RC11265-L

ReCap 360 – Advanced Workflows

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Learning Objectives

- Learn how to use ReCap 360 Ultimate's automatic registration features

- Discover best practices for common workflows like point cleanup, optimization, and presentation.

- Learn how to effectively use ReCap 360's advanced measurement tools

- Discover end-to-end, cloud-enabled collaboration workflows enabled by ReCap 360

Description

Since its first release in April 2015, Autodesk ReCap 360 and ReCap 360 Ultimate have represented a massive leap forward in capability for power users. This session will detail these capabilities, focusing the highest-impact features, including Automatic Registration, Advanced Measurement, Noise Cleanup, and Video Tools. The presenter will walk you through common workflows for these tools, using real-world data. You will be able to use the tools yourself with direct guidance from the Presenting Team. Finally, bring your questions for ReCap's engineering team.

Your AU Expert

Ryan Frenz is the Senior Software Development Manager for Autodesk's ReCap Product Group. In this role he oversees the day-to-day engineering effort for the ReCap 360 software product line, including user experience, software development, and quality assurance. Ryan has over 11 years of experience building software products for the Reality Computing industry. He is an accomplished software architect and possesses in-depth knowledge of the processes, workflows, and goals of the Reality Capture industry.

Introduction

The goal of this lab is to understand the major workflows enabled by ReCap 360 and practice the tools that are useful for them. Reality Capture workflows generally fall into three main categories:

1. ***Preparation*** – preparing the Reality Capture data for consumption by another user or system.
2. ***Interrogation*** – consumption of the data for analysis or to inform other work processes.
3. ***Collaboration*** – using the data as a basis for project/process coordination and communication.

ReCap 360 not only enables modern workflows in each category, but can also serve as a platform or hub for workflows from each category to co-exist on a project.

This lab will explain specific workflows and demonstrate the related tools in-depth. We will also touch on how the specific tools could apply to other workflows.

Preparation Workflows

All successful Reality Computing workflows depend on a clean, correct data set. In fact, this is ReCap's fundamental use case – creating a visually-useful, high-performing point cloud for use in other Autodesk products (e.g. AutoCAD). As ReCap has evolved, this case has been enhanced even further. The following sections will detail the tools available in ReCap, ReCap 360, and ReCap 360 Ultimate for data preparation.

Registration & Coordinate Systems
Raw laser scans require some processing before they can be consolidated into a single 3D representation. The term 'registration' describes the process of orienting each scan with the others in the data set (that is, onto a common coordinate system). Once registered, users may also wish to align the consolidated data set onto some other system, e.g. a geographic coordinate system or coordinates from an existing survey of a structure.

ReCap 360 Ultimate provides fast, intuitive tools for the above, including Automatic Registration and Survey Alignment via known points.

Automatic Registration
ReCap's scan registration engine works by matching features between a scan and a group of already-registered scans. This matching is helped by a rough estimate of the new scan's position and orientation in the group. Initial releases of the registration tool (2015, then known as 'ReCap Pro') required that the user give this estimate (by clicking three pairs of common points).
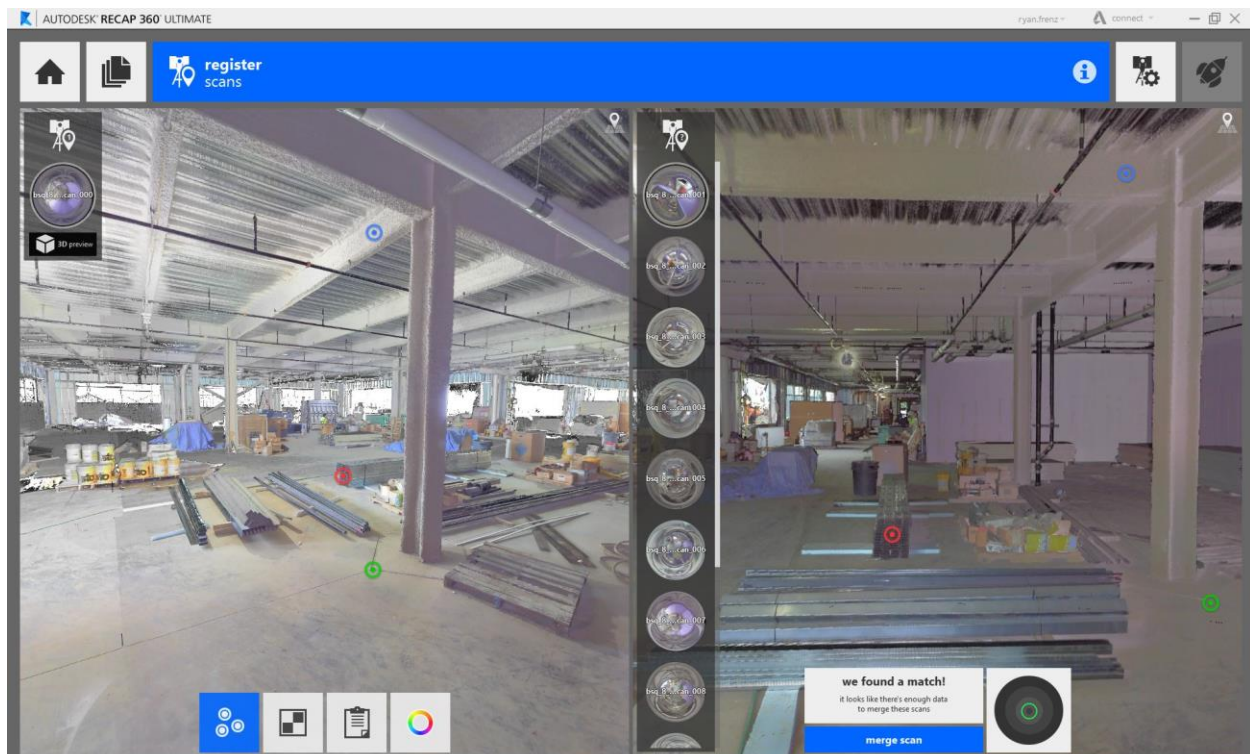

FIGURE 1: REGISTRATION VIA USER-PROVIDED ESTIMATE

For the 2016 release (now called ReCap 360 Ultimate), this mechanism was vastly improved to longer require this manual input in most cases. This improvement results in two nice features:

-    If the new scan has overlap with the loaded scan on the left, the engine can automatically search for and detect the estimate and show it to the user. We call this '**Auto-Suggestion**'.

To use the Auto-Suggestion feature, simply load a pair of scans in each pane which visually overlap. Each time the loaded pair is changed, the auto-suggestion will reset (it runs in the background).
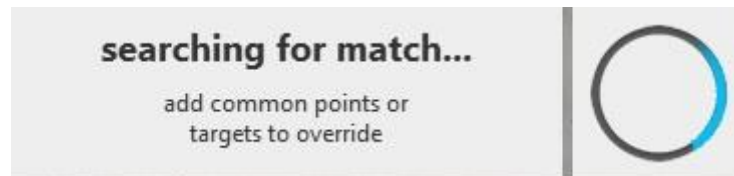

FIGURE 2: SUGGESTION SEARCH IN PROGRESS

After a few seconds, you should see the indicator on the right show you the automated result.
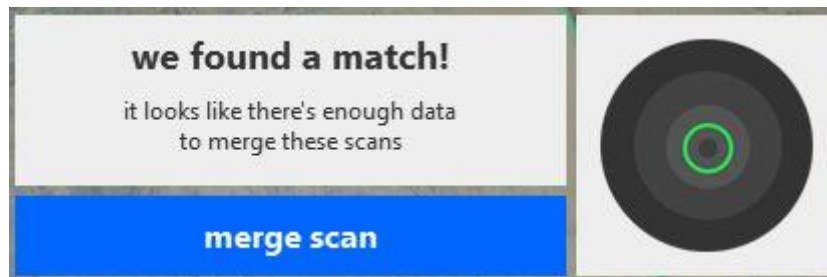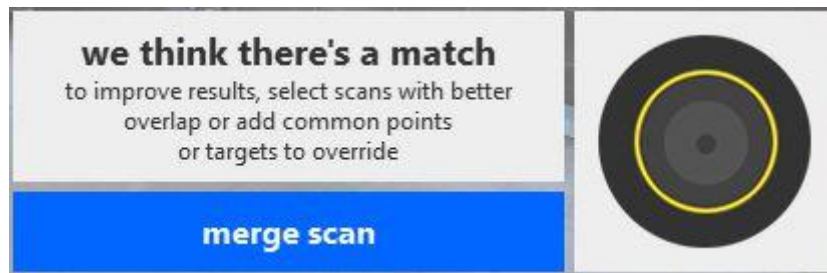

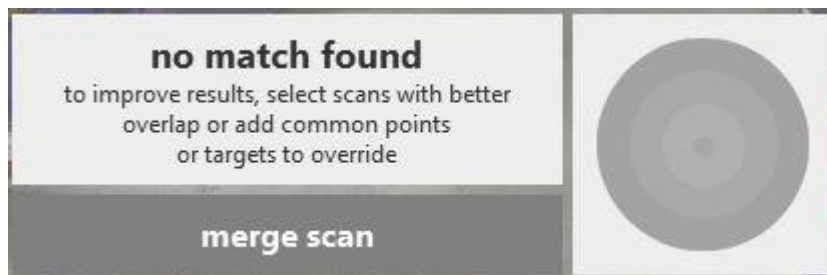FIGURE 3: GOOD SUGGESTION RESULT

FIGURE 4: OK SUGGESTION RESULT

FIGURE 5: SUGGESTED MATCH NOT FOUND

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To check the suggestion, place your mouse anywhere in the suggestion widget. A top-down image will display showing the new scan overlaid on the registered group.
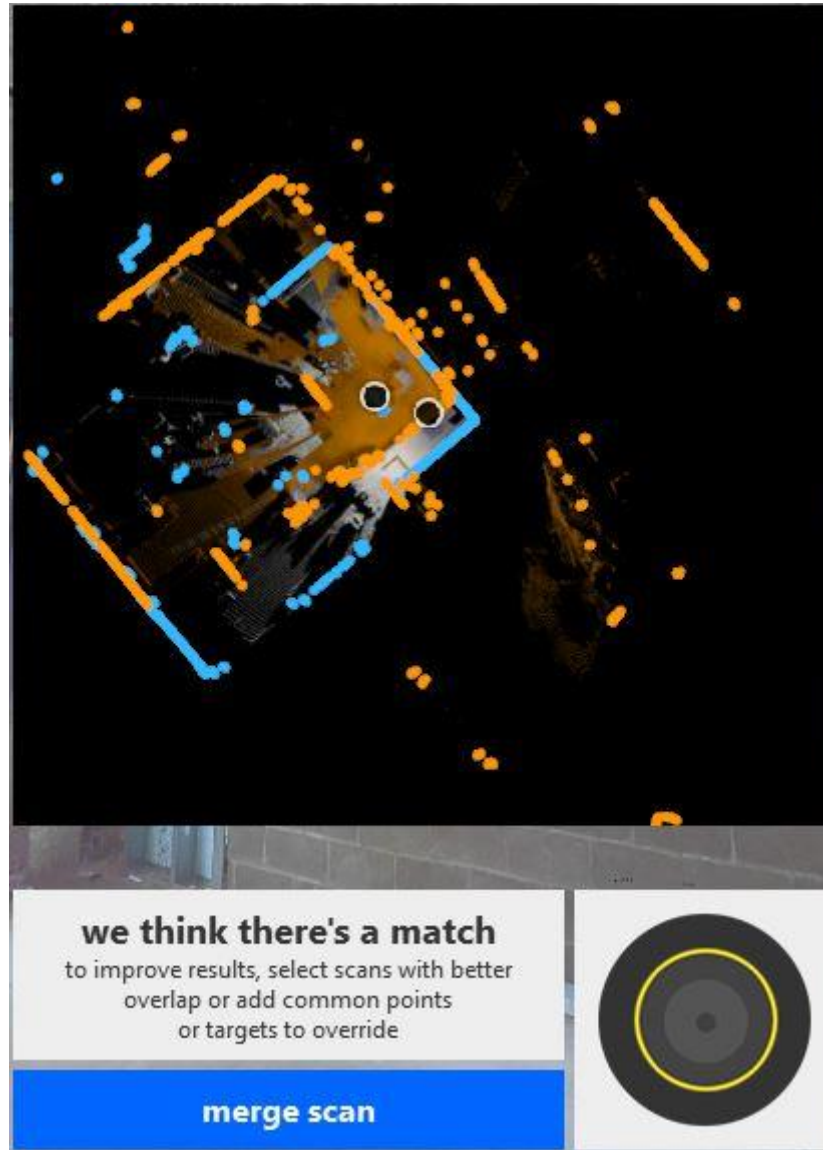

FIGURE 6: SUGGESTION PREVIEW

To accept the suggestion, click 'merge scan'. The new scan will then be fully registered to the registered group on the left.

