



STONEX SLAM XH120
Handheld Laser Scanner
User Manual



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1. Legal Notice

Copyrights and trademarks

STONEX®, the STONEX® logo, and XH120 are trademarks of STONEX® S.r.l.

STONEX® Cube-slam, STONEX® Cube-scan and STONEX® Reconstructor are trademarks of STONEX® S.r.l.

All other trademarks are the property of their respective owners.

2. Standard Limited Warranty

2.1 General warranty for instruments

The terms and conditions of this Limited Warranty constitute the complete and exclusive warranty agreement between The Customer or Dealer and STONEX® for the Product and it supersedes any prior agreement or representation made in any STONEX® sales document or advice that may be provided to Customer by any STONEX® representative in connection with Customer's purchase of the Product. No change to the conditions of this Limited Warranty is valid unless it is made in written form and signed by an authorized STONEX® supervisor.

The warranty period starts from date of first sale of the instruments. At its sole discretion, under the warranty period, STONEX® will repair the product or send parts for replacement at its expense. STONEX® agree to repair or replace the defected instrument within thirty (30) days, only if STONEX® recognizes that the defects of the instrument are not caused by human factors or no obvious damage to its surface is visible. STONEX® warrants any new replaced parts or products are warranted to be free from defects in materials and workmanship for thirty (30) days or for the remainder of the Limited Warranty Period of the Product in which they are installed, whichever is longer. Faulty Parts or Products replaced under this Limited Warranty shall become property of STONEX®.

All products that have to be repaired have to be returned to our technical representative office location via any delivery company the customer prefers.

NOTE: STONEX® is not accountable for the unlikely event that the Products get lost in transit.

Any damage inflicted by the customer or by third party after the products have been delivered to the customer is excluded from the limited warranty as well any damage arising from an improper use, from any action or use not provided for in the enclosed user guides and/or manuals.

2.2 Shipping policy

The Customer or the Dealer is required to pay for the charges for shipping of fault parts or instruments to STONEX® representative office and STONEX® (will provide) the shipping for return. Dealers needs to follow STONEX® repair/service procedure to achieve a better and prompt service result.

2.3 Return policy Dead on Arrival instruments

All returned products have to be shipped to STONEX® representative office.

The original Purchaser has a period of seven (7) days, starting from date (data) of purchasing to signal the existence of a defect in the instrument for a full refund (less shipping and handling), provided the merchandise is in new, resalable condition and returned in the original, undamaged packaging. Customer

has to pay for both the return and the original freight fees, regardless of the original freight paid by the Company. All warranty books, instruction manuals, parts and accessories must be included as well as the original box in which the item was shipped. We recommend placing the original carton inside another box, to avoid any additional damage to the carton itself. In some cases, returns of special items will require a re-stock fee. Acceptance of returned merchandise is final only after inspection by STONEX®.

Above terms and (policy shall apply as for hardware.) Dealers needs to follow STONEX® repair/service procedure to achieve a better and prompt service result.

2.4 Firmware/Software warranty

STONEX® doesn't warrant that operation of Firmware/Software on any instruments will be uninterrupted or error-free, or that functions contained in Firmware/Software will operate to meet your requirements.

STONEX® will forward the Software/Firmware Fix to the dealer or customer. Firmware/software Fix means an error correction or other update created to fix a previous firmware version that substantially doesn't conform to the instrument's specification.

2.5 Over Warranty repair(s) policy

Customer shall pay the standard repair fees for any service (whether part replacement or repairs) and performed by STONEX® under request and explicit authorization of the customer itself. In this case the customer is charged for return shipment's fees as well.

2.6 Disclaimer and Limitation of Remedy

All other express and implied warranties for this product, including the implied warranties of merchantability and fitness for a particular purpose and/or noninfringement of any third party's rights, are hereby disclaimed. STONEX® expressly disclaims all warranties not stated in this limited warranty. Any implied warranties that may be imposed by law are limited in duration to the term of this limited warranty. Some jurisdictions do not allow the exclusion of implied warranties or limitations on how long an implied warranty lasts, so the above exclusions or limitations may not apply to customer. Customer must read and follow all set-up and usage instructions in the applicable user guides and/or manuals enclosed. If customer fails to do so, this product may not function properly and may be damaged. Customer may lose data or sustain personal injuries. STONEX®, its affiliates and suppliers do not warrant that operation of this product will be uninterrupted or error free as do all electronics at times. If this product fails to work as warranted above, customer's sole and exclusive remedy shall be repair or replacement. In no event will STONEX®, its affiliates or suppliers be liable to customer or any third party for any damage in excess of the purchase price of the product. This limitation applies to damages of any kind whatsoever including (1) damage to, or loss or corruption of, customer's records, programs, data or removable storage media, or (2) any direct or indirect damages, lost profits, lost savings or other special, incidental, exemplary or consequential damages, whether for breach of warranty, contract, tort or otherwise, or whether arising out of the use of or inability to use the product and/or the enclosed user guides and/or manuals, even if STONEX®, or an authorized STONEX® representative, authorized service provider or reseller has been advised of the possibility of such damages or of any claim by any other party. Some jurisdictions do not allow the exclusion or limitation of incidental or consequential damages for some products, so the exclusions or limitations may not apply to customer. This limited warranty gives customer specific legal rights, and customer may also have other rights which vary from country/state/jurisdiction to country/state/jurisdiction.

2.7 Repair/Service procedure for Dealers

1. S/N of the instrument and a detailed description of the defect (sometimes pictures or video) will be required to indicate the cause and problem.
2. If dealer wants to repair an instrument under warranty period on their site:
 - If dealers don't have the part in stock, they have to send an official order to STONEX® and pay for it and then so STONEX® will send the new part to them so they can repair the instrument.
 - When the repair is over, the dealer has to fill the "Spare Part Refund" module and send it to the dedicated mail address.
 - Must wait for STONEX®'s authorization SPR.
 - When dealer receives the SPR authorization number they can send back to STONEX® appointed office the broken part with attached the SPR module.
 - When STONEX® receives the broken part, STONEX® shall verify it and if everything is ok the cost of the part shall be refund (refund will be done only after check of the failure part and final approval of STONEX®).
3. If the instrument needs to be sent back to STONEX® for repair/replacement, dealers/customers have to send to STONEX® a "Returned Merchandise Authorization (RMA)" before they send back the fault instrument. STONEX® shall, at its sole discretion, decide on the place of performance for work under warranty.

2.8 FCC Statement

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help

This device complies with part 15 of the FCC rules. Operation is subject to the following two conditions (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

2.9 Environmental recycling

The cardboard box, the plastic in the package and the various parts of this product have to be recycled and disposed of in accordance with the current legislation of your Country.

FOR COUNTRIES IN THE EUROPEAN UNION (EU)

The disposal of electric and electronic device as solid urban waste is strictly prohibited: they must be collected separately.

Contact Local Authorities to obtain practical information about correct handling of the waste, location, and times of waste collection centers. When you buy a new device of ours, you can give back to our dealer a used similar device. The dumping of these devices at unequipped or unauthorized places may have hazardous effects on health and environment.

The crossed dustbin symbol means that the device must be taken to authorized collection centers and must be handled separately from solid urban waste.



FOR COUNTRIES OUTSIDE EUROPEAN UNION (EU)

The treatment, recycling, collection, and disposal of electric and electronic devices may vary in accordance with the laws in force in the Country in question.

SAR Information Statement

Your Handheld Laser Scanner is a radio transmitter and receiver. It is designed and manufactured not to exceed the emission limits for exposure to radiofrequency (RF) energy set by the Federal Communications Commission of the U.S. Government. These limits are part of comprehensive guidelines and establish permitted levels of RF energy for the general population. The guidelines are based on standards that were developed by independent scientific organizations through periodic and thorough evaluation of scientific studies. The standards include a substantial safety margin designed to assure the safety of all persons, regardless of age and health. The exposure standard for wireless mobile phones employs a unit of measurement known as the Specific Absorption Rate, or SAR. The SAR limit set by the FCC is 1.6 W/kg. * Tests for SAR are conducted with the Handheld Laser Scanner transmitting at its highest certified power level in all tested frequency bands. Although the SAR is determined at the highest certified power level, the actual SAR level of the Handheld Laser Scanner while operating can be well below the maximum value. This is because the Handheld Laser Scanner is designed to operate at multiple power levels so as to use only the power required to reach the network. In general, the closer you are to a wireless base station antenna, the lower the power output. Before a Handheld Laser Scanner is available for sale to the public, it must be tested and certified to the FCC that it does not exceed the limit established by the government adopted requirement for safe exposure. The tests are performed in positions and locations (e.g., at the ear and worn on the body) as required by the FCC for each model. The highest SAR value for this Handheld Laser Scanner when worn on the body, as described in this user guide, is 0.47 W/Kg (Body-worn measurements differ among phone Handheld Laser Scanner models, depending upon available accessories and FCC requirements). While there may be differences between the SAR levels of various phones and at various positions, they all meet the government requirement for safe exposure. The FCC has granted an Equipment Authorization for this model phone Handheld Laser Scanner with all reported SAR levels evaluated as in compliance with the FCC RF exposure guidelines. SAR information on this Handheld Laser Scanner is on file with the FCC and can be found under the Display Grant section of <http://www.fcc.gov/oet/fccid> after searching on FCC ID: Y44-XH120 Additional information on Specific Absorption Rates (SAR) can be found on the Cellular Telecommunications Industry Association (CTIA) web-site at <http://www.wow-com.com>. * In the United States and Canada, the SAR limit for mobile phones used by the public is 1.6 watts/kg (W/kg) averaged over one gram of tissue. The standard incorporates a substantial margin of safety to give additional protection for the public and to account for any variations in measurements.

The SAR test distance is 0mm.

3. Introduction

3.1 General

Thank you for purchasing STONEX® SLAM XH120 Handheld Laser Scanner.

This manual includes important safety directions and instructions for setting up and using the product.

Please read this manual carefully before using, so that our products can serve you better.

When you begin to use the product, we assume that you are a competent user who has read through and understood the contents of this manual and is fully aware of the necessary dangers, warnings, and cautions.

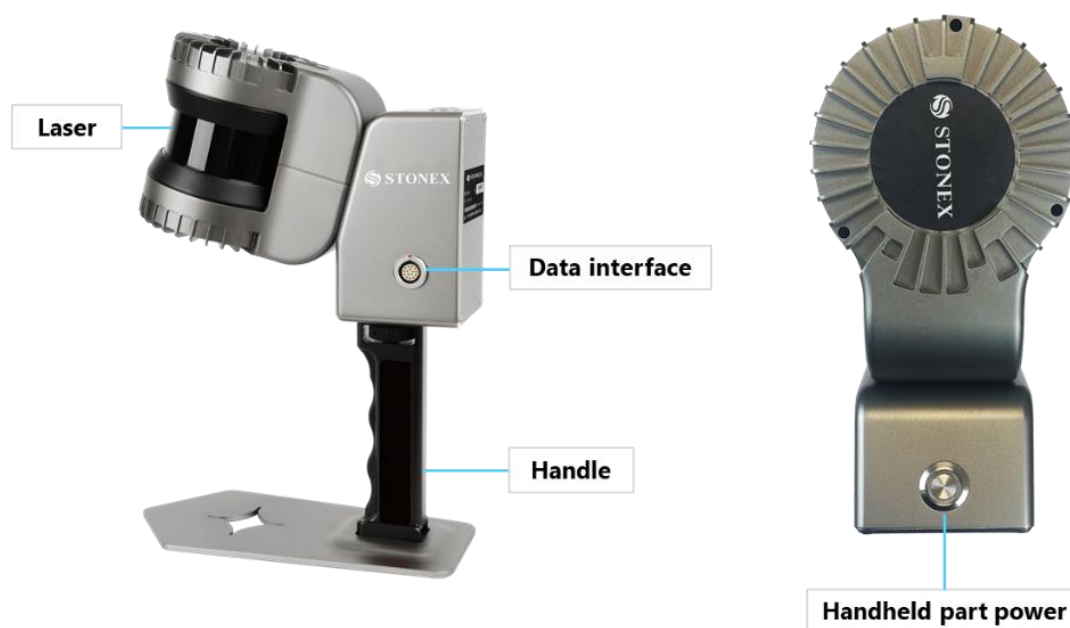
In the event of any discrepancy between the information contained in this manual and the actual, the actual information shall prevail, and the Company reserves the right to make further revisions or changes to this manual without notice.

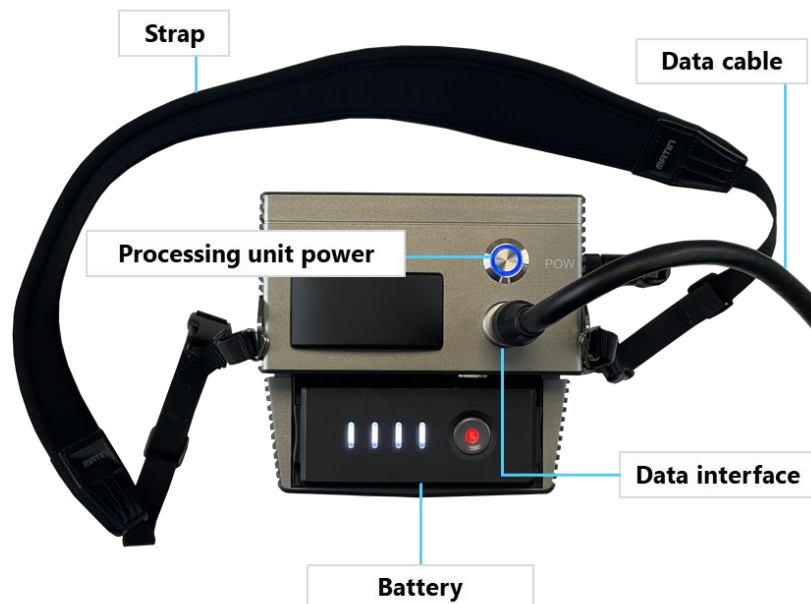
XH120 Handheld Laser Scanner provides a simple and quick way to obtain 3D point cloud data, outdoor or indoor, significantly improving work efficiency and speed compared to the use of a traditional 3D standing laser scanner.

Laser scanning is an automatic process during which real objects are surveyed and sampled almost completely to determine their location, size, orientation, and shape.

The SLAM (Simultaneous Localization and Mapping) algorithm used to process raw laser scan data into a 3D point cloud relies on features present in the scanning environment, which are scanned repeatedly when the operator passes through the scanning environment.

3.2 Description of the system





3.3 Precaution for safety

1. Avoid vibrations: when transporting, keep the instrument in the case and try your best to lighten vibrations.
2. Instrument carrying: when carrying, the instrument handle must be hold tight.
3. Check the battery power: before using the instrument, you should check the battery power whether it is enough.
4. Battery maintenance: if the instrument is not in using for a long time, the battery should be taken out from the instrument and stored in separate place. Meantime, the battery should be charged every month.

5. Taking out the battery: it is not suggested to take out the battery when the instrument is on. Otherwise, stored data may be lost. So, it is better to replace the battery after powering off the instrument.
6. High temperature condition: don't put the instrument in high temperature condition for a long time, it is bad for the instrument performance, and it can damage the hardware components.
7. Noise from the instrument: when the instrument is working it is normal if you hear noises from instrument motors. They will not affect the instrument work.
8. Stored data responsibility: STONEX® should not be held liable for the lost data because of wrong operation.

3.4 Transport and shipping

TRANSPORT IN THE FIELD

1. When transporting the equipment in the field, always make sure that you
 - a. either carry the product in its original transport container,
 - b. or carry the processing unit with the strap across your shoulder, and the handheld part firmly held.

TRANSPORT IN A ROAD VEHICLE

2. Never carry the product loose in a road vehicle, as it can be affected by shock and vibration.
3. Always carry the product in its transport container and secure it.

SHIPPING

4. When transporting the product by rail, air or sea, always use the complete original STONEX® packaging, transport container and cardboard box or its equivalent to protect the instrument against shock and vibration.

SHIPPING AND TRANSPORT OF BATTERIES

5. When transporting or shipping batteries, the person in charge of the product must ensure that the applicable national and international rules and regulations are observed.
6. Before transportation or shipping, contact your local passenger or freight transport company.

3.5 Storage

Respect the temperature limits when storing the equipment, particularly in summer if the equipment is inside a vehicle. Refer to technical datasheet for information about temperature limits.

3.6 Cleaning and drying

- Never touch the cover glass with your fingers.
- Use only a clean, soft, lint-free cloth for cleaning.
- If necessary, moisten the cloth with water or pure alcohol. Do not use other liquids.
- Keep plugs clean and dry. Blow away any dirt lodged in the plugs of the connecting cables.

3.7 Definition of indication

For the safe of your product and prevention of injury to operators and other persons as well as prevention of property damage, items which should be observed are indicated by an exclamation point within a triangle used with WARNING and CAUTION statements in this manual.

The definitions of the indications are listed below.

Be sure you understand them before reading the manual's main text.



ATTENTION:

Ignoring this indication and making an operation error could possibly result in death or serious injury to the operator.



CAUTION:

Ignoring this indication and making an operation error could possibly result in personal injury or property damage.



ATTENTION

1. Do not perform disassembly or rebuilding. Fire, electric shock, or burn could result. Only STONEX® authorized distributors can disassemble or rebuilt.
2. Do not cover the charger. Fire could result.
3. Do not use deflection power cable, socket, or plug. Fire, electronic shock could result.
4. Do not use wet battery or charger. Fire, electronic shock could result.
5. Do not close the instrument to burning gas or liquid, and do not use the instrument in coal mine. Blast could result.
6. Do not put the battery in the fire or high temperature condition. Explosion, damage could result.
7. Do not use the battery which is not specified by STONEX®. Fire, electric shock, or burn could result.
8. Do not use the power cable which is not specified by STONEX®. Fire could result.
9. Do not short circuit of the battery. Fire could result.
10. When this product encounters disturbance of severe Electrostatic Discharge, perhaps it will have some degradation of performance like switching on/off automatically and so on.



CAUTION

1. Do not touch the instrument with wet hand. Electric shock could result.
2. Do not stand or seat on the carrying case, and do not turn over the carrying case arbitrarily, the instrument could be damaged.
3. Do not drop the instrument or the carrying case.
4. Do not touch liquid leaking from the instrument or battery. Harmful chemicals could cause burn or blisters.
5. Do not drop the instrument. Series damage could result.
6. Before use it, check all the parts are connected firmly.

3.8 Safety standards for lasers

STONEX® XH120 adopts Laser Product classification of FDA 21 CFR 1040.10 and 1040.11. According to

this standard, the device is classified as Class 1 Laser Product.

3.9 Battery

HANDLING AND STORAGE

Use the battery properly according to the product specification, do not disassemble or short circuit the battery.

Keep away from sources of heat or ignition: over high temperature will make the cell inflate melt the separator, causing short circuit.

The storage area should be cool, dry, well ventilated, out of direct sunlight, away from metal or sharp edge, such as keys pins or wires. Store the battery in a charged state and charge it every 6 months.

3.10 About User

1. The XH120 Handheld Laser Scanner must be used by trained operators only. When operating the XH120, please always follow basic safety precautions to prevent injury or damage to equipment.
2. The user is required to be a qualified surveyor or have a good knowledge of surveying, in order to understand the user manual and safety instructions, before operating, inspecting, or adjusting.
3. Do not operate the equipment if it shows obvious defects or damage. Please follow STONEX® service procedure to repair the equipment.
4. Please use only the components and accessories provided by the manufacturer.
5. Before operating the XH120 for the first time, please read this manual completely.
6. The equipment contains electrical components and mechanical parts, so proper operation is required. Do not pull or bend the data transmission line forcibly.
7. Do not push any other objects into the data transmission line interface,
8. Place the device out of the reach of children
9. Do not modify or disassemble the XH120 handheld scanner under any circumstance without the prior written permission of STONEX®. Otherwise, the warranty would not be applied.

