

User Manual:

Dot3D™ Pro
on your
DPI Handheld
3D Scanning Kit

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Introduction

Welcome

Congratulations on purchasing your DPI Handheld 3D Scanning Kit (DPI Kit) and Dot3D Pro software for use with your DPI Kit and/or Intel® RealSense™ depth cameras D415, D435, D435i, or D410 (www.intelrealsense.com). This manual combined with online instructional videos will get you up and running as quickly as possible.

- A video guide for getting started is also available at the following link:
 - www.dotproduct3d.com/dpi8stutorial
- You may also find this manual, the above video, and additional updated materials at the following link:
 - www.dotproduct3d.com/dpiusermanual

Manual Conventions

The DPI Kit is powered by Dot3D software (Dot3D Pro). In this document, top menu line commands for Dot3D are indicated by **SMALL CAPS**; other commands are indicated by bold black font, e.g. **Open**. Dot3D elements that do not require user input, but instead provide cues to system performance, are highlighted with a green font, e.g. **Scene Fitness**.

The terms mapping, scanning and imaging are used interchangeably in this manual. The authors apologize for any confusion resulting from this.

Looking After Your DPI Kit

The DPI Kit is a calibrated, sensitive optical measurement device, please handle it with care. We **strongly** recommend shipping, transporting and storing the device in the rugged case that comes with the system, at all times when not in active use. Bumping or dropping the sensor can impact calibration and accuracy! Do not grab the device by the sensor when extracting it from the rugged case in order to avoid bending it. When putting the device down outside of the case, always place on a flat, level, sturdy surface. Take precautions to never drop or bump the sensor.

Periodically inspect the sensor and tablet for dust, dirt or fingerprints. The tablet screen and sensor lenses should be cleaned with a lens or screen cleaner.

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DPI KIT SYSTEM

System Components

The DotProduct DPI Kit contains the following components:

- DPI-10: Android or Windows tablet computer with 64GB of storage. DotProduct reserves the right to provide greater than 64GB depending on availability.
- DPI-8S/SR: Android Tablet computer with 32GB of storage. DotProduct reserves the right to provide greater than 32GB depending on availability.
- DPI-8X/SR: Android Tablet computer with 16GB of storage. DotProduct reserves the right to provide greater than 16GB depending on availability.
- Perpetual license of DotProduct Dot3D Pro software for the DPI tablet. One year of software maintenance (support & upgrades) is included. Also available with a 3-year (non-perpetual) license for the same price.
- DPI-8X/8S: DotProduct CalibratedPrimeSense Carmine 1.082 red, green, blue and depth sensor.
- DPI-8X/8S SR: DotProduct Calibrated PrimeSense Carmine 1.09 red, green, blue and depth sensor. (Short Range)
- DPI Handheld 3D Scanner Housing
- USB to micro USB connectors for connecting sensor to tablet (or USB to USB-C for DPI-10)
- Protective carrying case
- Tablet charger
- Quick Start Guide
- Calibration verification
- Optional: DPI Light Kit with attachment and charging supplies
- Optional: Intel® RealSense™ D415 Depth Camera

System Configuration Options

Supported Tablets	Microsoft Surface Go (DPI-10/SR/Intel® RealSense™)
	Samsung Galaxy Tab S4 (DPI-10/SR/Intel® RealSense™)
	Samsung Galaxy Tab S2 (DPI-8S/SR)
	NVIDIA SHIELD & SHIELD K1 Tablets (DPI-8X/SR)
	Microsoft Surface Pro 4+ (with Intel® RealSense™)
Tablet OS	Android 5.0 and up
	<i>Android OS version support varies by tablet.</i>
	Windows 10

Your Android/Windows tablet OS should always be kept fully up to date. To obtain Android upgrades, the tablet must be provisioned with an email account and registered with Google. A short video detailing Android upgrades may be found here: <http://youtu.be/XJ18M6FBPLM>.

Hardware Setup/DPI Kit

1. Remove the DPI Kit from the storage case. Slide the tablet into the DPI Kit and lock in place with top latch.
2. Connect the sensor to the tablet by carefully connecting the OTG cable (USB-A female connector to USB Micro-B or USB-C male connector) from the sensor to the tablet. Make sure the connectors are connected firmly.
3. Power on the tablet by long-pressing the power button.
4. Check the status of the battery charge icon in the upper right-hand corner of the display. We advise beginning operations with a fully charged battery.

Note: Button locations vary by tablet manufacturer and model.

Hardware Setup/RealSense

1. Carefully handle the sensor, taking care not to directly touch the lens.
2. Attach the sensor to the tablet back with a magnet or Velcro. Mounting kit available at dotproduct3d.com. Carefully connect the USB / USC cable between the sensor and the tablet. Make sure the connections are firm.
3. Power on the tablet by long-pressing the power button.
4. Check the status of the battery charge icon in the upper right-hand corner of the display. We advise beginning operations with a fully charged battery. *Note: Button locations vary by tablet manufacturer and model.*

Tablets with embedded RealSense™ cameras are also available from DT Research, MobileDemand, Panasonic, etc.

Hardware Care

Bumping or dropping the system **is very likely** to impact the sensor calibration and system accuracy. So, treat your instrument with care. We always recommend storing the device in the provided rugged case when it is not in use, and particularly when it is being transported.

Software Options

Dot3D is the core DotProduct software application for all 3D capture and editing on both Android and Windows platforms. Dot3D Pro is included with all DPI Kits, and enables all 3D scanning and editing functionality on the tablet of choice. Additional Dot3D versions/licenses include:

Dot3D Pro: Professional 3D scanning and editing on Android/Windows, including all DotProduct functionality.

Dot3D Scan: Entry level 3D scanning on Android/Windows tablets. (scene size, features, and photos limited).

Dot3D Edit Full-function 3D point cloud editor on Windows/Android devices (no scanning functionality).

Dot3D View Free, read-only viewer for DotProduct .DP data on Windows/Android. Also available from the Google Play Store

The figure below is a list of the features available for each of the licenses.


				
Features	VIEW	EDIT	SCAN	PRO
Intel® RealSense™ 3D Scanning			Up to 20 Million Points per Scan	Up to 160 Million PPS†
HD Photo Capture			Up to 3 Photos per Scan	Unlimited
Available on Windows & Android	✓	✓	Android Coming Soon	✓
3D Cropping	✓	✓	✓	✓
3D Annotation (3D Points)	✓	✓	✓	✓
3D Measurement (Point to Point)	✓	✓	✓	✓
Screenshots	✓	✓	✓	✓
Optimization (Single Scan)	✓	✓	✓	✓
Batch Optimization (Multi Scan)		✓	✓	✓
Advanced Measurement (Area, Diameter, Cube)		✓	✓	✓
User Coordinate Setting		✓	✓	✓
HD Photo Export		✓	✓	✓
DP, PTS, PLY Export		✓	✓	✓
E57, RCS, LAS, LAZ, POD, PTX, PTG Export		✓		✓
Plane & Cylinder Annotation		✓		✓
InfPoints DP Integration (Android)		✓		✓
Pointfuse Integration (Windows)		✓		✓
Perpetual / FlexNet Licensing Options		✓		✓
Scale Bar (Distance) Targeting		PRO / P3D*		✓
Hard (Survey) Targeting		PRO / P3D*		✓
Brunson AccuScale®-DP Targeting		PRO / P3D*		✓
Parallel Plane Constraints		PRO / P3D*		✓
Append (Link Multiple Scans)				✓
CAD Model Comparison & Registration				✓
Individual Sensor Factory Calibration				Included with DPI Kits
PrimeSense Carmine 3D Scanning				Included with DPI Kits
*Only supported for scans from Dot3D Pro or Phi.3D † Dependent on the hardware capabilities of your device	\$0 per year	\$119.40 per year	\$245.00 per year	\$995.00 per year

Figure 1 - Dot3D License Option

DPI Kit Performance

The data quality of the DPI Kit depends on range, temperature, ambient lighting conditions, reflectivity of the area of interest, operator skill, and other factors. System accuracy is significantly improved by using targets (various workflows available with various input requirements). System performance is degraded by long collection times, accumulation of frame-to-frame drift, and lack of scene fitness induced by geometry and texture limitations.

The working range is 0.6 to 3.7 m (2 -12 ft) for DPI models and 0.3 to 2 m (1-6 ft) for DPI SR models.

DPI Kit Accuracy

The data accuracy of the DPI Kit is summarized below.

Range	Typical Accuracy (RMS)	Minimum Accuracy
< 1 m (3.3 ft.)	0.2%	0.4%
1 m to 2 m	0.5%	0.8%
2 m to 3.3 m	0.8%	1.2%
> 3.3 m (11 ft.)	Not specified	Not specified

Percentage values are with regards to distance measured in the final post-processed model. For example, measuring a distance of 1 meter at an accuracy of 0.5% means +/- 5 millimeters of error. As can be seen in the table above the system will generally operate more accurately when operating closer to the surface scanned.

The recommended range for DPI models is between 1m and 2.5m (3ft - 8ft).

The recommended range for DPI SR models is between 0.4 m and 1.5 m (1 1/2ft to 5ft). The SR is designed for equipment, components and especially tight spaces. The standard DPI is the more versatile model for varied scene sizes.

Scan accuracy is further impacted by temperature. The recommended operating temperature is room temperature (approximately 73° F/ 23° C).

If used in higher temperatures, the system warm up time should be less than 15 minutes. It can be skipped entirely if used in 86° F (30° C) or higher.

If used in lower temperatures, the system warm up time should be extended slightly.

Continuous mapping time (time between start capture and stop capture) should be kept within 10 minutes per scan.

DOT3D PRO APPLICATION

Starting the Software

Find the Dot3D icon on the homepage of the tablet and touch it to activate the Dot3D application.



Figure 2 - Starting Software

If you see the screen, “Allow the app Dot3D to access the USB device?” select “OK” and the Dot3D software will launch.

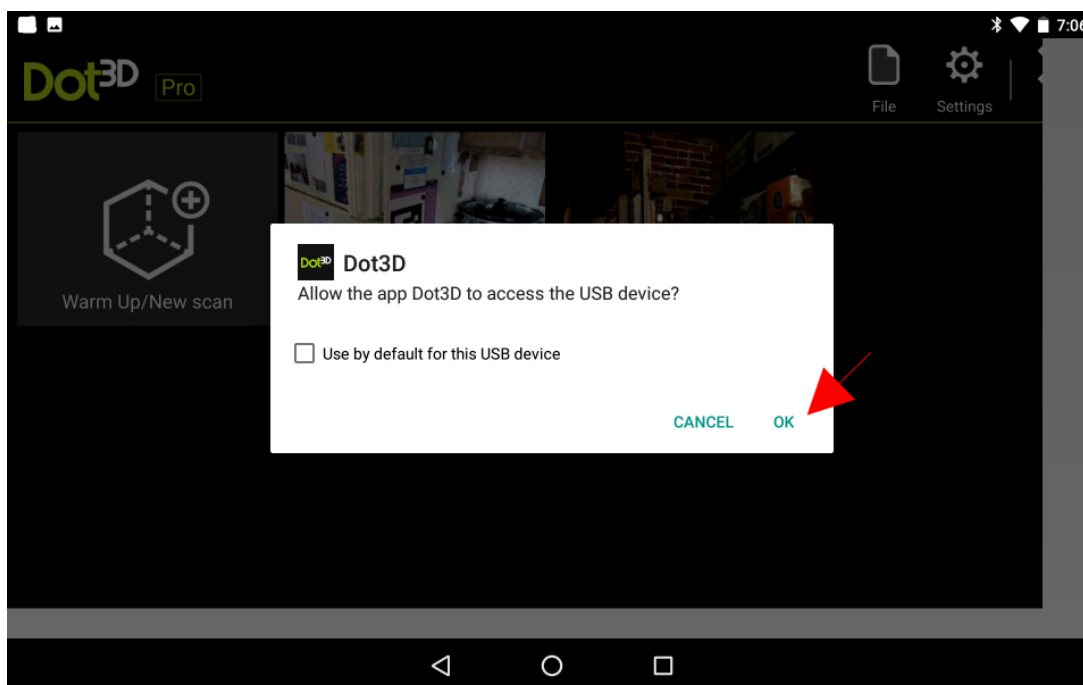


Figure 3 - Allow access to USB

If you start with no sensor connected, the program will open with a prompt on the left “Please connect a sensor to enable scanning”.

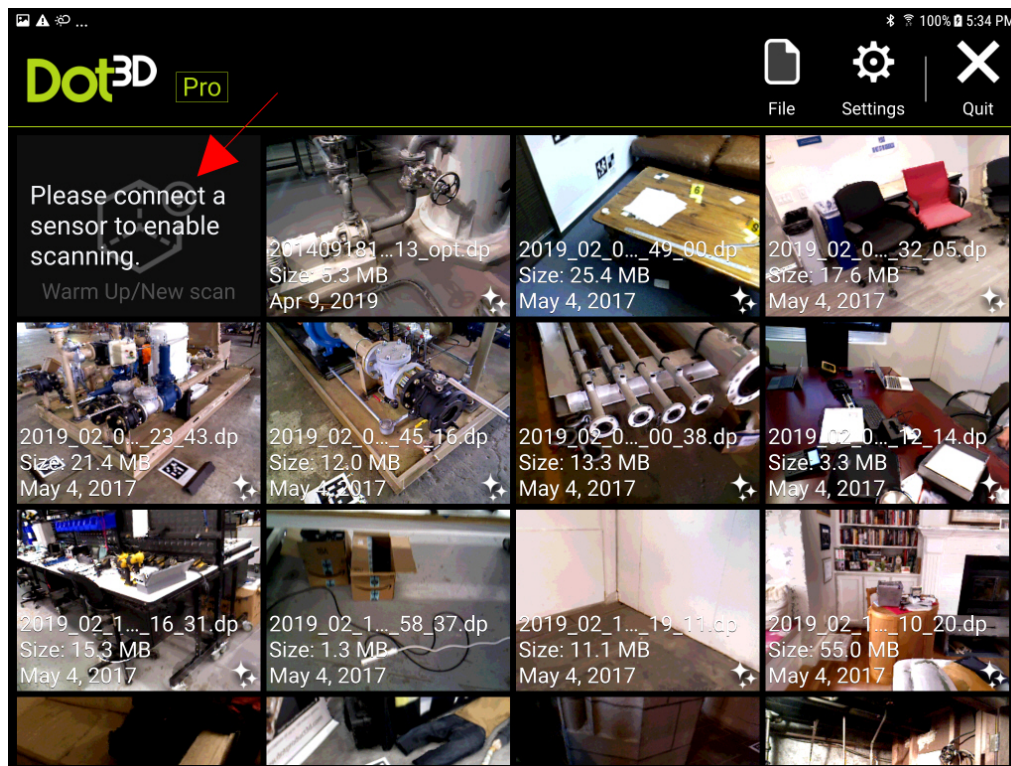


Figure 4 - Connect Sensor

If you start with a sensor connected, it will open to the Home screen with an icon on the left **Warm Up/New scan**.

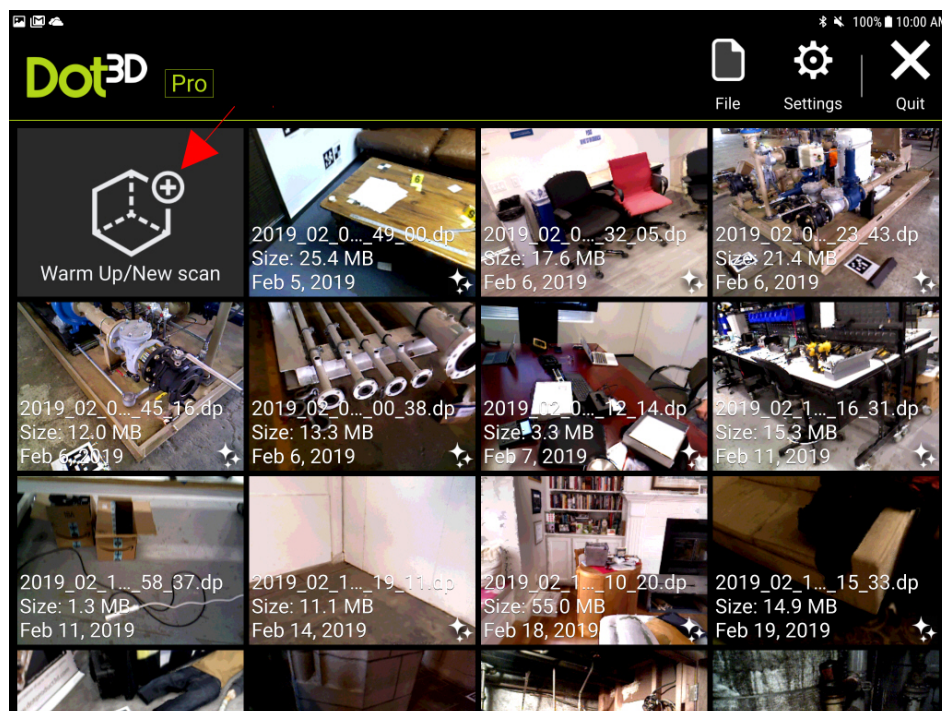


Figure 5 - Warm Up/New Scan

Once you have been using your DPI unit there will also be a Gallery view of thumbnail images of scans you have previously captured. By default this shows the Dot3D>Data folder on your tablet.

Also on the Home screen are **UPDATE**, **FILE**, **SETTINGS** and **QUIT**. (You will only see **UPDATE** if your tablet has been connected to wifi and detected a new update available).

Update

If your tablet is connected to wifi and there is a Dot3D software update available, the **UPDATE** tab will appear on the Home screen to the left of the **FILE** tab.

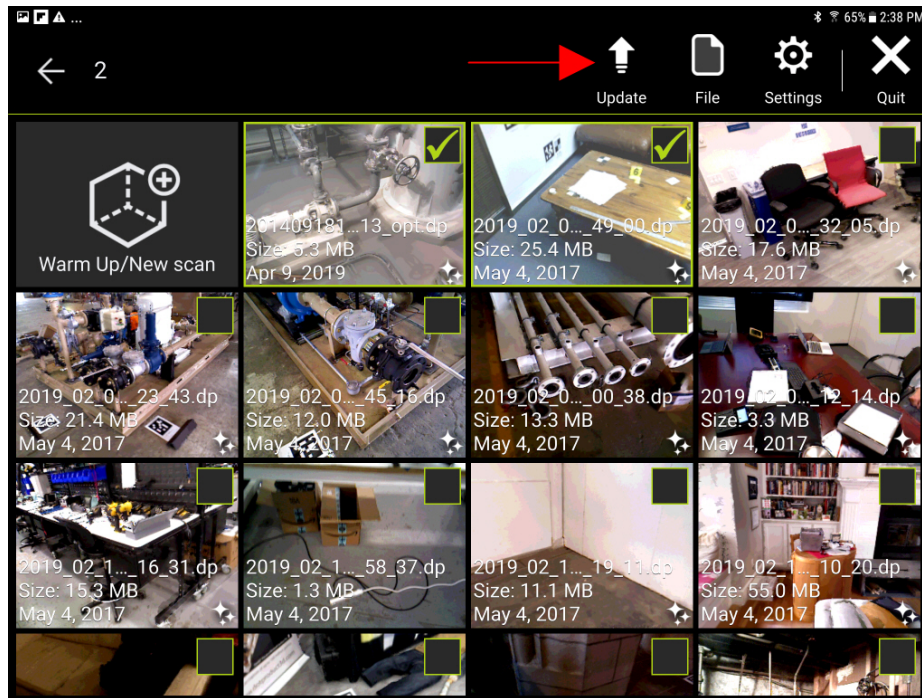


Figure 6 - Software Update

This will take you directly to www.dotproduct3d.com/dot3ddownload to download the most recent version of Dot3D. This can also be accessed from **SETTINGS>About**. For more information on updating your software see section [Software Upgrades](#) below.

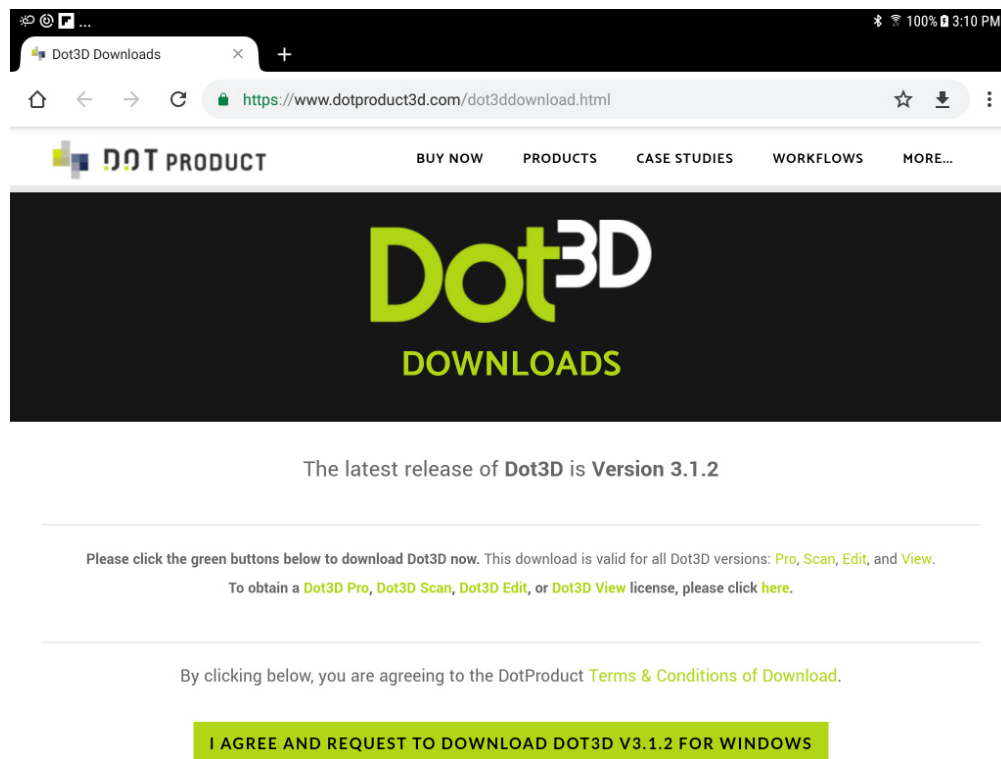


Figure 7 - Online Software Update

File

Selecting **FILE** from the home screen before opening a scan will give you the options to **Open**, **Share**, **Archive**, **Delete**, **Optimize**, or **Sort Order**.

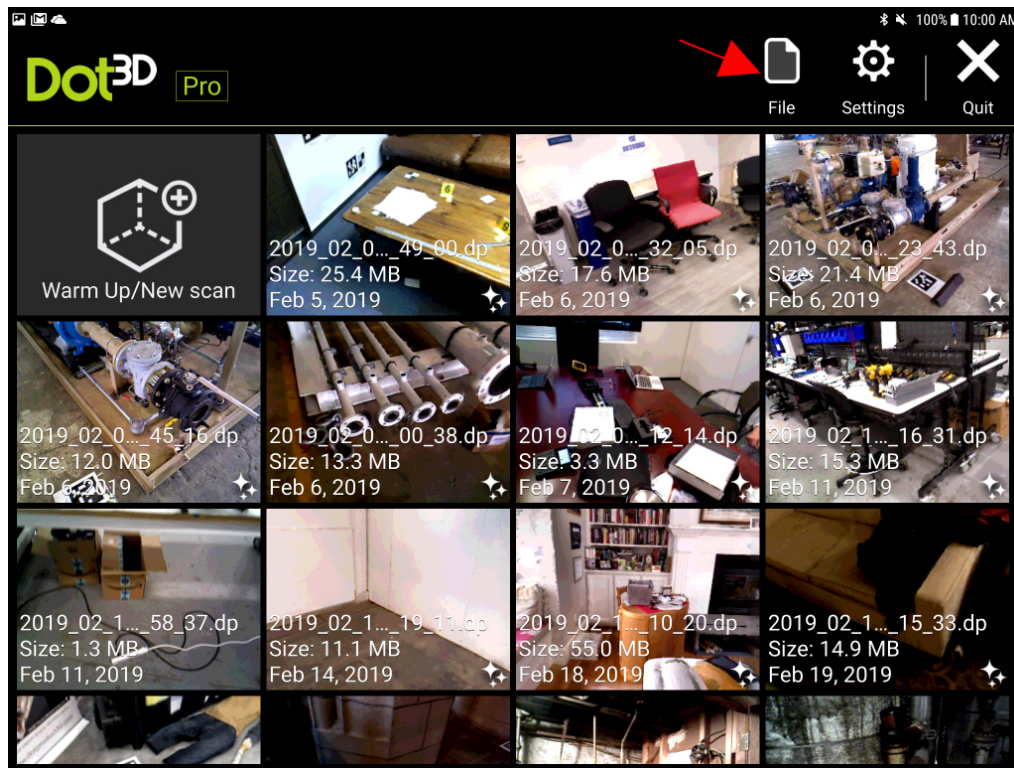


Figure 8 - File

There is also a **Back Arrow** to go back to the previous screen.

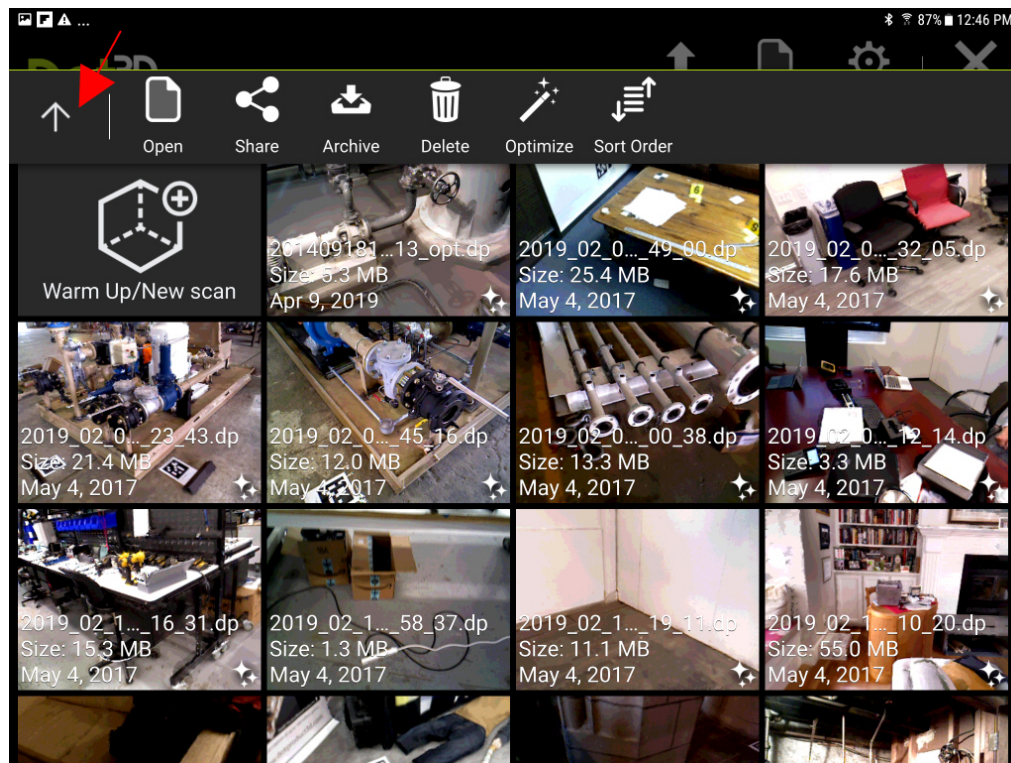


Figure 9 - Back

The **Open** tab will take you to files of previous scans you can open for editing. See [Open](#) below for more information.

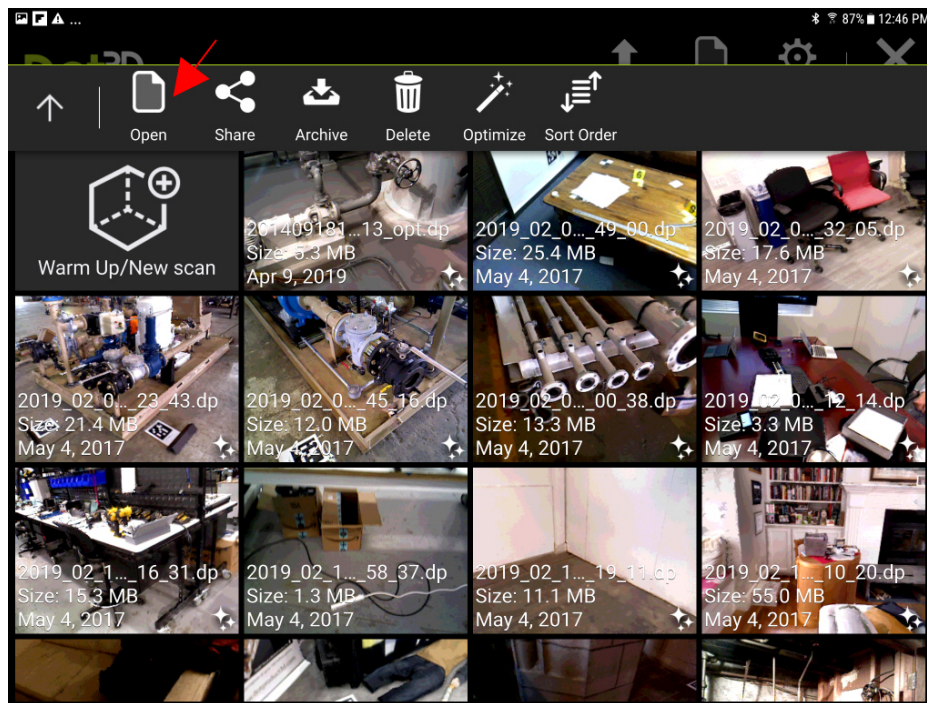


Figure 10 - Open

When you select the **Share** tab you will be prompted to select the scenes you want to share.

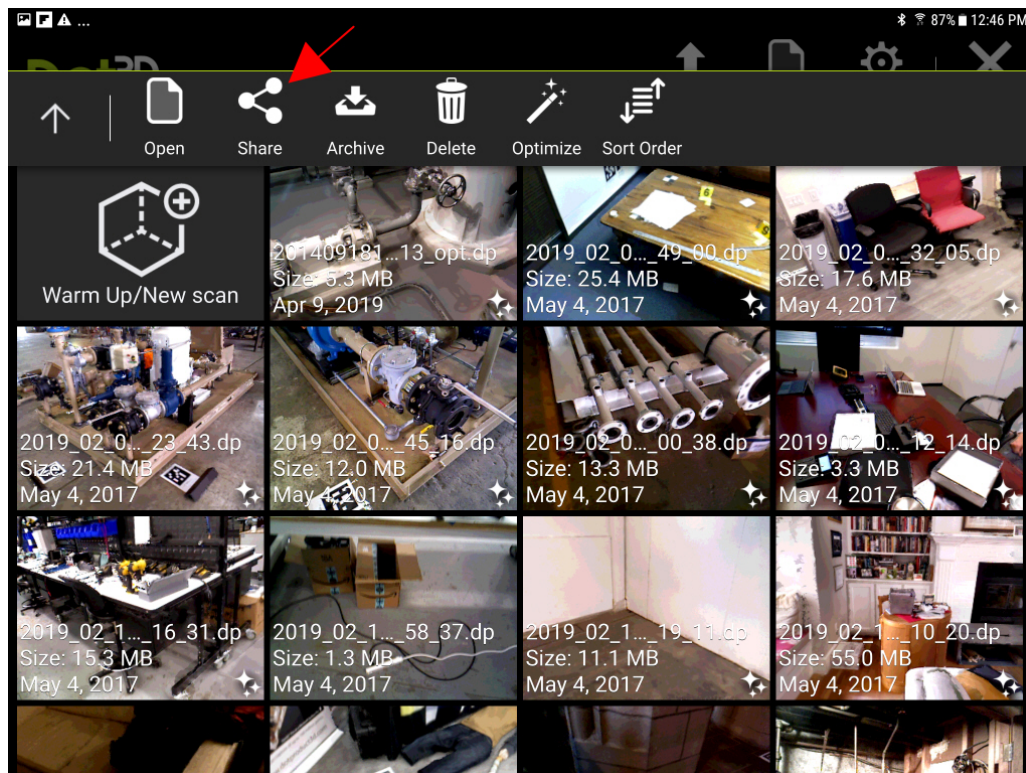


Figure 11 - Share

Select okay and then tap on the thumbnails in the gallery of the scans you want to share. A green check mark will appear in the upper right corner of each selected scan as well as the number of images selected in the upper left side.

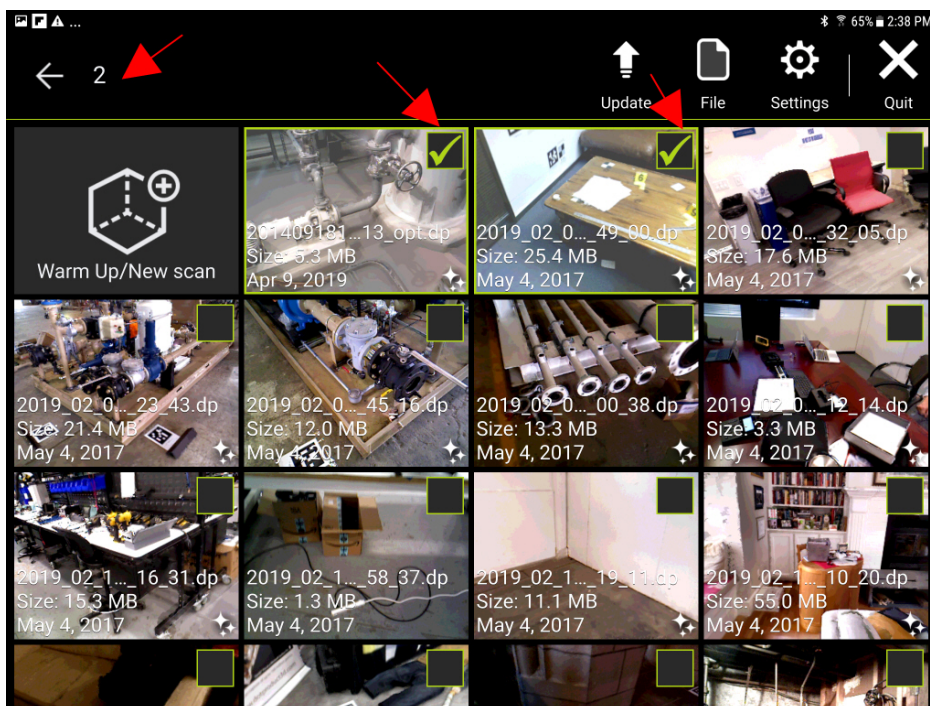


Figure 12 - Share Select

Then go back to **FILE Share** and you can select from the methods available on your tablet to send.

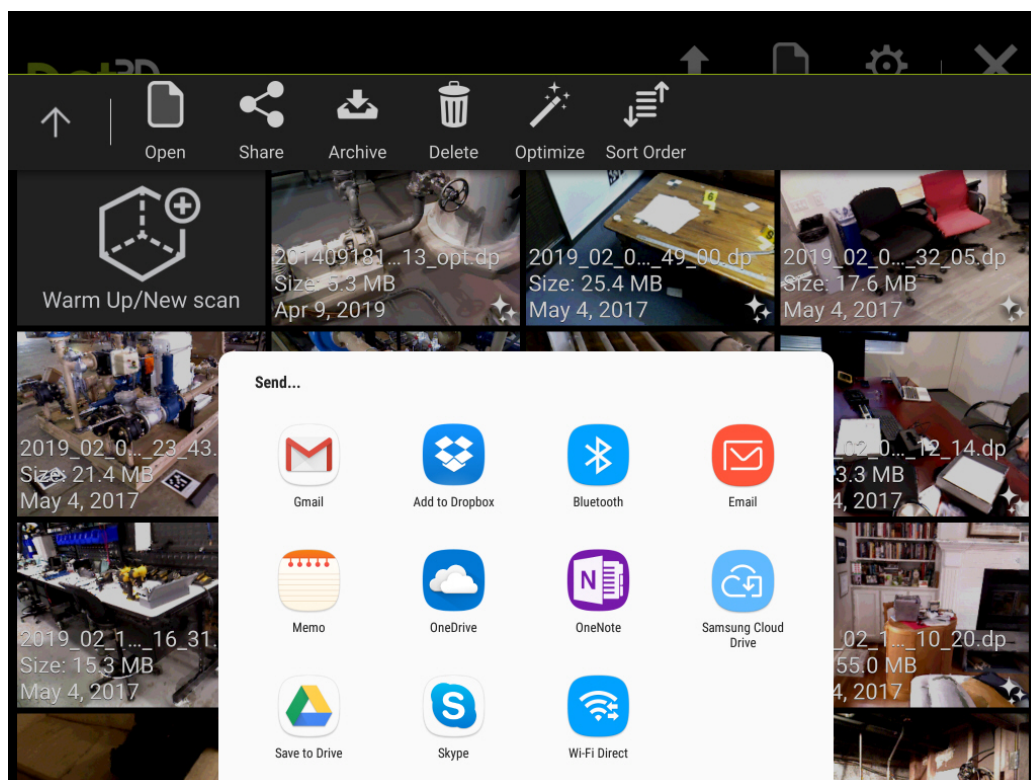


Figure 13 - Share Send

When you select the **Archive** tab you will be prompted to select the scenes you want to archive in a compressed file.

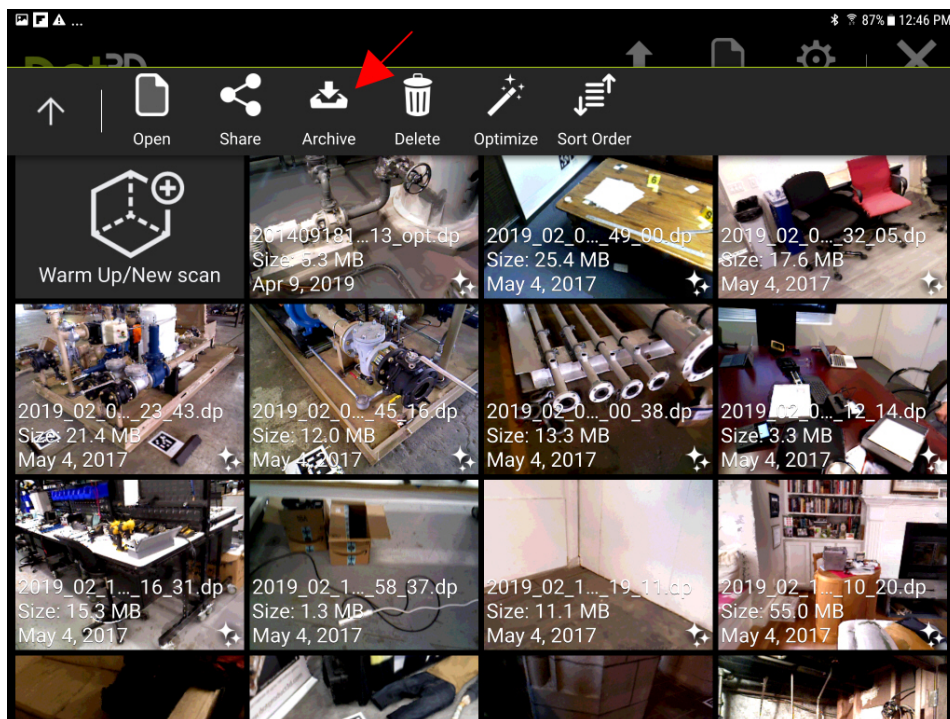


Figure 14 - Archive

Select okay and then tap on the thumbnails in the gallery of the scans you want to archive. A green check mark will appear in the upper right corner of each selected scan. Then go back to **FILE Archive** and choose a file name and where you would like it stored.

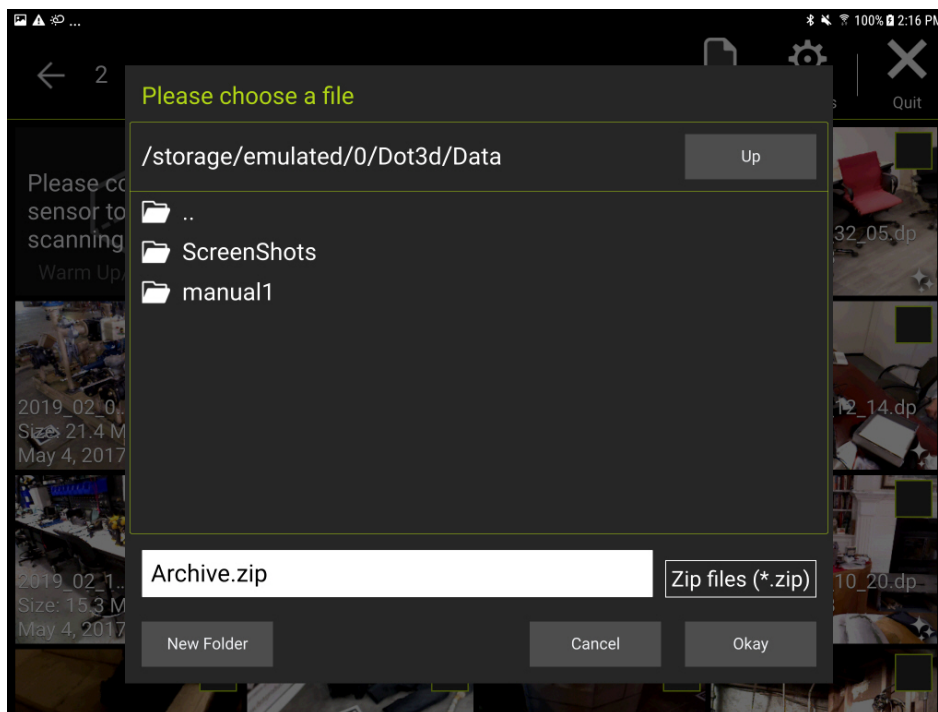


Figure 15 - Archive Save

When you select the **Delete** tab you will be prompted to select the scenes you want to delete.

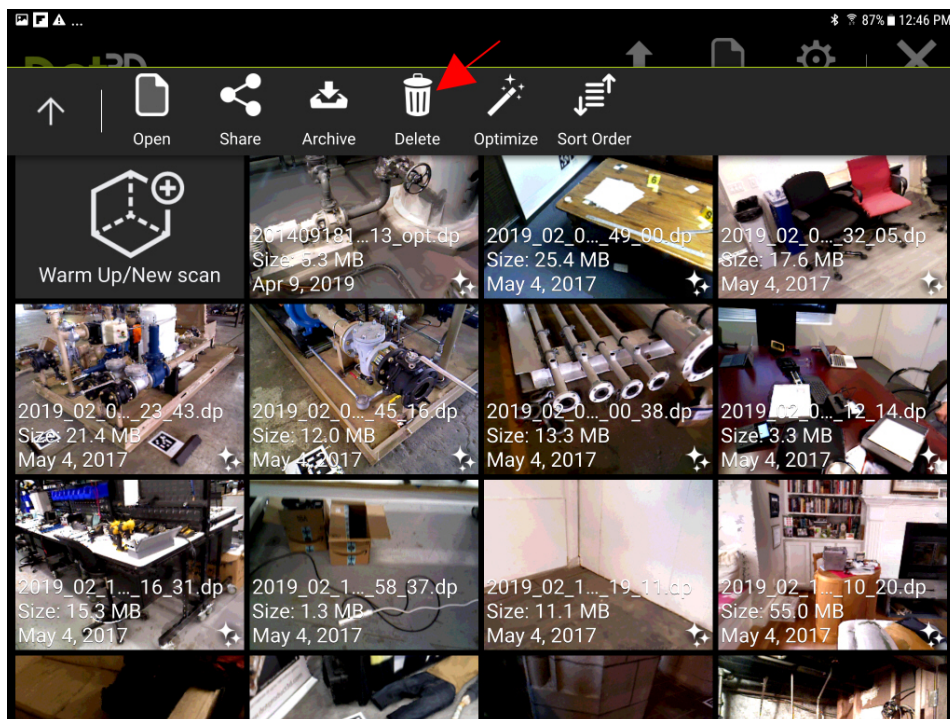


Figure 16 - Delete

Select okay and then tap on the thumbnails in the gallery of the scans you want to delete. A green check mark will appear in the upper right corner of each selected scan. Then go back to **FILE Delete** and a prompt will appear to verify you want to delete those scans.

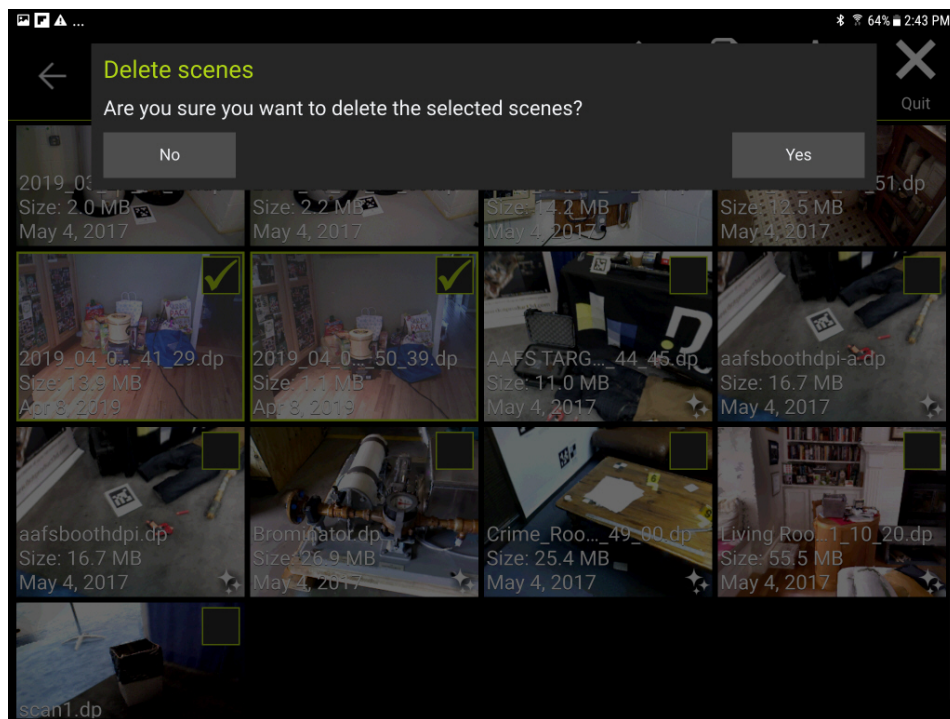


Figure 17 - Delete Verification

When you select the **Optimize** tab you will be prompted to select the scenes you want to optimize.

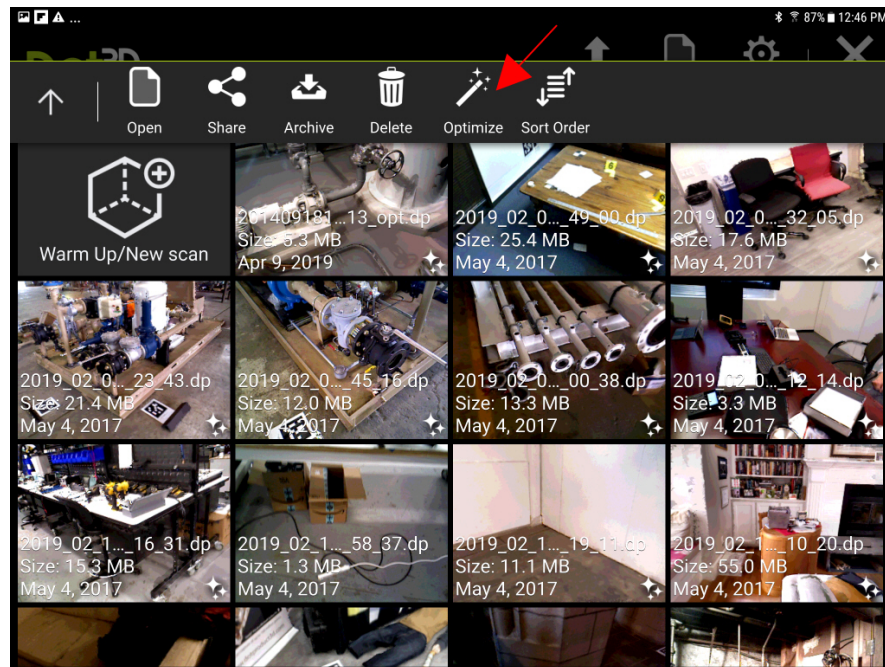


Figure 18 - Optimize

Dot3D will automatically select thumbnails in the gallery of scans that are not already optimized. A green check mark will appear in the upper right corner of each selected scan. You can unselect a scan by just tapping on it and the green check mark will clear. Then go back to **FILE Optimize** and a prompt will appear where you can select April Tags for loop closure (where possible) and then select Optimize Scenes.

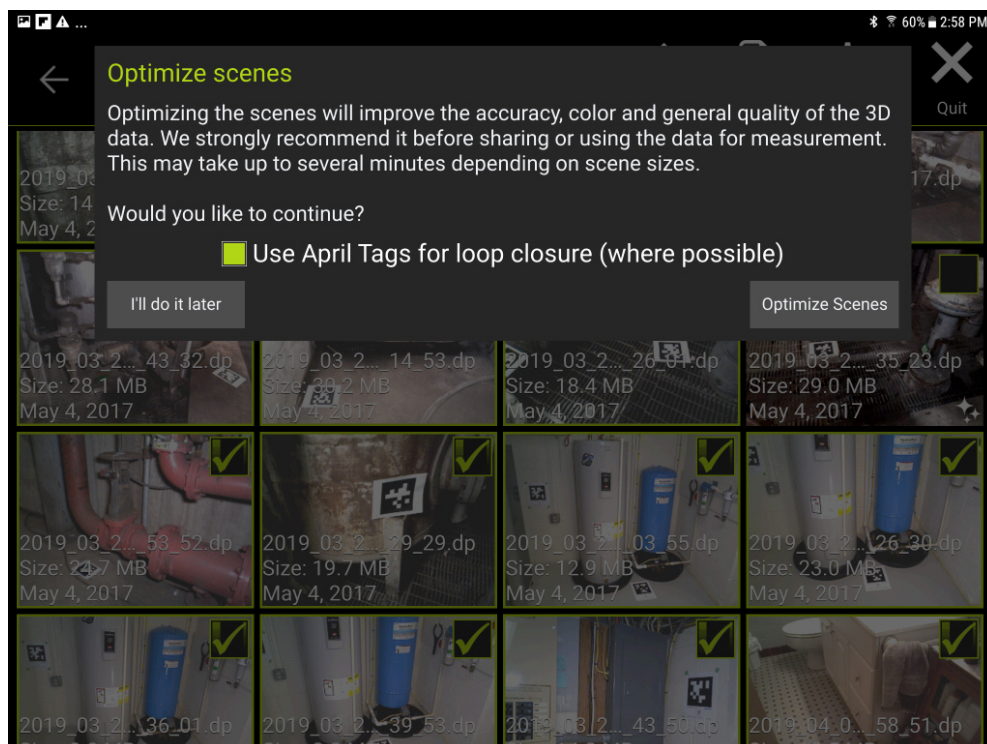


Figure 19 - Optimize with April Tags

It will do a Batch Optimization. A green bar will appear showing the optimization progress.

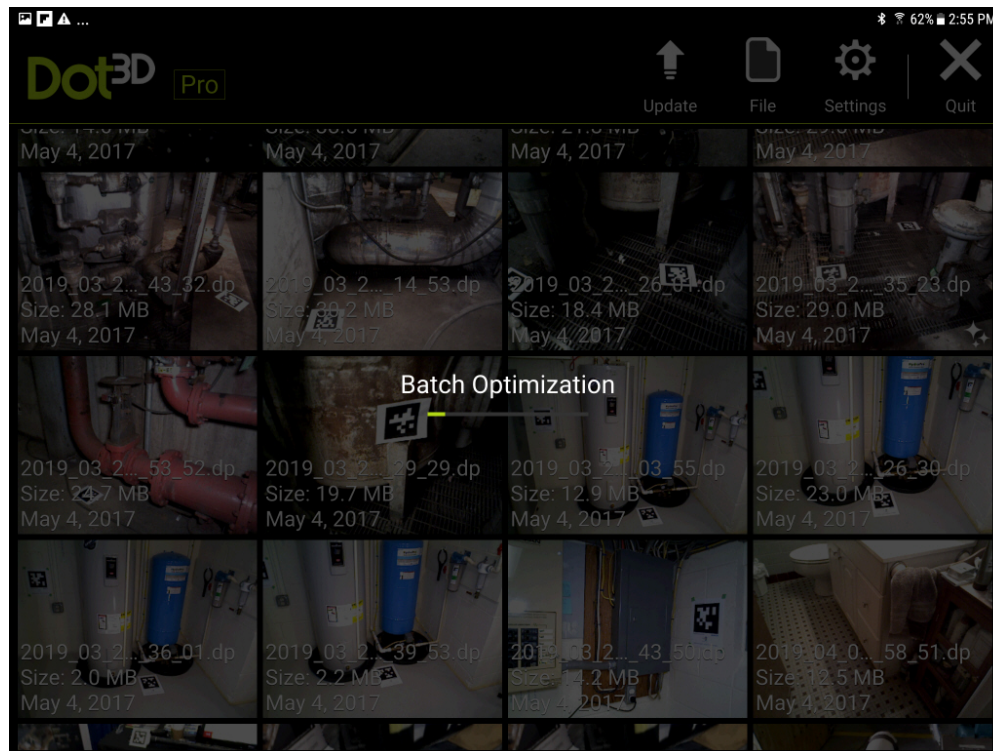


Figure 20 - Batch Optimization

After some progress the green bar will go away, and you can perform other commands while the scans are optimizing in the background. You do have the option of Optimizing later. For bulk optimizations, we recommend Dot3D Edit on a laptop or computer, or otherwise having the tablet plugged in.

When you select the **Sort Order** tab you will be able to select sorting by **Name (ABC)**, **Creation Date**, or **Modification Date**.

(Image on next page)

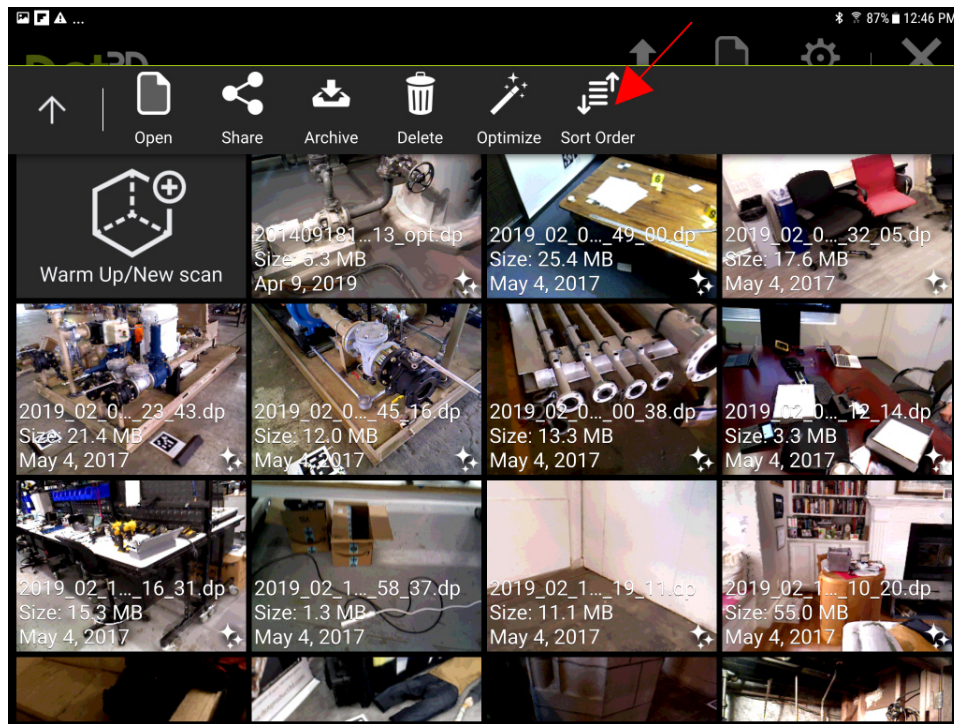


Figure 21 - Sort Order

All of these can be in **Ascending** or **Descending** order.