- Using the same logic, an entire set of unregistered scans can be searched up front, and all high-quality matches can be automatically accepted and their scans registered. This is what we call '**Automatic Registration**'. Automatic Registration runs from the Import screen, prior to entering the normal Registration UI. It performs a linear search of the input scans,

attempting to find matching features between each scan and the ones it has already seen. In many cases, this can result in a fully-registered dataset with no user input.

To start automatic registration, click 'register scans' from the main import screen.
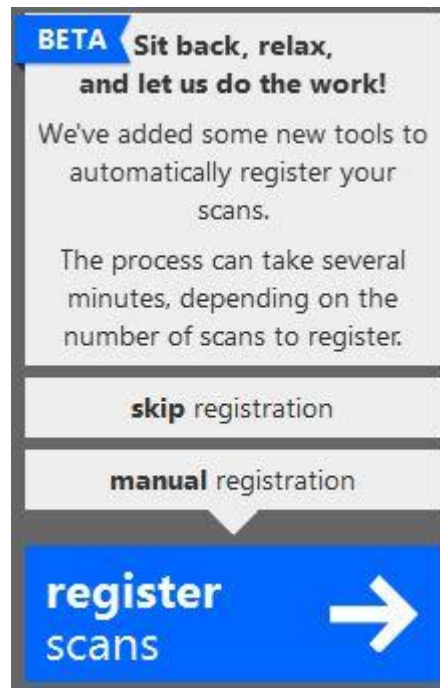

FIGURE 7: AUTOMATIC REGISTRATION BUTTON

Automatic registration can take some time for large projects and/or high resolution scans. A base group is created from the first scan. The subsequent scans are then checked against the registered group(s). If a match cannot be found, a new group is created. As a result, Automatic Registration can result in multiple registered scan groups (when matches can't be found to the same group for all scans).

While the process is running, an indicator is shown which displays the progress (Figure 8). The top row of text shows the number of scans analyzed and the number of new groups created. The large circular progress bar shows the overall progress as a percentage. The bottom row shows elapsed and estimated time.

When the process is complete, ReCap will transition to the Registration UI and show the results of the process (Figure 9). If a complete registration was not computed (that is, if multiple groups remain, or if some scans could not be matched), the usual manual registration tools can then be used to complete the project.
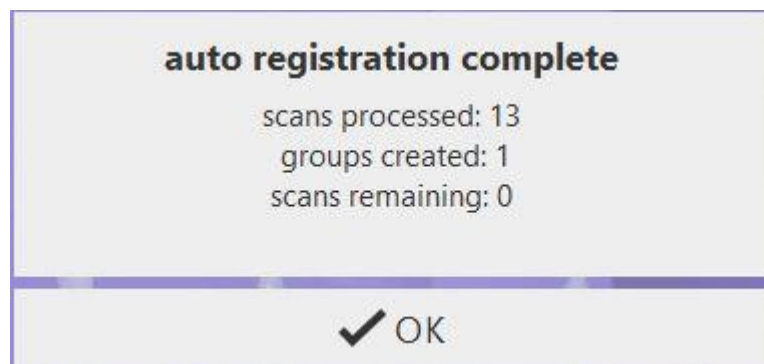
FIGURE 8: AUTOMATIC REGISTRATION PROGRESS

FIGURE 9: AUTOMATIC REGISTRATION COMPLETE

Survey Alignment

The registration tools described above place the scans on a coordinate system based on the first scan (i.e. a *relative* coordinate system). Many projects work in a coordinate system that means something to the project. This could be the coordinates of a plan or layout drawing, a building coordinate system, or a geospatial frame (e.g. a US State Plane). ReCap 360 Ultimate provides a simple tool for applying such a system to a registration project. The process works by identifying single points, checkerboard targets, or sphere targets for which you know the final coordinates. These identified points are referred to as '**Survey Points**'.

A Survey Point can be specified in a registered scan at any time during registration.

To specify a Survey Point:

1. **Select or verify the desired mode (single point, checkerboard target, or sphere target).**
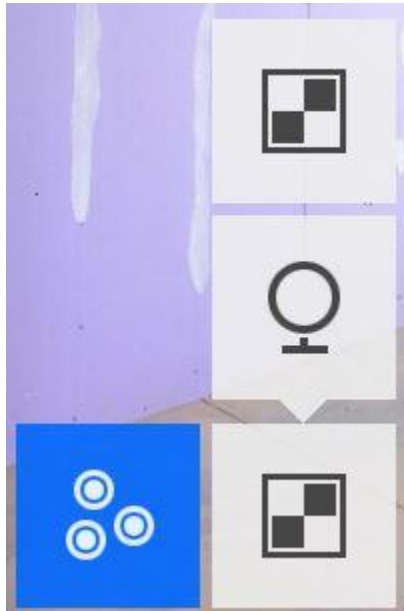

FIGURE 10: POINT MARKER TYPES

2. **Locate the desired point and click on it.** This will place a marker in the scene at the clicked point (or, at the center of the target for checkerboard or sphere targets). For target modes, a box will appear in which you can enter the point info.
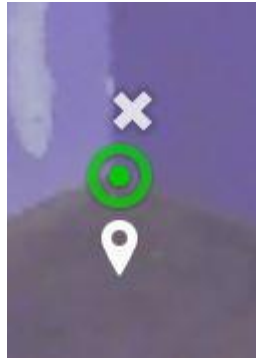
FIGURE 11: SINGLE POINT MARKER

3. **In single point mode, click the 'pin' icon below the marker.** A box will appear in which you can enter the point info.

FIGURE 12: POINT INFO BOX

4. **Click 'Make Survey Point' to enable Survey Point options.**
5. **Select the Survey Point's name from the drop down box, or enter a new name.** See below for instructions on importing known point names and positions.
6. **Confirm or enter the final coordinates for the point in the lower boxes.** *Note: coordinates must be specified in meters.*
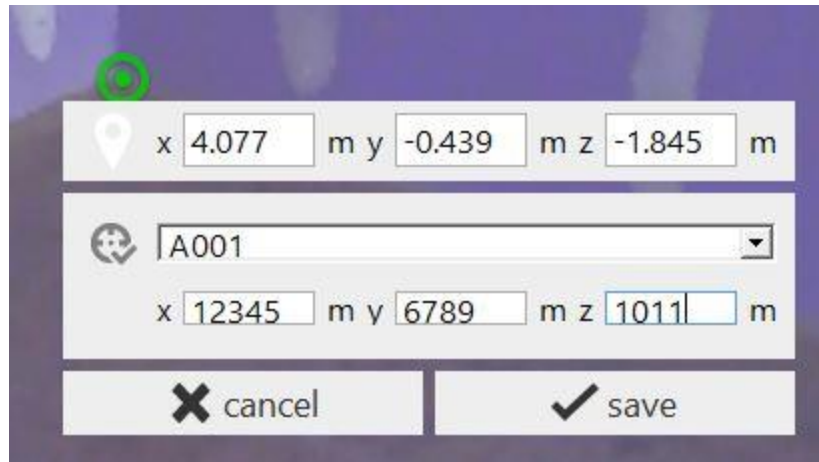7. **Click 'save' to set the point.**

FIGURE 13: SURVEY POINT INFO

You can also import a list of known marker names and coordinates by selecting one of the 'upload survey points' options from the drop-down box. ReCap will provide a dialog from which you can select a TXT file on your disk. This TXT file should contain a **space-delimited** list of points in the following format:

<name> <x position> <y position > <z position >

or

<name> <north position > <east position > <elevation position>

You can select the desired column format (XYZ or NEE) from the drop-down list. Once the file is read, the imported Survey Point names will appear in the drop-down list.

Once three or more points are added, ReCap will compute a best-fit alignment from the registration group to the final coordinates provided. The quality of this alignment is shown via an RMS value. This value can be inspected in two ways:

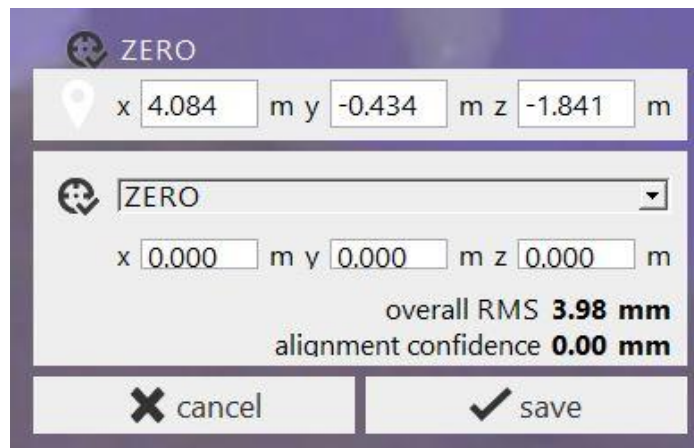1. **Click on the placed Survey Point to view its coordinates and RMS value.**

FIGURE 14: SURVEY POINT INFO AND RMS

2. **Hover or click on the Report tile (clipboard icon) at the bottom of the screen.**
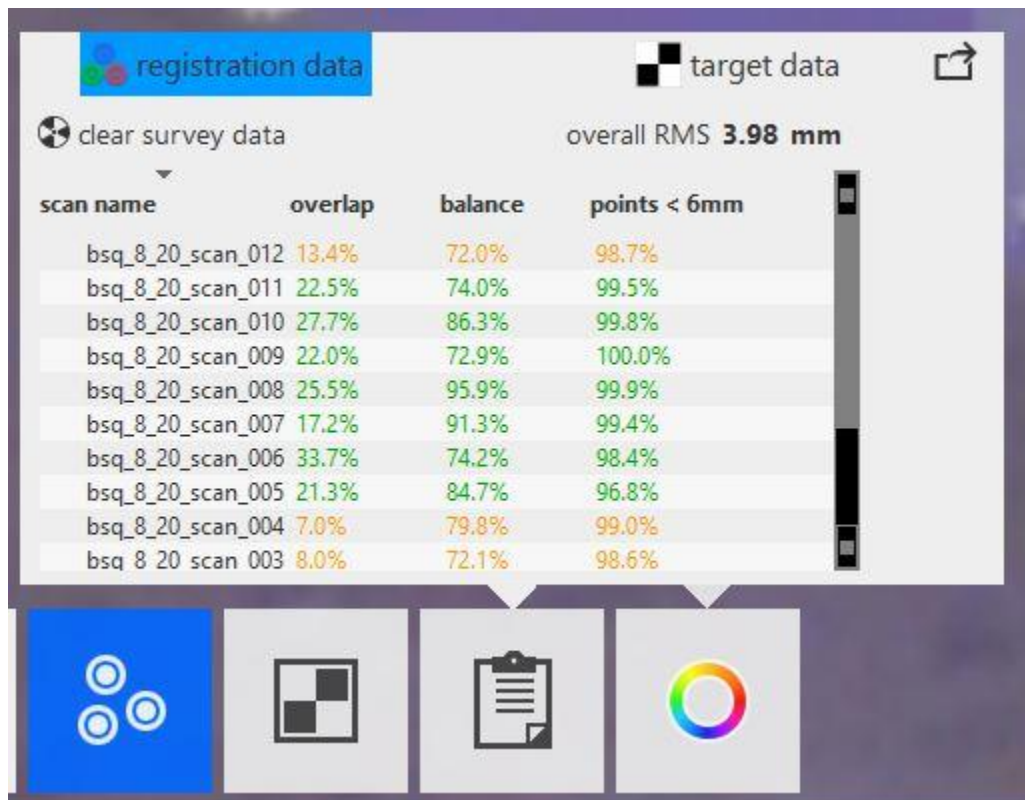

FIGURE 15: REGISTRATION REPORT AND SURVEY RMS

Editing Point Clouds

Editing of the point cloud is a critical and fundamental part of Preparation workflows. Editing operations consist of two steps:

1. **Select** a portion of the point cloud.
2. **Act** on the selection.

