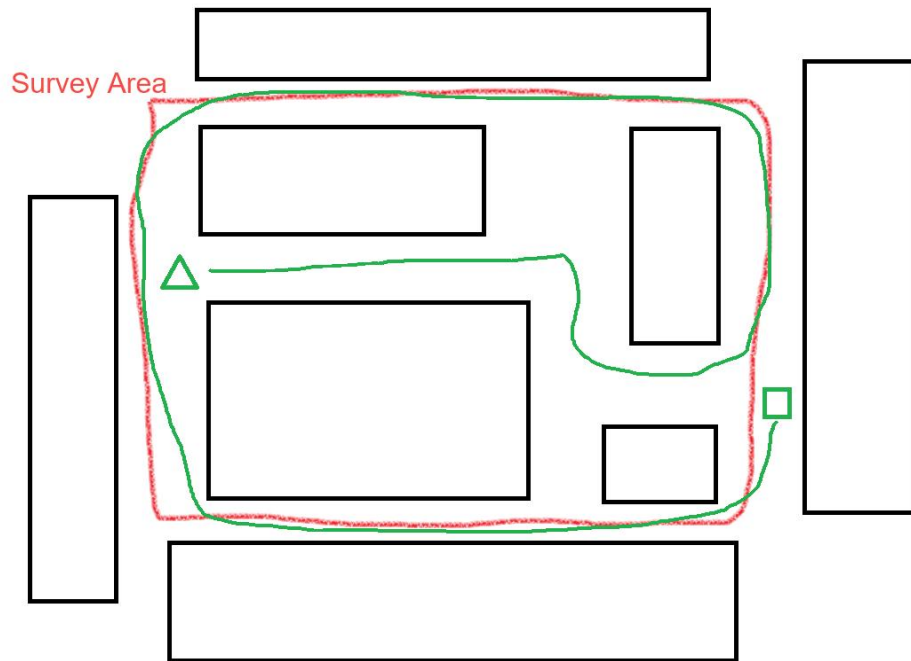
This route is suitable for small areas. However, in a large area, cumulative errors of the LiDAR IMU may cause point cloud stratification and deformation to occur.

Recommended route:

Survey Area

Try to start initialization at a location where the general structure of the whole survey area can be captured easily (such as the green triangle on the figure above). After initialization, scan the survey area one section at a time with small loops (as

indicated on the graph above), until you have covered the whole project area. In this way, cumulative errors can be limited to the lowest possible level.

4. Adding Control Points

• When the scanner is put down for marking the ground control point, avoid vibration caused by sudden collisions with the ground. When picking up the scanner after marking the control point, pick it up slowly and steadily, as violent movements will affect accuracy.

• With your device on the ground, add the control point using the Lixel Go app. After seeing "control point added successfully," pick up the device and circle around the control point 1-2 times or stay for a period of time to obtain a more complete point cloud around the control point.

• After recording a control point, if you want to end the project recording, please wait for more than 15 seconds before ending the project recording.

• For Lixel L2 and L2 Pro, to ensure post-processing accuracy, control point intervals need to be smaller than 100 meters and evenly distributed within the scanning measurement area. For K1 and L1, control point intervals should be smaller than 50 meters. Note: The control points cannot be on a straight line.

• Generally, when scanning, the device is located in front of our body. However, when scanning small indoor spaces such as corridors, we need to point the device sideways (to the left or right side), so that at any moment, the device Field of View contains both scanned areas and unknown areas. This will reduce inaccuracy when joining point cloud data points.

5. Collecting with RTK

• To receive RTK data, make sure that the RTK antenna is not blocked by buildings or objects. Ensure that the tilt angle of the RTK antenna does not exceed 20° from the vertical axis.

• Minimum requirement to perform absolute coordinate conversion (with compromized accuracy): On the Lixel Go app, while the RTK status is "Fixed", make sure that the device moves for more than 10 meters, with more than 10 available satellites. For better accuracy, try to keep the RTK status as "Fixed" throughout the scanning process.

• If you wish to perform Accuracy Verification, then the scanning route must be over 100 meters and should not be a straight line, with the RTK status being "Fixed" throughout.

- For Lixel L2 and L2 Pro, to ensure the post-processing accuracy of the point cloud, the RTK track must be continuous. When there are periods of poor satellite signal (RTK status is not "Fixed"), each "unfixed" section must be shorter than 100 meters (for K1, each "unfixed" section must be shorter than 50 meters).