3.11 Exceptions from Responsibility

1. The user of this products is expected to follow all operating instructions and make periodic checks of the product's performance.
2. The manufacturer assumes no responsibility for results of a faulty or intentional usage or misuse including any direct, indirect, consequential damage and loss of profits.
3. The manufacturer assumes no responsibility for consequential damage and loss of profits by any disaster, such as earthquakes, storms, floods etc.
4. The manufacturer assumes no responsibility for any damage and loss of profits, due to a change of data, loss of data, an interruption of business etc., caused by using the product or an unusable product.
5. The manufacturer assumes no responsibility for any damage and loss of profits, caused by usage except for explained in the user manual.
6. The manufacturer assumes no responsibility for damage caused by wrong transport or action, due to connecting with other products.

4. Setting up the STONEX® XH120

4.1 Setting up

1. Connect the strap to the processing unit and mount the Wi-Fi antenna



2. Connect the data cable to the processing unit and to the handheld part through the data interface connector (the linear interface should be connected to the processing unit, while the 90-degree angle interface should be connected to the handheld part)



3. Insert the battery in the processing unit battery slot



4. Make sure all these parts are connected/inserted firmly.

4.2 Battery charging

1. Plug the charger into an AC power source and the charger LED indicator will light up in green
2. Insert the charger wire firmly into the battery, and the four LED indicators above the battery will flash in sequence. When the four indicators are no longer flashing, the battery is fully charged
3. Disconnect the charger from the battery and AC power source
4. After the battery is fully charged, do not keep the charger connected to the battery for a long time

4.3 Real-time battery display

The four LED indicators placed on the battery light up to indicate about 25%, 50%, 75%, or 100% of the remaining power of the battery.



4.4 XH120 control options

To perform the data acquisition, to manage scans, and to download the results, the system uses **Cube-slam**, a software which applies the SLAM algorithm to obtain ready-to-use 3D point clouds at the time of scanning.

The software and calculation operations are carried out entirely within the system, but it is possible to view and control the various acquisition and management steps using a Windows PC or tablet. To interact with

the scanner via Cube-slam and check in real-time the progress of the scan and remapping steps, the user needs to install the launcher on your device, following the steps below.

It is also possible to control the scanner by connecting to the **web interface**, which can be accessed by reaching IP **192.168.10.1**. This allows to perform scanning, remapping and download of the data using any device with an internet browser.

4.5 Installing Cube-slam

1. Read the USB dongle provided with the instrument on your device
2. Unzip the Cube-slam folder
3. Copy the "opt" folder in your PC C: drive
4. Run the "setup.bat" file as administrator (right click on the file and select "Run as administrator") to install the software and follow the command window instructions
5. To verify the correct installation of Cube-slam, connect your PC to the instrument network
6. Start Cube-slam by clicking on the "Cube-slam" application file inside the unzipped folder
7. Cube-slam main window should appear, with the connection status "Connected".

4.6 Installing XH120 Manager

1. Read the USB dongle provided with the instrument on your device
2. Unzip the XH120 manager folder
3. Click on the application file inside the unzipped folder to start the converter

4. Operating the STONEX® XH120

5.1 Power on the processing unit

1. To turn on the battery, press once, then press and hold a second time, until the red LED on the power button and the available battery percentage indicator LEDs are lit

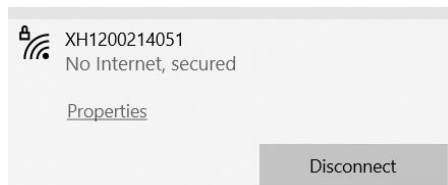


2. Proceed with powering up the processing unit of the XH120: press and hold the power button until the blue LED turns on



5.2 Wi-Fi connection to XH120

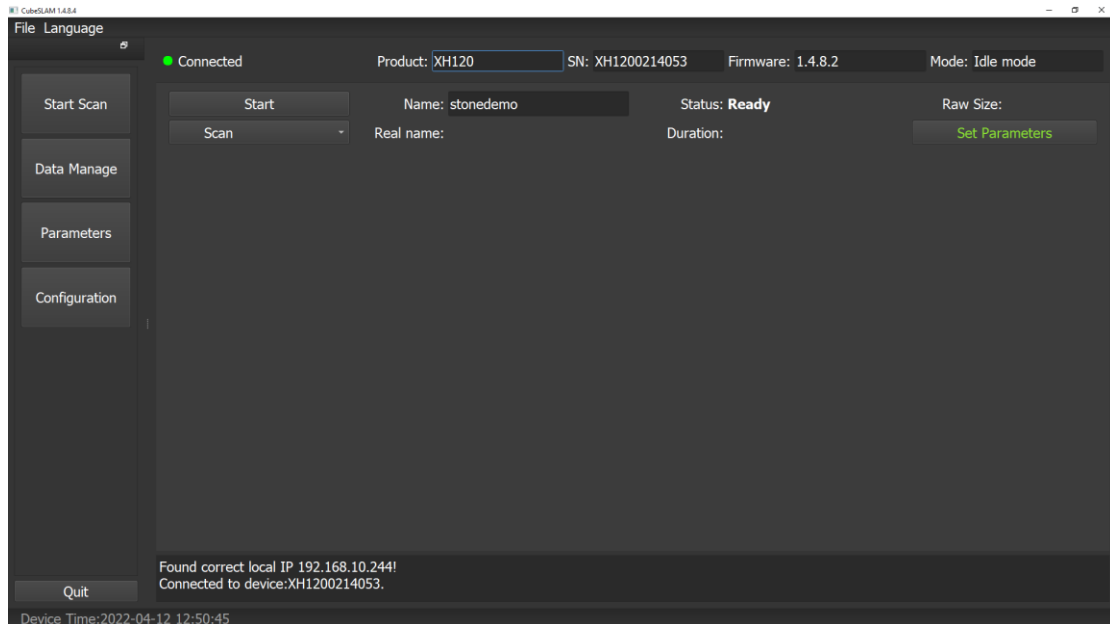
1. Enable the Wi-Fi connection on your tablet/computer
2. Search for the XH120 wireless network using the OS connection manager: the XH120 connection name is identified by its serial number



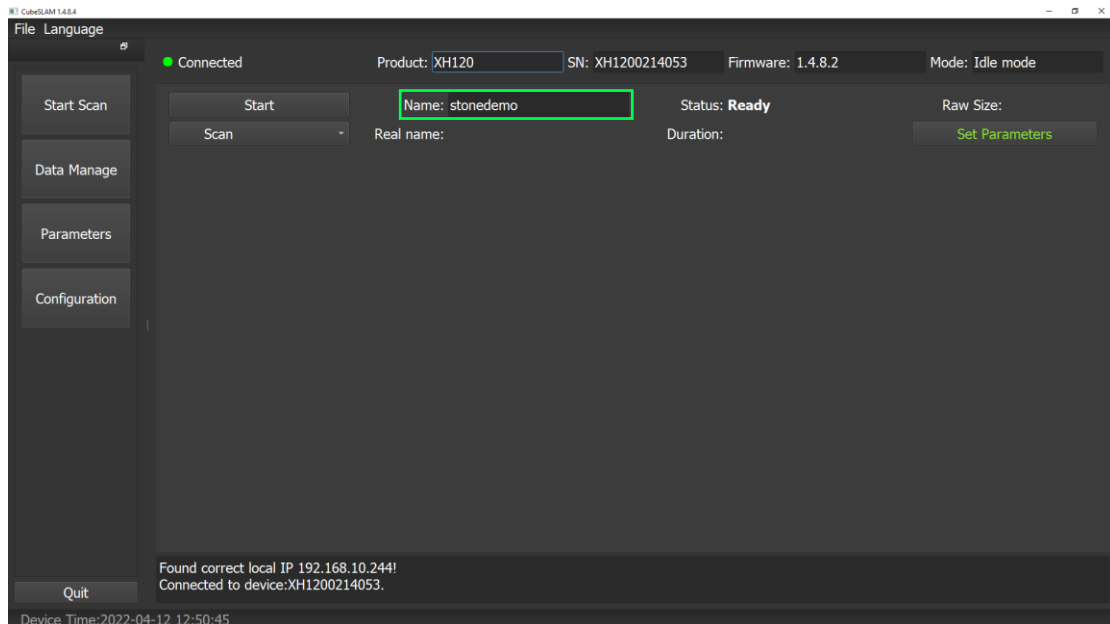
3. Connect to the XH120 network. The first time, the network requires a passcode: insert **"12345678"**

5.3 Cube-slam: scanning

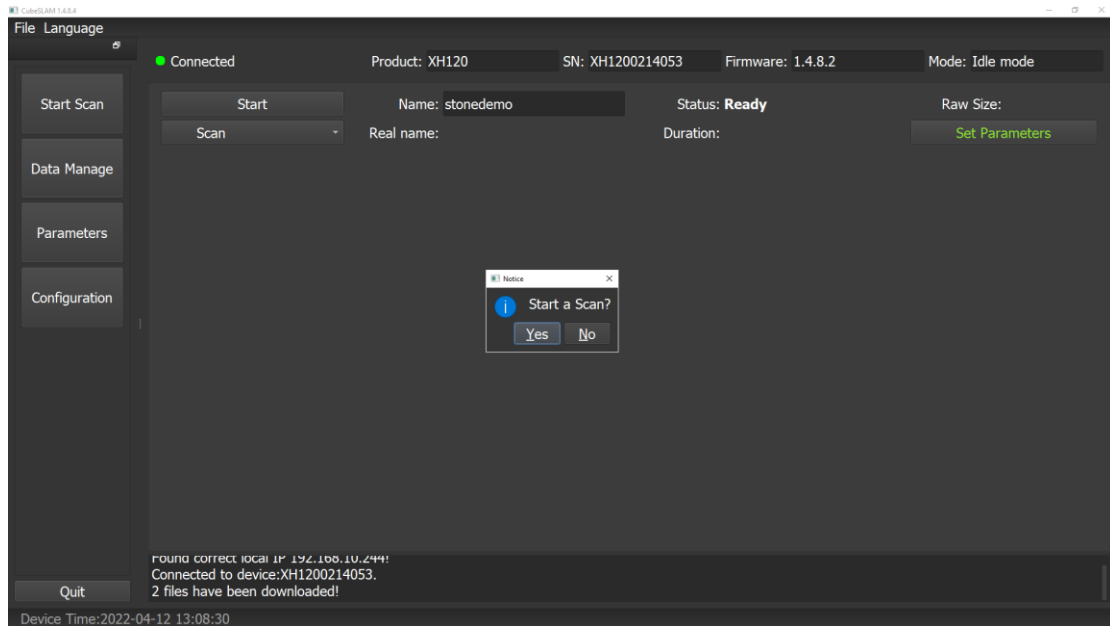
1. Launch the **Cube-slam** software and select the “**Scan**” environment (by default, it will automatically open on this section):



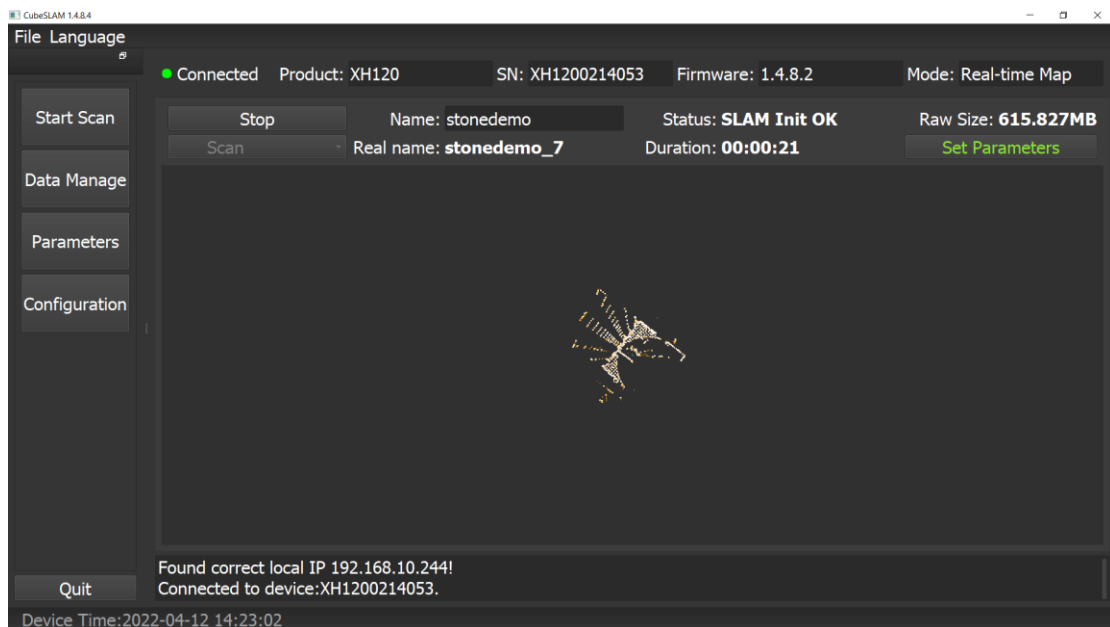
2. Enter an arbitrary name for the scan you are about to perform:



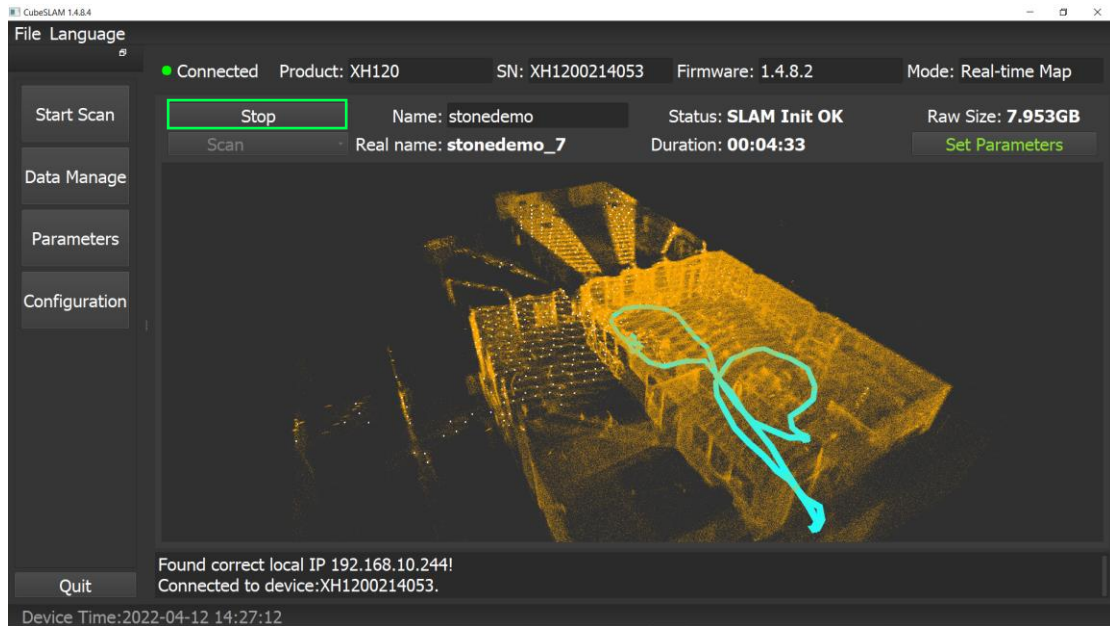
3. Click on the “**Start**” button to initialize the scan and click “**Yes**” on the popup that will appear:



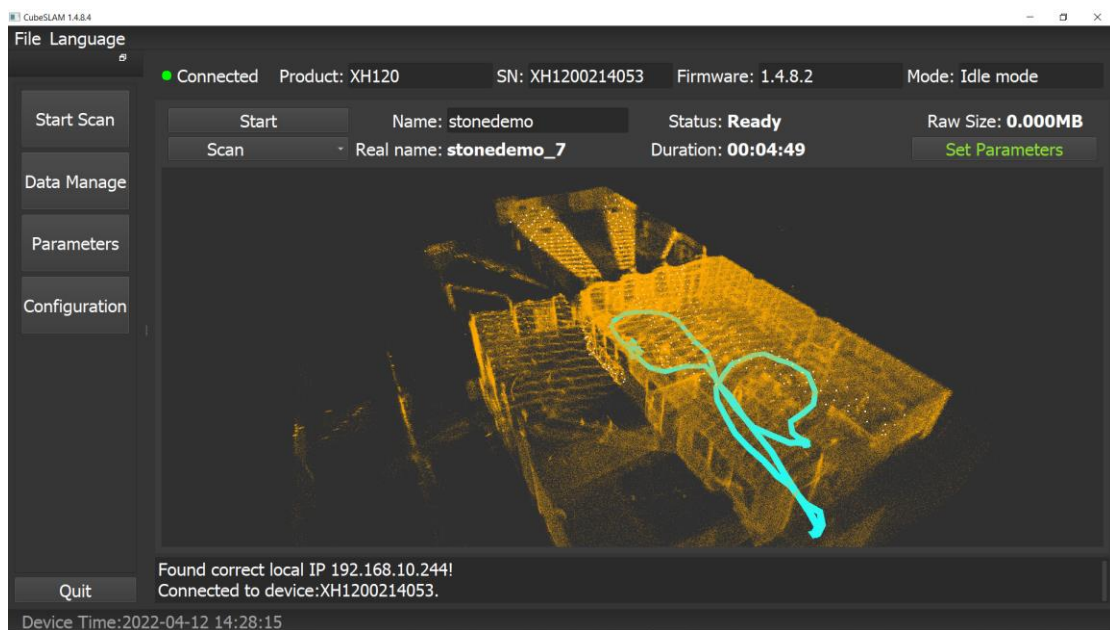
4. During this step, the calibration of the IMU unit is performed, it is then recommended to keep the handheld unit steady. After a while, you will be able to see the real-time preview appearing (**NOTE:** Cube-slam 1.4.7.4 shows a yellow-colored preview, while older versions show a height-colored preview. This change was applied to improve visibility): the initialization is complete. To help the scanner recognize landmarks which will help the SLAM algorithm, slightly move the handheld part up/down and left/right:



5. At this point, turn on the handheld part by pressing and holding the power button a few seconds, until it starts rotating; after a few seconds, you can begin your scan and move.
6. Once you have covered all the desired features/environments, stop the scanning by clicking on **"Stop"** button



7. Once the **"Status"** displayed on the interface is **"Ready"**, you can stop the handheld part by pressing and holding the power button:



8. The scanning process is completed, and the corresponding files will be stored in the processing unit memory.

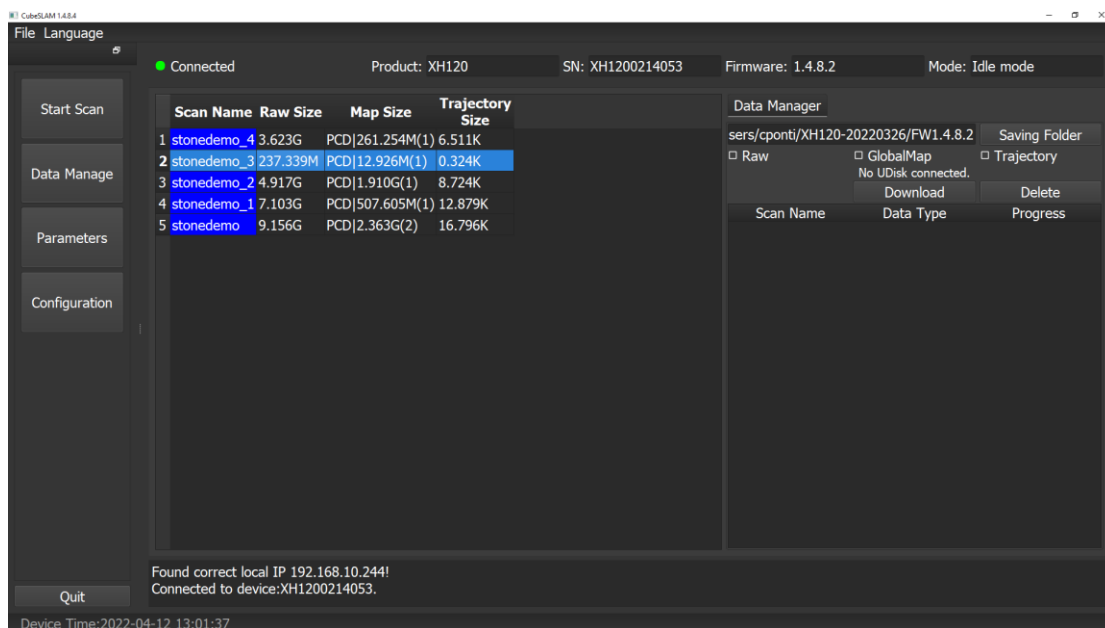
6. Data download, deletion, and processing

The results of the scanning sessions are stored in the processing unit memory and can be managed by accessing them via Cube-slam software or the web interface. Data can be downloaded in order to process them using point cloud processing software.