As of version 2.2 (Fall 2015), ReCap is also beginning to provide data services for streamlining common operations. This section will quickly outline the available tools for editing point clouds.

Selections

There are three tools for selecting portions of the point cloud:

1. **Window** – selects all available points within a defined screen rectangle
2. **Fence** – selects all available points within a closed screen polygon
3. **Plane** – selects all available points within a user-defined distance from a plane

The selection tools are available from the main tool menu at the bottom of the 3D view.
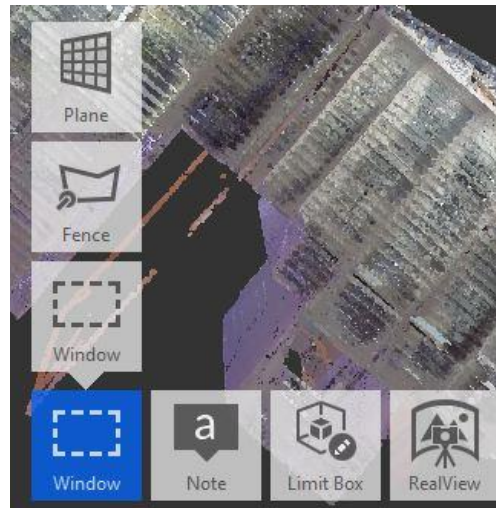
FIGURE 16: SELECTION MENU

To create a Window Selection:

1. **Select 'Window' from the Selection menu.**
2. **Click and hold the left mouse button at one corner of your desired Window.**
3. **Keep the left mouse button down and drag to define the Window.** A dotted line will be displayed to preview the Window.
4. **Release the mouse to finish the selection.**
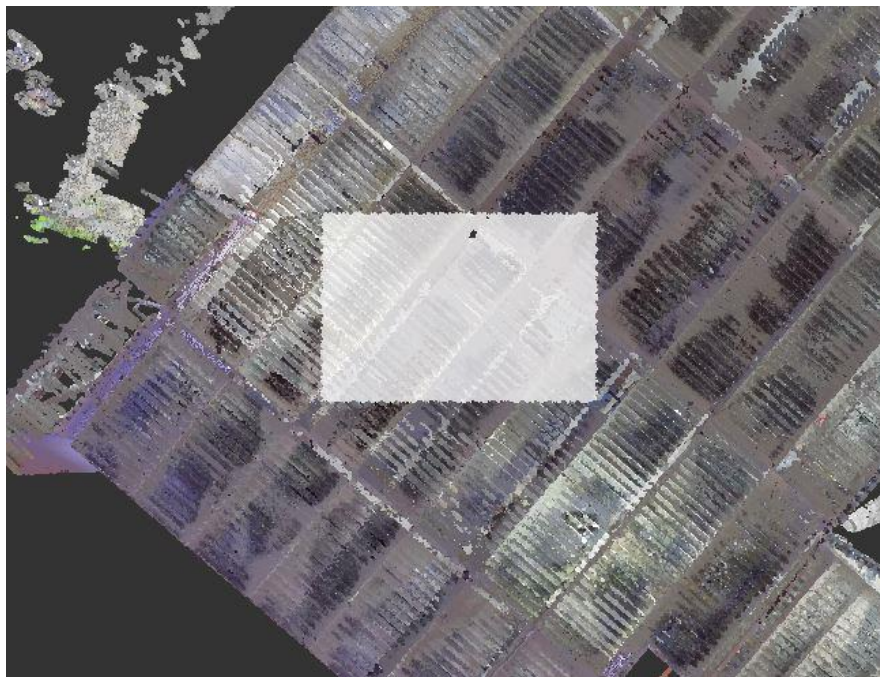
All available points in the Window will become selected.

FIGURE 17: WINDOW SELECTION

To create a Fence Selection:

1. **Select 'Fence' from the Selection menu.**
2. **Click on the screen to begin defining the Fence polygon.** A dotted line will be displayed to preview the Fence.
3. **To finish the selection, double-click the last point.**

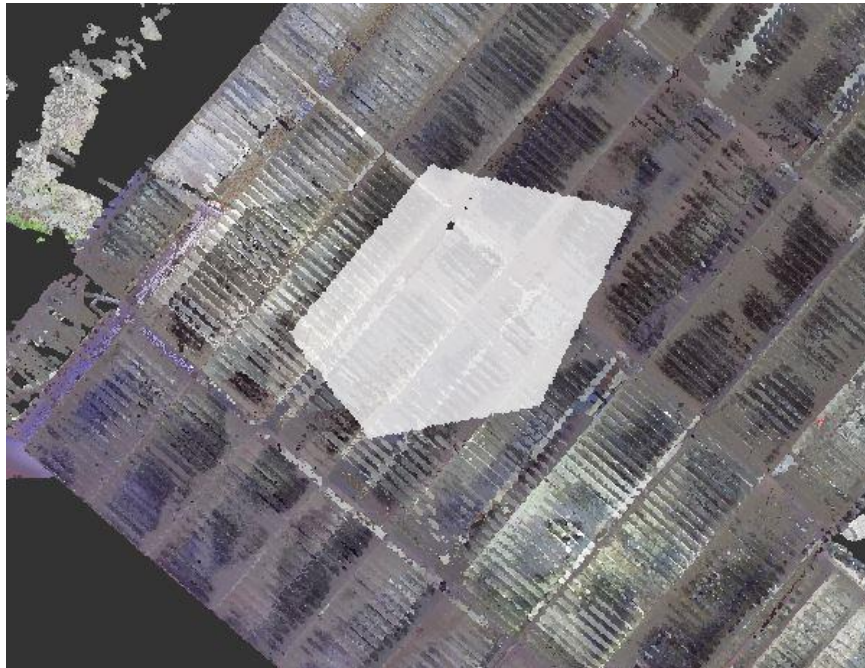All available points in the Fence will be selected.

FIGURE 18: FENCE SELECTION

To define a Plane Selection:

1. **Select 'Plane' from the Selection Menu.**
2. **Click points on the desired plane.** You must select at least 3 points from the point cloud. A yellow marker will be placed on each clicked point.
3. **Adjust the Plane Depth to the desired value.** This value defines the max distance a point can be from the plane to be included in the selection.

FIGURE 19: PLANE SELECTION TOOL

4. Press Enter to finish the selection.

A best-fit plane is computed from the clicked points, and all available points within the Plane Depth will be selected.
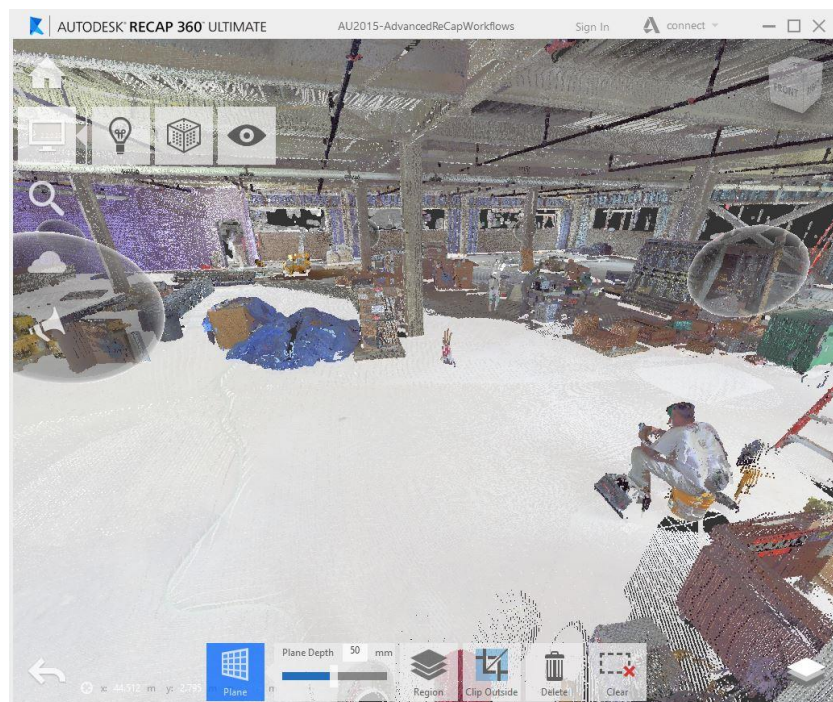

FIGURE 20: PLANE SELECTION

Once a selection is made, there are four actions which can be performed.

- **Modify** the selection by adding to or subtracting another selection from it.
- **Delete** the selected points.
- **Clip** the points inside or outside the selection.
- **Assign** the points inside the selection to a Region.

To modify a selection:

1. **Activate the desired selection tool.**
2. **Hold down the key corresponding to the desired modification:**
   o **SHIFT to add**
   o **ALT to subtract**
3. **Create the desired selection as described above.**

When the selection is complete, the result of the desired modification will be displayed.