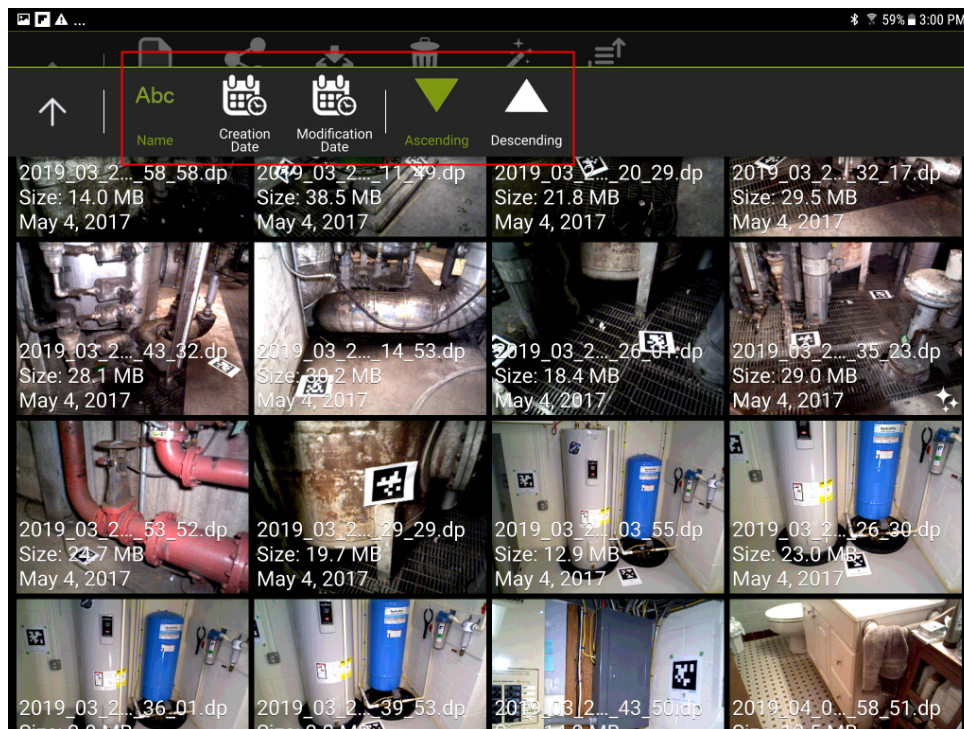


Figure 22 - Sort Choices

Once you pick the sort method, the Gallery view thumbnails will be in the new selected order.

Settings

Selecting **SETTINGS** will give you the options for **3D Sensor**, **Help**, **About**, **Scene Size Settings**, **Feedback**, **License Info**, **Re-enable UI Tips**, **Enable Bounding Dimensions**, **Point Size** and **Units**. More on these features can be found below and in the [Settings Section](#) under System Configuration Options.

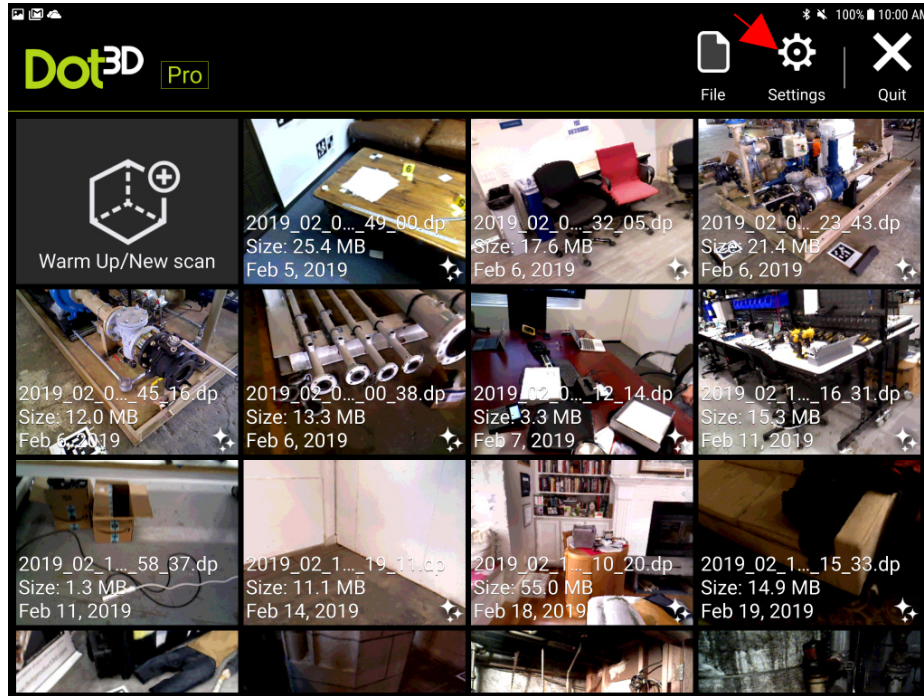


Figure 23 - Settings

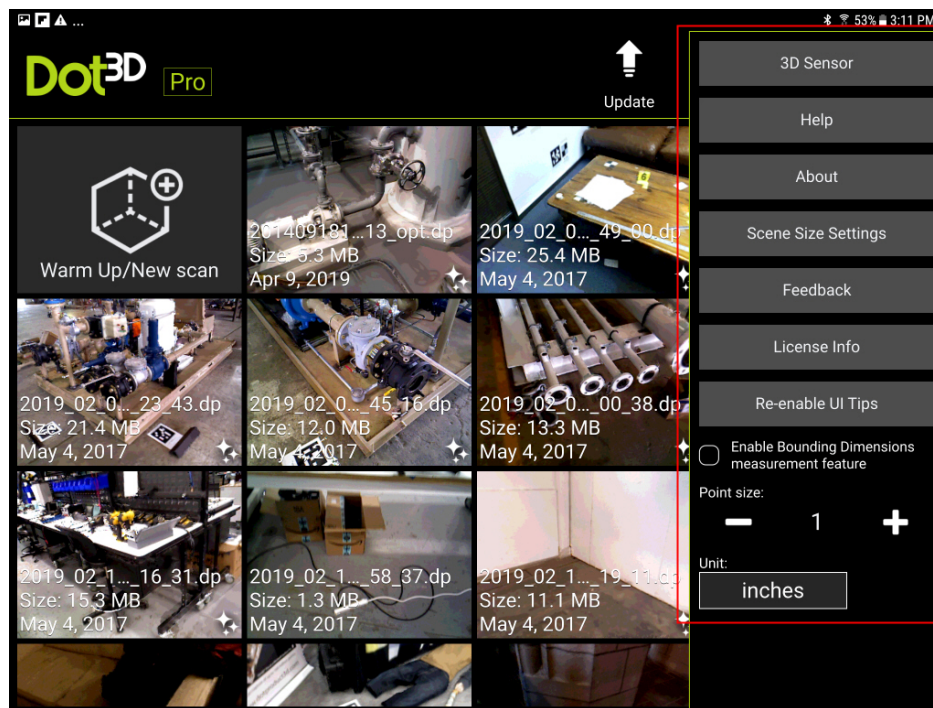


Figure 24 - Setting Options

Quit

Selecting **QUIT** will exit you out of the Dot3D software.

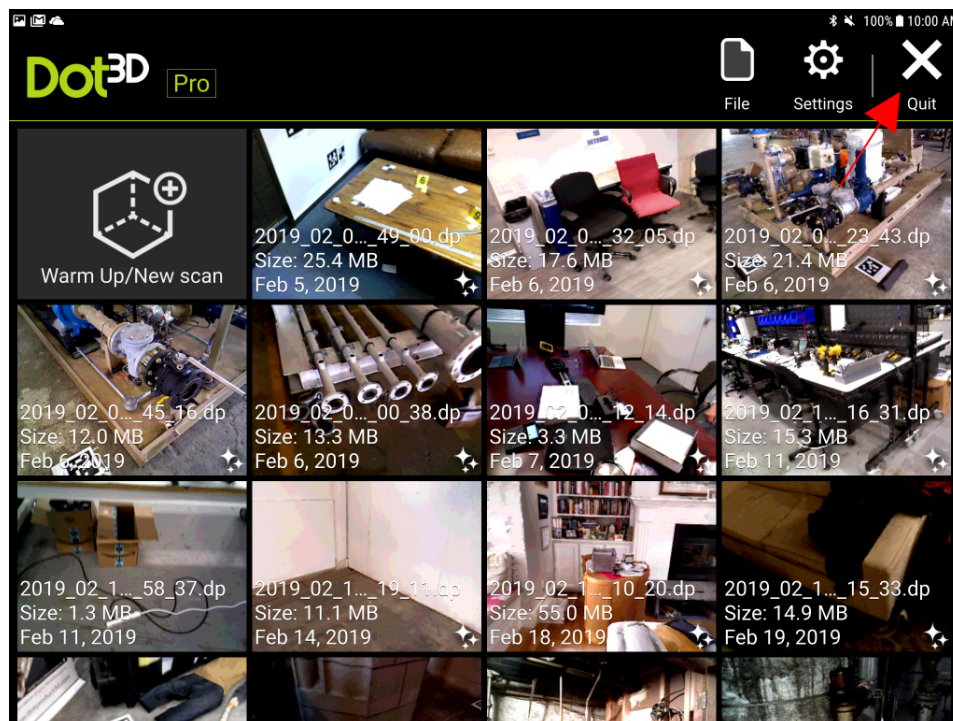


Figure 25 - Quit

Before you get started scanning, make sure there is a proper calibration file loaded. This is required for DPI Kits, and optional for Intel® RealSense™ setups. Results will be significantly improved by calibration. You can easily check or correct this by going to **SETTINGS** in the upper right and choosing **3D Sensor Settings**.

(Image on next page)

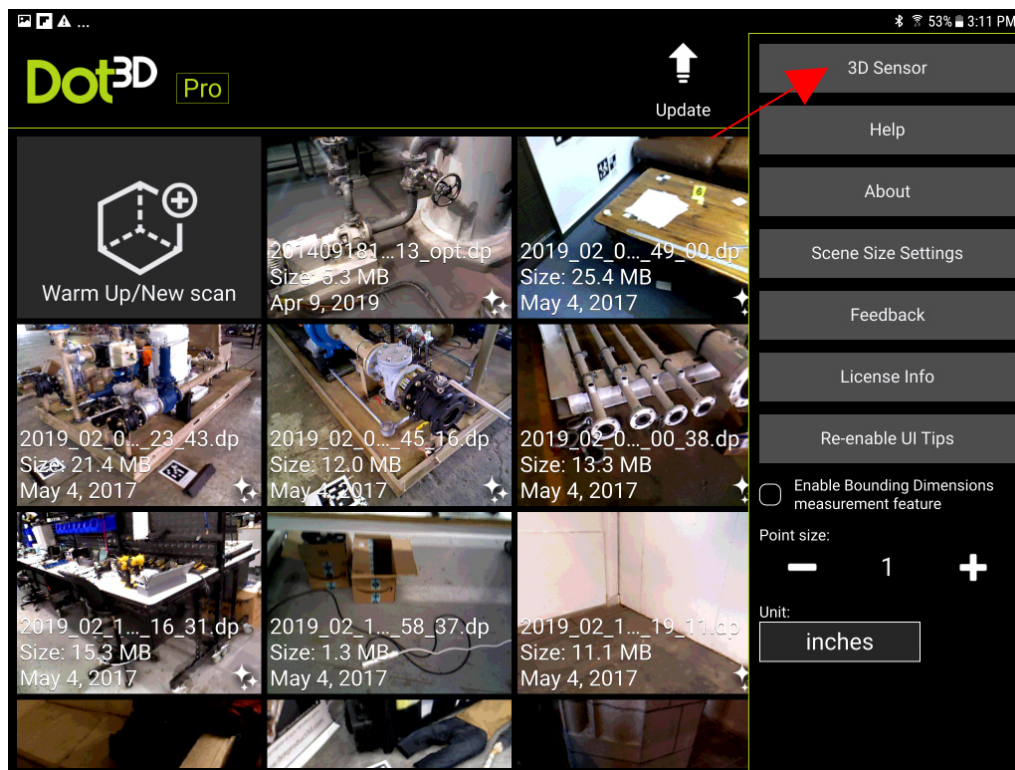


Figure 26 - 3D Sensor

It may take a few seconds for the **3D Sensor Settings** tab to display while the tablet detects the attached sensor.

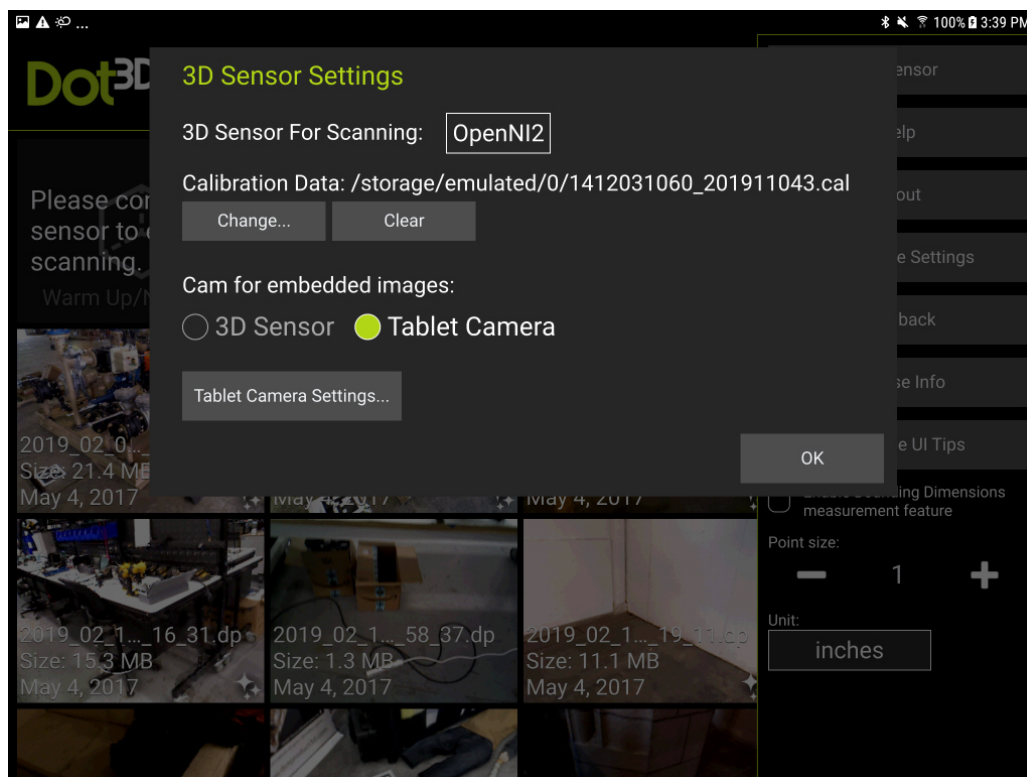


Figure 27 - 3D Sensor Settings

Under “3D Sensor for Scanning” you should see OpenNI2 for use with your DPI (PrimeSense) sensor or RealSense for use with your RealSense sensor. Under “Calibration Data” you should see the correct calibration file loaded for the unit. The number at the end should match the number on the back of your unit. If you do not see the calibration file, select “Change” under “Calibration Data”. To find the calibration file you will need to go up to the /storage/emulated/0 folder. The calibration file is the .cal file (example: 1412031060_201911043.cal).

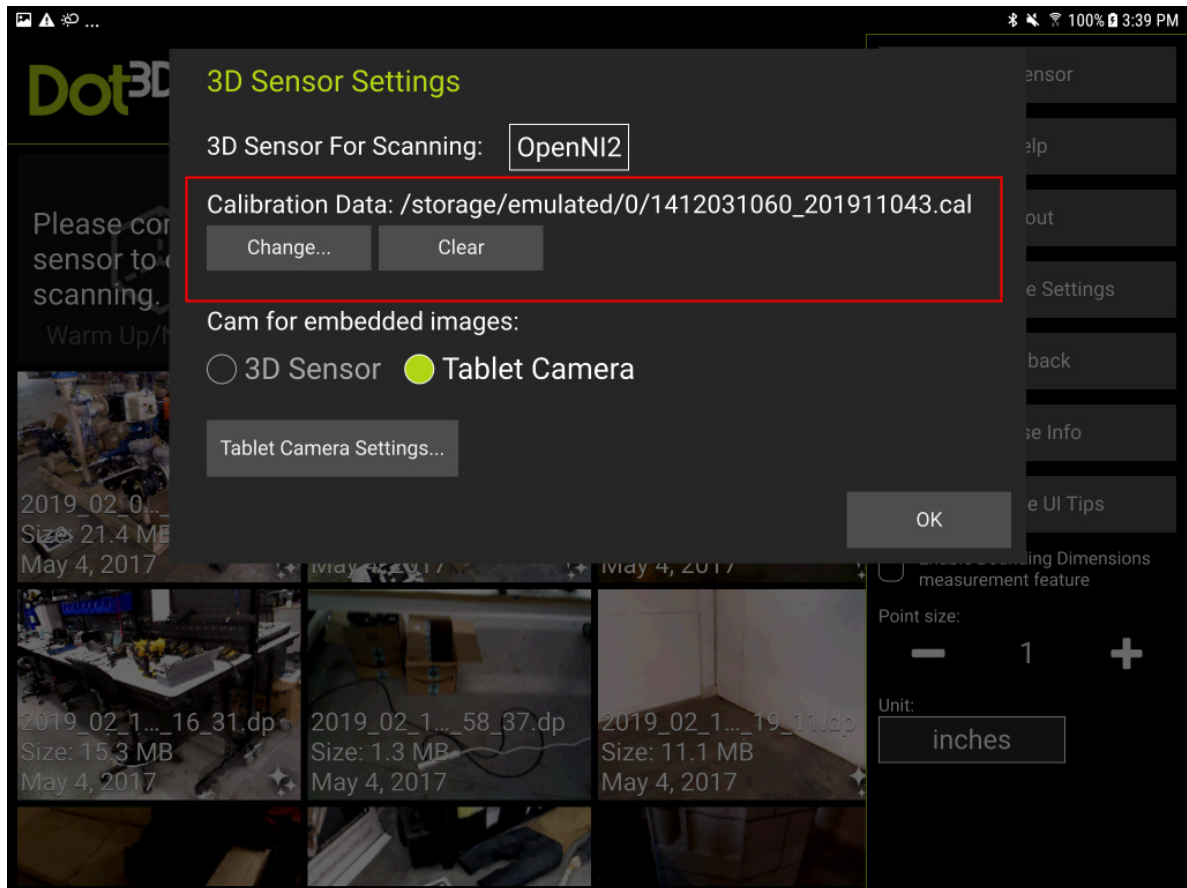


Figure 28 - Example Calibration File

On the DPI-8S/SR and DPI-10/SR you will have access to the tablet HD camera for 2D photo capture while scanning. As seen in the image above, there is also an option to access the sensor camera for 2D photos. This is only available when using the Intel® RealSense™ 3D Sensor Camera. Unless you are detaching your sensor from your tablet (i.e. Pole Kit), you will generally always want to have Tablet Camera selected.

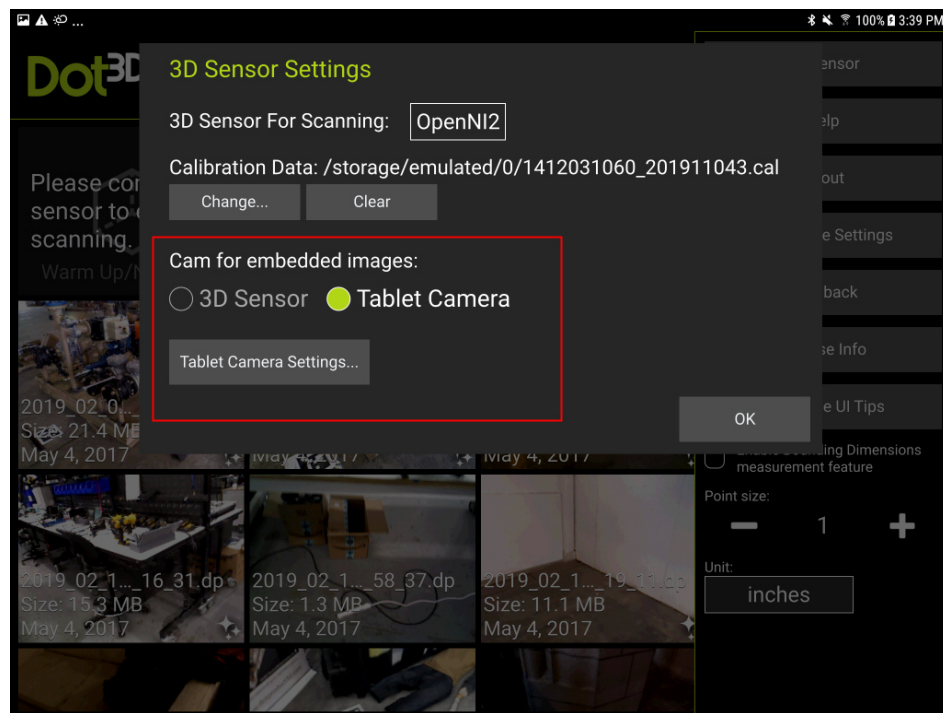


Figure 29 - Tablet Camera

Select “Tablet Camera Settings” to modify resolution and proportions of the HD image to be captured. Usually you will want a high Capture Resolution and Auto White Balance. Select “Apply” to implement your settings. It also shows you a preview of what the camera sees.

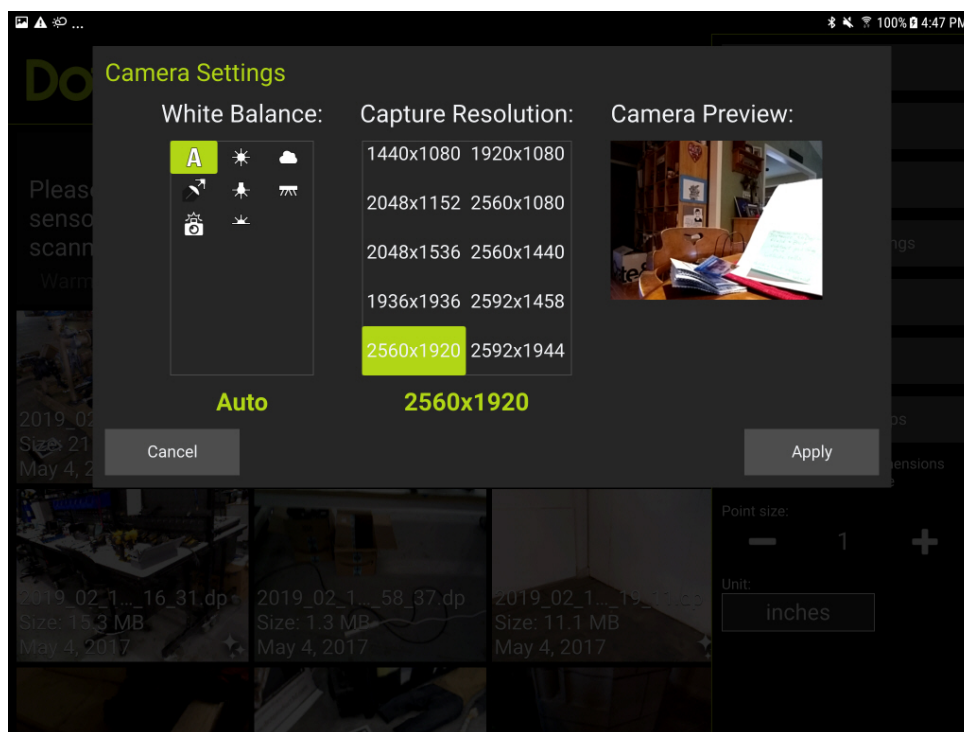


Figure 30 - Tablet Camera Settings

Tablet Camera option is not available for the DPI-8X/SR or older models.

Verify your license file is loaded in **SETTINGS** under **License Info**.

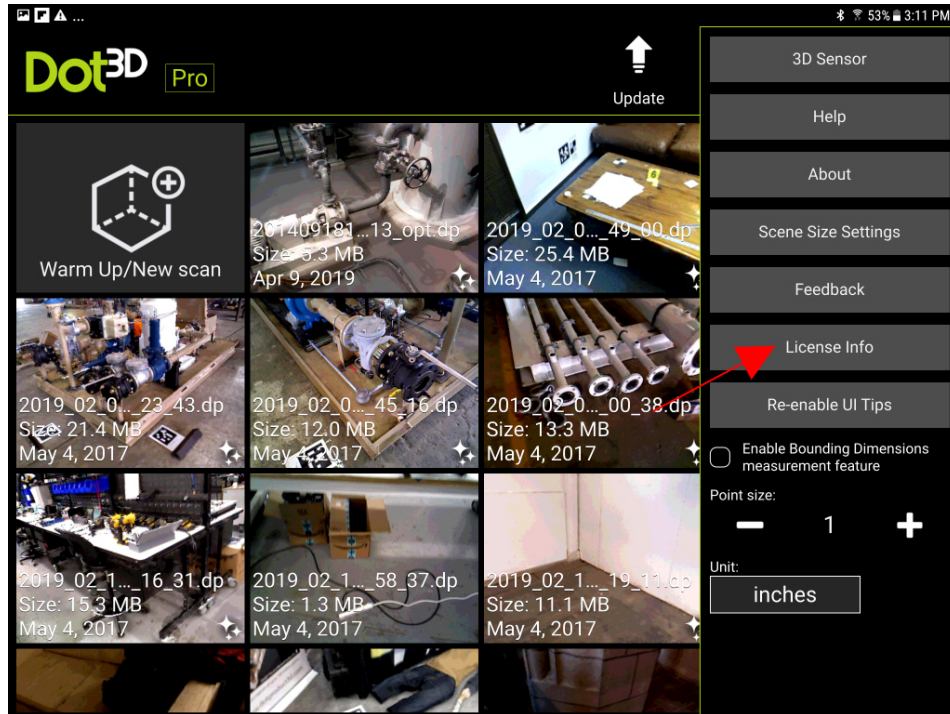


Figure 31 - License Info Tab

It will tell you if you have a valid license and when it expires. For perpetual licenses you will see “It does not expire.” If you need to update your license press the “Change Key” and load from the /storage/emulated/0 folder.

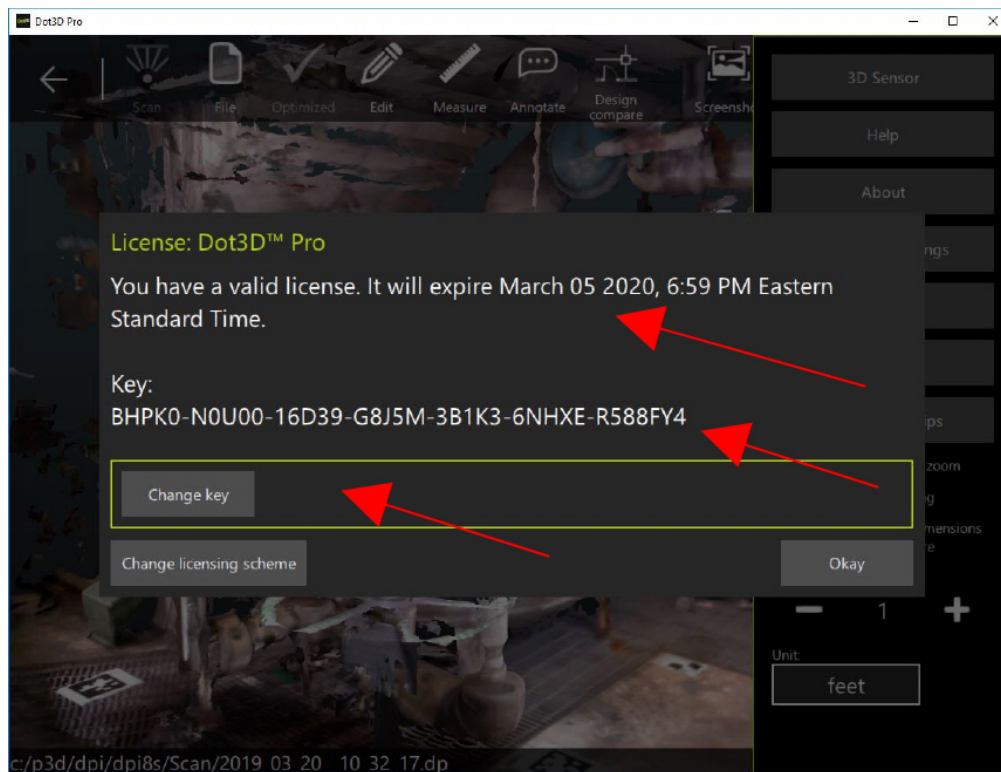


Figure 32 - License Info

Also, under **SETTINGS** is the “Enable bounding dimensions measurement **feature**” for capturing cubic volume dimensions and measurements for logistical purposes. You can also change **Point size** and **Units** for measurement.

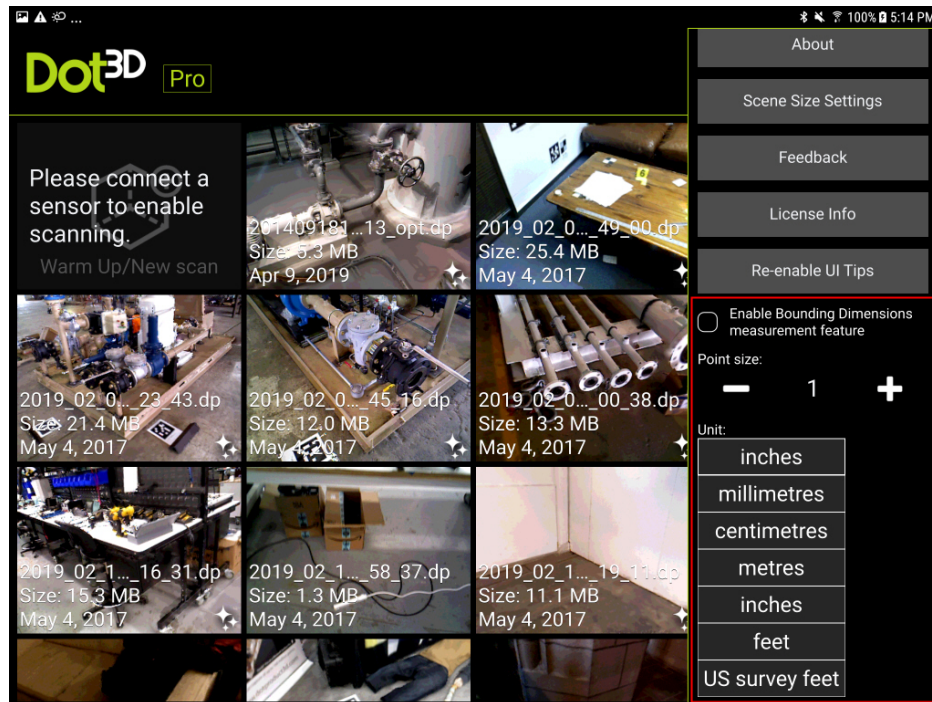


Figure 33 - Unit Choices

To start capturing data, press **Warm Up/New scan** on the Home page. This will prompt the sensor to connect to the software and you will see what the sensor is seeing. The DPI Kit (PrimeSense) does require a 15-minute warm-up before the first scan of the day. After initial warm-up there is a 30-40 sec warm up between scans. If the prompted warm-ups are longer or repetitive to what is mentioned here, you can bypass by pressing and holding the button on the right of the scanning screen.

(Image on next page)

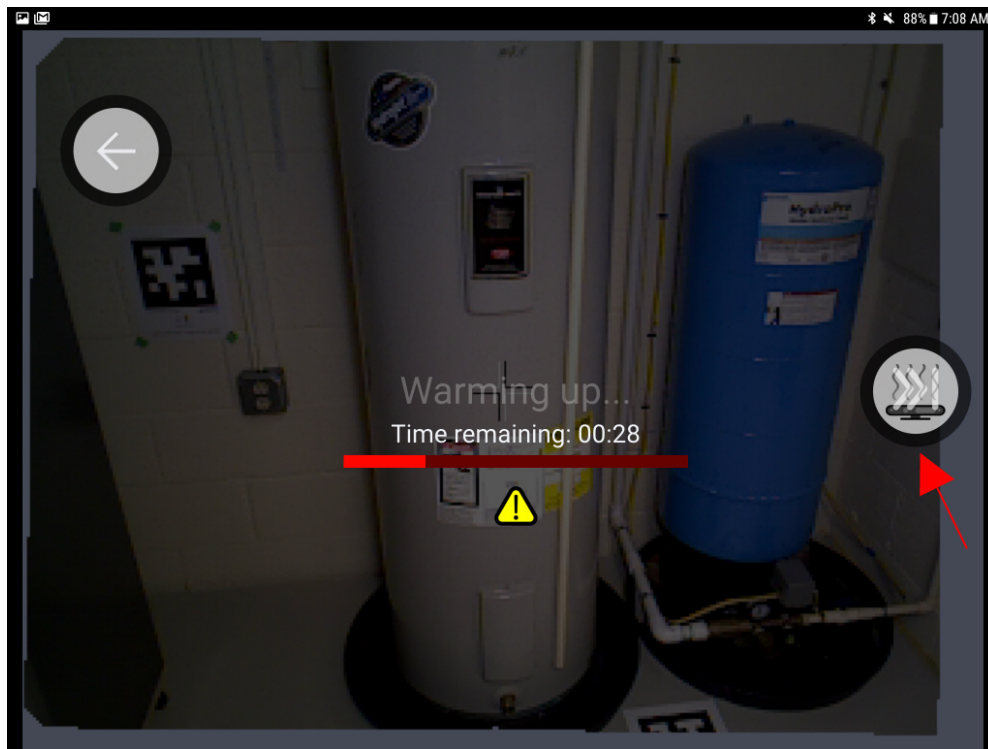


Figure 34 - Warm Up

Once warmed up you will see a green circle around the **Scan Start/Stop** cube scanning button on the right.



Figure 35 - Scene Fitness

The green circle is an indication of **Scene Fitness** or how well the device is tracking. The more full the circle, the better the device is tracking. You should start your scan at an area of good Scene Fitness, and keep an eye on this circle to assist with tracking during scanning. If too close, too far away, or approaching flat areas the tracking will go down to zero and you may lose tracking. AprilTags are targets suggested for improving the accuracy and quality of the data automatically behind the scenes, and can also assist with tracking in difficult areas. Start and end at the same April Tag to close the loop.

Press the **Scan Start/Stop** cube scanning button on the right to start the scanning.



Figure 36 - Start/Stop Scanning

You should start seeing a live gray image feed from the sensor in the scanning window. If you do not see the live image, look to see if there is a warning that a sensor is not detected. In this case, it is most likely your USB connection has a problem. Check your connection into the tablet as well as the connection from the sensor to the micro USB connector.



Figure 37 - Scanning

The grayed color view of the image serves as a viewfinder and to inform the user about non-captured areas. As you capture the image the color will go from grey to yellow to green as more quality data is collected. Anything beyond the sensor range or below its minimum range is not captured. Shiny or black surfaces can also present challenges, but can often be filled in by approaching from different angles or distances.

Note: On the left side of some DPI units there is a ridged line. Keep your fingers below this line when scanning and capturing HD photos to keep them out of your images.

SYSTEM PREP - WARM-UP

System Warm-up

There are two types of warm-up for the DPI Kit. First, there is the initial system warm-up required when you first activate the software and the sensor. This system warm-up must be performed before every job and should be performed if the scanner has been turned off for more than 2 hours. Second, there is the session warm-up, required each time you begin a scan session.

Initial System Warm-up

For each hour the device has not been used (sensor not plugged in or device battery empty), you should warm-up the device for about 7.5 minutes but not exceed a warm-up time of 15 minutes, depending on environment temperature (less warm-up is required in warmer environments.) See section "DPI Kit Accuracy" for details. Warm-up means the device is powered-up and the sensor is running, with the instrument lying flat and sensor facing up.

Sensor Disconnect Time	Warm Up Time
1 hour	7:30 minutes
2 hours	15 minutes

Warm-up Procedure

Place the scanner on a flat surface with the sensor facing up. The **System Warmup** progress bar shown in (Figure 34 - Warm-Up in last section) tracks how long the sensor has been activated. Once the **System Warmup** progress bar reaches 100%, the sensor is activated and warmed.

Note: The **System Warmup** can be bypassed by pressing and holding the sensor button on the right. This option should only be selected for demonstration purposes as it may result in undesirable measurement results.

Session Warm up

Each time you begin a new image session, you will need to let the sensor warm-up for about 30-40 seconds. This will be required each time you start or append the SCAN. You will not be able to capture data until the Session Warmup bar reaches 100% or if it is taking longer than 30-40 seconds you can press and hold the sensor button.

Note: Intel® RealSense™ depth cameras do not require these war-mup periods. This is only necessary for DPI Kits (PrimeSense).

SYSTEM CONFIGURATION OPTIONS

Settings

System configuration options can be accessed from any screen by pressing the **SETTINGS** gear on the top right side of the screen. Under **SETTINGS** you will find **3D Sensor** and **License Info** options (See [Starting the Software](#)) as well as the following Options:

Help

This brings you to the webpage for Dot3D support materials if you are connected to the internet. (www.dotproduct3d.com/dot3dhelp)

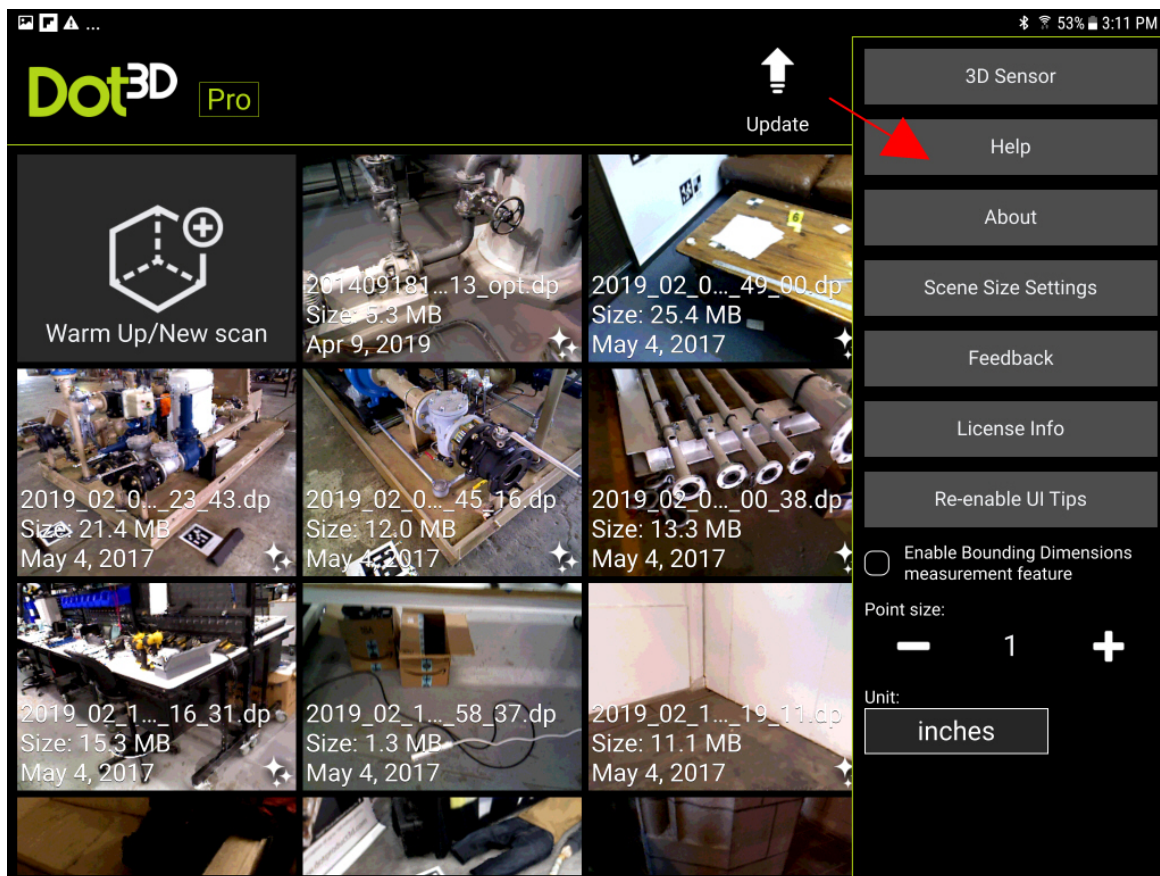
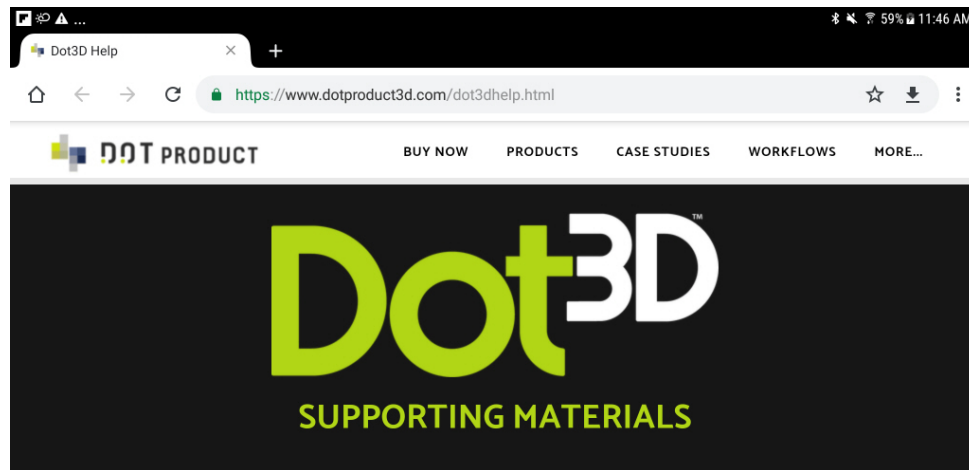


Figure 38 – Help



Dot3D Scan & Pro Overview:



Figure 39 - Help Online

About

This section tells you which version of the Dot3D software you are running. You can also check for updates here, although if you have an internet connection you will also see the update button in the main menu if there is a software update. You can also see the EULA and OS license information.

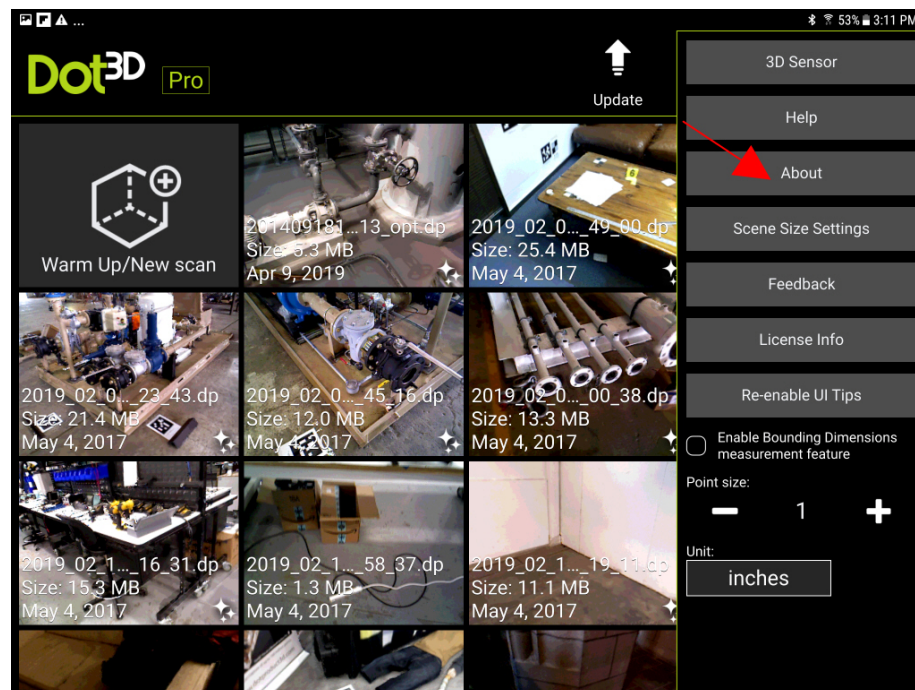


Figure 40 - About Tab

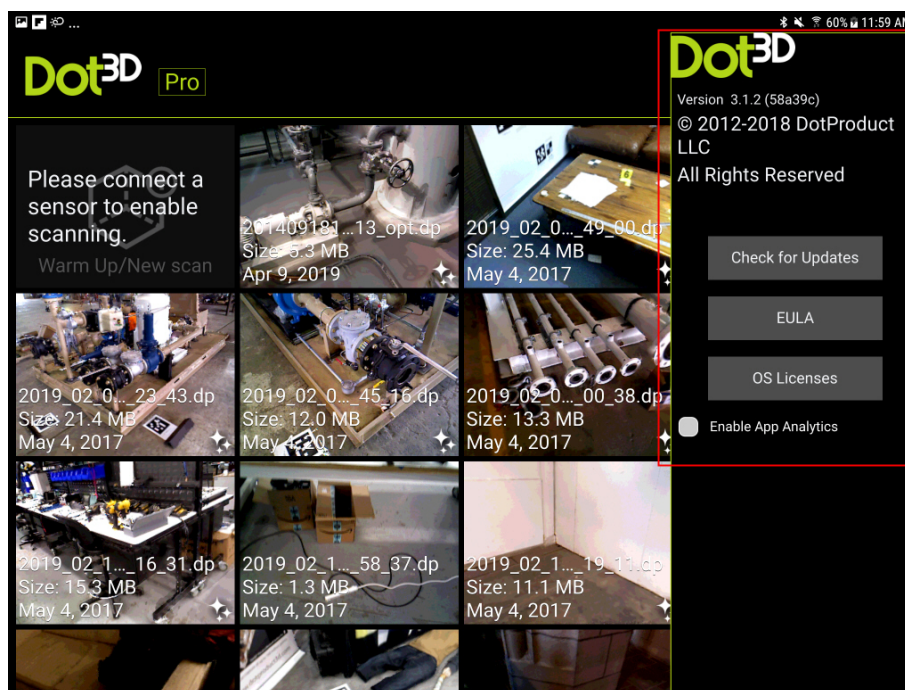


Figure 41 - About

Scene Size Settings

Allows you to modify the maximum scene size you can capture. By default, it is set to 55 million points which is recommended for the Samsung S2 tablet.

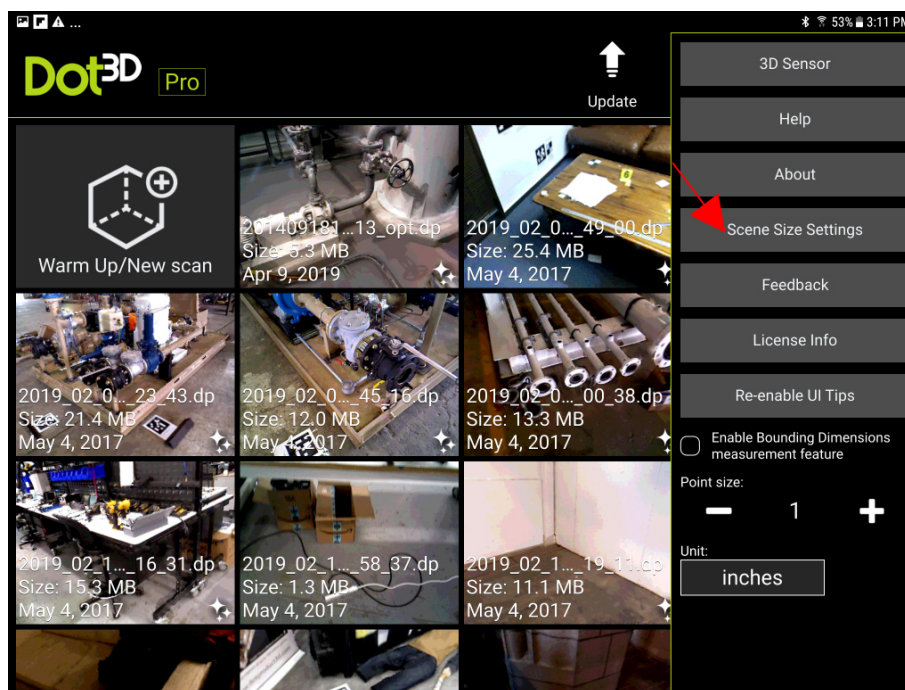


Figure 42 - Scene Size Settings

If you want to try to push the scene capture further, you can override up to 160 million points. An “Overriding Scene Size Limits” warning will appear before you can change the points. If you choose to perform this override on any device, please take note of all warnings and perform extensive testing before deploying for these purposes on a live job site.

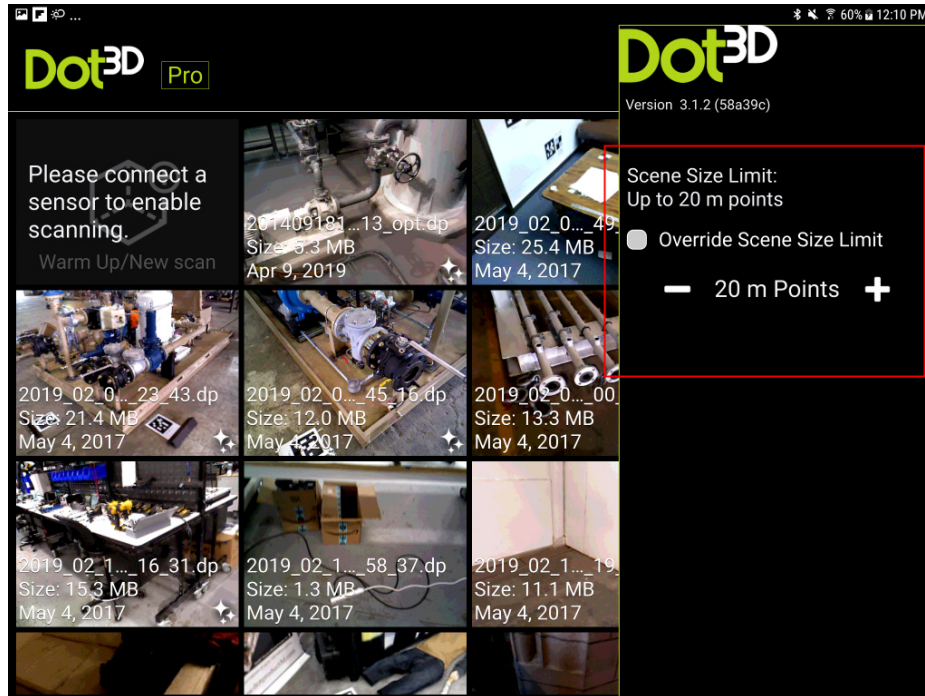


Figure 43 - Override Scene Size Limits

Feedback

Provide feedback if you are connected to the internet. (www.dotproduct3d.com/dot3dfeedback)

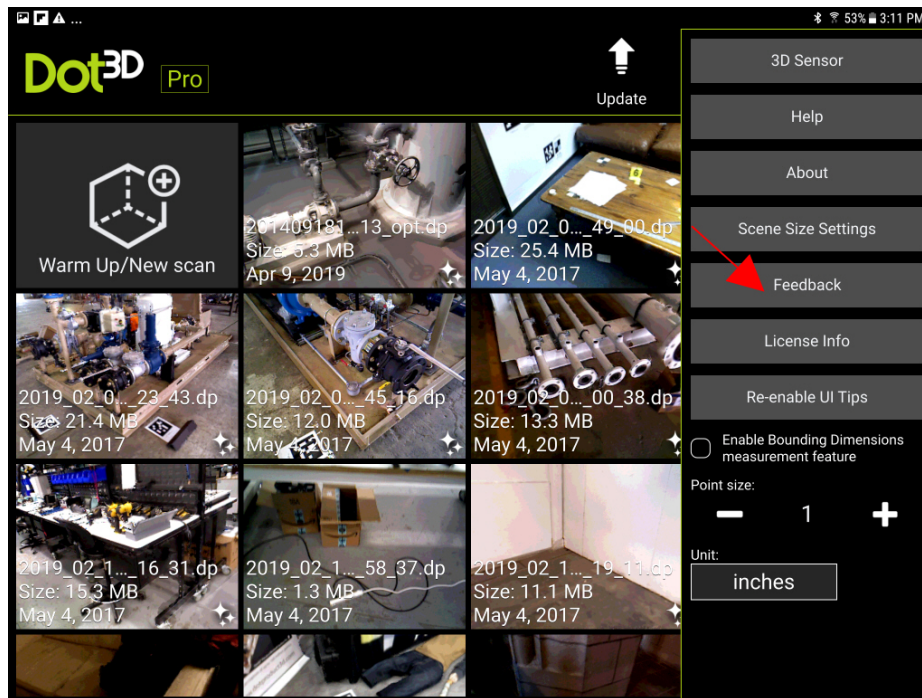


Figure 44 - Feedback

Dot3D Software Feedback

Thank you for using Dot3D. Please provide your feedback below:

*** Required**

Name *

Your answer

Company/Organization *

Your answer

Email *

Figure 45 - Feedback Online

IMAGE CAPTURE

The Capture Process

The DPI Kit will capture data in a contiguous path or sequence, storing the results as a scene. A scene is composed of image frames. The data that is captured for each image frame is a combination of color (RGB) values and positional information for each pixel. In a post capture process known as Optimization, the position and orientation for each of the image frames is refined to minimize global misalignment of all the frames to each other.

Capturing Your First Image

If the sensor has finished the **System Warmup**, as explained above, you can begin imaging by pressing the **Scan Start/Stop** cube scanning button on the right. The screen will then show the capture in progress. You are immediately capturing color 3D point cloud data. Move the device slowly around the area of interest. A slow, circular “washing” motion works well. Avoid sudden jerky movements of the scanner. Keeping your wrists locked will help keep the scanner motion fluid. The pixels for the area of interest will start out grey, then turn yellow, and then green, as the scanner collects progressively denser and higher quality data. The idea is to paint the area of interest green on the tablet screen. Start and end your scanning at the same spot to close the loop.



Figure 46 - Start Scanning

Touch the right-hand **Scan** button again to end data capture. In seconds the 3D point cloud image will appear in the Image Window. The scan will be automatically saved to Dot3d/Data.



Figure 47 - Stop Scanning

After your first capture, to capture a new scene touch the **Scan** icon at the top or the **Warm Up/New scan** on the Home page. Please save all changes before capturing a new scan. When starting a new scan with a previous scan open you will have the choice to **Start new scan**; **Append to this scan**, **Align to this scan** (only available if the existing scan has been optimized).