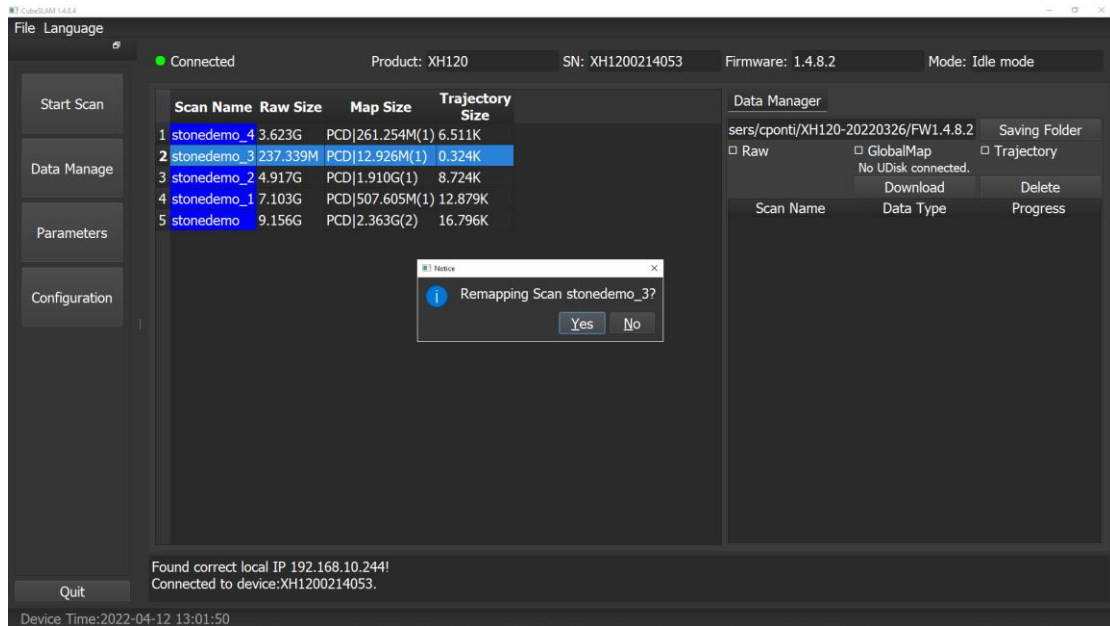
6.1 Cube-slam: remapping

After the scan, to improve the data quality, the user could perform a remapping operation, which executes the SLAM algorithm on the collected raw data, with deeper optimization than the real time process, according to the Parameters selected by the User.

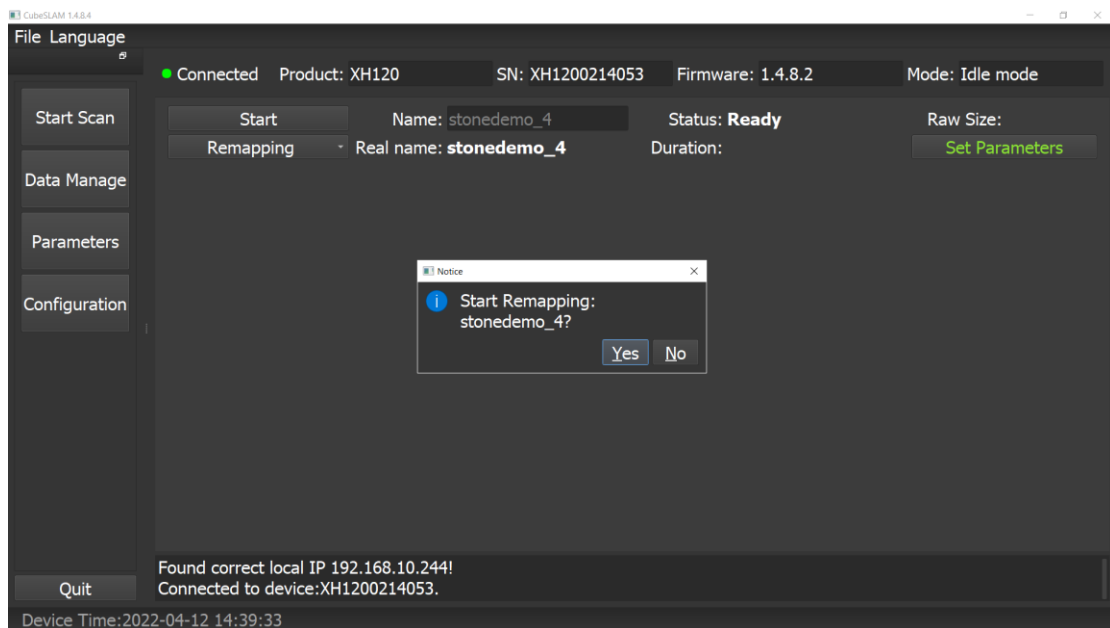
1. Launch the **Cube-slam** software
2. Open the **"Data Manage"** environment and select the scan you want to remap



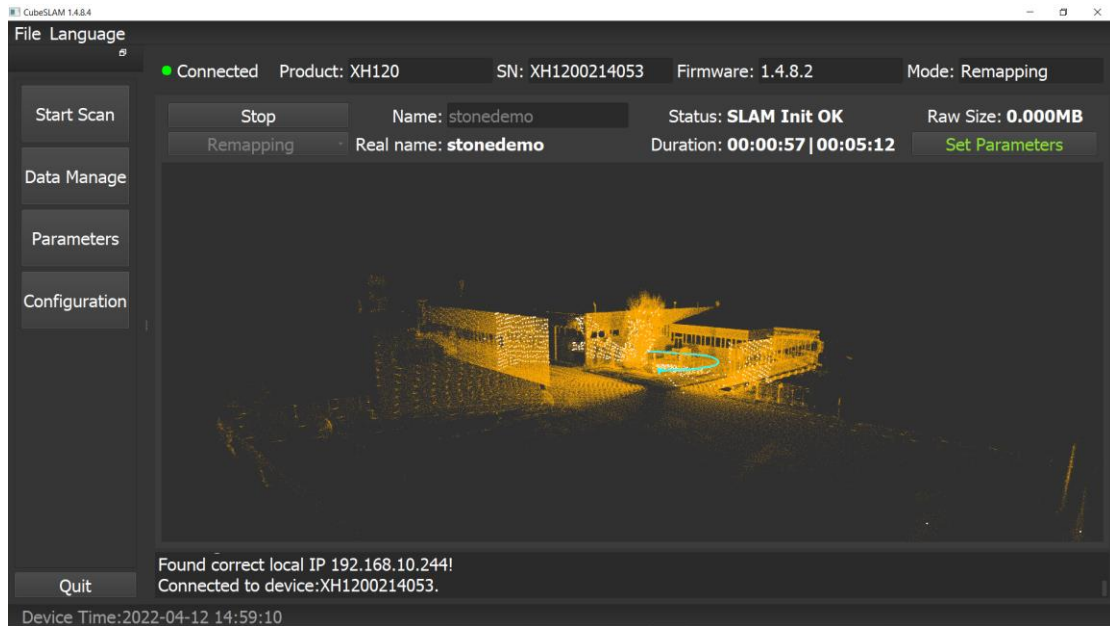
3. Double click on its name, then confirm that you want to proceed with remapping by clicking **"Yes"** on the popup that will appear



- The software will automatically redirect you to the “Remap” environment; you can select the level of density of the resulting point cloud by changing the “Map filter” parameter: 1 corresponds to the higher possible density. The parameter can be set in the “Parameters” page.
- Click on the “Start” button to begin the remapping and then click “Yes” on the popup appearing

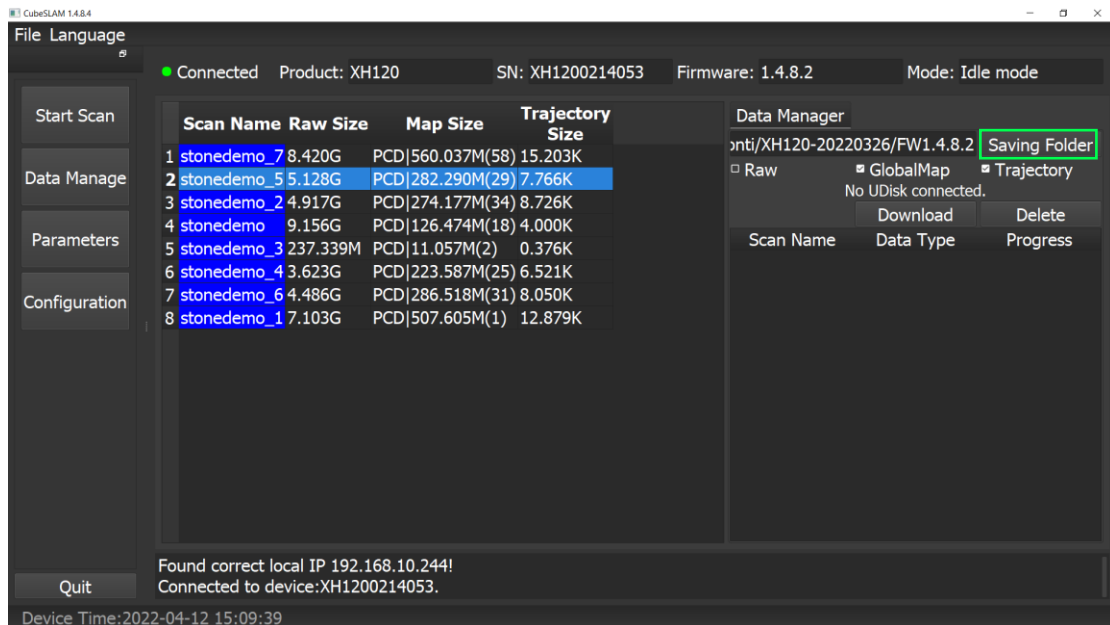


- You can check the progress of the operation by following the blue line describing the path of the scan; once the blue path is still, the remapping is done and it will automatically stop, the Status will become “Ready” and you can download the data for processing. You can also stop it in advance by clicking on the “Stop” button, but the remapping operation will not be saved.

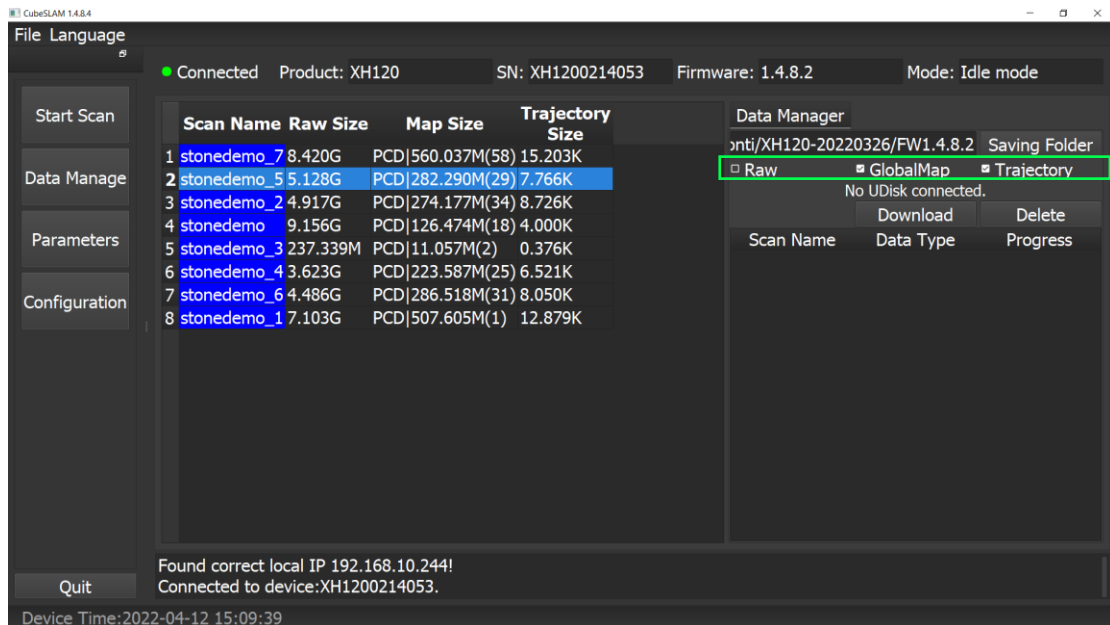


6.2 Cube-slam: data download

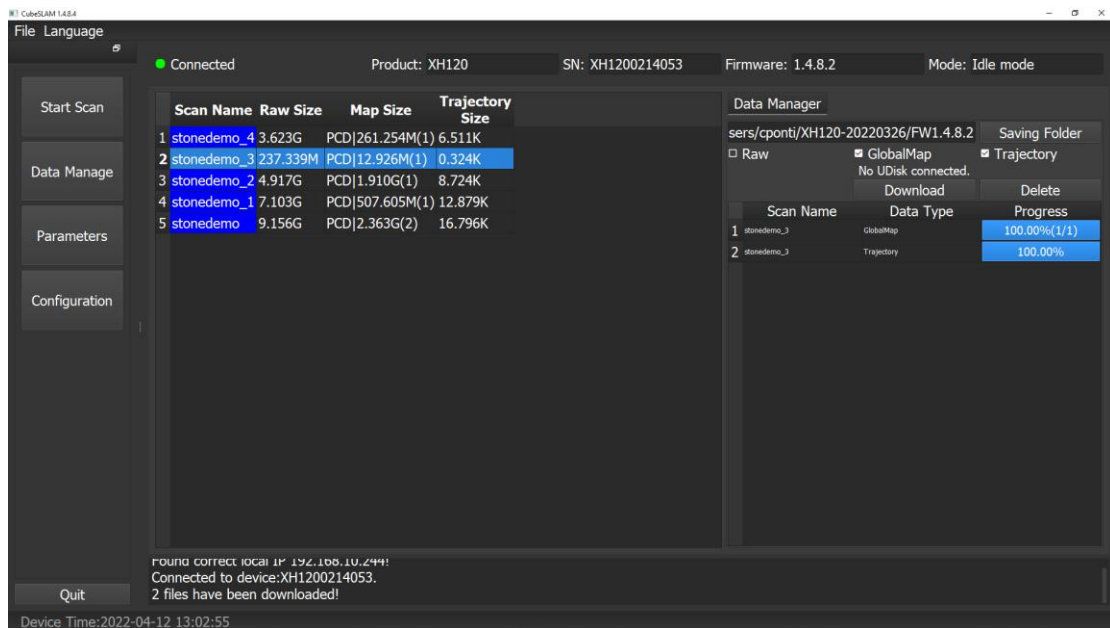
1. Launch Cube-slam software
2. Open “**Data Manage**” and select the scan you want to download; you can select multiple scans with Control button
3. In the right panel, you can choose in which folder you want to save the data: click on “**Save Folder**” to select to one you prefer on your tablet/PC



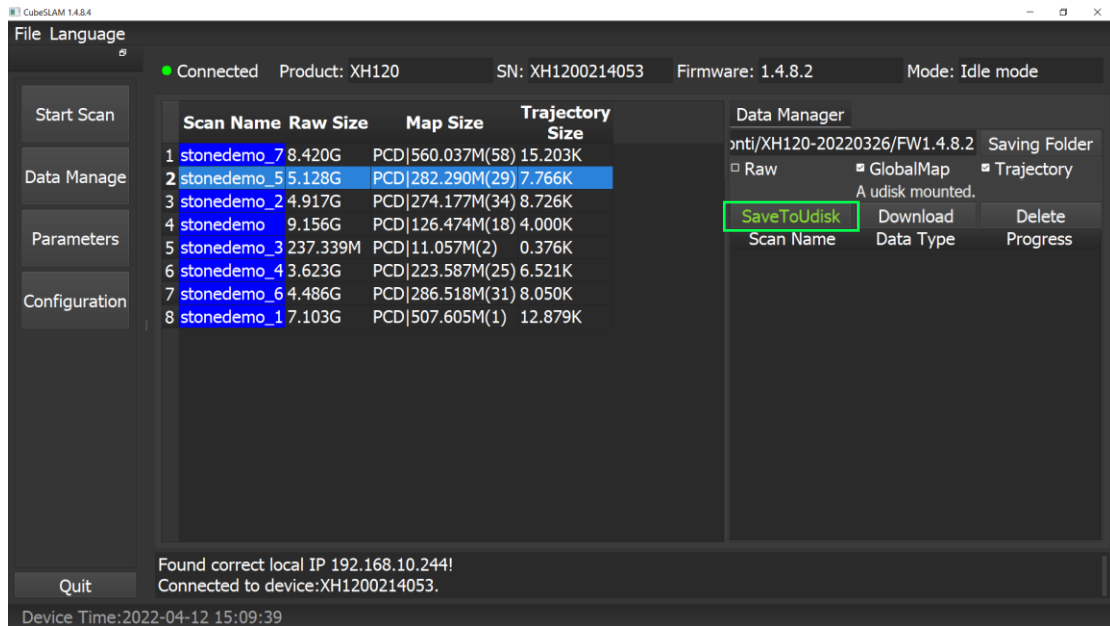
4. Select the elements you want to download:
 - a. *Raw* (the original point cloud not processed by the SLAM algorithm)
 - b. *GlobalMap* (point cloud data processed by SLAM algorithm)
 - c. *Trajectory* (scanning trajectory)



5. Click on **“Download”**: you can check the progress of the operation in the right panel

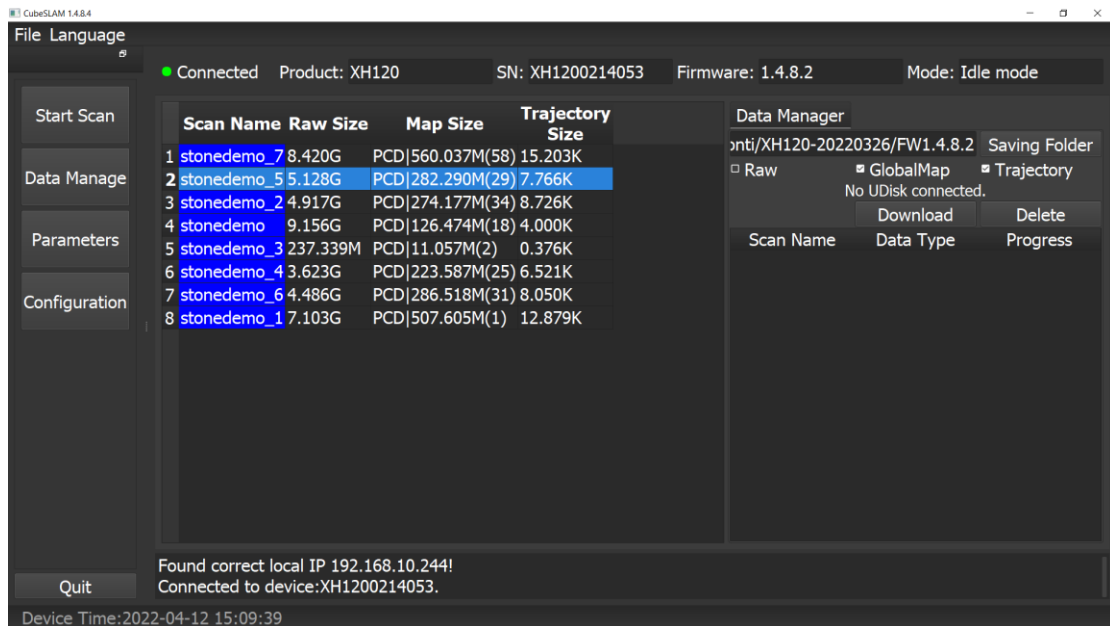


6. You can also connect a USB disk to the processing unit using the provided cable, and save the scans directly on it. Udisk format must be NTFS or FAT32 (Recommended NTFS) and the Udisk must contain only one partition.