FIGURE 21: RESULT OF SUBTRACTING TWO WINDOW SELECTIONS

To Delete the points in a selection, press the Delete key or click the Delete tile at the bottom of the screen.
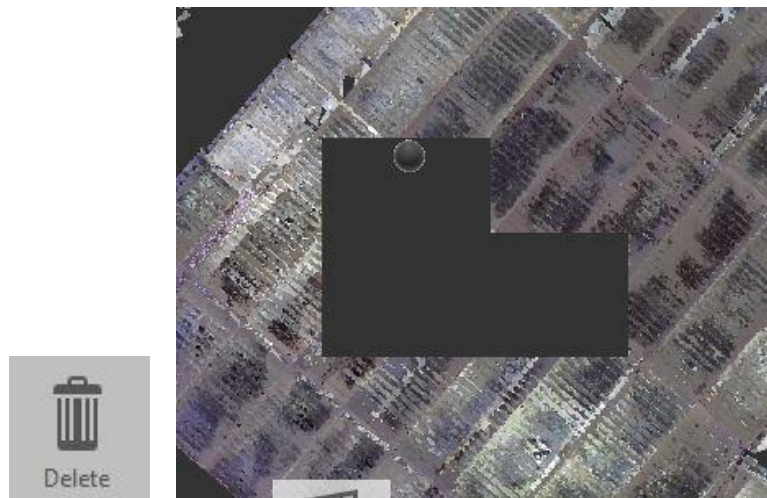
FIGURE 22: DELETING A SELECTION

To Clip the points inside or outside the selection, select the desired tile from the bottom menu.
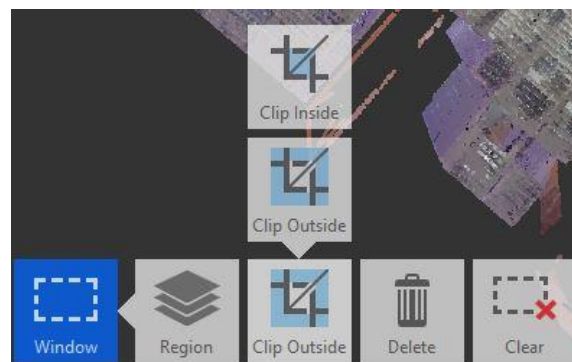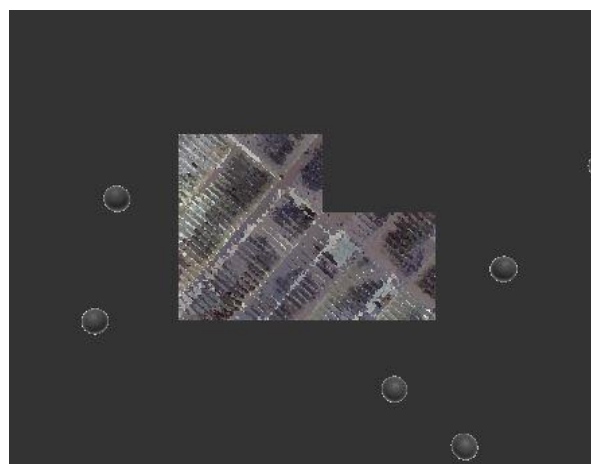

FIGURE 23: CLIP MENU

FIGURE 24: CLIP OUTSIDE OPERATION

To Assign the points in a selection to a Region:

1. **Hover on the 'Region' tile at the bottom of the screen.** A horizontal menu will appear showing all existing Regions and a button to create a New Region.
2. **Click the desired Region or 'New Region' to create a new region.**
3. **If creating a New Region, enter a name for the Region when prompted.**

Once assigned, the selected point will be displayed in the color assigned to the Region. See below for more info on working with Regions.
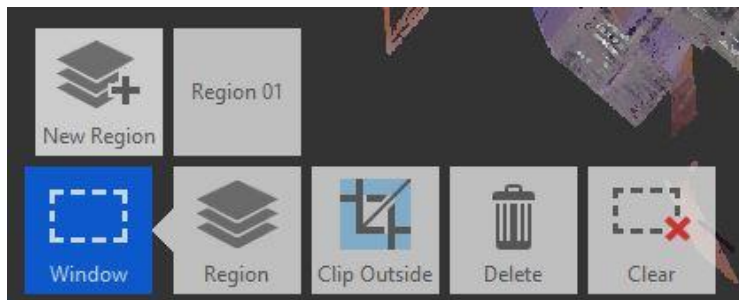

FIGURE 25: REGION MENU

FIGURE 26: POINTS ASSIGNED TO REGION

Regions

Once you have a good grasp on how to select and operate on data, the next step is to organize selections and operations in a meaningful way. ReCap provides this capability through a concept called 'Regions'. Regions are logical groups of points with associated settings or metadata. The following sections describes how to work with regions and what you can do with them.

Regions are accessible via the 'Project Navigator' widget. The Project Navigator can be accessed via the icon in the lower-right of the 3D view. Mouse over the icon to show the Navigator temporarily, or click the icon to maximize it.
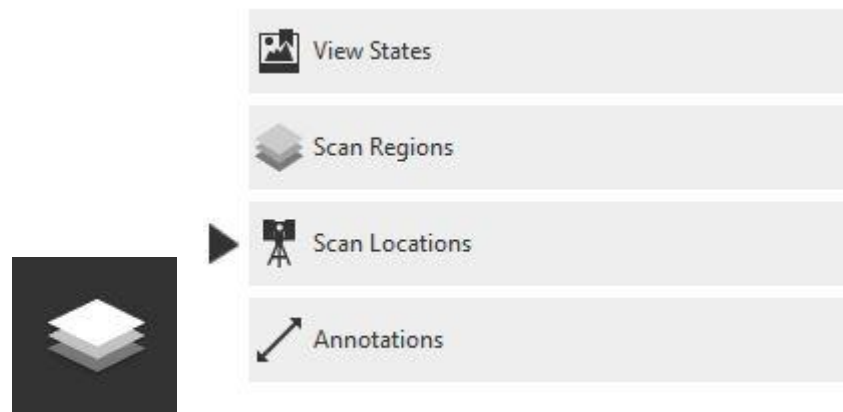
FIGURE 27: PROJECT NAVIGATOR

Regions are shown under the 'Scan Regions' heading. Regions can be created in two ways.

To create a new, empty Region, hover on the Scan Regions header and click the '+' icon. This will create a region with default name ('Region' + a unique number). You can also create a new region from any active selection (see previous section).

To rename a Region, double-click on its name and edit the text as desired. ReCap will warn if the new text has already been used for another Region name.

FIGURE 28: RENAMING A REGION

Regions can also be arranged into meaningful, named groups. This is useful for organizing points for different people/groups on a project, or otherwise managing your work.
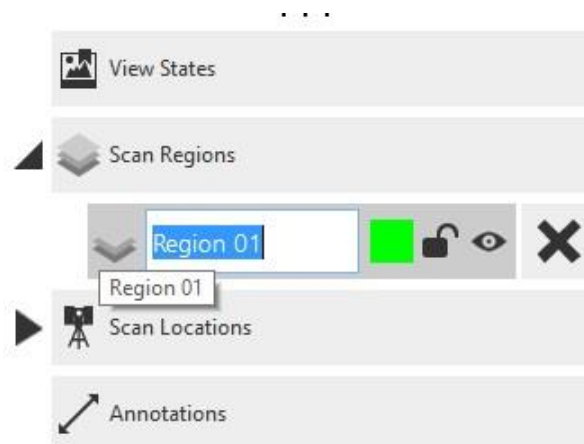
To create a Region Group, click on a region and drag it 'on top' of another. You will see a preview of the drag/drop operation as you perform it.
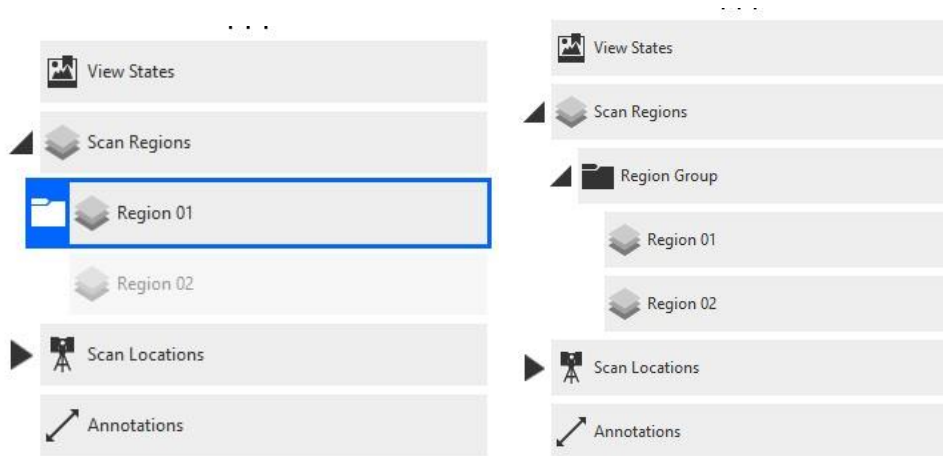
FIGURE 29: GROUPING REGIONS

Regions can be removed from groups in the same fashion.

Regions can contain any number of point selections, and allow the following operations:

- **Modify Color** – set the color to shade the points when the Region is highlighted
- **Lock/Unlock** – locking a Region causes it to never be included in subsequent selections
- **Show/Hide** – sets the visibility of points in this region
- **Delete/Unassign** – deletes the region, and, optionally, also removes the points inside it

To modify a Region's color, click on the colored square and select the desired color from the provided color wheel. The color can be set visually by clicking on the spectrum, or via text input in RGB, HSV, or HEX format.

FIGURE 30: MODIFY REGION COLOR

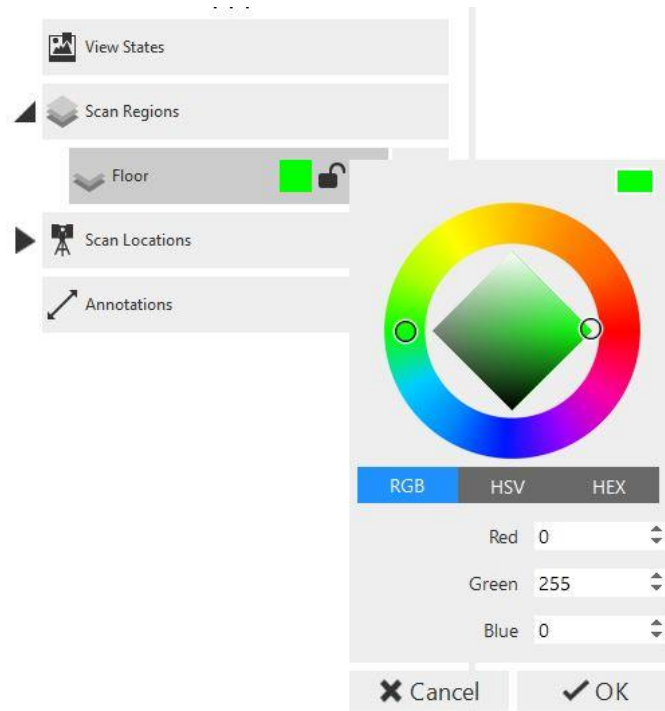**To lock or unlock a Region, click the 'lock' icon next to the Region's color.** A locked region cannot be selected or operated on.
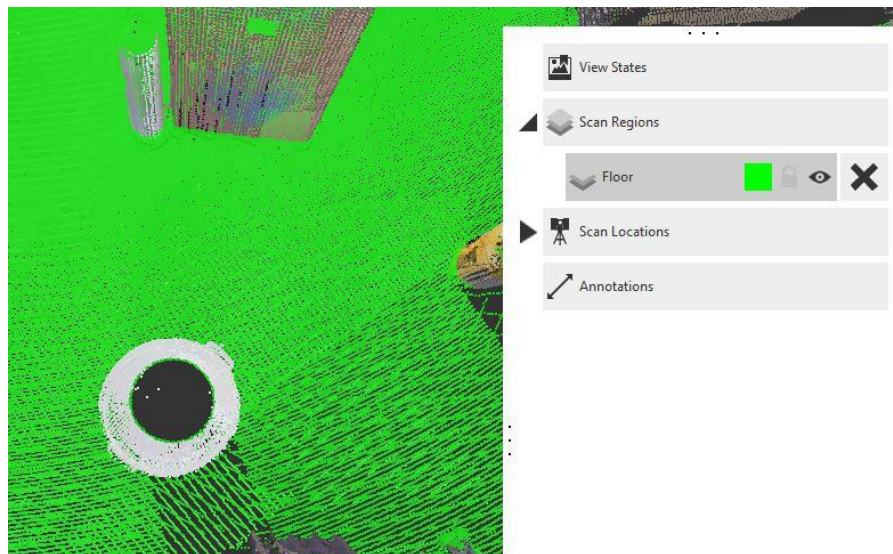
FIGURE 31: LOCKED REGION

Locking Regions is a very important operation, as it allows you to accurately exclude points from all other operations. A good example is editing people or cars out of a point cloud. You can use

a Plane Selection to select the ground/floor and assign it to a Region. Then, lock that Region while selecting the other objects for removal.

To show or hide a Region, click the 'eye' icon on the right side of its item in the Project Navigator. Hidden regions can still be selected, but will be hidden in all views of the point cloud.