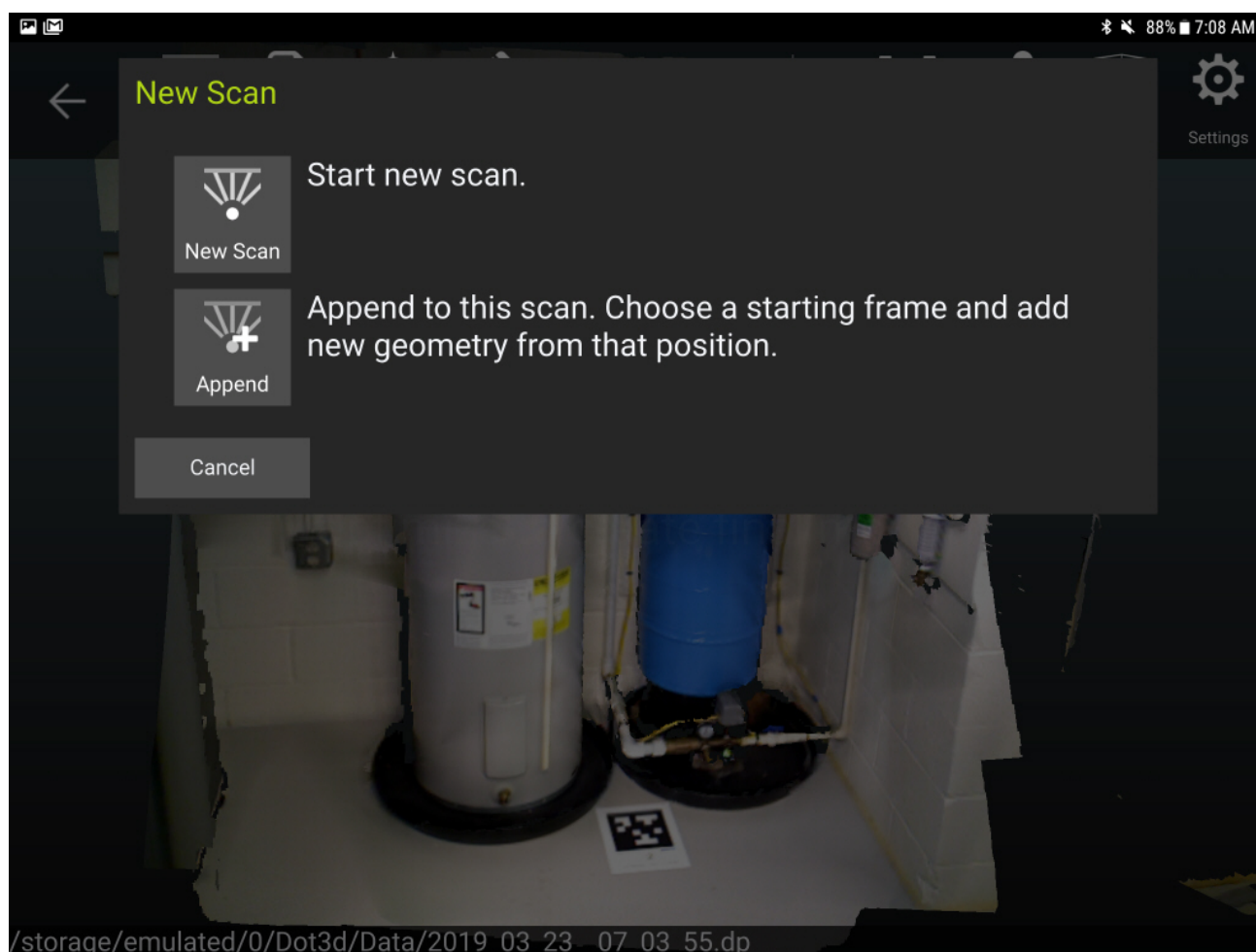


Figure 48 - New Scan

Capture Guidelines

Keeping the scanner orthogonal, i.e. normal to the main surface will have a positive effect on accuracy. Mapping at an angle against surfaces usually results in reduced accuracy caused by increased sensor distortion. Holding the DPI Kit as orthogonally as possible will help with overall result quality. The exception to this recommendation is during the capture of difficult areas. For example, shiny surfaces can be captured by varying the scanner angle to change the angle to the surface which will minimize tracking issues, however it may reduce accuracy. Moving the scanner closer to areas of interest, and centering the areas of interest, will boost the quality of the capture. Do not move so close that the current scene has too few overlapping features with the previous or next frame keeping in mind the minimum distance (60 cm / 2ft for the DPI-8S and 30 cm / 1 ft for the DPI-8S SR). Going closer to the surface than the minimum distance may result in less dense data and often leads to loss of tracking.

Scene Feedback

[Scene Fitness](#) The green **Scene Fitness** arc surrounding the **Scan** button, located on the right side of your screen indicates the suitability of the scene for capture with the DPI Kit.



Figure 49 - Scene Fitness

Scene Fitness is positively impacted by scenes with geometric features. The **Scene Fitness** for a blank white wall will be poor. The **Scene Fitness** for a scene that includes the intersection of three planes, e.g. a corner that includes two walls and a floor, will be much better. We recommend beginning a scan with good **Scene Fitness**. The better the **Scene Fitness** the bigger the green arc.

Scene Size The main display includes a basic **Scene Size Bar** on the left side of the main tracking window that progressively fills green as you scan to red when the scene size increases and reaches critical sizes. Also, a warning message is displayed once a critical size is reached. Each scene is stored in memory as it is captured, therefore managing scene and file size is important to prevent memory allocation or data loss issues.



Figure 50 - Scene Size

Lost Tracking

Occasionally, you may find that the scanner loses tracking. In these instances, move the scanner back to an area where you were collecting good data and had good scene fitness, and typically the scanner will re-localize, i.e. find itself. Then, you can continue the data acquisition. In the event that you are unable to re-localize the scanner, it will be necessary to stop the collection, but you can still Append. The scanner will save the data collected to the point that it lost tracking.



Figure 51 - Lost Tracking

While mapping, if there are limited geometric features in the area of interest (scene fitness is low), the screen will get a red tint on the left and right borders of the image, for example, when imaging a flat area or moving too quickly. This is a warning that the scanner may lose tracking for the lack of features. In this case it is important to slow down capture and to avoid sudden movements! Remedies include changing the scanner angle or backing up to capture more geometry. In some scenes the warning is unavoidable. In cases where you are unable to recover from lost tracking, you can stop the capture and append to it. See the APPEND section below for more details.

Precision Considerations

While mapping, the color feedback can be helpful in determining the capture precision of the surface. Green is very good, yellow is usually acceptable. Avoid pale or grey areas if you need high precision in these areas.

Bumping or dropping the sensor will knock it out of calibration, so it is strongly recommended to use a well-cushioned transport case for the sensor (such as the one it ships with).

For each hour the device was not used (sensor not plugged in, or device battery empty) you should warm-up the device for about 7.5 minutes, but not exceed a warm-up time of 15 minutes depending on environment temperature. A shorter system warmup time is recommended for environment temperatures higher than 75 deg F (24 deg C). If the environment temperature reaches or exceeds 86 deg F (30 deg C) it is recommended to skip the system warmup entirely.

HD Photo Capture

While mapping with the DPI-8S you also can take HD photos in your scene. The Samsung S2 tablet has an 8MP camera. Make sure you have selected the Tablet Camera under **3DSensor Settings**. (See Starting the Software above.) Select the camera button in the lower right corner to take an HD photo. Hold the camera button and then release to take the picture. There is a preview window in the upper right to see what your camera sees. Be sure to hold your camera still and keep your left-hand fingers below the ridge on the housing to keep your fingers out of the scene.

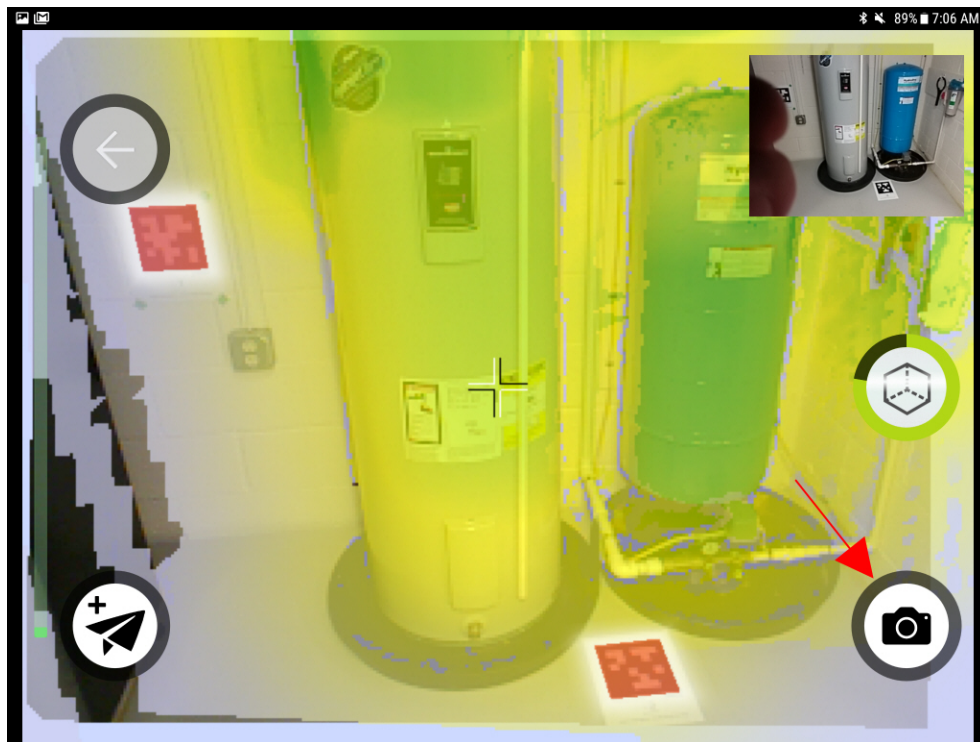


Figure 52 - HD Photo Capture

To view the HD photos after optimizing, select the **VIEW** icon and then **Hi-Res Frames**.

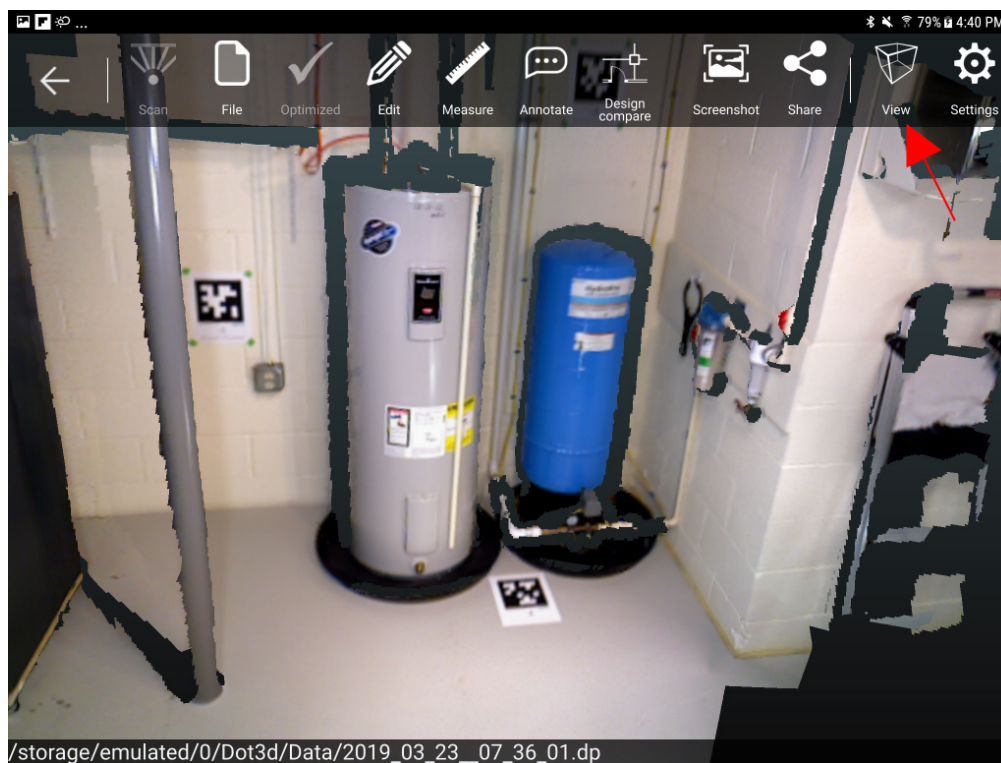


Figure 53 - View

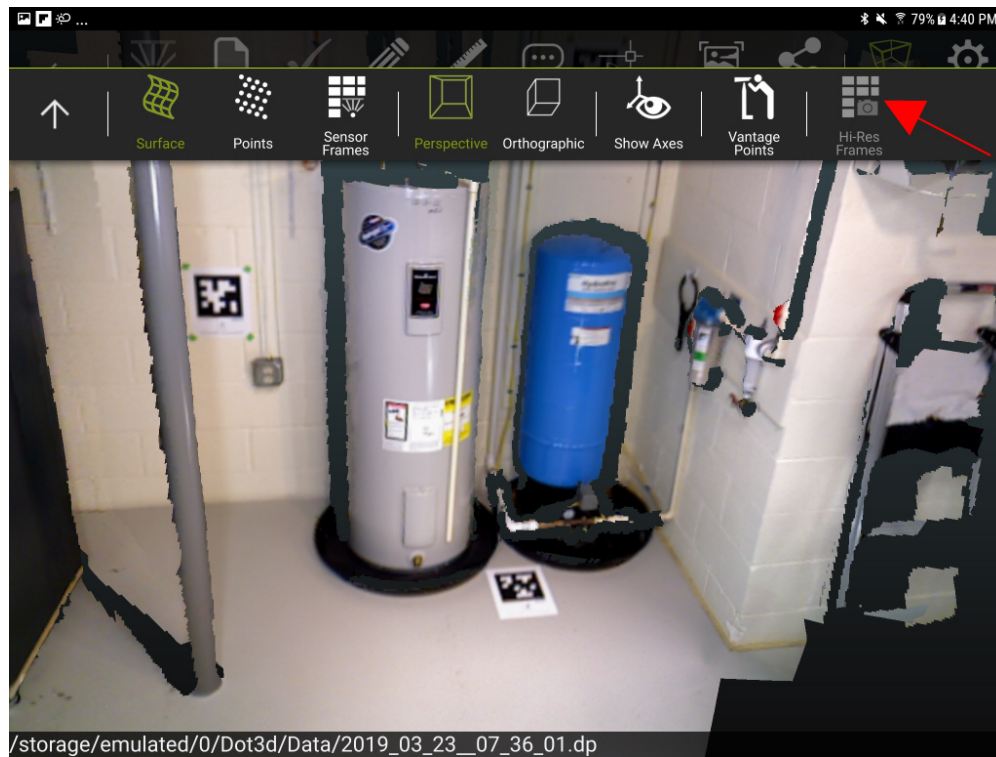


Figure 54 - Hi-Res Frames

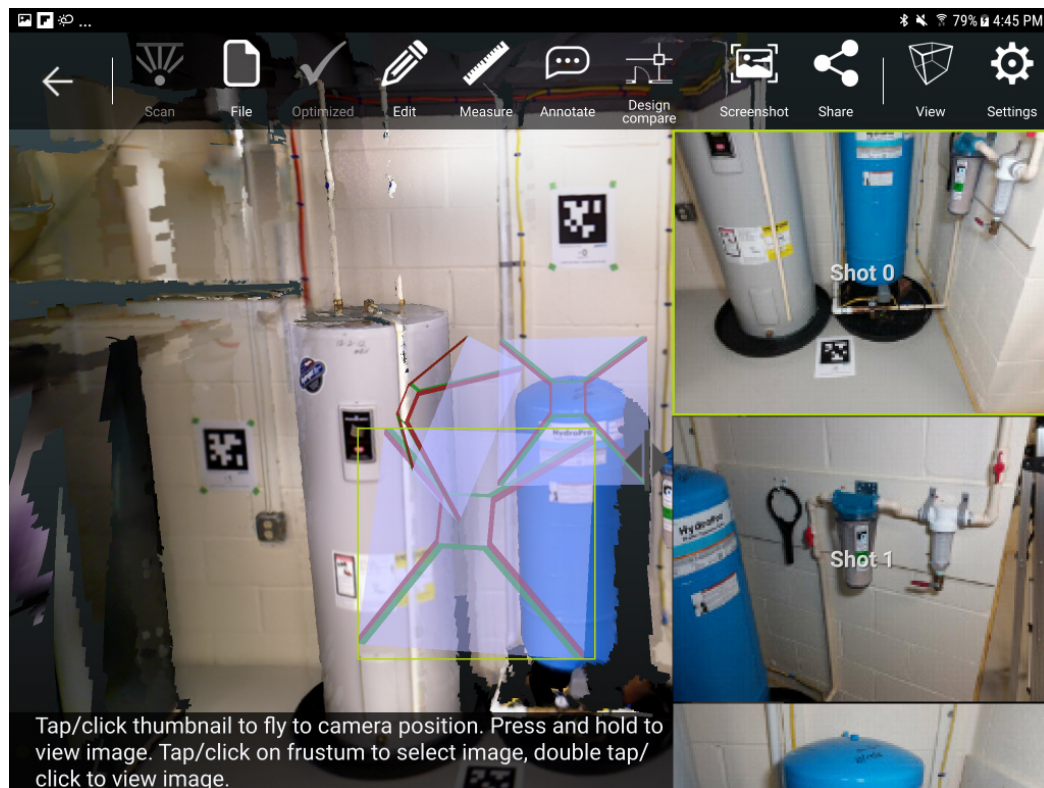


Figure 55 - HD Photo Capture Locations

In the point cloud you will see the camera icons (purple camera frusta) appear in the locations you took the photos. It shows the camera position and orientation in the scene. You can navigate between the 3D and 2D view. On the right-hand side of the screen will be a gallery of thumbnails of the photos you captured. Tap/click thumbnail to fly to camera position. Press and hold to view image to see more detail. Tap/click on frustum to select image, double tap/click to view image.

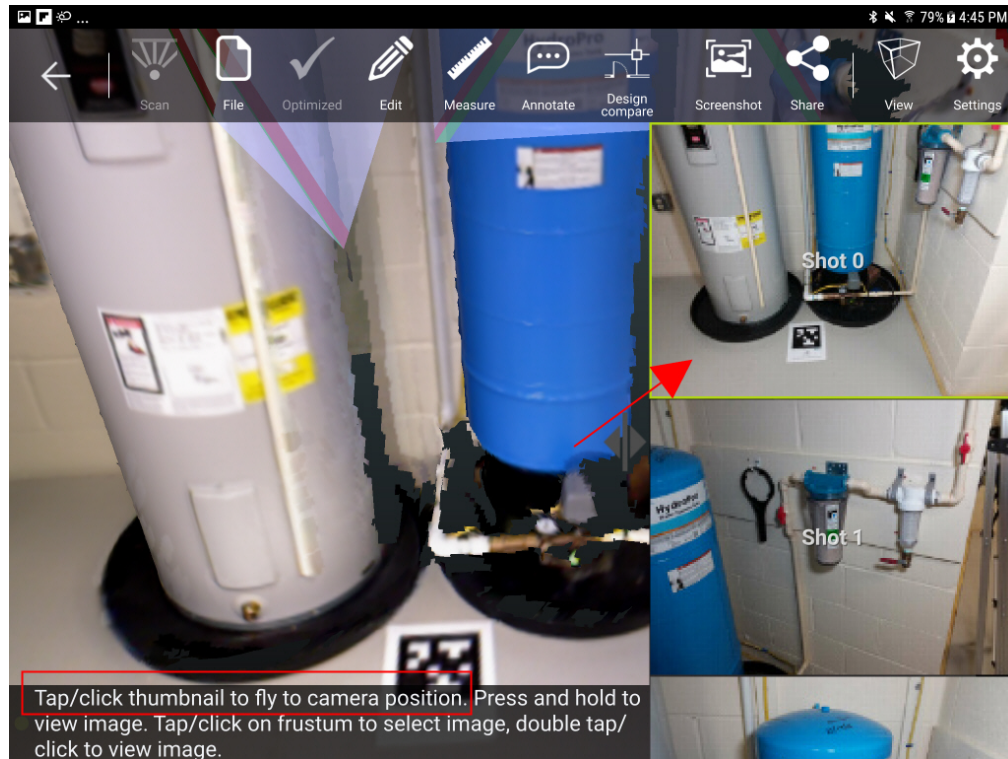


Figure 56 - Tap Thumbnail to Fly to Camera Position



Figure 57 - Press and Hold to View Image

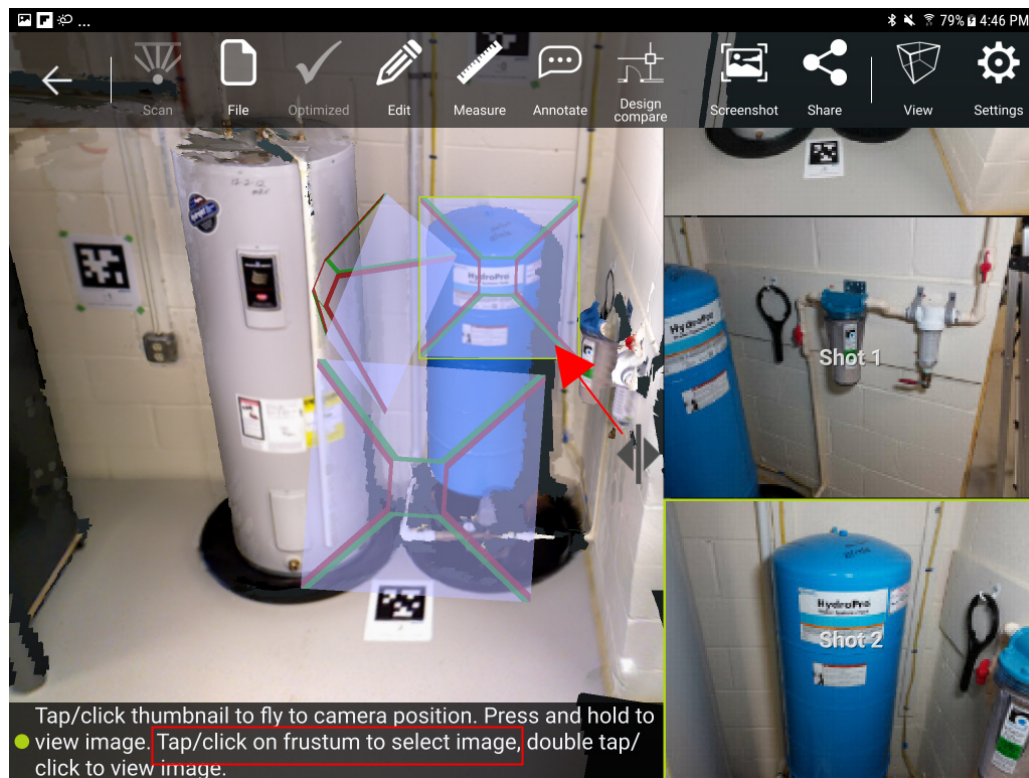


Figure 58 - Tap Frustum to Select Image

It is recommended to save the file with HD in the name so you know there are embedded photos. To export the photos, select **FILE** icon and then **Export Photos**. Choose a photo storage folder. This is very helpful for walk down processes to know where you are in the scene.



Figure 59 - Export Photos

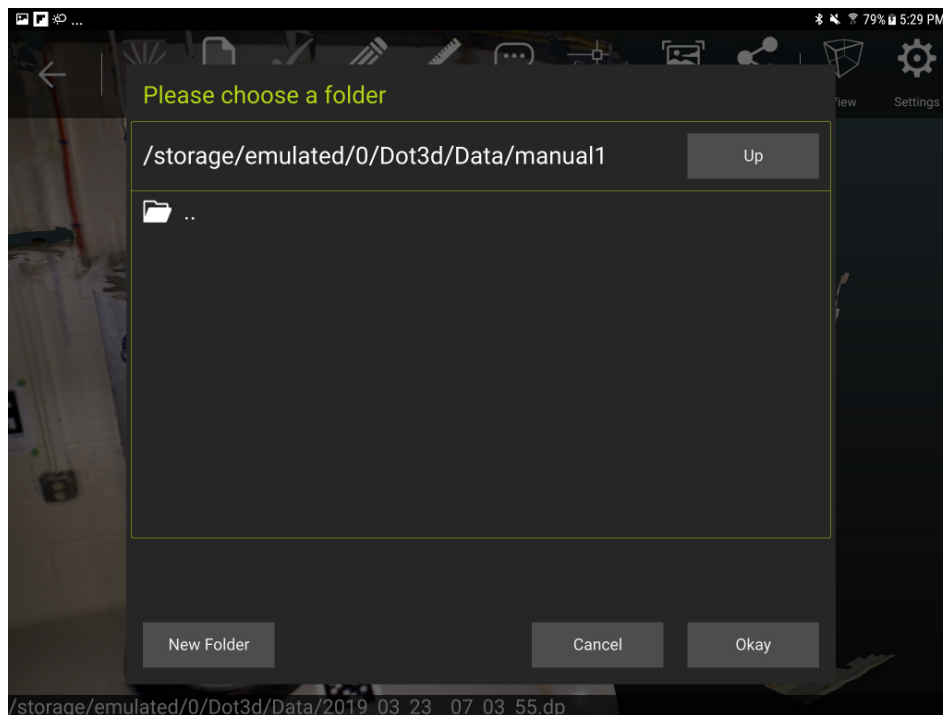


Figure 60 - Choose Photo Storage Folder

Plane Constraints

Dot3D can discern planes in a scene. Flag floor or walls as a level plane, flat surface. This provides a basis for additional accuracy in registering and optimizing the point cloud data by using planar constraints, parallel planes. During image capture, the 'Plane' button appears in the lower left corner.

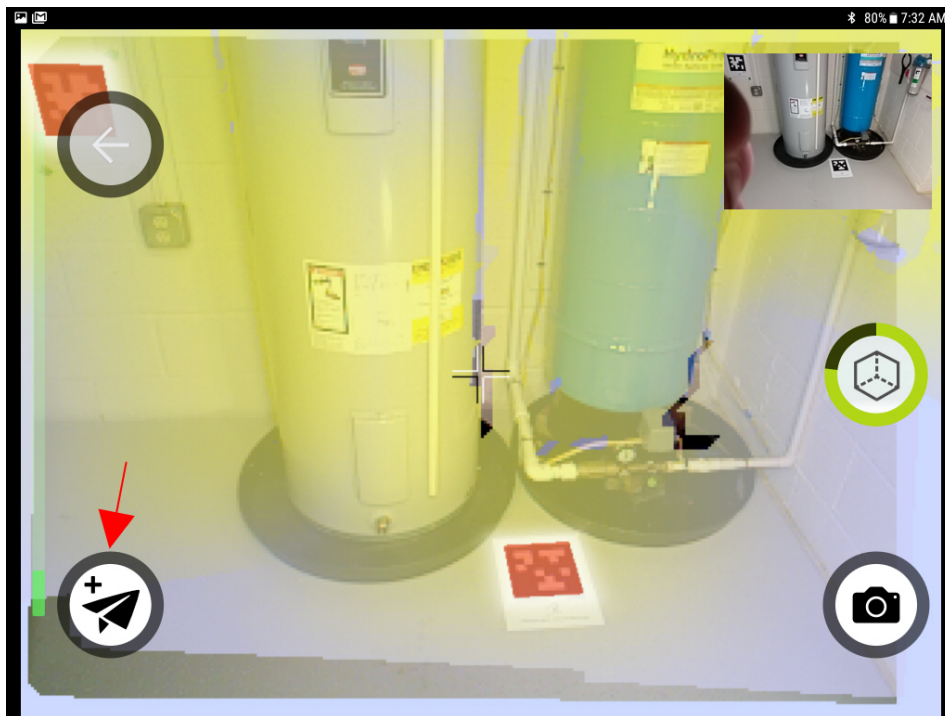


Figure 61 - Plane Button

With a planar section (wall, floor, front panel door, etc.) in view and within the crosshairs, pressing the Plane button will request that the plane be identified. Dot3D will attempt to locate a planar surface associated with the pick and turn all candidate points purple. If properly identified, the message 'Plane Pick Successful' will appear in the upper section of the screen and the plane will show purple. If not identified, the message 'Plane Pick Failed' will appear. Larger planar areas have a better chance of being detected, smaller areas will more frequently fail. These planes are then referenced during the optimization phase.

Note: Plane constraint functionality should only be used in situations where you trust that corresponding planes are indeed parallel (i.e. parallel walls, different sections of the same flat floor/wall, parallel landings of a staircase). If you are not confident that surfaces are parallel, you should not use this function on them.

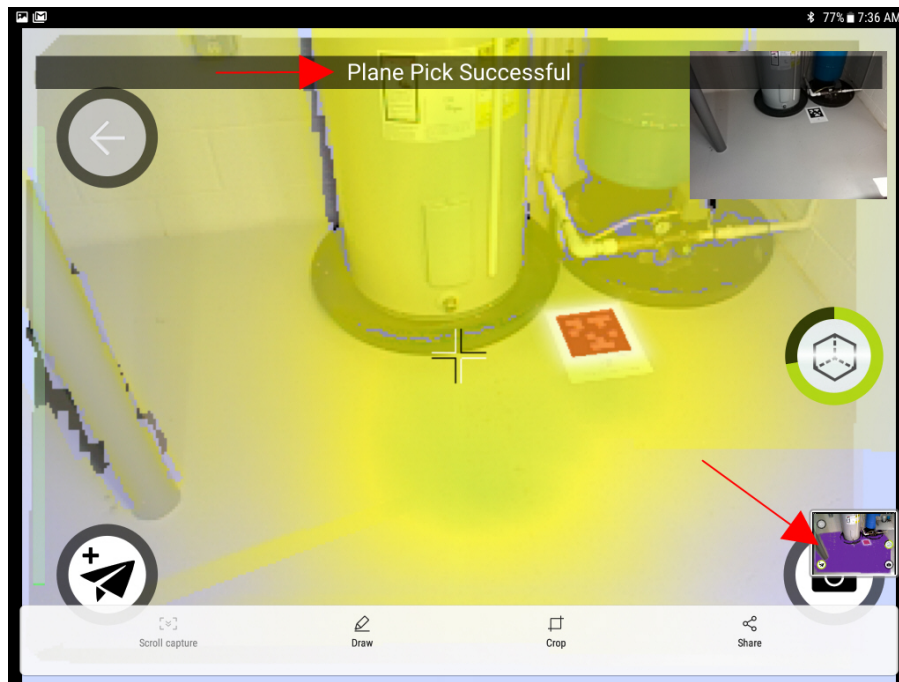


Figure 62 - Plane Pick Successful

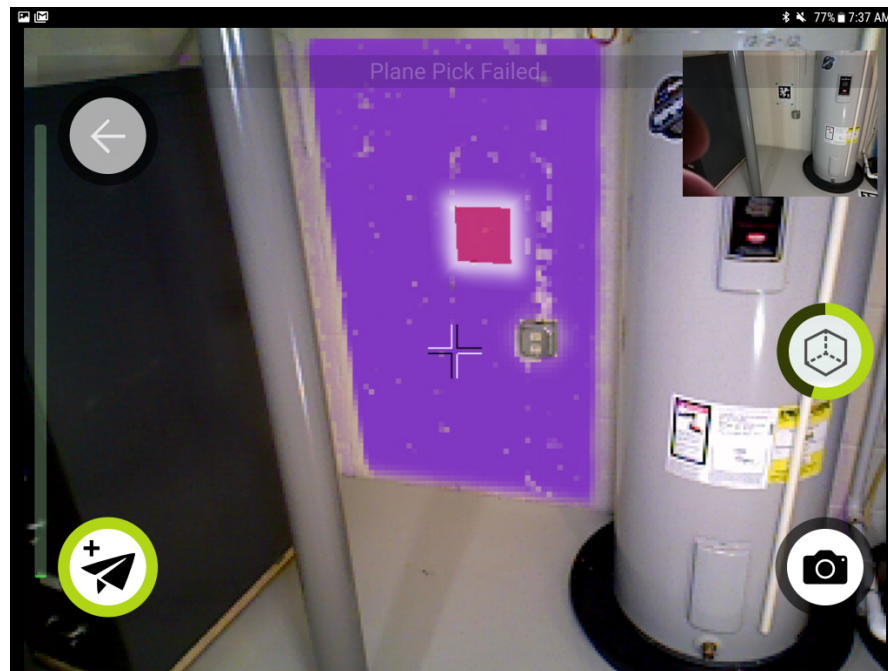


Figure 63 - Plane Pick Failed

NAVIGATING THE POINT CLOUD

View Button

The **VIEW** button is in the top tool bar once there is a 3D image loaded into Dot3D from a recent scan or previously saved scan. The following are choice in viewing the point cloud.



Figure 64 - View

Surface – Image based rendering view



Figure 65 - Surface

Points – Point cloud view



Figure 66 - Points

Sensor Frames – Each frame captured to create the whole point cloud



Figure 67 - Sensor Frames Tab

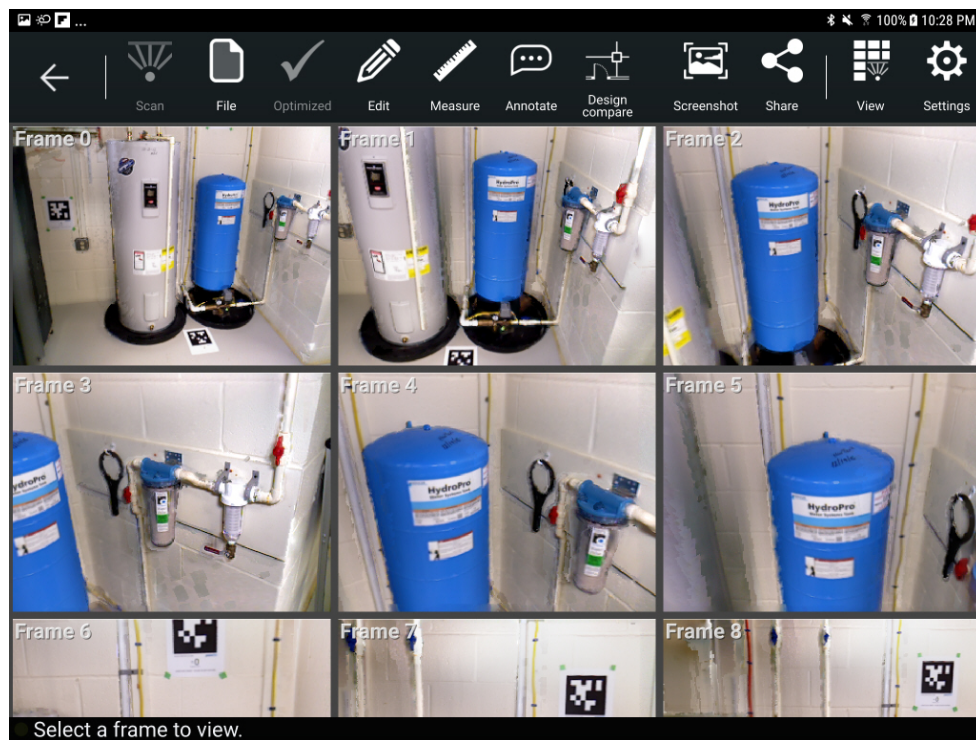


Figure 68 - Sensor Frames

Perspective – Perspective view of point cloud



Figure 69 - Perspective

Orthographic – Orthographic view of point cloud



Figure 70 - Orthogonal

Show Axes – Show the x,y,z axes in the 3D image



Figure 71 - Show Axes

Vantage Points – View 3D data from **Top**, **Front**, **Side** or **Home** for original view. Based on active coordinate system.



Figure 72 - Vantage Points



Figure 73 - Home, Top, Front, Side

Hi-Res Frames – Shows the HD photos taken during the data capture and where they are in the point cloud. See [HD Photo Capture](#) above.



Figure 74 - Hi-Res Frames

Other 3D Controls



Figure 75 - 3D Controls

Zoom In/Out – By pinching, or reverse pinching, the Image Screen with two fingers, you will zoom in or out (respectively) to/from the center of interest.

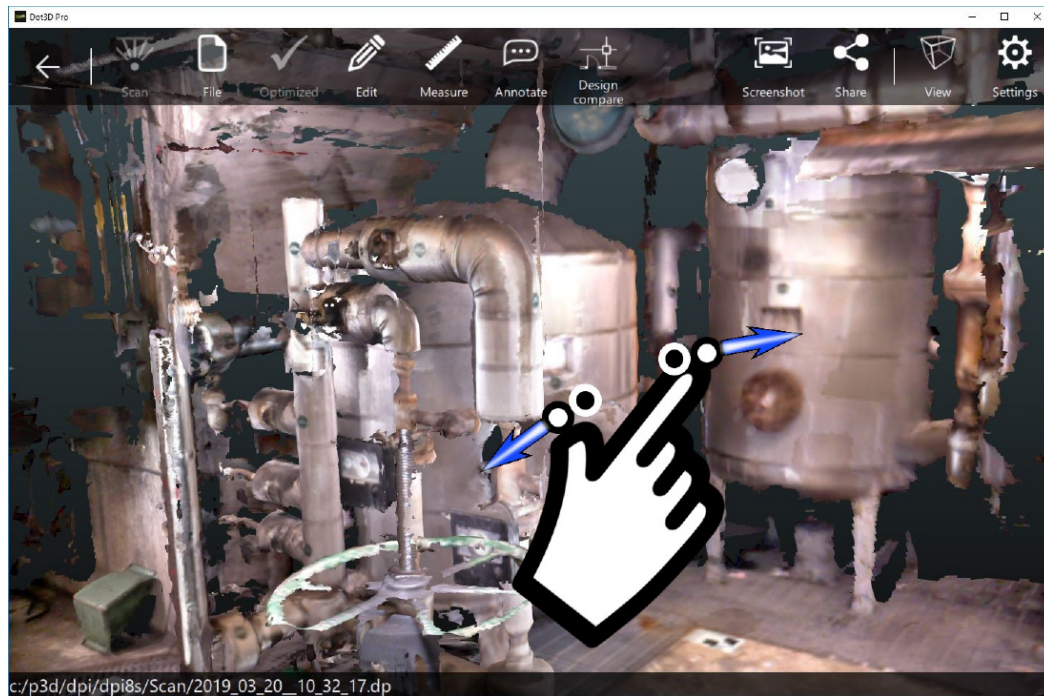


Figure 76 - Zoom

Rotating the Image – You may rotate the scene by moving it with your finger.

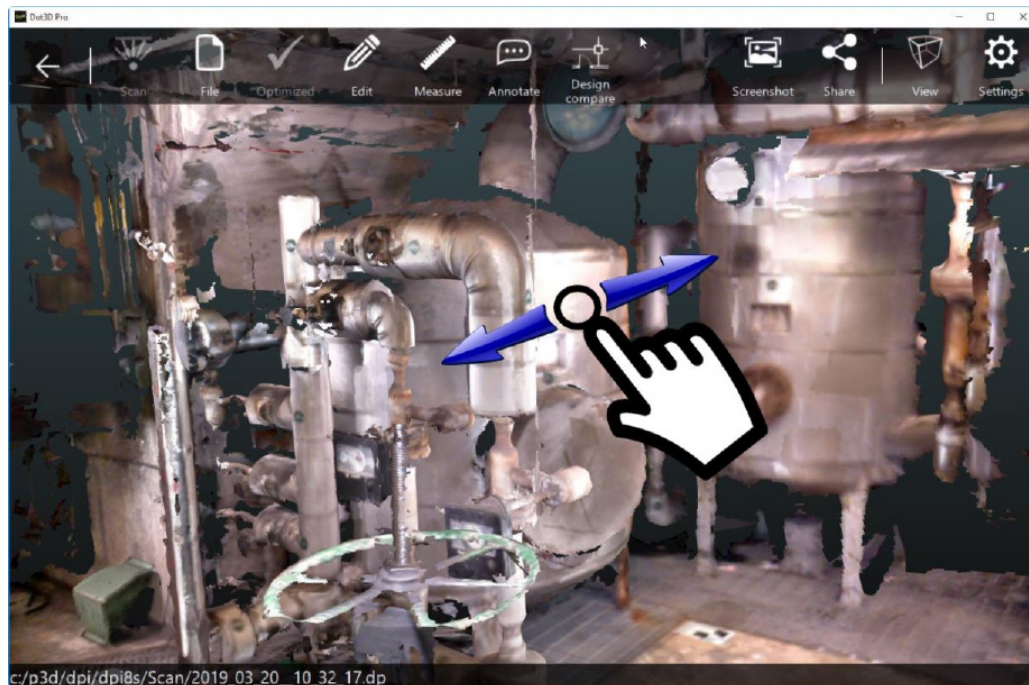


Figure 77 - Rotate

Translate View– To translate the entire scene, drag with two fingers or SHIFT-drag.

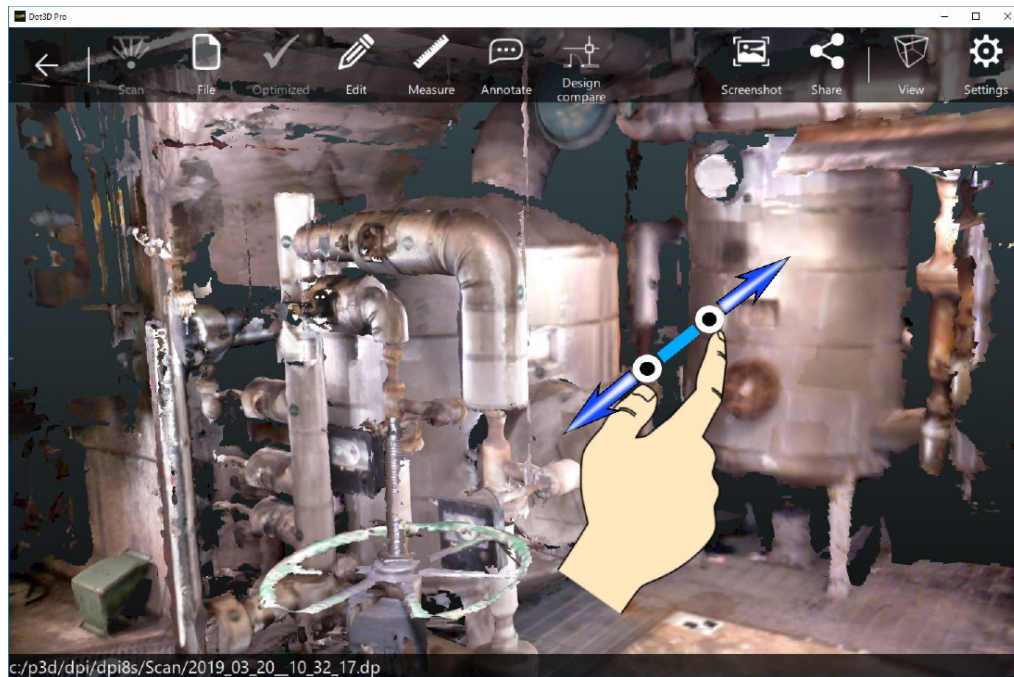


Figure 78 - Translate View

Set Pivot Point– Double click or double tap to change the pivot point (center of rotation). This can also be helpful before zooming in to particular areas of interest.

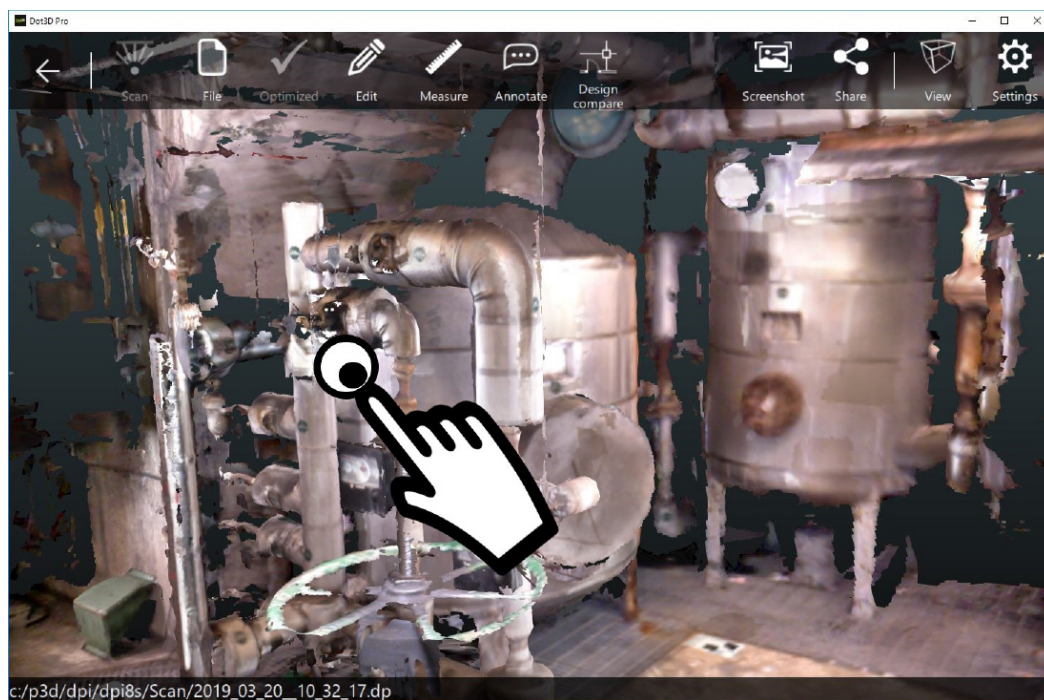


Figure 79 - Set Pivot Point

Roll Camera – You may roll the scene by using two fingers in a circular motion.

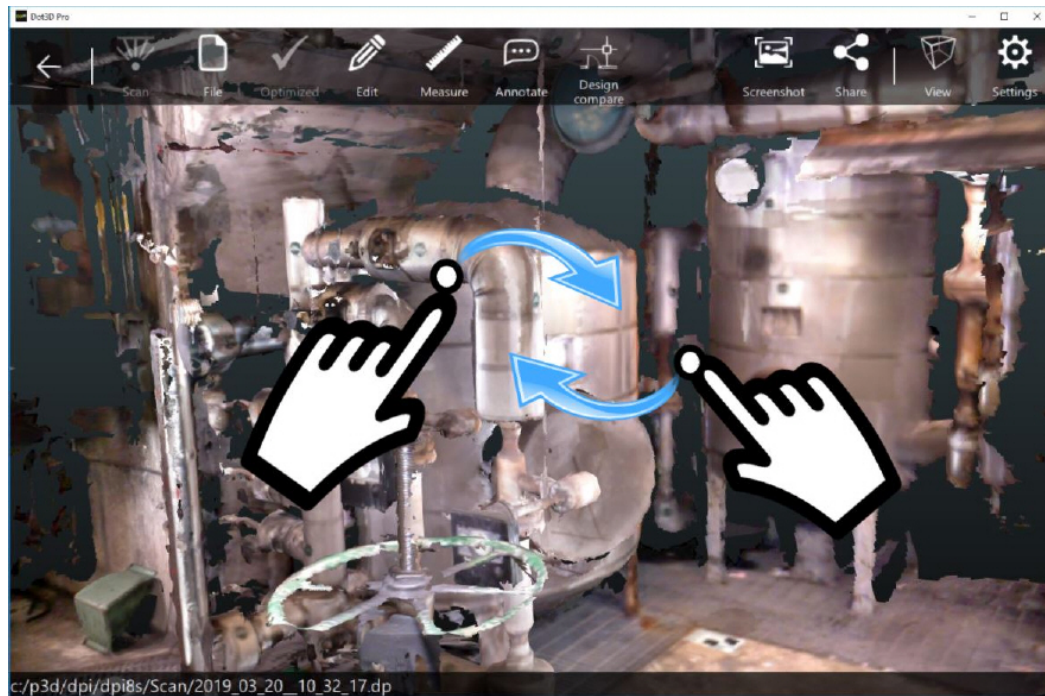


Figure 80 - Roll Camera

APPEND & ALIGN

Add Data to Existing 3D Scans

Appending/aligning to an existing scan allows you to capture additional data from a previously captured position. It starts with the selection of the scan from the home screen or the **FILE** screen, which opens the current view. Note that the software analyzes the frame data and allows you to select frames where the append procedure is likely to succeed.

There are two modes for appending: the default mode is to append data to an existing file. In the default mode all the old and appended data will be contained in a single new file after appending. This mode should be utilized before optimizing the first scan, as both scans can then be optimized into a single scan file.

The second mode is to align and then start a new scene. This mode is selected by checking the “Start a new scan aligned to this scan.” The new file will be in the same coordinate system as the existing file but will not have all the data from the existing file. The new file will have only the overlapping frame used for the append operation. The second mode offers the advantage that as soon as the scanner is moved from the append frame, the existing scene will be cleared from working memory (RAM), allowing a whole new data set to be collected. In this way scene size limitations are mitigated, and it is a good way to partition a capture session into several connected scenes (rather than one big scene). Multiple append operations of this type can be performed. To minimize drift, it is advisable to align new data sets to the initial file. For example, if file 2 is appended to file 1, then file 3 ought to be appended to file 1, not file 2.

Append & Align Steps

After selecting your scan from **FILE** or after you have just captured a scan, press the **Scan** button to begin the **APPEND** procedure. The **APPEND** procedure will be available on both unoptimized and optimized scans, and it is recommended to append to the unoptimized data whenever possible. The **ALIGN** procedure is only available for scans which have already been optimized and saved.

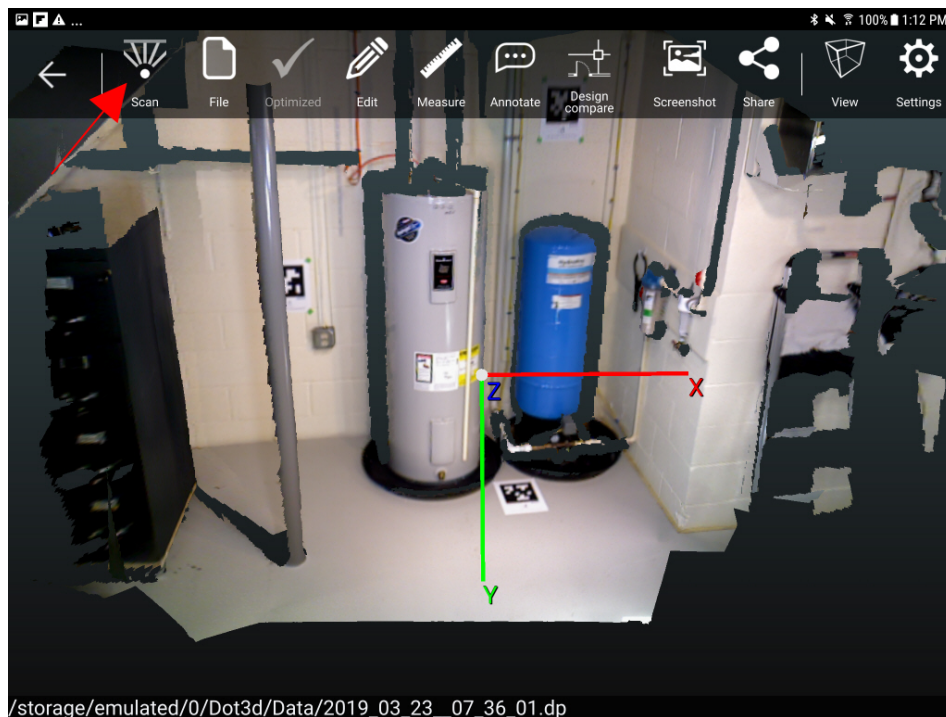


Figure 81 - Scan to Append

Then you will have the choice to Append to add to your existing scan or Align to start a new scan aligned to this scan.