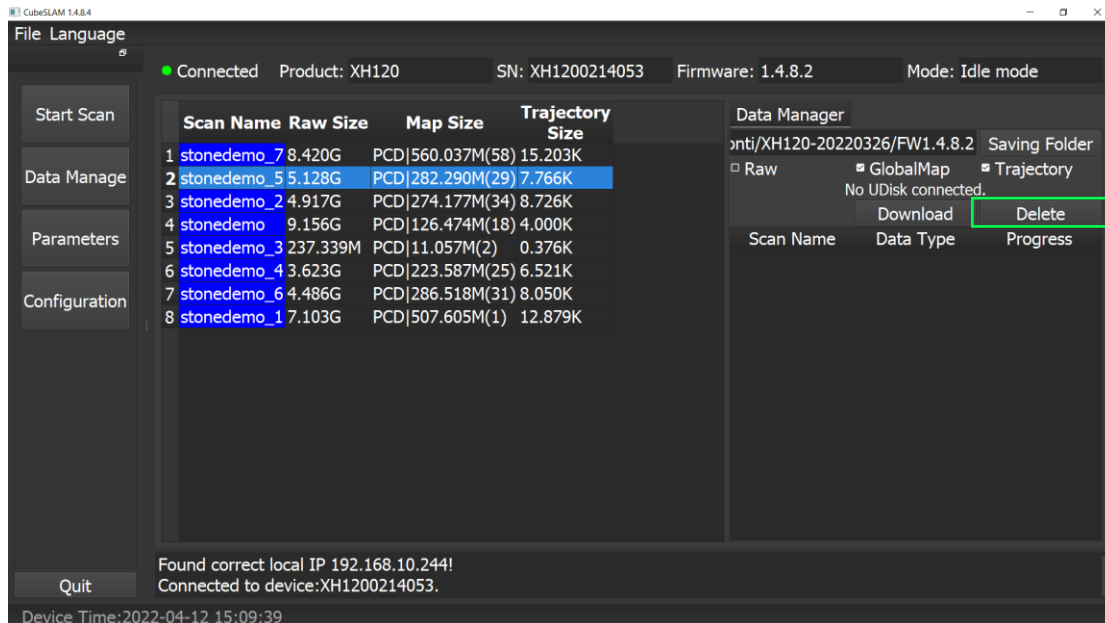


6.3 Cube-slam: delete scans

1. Open the “**Data Manager**” and select the scan you want to delete; you can select multiple scans with Control button



2. On the right panel, select the scan files you want to delete (Raw, GlobalMap, Trajectory) and click on “**Delete**”

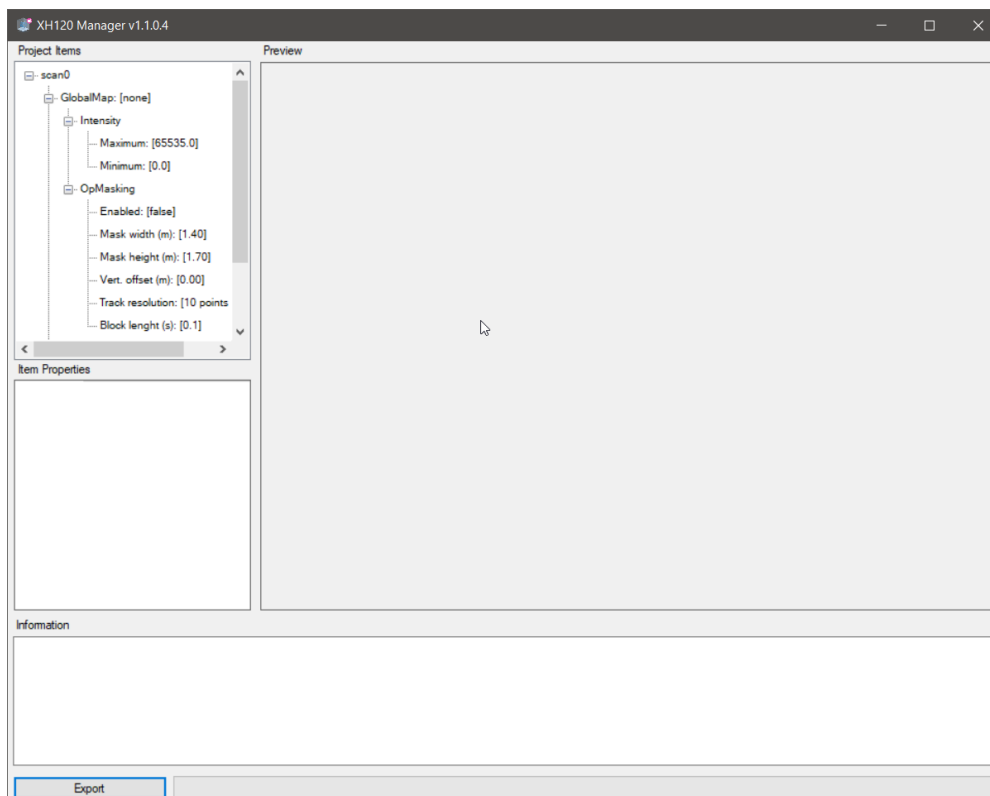


6.4 Data processing (XH120 Manager)

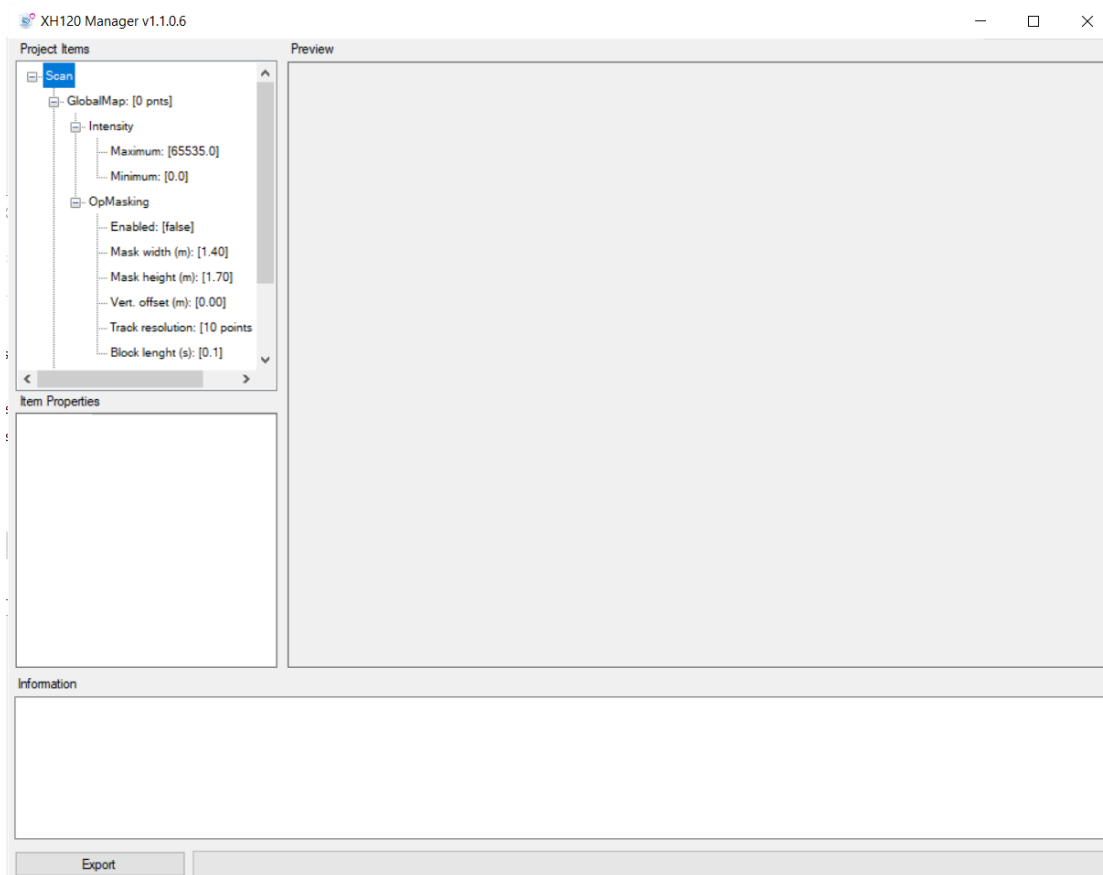
Data obtained using XH120 are in .pcd or .dat format and can be read by STONEX® Cube-scan. To convert the file into third party-compatible formats, use the XH120 Manager software.

File Upload

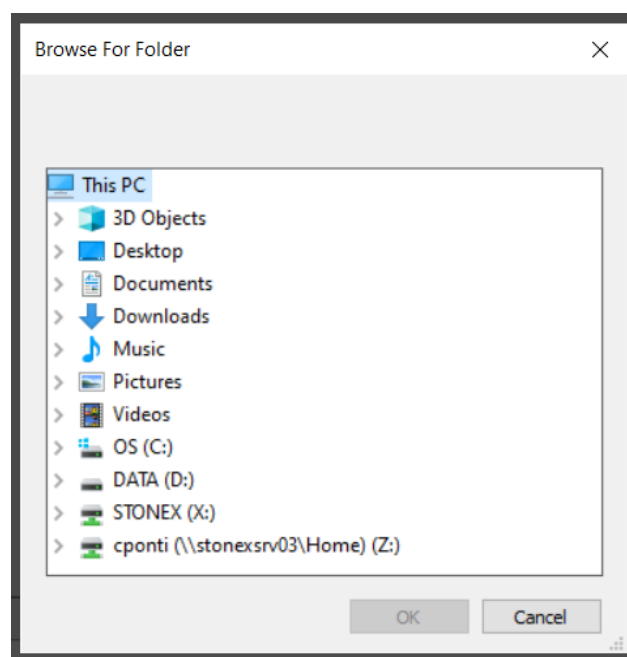
Open XH120 Manager:



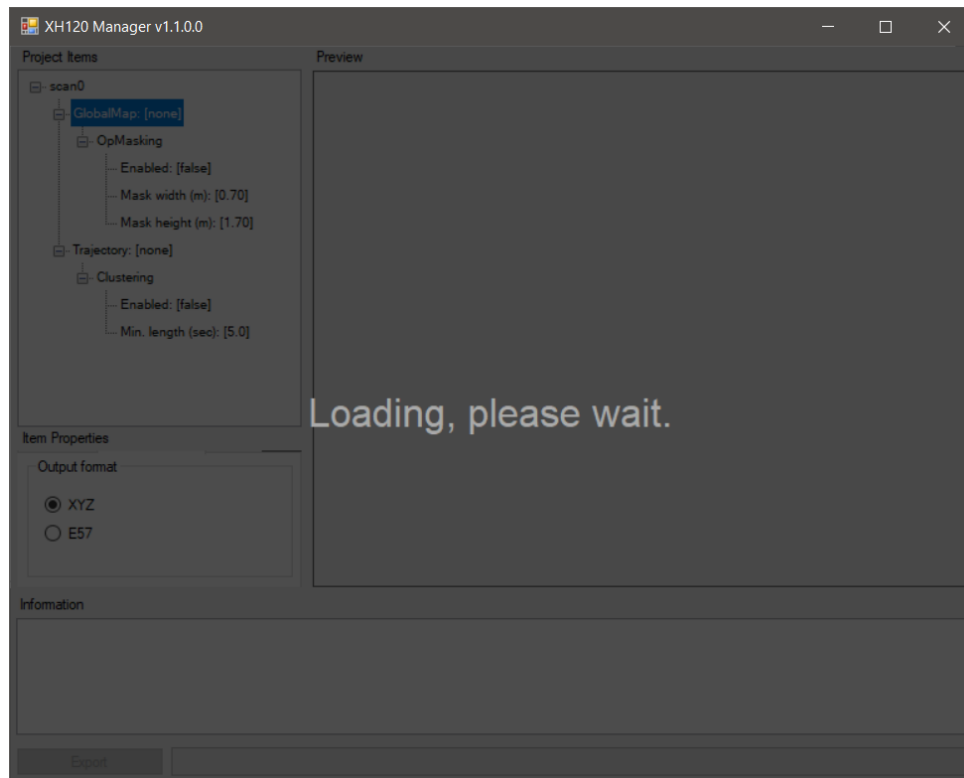
Double click on the Scan project item to load GlobalMap and Trajectory files:



Select the scan folder downloaded from Cube-slam (for scans saved in .pcd format, the files "timelist.txt", "GlobalMap.pcd", "trajectory.txt" must be present in the folder; for scans saved in .dat format instead "timelist.txt" and "GlobalMap.dat"):

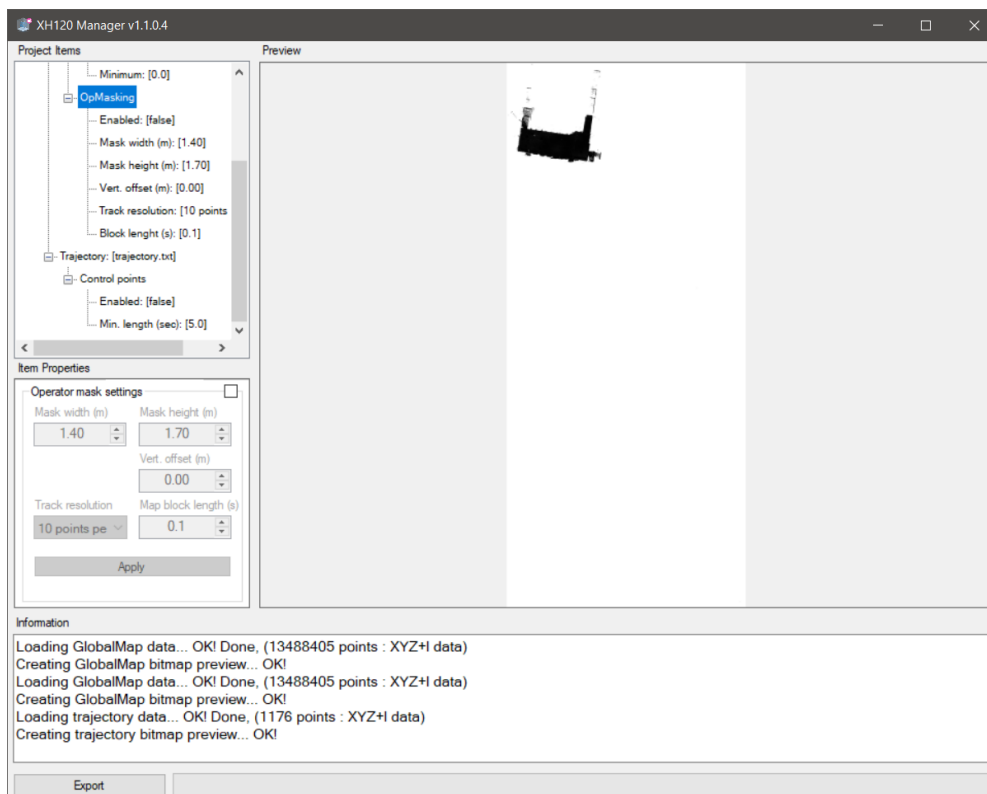


Wait until files are loaded:

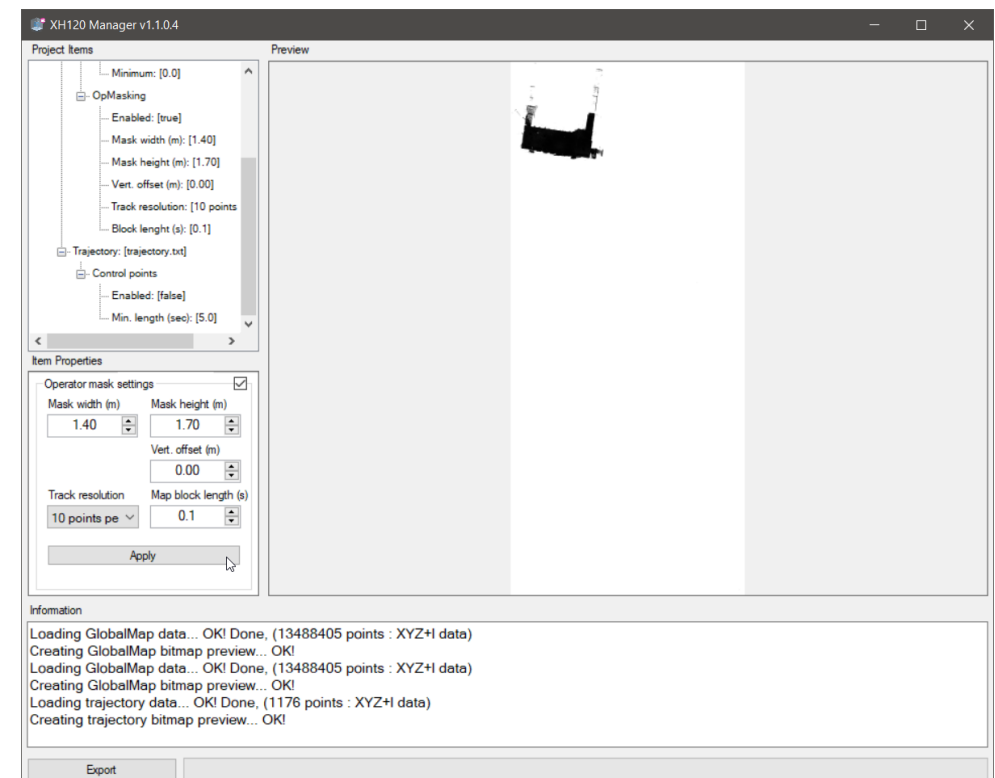
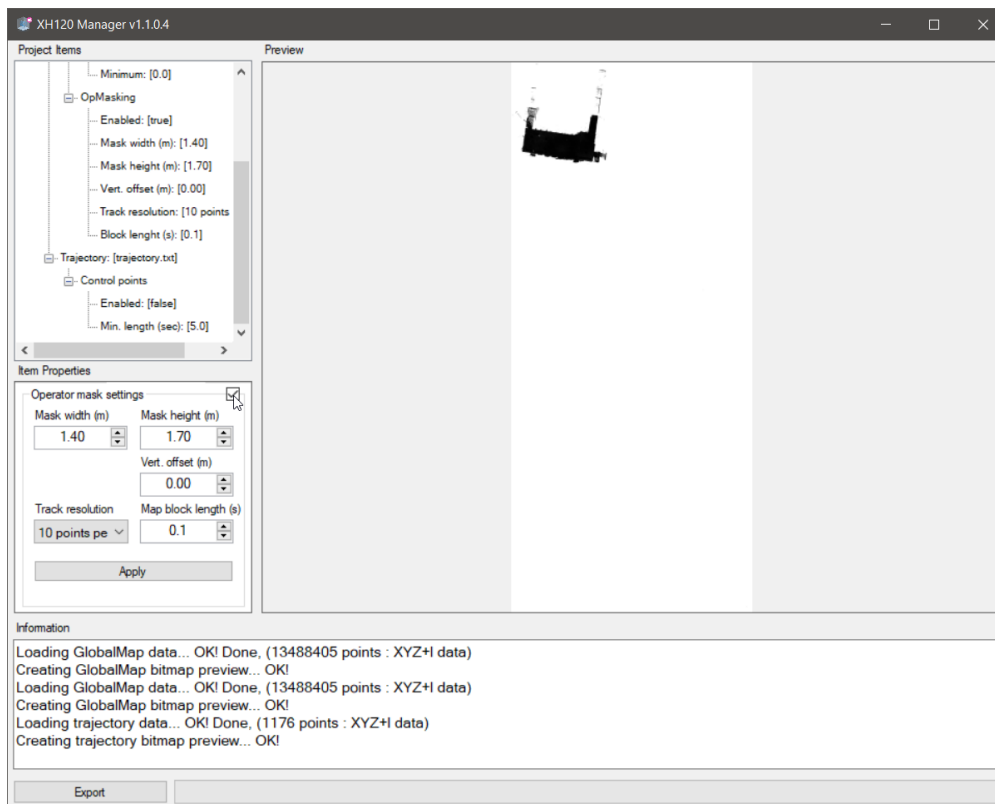