FIGURE 32: HIDDEN REGION

To delete a Region, click the 'X' on the right side of its item in the Project Navigator. You will be prompted for how to delete the Region. You can choose to delete the points assigned to the Region, or just remove the Region and unassign the points.

FIGURE 33: DELETE REGION OPTIONS

Automatic Noise Cleanup (BETA)

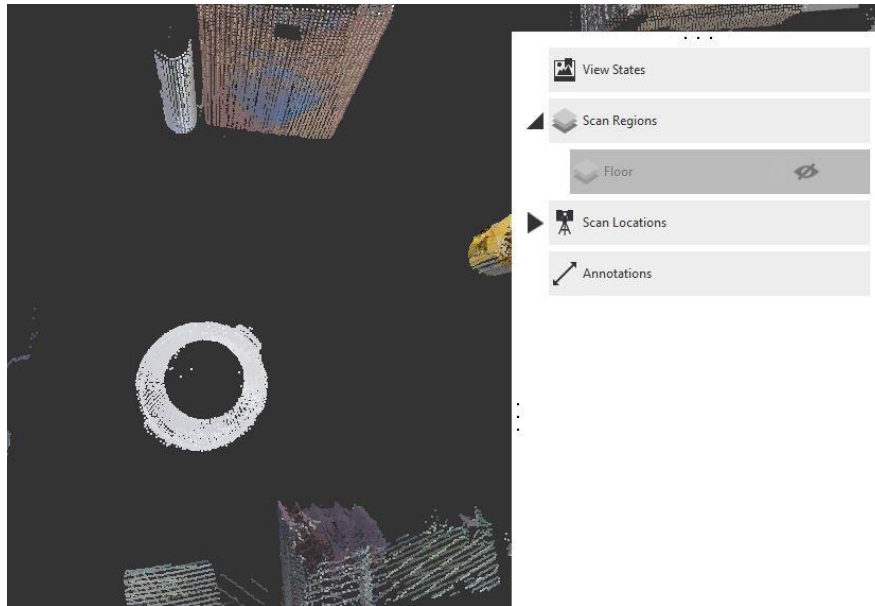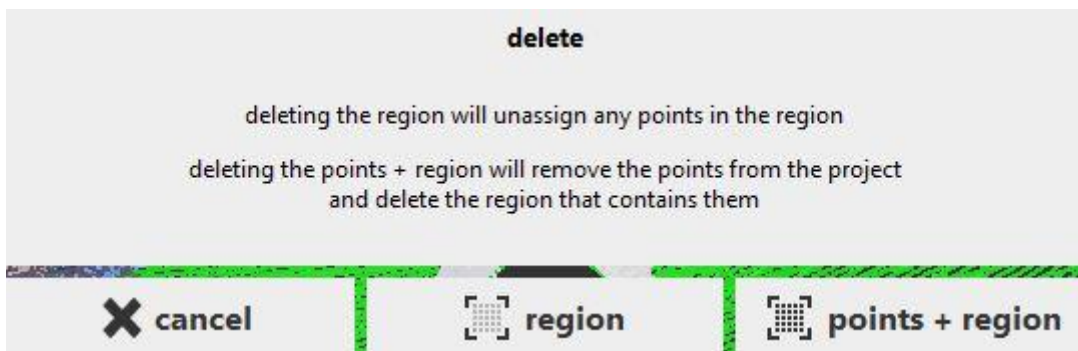The tools described above provide a broad, flexible toolset for cleaning up and otherwise preparing a point cloud for use. As you use the tools, you'll find yourself using the same combination of selections and operations repeatedly. ReCap 2.2 introduces the first feature which helps streamline a common selection/operation workflow (specifically, isolating noise points and removing them). This type of feature is referred to more generally as a Data Service.

The Noise Cleanup Data Service operates as follows:

1. Process the entire data set.
2. Using line-of-sight and other scanner information, determine points which belong to non-fixed objects other moving/noisy surfaces.
3. At a configured precision, create a selection around each identified point.
4. Add all selections to a Region.

This workflow allows users to quickly identify all noise created by moving objects. In past releases, these points could only be selected by a tedious combination of creating and locking regions for fixed surfaces.

To use the Noise Cleanup Data Service, select 'cleanup' from the ReCap Data Services menu on the left of the screen. You will be shown a dialog from which you can configure the cleanup operation. *Note: the Noise Cleanup Data Service is a cloud-connected service and requires the user to be signed-in to Autodesk 360.*
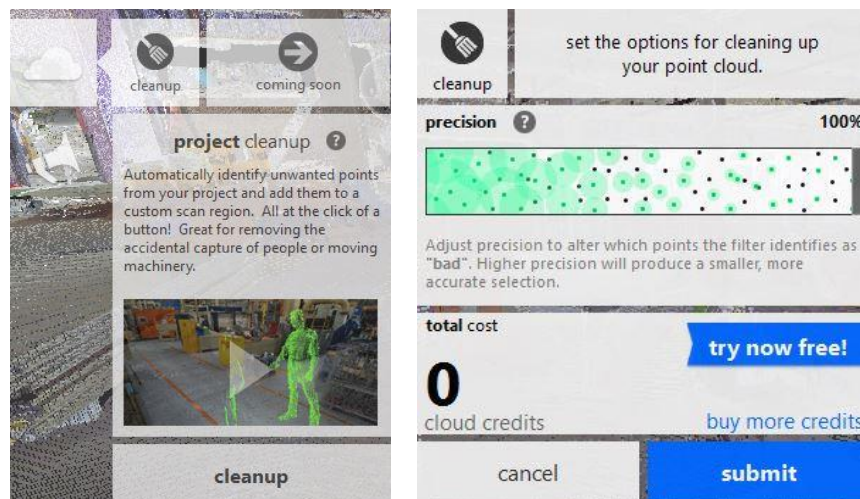
FIGURE 34: NOISE CLEANUP DATA SERVICE

Noise Cleanup allows you to set a 'Precision' value which defines the size of the selection (box) that is placed around each identified point. A high precision uses a very small box, which minimizes the chance that a box overlaps good data (effectively each point is selected individually). A lower precision uses a larger box, which can select more data with a single selection. This results in a coarser selection but a smaller/faster result.

Note: The Cleanup dialog will also show the cost (price) for the Service. As of this writing, the Service is currently in Beta and is free to try.

To set the desired precision, drag the slider bar to the desired percentage.

To start the cleanup process, click 'submit'. You will see a progress bar while the operation is running. When the cleanup is complete, the identified points will be placed on a new region called 'cleaned points'. You may now work with them (color, lock, hide, delete) as you would any other region.

Note: Regions created with the Noise Cleanup Service may not be compatible with previous versions of ReCap or other Autodesk products. This also applies to deleting the regions. To clean projects for use in 2016 and earlier products, you should optimize the project (via Save As) or export it to a unified RCP or RCS.
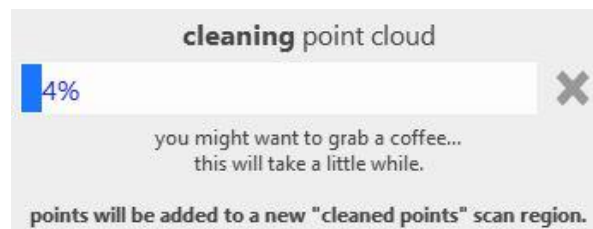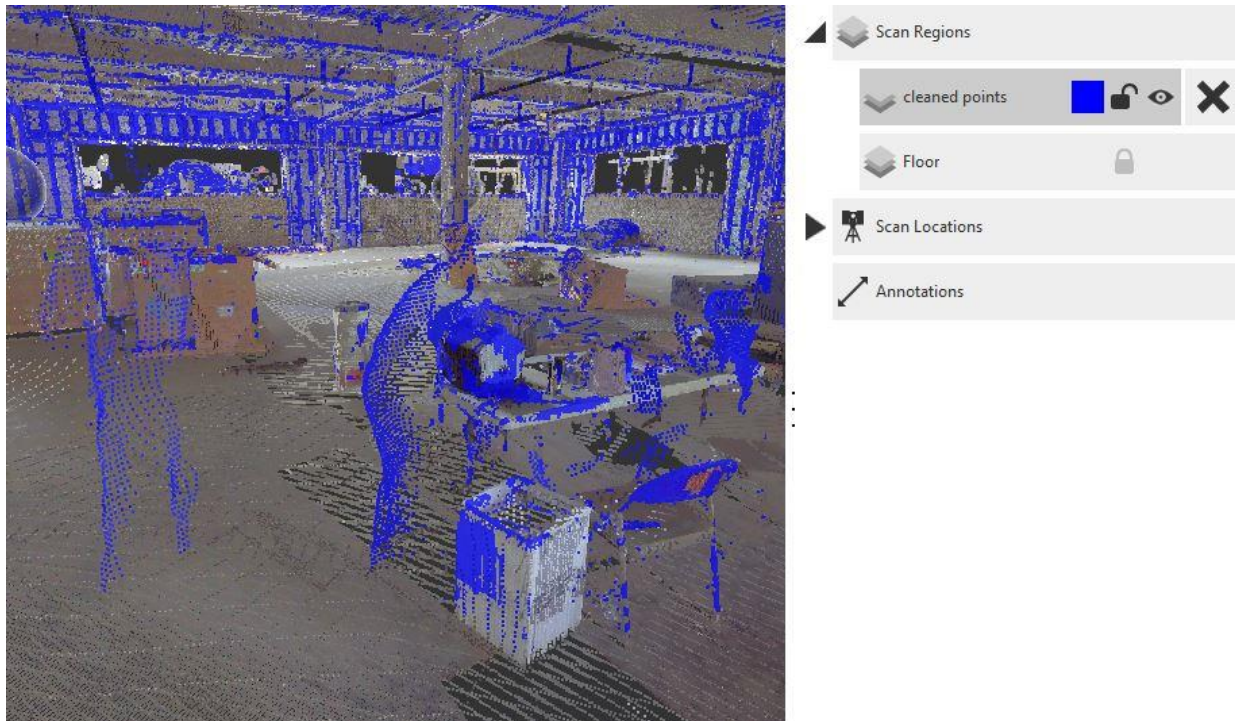

FIGURE 35: CLEANUP IN PROGRESS

FIGURE 36: CLEANUP RESULTS

Data Optimization

Also new in ReCap 2.2 are two great new ways to optimize your project after editing. For maximum flexibility, ReCap's editing engine works by keeping track of a (possibly long) tree of operations and transformations on the data. This allows us a lot of interesting features, like being able to maintain multiple sets of operations, rolling back to any point in the tree history, etc. However, this approach takes a lot of processing to determine the status of any point in the project.