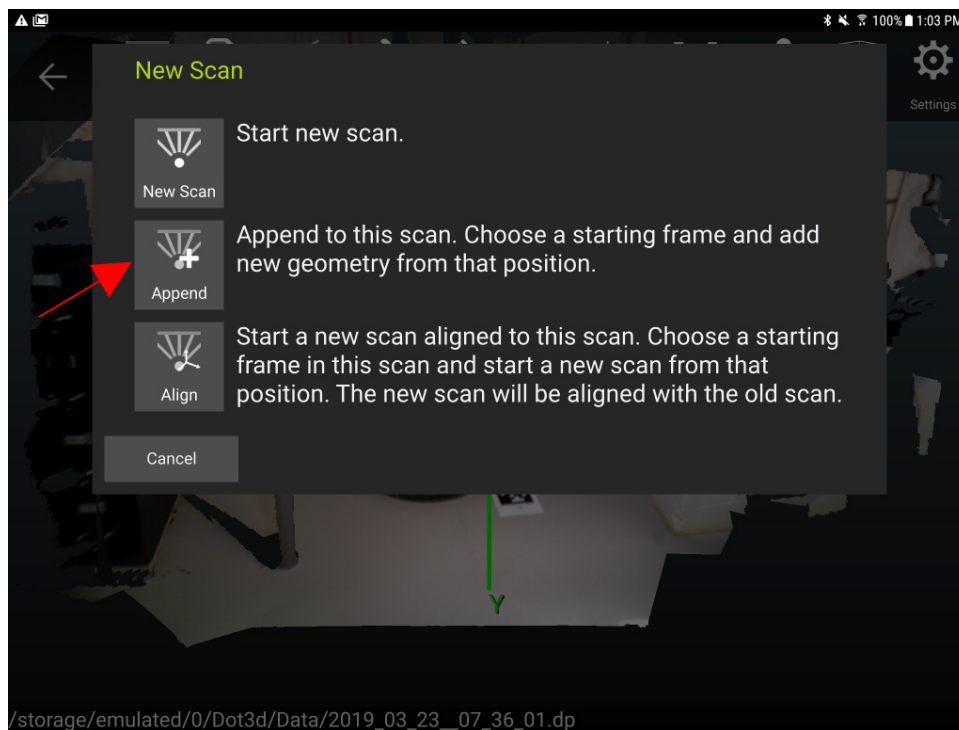


Figure 82 - Append to this Scan

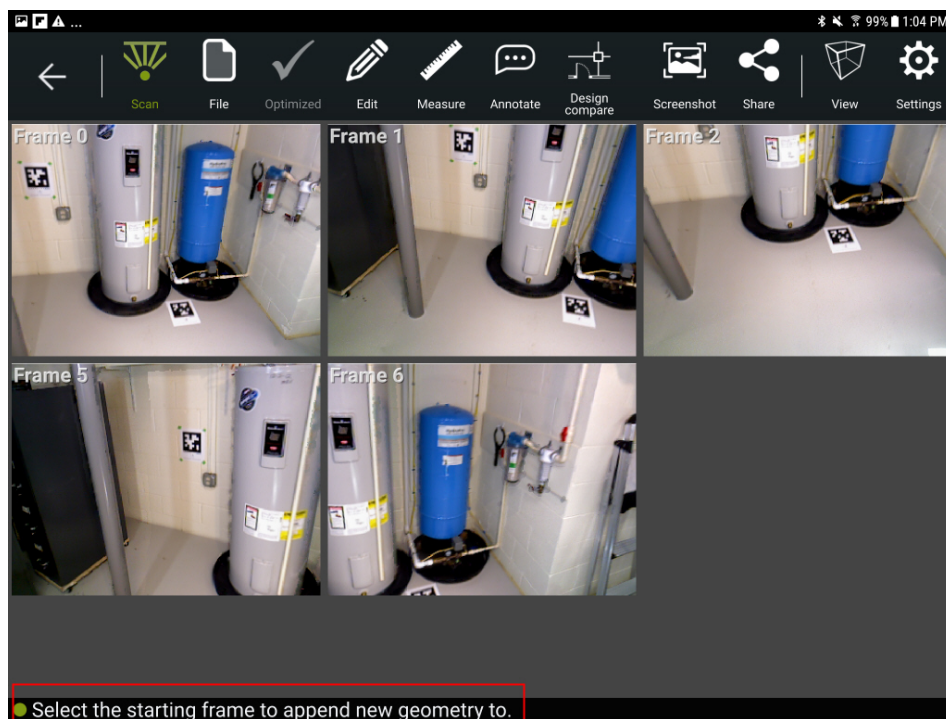


Figure 83 - Select Frame to Append New Data into the Same Scan

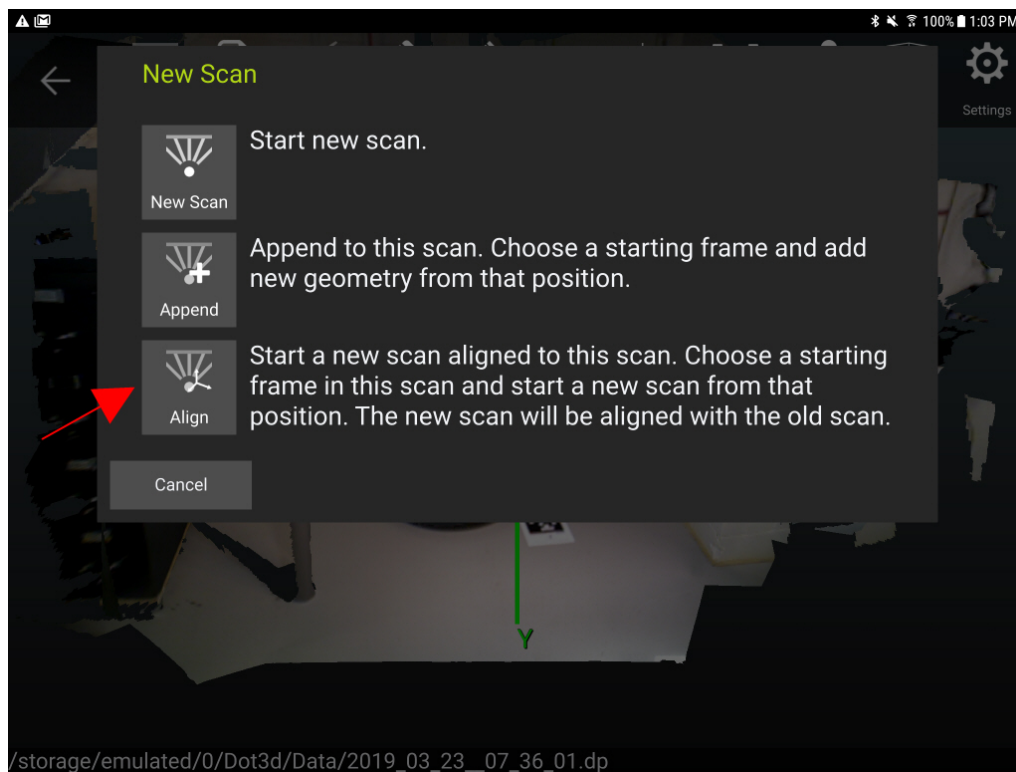


Figure 84 - Start New Scan Aligned to Scan

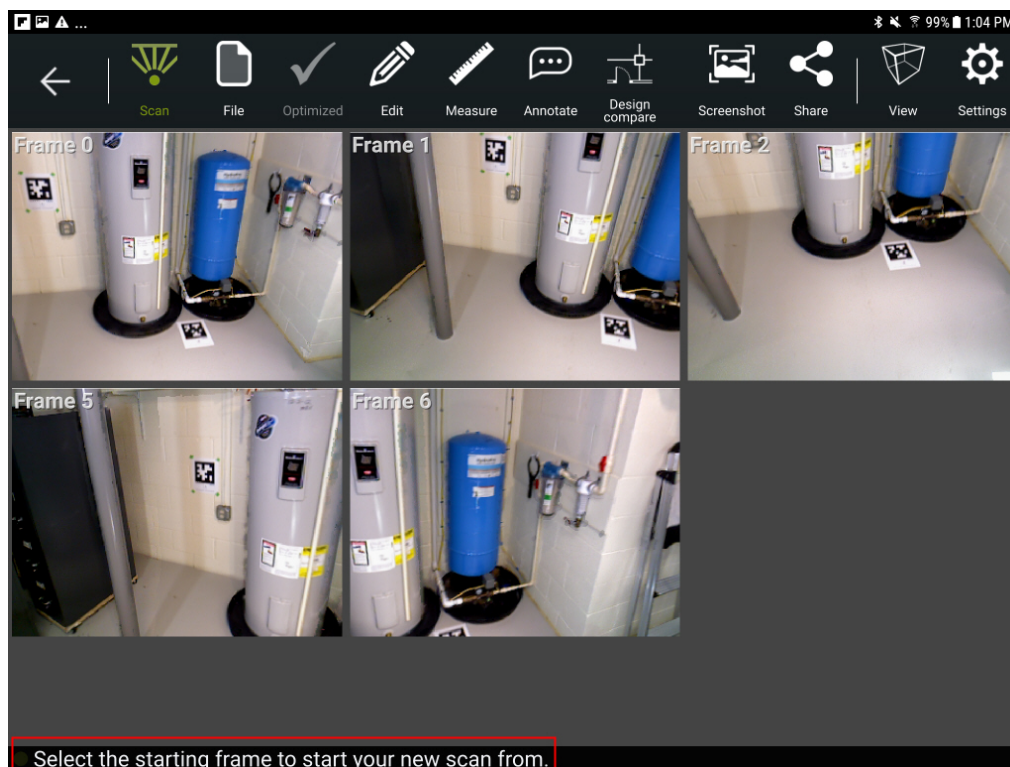


Figure 85 - Select Frame to Start New Scan

Once you have selected the frame, wait for the sensor to warm up. Once the sensor has warmed up, position the scanner in the scene to match the view in the desired frame and re-localize. There is a ghost image of the frame you selected to help in aligning the sensor. Once you have aligned the frame, the scanner will automatically begin capture.

For this feature to work, it is best to choose a frame that represents a view with clearly recognizable geometry in the scene and to position the DPI Kit as close to the same position represented in that view as possible. Otherwise the DPI Kit may have difficulty re-localizing. If you struggle with one frame, you should try another.

EDIT

Under the **EDIT** tab on the main page you can select **Cropping**, **Quality Filter**, **Coordinates** and **Targets**. You can use these to edit the point cloud.

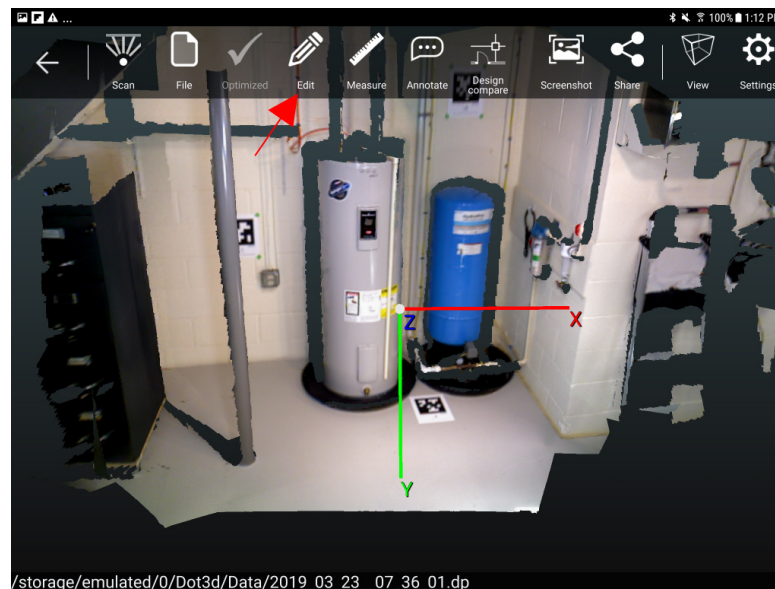


Figure 86 – Edit

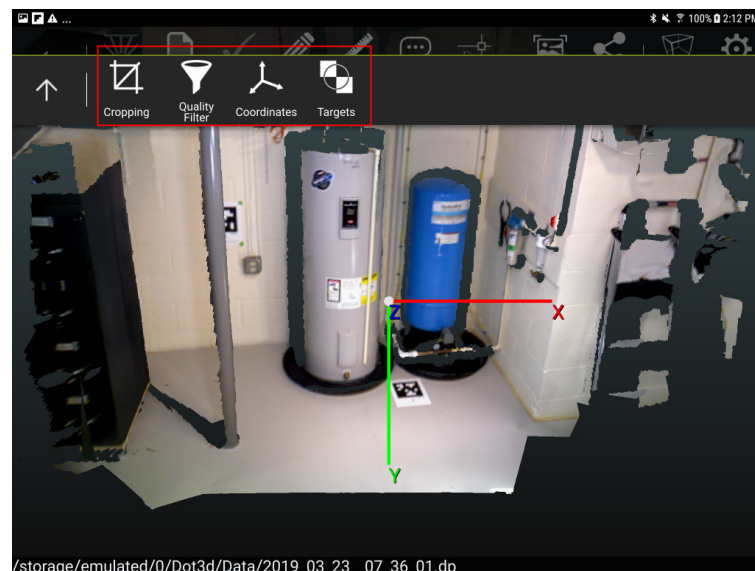


Figure 87 - Edit Options

CROPPING

Cropping

Select the **EDIT** tab and then the **Cropping** tab to select points to crop out or keep. It is often helpful to go to the orthographic view (Select **VIEW** then **Orthographic**) and top down view (Select **VIEW** then **Vantage Points** then “Top”) to do the cropping. You can “Select” an area to be filtered out, “Deselect” an area to not be filtered, or “Invert” your selection. Select your cropping area by dragging on the green circles on the corners of the square. After selected your cropping area you can also go to “Front” and “Side” to refine your cropping area even more. Once you have selected what you want filtered (red area) select “Crop” to apply.

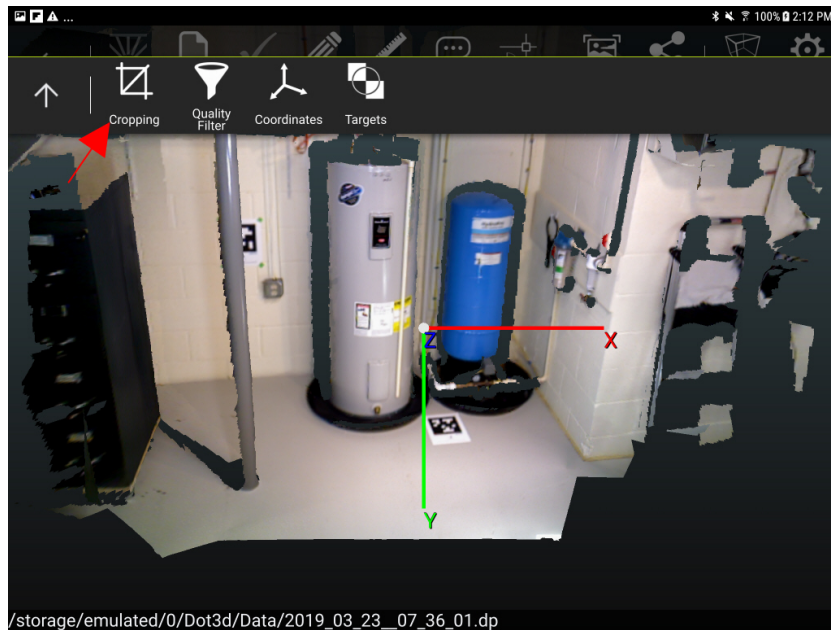


Figure 88 – Cropping

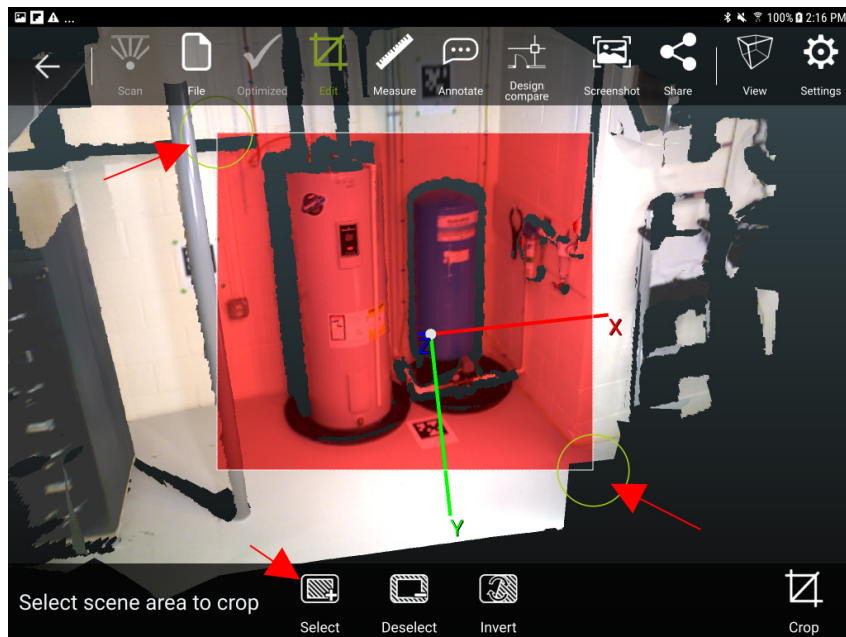


Figure 89 - Crop Select

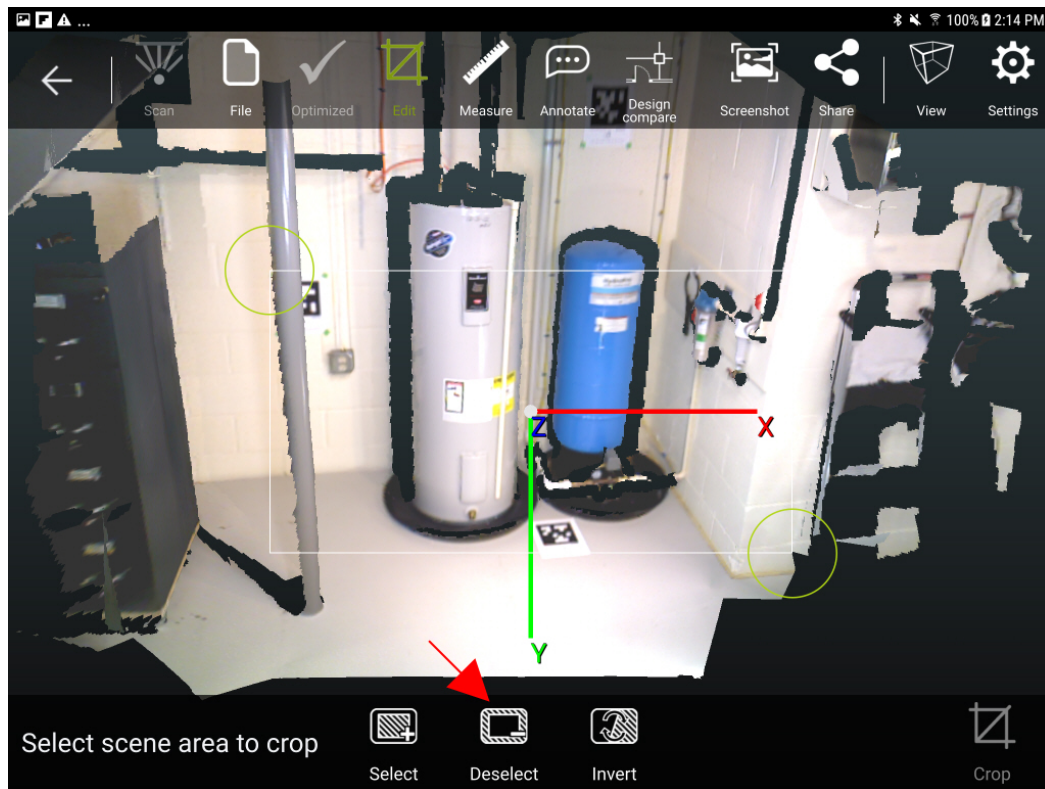


Figure 90 - Crop Deselect



Figure 91 - Crop Invert

QUALITY FILTER

Quality Filter

Select the **EDIT** tab and then the **Quality Filter** tab to edit the data based on the green and yellow feedback during scanning to get rid of some of the lower quality points at a threshold. Adjust the threshold by moving the circle right for more filtering or left for less filtering. What is getting filtered shows as red on the point cloud. Once you have selected your quality threshold select “Apply”.

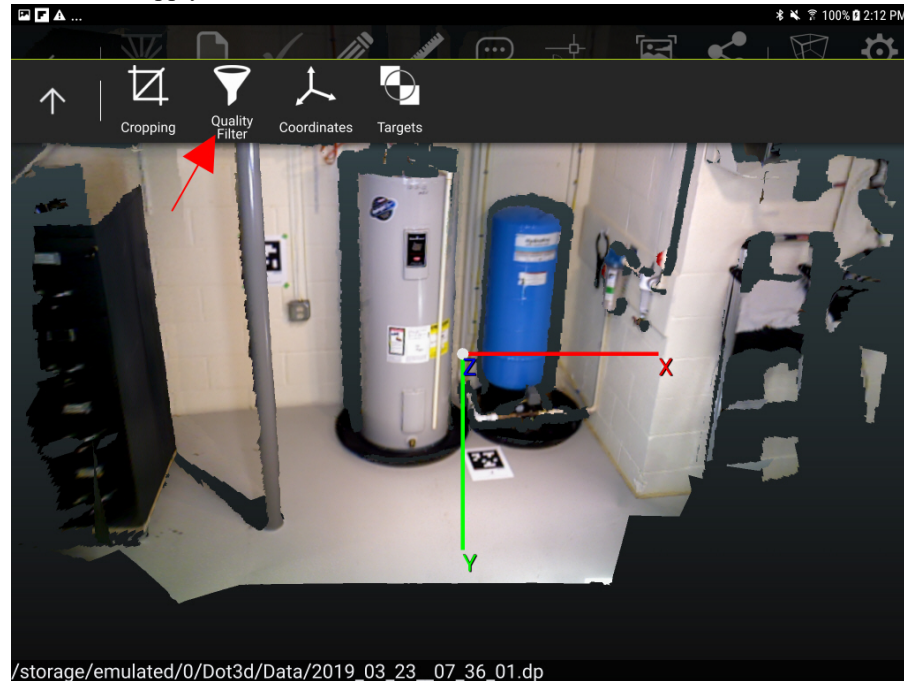


Figure 92 - Quality Filter

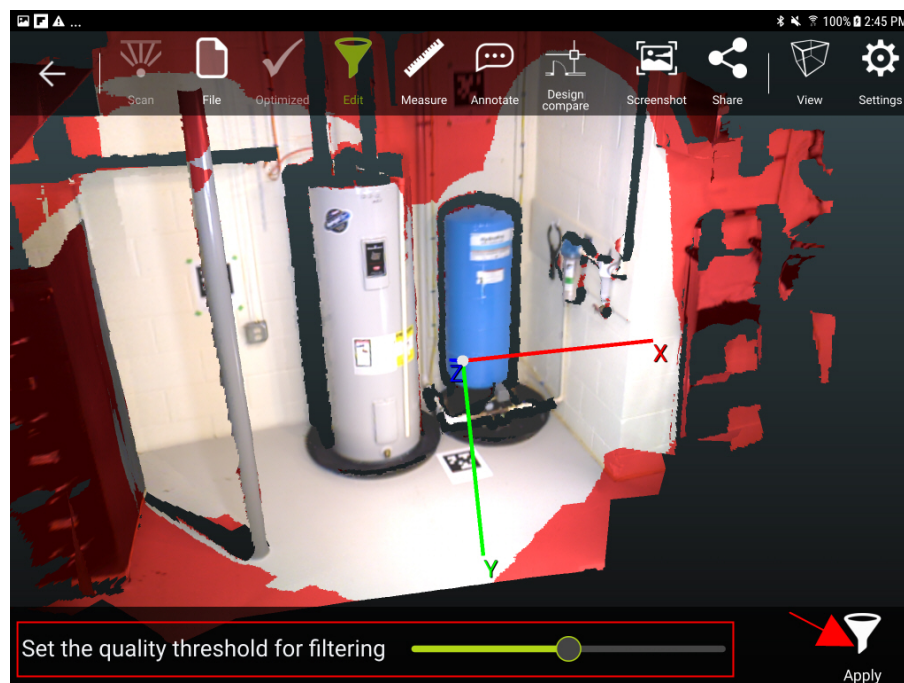


Figure 93 - Set Quality Threshold

COORDINATE SYSTEM

Active System

Under **Coordinates** you have the option to set the Active System to select the coordinate system with Raw, Auto, User Defined, Target or Design.

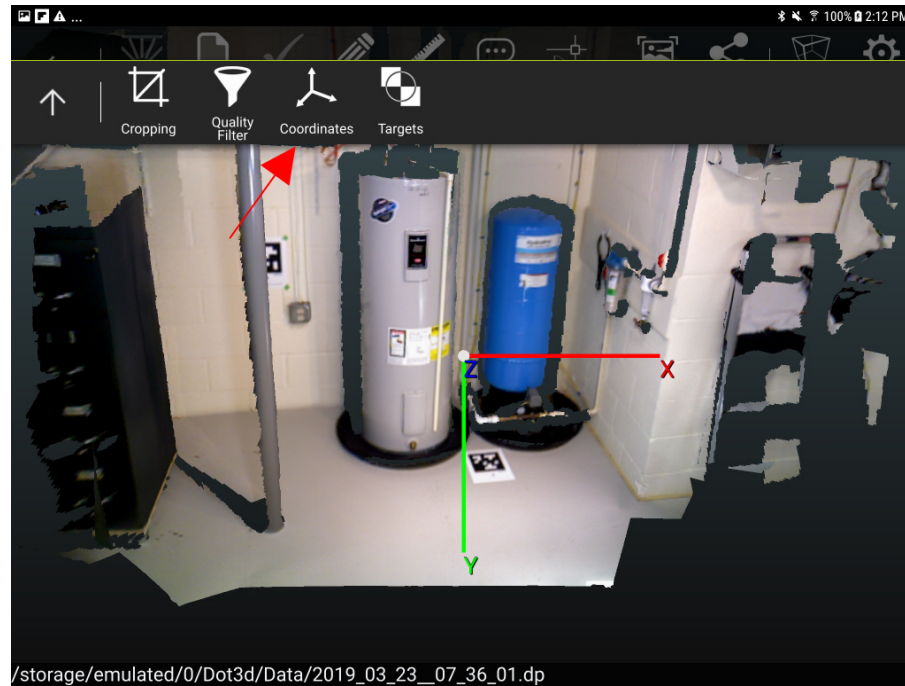


Figure 94 - Coordinates

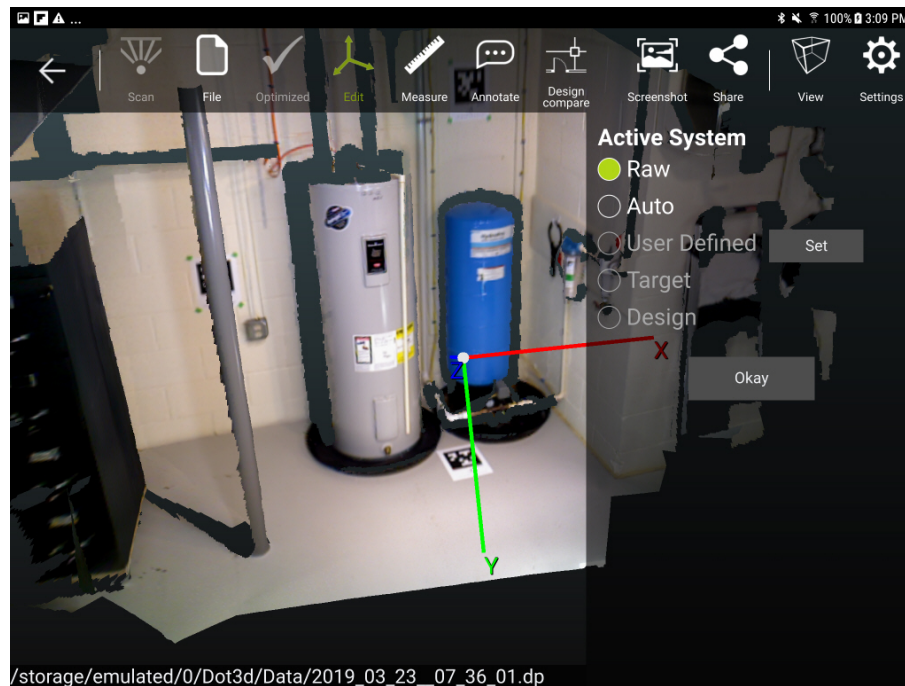


Figure 95 - Active System

User-defined coordinates

Select the **EDIT** tab and then the **Coordinates** tab to allow a user-defined coordinate frame to be specified that can be used for measurements and exported. There are a range of options that can be used individually or combined. Note that Dot3D follows the common convention that the red axis is X; the green axis is Y and the blue axis is Z. Before a user-defined coordinate frame is established, Z points in the direction the scanner was facing at the time the capture began. To set the X Y and Z axis and origin select “Set” under **User Defined**.



Figure 96 - Set User Defined

Pick Origin

Pick Origin can set the position of the origin at a point in the scene.

- Select **Pick Origin** to set a 0,0,0 point. Hold the point and it will give you a zoom window so you can select your exact point. Long press the point to set it as the new origin.

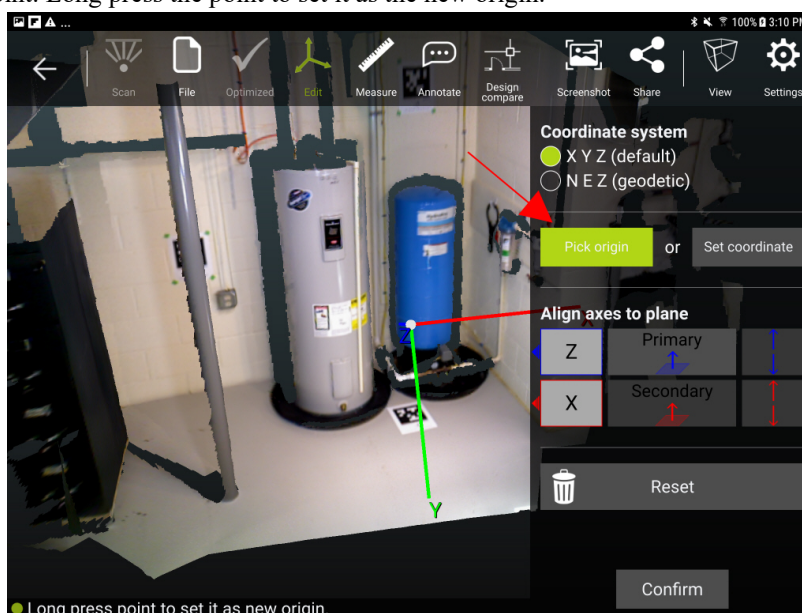


Figure 97 - Pick Origin

Align Axes to Plane in Scene

- To align the coordinate system with a plane in the scene, first select the axis you wish to be perpendicular to the plane (default Z). Click *Primary* and select a point in the scene on the plain of interest. This will force the selected axis to be perpendicular to the selected plane.
- To add a secondary constraint, select the axis and click *Secondary* and select a second point in the scene. Click the up or down arrows for the direction you want your axis.
- Select Confirm to save the Origin and Axes.

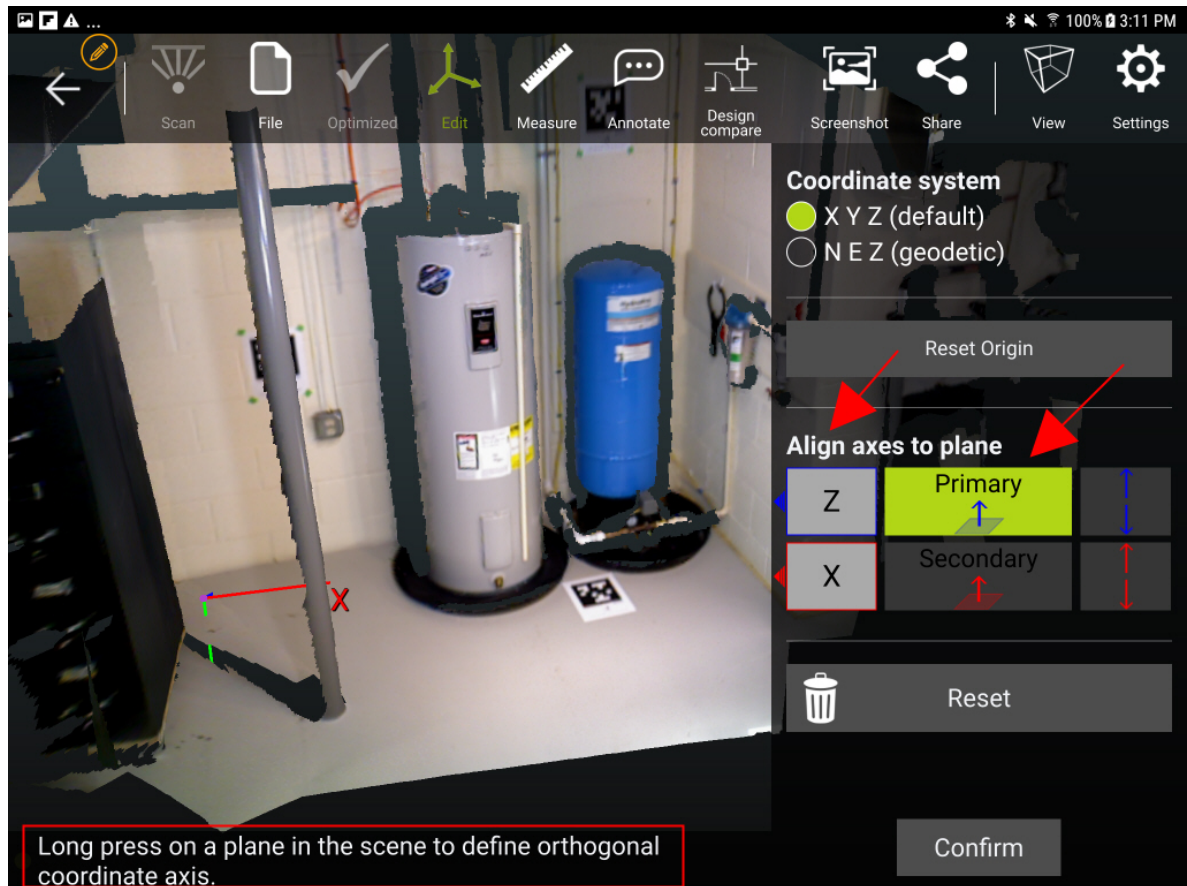


Figure 98 - Select Primary Axis

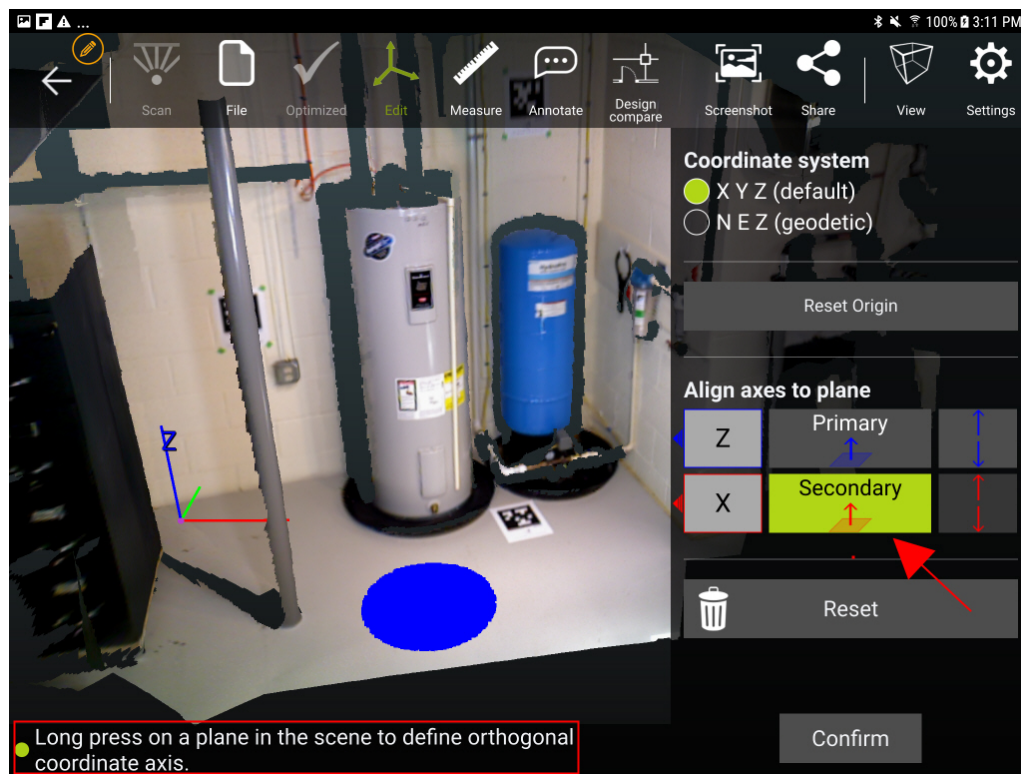


Figure 99 - Select Secondary Axis

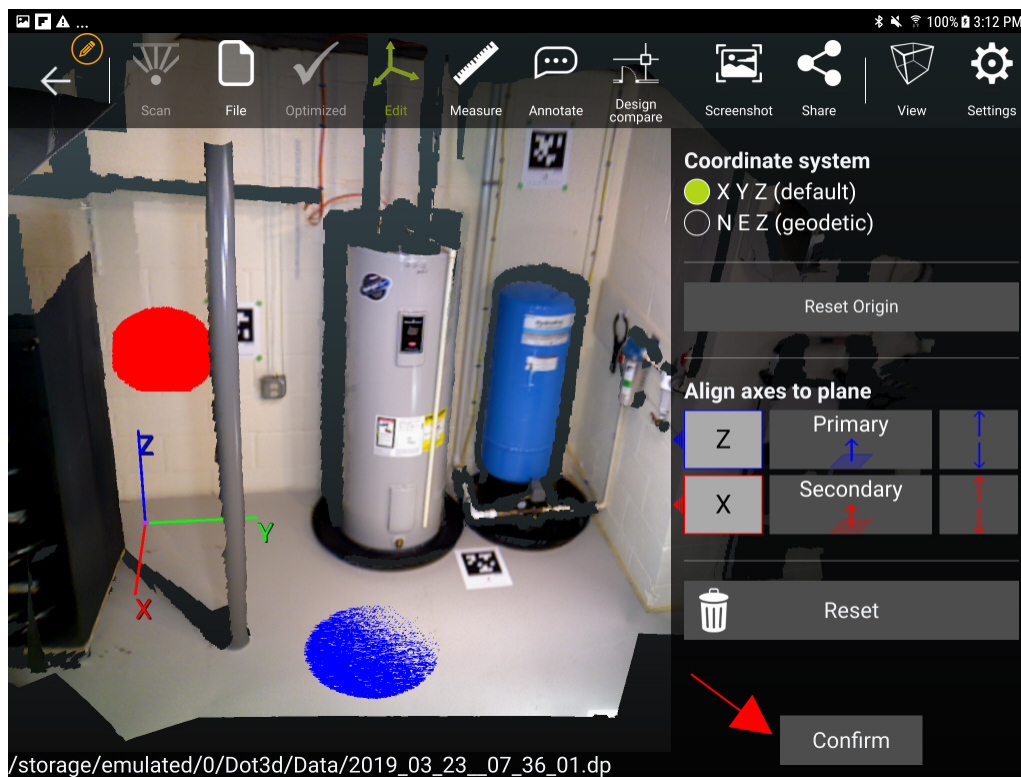


Figure 100 - Confirm Origin and Axes

Set Coordinate

Set Coordinate will set a fixed coordinate at a point in the scene.

- Click *Set coordinate* to enter the coordinate you wish to assign and select the *Measurement Unit* desired.
- Click *Okay* and pick a point in the scene with a long press.

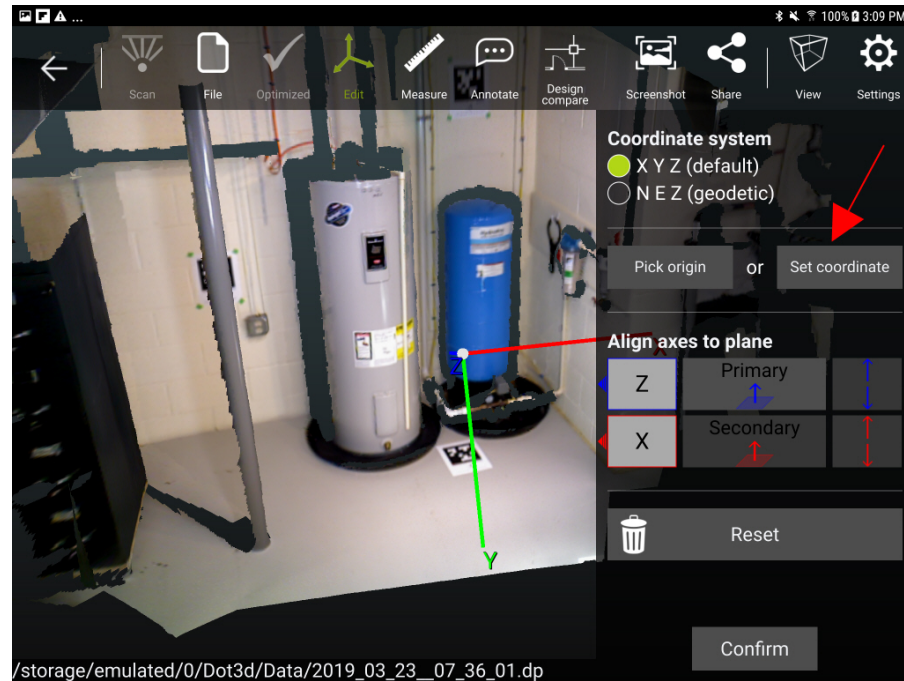


Figure 101 - Set Coordinate

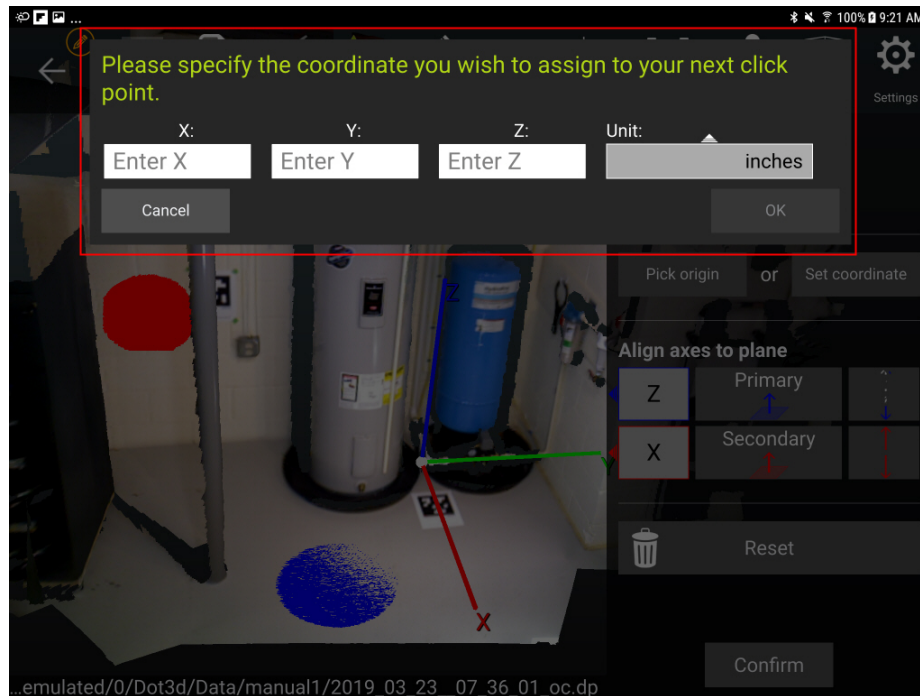


Figure 102 - Specify Coordinate for Origin

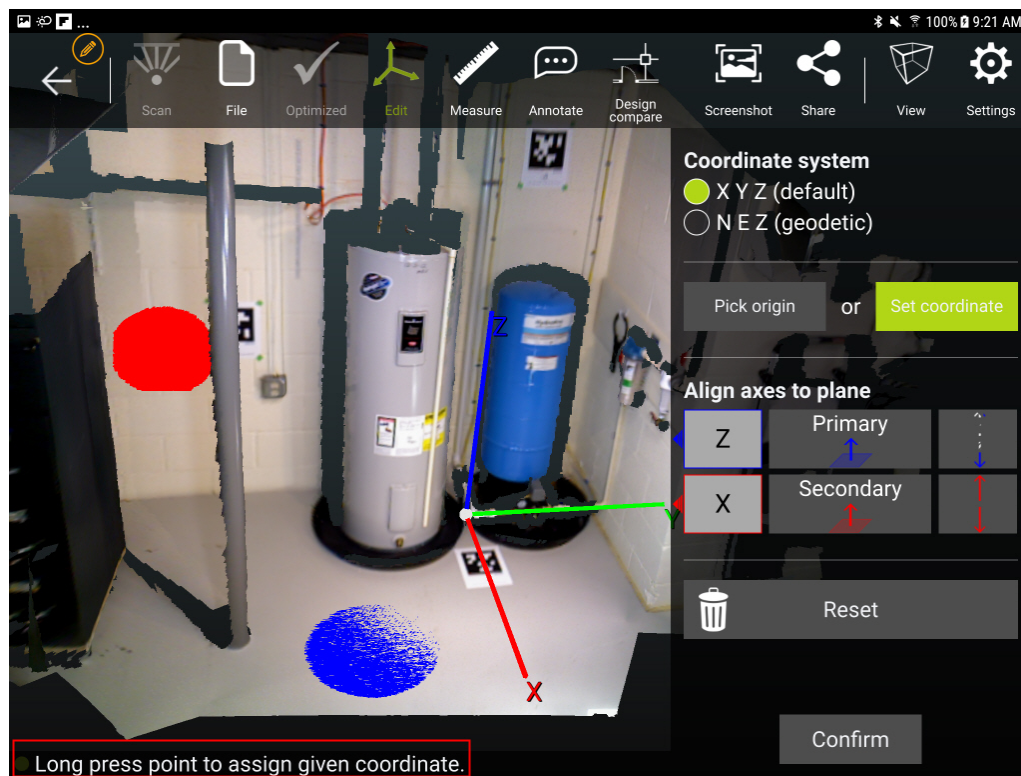


Figure 103 - Assign Given Coordinate to Origin

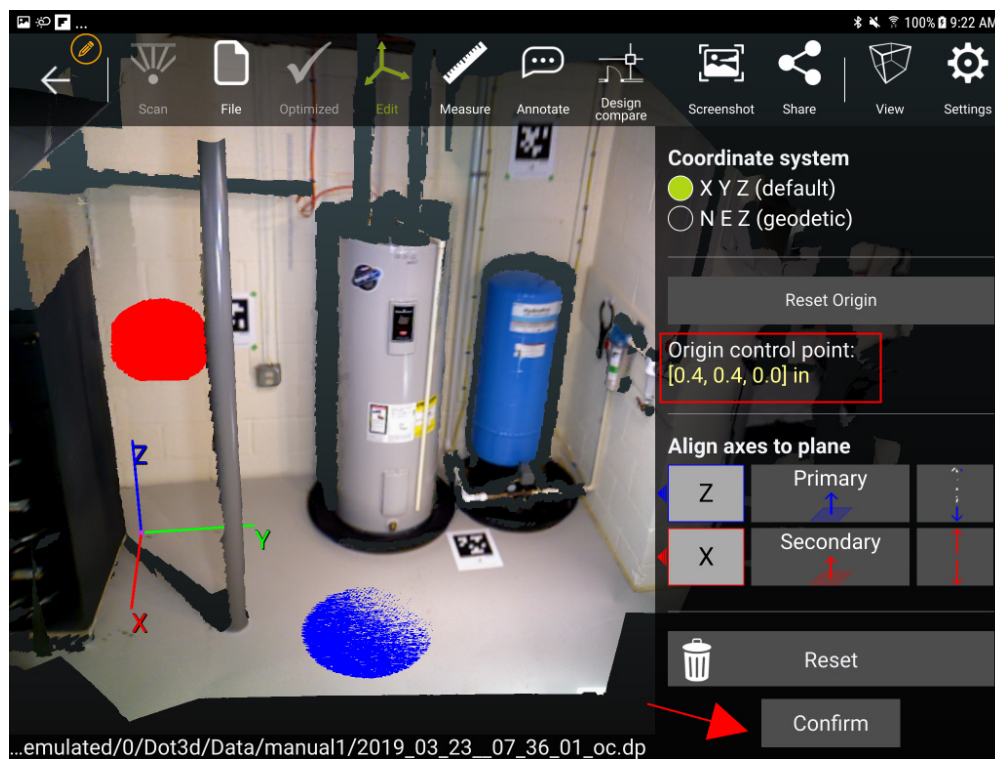


Figure 104 - Origin Control Point, Confirm

MEASURE

Measurement

The **MEASUREMENT** tab allows for a simple straight-line measurement. Press and hold, then drag and release to set start point. Press and hold, then drag and release to set end point. A zoom window will appear when picking both the start and end point so the exact point can be chosen. Once you have chosen your start and end position the **Distance** and **Components** (change in x, y, z) will be displayed on the right-hand side. You can also select the **Units**. You can edit the measurement by dragging on the green circle at either end of the line.



Figure 105 - Measure

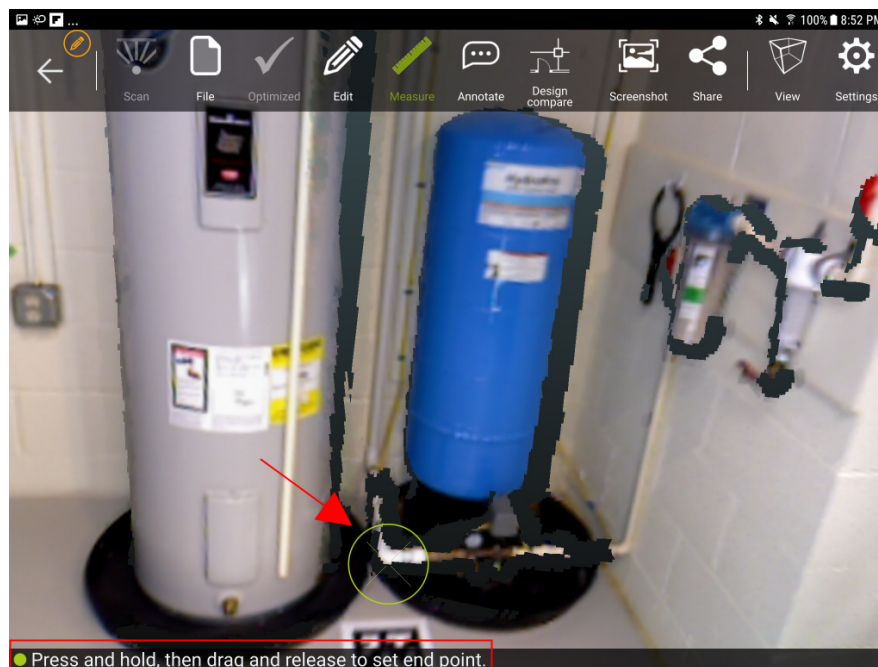


Figure 106 - Set Start and End Points



Figure 107 - Measurement

ANNOTATION

Annotation

The **ANNOTATION** tab allows for annotating objects in the scene.



Figure 108 - Annotation

Select the **Add** button then press and hold, then drag and release to place the annotation. A zoom window will appear when picking the annotation spot for refined picking. There are three types of annotation to choose from: **Point**, **Plane** or **Cylinder**.

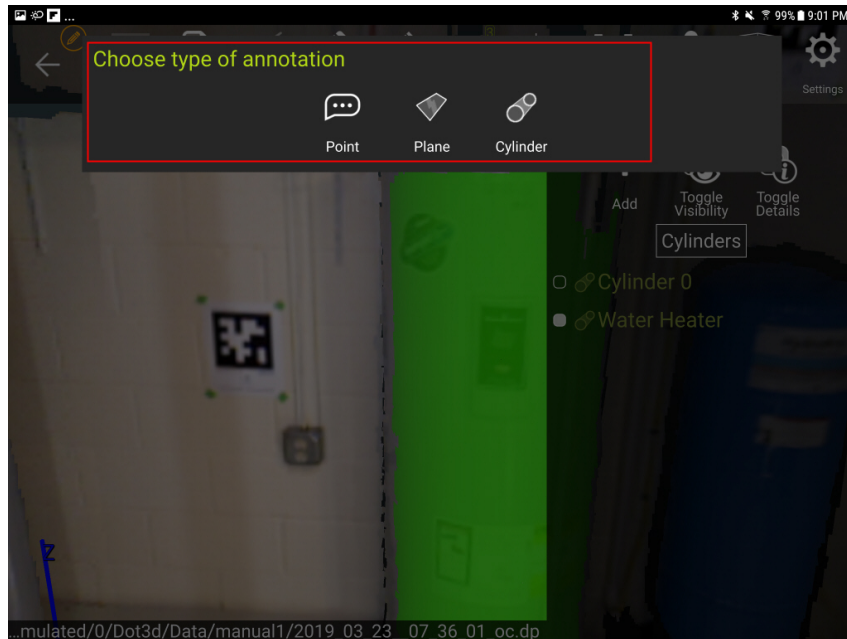


Figure 109 - Annotation Type

Once you select your type of annotation it will highlight your selection and name it. The annotation will appear on the right-side of the screen where you can select the pencil to rename the point/plane/cylinder and it will display: the X,Y,Z location of the point; the surface area of the plane; and the diameter and length of the cylinder.

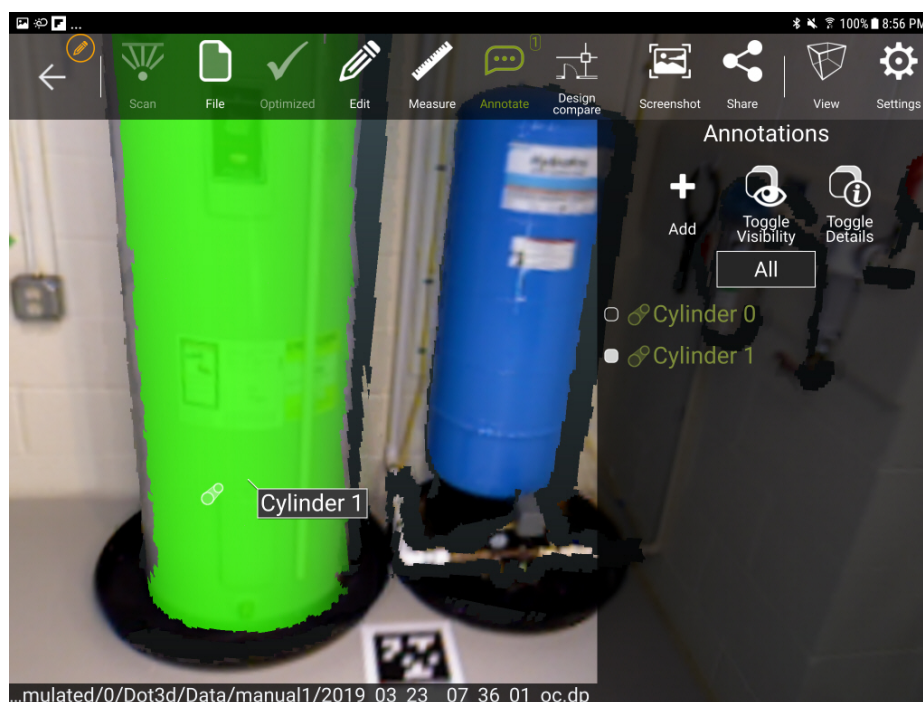


Figure 110 - Cylinder

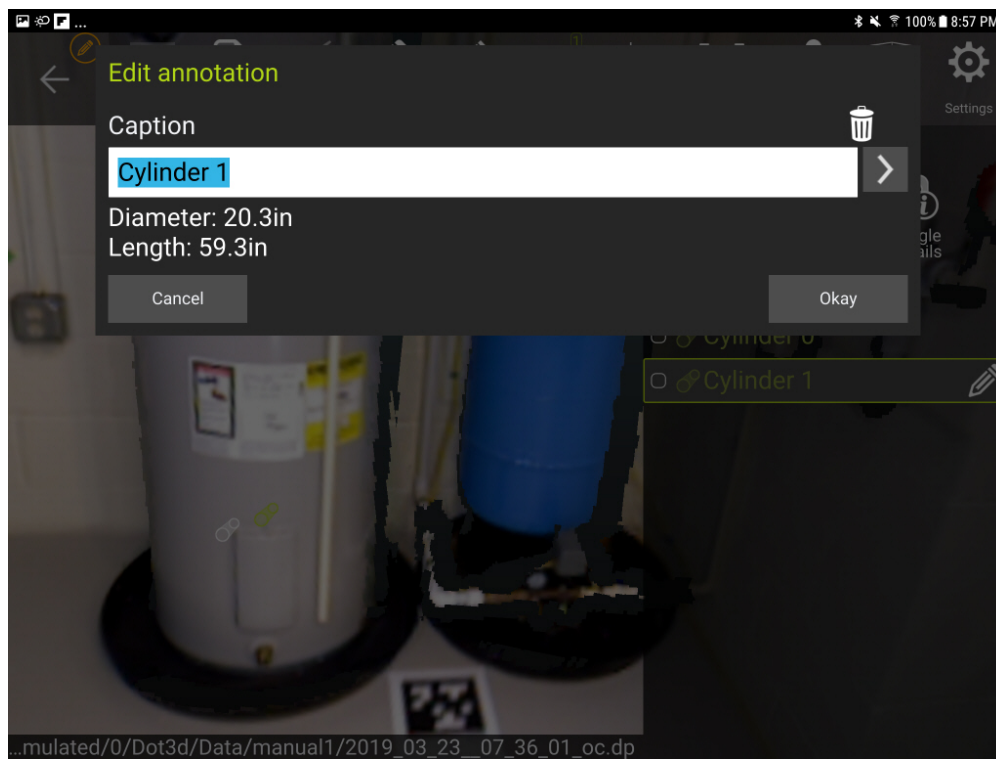


Figure 111 - Edit Cylinder Annotation

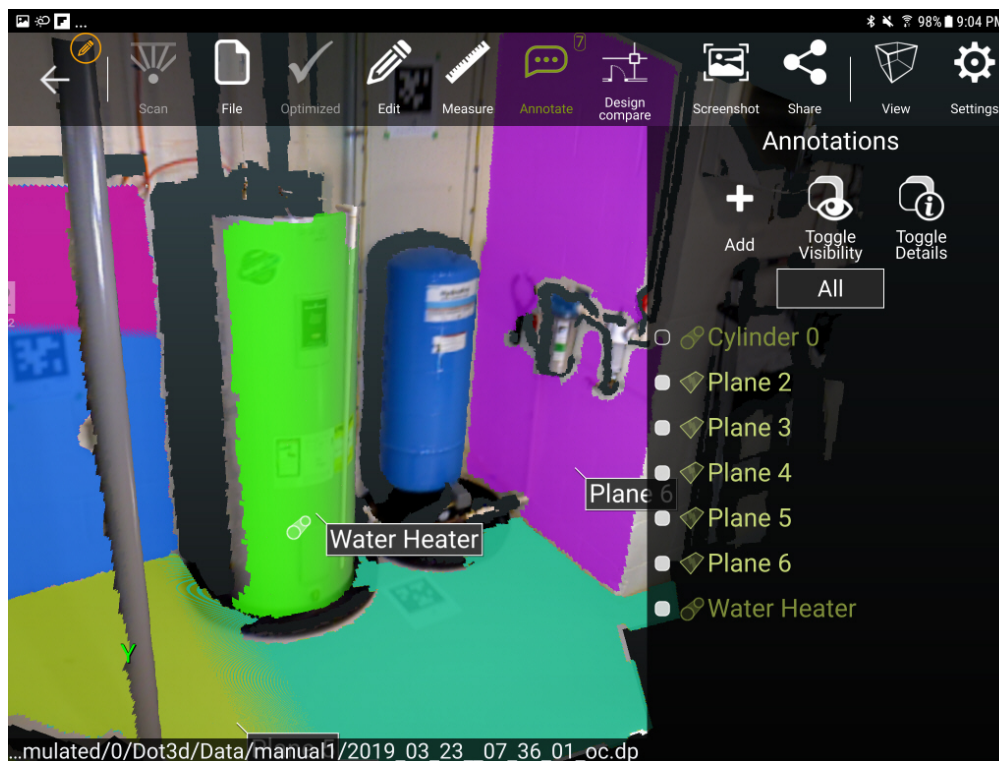


Figure 112 - Plane



Figure 113 - Edit Plane Annotation



Figure 114 - Point

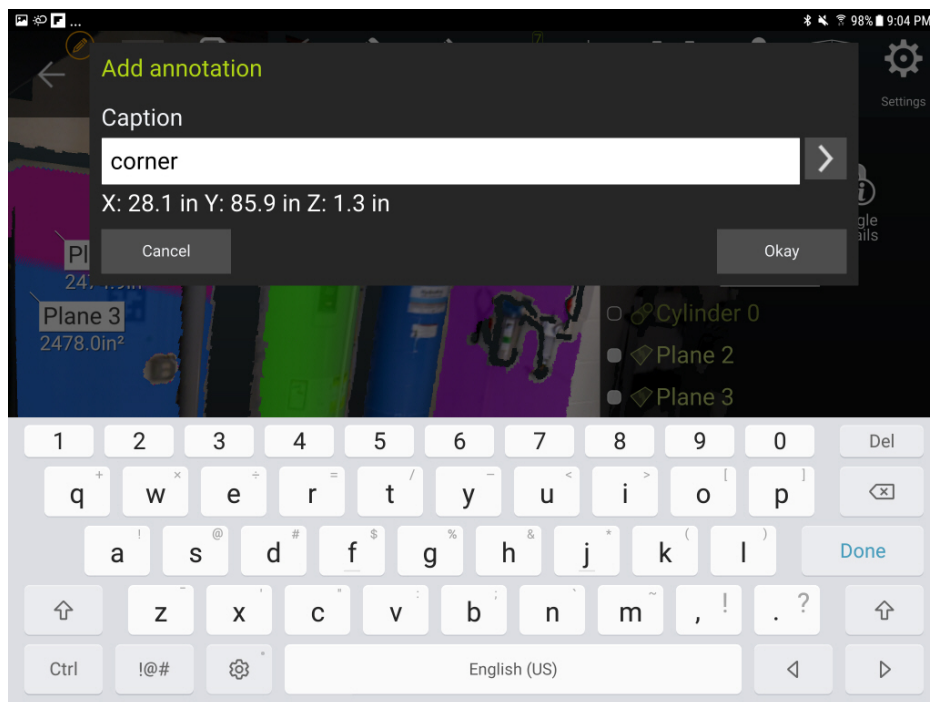


Figure 115 - Edit Point Annotation

You can **Toggle Visibility** on/off. When **Toggle Visibility** is off it shows a symbol of your annotation type where you placed it. An annotation bubble for points, plane for plane and cylinder for cylinder.