6. Collecting with PPK

- **Minimum Requirement** [Enables absolute coordinate transformation with potential accuracy loss]: To ensure post-processed point cloud coordinates can be transformed, pay attention to the scan area coverage during scanning. Ensure there is a sufficiently large open area within the region. The required scan area must exceed 10 meters, and the number of valid data points after PPK processing must be >20. [Valid Data: Valid points displayed in LixelStudio >20]

- **Minimum Requirement** [Enables absolute coordinate transformation with potential accuracy loss]: The straight-line distance between the base station and the rover must be <5 km. For high-precision results, minimize the straight-line distance between the base station and the rover as much as possible.

- **Note the impact of ionospheric activity**: Conduct data acquisition during non-active periods whenever possible.

- **Ensure that the tilt angle of the RTK antenna does not exceed 20° from the vertical axis.**

- **PPK Acquisition Procedure:**
  - Deploy the base station first.
  - Base station data logging must commence at least 5 minutes before starting the SLAM scanner.
  - At the end of the session, stop the SLAM scanner first.
  - Wait at least 5 minutes after stopping the rover before stopping the base station logging.
  - Recommendation: The total base station deployment time should ideally exceed 15 minutes.

- Initiate the SLAM scanner in open areas whenever feasible.

- **For accuracy verification**: If performing an accuracy check, the acquisition path must be non-linear and exceed 100 meters in length.

- **L2 Pro Device** (Point Cloud Accuracy): To ensure post-processed point cloud accuracy, strive to keep the distance of continuous complete obstruction below 100 meters.

- **K1 Device** (Point Cloud Accuracy): To ensure post-processed point cloud accuracy, strive to keep the distance of continuous complete obstruction below 50

meters.

7. For Lixel Studio Colorization

• When colorizing using an external camera, the Insta360 should be set to time-lapse shooting mode, 6K resolution, and a 1-second interval.

• When starting the scanning project, the record-starting-time interval between the panoramic camera (hit record button on the camera) and the scanner (choosing scanning mode on the app) should be within 5 seconds.

• For the colorization process to proceed smoothly, the scanning time should be longer than 2 minutes, and there should be device movement during scanning. In other words, the scanner should not stay at the initialization position throughout the scanning process.

• The coloring effect of the Point Cloud depends on the surrounding environment and ambient light. For dim environments, if colorization is needed, it is recommended to turn on the light to ensure uniform, unchanging brightness in the surrounding environment. During the scanning process, excessive light and overexposure should also be avoided.

• When scanning, pay attention to the way the scanner is held, and try to avoid blocking the panoramic camera or the body camera. Also, avoid having objects on one or both sides of the camera for an extended period.

8. Accuracy verification

• For accuracy verification, the reflective stickers (where you collect absolute coordinates) need to be scanned properly. Doing this will help improve the success rate of automatic target point selection in the subsequent accuracy verification process in Lixel Studio.

• When georeferencing using GCP: To ensure that the stickers are not missed, it is recommended that you walk around the sticker before putting down the device to collect the control point.

• When georeferencing using RTK: When checking the accuracy of your RTK data, there is no need to put your device on the ground when scanning the target points. Simply walking around the sticker will allow you to scan them properly.

9. Map Fusion

•	Planning ahead before collecting map fusion projects. The projects must have at least some areas of overlap for them to be merged successfully. The overlapping area should be above 15 meters in length and should not be overly empty like open soccer fields, or overly narrow such as staircases.

•	Each individual project should be within 20 minutes. And you can only merge up to 8 projects in current version.

•	Map fusion can't be used between device series (i.e. Cannot merge between K1 and L2 Pro)

•	**Performing map fusion using connection points**: If you are interested in linking projects by using connection points, follow the steps below.

1.	 Scan project one as usual. When you arrive at the area where you'd like to joint project one and two, slowly lowering the device to the ground.

2.	Once the device is stable, collect a control point and give it a name (for example control point "a")

3.	Once the control point is collected successfully, wait for 15 seconds and then end project one.

4.	With your device still on the ground, start your second project. After initialization, add a control point and give it the same name as in project one ("a" in this case).

5.	Gently lift up your device and rescan some areas of project one so that the overlap is longer than 15 meters.

6.	After scanning the overlapped area, proceed to scan the new areas.

7.	Repeat this process if you would like to merge more projects.

•	**Performing map fusion using RTK**: If you are interested in linking projects with RTK, make sure that throughout all the projects, RTK status is "fixed" (see the RTK section above for details).

1.	Scan project one as usual. When you arrive at the area where you'd like to joint project one and two, slowly lowering the device to the ground.

2.	End the first project.

3.	After ending the first project, with your device still on the ground, start a second project.

4.	After initialization, walk back to the overlapping area and scan for more than 15 meters. Then proceed to scan the new areas.

5.	Repeat this process if you would like to merge more projects.