To address this, we've added two optimizations:

- **'Burn' Deleted Points** – on Save, ReCap will offer to optimize the project by marking all deleted points on disk. This will allow those points to be hidden in ReCap 'for free', without the need for processing of an operation history. An added bonus is that the points can still be recovered by simply 'unmarking' the points. *Note: these points will not be considered as deleted by previous versions of ReCap or other Autodesk products.*
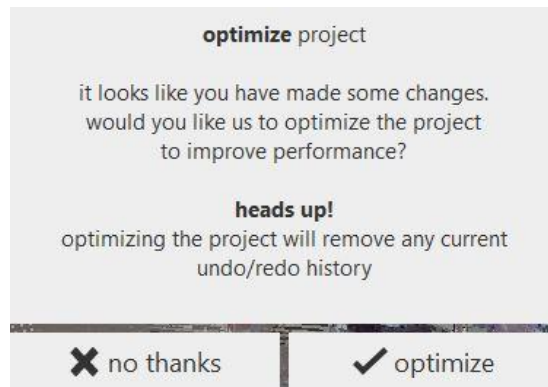
FIGURE 37: OPTIMIZE DURING SAVE

- **'Shrink' Deleted Points** – on Save As, ReCap will offer to optimize the project by completely removing deleted points from the new copy of the project. This allows you to easily create an optimized project while still maintaining full resolution and per-scan features like RealView. This operation is not recoverable, but since it's part of Save As, you'll always have a previous copy of the project.
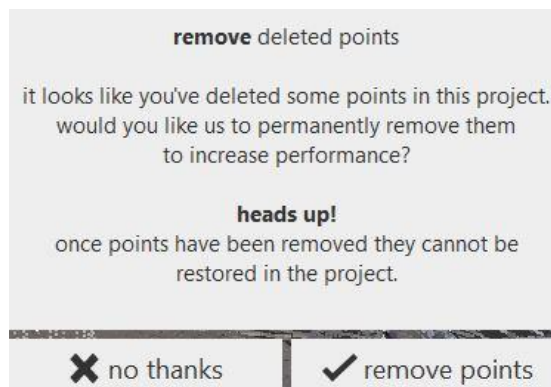
FIGURE 38: OPTIMIZE DURING SAVE AS

Interrogation Workflows

The second common class of Reality Capture Workflows relates to querying or interrogating the dataset. These workflows are usually focused on extracting smaller, more specific data or derivatives from the project. These derivatives can be both qualitative (e.g. visualizations of information) or quantitative (dimensions, extractions).

Visualization Tools
ReCap provides best-in-class tools for creating useful visuals from your project. Workflows here usually consist of some combination of navigation (find the appropriate view) and visualization (display it in the necessary manner) tools.

Navigation Modes
ReCap provides five main navigation modes, available via mouse action, keyboard shortcut, or main menu:

- **Window/Extents** - zoom the view to the specified window or project extents
- **Pan –** translate the camera via left-drag
- **Orbit** – rotate the camera about a focal point via left-drag
- **Look** – fix the camera position but change the look angle via left-drag
- **Fly** – smoothly dolly the camera in the direction of the left-drag, with configurable speed
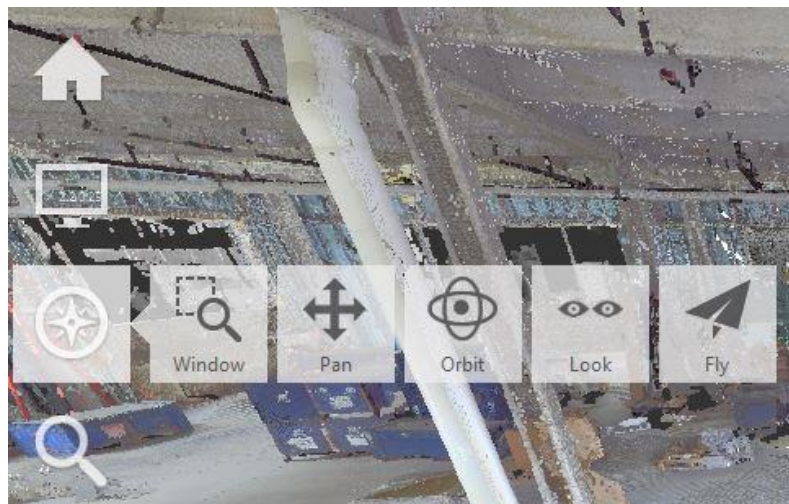

FIGURE 39: NAVIGATION TOOLS

To activate Window/Extents mode, click the desired operation from the Navigation Menu.
For Window mode, click the left mouse, drag on the screen, and release to define the desired window. When complete, the view will be zoomed to fit the window or project extents.
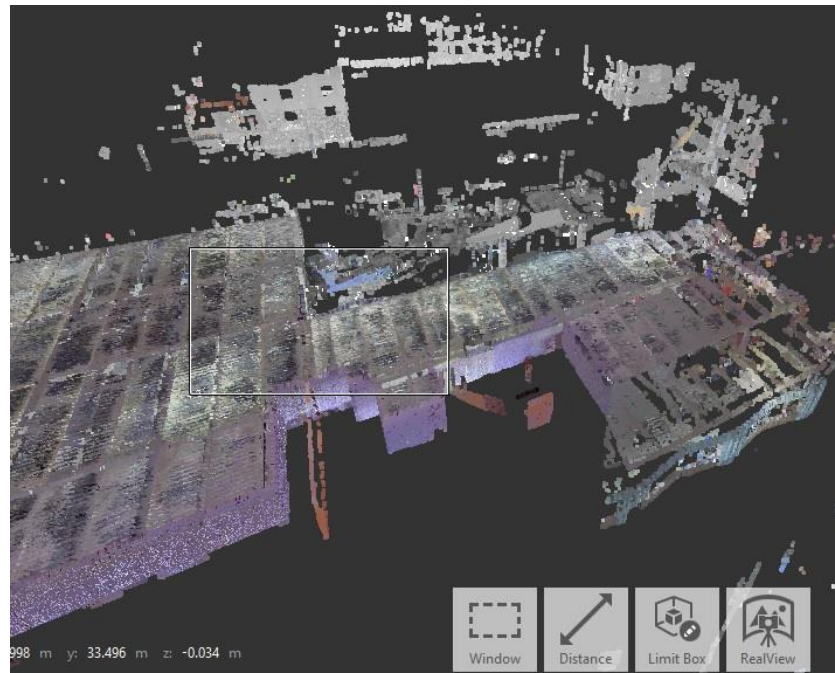
FIGURE 40: ZOOM TO WINDOW

To activate Pan mode:

- **Select 'Pan' from the Navigation Menu, or**
- **With no active mode, hold down the space bar**

Once activated, hold down the left mouse button and drag to pan the camera.

A single Pan operation can also be done at any time by holding down the middle mouse (or scroll wheel) button and dragging the mouse.

To activate Orbit mode:

- **Select 'Orbit' from the Navigation Menu, or**
- **With no active mode, hold down the 'x' key**

Once activated, hold down the left mouse button and drag to orbit the camera.

A single orbit operation can also be done at any time by holding down the right mouse button and dragging the mouse.

To activate Look mode, select 'Look' from the Navigation Menu. Once activated, hold down the left mouse button and drag to change the look angle. A single look operation can also be done at any time by holding down the CTRL key and the right mouse button and dragging the mouse.

To activate Fly mode, select 'Fly' from the Navigation Menu. Once activated, hold down the left mouse button and drag to fly the camera. A single fly operation can also be done at any time by holding down the SHIFT key and the right mouse button and dragging the mouse.

To change the speed of the Fly operation, scroll the mouse wheel up (faster) or down (slower) during the operation.

Visualization Modes

ReCap provides an extensive suite of tools for visualizing your area of object of interest in useful ways. These tools are available via the 'Display Settings' menu.

FIGURE 41: DISPLAY SETTINGS

The 'Color Mode' sub-menu provides a series of modes which allow you to color the point cloud in various ways.

RGB Mode – Default mode which colors the points based on the RGB values in the original scans. If RGB is not available, this mode will show grayscale based on the points' intensity values.

Elevation Mode – colors the points based on their elevation, with configurable Gradient Ramp (see below)

Intensity Mode – colors the points based on the intensity values in the original scans. If intensity is not available, this mode will show a conversion of the points' RGB values (effectively a brightness value). The Gradient Ramp used to shade the points is configurable (see below).

Normal – a visualization of each point's surface normal (direction)

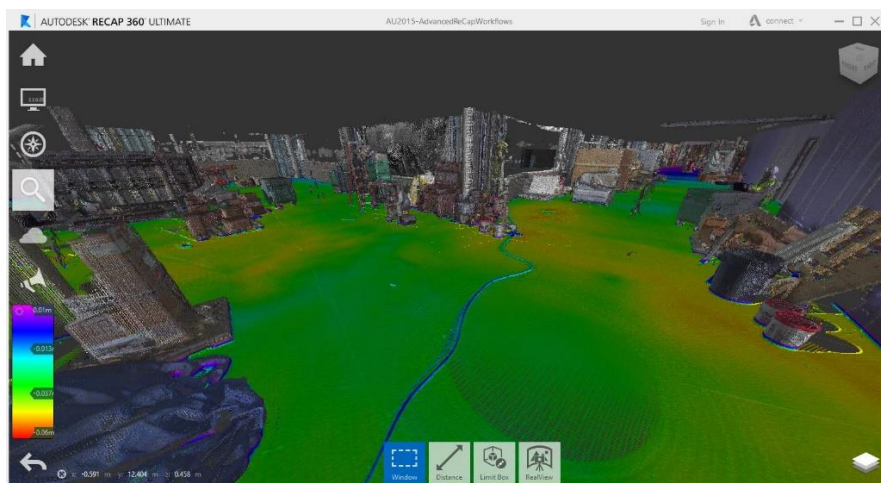**Scan Location** – points are assigned a color based on the scan position from which they originate

FIGURE 42: EXAMPLE OF ELEVATION MODE WITH CUSTOM GRADIENT RAMP

Working with Gradient Ramps

Elevation and Intensity mode support mapping the values to a color based on a customizable 'Gradient Ramp'. This Gradient Ramp consists of several parameters:

- **Coloring style** – choose from various output palettes, including Spectrum, Grayscale, and various presets.
- **Color transitions** – define the transition between colors in the palette. Choose from smooth, stepped, and banded.
- **Range** – you can customize the value range in which the mapping applies, as well as how to treat the values outside the range.

To configure the current Gradient, click the 'gear' icon at the upper left of the on-screen display. The displayed list shows a number of built-in presets, along with several placeholders for custom Gradient Ramps.

Choose the desired Gradient Ramp from the list, or click 'Edit Current' to modify the current Ramp.
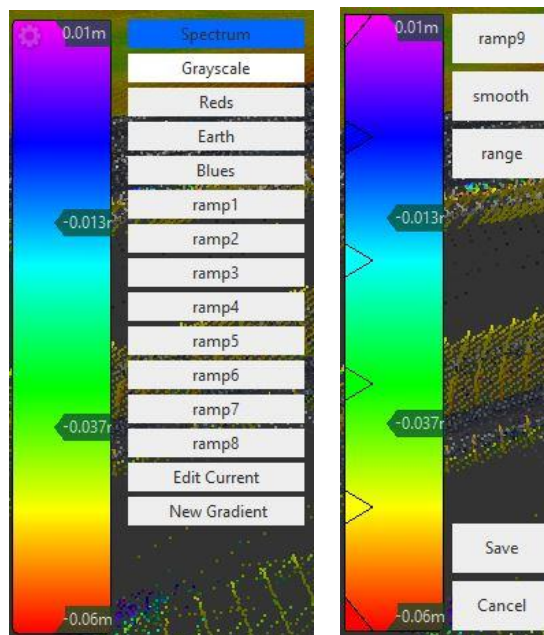

FIGURE 43: EDITING RAMP

To change the Coloring Style, click on the current style at the top of the displayed list and choose the desired style

FIGURE 44: COLORING STYLE

To change the Color transition mode, click the current mode (second in displayed list) and choose the desired mode.
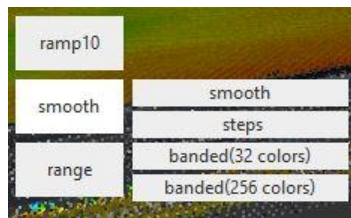
FIGURE 45: TRANSITION MODE

To edit the Range, click 'range' in the displayed list. You will be shown a dialog from which you can change the Range settings:

- **Range type (Elevation Mode only)** – choose 'Limit Box Extents' to reset the range to the current extents. Choose 'custom range' to set your own values.
- **Min/Max values** – type in the desired values. In Elevation Mode, you can also click the pin icon next to the value and select a 3D point to use.
- **Out of Range Points** – define how to treat points outside of the range
    - o **Use RGB** – use the RGB value for the out-of-range points
    - o **Use Min/Max** – clamp out-of-range points to the nearest min or max value
    - o **Hide Points** – hide out-of-range points from view

FIGURE 46: EDITING RANGE

Measurement Tools

Most interrogation workflows are based on measurement of dimensions in the point cloud (or individual scans). ReCap 360 provides a full-featured suite of tools for all types of measurement.
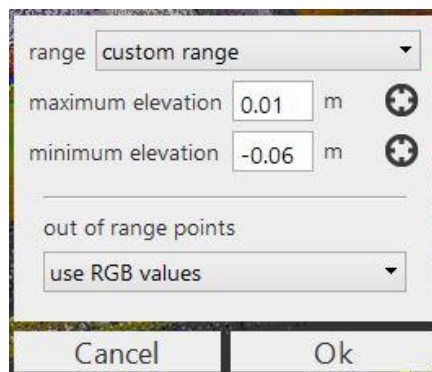
Distance Measurement

The simplest form of point cloud interrogation is to measure the distance between two points.