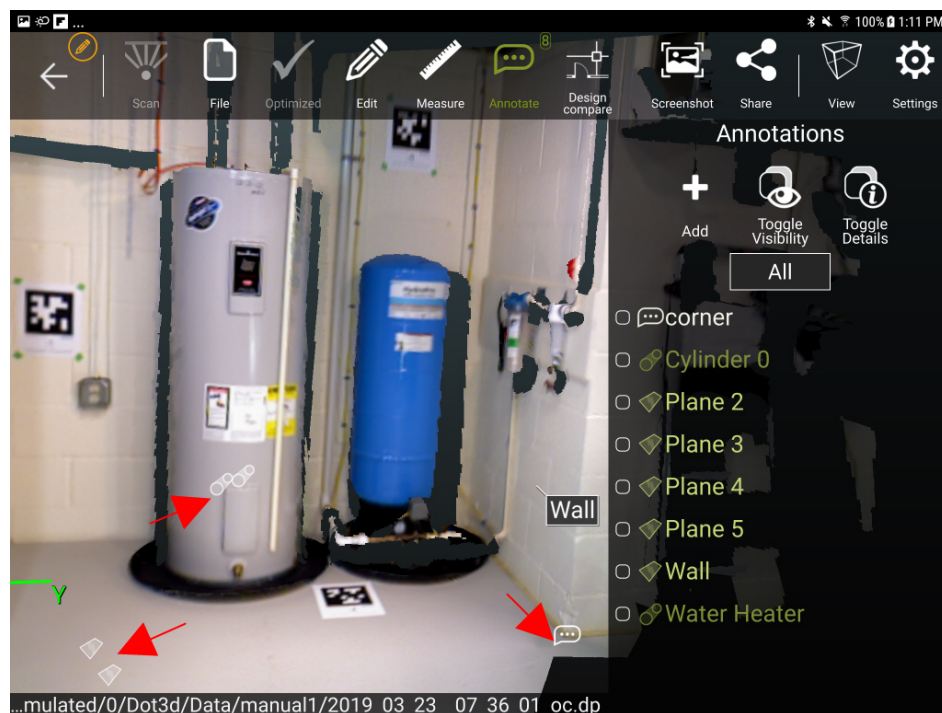


Figure 116 - Toggle Visibility Off

When **Toggle Visibility** is on it shows the full plane and cylinder highlighted in the scan. You can also choose whether to have **Points**, **Planes**, **Cylinders** or **All** visible. The number of annotations in a scan will be displayed above the Annotate tab at the top of the screen.



Figure 117 - Toggle Visibility Choices

You can **Toggle Details** on/off. When **Toggle Details** is on it displays the information about the point, plane, or cylinder in the scan. When you double tap on the annotation in the list on the right it will take you to that spot in the scan.

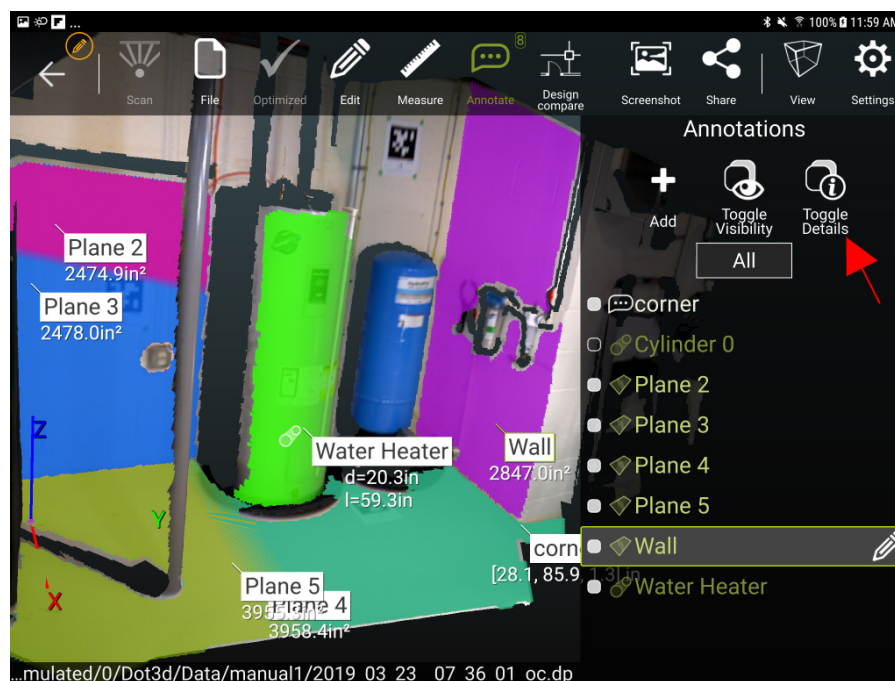


Figure 118 - Toggle Details

Annotating planes helps with measurements when measuring from one plane to another. The **MEASUREMENT** tab will see the plane and give you a choice of selecting “Selected Point” or “Plane”. If you select “Plane” it will move all your measurements perpendicular to that plane.

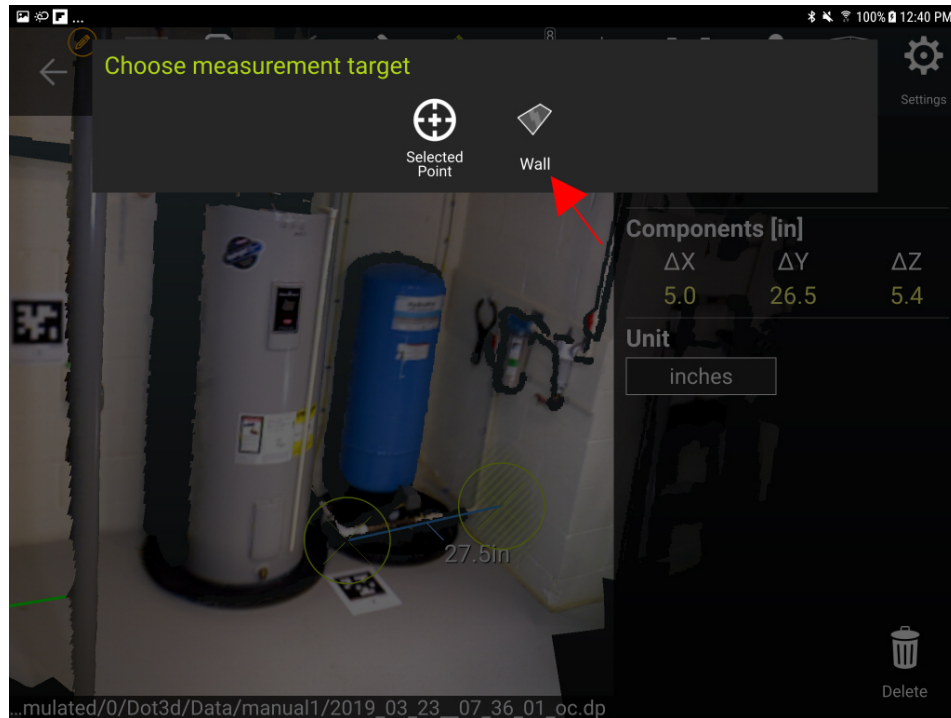


Figure 119 - Choose Measurement Target (Plane)

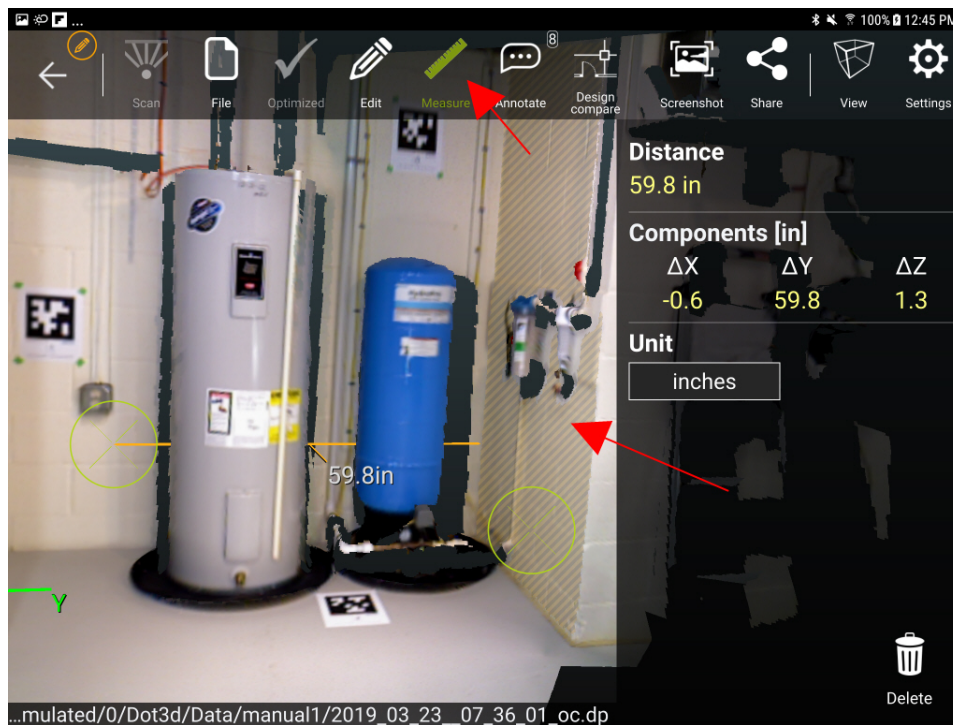


Figure 120 - Measurement from Plane

DESIGN COMPARE

Design Compare

The **DESIGN COMPARE** tab allows for comparing the captured scene to a .OBJ design file for infield comparison and registration of data to design model. Once you select the design file to compare, choose the method for aligning the two coordinate systems (flanged pipe, 2 cylinders, or 3 planes). The point cloud and model will then be aligned. **Blend** has a slider that shows only the model to the right and the point cloud to the left but a blend of both in the middle. Choose deviation map to compare the two. Blue shows a good match, while red/pink indicates differences between point cloud and model.

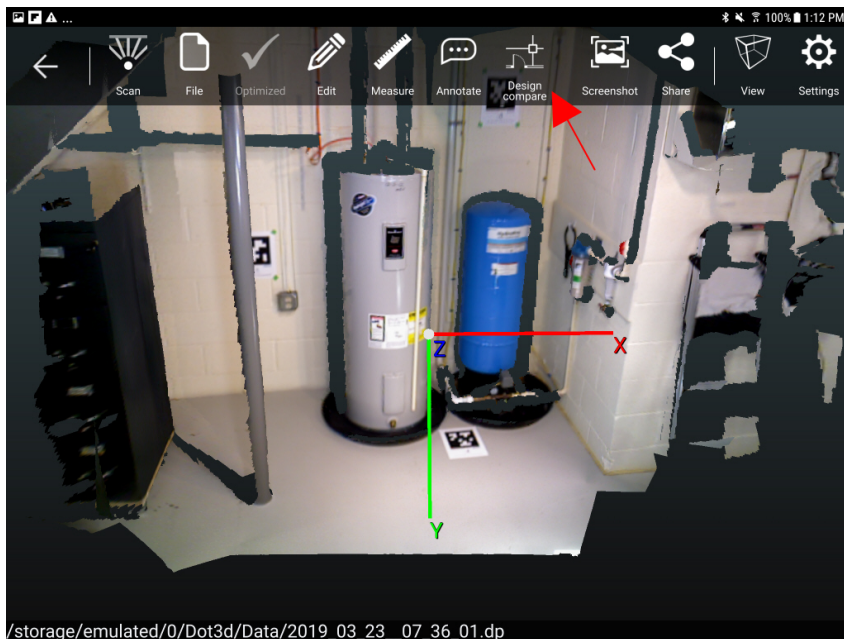


Figure 121 - Design Compare



Figure 122 - Open Local Design File

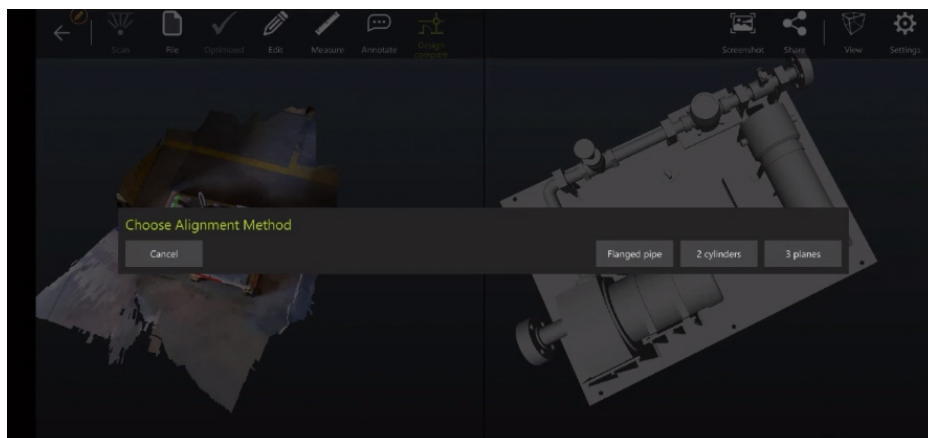


Figure 123 - Choose Alignment Method



Figure 124 - Blend

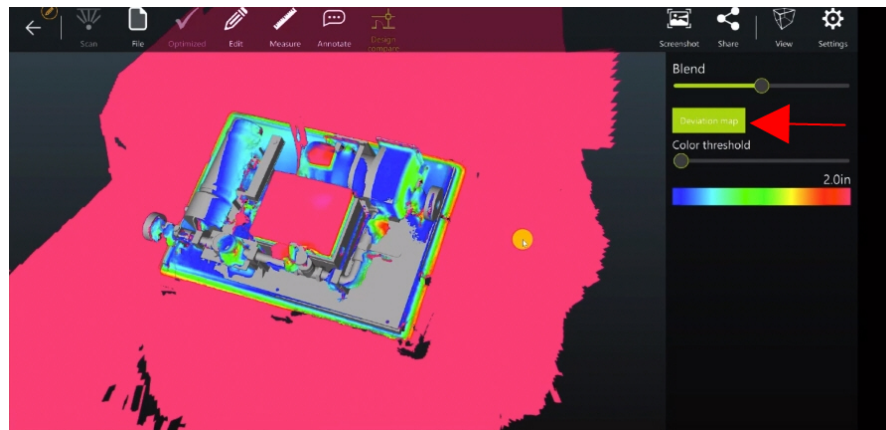


Figure 125 - Deviation Map

Today DotProduct can import, register, and compare to .OBJ 3D files. Future updates may add other file format options. To export from AutoCAD, Revit, and more, DotProduct recommends [ProtoTech Solutions OBJ Export plugins](https://www.dotproduct3d.com/designcompare.html). For videos on the design compare function with AutoCAD, Ship Constructor Design Model, and Assemble see <https://www.dotproduct3d.com/designcompare.html>.

SCREENSHOT

Screenshot

The SCREENSHOT tab allows you to take screenshots of your annotations, and measurements to be shared as PNG files.

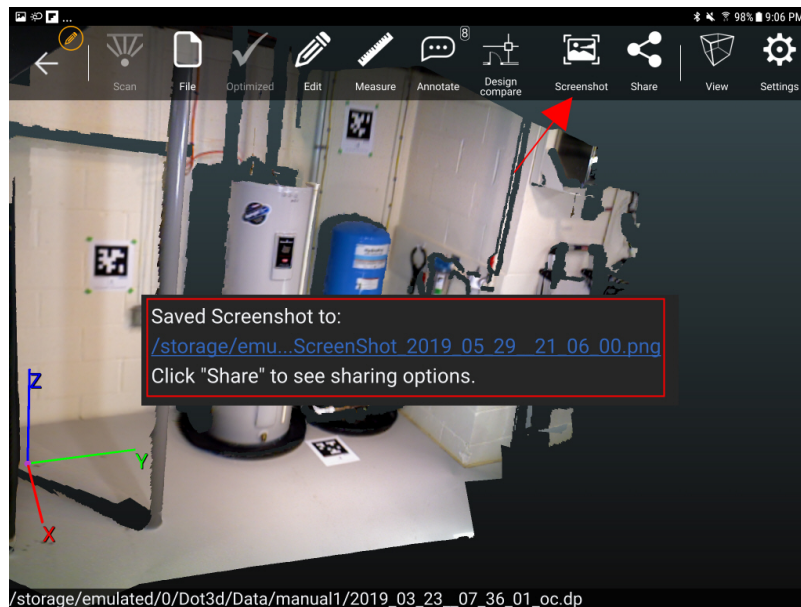


Figure 126 - Screenshot

TARGETING

Introduction

Dot3D supports different targeting systems and markers to control scene accuracy, orient scenes to established coordinate systems, and provide quality assurance for data. The supported types include AprilTags and Checkerboard (black & white pattern) targets. The use of targets is recommended whenever possible because it will improve scene accuracy and tracking stability. When targets are surveyed independently and survey control has been established, for example with a total station, or their position has previously been determined by some other reliable method, then these targets can be used to rotate and translate DPI Kit data into the coordinate system of the control network on the tablet. Targets also serve as a constraint network in global scene optimization.

Target Coordinate Systems

Dot3D supports both righthanded and lefthanded coordinates for target files. The usual way of orienting the axes, with the positive x-axis pointing right and the positive y-axis pointing up (and the x-axis being the "first" and the y-axis the "second" axis) is considered the positive or standard orientation, also called the right-handed orientation.

To define a positive orientation according to the right-hand rule, place a closed right hand on the plane with the thumb pointing up, the fingers point from the x-axis to the y-axis, in a positively oriented coordinate system. Alternately in the left-hand rule, orientation is defined by placing the left hand on the plane with the thumb pointing up.

It is necessary to specify the handedness of the coordinate system. See Figure 1. The default target file orientation is right handed in the following format: target ID, x, y, z. Switching any two axes will reverse the orientation, hence a survey control file that is written as (Target ID, northing, easting, elevation) should be opened as a left handed coordinate system. Note that Dot3D data files will default to the right-hand coordinate system, unless otherwise specified.

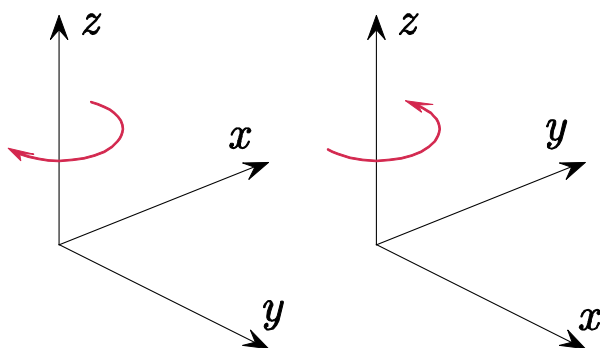


Figure 127 – Left Hand and Right-Hand Coordinate System

Targeting Overview

Targeting may be employed in the capture process for a number of reasons, including:

- (a) To improve overall scene accuracy and to eliminate drift (see section "Targeting Modes in Global Optimization")
- (b) To transform a captured scene into a target coordinate system.

Usually the necessity for (a) and (b) comes in tandem, i.e. it is likely that if a scene is to be transformed into a project coordinate system (b), it is also required that the scene has highest possible accuracy (a) so that it fits well with existing data.

In this case the user would first carry out target association, then "Fit all Targets", then perform global optimization with Hard or Soft Targeting enabled.

There are however other use cases in which a) and b) can be used and achieved independently of each other:

For example, target association and "Fit all targets" may be performed on an already optimized scene to transform that scene into project coordinates (b) "after the fact". This workflow is possible but comes at the expense of lower accuracy since no target information was available when the scene has been optimized.

Another example is using un-surveyed targets, possibly in combination with provided inter-target distances, to achieve a). This would be done by first associating the targets and then using the "scale bar targeting" or "correspondence-only targeting" modes in Global Optimization. No "Fit all targets" step is required here.

Some rules of thumb:

1. Any Targeting Mode in Global Optimization (Hard, Soft, Scale Bar, Correspondence-Only) can only be used on un-optimized scenes.
2. If survey targets are used on an un-optimized scene, there is usually no reason *not* to use Hard or Soft Targeting Modes for Global Optimization.
3. The only reason to use targeting on an *already* optimized scene is the transformation into a project coordinate system "after the fact" which is not optimal in terms of achieved accuracy.
4. Transforming a scene into project coordinates requires control targets to have 3D point locations.
5. Hard and Soft Targeting modes in Global Optimization require control targets to have 3D point locations.
6. Hard and Soft Targeting modes in Global Optimization require the scene to have a coordinate transform (Step "Fit all Targets").
7. Hard and Soft Targeting modes will usually be more accurate than Scale-Bar or Correspondence-Only Targeting.
8. The Scale-Bar Targeting mode in Global Optimization requires no 3D point locations for control targets but requires inter-target distances to be provided.

AprilTags

Dot3D has the ability to detect "AprilTags" targets while mapping. AprilTags are fiducials that contain a unique 2D barcode. They can be used to help Dot3D close large loops during Post-Processing. AprilTags do not need to be surveyed to be of value for loop closure. However, they can also be utilized with survey coordinates for hard targeting with Dot3D Pro 3.1 and up. In either case, the AprilTags must always remain stationary **withno duplicate tags in the scene**. With or without survey coordinates, Dot3D will use the AprilTags to improve results during post processing. Dot3D automatically enables AprilTag detection while mapping. When AprilTags are detected, they will be drawn onto the current image as a red see-through polygon.

A set of AprilTags recognizable by Dot3D can be downloaded [here: https://www.dotproduct3d.com/targets.html](https://www.dotproduct3d.com/targets.html).

Note that AprilTags downloaded from elsewhere are unlikely to be supported by Dot3D.

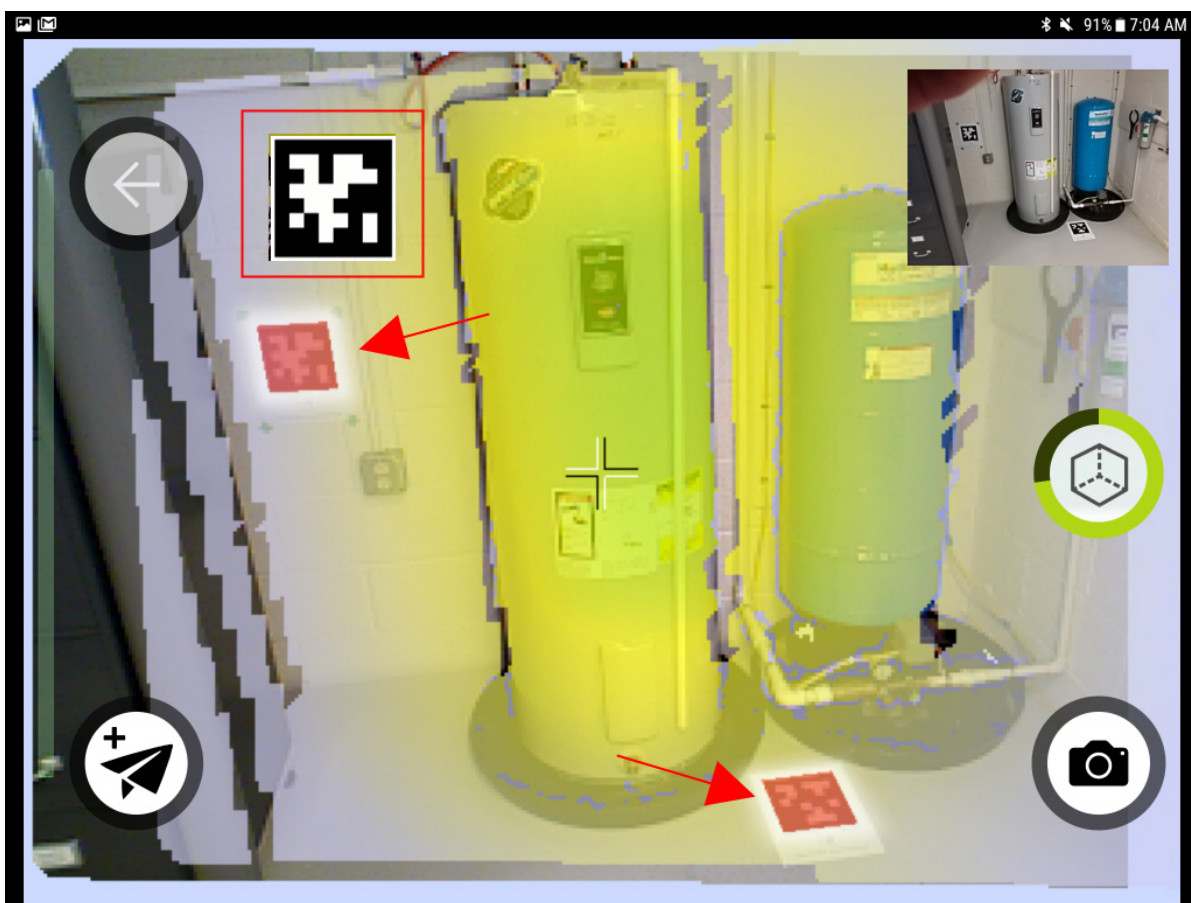


Figure 128 - April Tags

Checkerboard Targets and AprilTags with Survey Control

The Dot3D software can automatically determine the centroid of a checkerboard target captured by the DPI Kit. When these targets are surveyed independently and survey control has been established, for example with a total station, then these targets can be used to rotate and translate DPI Kit data into a coordinate system. Association of these target centroids with survey control targets is achieved semi automatically.

Detecting Targets

Press the **EDIT** Tab at the top menu and then **Targets** to begin targeting functions.

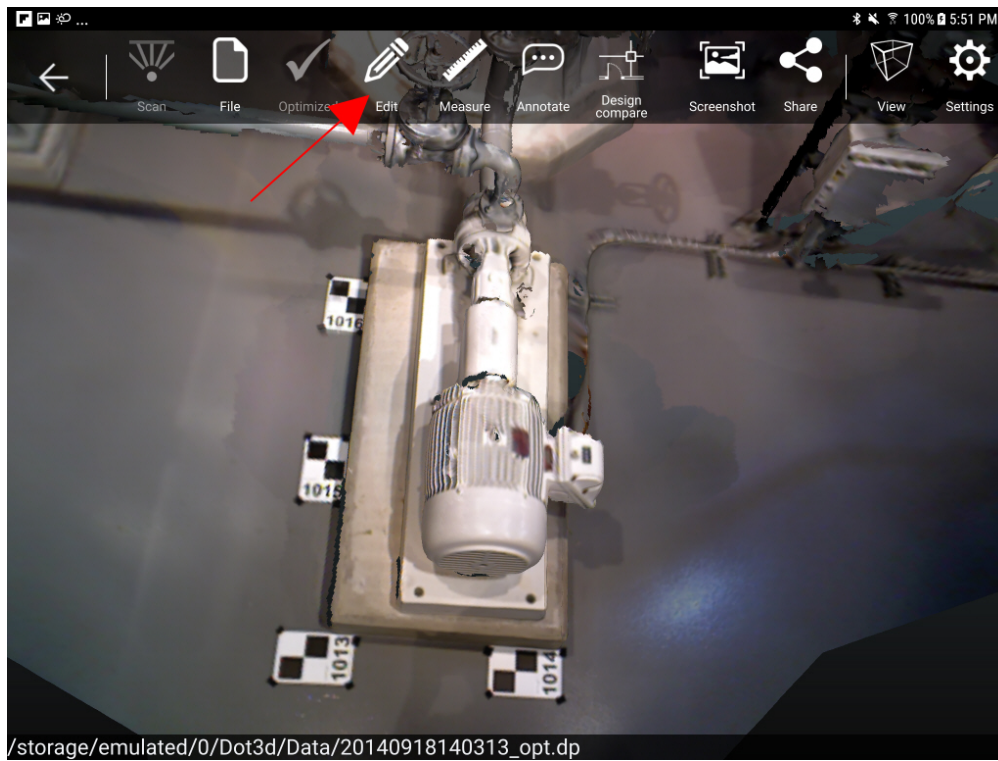


Figure 129 - Edit

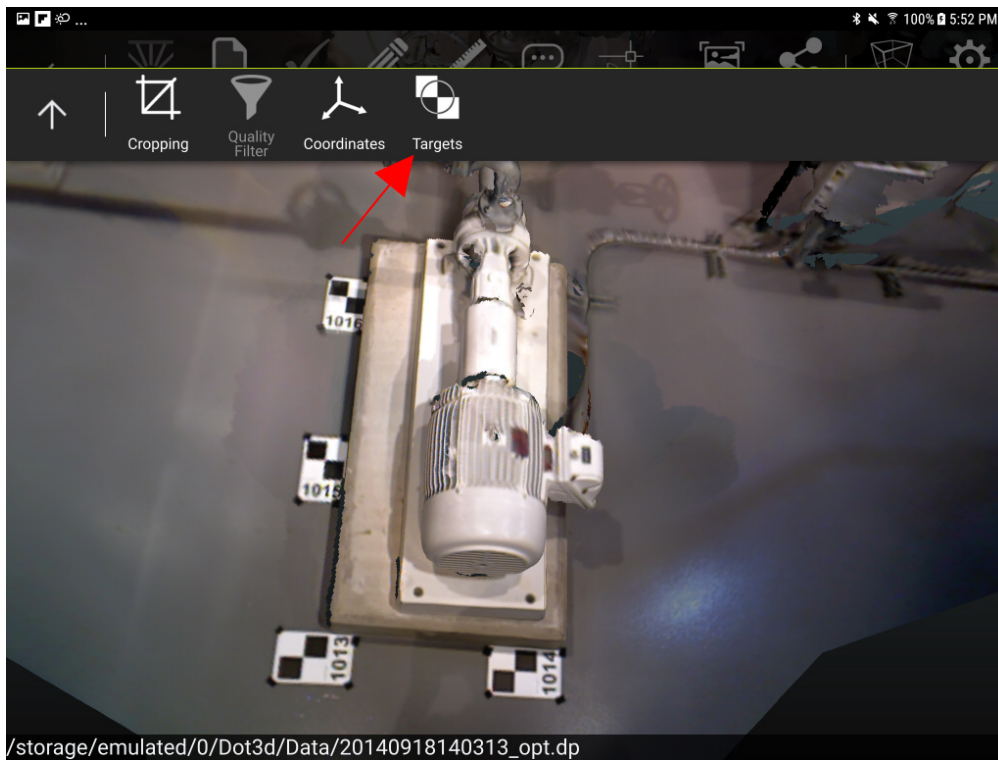


Figure 130 - Targets

A window will appear that says “Targeting Wizard” where you choose the type of targets you are going to use: AprilTags or Checkerboard targets.

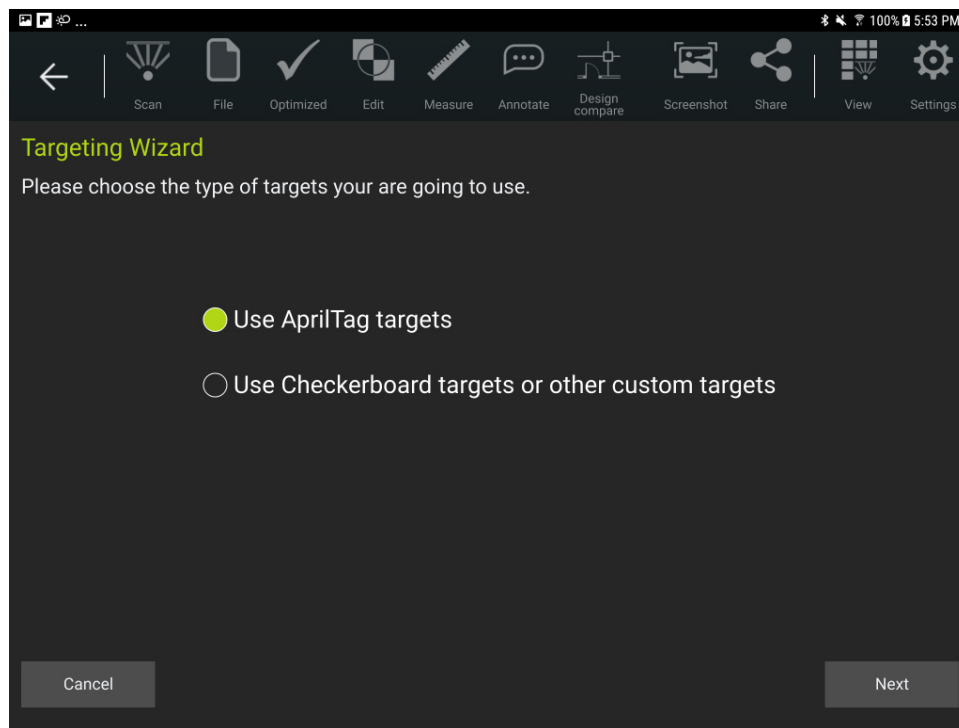


Figure 131 - Targeting Wizard

“Manage Targets And Reference Distances” window will then display. You can load a survey file or add control points, scale targets or reference distances program detects targets in the scene.

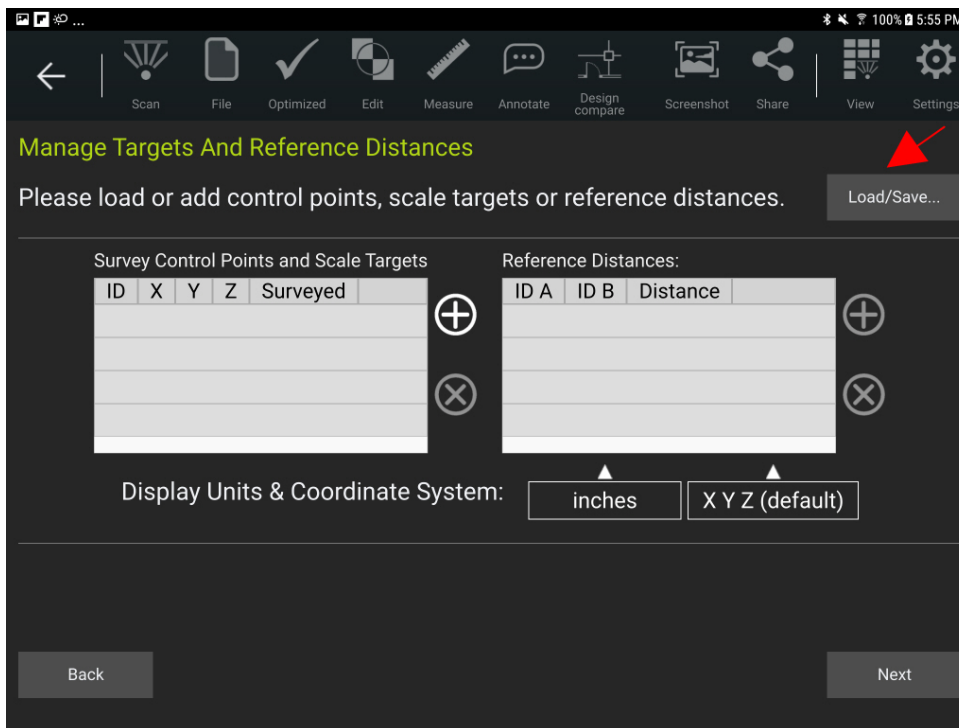


Figure 132 - Manage Targets And Reference Distances

Note that the type of coordinate system for the target file must be specified. The default is **XYZ (local, right-handed)**. The alternative is **NEZ (geodetic, left-handed)**.

Note that, if the control target coordinate system is selected on export, the exported data files will be in the coordinate system of the target file, following optimization using the target file. For example, if a survey control file with a left-handed coordinate system is specified, then any data files exported in PTS or PTX formats will have a left-handed coordinate system (provided the corresponding option is chosen in the export dialog). Binary .DP files are always stored with right handed coordinates.

The survey file units may be Meters, Centimeters, Millimeters, Inches, Feet, or US Survey Feet, and the units must be specified when importing/creating the survey file.

The target file should be a comma delimited file that lists the target ID and coordinates of the target center.

This survey file can be stored in any folder, however for good file management, create a folder named \Survey. The survey control file is loaded on the tablet by connecting the tablet with a USB cable to a computer which has the file and uploading it from the computer. Note that it is possible to have multiple survey control files on the tablet, a different file for each project for example. Alternatively, the control file can be emailed to the tablet's email account and downloaded from the email account inbox. Of course, a WiFi connection is needed in this instance. The control file can be added either before or after data collection.

Select **Load/Save** to enter the control file. The file can be a .txt, .csv or .asc file. Once you select your file enter the Units and Coordinate System. The Coordinate System can be XYZ (default/right handed) or NEZ (geodetic/left handed).

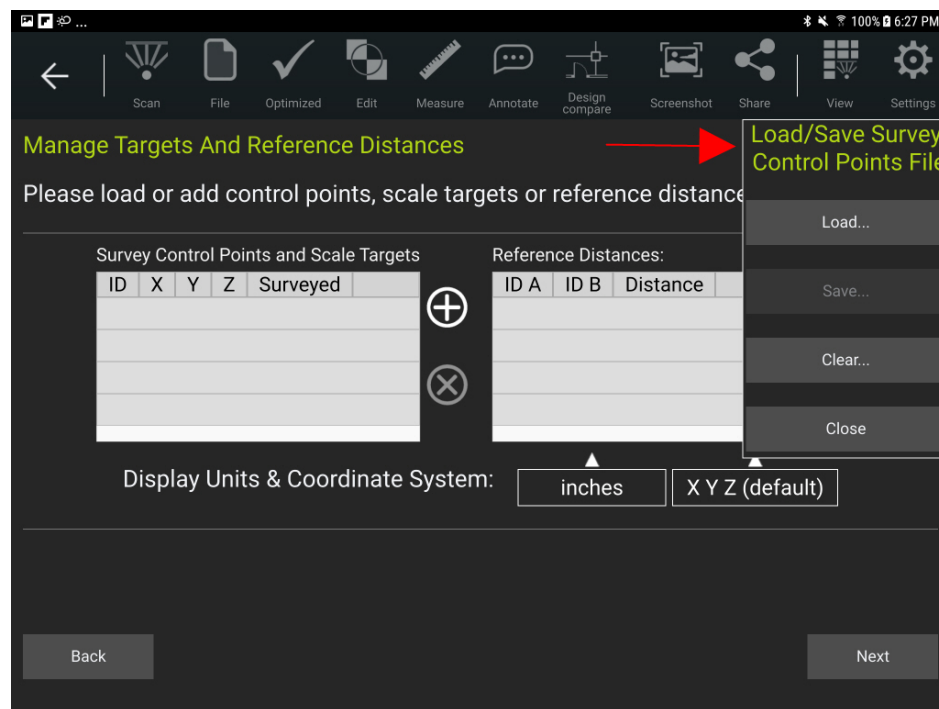


Figure 133 - Load Survey Control File

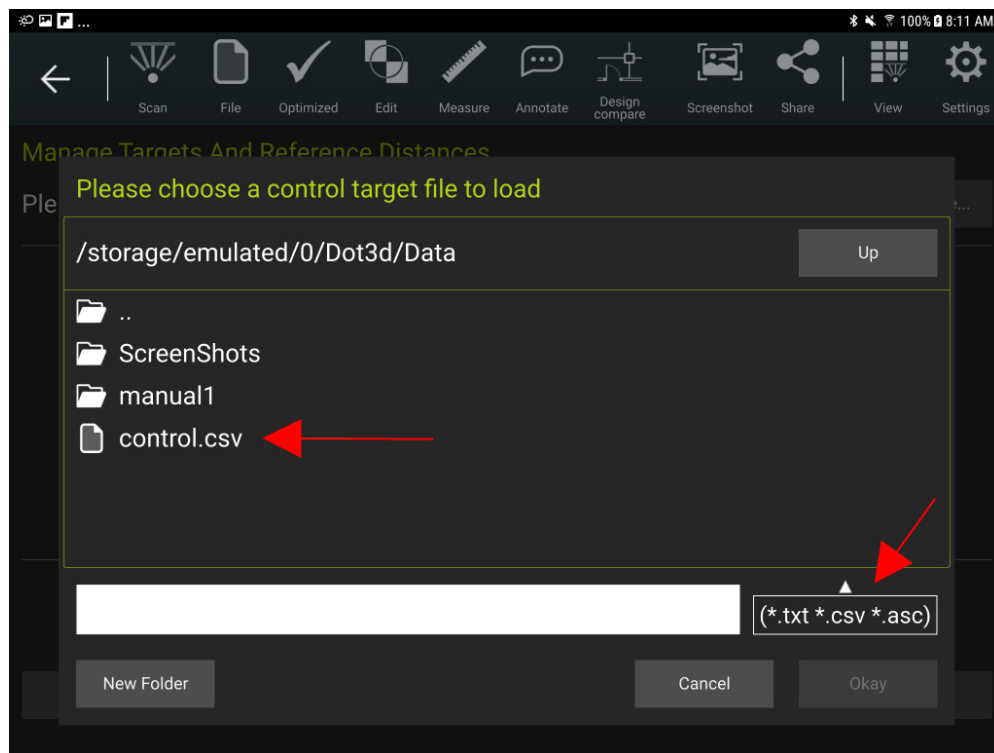


Figure 134 - Choose Target File

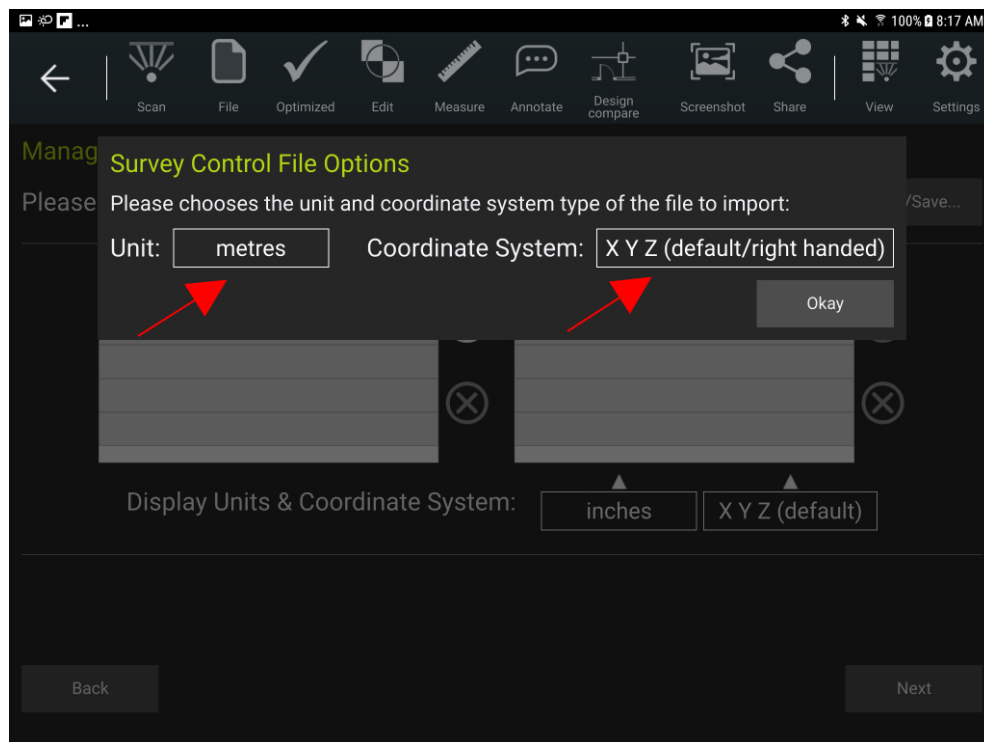


Figure 135 - Survey Control Points Units

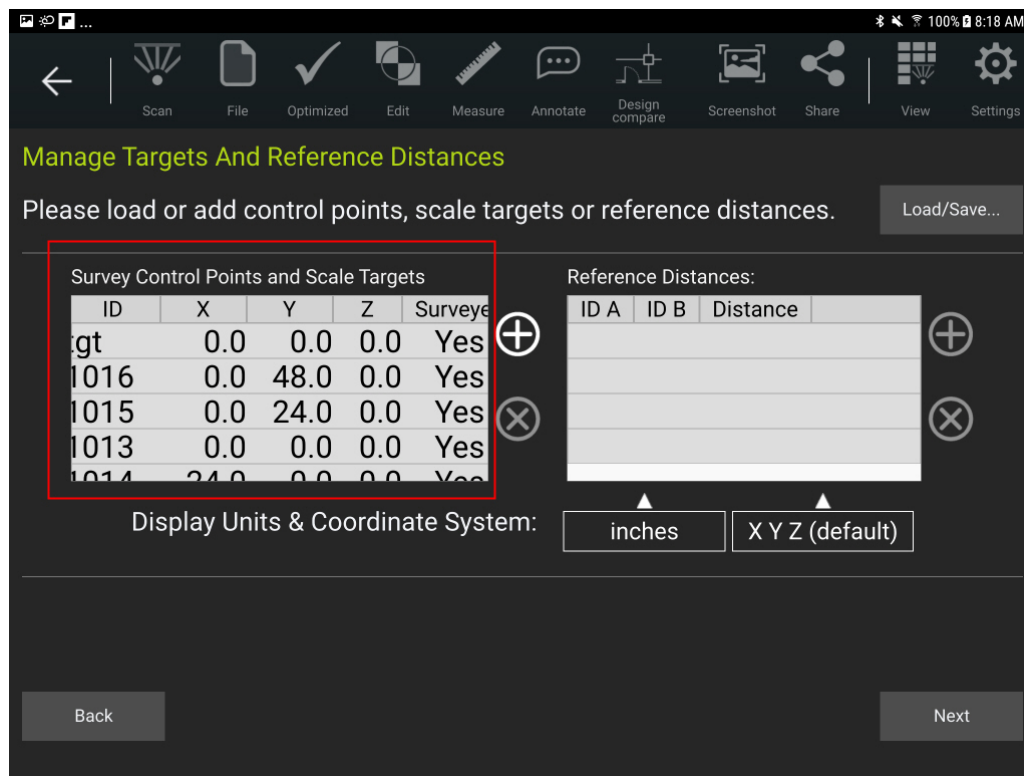


Figure 136 - Survey Control Points File Loaded

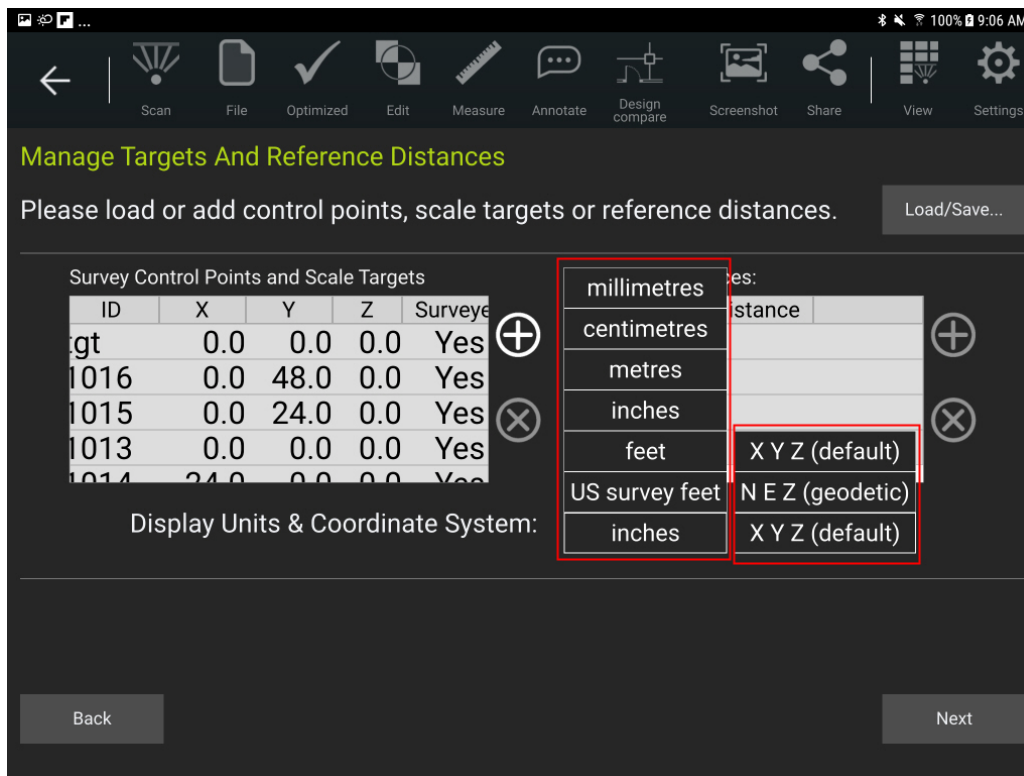


Figure 137 - Unit and Coordinate System Choices

You can edit the control points or if there is no survey file to load, you can create a file within Dot3D Targeting by pressing the “plus” button in **Manage Targets and Reference Distances**.

Then you can either create a **Target** or **Target Distance** file.

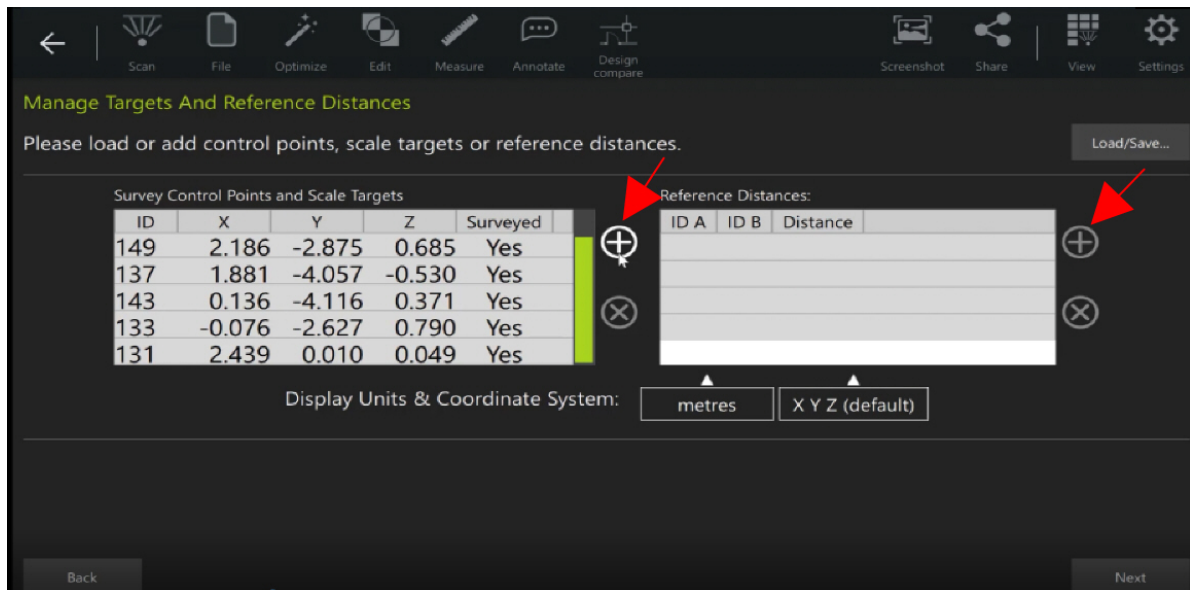


Figure 138 - Add Control Target or Reference Distance

When you select the **Target “Plus”** you create a new target name and if it is a surveyed target you enter the x, y, z coordinates.

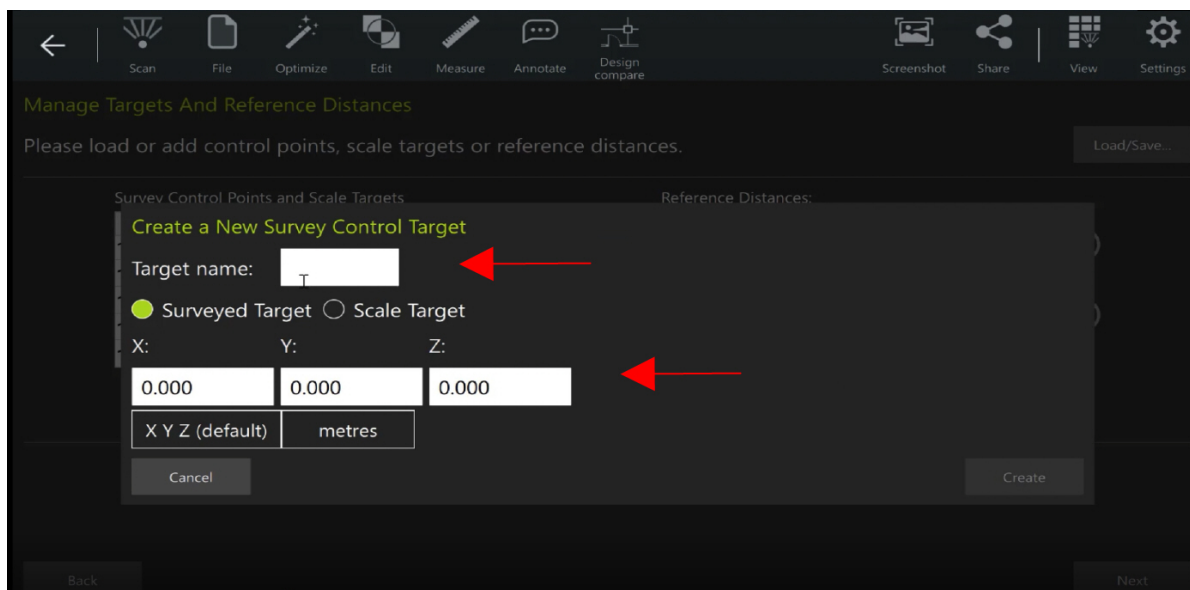


Figure 139 - Add Control Target Name and Coordinates

Once you have entered the target name and coordinates and selected “Surveyed Target” press **Create**. Continue selecting “Plus” until you finish creating all the new targets. If you need to delete a target, select the “X”.