Operator Masking

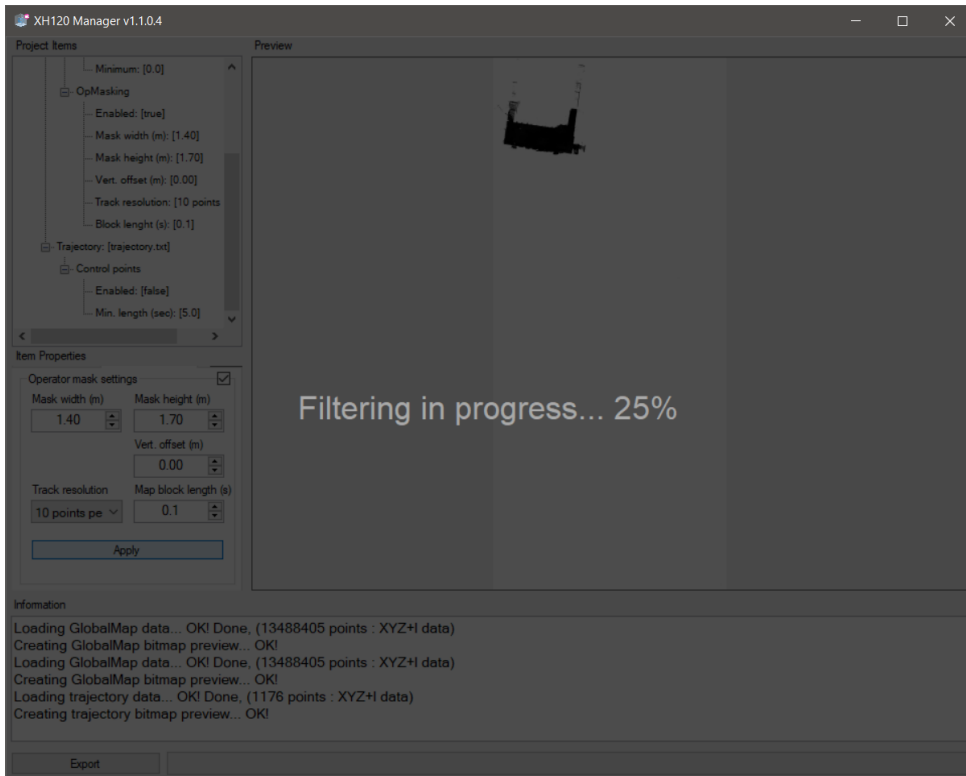
Click on the "OpMasking" project item to perform the operator ghost deletion:



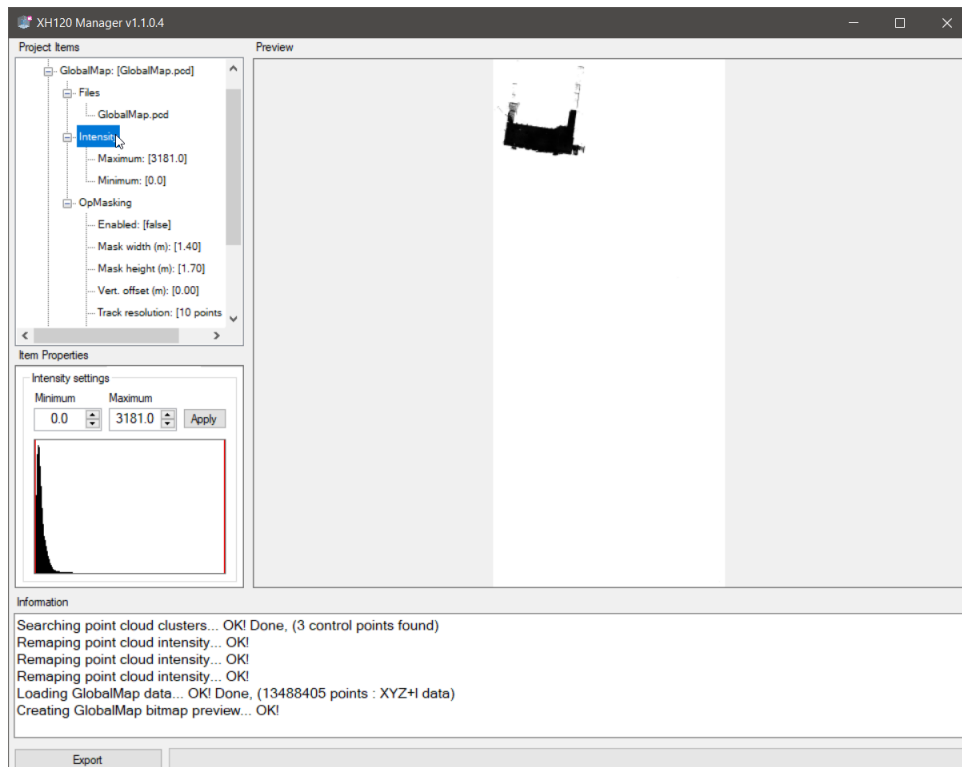
In the Item Properties window, tick the Operator mask settings to enable the operation, then set the size parameters and click on Apply:



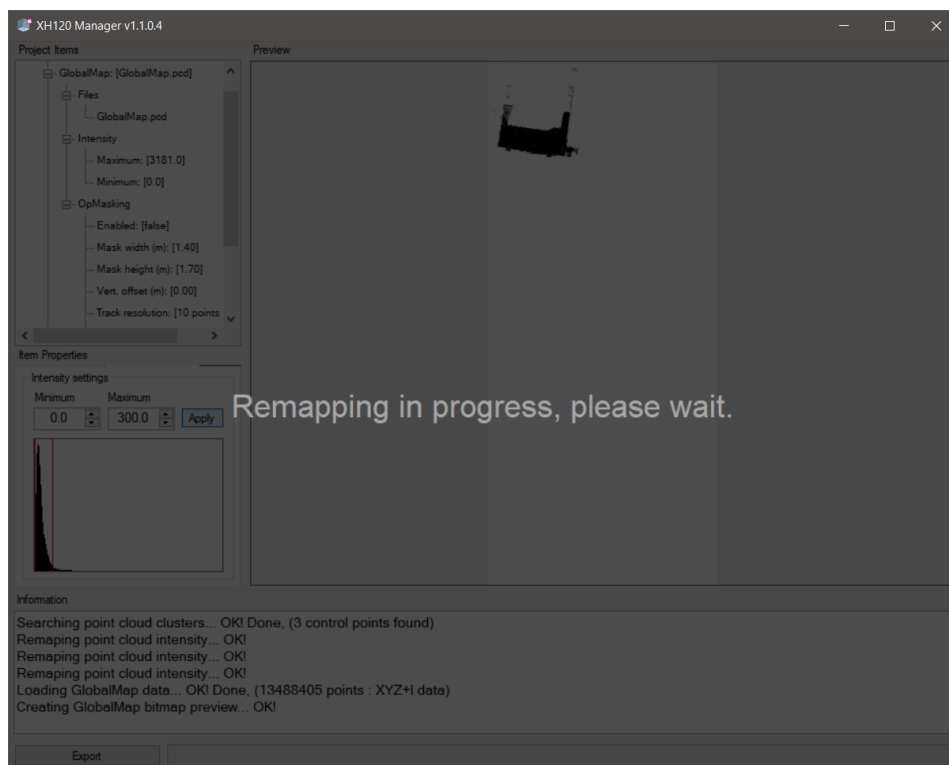
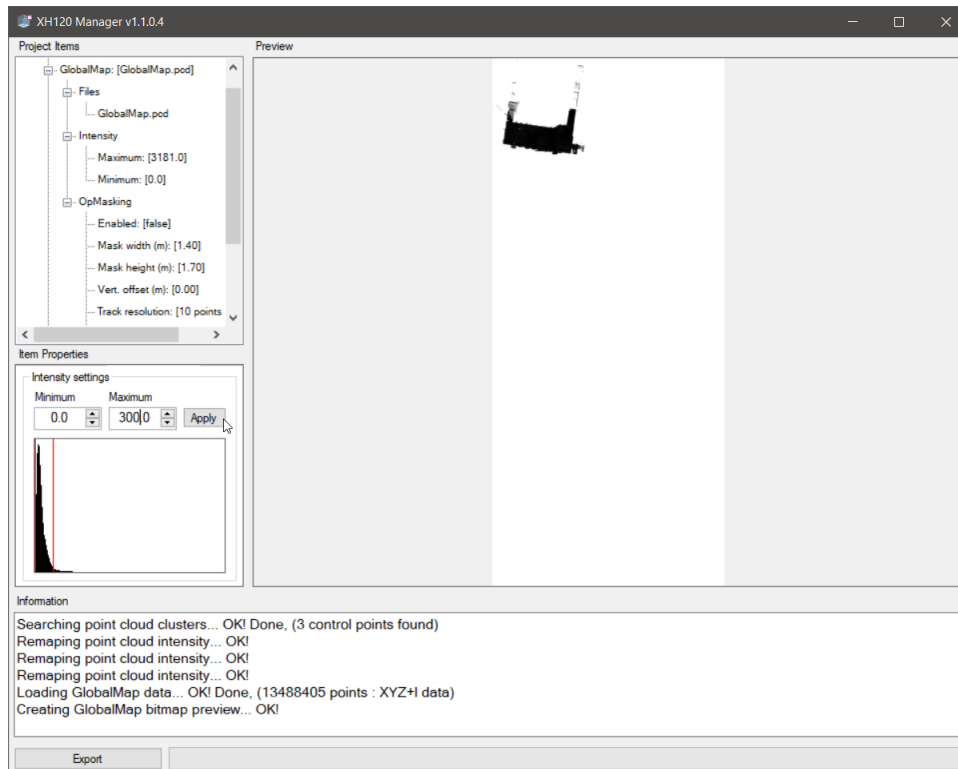
Wait until the filtering is applied:



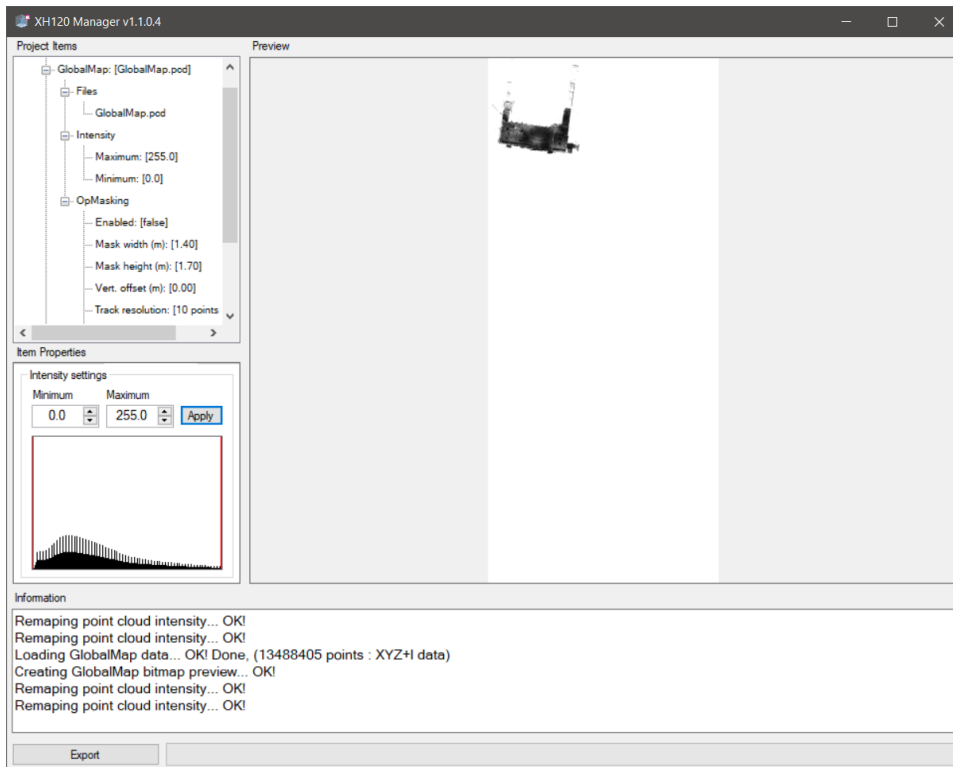
Click on Intensity to access the Reflectance histogram and modify it:



Modify min. and max. values and click on Apply:

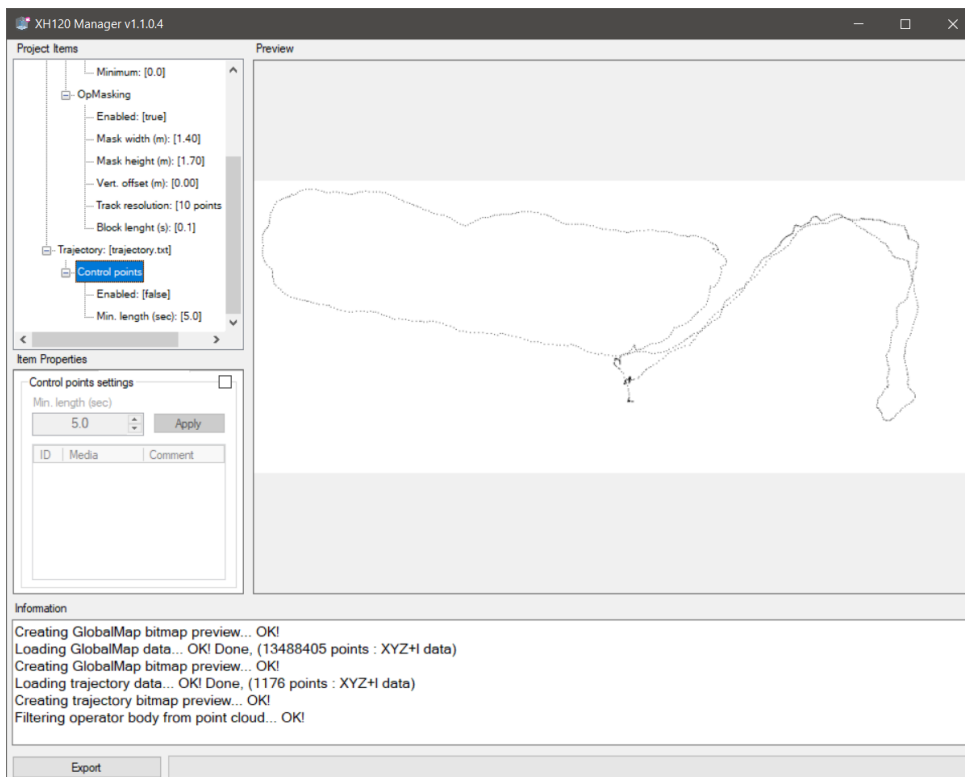


For later use in Stonex Reconstructor, we suggest using 0-255 extreme values



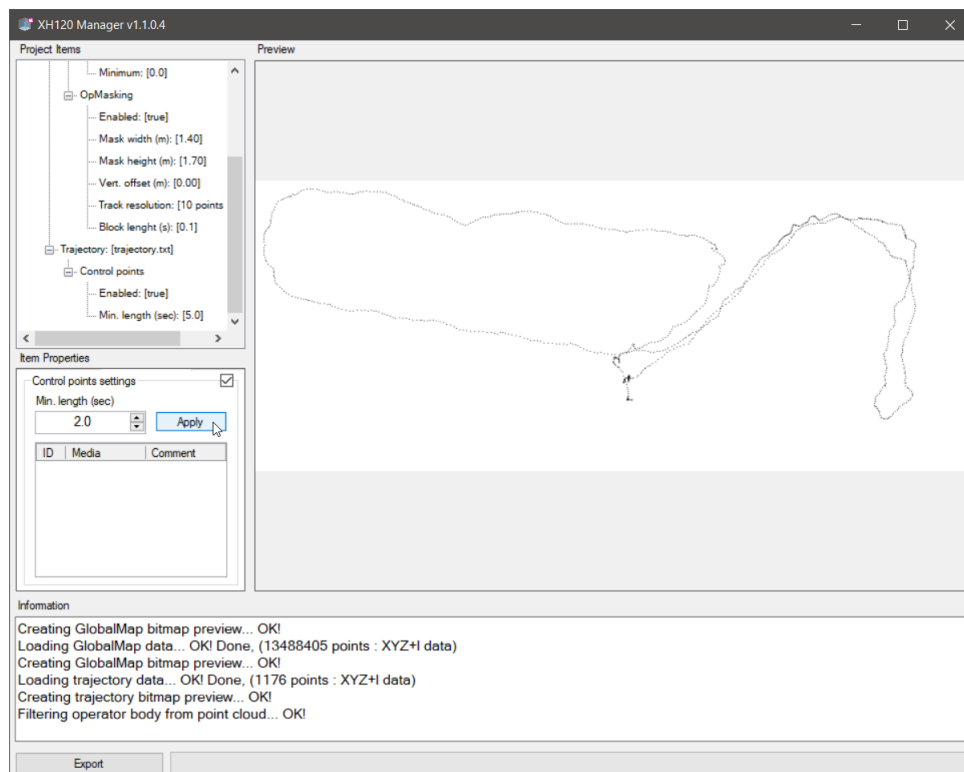
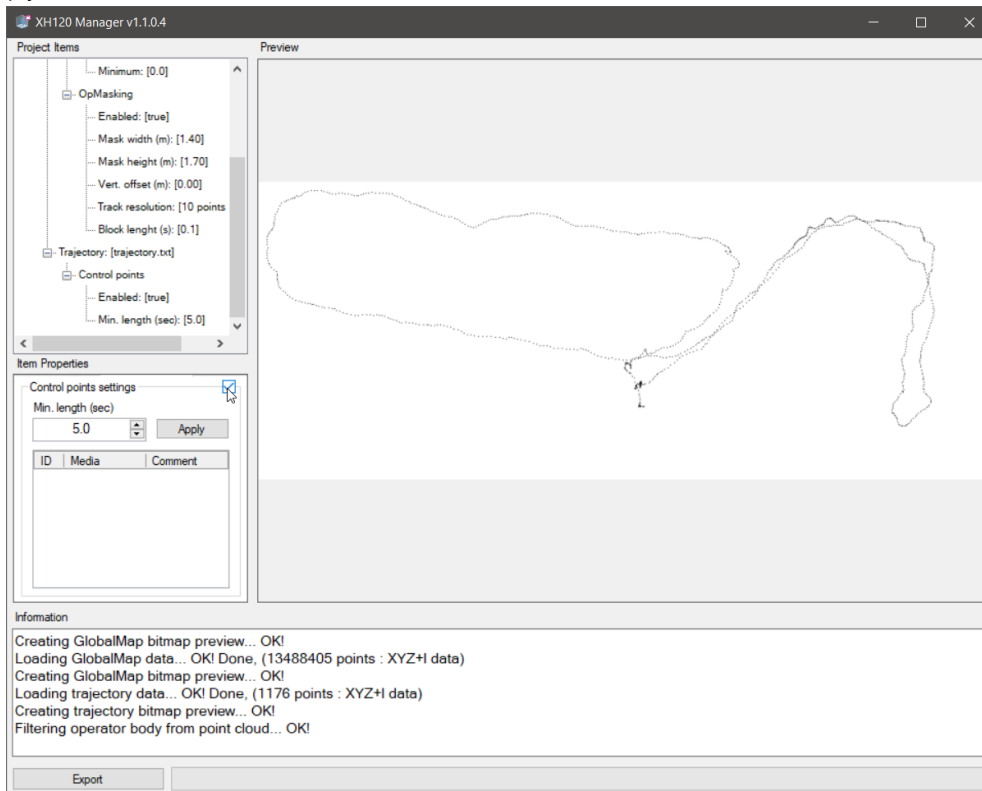
Control Points

Click on the Control Points project item to detect control points:

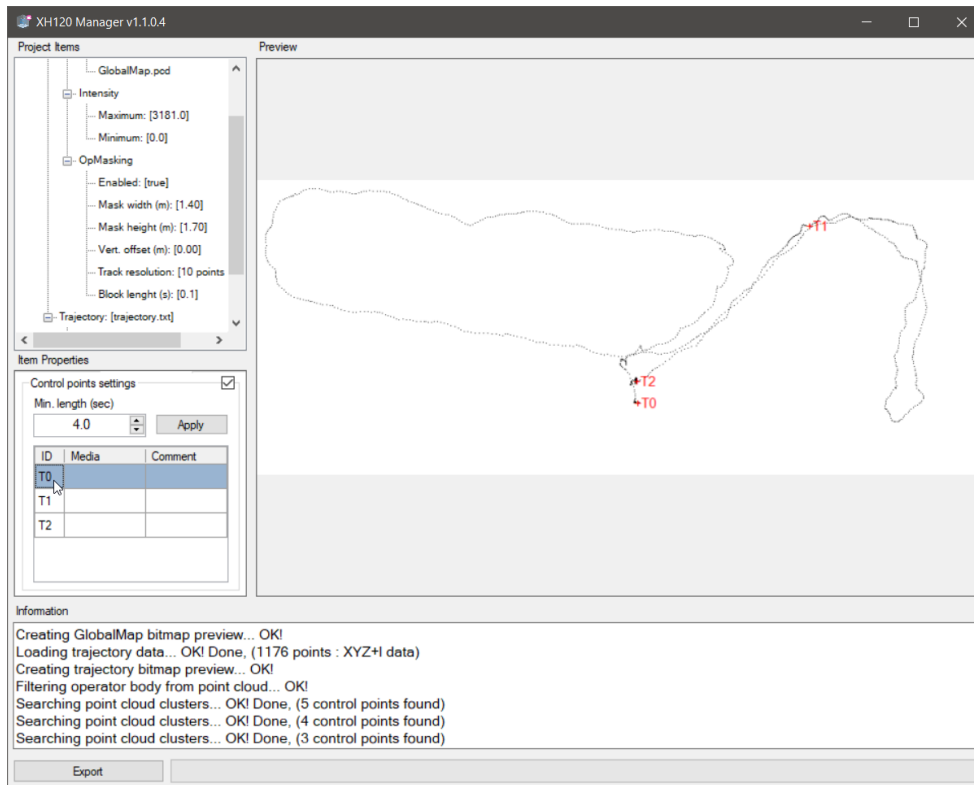


Tick the Control points settings item properties box to change the cluster detection parameter, then click

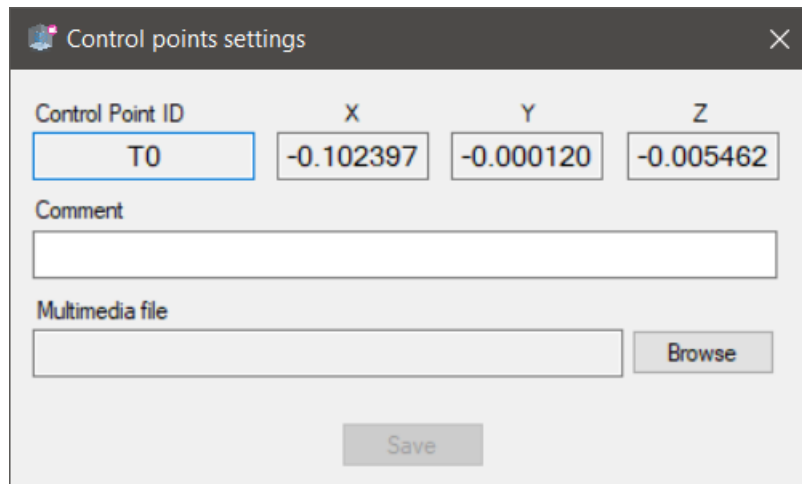
on apply to show the detected CPs:



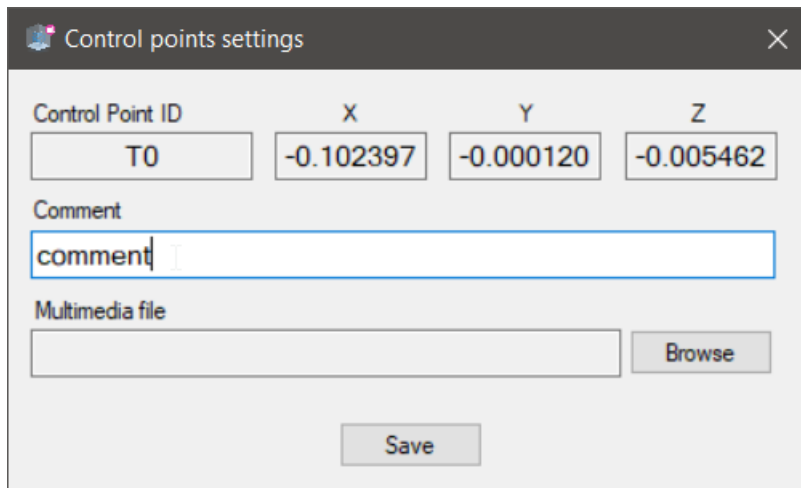
Click on a point name to access the control points settings window:



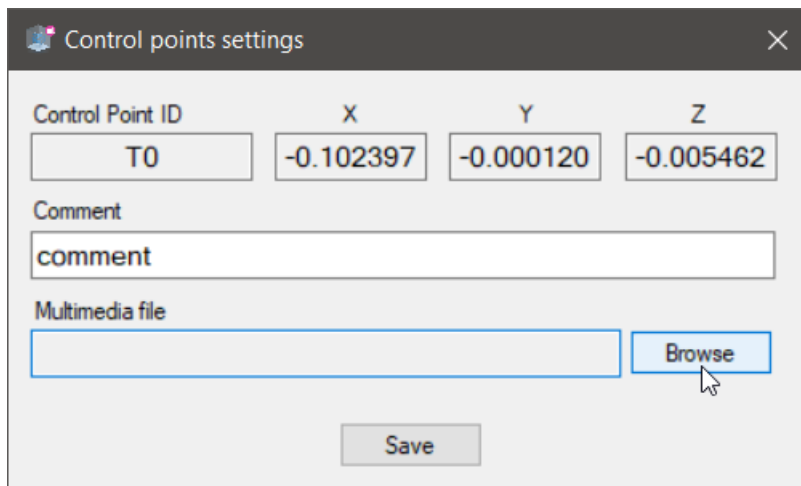
The control point, with its coordinates, will be loaded:



In the Comment section, you can write a comment for the selected control point (no commas or spaces allowed)

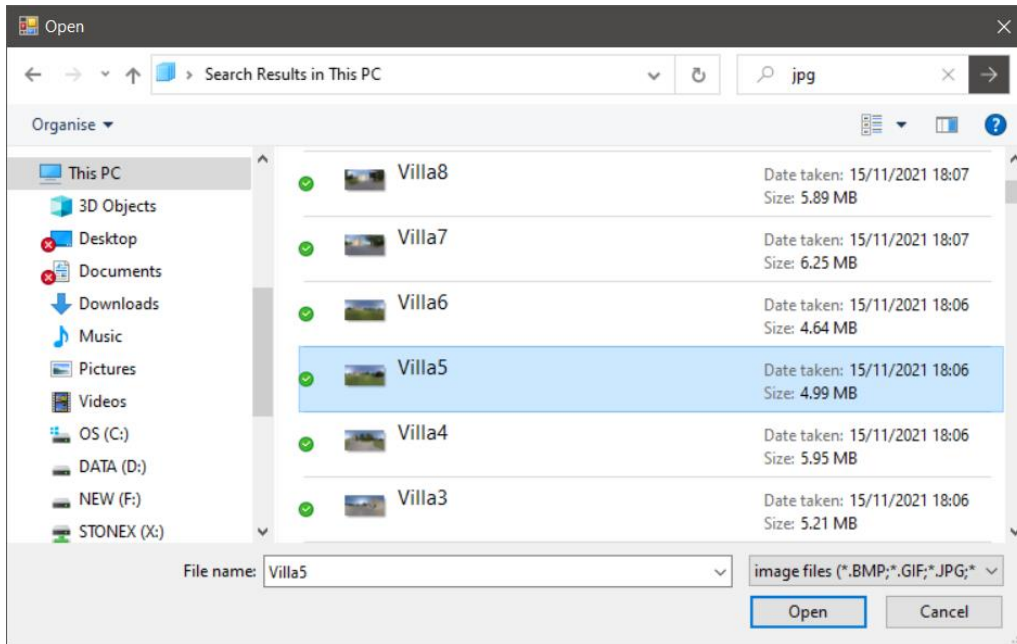


In the Multimedia file section, you can upload an image or video file to be linked to the selected control point. Click on browse:

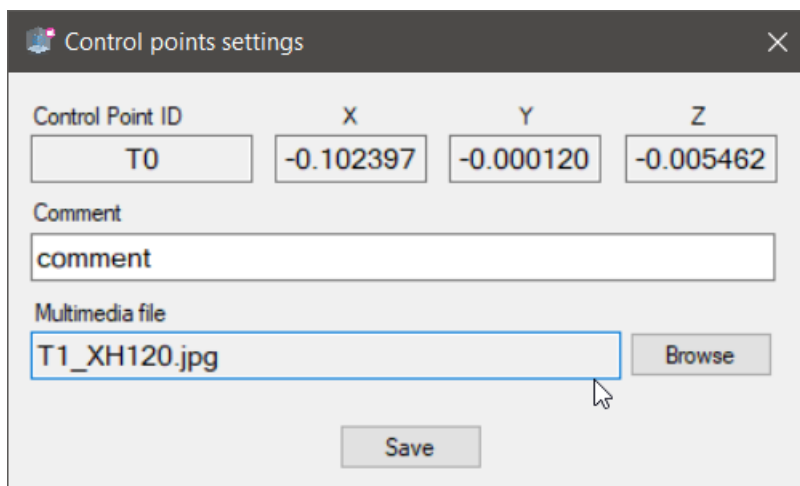


Select the image or video file:

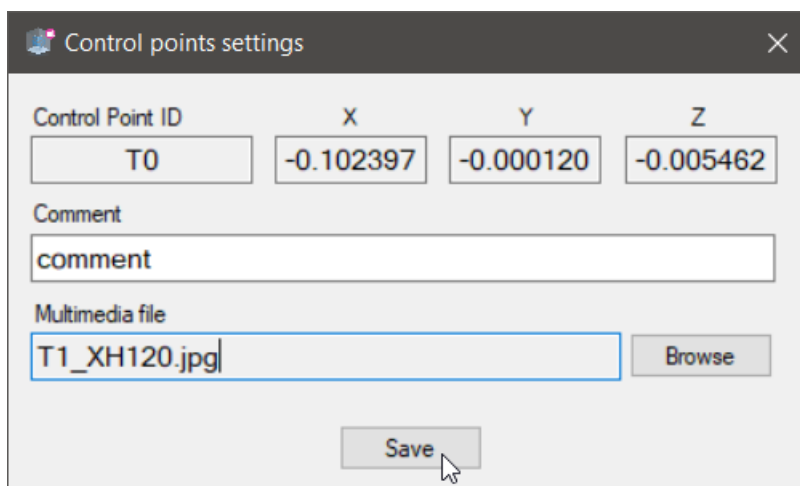
Note: all the image and video files to be used should be stored in your computer in a folder called “media” placed in the same location of the scan files, for the hyperlink generated by XH120 converter is relative to and will be stored in such folder.



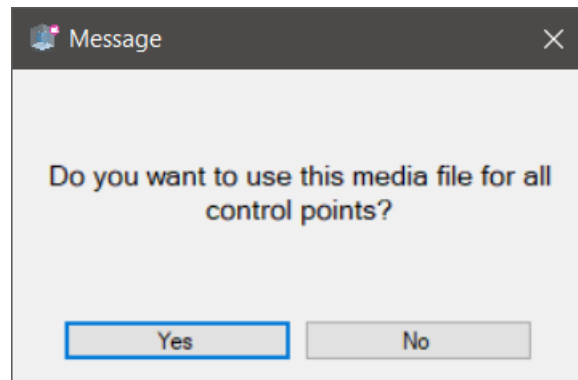
The file is uploaded:



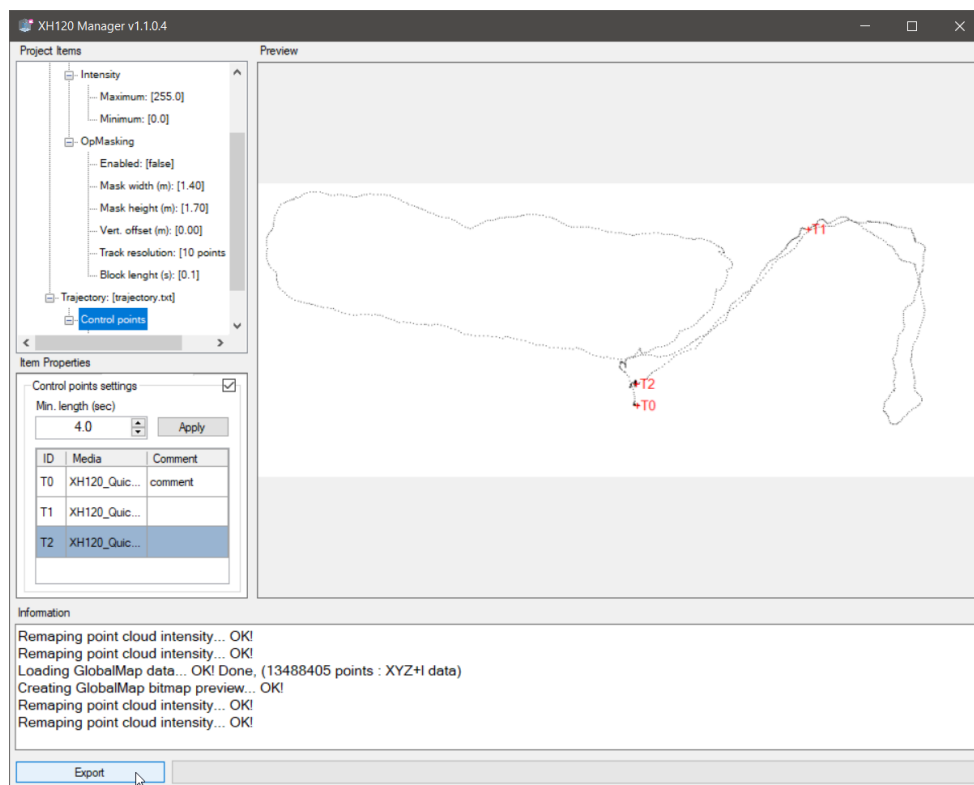
Click on Save to confirm the changes and move to the next control point:



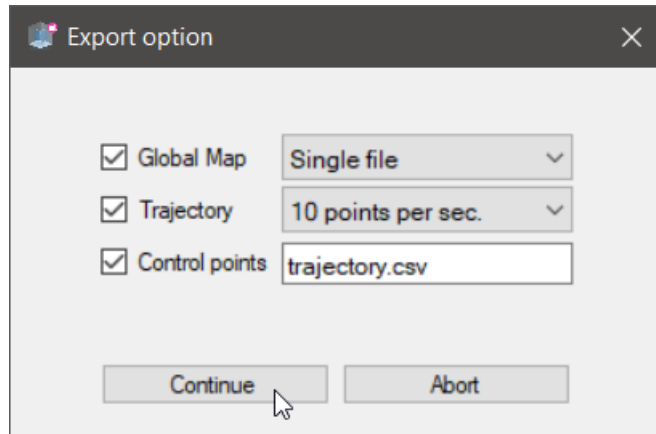
If a video file is chosen, XH120 Manager will ask if the user wants to use the video for all the control points: the video will be linked at the correct timestamp for each control point.



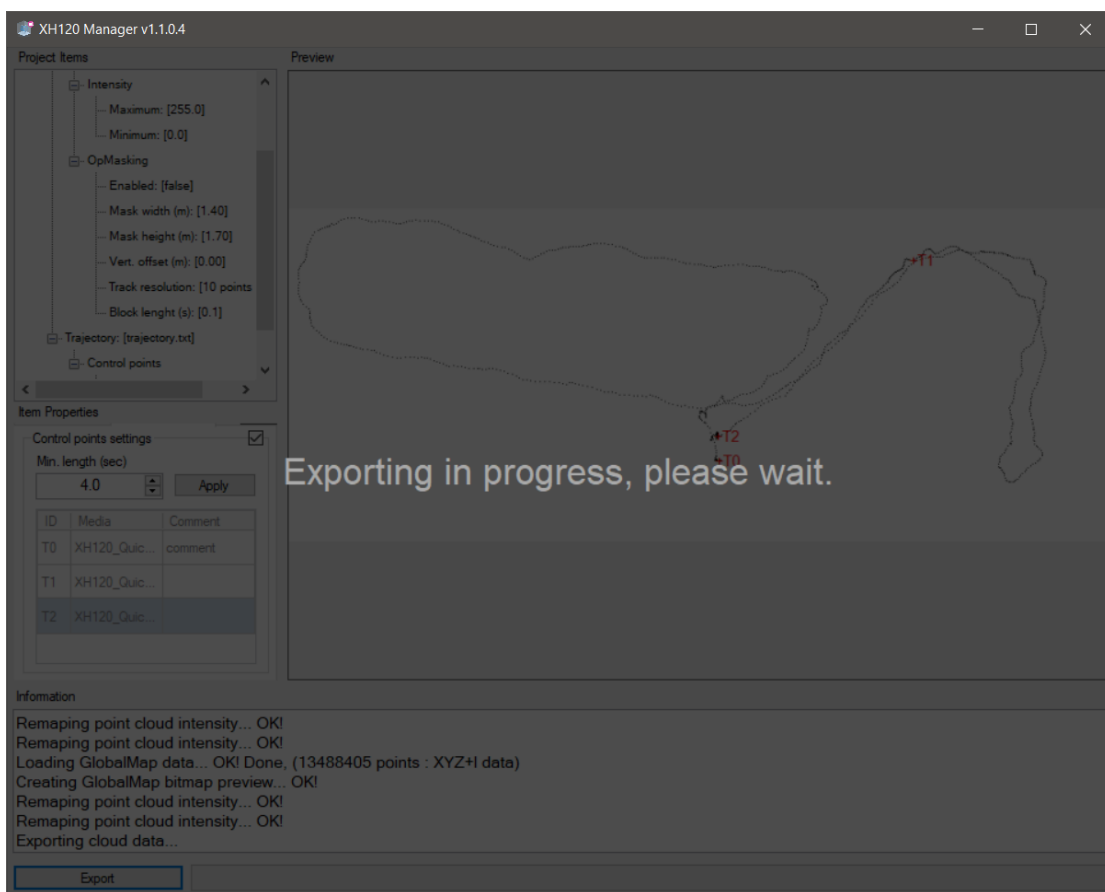
Once you have finished, to download the Map and trajectory files, click on the Export button:



Select the files you want to export, choose the settings and name for the trajectory file, then click on Continue

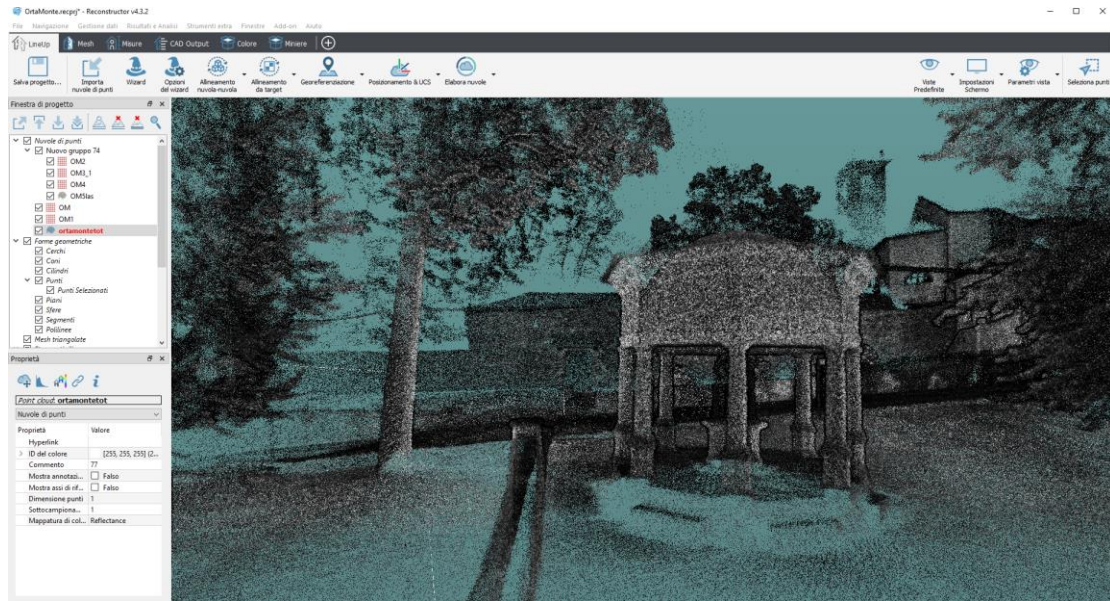


The files will be exported in .e57 format, while the control points will be exported in .csv format, ready to be imported as Annotations in Stonex Reconstructor.