FIGURE 47: DISTANCE TOOLS

To measure distance between two points:

1. **Select the 'Distance' tool from the main toolbar.**
2. **Select the first point by left-clicking on it in the view.** While the measurement is in progress, the X/Y/Z components of the measurement are shown as colored, dotted lines.
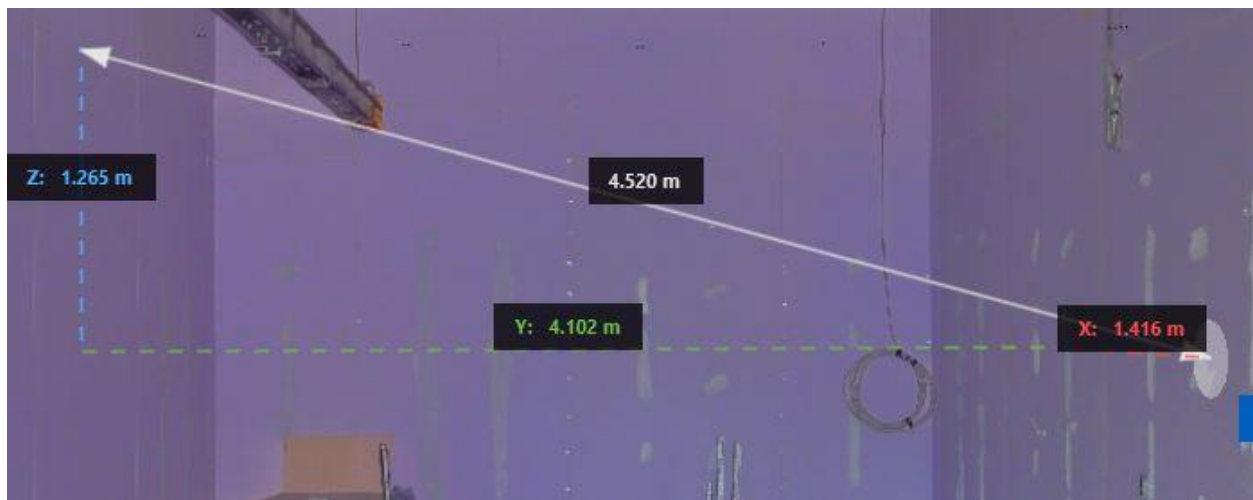3. **Select the second point by left-clicking on it in the view.**

FIGURE 48: FREEHAND DISTANCE

Once the measurement is complete, you can start another or close the tool by pressing ESC or clicking the 'Done' button. The X/Y/Z components of the measurement can be seen later by highlighting the measurement by placing the mouse on its text label.

Ortho Modes

ReCap also provides advanced tools through which you can constrain a distance measurement to be orthogonal (perpendicular) or parallel to a specific plane. There are four modes you can use to define this plane. These modes are available via the Distance Tool menu or by tapping SHIFT at any time before or during a measurement.

- **X Ortho** – constrain the measurement to the X-axis. In this mode, the measurement will be displayed as a red line. You can toggle between orthogonal and parallel (in-plane) by tapping the TAB button.
- **Y Ortho** – constrain the measurement to the Y-axis. In this mode, the measurement will be displayed as a green line. You can toggle between orthogonal and parallel (in-plane) by tapping the TAB button.
- **Z Ortho** - constrain the measurement to the Z-axis. In this mode, the measurement will be displayed as a blue line. You can toggle between orthogonal and parallel (in-plane) by tapping the TAB button.
- **Plane Snap (*ReCap 360 Only*)** – constrain the measurement to the plane defined by the area of data at the first point. In this mode, the measurement will be displayed as a yellow line. You can toggle between orthogonal and parallel (in-plane) by tapping the TAB button.

During and after an Ortho measurement, the alternative measurement (orthogonal or in-plane) will be shown with a dotted line from the snapped-point to the mouse. This serves as a hint to remind you of the specific 3D point used to compute the measurement.

FIGURE 49: Y-ORTHO MEASUREMENT

FIGURE 50: PLANE SNAP MEASUREMENT

Pipe Snap

ReCap 360 also provides the capability to snap a measurement endpoint to the centerline or outer surface of a cylindrical object (e.g. a pipe). This option can be enabled for one or both measurement end points.

To snap an endpoint to a Pipe, click the 'Pipe Snap' button or tap 'ALT' prior to clicking on the cylinder. Once you click, ReCap will extract the cylinder geometry and show it on the screen.

Pipe Snap supports snapping to the centerline or outer surface of the cylinder. To toggle between the two, tap CTRL.

Pipe Snap supports all measurement and ortho modes described above. For example:

- Use outer snap with Z-Ortho to measure precise vertical clearances.
- Use center snap with Plane Snap to measure directly along a pipe centerline.

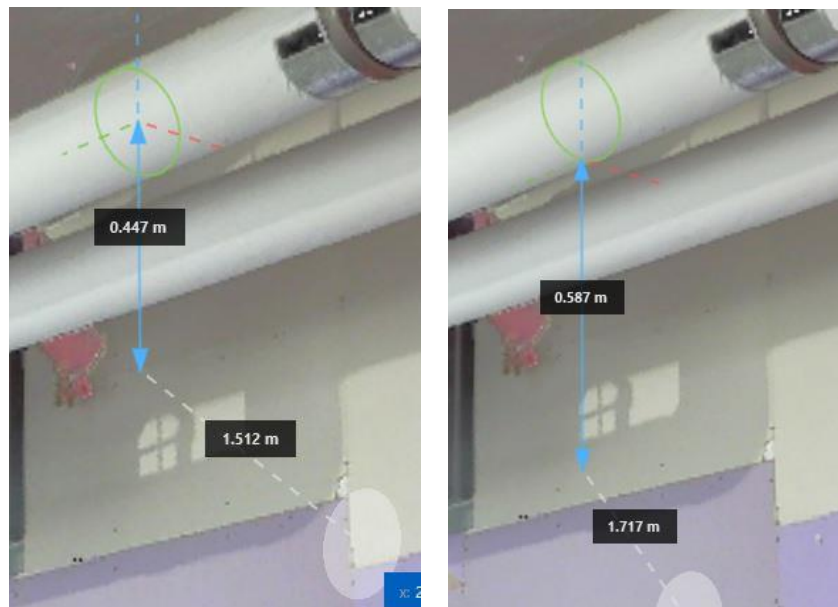FIGURE 51: CENTER AND OUTER PIPE SNAP

You can also extract just the cylinder without creating a distance measurement.

To extract a cylinder:

1. **Start a distance measurement and activate pipe snap.**
2. **Click on the desired cylinder.**
3. **Press enter.** The cylinder's diameter will be shown at the center point.

FIGURE 52: CYLINDER DIAMETER MEASUREMENT

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Collaboration Workflows

Collaboration lies at the center of any successful large project. With sufficient scale, projects and initiatives can succeed or fail based on the ease and frequency of communication between the companies, teams, and individuals involved. Increasingly, this collaboration is done virtually and remotely. ReCap provides a modern set of capabilities which allow such collaboration to include and center around data captured in the field.

Annotation Tools

Annotation is the basic building block of collaborating with Reality Capture data. Annotation allows us to attach human intelligence to the data, as well as provide loose integration with other captures (like photographs) or systems like databases, websites, or other enterprise tools.

In ReCap, an Annotation is a collection of metadata, including text, hyperlinks, and image attachments. These annotations can be attached to the project in a number of ways.

Notes & Markups
The simplest form of annotation is the Note. A Note is placed at a single 3D coordinate (in the 3D view or in RealView).

To create a Note Annotation:

1. **Select 'Note' from the tool menu at the bottom of the view.**
2. **Click the desired point.**
3. **Enter the Annotation Details (see below).** You must enter at least a Title for display in the scene.
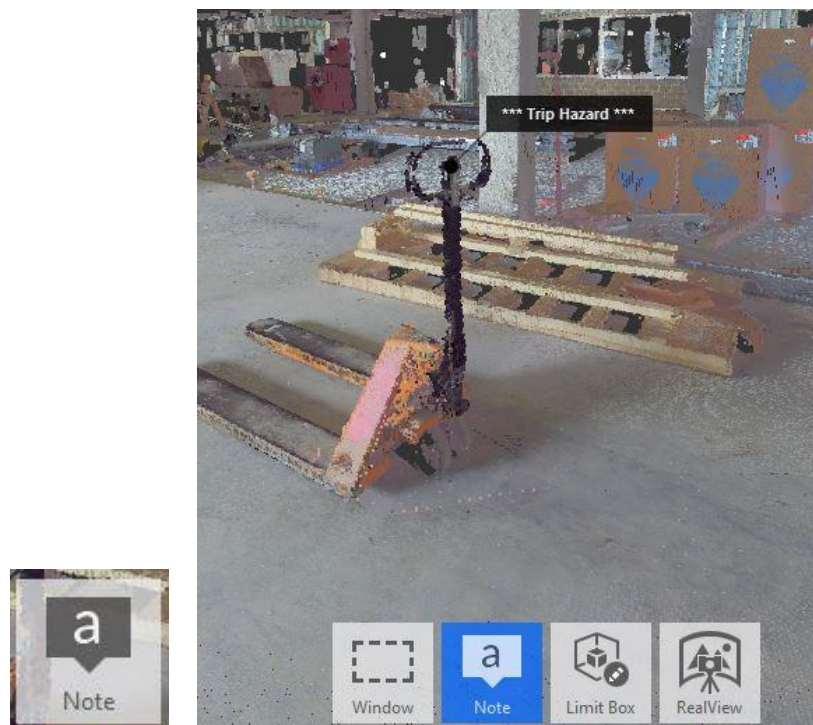

FIGURE 53: CREATING NOTE

A more advanced type of Annotation is the Markup. Markup is a RealView-based tool for highlighting a section of a scan visually. The highlighted section can be a screen rectangle or polygon (fence).

To create a Rectangle Markup:

1. **Select 'Markup' from the tool menu at the bottom of the view.**
2. **Select Rectangle from the Markup Type menu.**
3. **Left-drag on the view to define the Rectangle.** Release the mouse when done.
4. **Click 'Done' (or press ESC) or repeat Step 3 to create another Rectangle Markup.**

To create a Fence Markup:

1. **Select 'Markup' from the tool menu at the bottom of the view.**
2. **Select Fence from the Markup Type menu.**
3. **Left-click in the view to define the Fence (polygon).** You must provide at least three points.
4. **Double-click in the view to place the last point and finish the Fence.**
5. **Click 'Done' (or press ESC) or repeat Steps 3-4 to create another Fence Markup.**

FIGURE 54: RECTANGLE AND FENCE MARKUPS

Once a Markup is created, several actions are available via the Markup Menu.