To create Scale Bar Targets or Scaled Measurements first add a Scale Target name and select “**Scale Target**” then press **Create**.

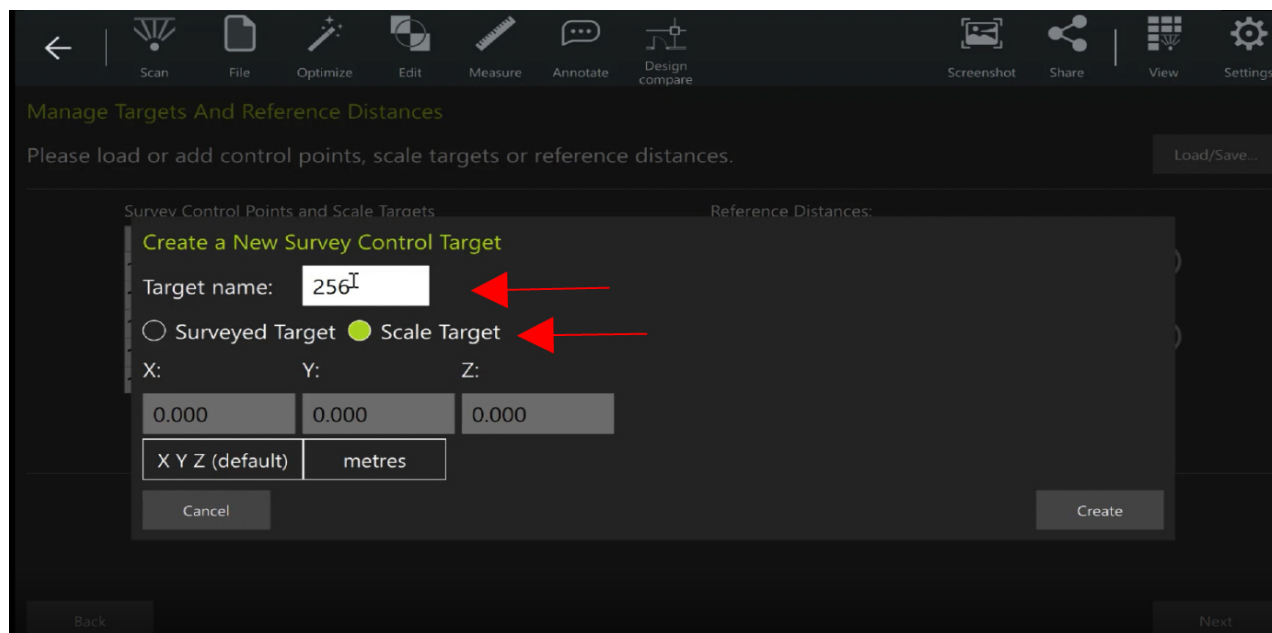


Figure 140 - Create First Scale Target

The new Scale Target will appear in the list of Targets as “Not Surveyed”.

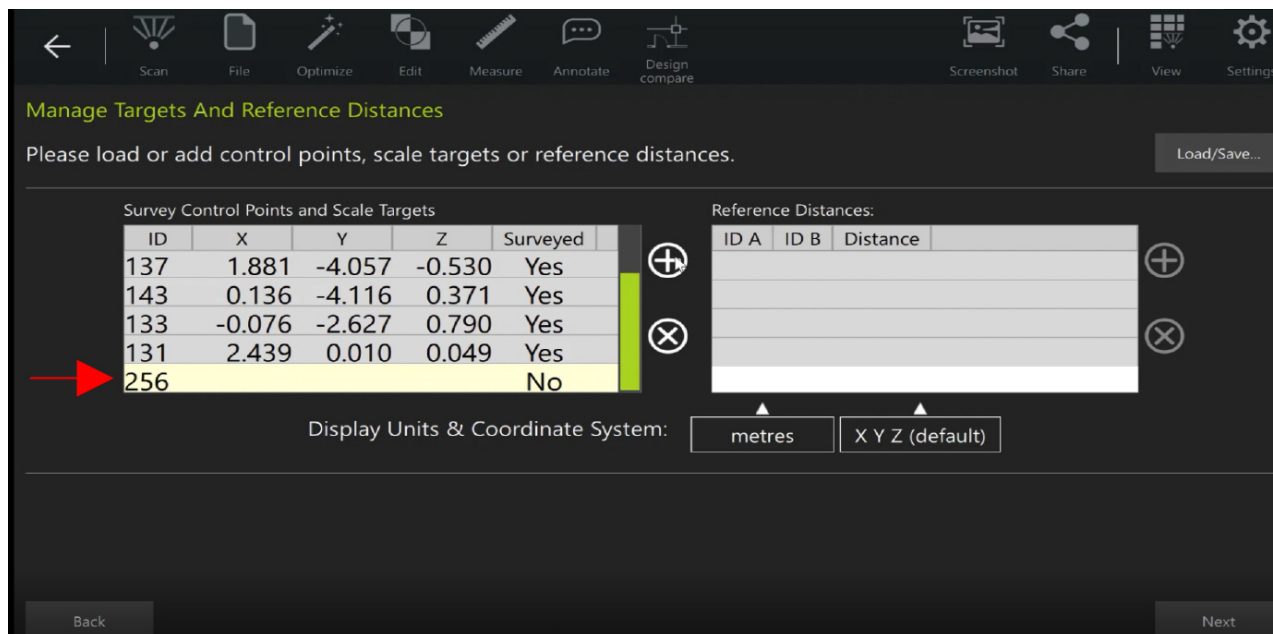


Figure 141 - Displays in Target List as Not Surveyed

Create the next Scale Target and then both Scale Targets will display in the list of Targets. Select the “**Plus**” sign next to **Reference Distance**. Continue adding any additional Scale Targets.

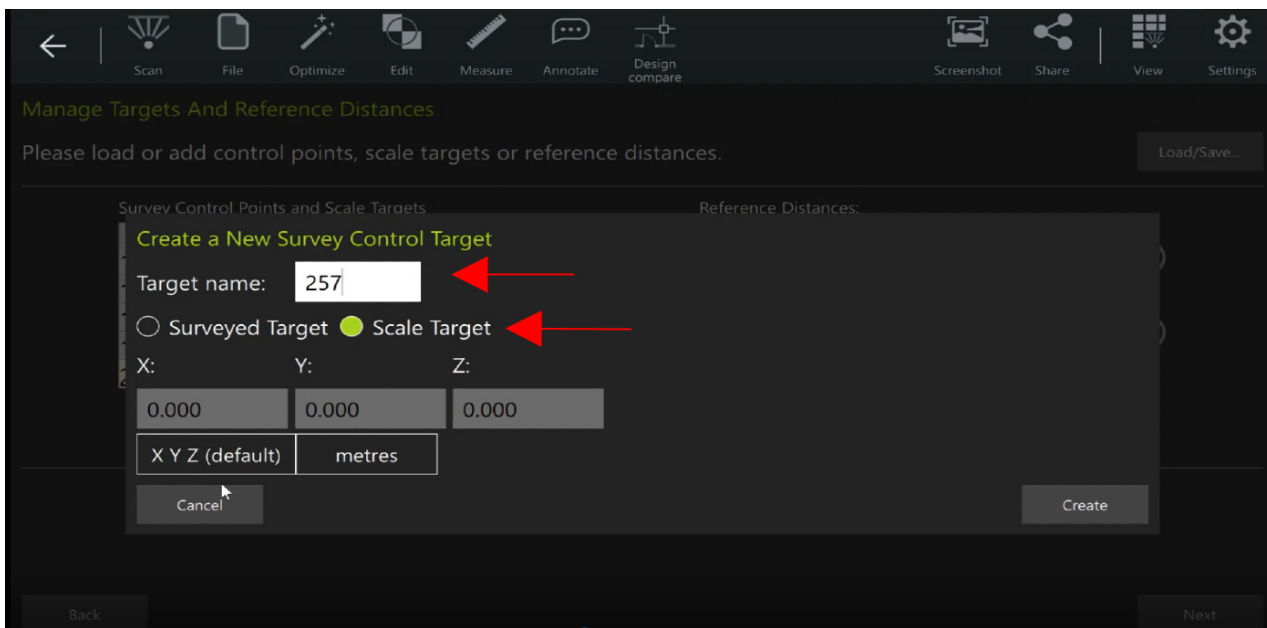


Figure 142 - Create Second Scaled Target

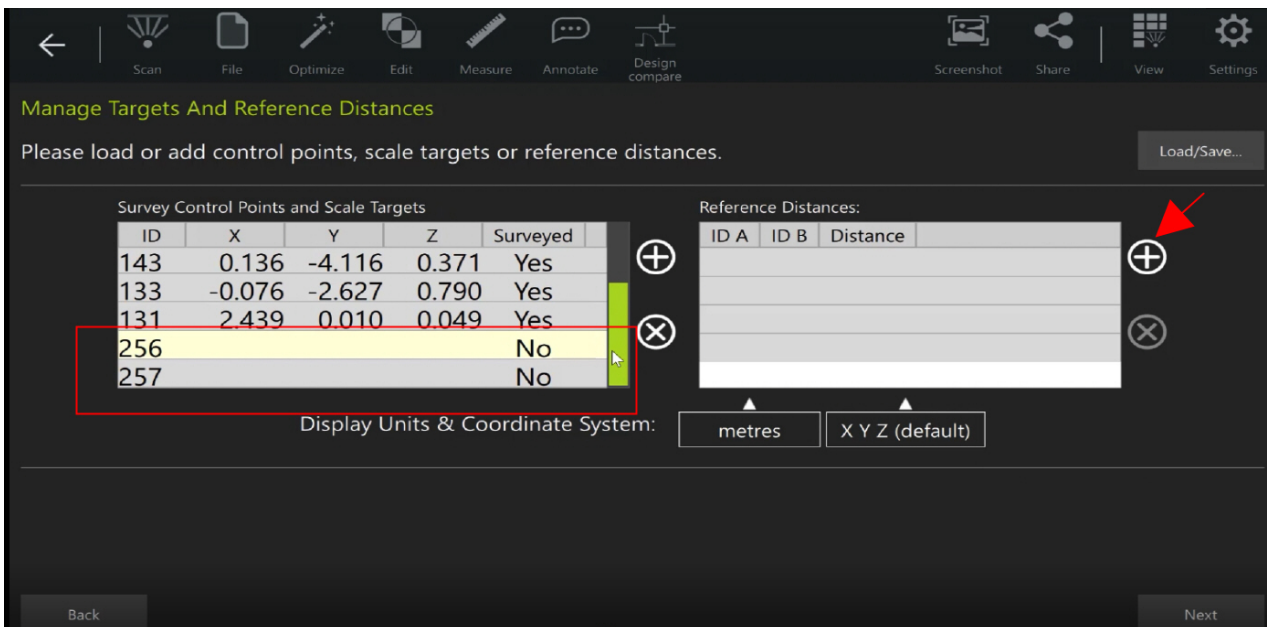


Figure 143 - Select Add Reference Distance

Enter the Reference Targets, Distance and Units. The Reference Distances will now display under **Manage Targets and Reference Distances**.

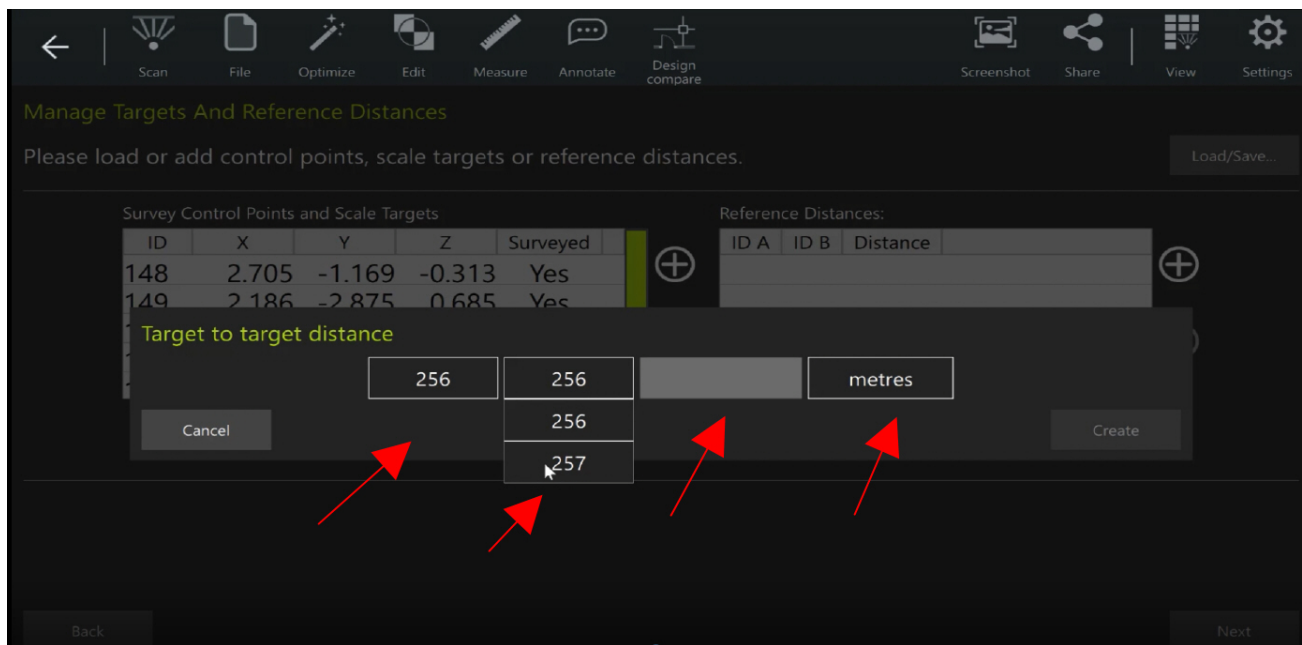


Figure 144 - Enter Reference Targets, Distance and Units

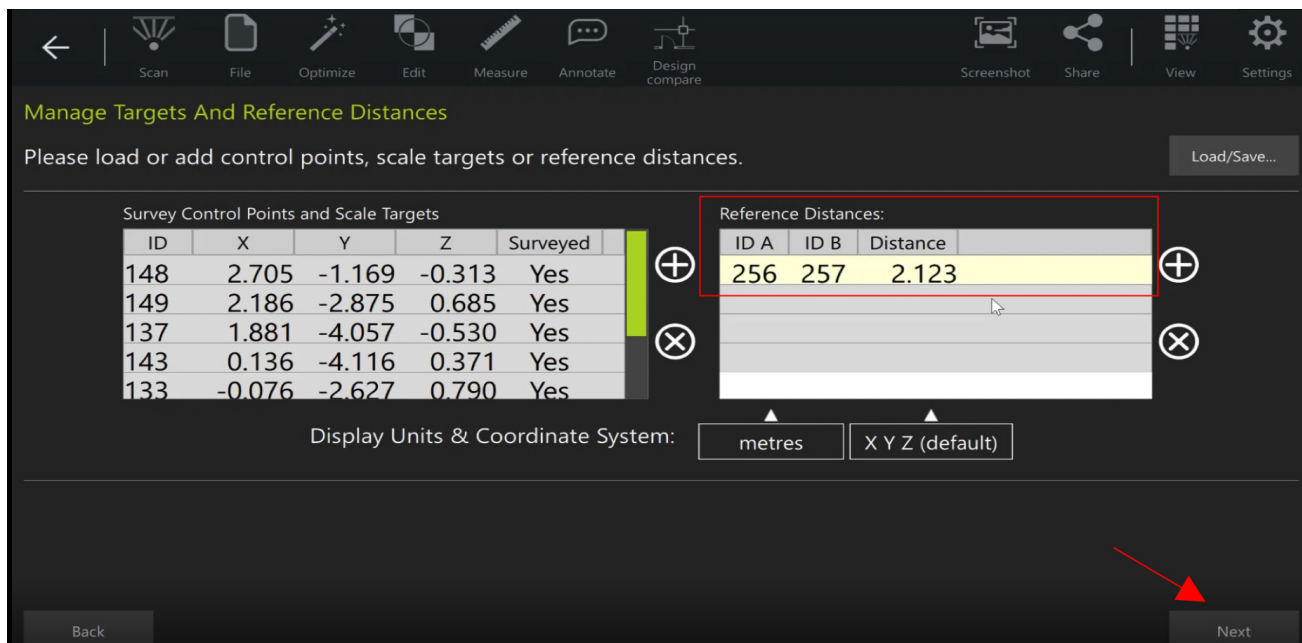


Figure 145 - Lists Reference Distances

You can save the control points by clicking **Load/Save** and then select **SAVE** and create a file name and location. After you finish creating new targets, then select **Next**. This will take you to the **Targeting Wizard**. Specify using Survey Targets or Scale Bar Distances.

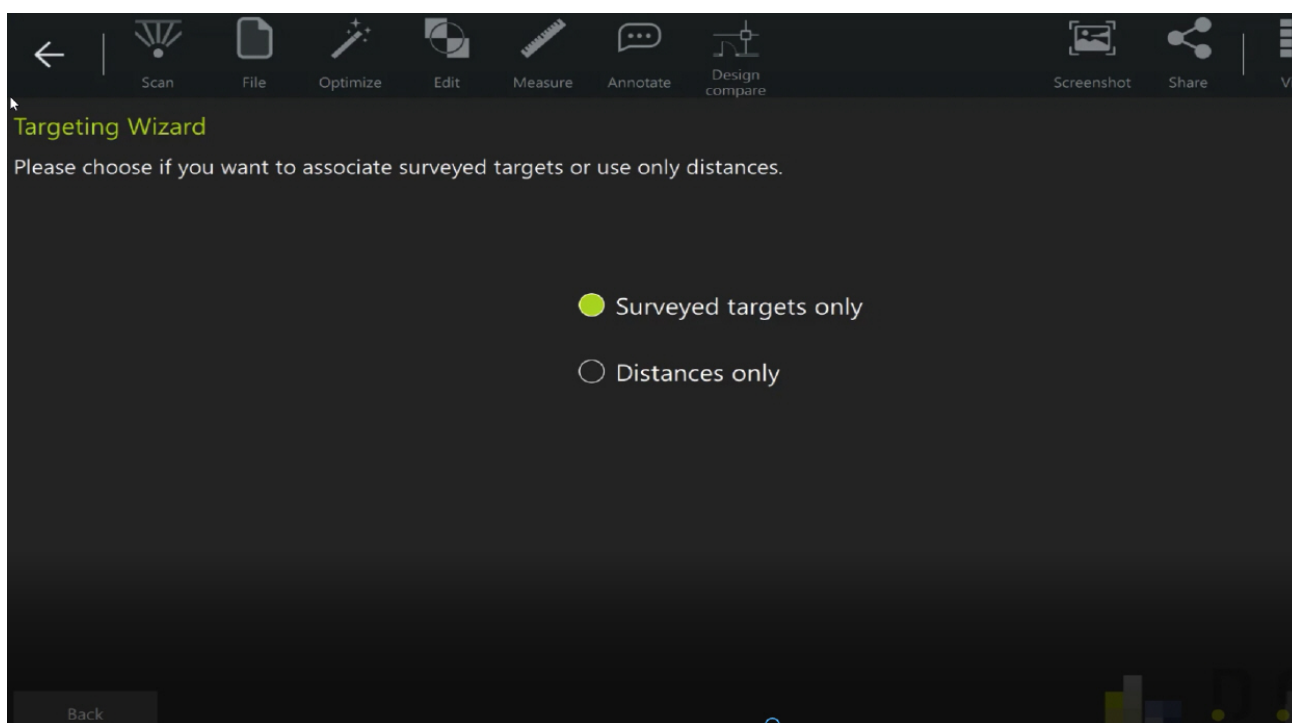


Figure 146 - Targeting Wizard

The **Targeting Wizard** will then tell you if the control targets were successfully associated to the detected points. It will confirm the number of control targets found. You must have at least 3 control targets. Select **View/Change Associations** to visually verify target associations in the Frames. You can edit if they are not correct. Select **Next** to finish Targeting.

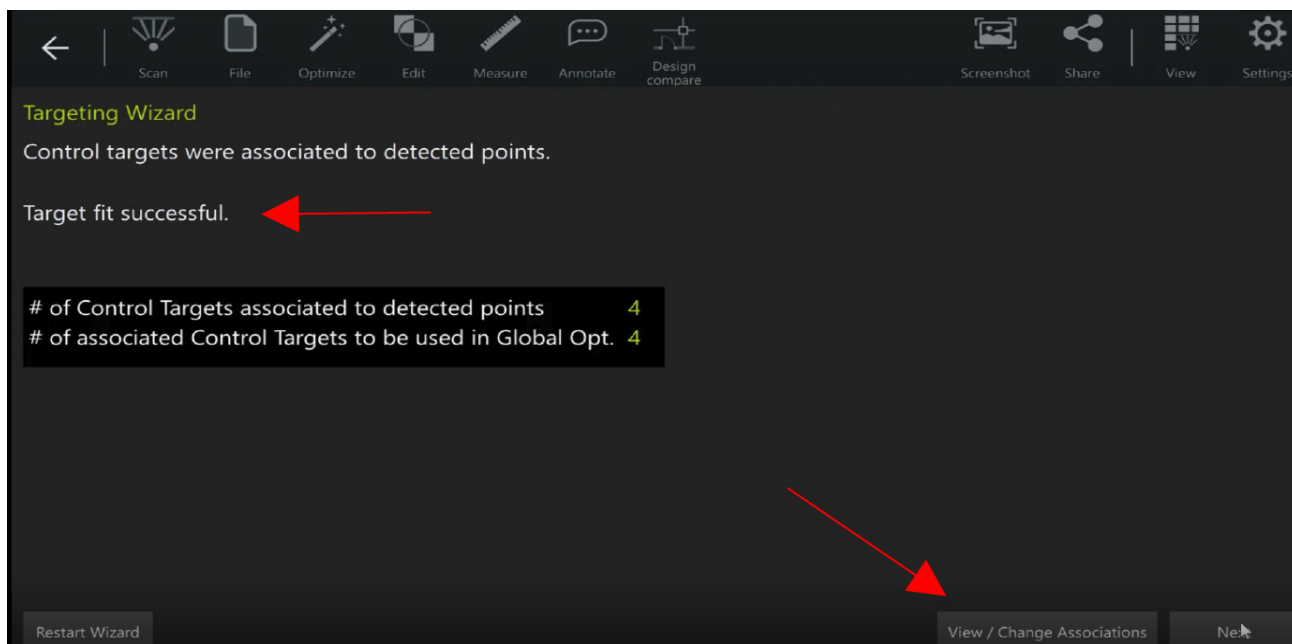


Figure 147 - Target Fit Successful

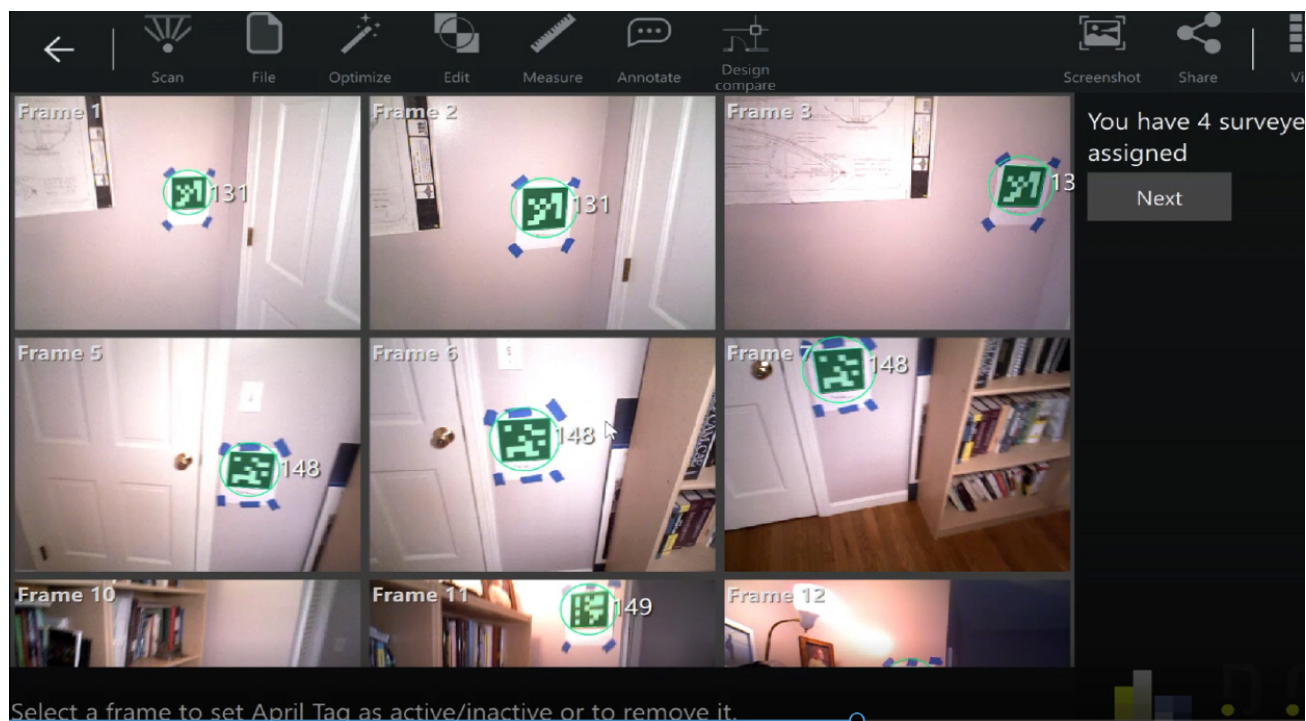


Figure 148 – View/Change Target Association

The control target coordinate system is now available as export transformation or as display coordinate system for measurements and annotations and optimization. Select **Close and Optimize**.

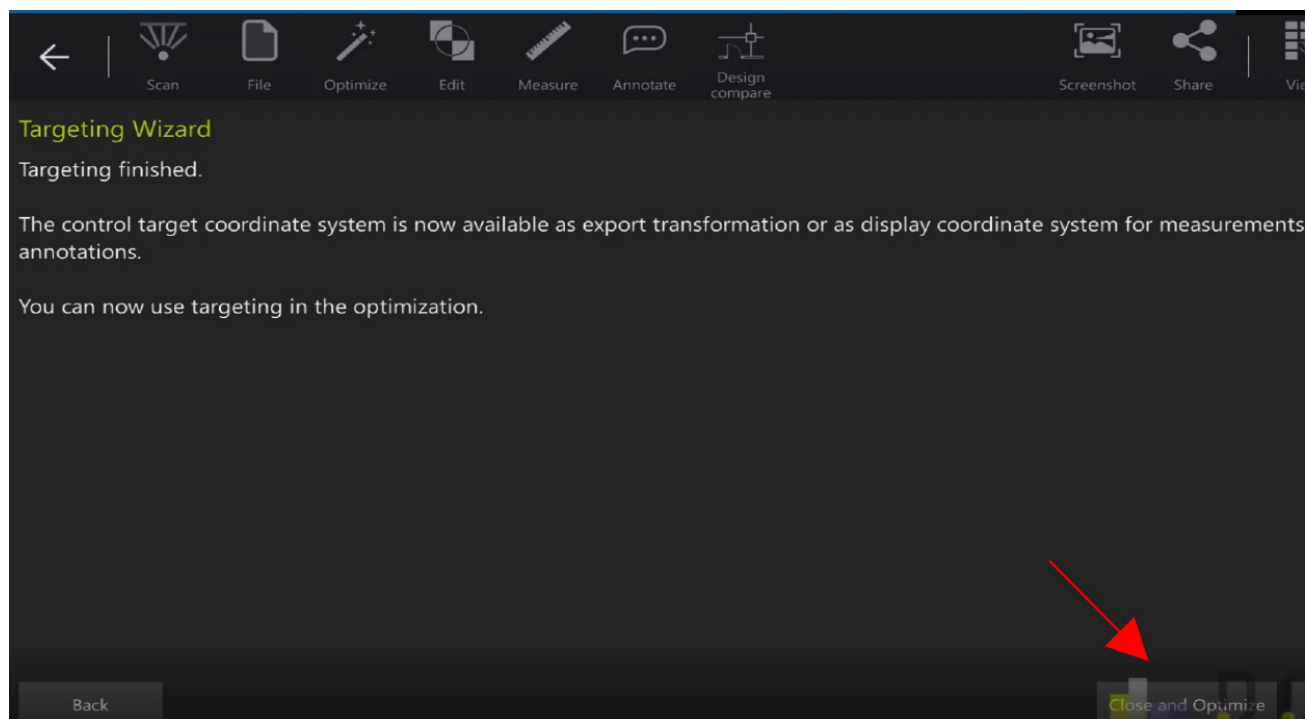


Figure 149 - Targeting Finished

Optimize Scene information will appear with “Use April Tags for Loop Closure” auto-selected anytime there are AprilTags recognized in the scene, and “Use Targeting in Optimization” selected whenever scale bar or survey target coordinates have been added to a scene. Hard Targeting will optimize the scene with the Survey control coordinate system as well as correct for scale and drift. Select **Optimize Scene**.

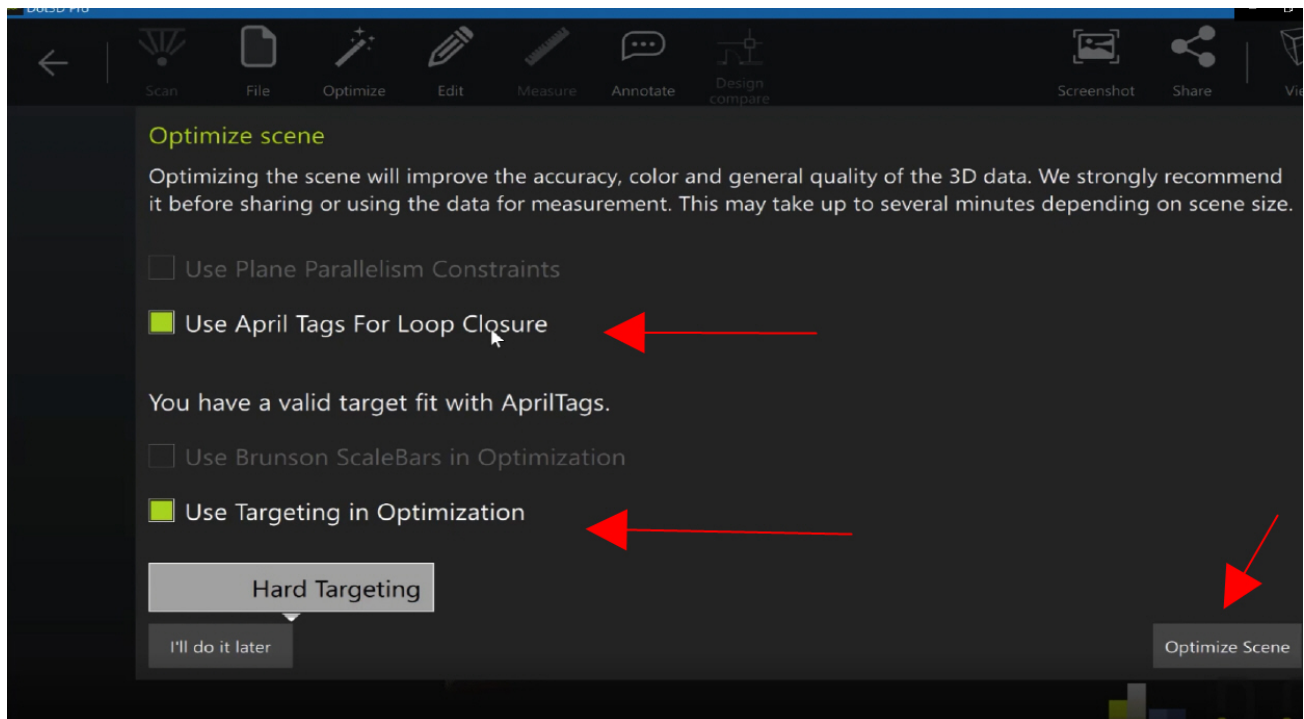


Figure 150 - Optimize Scene

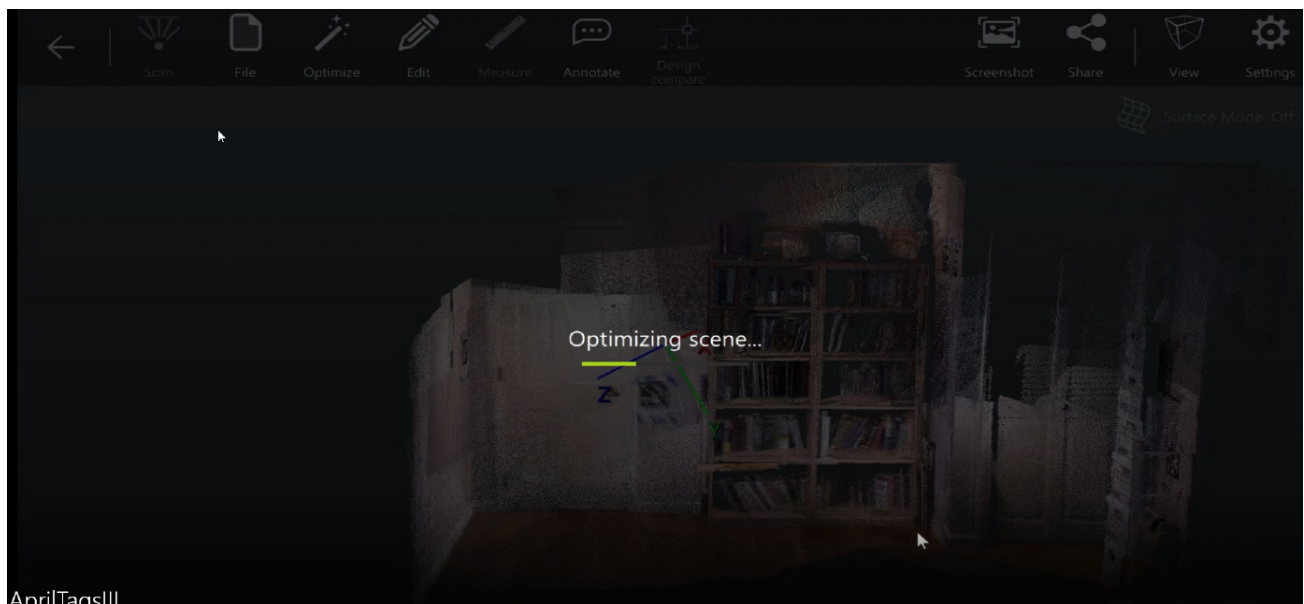


Figure 151 - Optimizing Scene

Once the data is optimized you can export the identified AprilTag positions so you can use them at a future date. Select the **FILE** Tab on the main menu and then **Export AprilTags**.

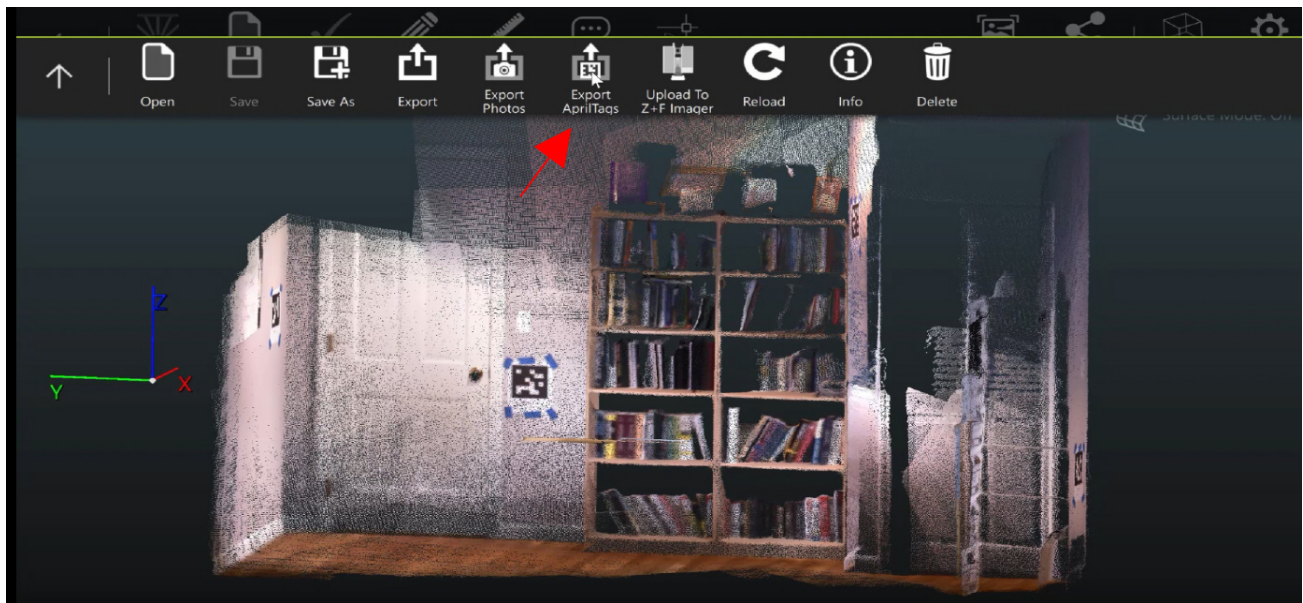


Figure 152 - Export AprilTags

You will then see a list of the detected AprilTags in the scene. Select **Export**. Choose the file name for the AprilTags. Select the **Export Options** of “Units” and “Output Transform”. Then select **Export Tags**.

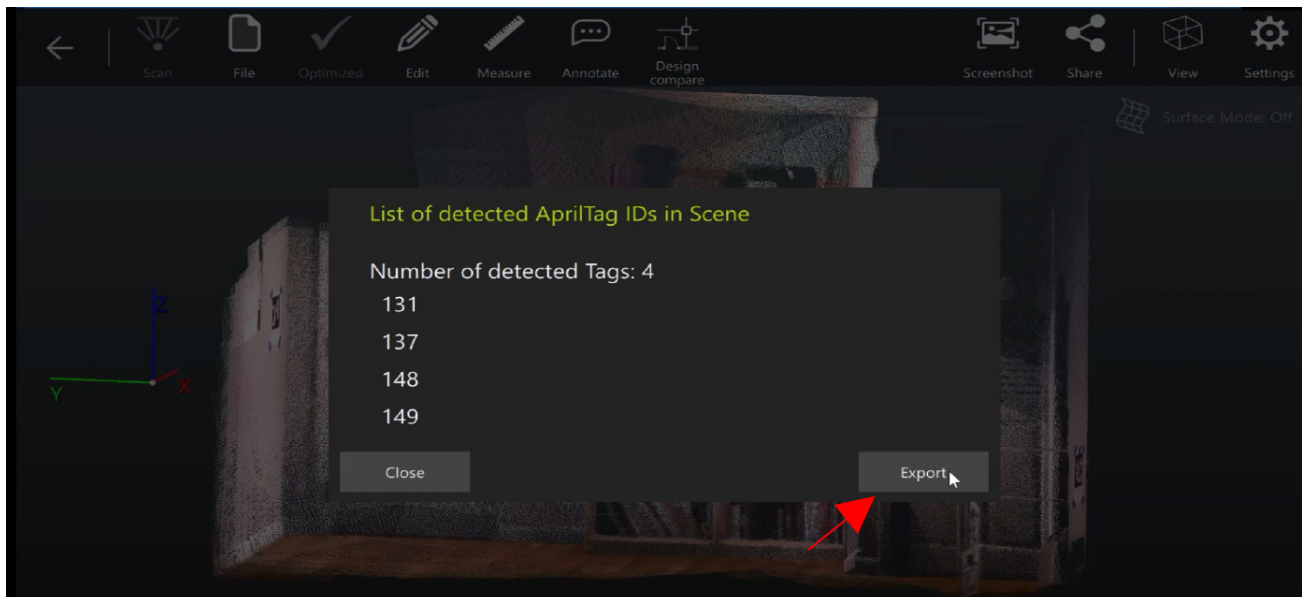


Figure 153 - List of Detected AprilTags in Scene

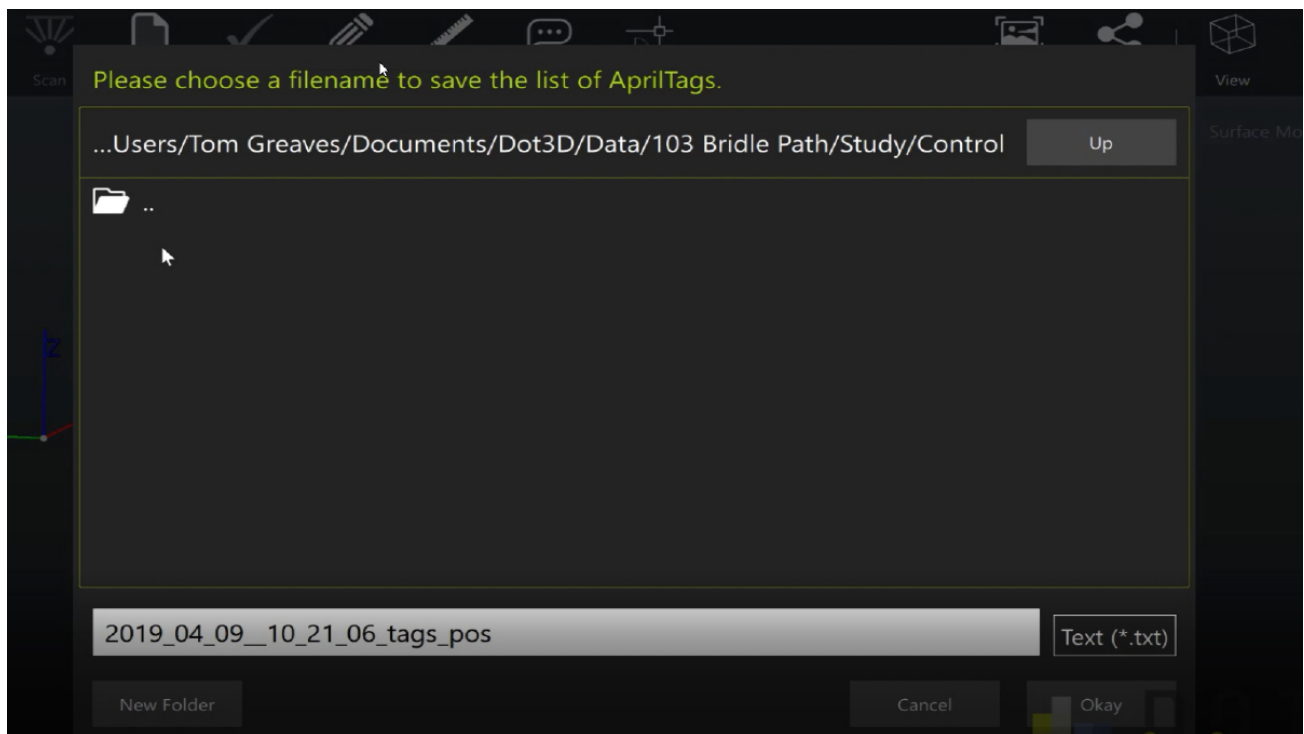


Figure 154 - Save List of AprilTags

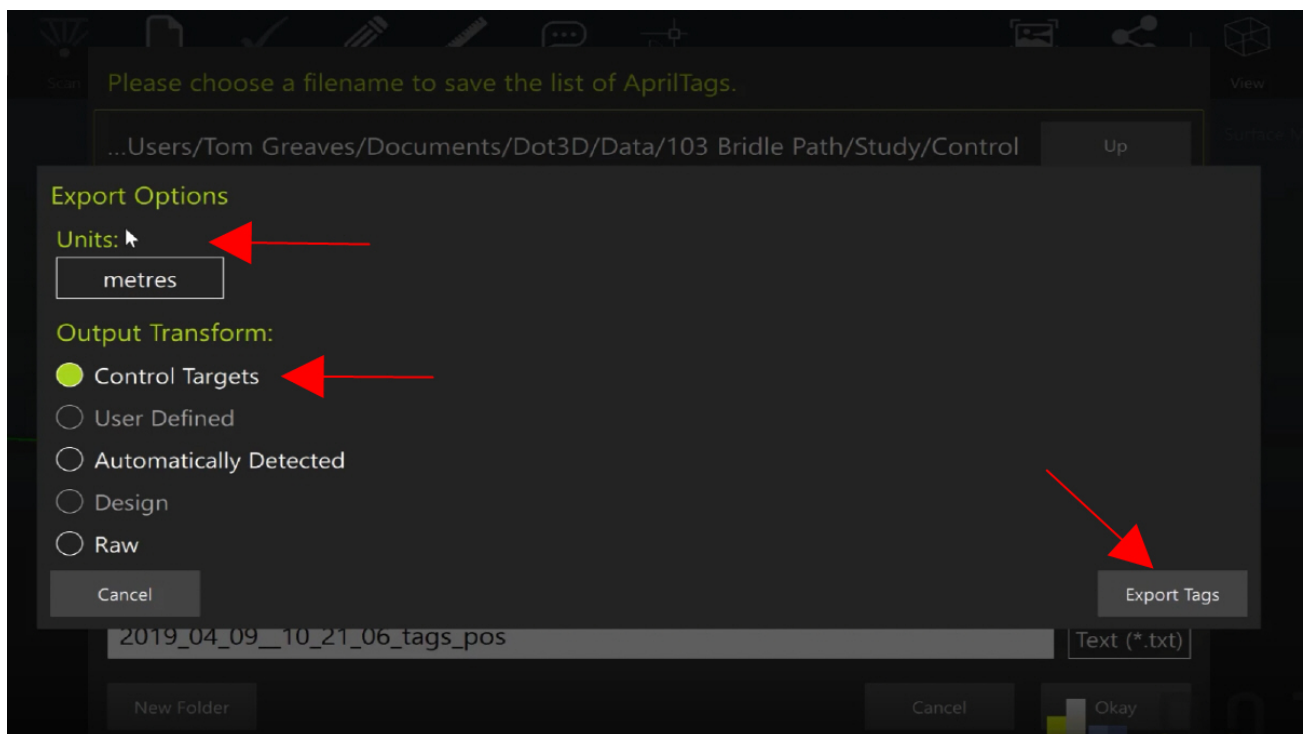


Figure 155 - Export Options

Targets in Scene Optimization

Once a target fit has been found for the scene, the target control network can be made active during global optimization / post processing. This means that the scene geometry will match the absolute target locations at the target center points. This will effectively eliminate drift in the neighborhood of target locations. DotProduct recommends this practice for long stretches of captured data and whenever absolute accuracy over long measurement distances is required.

Using Survey Targeting After Scene Optimization

It is possible to associate and fit targets to already optimized files, however, only to obtain a coordinate transform of the complete scene. It is not possible to re-optimize an already optimized file, regardless of whether there is a targeting mode involved or not. The recommended best practice is to use targeting on un-optimized datasets, then optimize with the desired targeting mode.

Other Uses for Targets

Even if the target positions are not surveyed independently, it is often helpful to include them in a scene. Adding targets to a scene in areas where there is little geometrical or texture variation, a flat monochrome wall or a stretch of pipework for example will allow the scanner to track better than without targets.

TARGETING MODES IN GLOBAL OPTIMIZATION

Several modes for targeting can be used in global scene optimization in Dot3D:

- Hard targeting
- Soft targeting
- Scale-Bar targeting
- Correspondence-only

Hard Targeting

This is the most standard targeting mode: It uses a list of named targets and their XYZ spatial coordinates. The use of Hard Targeting in global optimization will result in highest accuracy of the model after the optimization. Hard Targeting enforces the co-location of detected target center points in the scene with associated control target 3D points.

Soft Targeting

The difference between Soft and Hard Targeting is that scene optimization favors fidelity and color accuracy over absolute accuracy. Results after an optimization with Soft Targeting are still going to be at least as accurate as optimizing without targeting but will not exceed the accuracy of a model that has been optimized with hard targeting.

Note that for Hard and Soft Targeting to be available in the Global Optimization, the targets to be used need to have 3D positions (see section "detecting targets") and a "Fit All Targets" step needs to have been performed prior to the optimization.

Scale-Bar Targeting

This targeting mode relies on relative target-to-target distances rather than target absolute positions. It does not require a "Fit All Targets" step. Scale-Bar targeting will improve the accuracy of the model in post processing (Global Optimization) by ensuring the specified target-to-target distances are met. It will not however provide a coordinate transformation.

To use scale-bar targeting use a target control text file that is structured as follows:

```
unsurveyed_0,0,0,0
unsurveyed_1,0,0,0
unsurveyed_2,0,0,0
...
distance,unsurveyed_0,unsurveyed1,A
```

```
distance,unsurveyed_0,unsurveyed2,B
distance,unsurveyed_1,unsurveyed2,C
```

A, B and C are target-to-target distance values (decimal values with dot decimal point, e.g. 1.234). Each individual target should have an entry in the control file that starts with "unsurveyed_" followed by an arbitrary name (e.g. "unsurveyed_0" or "unsurveyed_first"), followed by an arbitrary position (0,0,0 in the example). Also, for each target-to-target distance measured there should be an entry in the control file consisting of four fields separated by a comma, the first field being "distance", the next two being the names of the two targets where the distance refers to, followed by the distance as the last field.

The control file for Scale-Bar targeting can be loaded just as any other control file through the "Load Targets File" button in the TARGETS tab. After the file has been loaded all targets need to be associated (see section "Hard targeting" for an explanation of how to associate targets). After all targets have been associated, Scale-Bar targeting will become available as a targeting mode in the OPT tab. A Fit-Targets step must not be performed.

Correspondence-only targeting mode

This mode of targeting is no longer relevant with the option of using AprilTags for loop closure. Correspondence-only targeting allows you to use checkerboard targets for loop closure. However, we would recommend just using AprilTags in your scene to achieve the same results fully automatically. This mode does not constrain any distances, scales or absolute positions (therefore no positions or distances are needed in the control file), however it uses targets identified across image frames to help close large loops and generally improve optimization performance. To use correspondence-only targeting in Global Optimization it is sufficient to only provide target names and arbitrary positions in the control target list. If correspondence-only targeting is chosen for Global Optimization no absolute point positions or distances will be used as constraints in Global Optimization even though the used control target list may contain these. *Use only a few target correspondences or distribute targets well throughout the area of interest.*

Best practices

Scale-Bar targeting should only be used with at least one target-pair that is at least half of the scene / object size. For example, if the object size is 4 meters, then one target pair for Scale-Bar targeting should be at least 2 meters apart. Alternatively, a large number of short distances may be used. In this case however, no distance should be shorter than a quarter of the scene size. The use of only a few short target-to-target pairs on a large scene in Scale-Bar targeting may actually hurt accuracy and should be avoided.

DATA OPTIMIZATION

Optimization Background

The scene is composed of "image frames". Every image frame has a depth map that carries a depth value for each pixel. These depth values can be inaccurate, especially at longer ranges. Optimization is the post-processing step that optimizes the scene. It tries to find a position, orientation and depth map for each of the image frames that minimizes global misalignment of all the frames to each other. Optimizing the scene will improve the accuracy, color and general quality of the 3D data. We strongly recommend it before sharing or using the data for measurement.

You may perform automatic 3D data optimization right on the tablet while still in the field. We recommend saving the raw data first. (See "Saving Un-Optimized Data".) Select the **OPTIMIZE** Tab on the main menu. It will look like a magic wand if your scene has not been already optimized. Optimize will automatically recognize AprilTags, Plane Parallelism Constraints, Brunson Scale Bars and Black/White Checkerboard Targets if used in the capture. You can select or deselect what you want to use. Select the **Optimize Scene** button to start the optimization. This will take anywhere from 30 seconds to a several minutes depending on the size of your scene. A progress bar will be displayed while the function is operating. Once the optimization process is complete, the optimized scene will be shown in the 3D display. There will be a check above the **Optimization** button when the data is optimized. You may then save the optimized dataset in the same fashion as discussed in Save Scene.