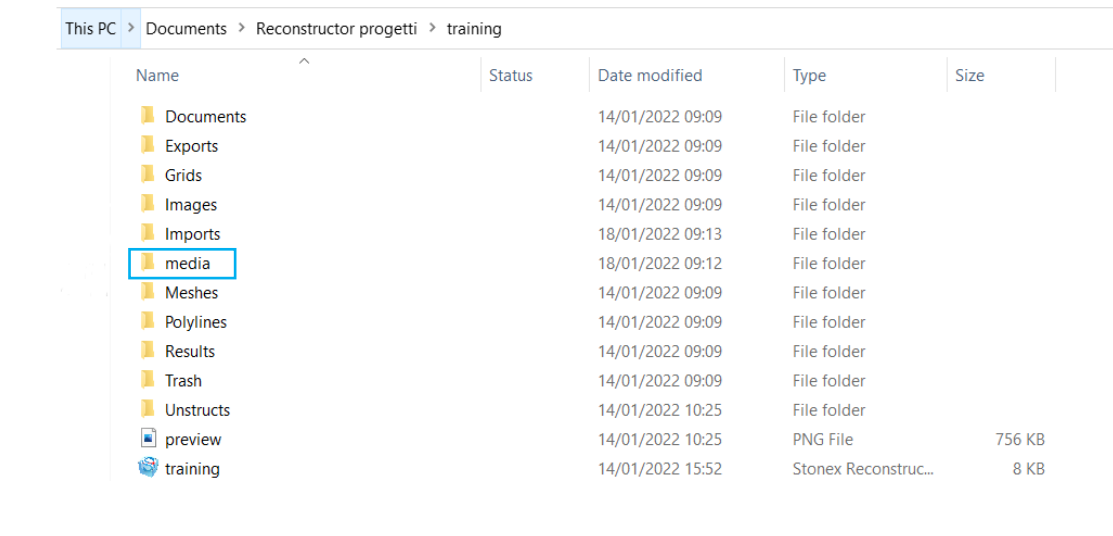


6.5 Data Processing (Advanced)

Now, scans are ready to be imported in a 3D point cloud software like STONEX® Reconstructor, Cube-scan or other third-party software to perform cloud filtering, registration, and other useful operations.



Note: If you are using Stonex Reconstructor to further process your scanner data, you can directly display the trajectory control points as “Annotations”. To automatically show comments and hypelinks in the software, place the “media” folder inside the Reconstructor project folder, like this:



7. Operational recommendations

Before scanning, user should plan the optimal scanning path to identify potential problem areas, such as harsh environments, through doorways and stairwells, etc. The scan path of the plan should also be a "closed loop" as much as possible. Please refer to the guidelines of these chapter in order to achieve the best scanning results.

7.1 Environment

The SLAM algorithm, which is used to process raw laser scan data into a 3D point cloud, relies on identifying features present in the scanning environment, which are scanned repeatedly when the operator passes through the scanning environment. For the feature to be prominent, the ratio of its size to the range must be approximately 1:10. For example, within the range of 5m, the size of objects with distinctive features must be greater than 0.5m.

Environments with "poor characteristics" include open spaces (such as roads without buildings, smooth long tunnels, etc.). In these environments, the SLAM algorithm may not have enough features in the direction of travel to determine the moving direction. We recommend the following steps:

1. If possible, use other objects to enhance the environmental characteristics. For example, in an empty long corridor, placing boxes or parking vehicles in open spaces, etc.
2. When moving in the environment, please ensure that any available features are scanned repeatedly. By doing so, enough feature points can be obtained, which increases the possibility of using this feature by the SLAM algorithm. This is especially important when the element is at a long distance (>10m). For example, when scanning a smooth wall passage, the only feature in the direction of travel is the end of the wall passage or door.
3. Avoid scanning moving objects (for example, pedestrians or vehicles walking close to you during scanning, especially large trucks), because the SLAM algorithm may lock these objects as static features, which will cause the mapping to fail.

7.2 Loop closure operation

The SLAM algorithm uses the previous positions to determine its current position. This method may introduce some errors and cause the measurement position to "drift". A good measurement habit is to "close the loop" by re-visiting a known position so that the compound error can be constrained within the loop range.

The minimum requirement for loop closure operation is that the operator must start and end the measurement at the same location to ensure that at least one loop is closed. However, it is recommended that the operator close the loop as often as possible, to minimize errors and improve the accuracy of the resulting point cloud. Replace a big single loop with multiple small loops.

It is also better to make a "circular loop" rather than a "forward/backward loop", because in the latter case, the survey path simply doubles itself, which is not helpful for the SLAM algorithm. That is, if possible, enter and exit through different doors, and move between floors through different stairwells.

It is important to scan the closed loop area carefully to ensure that key features are scanned from a similar angle. If you return to an area from another direction, it may be necessary to turn around. This is especially important in environments with poor characteristics.

7.3 Transition between environments

When transitioning between environments (for example, passing through a doorway or turning around a sharp bend), extreme care must be taken to avoid introducing errors, because when switching between different environments, the local view may suddenly change, and adjacent contours change too much, making it difficult for the SLAM algorithm to place a new environment relative to the previous environment. This may cause the rooms on both sides of the passage to be slightly misaligned or even fail the alignment. You should walk through the doorway slowly and ensure that the scanner can view features on both sides of the doorway (i.e., the two "rooms") for a period. Before starting the scan, try to open all the doors. Avoid opening the door while scanning the door. If you can only open the door while scanning, please turn your back to the door, open the door from behind, and then back through the doorway.

Transition slowly around sharp bends and ensure that the scanner can view features on both sides of the bend for a period.

When transitioning from a closed environment with rich elements to a harsh environment with open elements. Please be careful. For example, when you walk out of a building, if there are no other features in the range, you may need to turn and face the exit and the external facade of the building. When crossing a transitional section, avoid scanning any other moving objects (for example, walking pedestrians or moving cars).

7.4 Walking speed

It is recommended to capture data at walking speed to ensure good coverage and high-resolution data. If you move forward too fast, the SLAM algorithm may not have enough repeated scanning features to process the original laser data into the point cloud.

7.5 Minimum and maximum range

(By default) Data within a smaller range than 0.2 m from the scanner will not be processed to eliminate data from the scanner operator in the final point cloud. Avoid getting close to walls and ceilings.

The maximum range of the scanner is 120 m. This range can only be reached under optimal conditions (indoors with good target reflectivity). In most cases, the typical maximum range is 60-80 m. It is recommended to keep the range within less than 50m to ensure a good point density and assist the SLAM algorithm.

7.6 Initial position

It is recommended to start the scan initialization positioning the handheld part on a horizontal and stable position (e.g. on a table or on the suitcase), this will allow the SLAM algorithm to automatically define the correct directions for the horizontal plane.

7.7 Scan time

For large scanning areas, the project should be broken down into multiple scanning tasks. This is to avoid excessive file size and reduce possible drift in the data. It is recommended for each scan to be limited to 10 minutes. With a slow walking speed, it can cover a measurement distance of 1000 m.

7.8 Access to restricted or difficult scanning areas

The scanner can remain stationary for a short period of time, while the operator can hold the scanner to

enter restricted or difficult areas (such as narrow passages). It is possible to scan objects in hard-to-reach situations by simply extending/moving the arm holding the handheld part.

7.9 Moving objects in the environment

In most cases, the SLAM algorithm can handle moving objects in the environment. To estimate the trajectory of the sensor, the algorithm assumes that the static proportion of the environment is large. However, in some harsh environments lacking 3D structural features, moving objects will have a greater impact on the solution. Especially in long tunnel environments (such as long corridors), relatively open spaces and transitions through doorways, avoid moving objects. The best practice is not to let other people closely accompany the operator during the scan acquisition, because they will be scanned across the entire map, leaving data streaks that may destroy the algorithm in a harsh environment. If other people are required to follow the operator, they should ideally keep 20m or more from the operator.

7.10 Control Points Acquisition

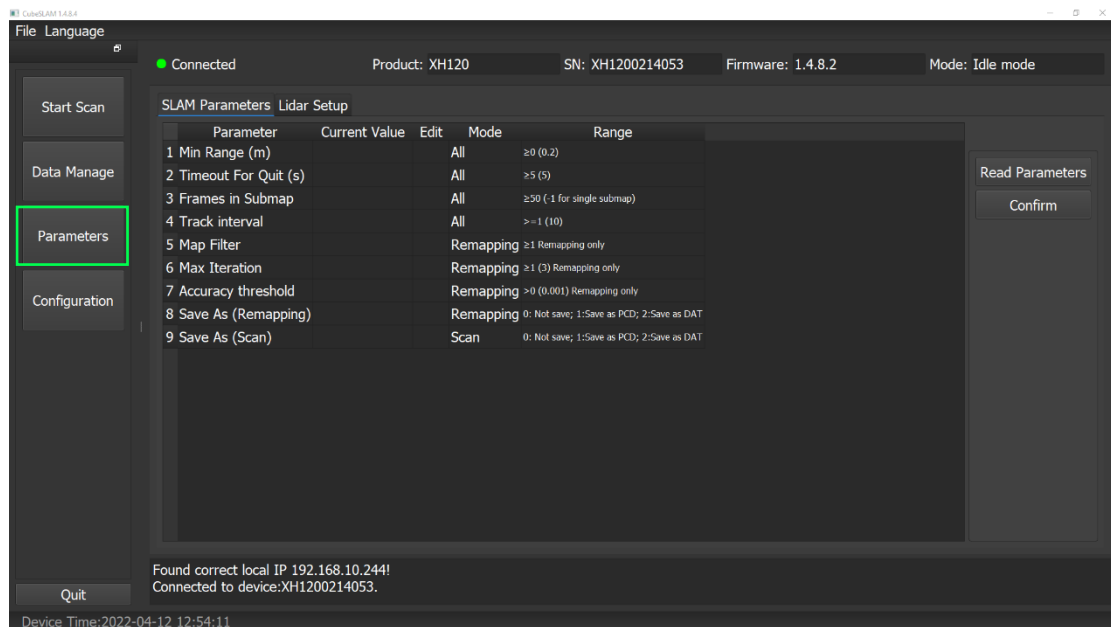
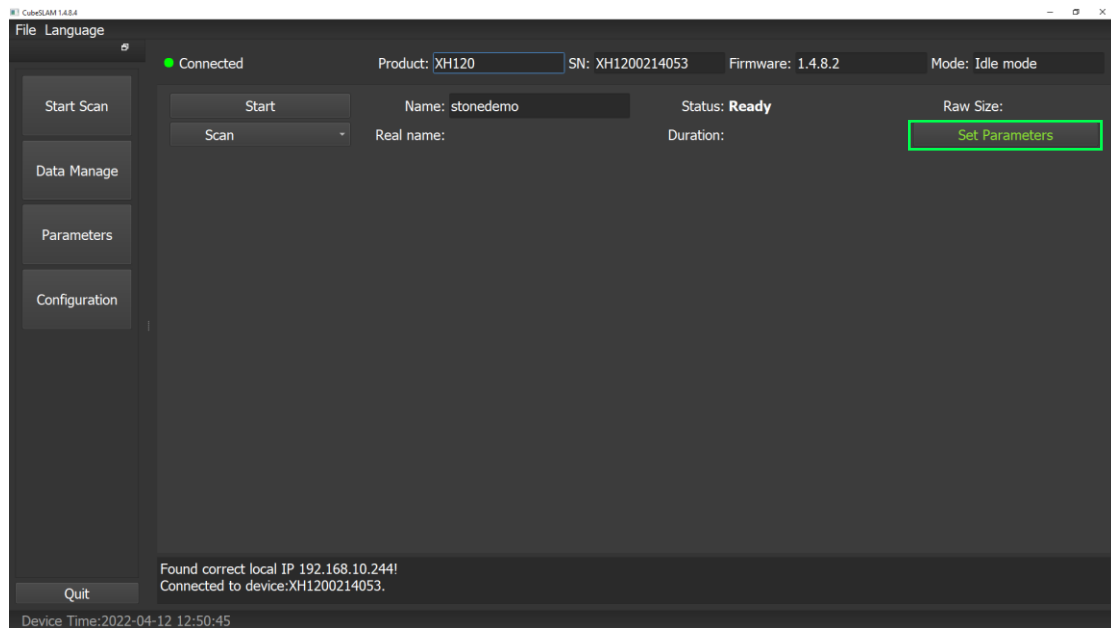
During scanning operations, it is possible to locate certain control points by standing in the same position for a few seconds. The trajectory will then present clusters of points that can be recognized within the XH120 Manager software, and these can be associated with video or images.

Center of LiDAR sensor – control mark offset is of 232 mm.

8. Instrument settings and management

8.1 Parameters

Users can edit the SLAM parameters according to their preferences, by clicking on the “Set Parameters” button or by accessing the “Parameters” page from the corresponding button placed on the left part of the screen:



Slam Parameters

PARAMETER	FUNCTION	VALUE RANGE	DEFAULT VALUE
Min Range (m)	<p>Minimum ranging to the Lidar's center point.</p> <p>Points less than this distance are automatically ignored during SLAM operation.</p>	≥ 0 m	0.2 m
Timeout For Quit(sec)	If XH120 cannot get any frames from the Lidar sensor, it will close the SLAM and quit the operations.	≥ 5 s	5 or 10
Frames In Submap	<p>How many frames are saved in a GlobalMap file. The bigger value, the larger the GlobalMap size. 600 frames correspond to 1 minute scan.</p> <p>-1 : All data will be saved in one GlobalMap.pcd file.</p> <p>After scanning, the number of files is shown next to the GlobalMap size in parentheses.</p>	≥ 50 or -1	-1
Map Filter	<p>This parameter applies only for remapping, when scanning, the value is set to 6</p> <p>By setting it to 1 the remapping will produce the highest point density, the higher the value, the sparser the point cloud obtained after remapping.</p> <p>(Remapping only)</p>	≥ 1	4
Max Iteration	Max Iteration times during SLAM progress. The bigger value, the slower Remapping speed, and the better the effect. (Remapping only)	≥ 3	
Trajectory Interval	<p>Subsampling factor for the trajectory points.</p> <p>1: All the trajectory points (one every 1/10th sec.) are saved in trajectory.txt;</p> <p>10: One every 10 trajectory points (one every sec.) are saved in trajectory.txt;</p>	≥ 1	
Accuracy Threshold	<p>Threshold for the Remapping algorithm.</p> <p>The smaller, the more accurate the point cloud.</p>	> 0	0.00001

Combined with parameter "Max iterations", you can improve the accuracy of GlobalMap.

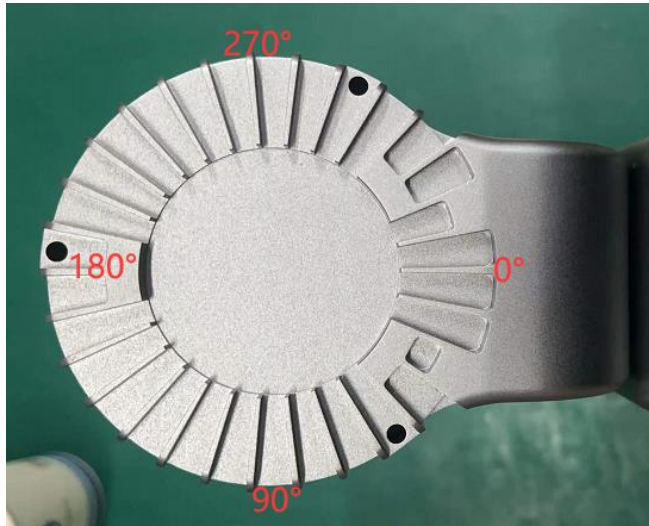
Save As	Choose file saving format	0 = No, 1 = PCD, 2 = DAT
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Recommended Parameters

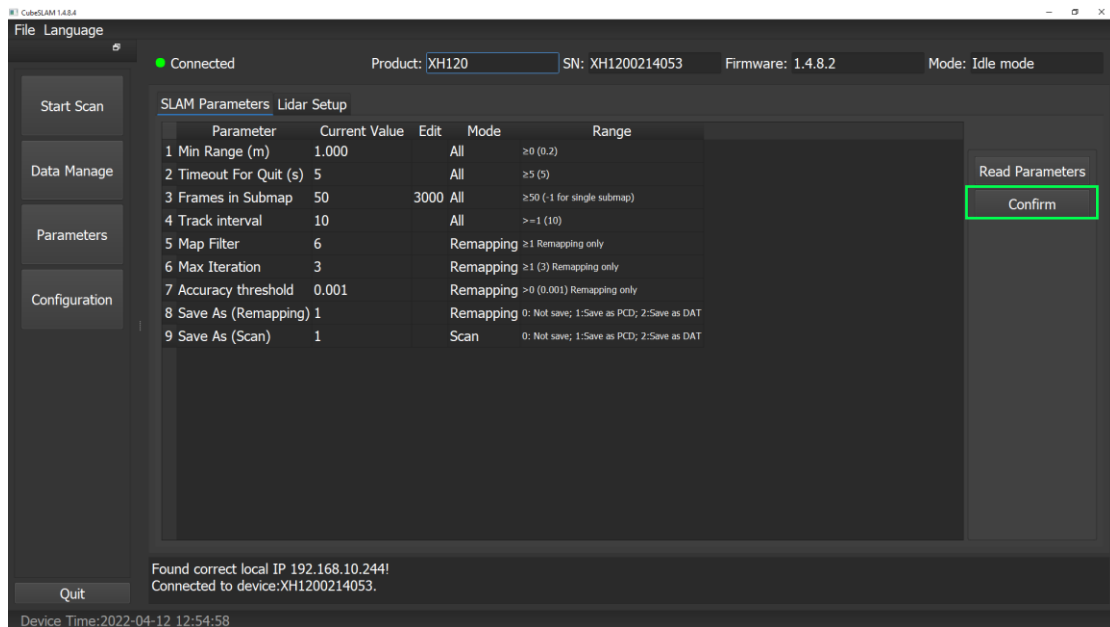
+ SLAM Paramters		+ Lidar Setup		
Parameter	Current Value	Edit	Remark	
1 Min Range (m)	0.200		≥0 (0.2)	
2 Timeout For Quit (secs)	10		≥5 (5)	
3 Frames In Submap	3000		≥50 (-1 meas all)	
4 Map Filter	1	1	≥1 Remap Only	
5 Max Iteration	50	50	≥1 (3) Remap Only	
6 Track interval	1		>=1 (10)	
7 Accuracy threshold	1e-5	0.00001	>0 (0.001) Remap Only	

Lidar Setup

PARAMETER	FUNCTION	VALUE RANGE	DEFAULT VALUE
FOV (degrees)	The range of data acquired by lidar. The format is angle1-angle2. For example, 0° - 360° indicates that all points within the range of 0° - 360° of lidar FOV can be obtained. 45° - 315° indicates that the lidar FOV is 45° ~ 315° , and points within 270° in total can be obtained. The remaining 90° range points cannot be obtained.	The value range of each angle is 0° ~ 360° . The first angle must be less than the second one.	0° - 360°