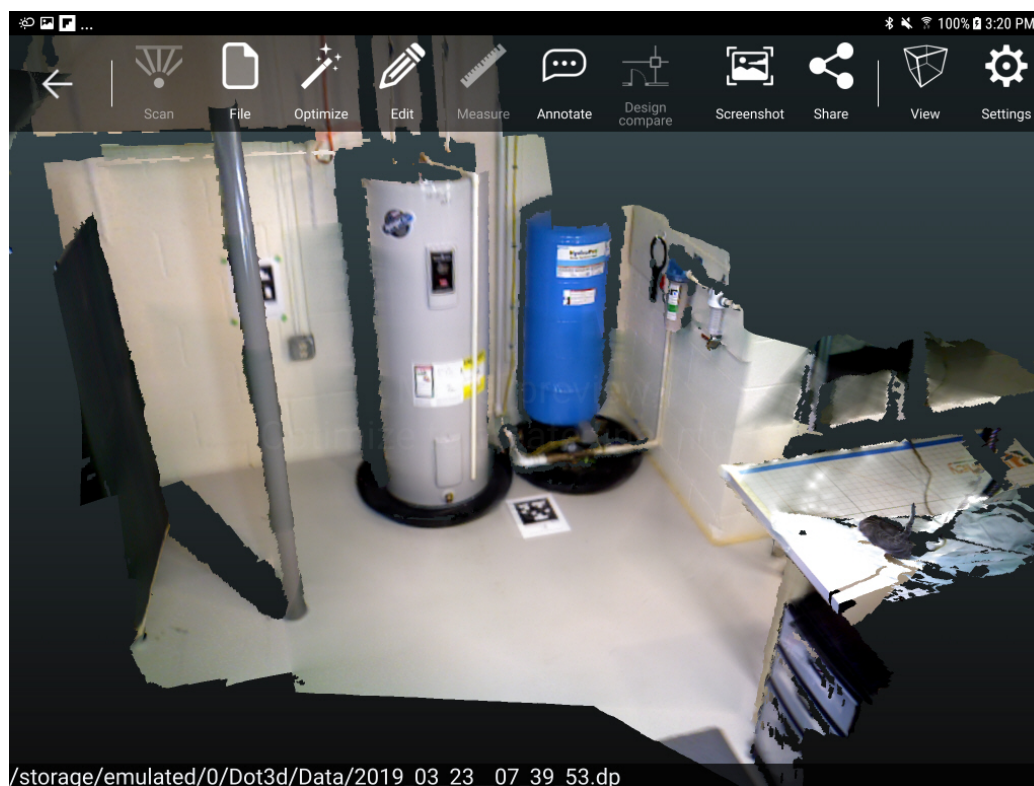


Figure 156 - Optimize Tab before Optimization

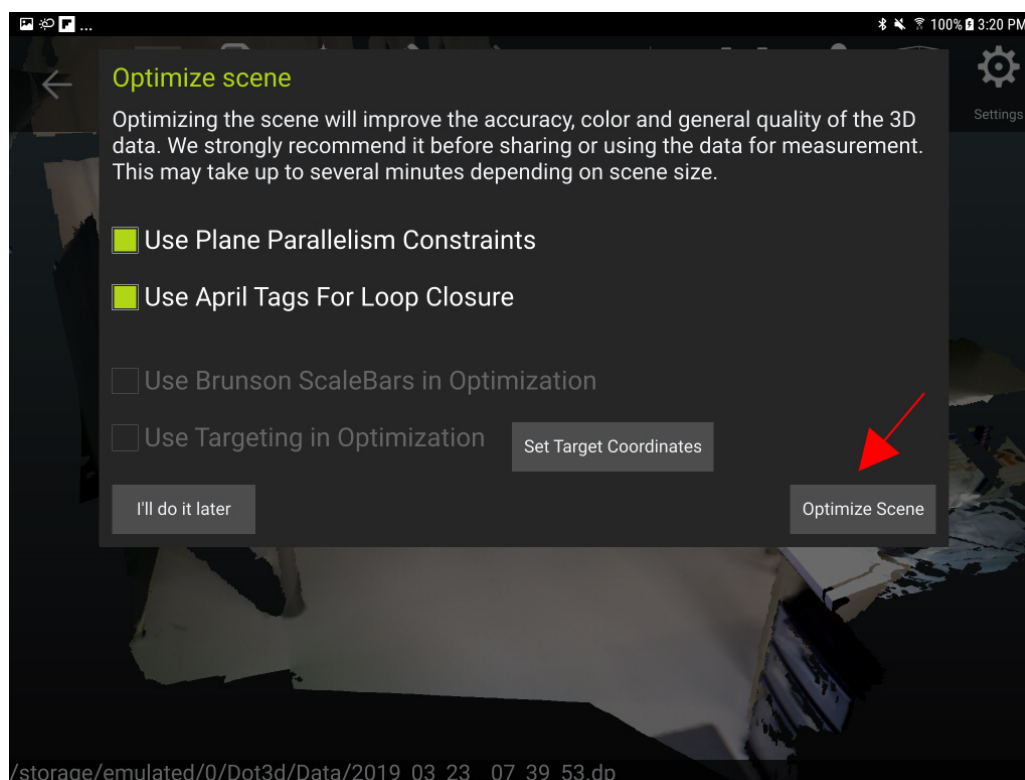


Figure 157 - Optimize Constraint Options

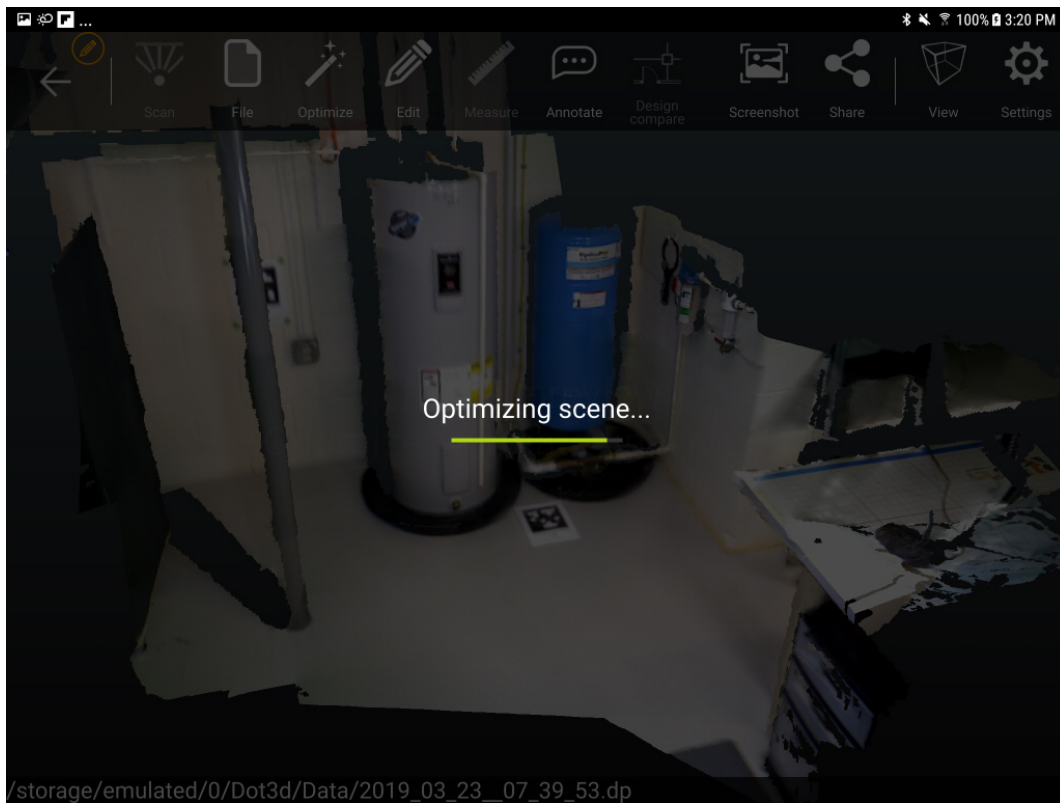


Figure 158 - Optimizing Scene

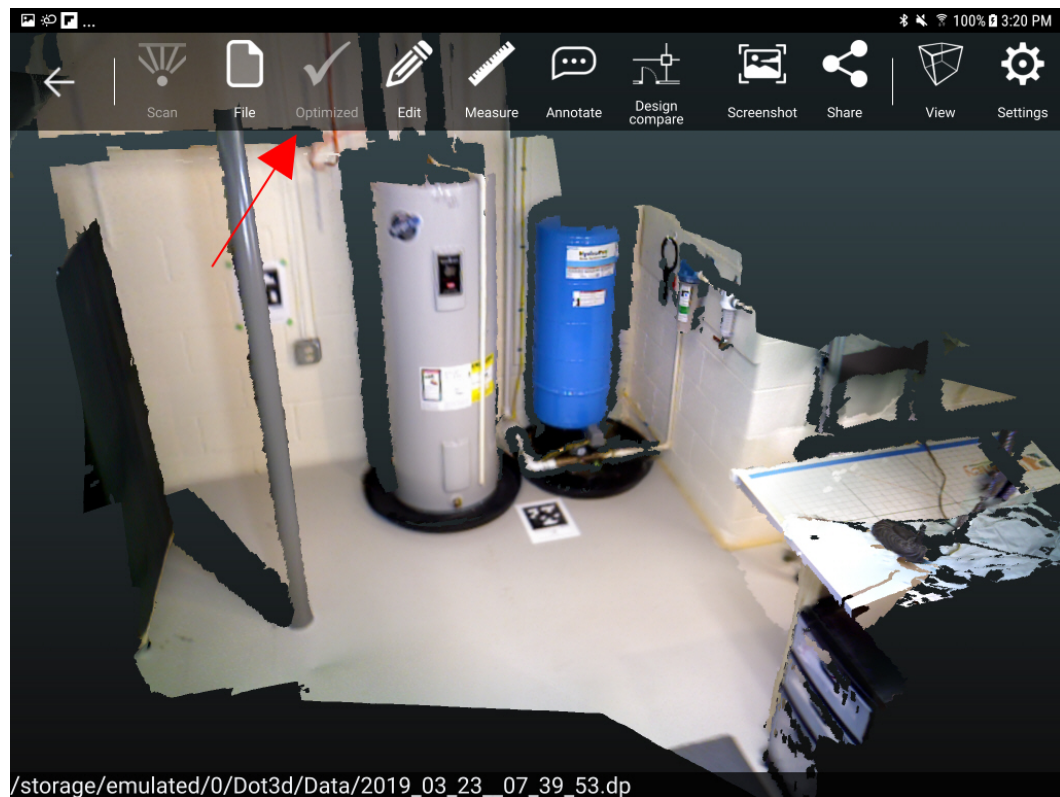


Figure 159 - Optimized Tab when Scene is Optimized

Optimizing modes

The **Optimization** button is available to you every time you record or append to a scene, and have not yet optimized. Optimization is not available on scenes that have been optimized already.

Optimizing your data after scanning

You can defer the optimization step until later, after you've finished all the data collection in the field on the tablet or on a PC if you have Dot3D Edit. The steps are outlined in the following:

- The first step is to retrieve the file you want to optimize by selecting the **FILE** tab. Then select **Open**. This will bring up a list of files in the /storage/emulated/0/Dot3D/Data directory.
(Note: /storage/emulated/0 is just an alias for /sdcard which is the root directory.)
- You can easily navigate to other directories from this list too by scrolling up to the top of the listing. *You cannot optimize a previously optimized file unless you append more data.*
- After you have selected a previously un-optimized file by tapping it and selecting okay, the file will load. Then select the **Optimize** tab, and then select any constraints and press **Optimize Scene** button. Then wait for the file to optimize.
- Save the optimized file with a new name, e.g. newfile_opt by first selecting the **FILE** tab and then selecting **Save Scene**. Then enter the new name and set the File type to **DP_BINARY** and select to continue. There will be a choice of save options; select **Save Scene**.

To continue optimizing more files, select the **FILE** tab, then select **Open** to select the next file to optimize, then go to the **Optimize** tab and repeat steps. You also have the ability to batch optimize multiple files at one time.

DATA LOAD, SAVE AND TRANSFER

FILE

The **FILE** Tab on the main menu after scanning gives you the option of **Open**, **Save**, **Save As**, **Export**, **Export Photos**, **Reload**, **info** and **Delete**.

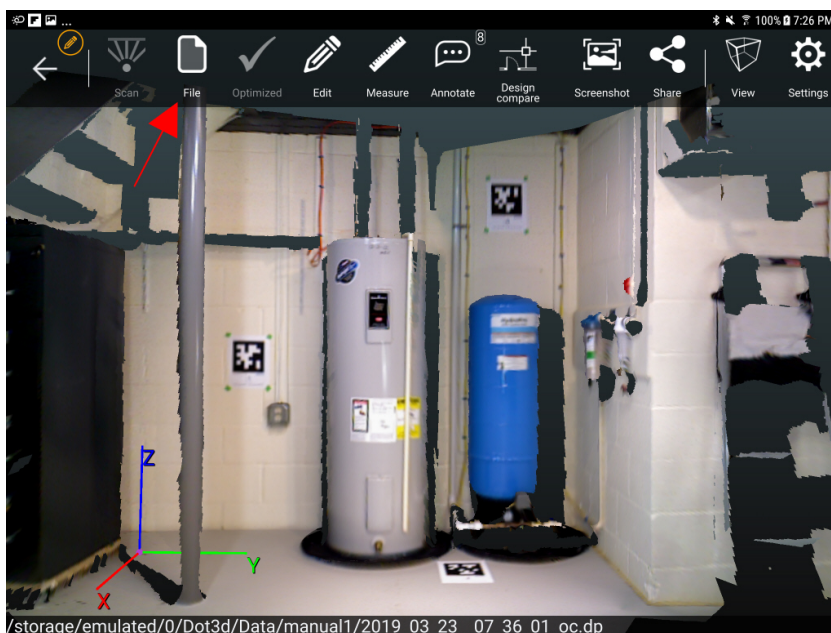


Figure 160 - File

Open

To open an existing DP scan file, go to the **FILE** Tab and select **Open**. This will bring up a list of files in the Dot3D/Data folder. You can easily navigate to other locations from this list by scrolling up to the top of the listing.

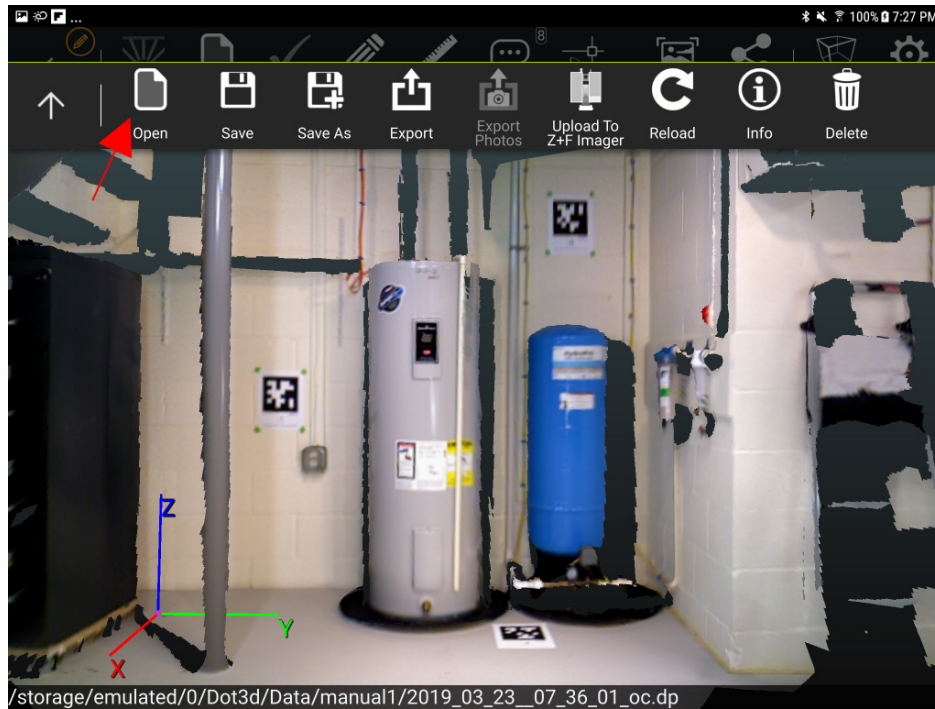


Figure 161 – Open

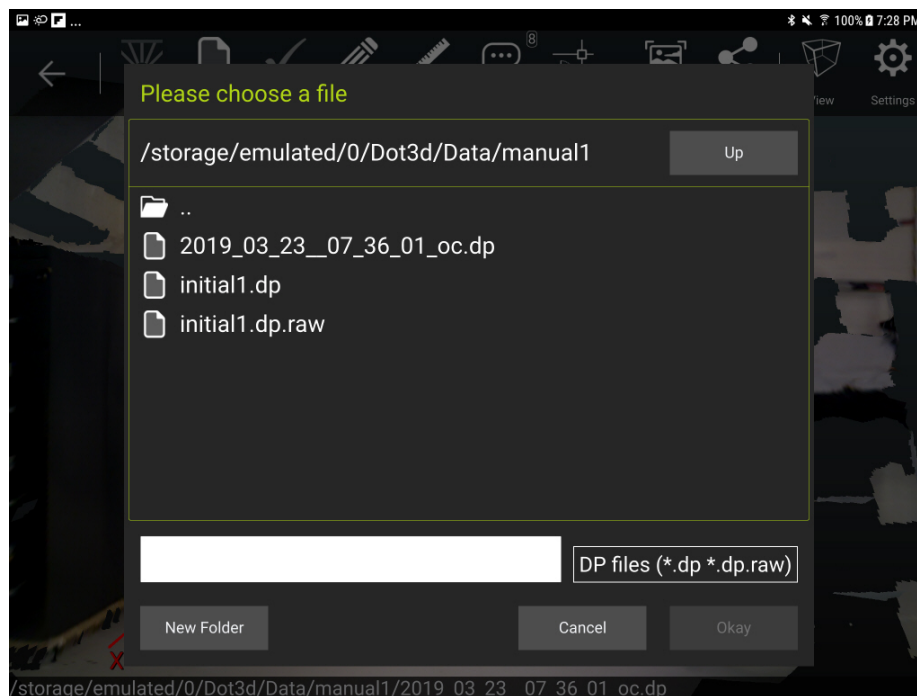


Figure 162 - Open File

Save

When you finish imaging, touch the **FILE** Tab on the main menu and then select **Save** to save the image data to the internal tablet drive storage. You will then be able to select Save Options for the Output Transform (Control Targets, User Defined (XYZ), Automatically Detected, Design and Raw). Depending on edits you have made to the scene it will automatically select the option. This will save the image with the same name in the same place.

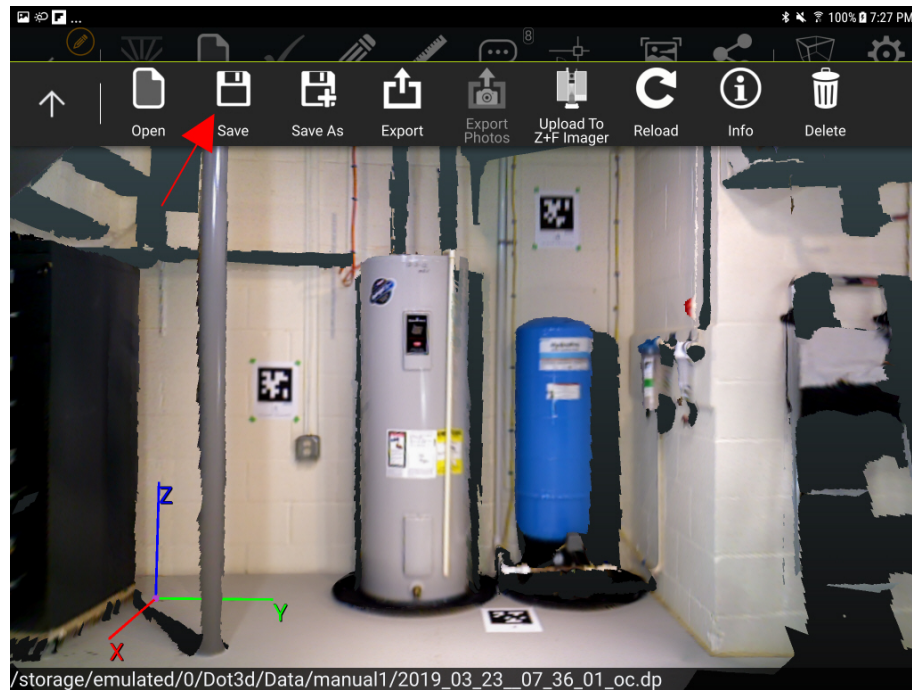


Figure 163 – Save

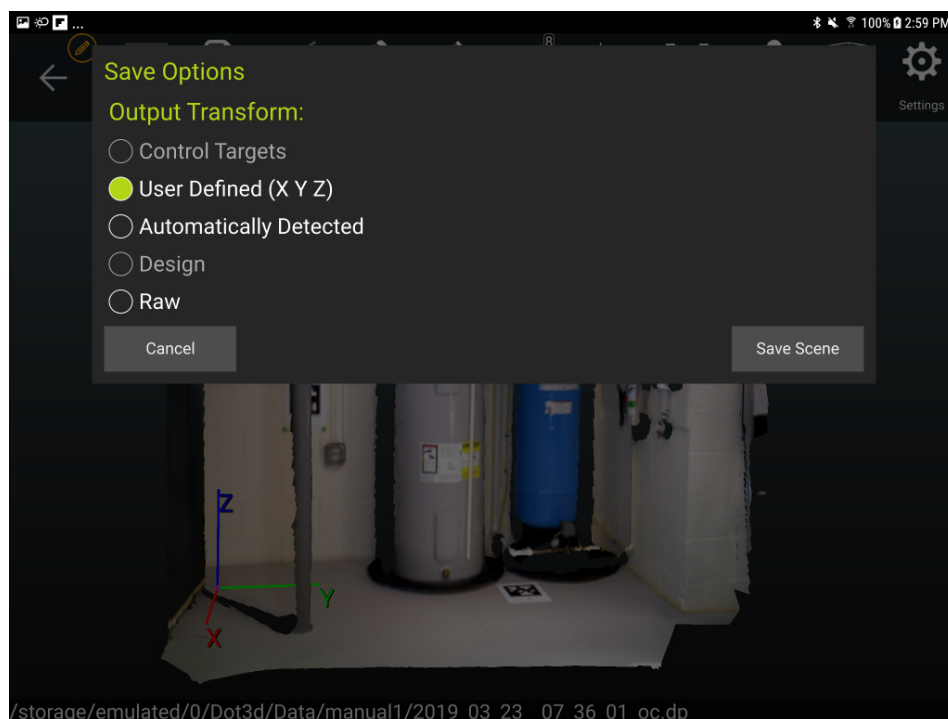


Figure 164 - Save Options

If you have made changes to your scene you will see an orange pencil in the top left corner. If you attempt to switch to a new or different scan you will get a prompt asking if you want to save the data first.



Figure 165 - Pencil Prompt for Scene Changes

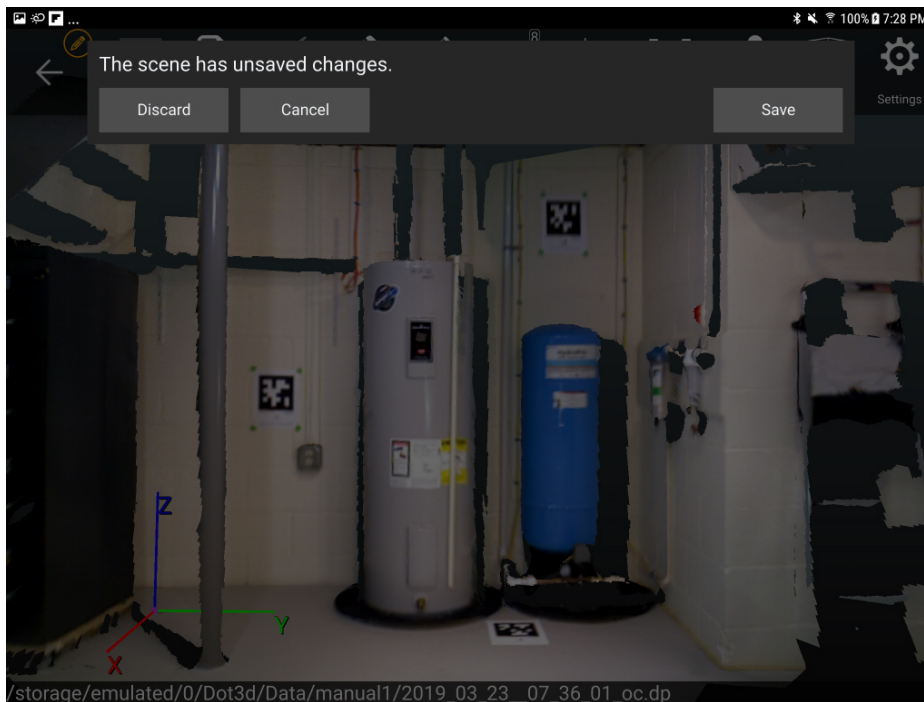


Figure 166 - Save Scene Prompt

Save As

To save with a different name, touch the **FILE** Tab on the main menu and select **Save As**. Change the file name and location, then press **Okay**.

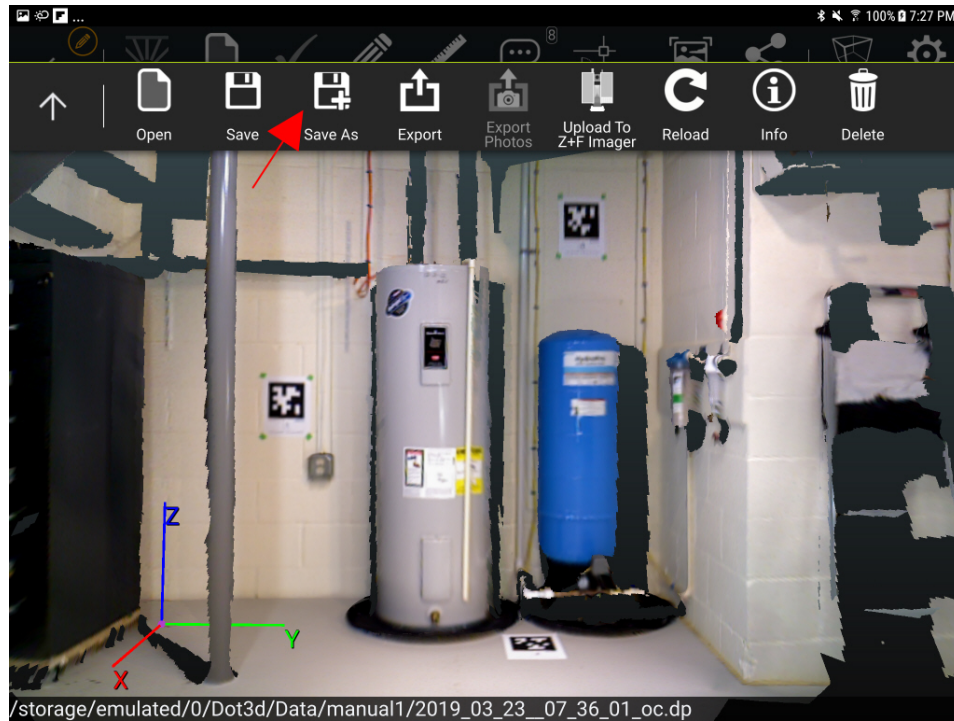


Figure 167 - Save As

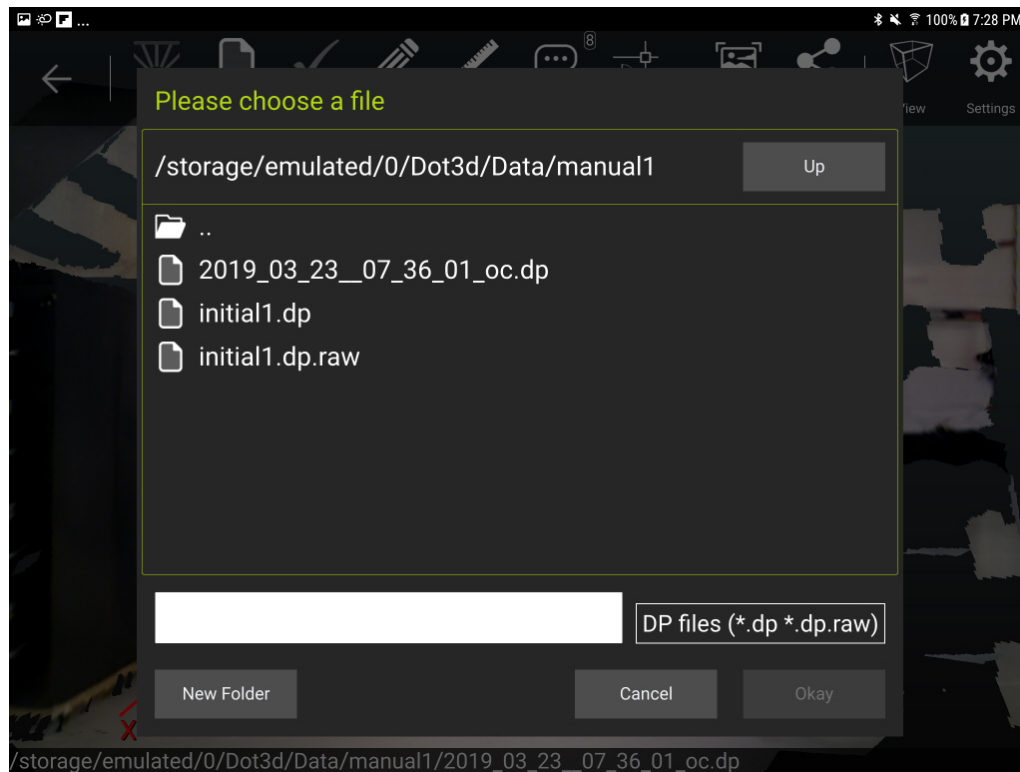


Figure 168 - Choose Name and Folder

Saving Un-Optimized Data

When you save the image data, you will be asked “Scene has not been optimized. Save anyway?” It is recommended you save the raw data first. You can optimize immediately afterwards or save this for processing after you finish the data capture.

- When saving and exporting after post processing Optimization, it is recommended to append a suffix in the proposed filename, “_o” or “_opt”.
- Since PTX is a gridded format, image frames of a file are exported as individual PTX scans when this option is chosen. The PTX scans can be exported as individual files or as a single file with separate scans in the file.

If you choose a file name to export to that already exists, the export dialog box will warn you, giving you the option to overwrite the file.

Export Data Formats

On the **FILE** Tab and after selecting **Export**, you can enter the new file name and select the desired output format/file type from a dropdown menu. Using DotProduct Dot3D software with the DPI Kit, you may save your data to the following formats using the **Export** Tab:

- **PTX** Grid structure point cloud, ASCII, unit of meters, space delimited, RGB color.
- **PTS** Unstructured point cloud, ASCII, user-defined units, space or comma delimited, intensity, RGB color, or both intensity and RGB color.
- **DP** DotProduct native file format, binary (highly compressed), RGB color.
- **PLY (binary)** Polygon mesh format, point elements, RGB color (Stanford Triangle Format).
- **PTG (binary)** Point cloud, binary, unit of meters, RGB color.
- **ASTM E57** A file format developed by ASTM International for storing point clouds and images
- **LAS / LAZ** LIDAR Data Exchange file format commonly used in GIS applications.

- **POD (Windows only)** – The POD (POint Database) format is the proprietary file type directly loaded by Bentley Pointools applications.
- **RCS (Windows only)** – RCS is the Autodesk point cloud format which can be imported into projects in AutoCAD, Revit, Navisworks, Inventor, and more. DP files can also be imported into Autodesk ReCap.

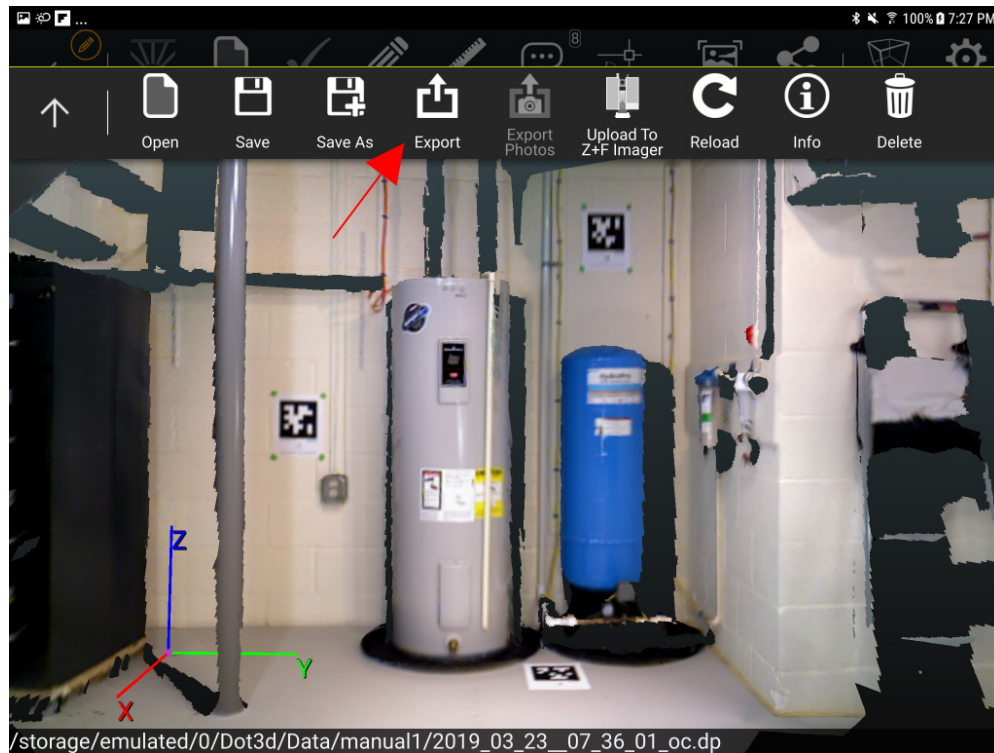


Figure 169 – Export

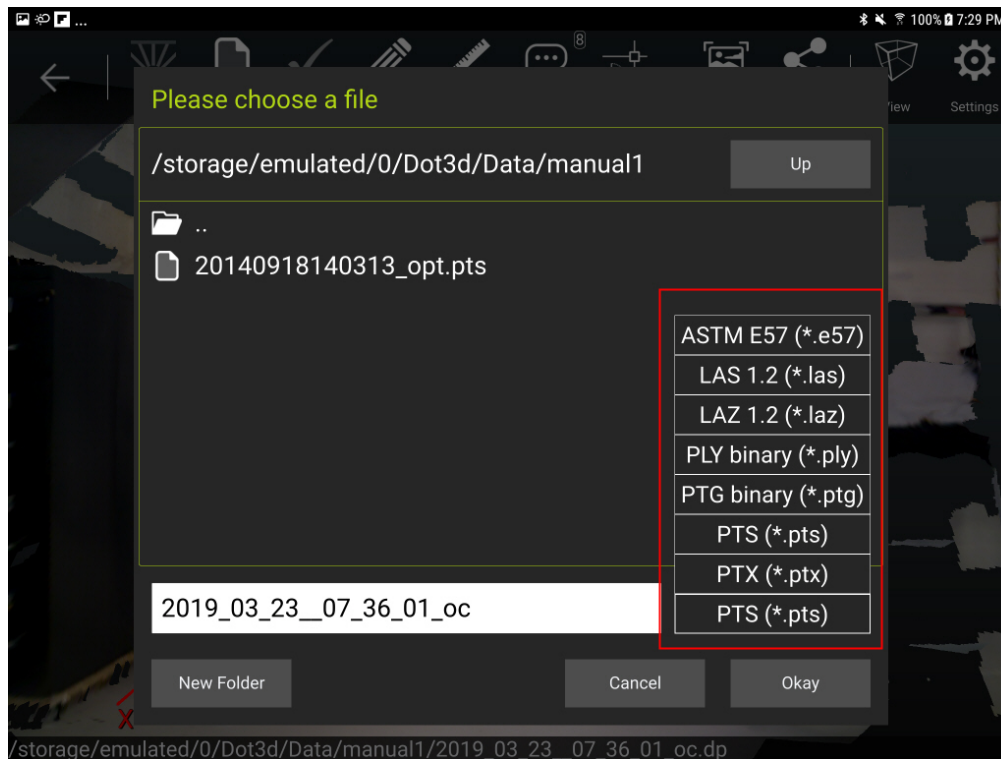


Figure 170 - Export Formats

When you select your export format and press okay you will see a screen of **Export Options**. In **Export Options** you can select the **Output Transform** (Control Targets, User Defined, Automatically Detected, Design, or Raw), **Units** if choices available and **Percentage of Points**. Once you select your export options select Export Scene. You will see a green progress bar as the data is exported.

If you choose to export in PTS format, remember that the Units, Separators, and PTS Format are user defined; import settings must match export settings to get the correct scaling and location.

- Units (Meters, Centimeters, Millimeters, Decimal Feet, US Survey Feet, Decimal Inches)
- Separators (spaces, commas, tabs, semicolons, colons)
- PTS Format (XYZIRGB, XYZI, XYZRGB)

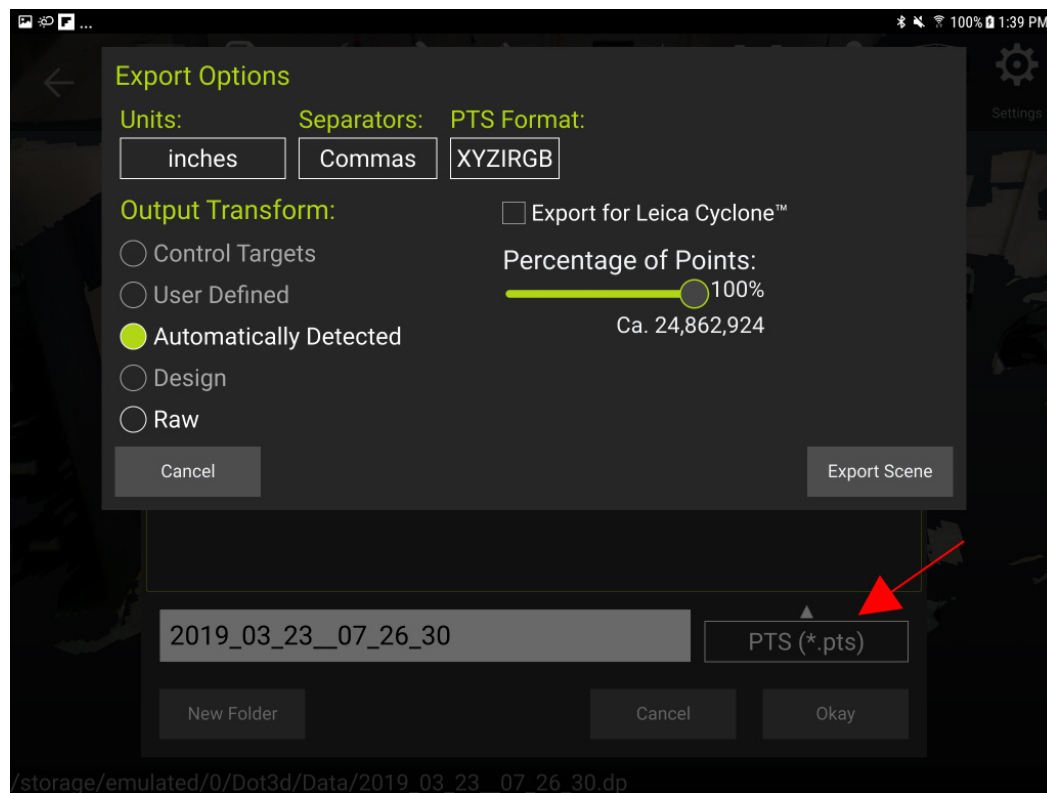


Figure 171 - Export Options PTS

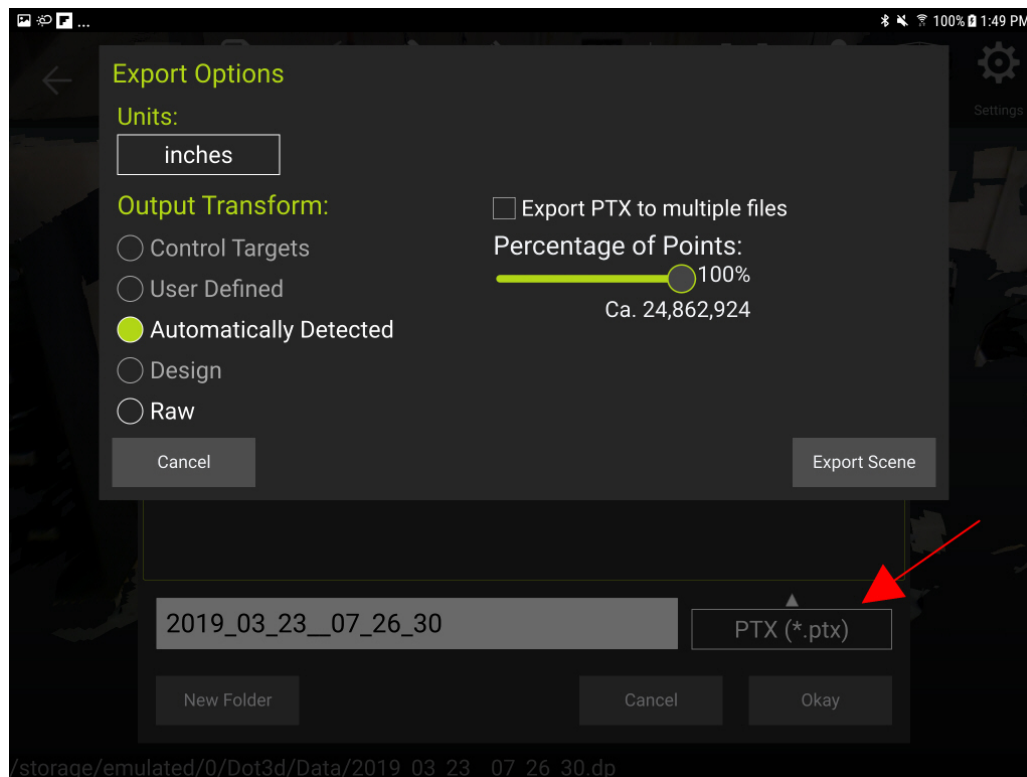


Figure 172 - Export Options PTX

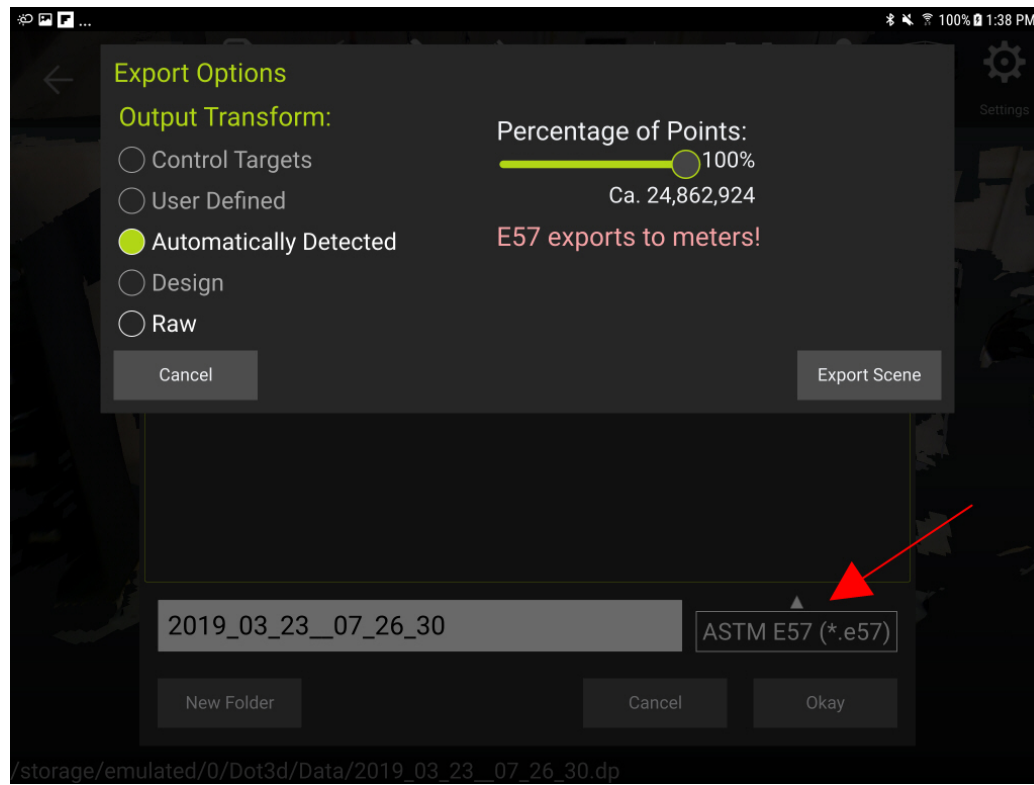


Figure 173 - Export Options E57

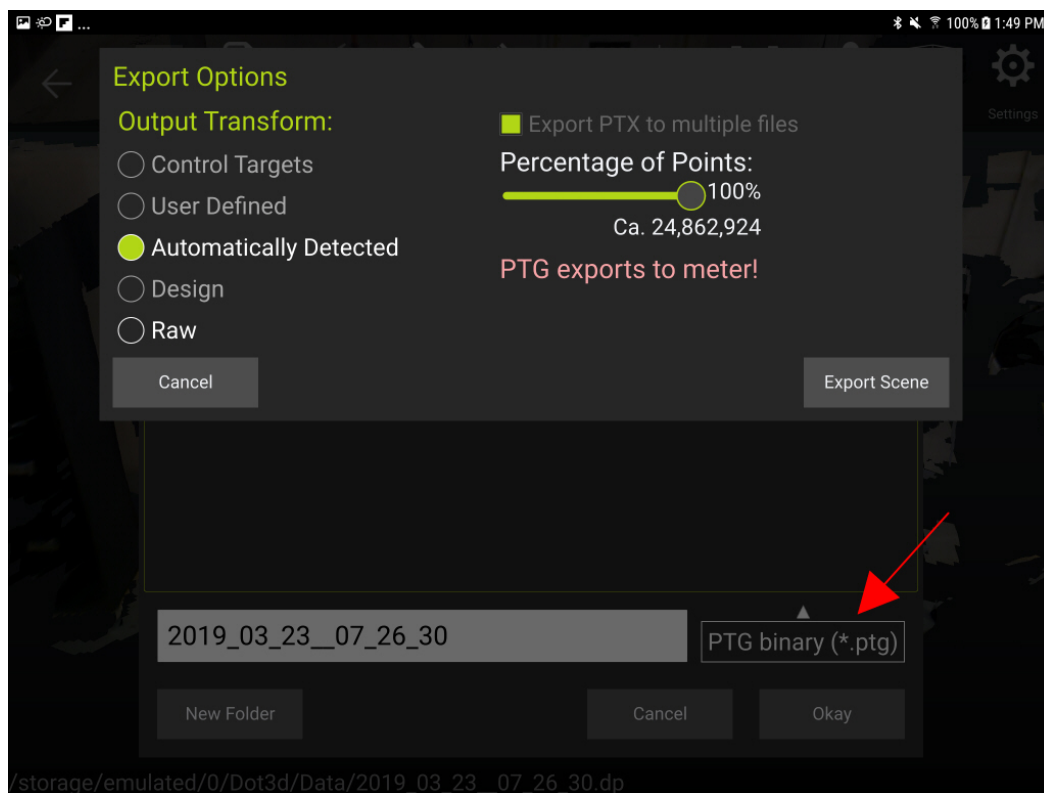


Figure 174 - Export Options PTG binary

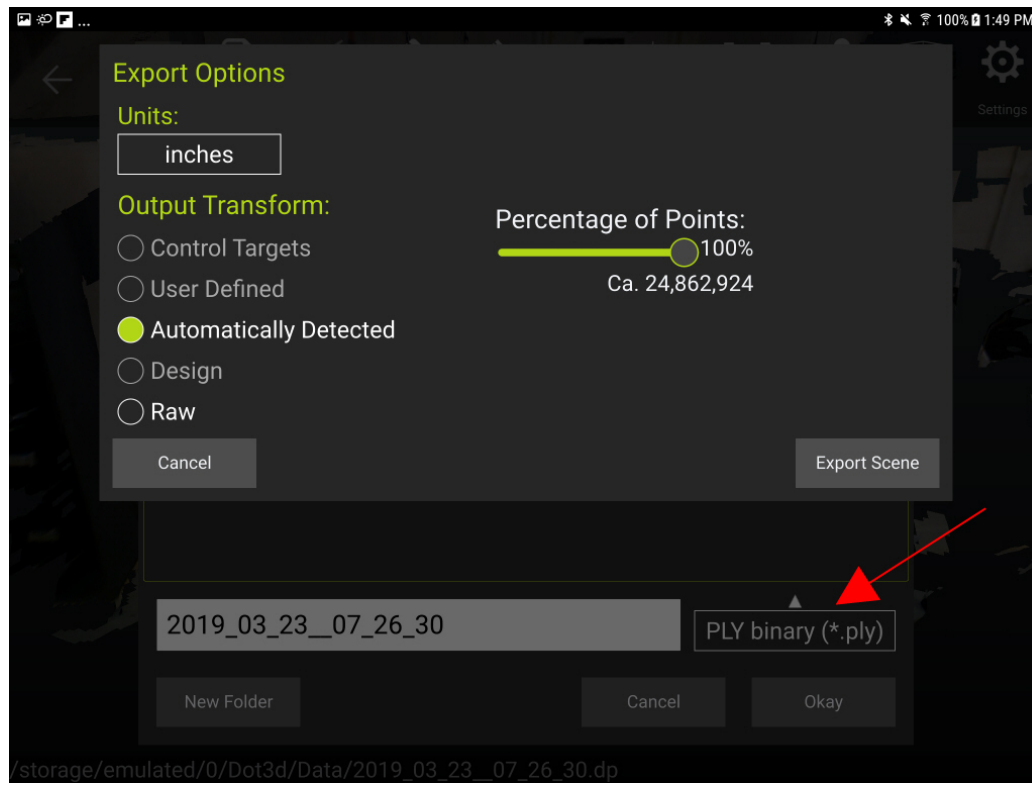


Figure 175 - Export Options PLY binary

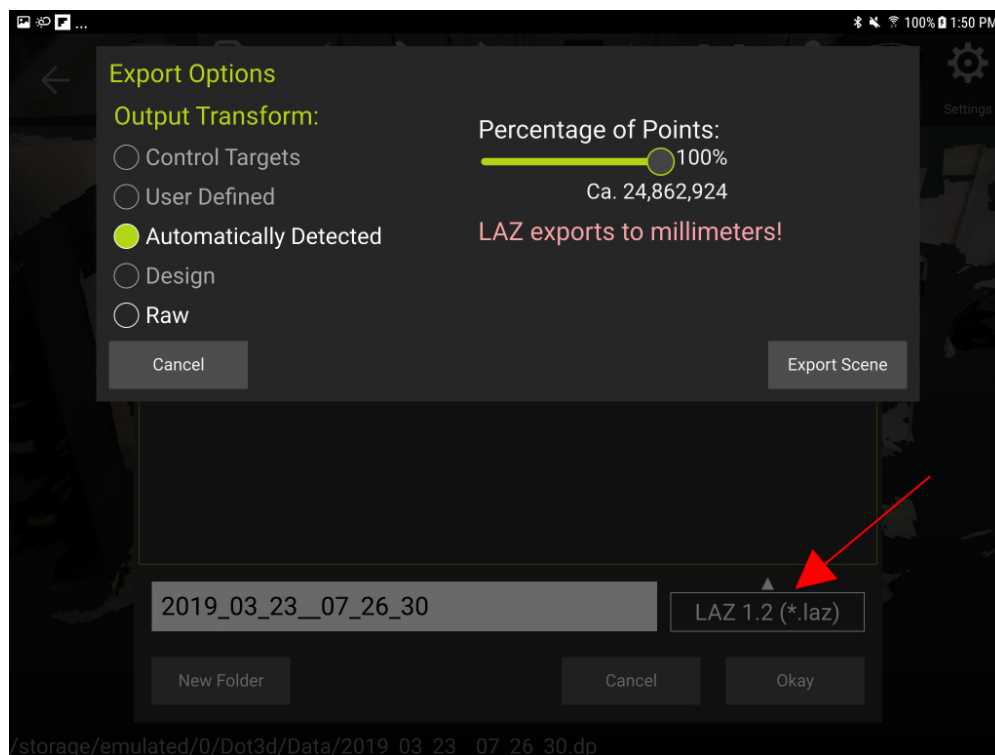


Figure 176 - Export Options LAZ 1.2

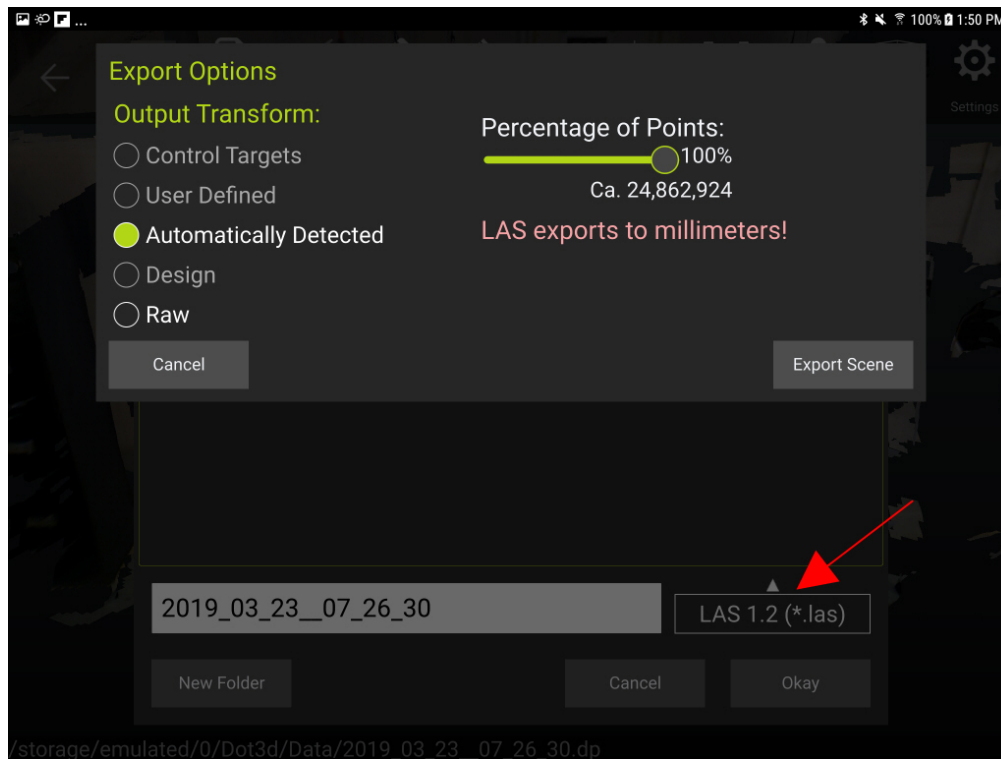


Figure 177 - Export Options LAS 1.2

Export Coordinate Systems

When results are exported the standard coordinate system has the origin (0,0,0) where the scanner started capturing. Axis X is pointing to the right side of the sensor, Y pointing downwards and Z pointing along the optical axis into the scene. If a different coordinate system is desired when data is exported Dot3D offers several choices:

1. Automatically detected: This option performs calculations in the software to guess at a good location for the origin and axes directions (i.e. the bottom corner of a room).
2. Control targets: This will apply the transform obtained by identifying and matching a number of control targets (see section "Using Targets").
3. User defined: This will apply any coordinates that were set in the **EDIT/COORDINATES** Tab
4. Raw: This applies the origin point to the scanner location at the start of scanning, as described above.
5. Design: This applies the coordinate system set by registering to a CAD file in the **DESIGN/COMPARE** Tab.

Export Photos

From the **FILE** Tab you can select **Export Photos** and export the HD photos taken during the data capture.