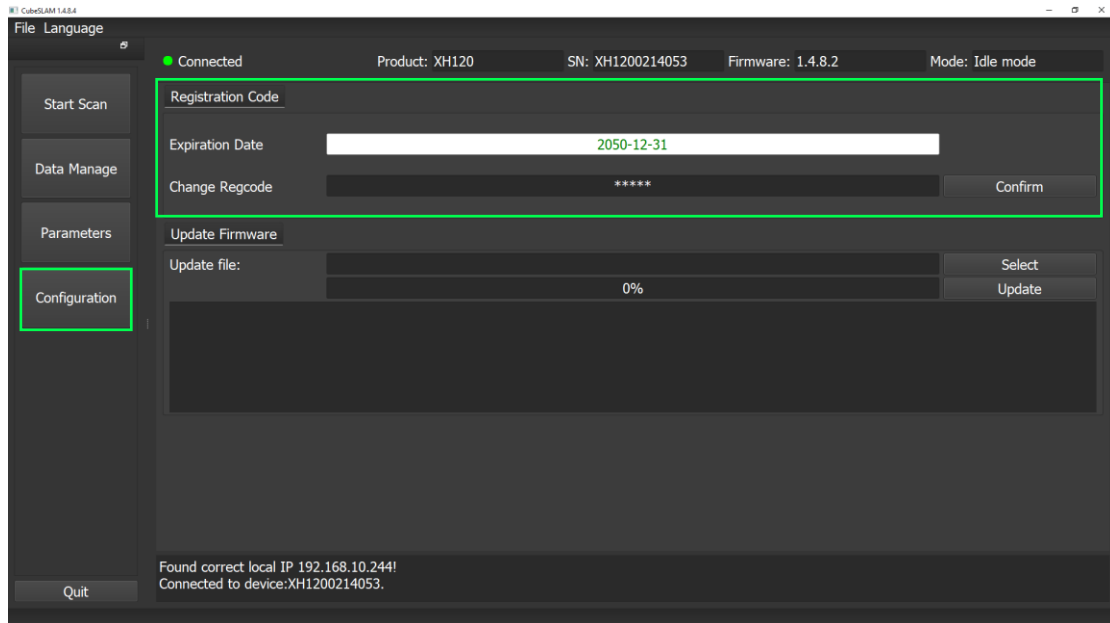


To edit a parameter, write in the Edit column the new parameter, then click on “Confirm”:



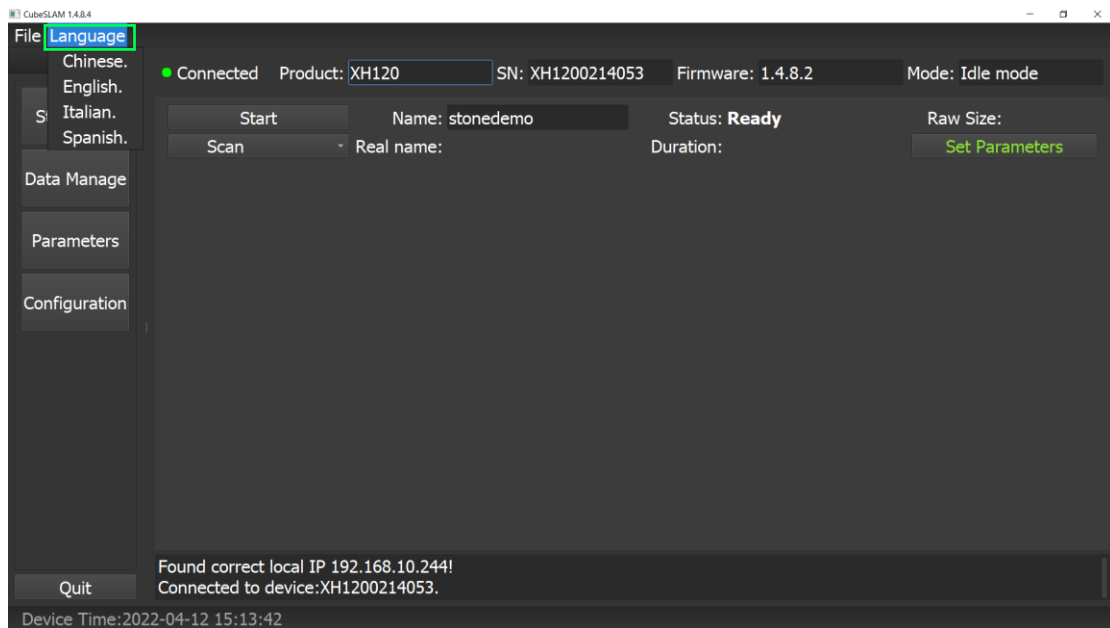
8.2 Product registration

Check the registration code and the expiration date in the Device Configuration panel



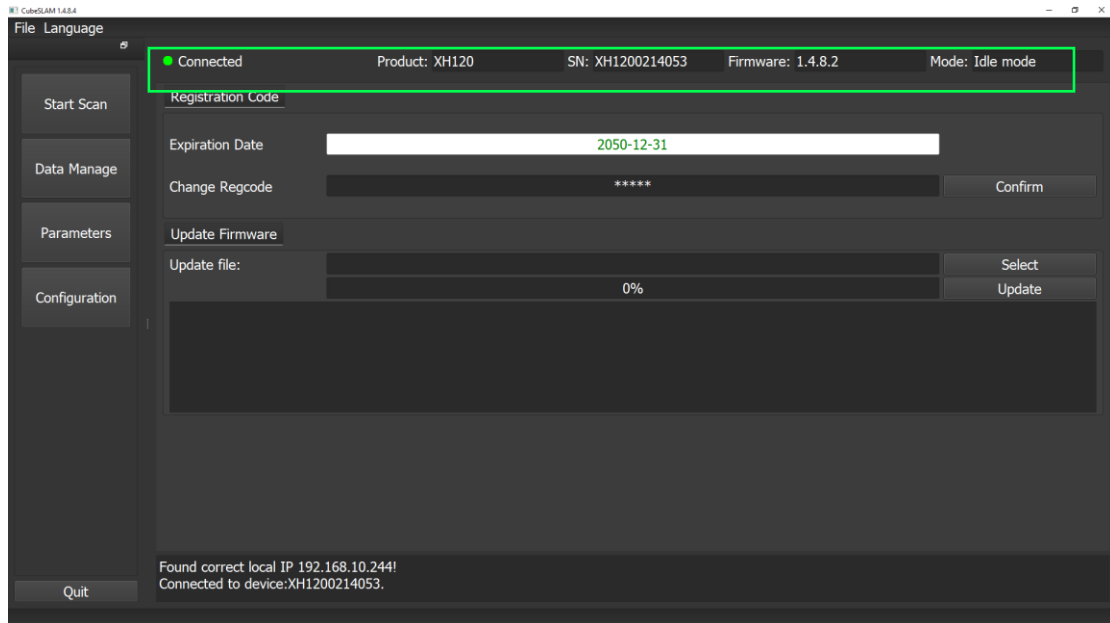
8.3 Language

Change the language of Cube-slam by clicking on the button on the upper left part of the interface



8.4 Product information

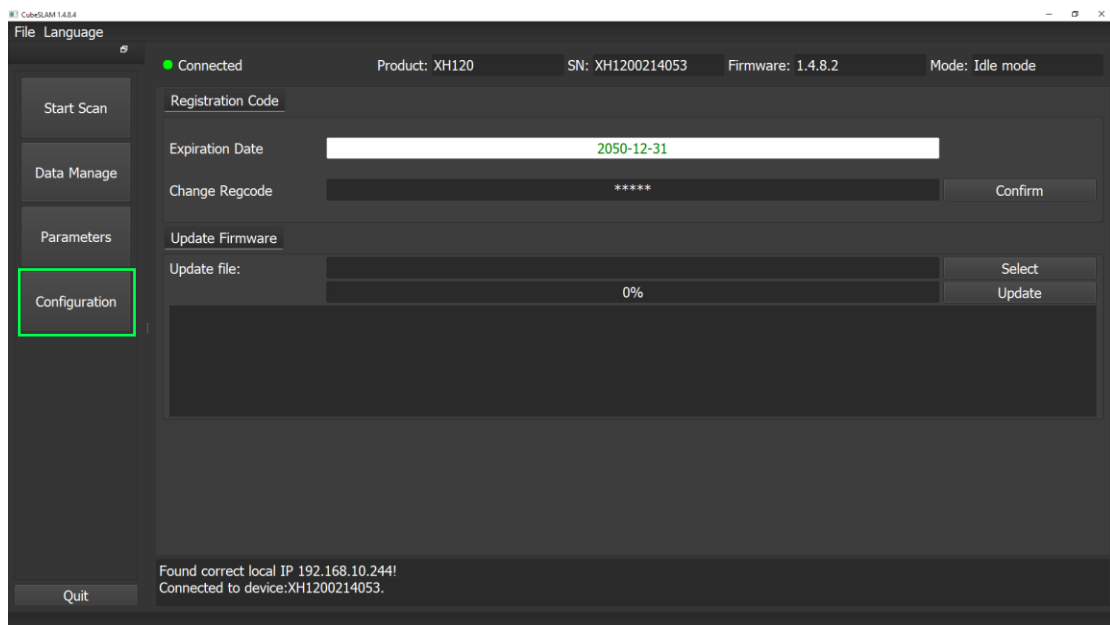
Check the product information (S/N, Firmware) on the upper part of the interface



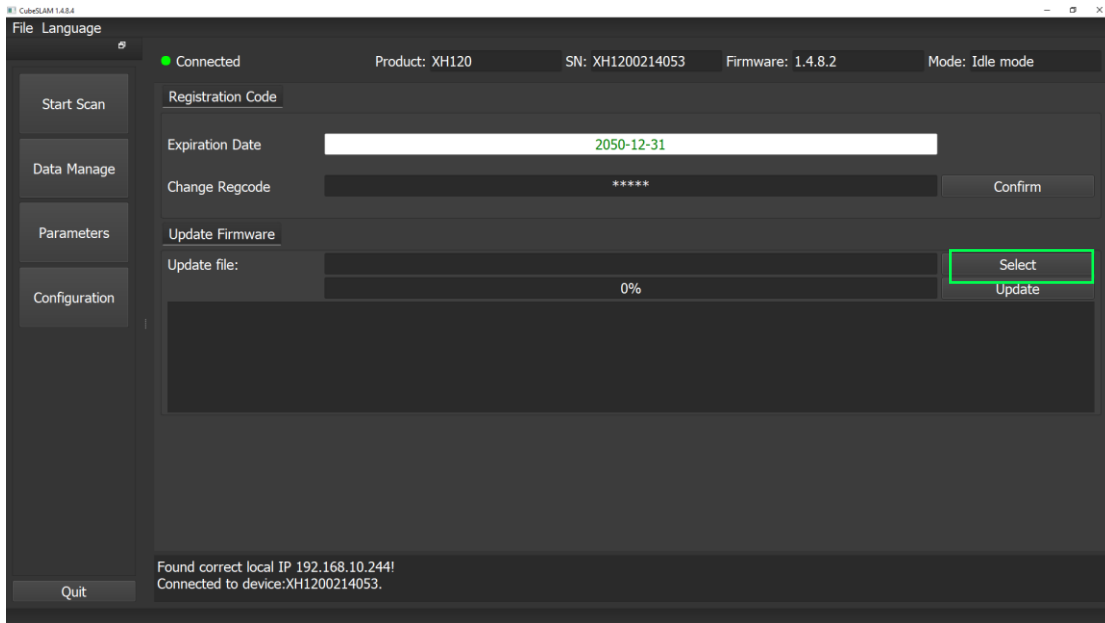
8.5 Firmware update

Users can update the instrument with a new firmware version when it is released.

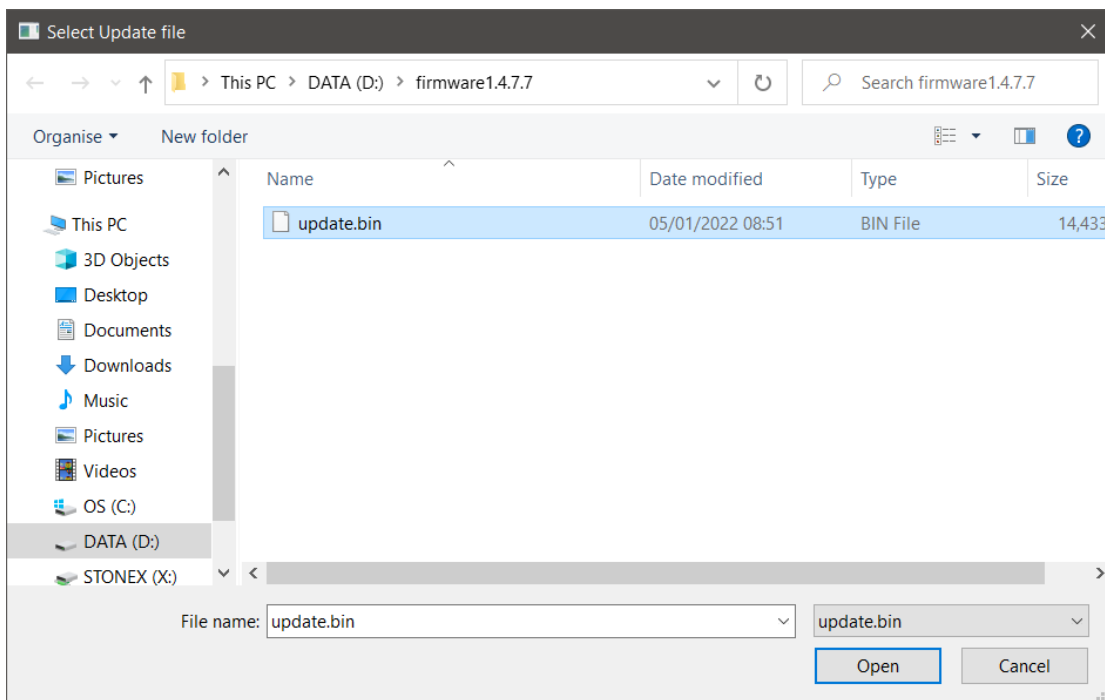
To update the firmware, open the “Device Config” page by clicking on the corresponding button, placed on the left side of the interface:



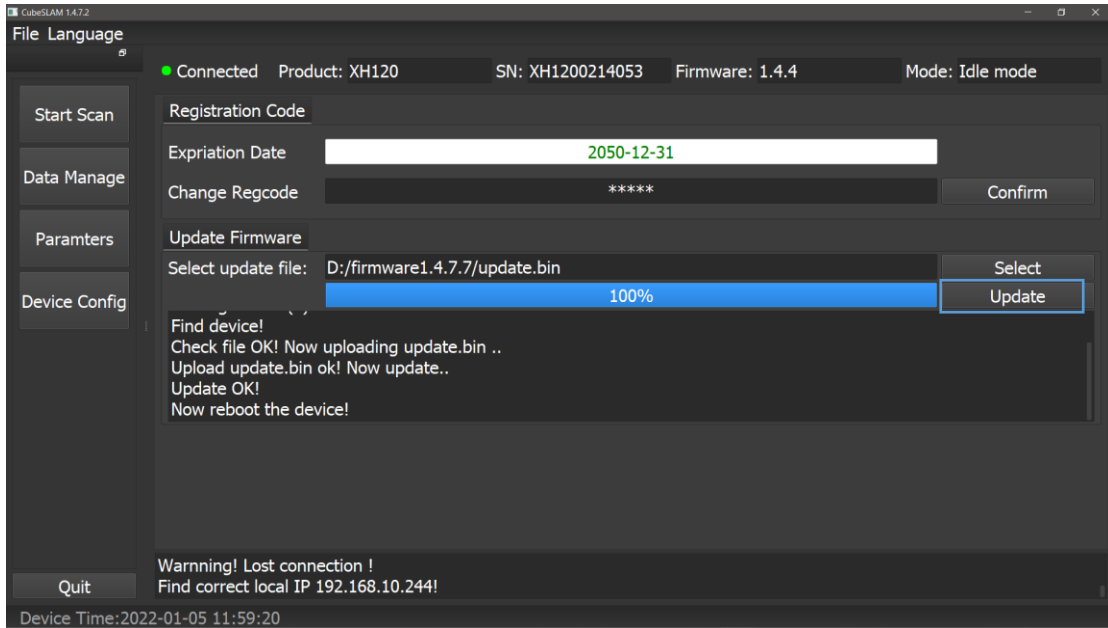
Click on “Select” to choose the update file from your PC:



Click on “Open” to upload the file:

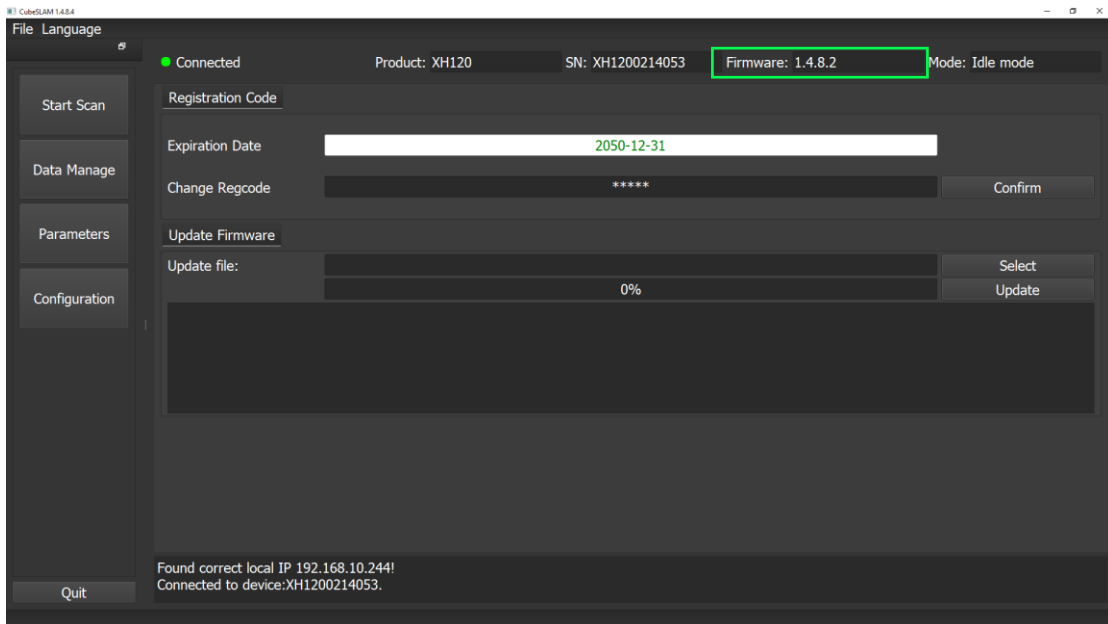


Click on “Update” to start the firmware update:



Check the progress of the operation in the update log, and wait until the % bar shows 100% and the log displays the "Update OK".

Reboot the instrument, and check that the firmware version is updated.



8. Technical data

8.1 XH120 technical features

PERFORMANCE

Max Range	120 m
Scan speed	655.360 points/s
Ranging accuracy	Up to 1cm
Vertical resolution	32 channels
Field of view	360°x360°
N° of returns	1 (strongest)
Rotation rate	20 Hz
Angular Sampling Accuracy	Vertical: ±0.01° Horizontal: ±0.01°
Safety	Class 1 (eye-safe) laser
Max Range	120 m
Scan speed	655.360 points/s

SYSTEM

Memory	500GB (expandable)
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ELECTRICAL SPECIFICATION

Power supply	DC 18-36V/40W
Operating time	4 hours (single battery)

PHYSICAL SPECIFICATION

Scanner weight	2 kg
Processing unit weight	1.7 kg
Operating temperature	0° C to +50° C (32° F to 122° F)
Waterproof/Dustproof	IP54
Material	Aircraft grade aluminum

BATTERY SPECIFICATIONS

Model	TB48S
Capacity	5700mAh
Voltage	22.8V
Battery type	LiPo 6S
Energy	129.96Wh
Overall battery weight	680g
Working environment temperature	-10°C to 40°C
Storage temperature	If storage time < 3 months: -20°C to 45°C If storage time > 3 months: 22°C to 28°C

Charging environment temperature	5°C to 40°C
Maximum charging power	180W

8.2 Bundle components



1. XH120 Handheld Laser Scanner
2. XH120 Processing unit
3. Data and USB cables
4. Processing unit strap
5. 2x Battery
6. Battery charger
7. Wi-Fi antenna
8. USB dongle with manual, software (Cube-slam, XH120 Manager), and video tutorials
9. Transport case



STONEX® SRL

Viale dell'industria, 53 | 20037 - Paderno Dugnano (MI) | Italy

Tel: +390278619201 | Fax: +390278610299

www.stonex.com | info@stonex.com