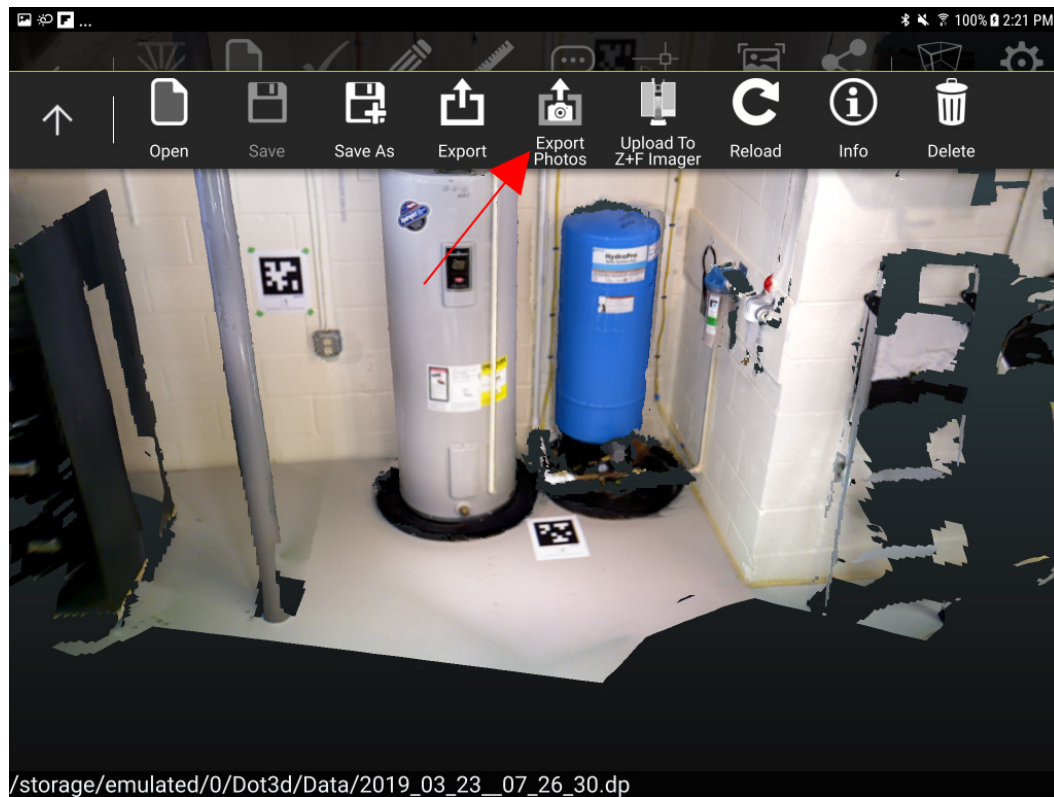


Figure 178 - Export Photos

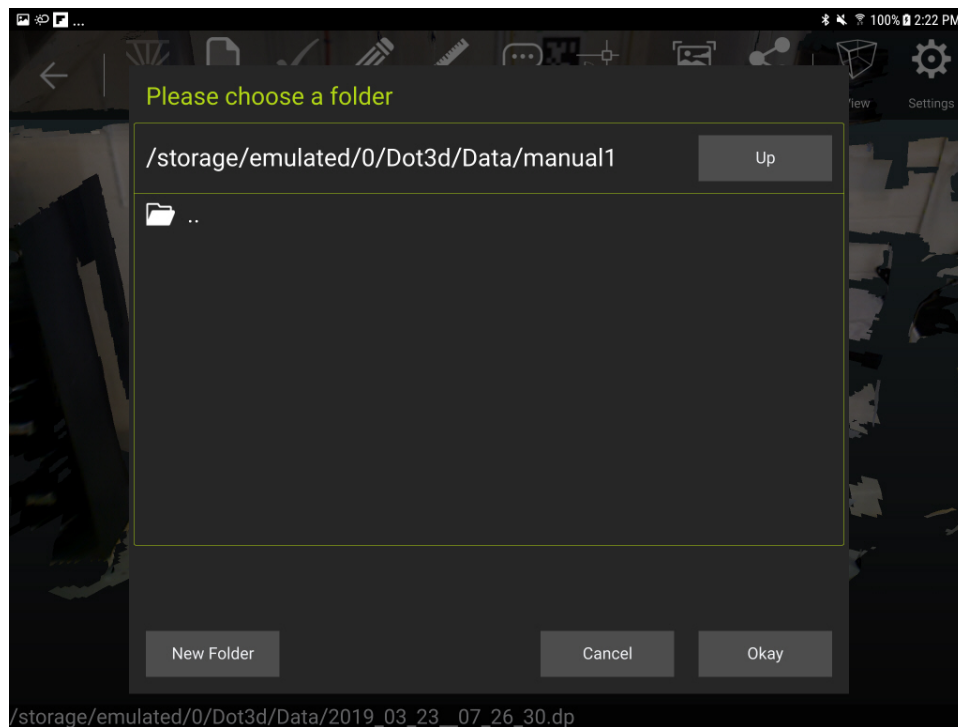


Figure 179 - Choose Folder for Exported Photos

Upload to Z+F Scanner

From the **FILE** Tab you can select **Upload to Z+F Scanner** to upload the scene (point cloud) to a Z+F Scanner.

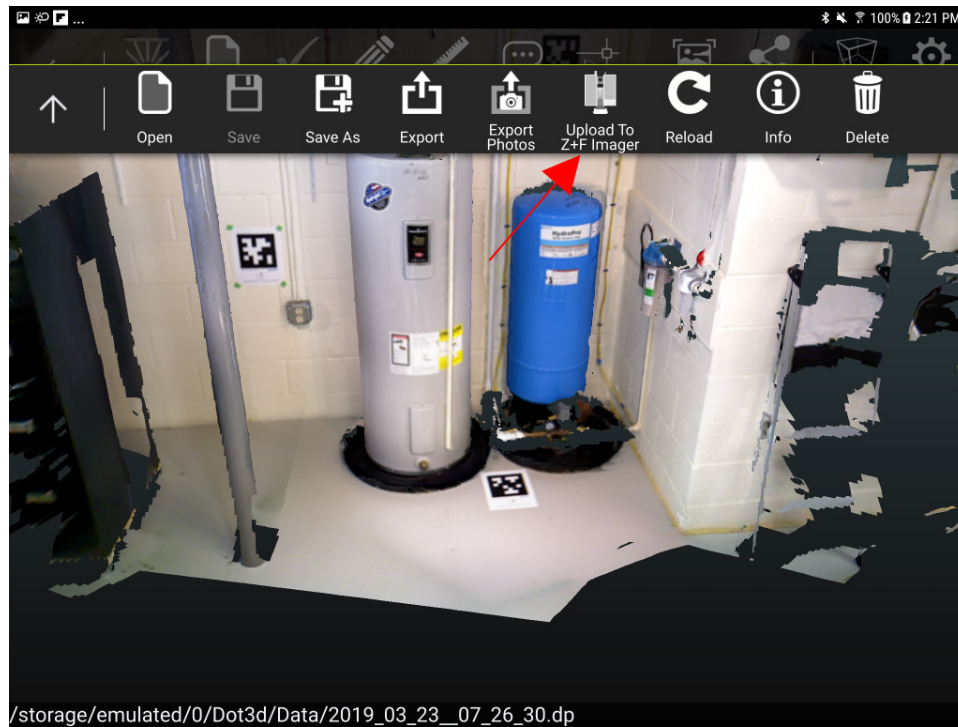


Figure 180 - Upload to Z+F Scanner

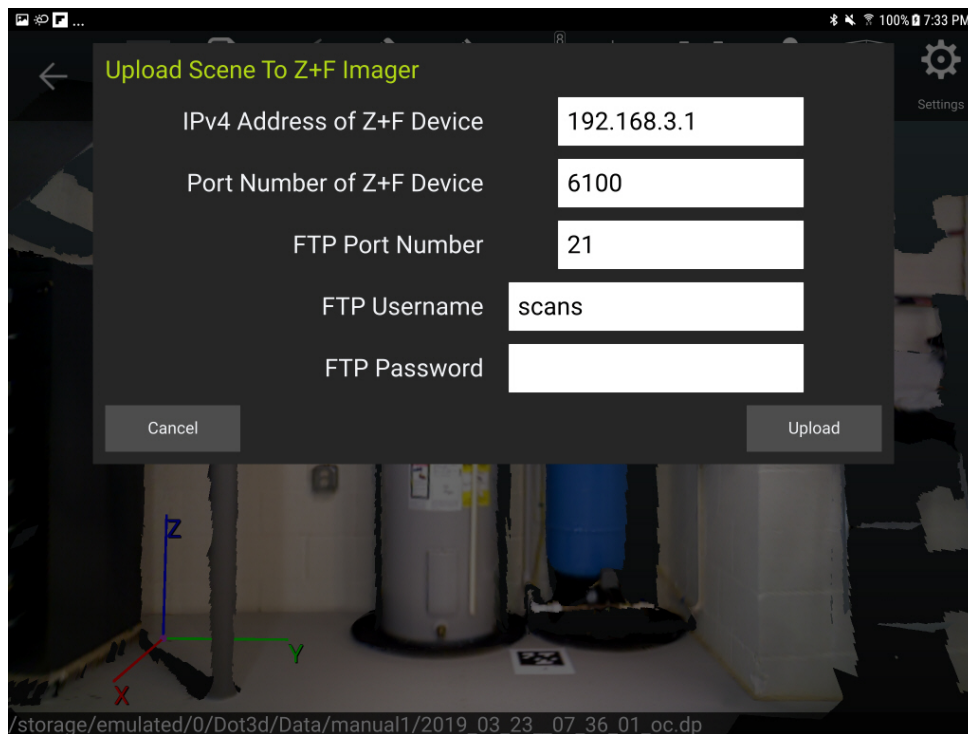


Figure 181 - Upload Scene

Reload

From the **FILE** Tab you can select **Reload** to reload the scene.



Figure 182 - Reload

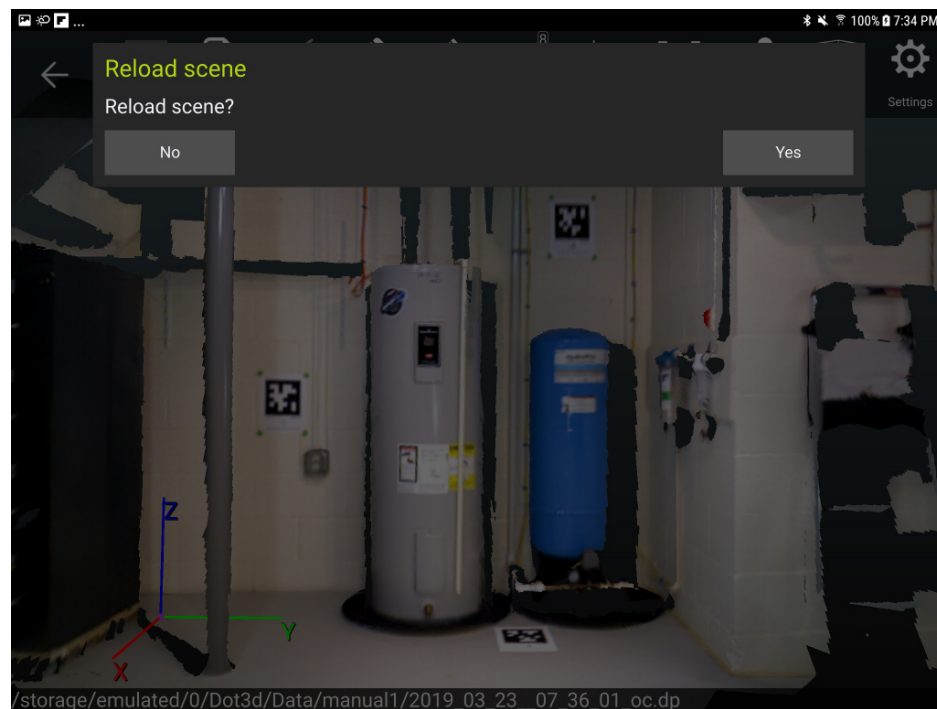


Figure 183 - Reload Scene

Info

On the **FILE** Tab and after selecting **info**, you can enter scene information for Caption and Details. It also tells you the number of frames and number of points.



Figure 184 - Info

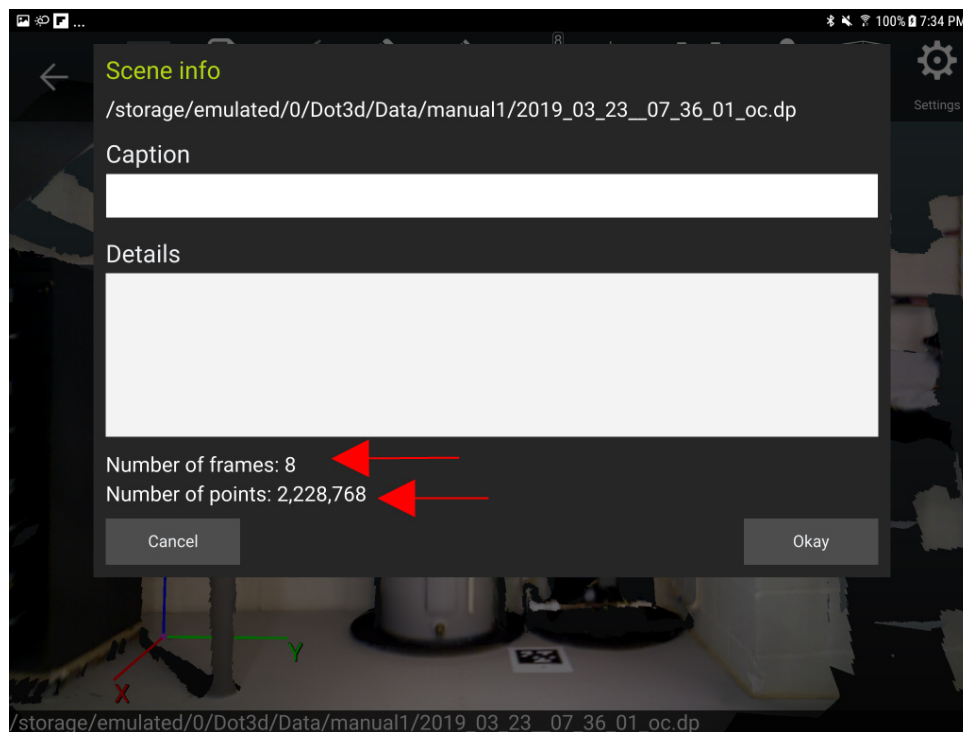


Figure 185 - Scene Info

Delete

From the **FILE** Tab you can select **Delete** to delete the scene.

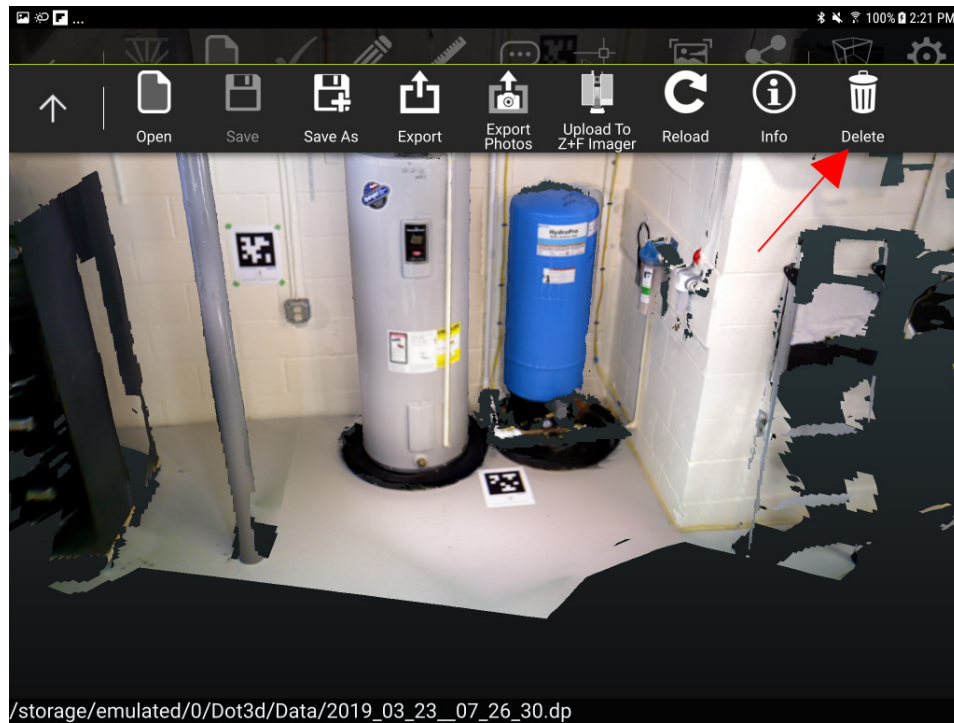


Figure 186 - Delete

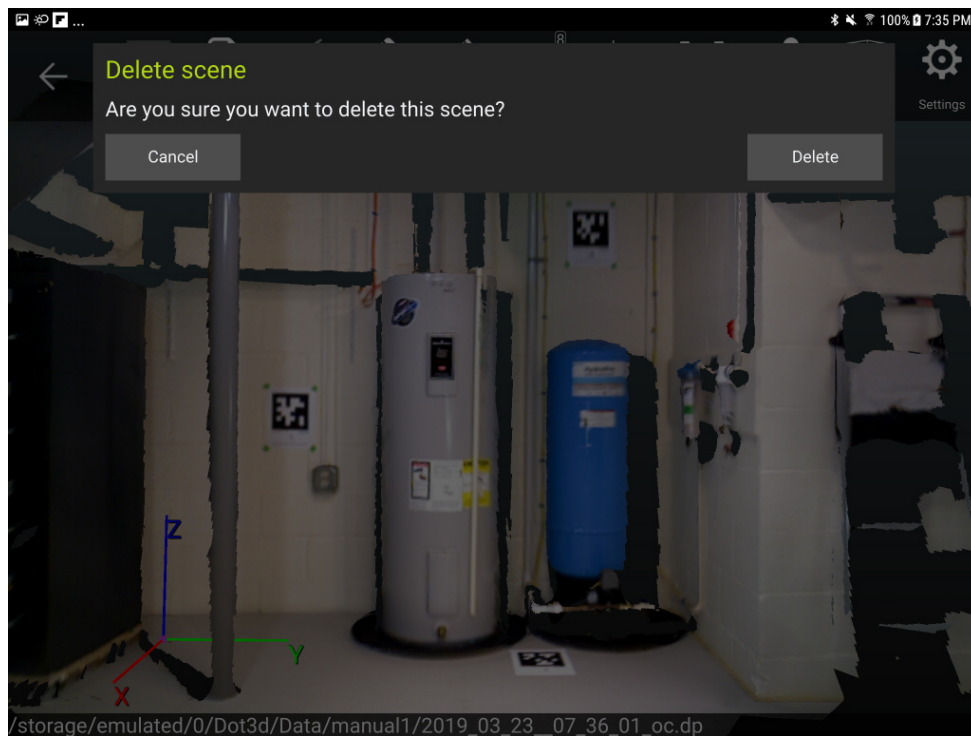


Figure 187 - Delete Scene

Transferring Data - SHARE

There are four ways to access the data you create on the DPI Kit depending on the format and tablet you are using. The default storage location on your Tablet is the /Dot3D/Data folder. Make sure you look at the correct folder.

1. **USB** - You may connect your tablet to your desktop or laptop computer with the micro-USB to USB cable provided which is also used for recharging your tablet. Depending on the computer you may need to download an application like ES File Manager (free on Google Playstore) to your tablet or Android File Transfer (Mac) to your computer. Most computers will recognize the tablet when it is plugged in and display it as a removable media device. Tutorial video for the NVIDIA tablet at <https://vimeo.com/209933128>.
2. **MicroSD** (*up to 32GB of expandable storage*) - You may plug a MicroSD card into the tablet and transfer data to the card. Eject the card and plug into a compatible laptop or workstation to transfer.
3. **WiFi** - Depending on file size and WiFi access, you may use the Wifi capability of the tablet to upload your data to the Web/Cloud. Some customers install DropBox or similar applications to upload data using an application like ES File Manager.
4. **Email** - Depending on file size, you may email from the Gmail account set up already on your tablet (or another account you set up). Because of file size issues, it is most likely you would only use this in the DP Binary, our highly compressed format.
5. **Upload to Cloud Storage** – You may utilize your full-function tablet to update to the wireless storage destination of your choice such as Dropbox, Google Drive, etc.

On Android, using the **SHARE** Tab on the main menu in a scan/scene you have the options to select **Last Screenshot**, **All Screenshots**, **DP File** and **To Infipoints DP**. For the first three you will have the choice of how to send the file. For the last you will have export options.

On Windows, the **SHARE** tab will allow you to export the data to Pointfuse for DP. To transfer the data off a Windows tablet we recommend using a USB stick.



Figure 188 - Share

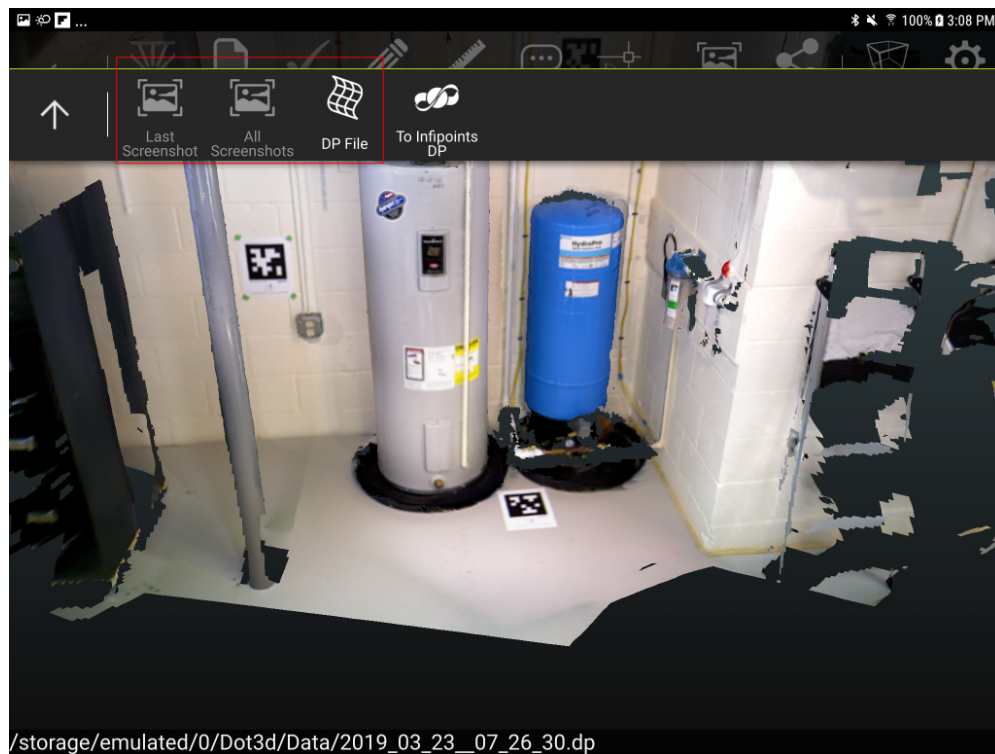


Figure 189 - Share Last Screenshot, All Screenshots, DP File

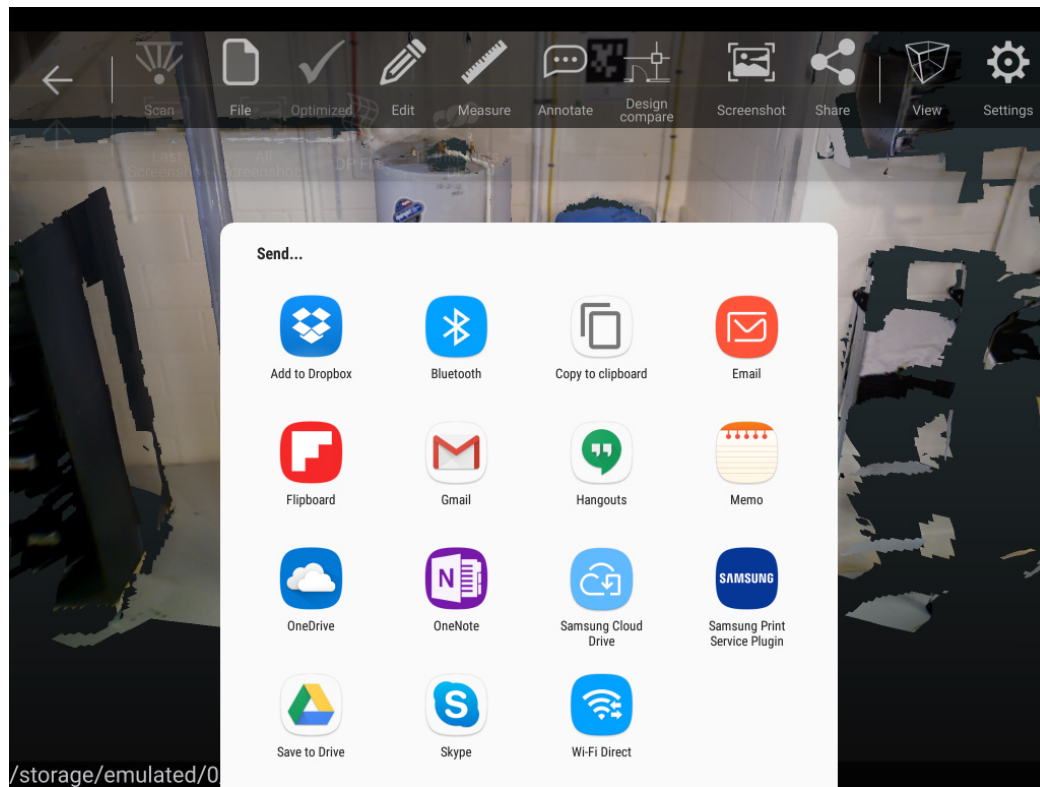


Figure 190 - Options to Send

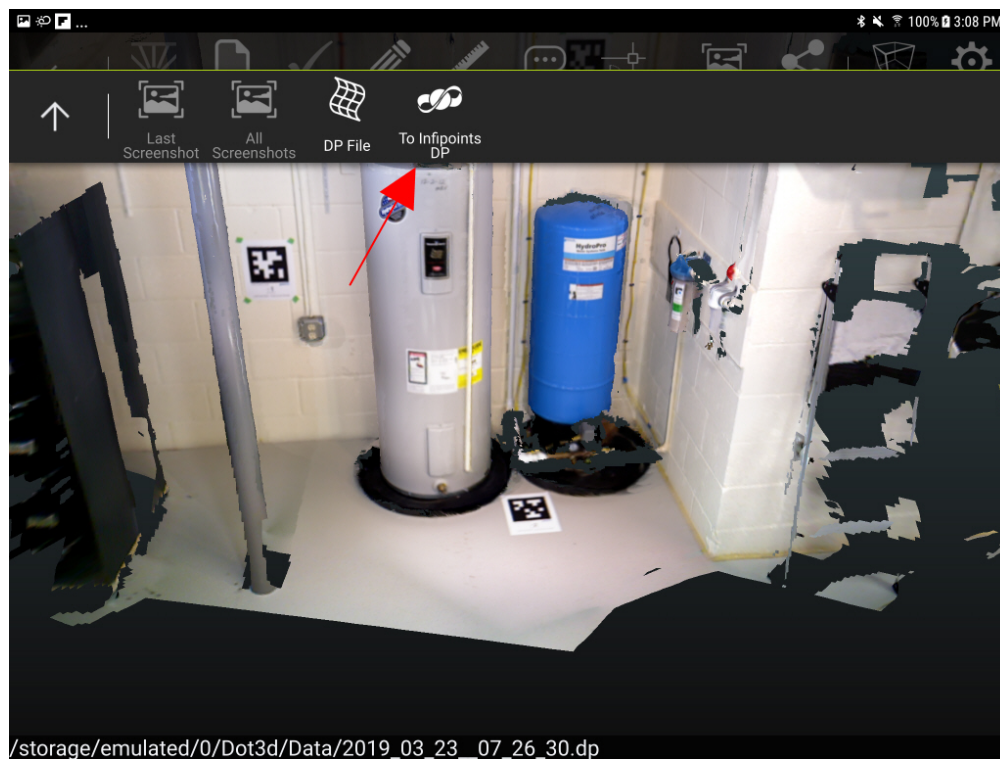


Figure 191 - Share to InfiPoints DP

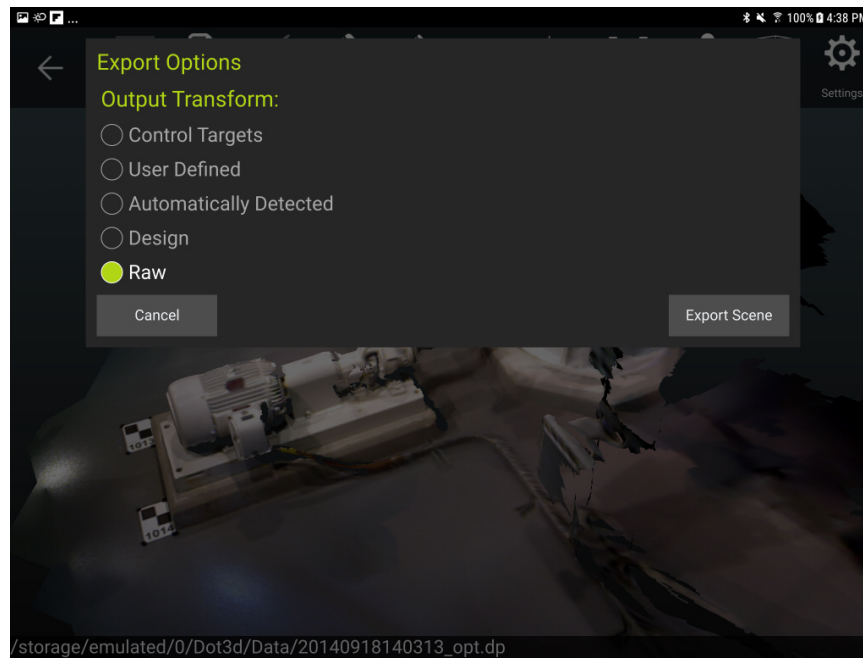


Figure 192 - Export Options to InfiPoints

ADDITIONAL FUNCTIONS

Elysium InfiPoints DP

.DP files will import directly into InfiPoints DP on Android tablets, from Phi.3D or Dot3D. This powerful workflow will export CAD surfaces and cylinders in IGES or DWG format, all on DPI tablet.

.DP files will also import directly into the full-function version of InfiPoints. This Windows application is a complete solution for point cloud processing, registration, CAD modeling, and more.



Figure 193 - InfiPoints DP

WORKFLOWS

Autodesk Workflow

.DP files will now import directly into Autodesk ReCap version 3.1 or higher (no plugin required). To maintain the density of your scans, it is recommended you bring the decimation down to 0 in the "Advanced" tab before importing your data.

Within ReCap, you can crop, measure, annotate, and more. With the release of 3.1, you are also able to manually register DotProduct data with traditional tripod scan data during import.

ReCap is your portal into the entire Autodesk suite of products. Export .RCS or .RCP files to import directly into AutoCAD, Revit, Navisworks, Inventor, and more. It is also recommended that you dial down the point cloud decimation during export. RCS files can also now be exported directly from Dot3D Edit or Pro on Windows.

Bentley Microstation and Pointools

Dot3D Pro or Edit on Windows will export POD files for use in MicroStation-based applications.

ClearEdge3D EdgeWise

EdgeWise 5.0 and up will now read .DP data directly, allowing users to utilize its advanced modeling and feature extraction tools without the need for PTS/PTX export.

Tutorial: <https://vimeo.com/183361689>

CloudCompare

CloudCompare now both reads and writes DotProduct .DP files directly with v2.6.3 and up. CloudCompare is an open source 3D point cloud and mesh processing software and is available at the link below. Documentation is at the link marked documentation.

Program: <http://www.danielgm.net/cc/>

Documentation: <http://www.danielgm.net/cc/doc/qCC/>

Tutorial: <https://vimeo.com/169150574>

Leica Cyclone

With the release of Leica Cyclone v9.1.4 we are glad to see improved functionality for registration with DotProduct point clouds. Users can now choose between target-based registration or visual registration with .DP data.

Tutorial: <https://www.youtube.com/watch?v=DQ2TNUfha28&feature=youtu.be>

AVEVA LFM Software

LFM can read .DP files directly in Gateway Mode and convert them for design review, clash and validation applications. LFM is a powerful point cloud tool, as well as the portal for other AVEVA workflows. Pre-aligned scans can be added to Register Groups directly. Unregistered scans with targets can be id'd in a 3D window. DP scans are processed with other scans in a LFM Project into a Server dataset for application use. Within LFM Server DP scan data is viewed in a static 3D view, or as a Solid Point Cloud.

The current release is available at the Program link below and help is provided with the LFM installer

Website: https://www.aveva.com/en/Solutions/Laser_Solutions/

Program: <https://www.lfmsoftware.com/solutions/products/downloads/>

Documentation: (provided with installer)

Evaluation: <https://sw.aveva.com/campaigns/aveva-trusted-living-point-cloud/evaluate-aveva-lfm>

Trimble RealWorks

Trimble RealWorks V9.0 supports import of binary .DP files. If you wish to export your data to older versions of Trimble RealWorks, then select PTS with the Commas option. Note that the comma delimited files will be larger than the corresponding space delimited file.

Veesus Ltd.

Veesus's Arena4D Data Studio V1.19 and Rhino plugin v1.2 support the import of binary.DP files.

Pointfuse

Pointfuse can read .DP files directly. Pointfuse is an excellent solution for automatic creation of lightweight, colorized vector geometry out of DotProduct .DP scan data. Pointfuse for DP is a special version just for DP data that can instantly convert DP point clouds into colorized 3D vector models. Export options from Pointfuse include DAE, DXF, FBX, IFC, SKP, STL, OBJ, X3D, and NWC.

A Free Trial of the current release is available at the Program link below, just select the FREE TRIAL icon. Help is available at the Tutorial link.

Website: <https://pointfuse.com/>

Program: <https://pointfuse.com/> (select free trial)

Tutorial: <https://vimeo.com/195875903>

Bloom Cloud Engine

Bloom Cloud Engine can read .DP files directly. DP point clouds can be cloud aligned with other point cloud data from tripod to airborne, or even aligned to 2D and 3D CAD geometry. BloomCE can also edit, align and best-fit DP point cloud data to planes and cylinders. BloomCE can publish to a file or cloud based portal for sharing and collaboration.

The current release is available at the Program link below and help is at the Documentation link.

Website: <https://bloomce.com/#/>

Program: http://bloomce_assets.s3.amazonaws.com/HelpNDoc/LatestRelease.html

Documentation: http://bloomce_assets.s3.amazonaws.com/HelpNDoc/helpPage.html

Z+F LaserControl

The Z+F SCANNER® 5016 and 5010X support direct communication with the DPI Kits in the field via WiFi. With Z+F LaserControl® Scout, you can wirelessly download the data from DPI and 5016/5010X scanners to register the scans live in the field. DotProduct .DP data will also import into Z+F LaserControl® for registration with tripod scans.

Tutorial: <https://vimeo.com/200419542>

For software workflows with many other products please see the DotProduct website at <https://www.dotproduct3d.com/workflows.html>.

SOFTWARE UPGRADES

Background

DotProduct upgrades DOT3D from time to time. To upgrade your DPI Kit, you will need to install a new application file on the tablet. The new application file will be named Dot3D-x.apk where x identifies the release number. The most recent application file can be downloaded from www.dotproduct3d.com/dot3ddownload.html. If your DPI tablet is connected to the internet you can go to the **SETTINGS** Tab, select **About** and then you can select **Check for Updates**. This will bring you to the link above so you can download if it is an updated version of DOT3D. If your tablet is connected to the internet and there is an Update available, you will see an **UPDATE** Tab on the home page that will also bring you to this link. The file will go to your “Download” folder which can be accessed through **My Files**. You can also see the file in “Recent files” when you first open **My Files**.

In rare cases you will need to uninstall the old Dot3D application before you can install the upgrade release. Do not uninstall the existing version unless you are having trouble installing the upgrade. Uninstalling will require you to load some application settings, such as the calibration file.

Upgrade Procedure (short)

1. Download or Install the Dot3D-x.apk file in the Download directory of the tablet.
2. Open My Files/Download or Recent files and tap the Dot3D-x.apk file.



Figure 194 - My Files

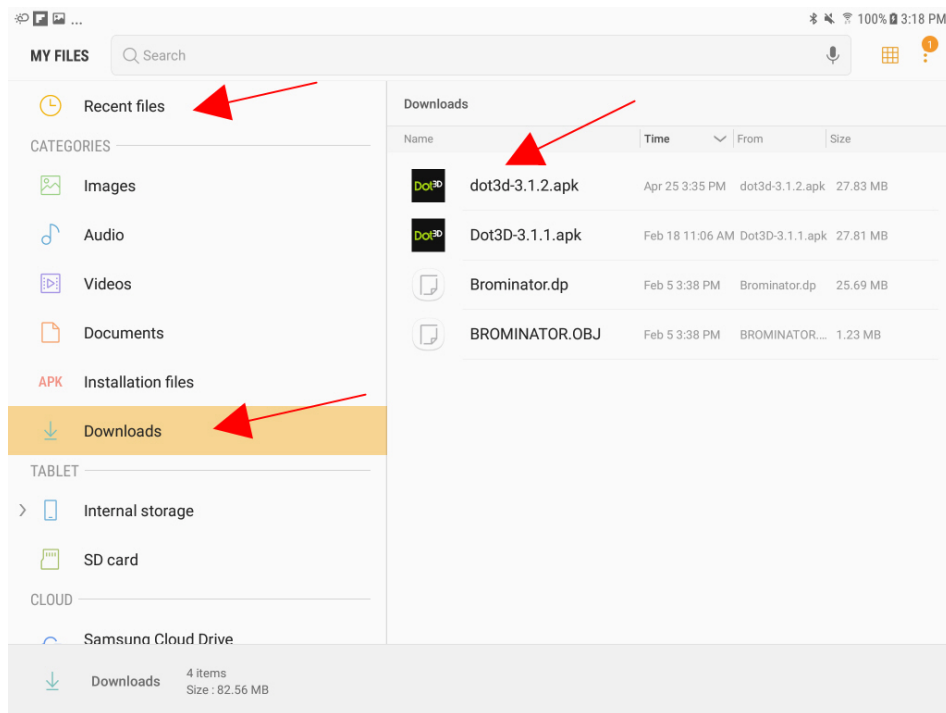


Figure 195 - Install Dot3D

In rare cases you will need to uninstall the old Dot3D application before you can install the upgrade release. See the Upgrade Procedure (long) in the section below.

Upgrade Procedure (long)

Follow these steps if you are prompted to uninstall the old release of Dot3D before installing the upgrade.

1. Uninstall the current version of Dot3D.
 - a. Power on the tablet and select the Google Apps button.



Figure 196 - Apps

- b. Select Settings then select Apps, then select Dot3D.



Figure 197 - Tablet Settings

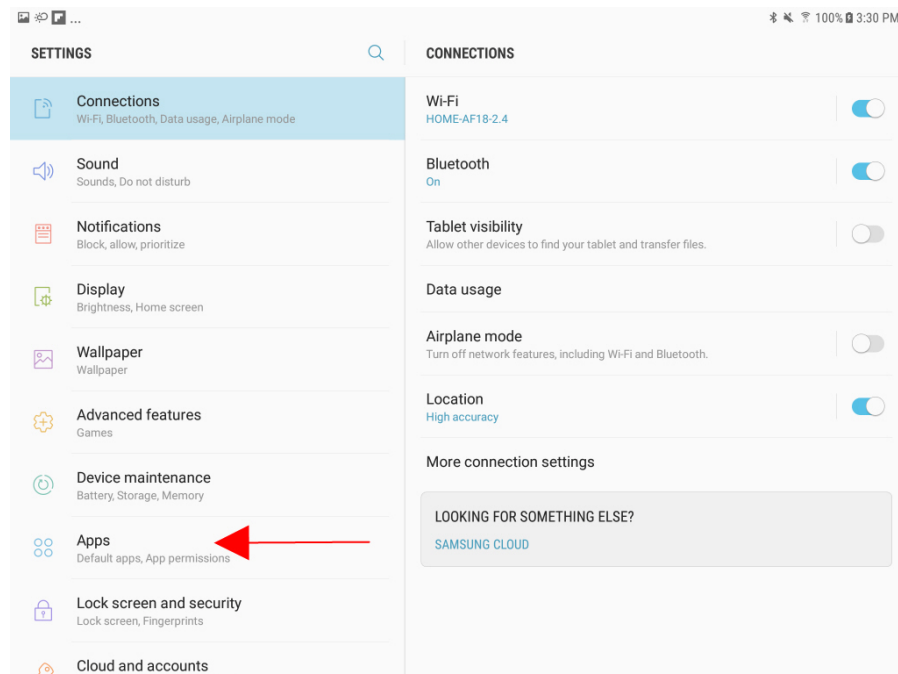


Figure 198 - Tablet Apps

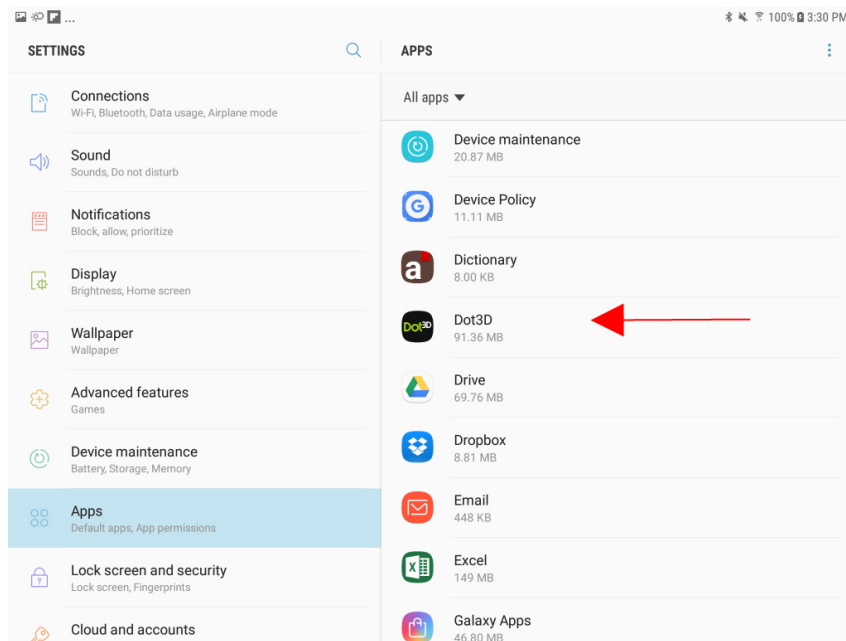


Figure 199 - Dot3D App

- c. Select Uninstall and select OK when asked to uninstall the App.

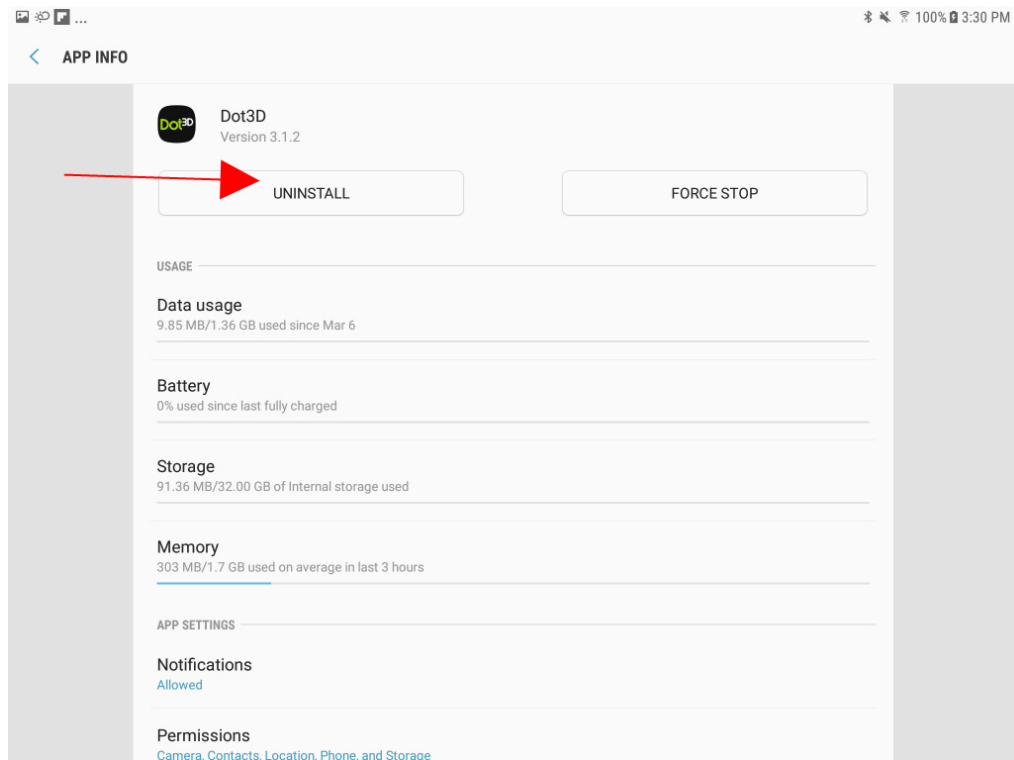


Figure 200 - Uninstall Dot3D

Load the Dot3D-x.apk file in the root directory of the tablet. This is accomplished by connecting the tablet to WiFi and downloading or connecting to the laptop or PC where you downloaded the Dot3D-x.apk file. The tablet will look just like any other USB drive. Copy the Dot3D-x.apk file to the root directory (“Internal Storage”) of the tablet or a subdirectory where you can find it later. The root directory (“Internal Storage”) will also contain a calibration file with .cal file extension. shows a Samsung tablet **My Files** where the files are stored.

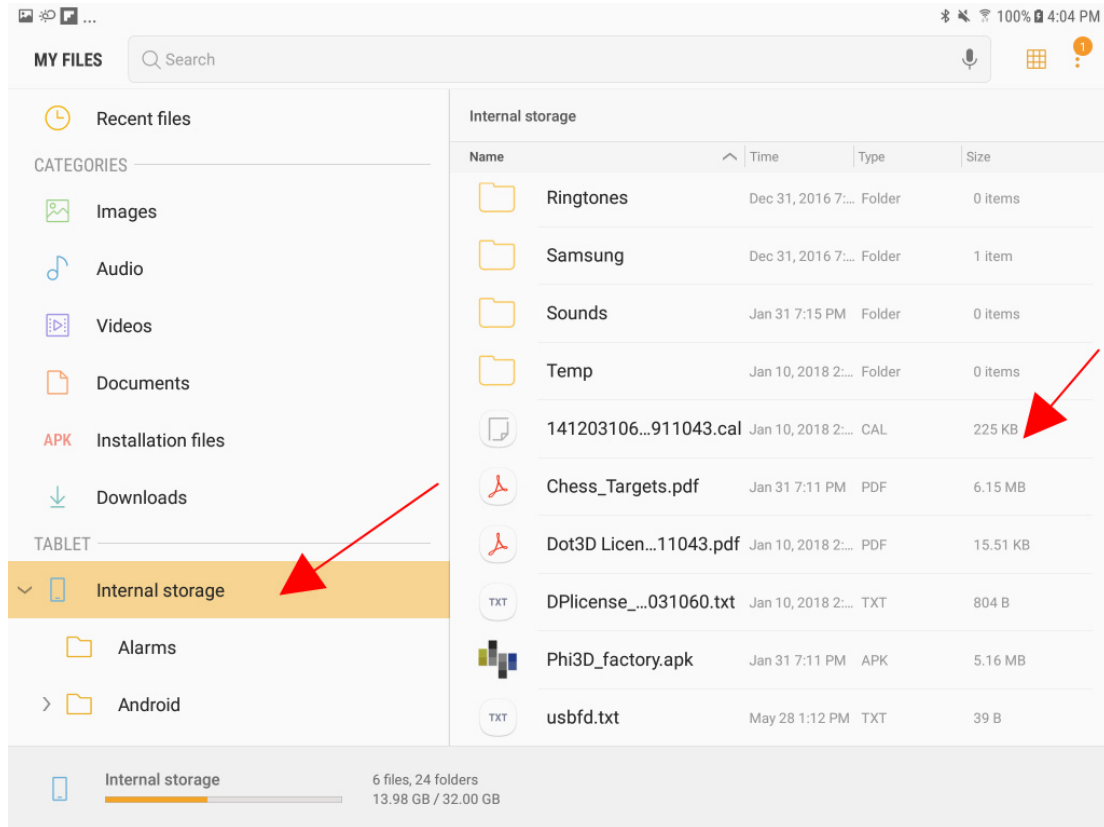


Figure 201 - Internal Storage, Calibration File

Open **My Files** on the tablet. “Recent files” will have the new Dot3D-x.apk or you can find it under “Download Files”. Tap the Dot3D-x.apk file to start the installation. Note that the Dot3D-x.apk file needs to be located either in the root directory on the tablet or in another directory previously created. In this case it is saved in the Download folder.

2. Reload the calibration file by opening Dot3D from the Apps screen on the tablet. Then select the **SETTINGS** tab and select **3D Sensor Settings – Calibration Data**. See “Starting the Software” above.

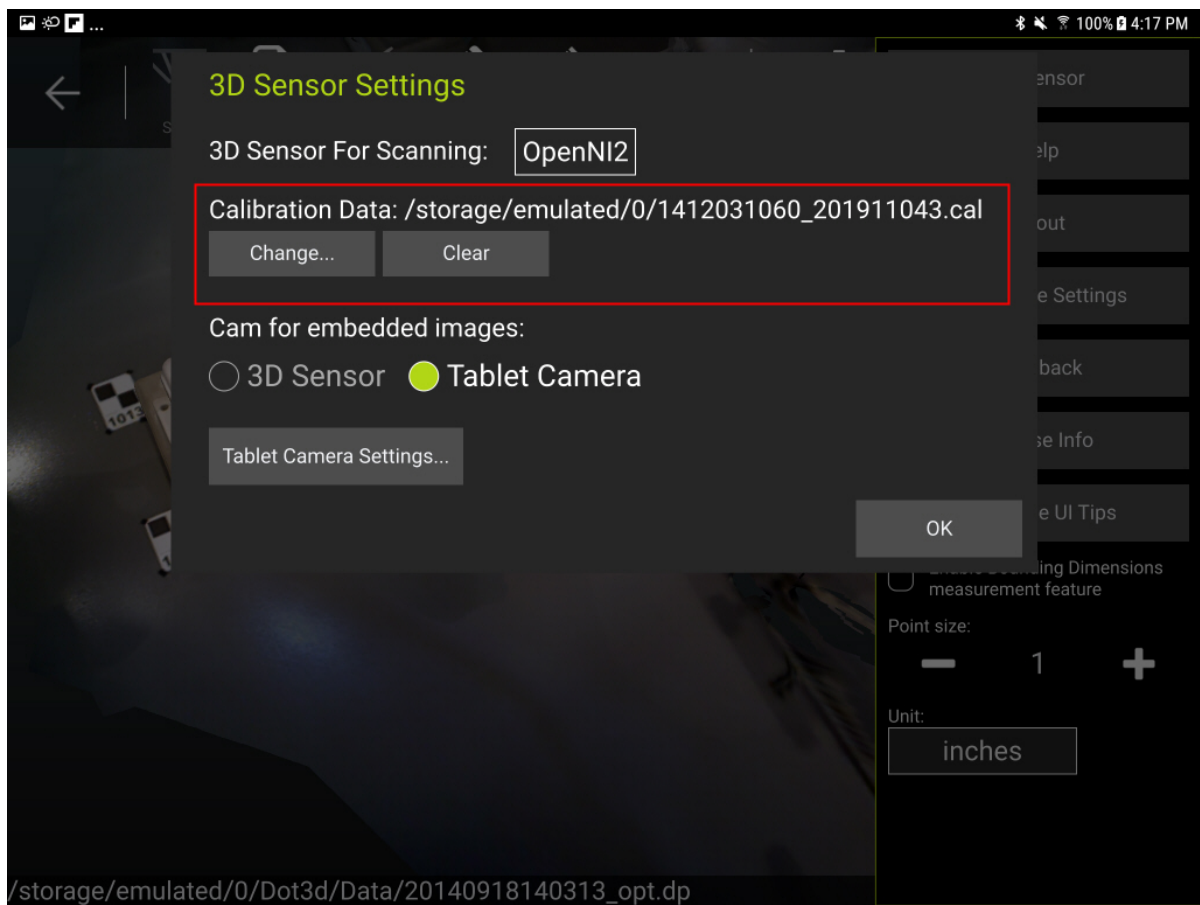


Figure 202 - Calibration Data

TIPS AND TRICKS

Configuration Back-Up

Make a backup copy of your calibration file in the event of hardware failure. You can always source a replacement tablet should there be a problem.

Start-Up

Before you get started make sure there is a proper calibration file loaded. If not, it will affect your results. You can easily check or correct this by going to SETTINGS and choosing the right calibration file for the unit. This must be done prior to starting to capture data. Customers should use the X_Y.cal. X represents the sensor manufacturer serial number and Y represents the DotProduct sensor serial number. Contact support@dotproduct3d.com if your file is missing.

Scene Path

When you begin scanning, remember to consider the following when choosing your starting point:

- Have good geometric features such as intersecting planes and objects (as indicated by the "Scene Fitness" bar.)

-
- If traversing an object, start at the logical beginning and the end of a closed path.
 - Begin at point you can come back to if you think you will need to pause.

Scene Consideration

Make sure there aren't gaps in the scene such as large spaces between vessels otherwise the system may lose tracking. Add a feature to the scene such as a trash can or chair to bridge the gap. Capturing floors, ceilings and walls can be very problematic if they are monochromatic or reflective. Tracking depends on stable geometric and photometric features in the scene. You can improve results by panning along the floor/wall or wall ceiling edge. Adding targets will also allow better tracking. This is particularly important when the runs are long, for example a long piping run, and the tracking features are few.

Scene Surface Consideration

If possible, transparent or semi-transparent surfaces should be covered before scanning. The reason is that the infrared pattern from the sensor could get distorted when it goes through glass or similar materials, resulting in non-accurate readings. If possible, also cover wide-area reflective surfaces. Small chrome handles etc. are perfectly fine but large mirrors etc. could be a problem.

Imaging Technique

When imaging an area of interest, it is recommended to traverse the area initially with goal of capturing as little detail as possible. If higher detail is needed on a particular spot, or if capture of a hidden or shadowed area is needed, do an initial traverse first without details, then going back to the particular areas of interest to fill in the details. This may also be separated into several capture sessions using the append feature.

Scanner Handling

Keeping the scanner orthogonal i.e. normal to the main surface has a positive effect on accuracy. Scanning at an angle against surfaces usually results in reduced accuracy caused by sensor distortion. Holding the DPI Kit as orthogonally as possible will help with overall result quality.

Measurement Accuracy versus Tracking Stability

Getting close to objects in the scene generally leads to more accurate data but at an increased risk of tracking loss, depending on the amount of surface geometry and texture of the captured object. Getting far away generally includes more features and textures into the field of view and hence leads to more stable tracking but it can introduce distortions when the scanning range exceeds 2 m. Therefore, users should always get as close as possible to get accurate results but as far away as necessary to guarantee stable tracking.

Image File Size

DP files are highly compressed. A size of 30 MB or more is considered large. When DP files are loaded into memory, the space requirement increases 25 fold; *10 MB of DP file expand to about 250 MB of memory allocated internally for all the data.* Targeting

Target picks should be on close objects / surfaces and the picked targets should face straight towards the viewpoint. Avoid picking targets at the borders of a target frame. These recommendations will improve accuracy of the target pick. Picking targets that are far away, at high angles, or at the very borders of a target frame, will result in less than optimal results.

One physical target (as declared in the control file) may be associated to detections in any number of image frames, however at most one target per target frame may be associated.

Target RMS value can be improved by user-associating a broad range of targets (going well beyond the 3 required ones) and also associating targets that are physically well distributed in the scene (as opposed to associating for example 3 targets that are physically close together in a large scene).

After obtaining a target transformation through pressing the "Fit All Targets" button, it is recommended for the user to check for mis-associated targets. This is because while obtaining the target transformation the system tries to automatically associate control targets with target detections, and hence it is recommended for the user to double-check if the automatic association was successful. A failed automatic association typically shows up as purple circles that are far off center of the green circles in the frame view (See section about Targeting in this manual for more details).

Pressing the "Fit All Targets" button again, once mis-associated targets have been checked and possibly corrected, typically improves the target fit.

Accuracy

- Bumping or dropping the system **is very likely to** impact the sensor calibration and system accuracy. So treat your instrument with care. We **strongly** recommend storing the device in the rugged case it is provided with when it is not being used, and particularly when being transported.
- Drift errors are possible due to the natural operating principles of a mobile 3D capturing device. The use of targeting in the scene will reduce or entirely get rid of drift. For best results assign targets and do 'fit targets' before you post-process the data.
- During scanning the color feedback can be helpful in determining the capture precision of the surface. Green is very good and yellow is usually acceptable but avoid pale or grey areas if you need high precision on these spots.
- Allow the device to warm-up for full time (dependent on disconnect time) for best results.

File Management

Append characters (i.e. "_O") to the DP file name to indicate its updated status.

- Optimize O
- Target T
- Coordinate System C

All work on the DP scanner is automatically saved to folder Dot3D/Data. If you forget to export to a new name, you can use the FILE Load Scene function to review previously autosaved files, then reload and save.