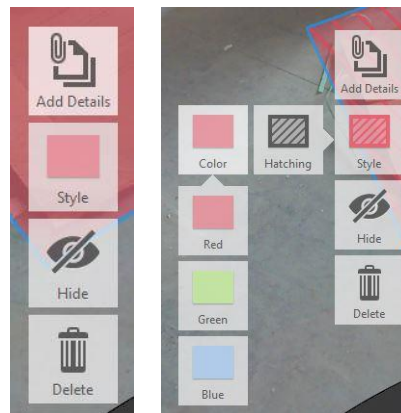**To activate the Markup menu, left-click anywhere on the Markup.**

FIGURE 55: MARKUP MENUS

From this menu you can do the following:

- **Add Details** – attach annotation details to the Markup.
- **Style** – choose between built-in colors and turn hatching on/off.
- **Hide** – hide the Markup.
- **Delete** – delete the Markup.

Attaching Annotation Details

Annotation Details can be attached to the following project objects:

- Notes
- Markups
- Measurements (including Cylinders)

Annotation Details are shown whenever one of the above objects is highlighted in the view. Similarly, the UI to attach the details is accessed in two ways:

- Via the object's display in the view.
- Via the object's record in the Project Navigator.

To attach Annotation Details to a Note or Measurement:

1. **Select the object in the view.** This is done by clicking on the object's text display. For Markups, click anywhere on the Markup.
2. **Click the 'Add Details' button next to the text display or from the tool menu at the bottom of the view.**

To attach Annotation Details to a Markup:

1. **Click anywhere on the Markup to select it.**
2. **Click the 'Add Details' button from the displayed Markup menu.**

To attach Annotation Details to an object in the Project Navigator, place your mouse on the object's row and click the 'Add Details' button.
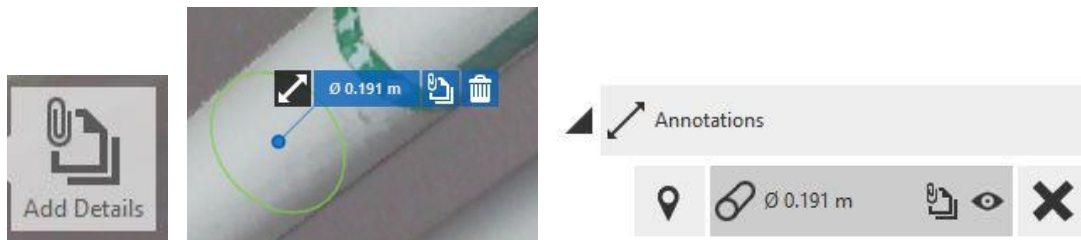
FIGURE 56: ADDING ANNOTATION DETAILS

Any of these steps will display the Annotation Details dialog. This dialog allows you to review and edit the details of the annotation.
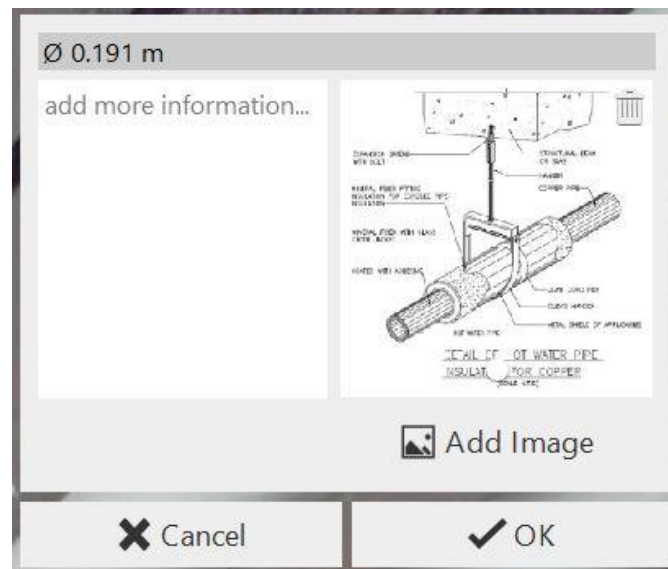

FIGURE 57: ANNOTATION DETAILS

The Title of the Annotation is shown at the top of the dialog. The main or left text box shows any Description added. The left box shows the first of any attached images. Any of these Details can be edited by clicking on the corresponding element.

To edit the Title or Description of an Annotation, click in the desired text box and edit the text as desired. *Note: The Title cannot be edited for a Measurement object. The Title is always the Measurement's display text.*

To review previews of attached images, place your mouse in the image box and use the arrows to see the next/previous image. You can also see full-size versions of the image set by clicking anywhere in the preview box.

To delete an image from the preview, click the 'trashcan' icon in the upper-right of the preview box.

To add an image to the annotation:

- **Locate the image or images on your computer and drag onto the dialog, OR**
- **Click 'Add Image' and browse to the desired image(s)**

Once your edits are complete, click 'OK' to save them. They will now be visible when the object is highlighted, or when you return to the Annotation Details dialog.

Presentation Tools

A critical part of collaboration on a project is visual communication. Previous sections have described the many tools available to visualize and annotate the data in meaningful ways. ReCap and ReCap 360 also provide tools to present these customized views to others.

View States

The core mechanism for visual communication is the View State. You can think of a View State as a record of the exact visual state of the application. A View State record includes:

- Position, orientation, and zoom level of the camera
- View mode (3D/RealView and Color Mode)
- Clip stack and current limit box (3D only)
- Visibility of Scans (3D only)
- Visibility of any Regions in the project (3D only)
- Visibility of any Annotations and Measurements in the project

View States can be created at any time in the application.

To create a View State, click the '+' icon next to the 'View States' header item in the Project Navigator. A new item will be created under the header with default name ('View State XX').

FIGURE 58: ADDING A VIEW STATE

To edit a View State's name, double-click on its row in the Project Navigator. The name will become editable. Press Enter to finish.

Once a View State is created, it can be updated (set to the current view) or deleted from the buttons on its row in the Project Navigator. View States can also be grouped into logical collections (like Regions or Scans).

To create a View State group from two View States, click on one of the States and drag it onto the other. You will now have a sub-group which can be renamed as above.
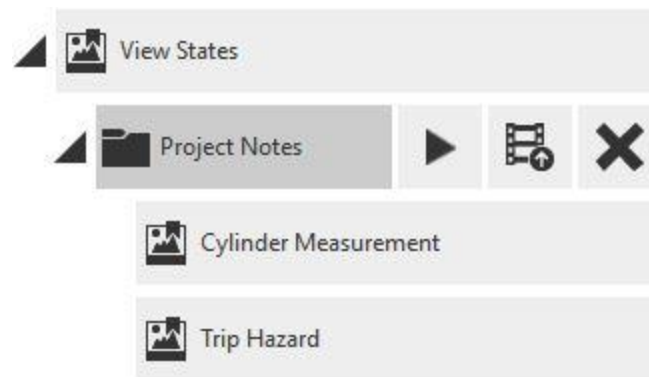
FIGURE 59: VIEW STATE GROUP

To activate a saved View State, simply click on it in the Project Navigator. The application will be transitioned to the exact visual state recorded in the View State.

As you can see, View States and View State Groups provide building blocks through which you can communicate visually through one or more named, sequenced series of views. A collaborator can 'walk through' the views by clicking on each of them in sequence. This capability is very useful for project collaboration. For example, a View State Group can be created for each phase or group of actions required on a project. Inside each group, the individual states represent a sequence of operations or tasks. The view itself can show the area in question along with any relevant annotations, markups, or clearance measurements.

Playback & Video Export
As mentioned above, View State Groups provide a logical, organized approach for visual communication. As of version 2.2, ReCap 360 provides a two simple tools to 'present' a View State Group visually.

The Playback tool provides an animated 'tour' of the sequenced View States in the group. This effectively automates the process of clicking through each state.

To Playback a View State Group, click the 'Play' icon on the group's row in the Project Navigator. ReCap will display each View State in the group, in sequence, using the built-in transitions between each. There is a short pause at each View State so the viewer can see any configured modes or annotations.

Similarly, ReCap 360 provides the ability to export the same animation to a video file. This allows for sharing the visual communication for consumption by people or platforms which don't have ReCap installed.

To export the animation for a View State Group:

1. **Click the 'export animation' button on the Group's row in the Project Navigator.**
2. **From the displayed dialog, choose the desired file format (MP4 or AVI).** *Note: MP4 export uses the OpenH264 codec provided by Cisco Systems. For licensing reasons, this codec must be downloaded from Cisco and installed separately from the main application. The first time*

you try to export an animation to MP4, ReCap will prompt you and perform this operation in the background.

3. **Choose the output resolution from the provided drop-down box.** ReCap 360 supports standard 16:9 resolutions (1280x720, 1920x1080, and 3840x2160).
4. **Set the desired output file path and name by clicking 'browse'.**
5. **Click 'export'.**

You will be shown a progress bar while the animation is rendered and saved to the output file.
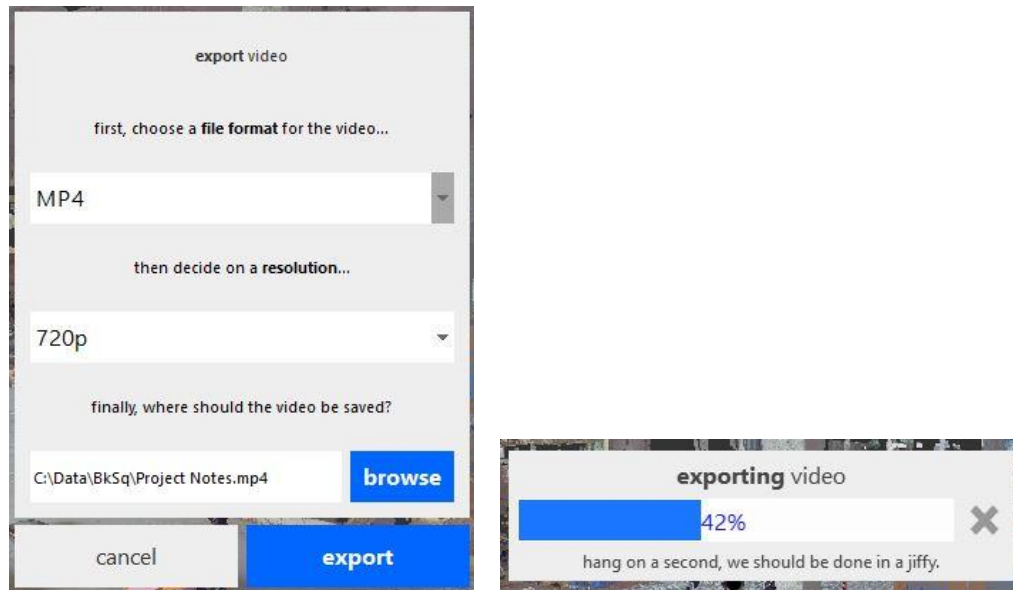

FIGURE 60: VIDEO EXPORT

Search

All of the tools described above allow you to add value to your Reality Capture data by adding, organizing, and sharing information. When used effectively, the measurement, annotation, and presentation tools can result in quite a bit of project metadata.

ReCap 360 provides a fast, easy way to search this data to quickly find and act on what you need. The Search tool is accessible via the main menu in the upper-left of the screen. The Search tool supports text-searches of the following project objects by name:

- View States
- Scan Regions
- Scan Locations
- Annotations (including Measurements)

To perform a search:

1. **Click the Search icon in the main menu.**
2. **Enter the search text.** As you type, the results will appear below the text box. Any supported item which contains a matching substring will be shown.

When the desired results are achieved, you can act directly on the search results, just as you would from the Project Navigator. Examples include:

- Locating a measurement or annotation (via the 'pin' icon)
- Activating a View State
- Hide/Show or Highlight a Region
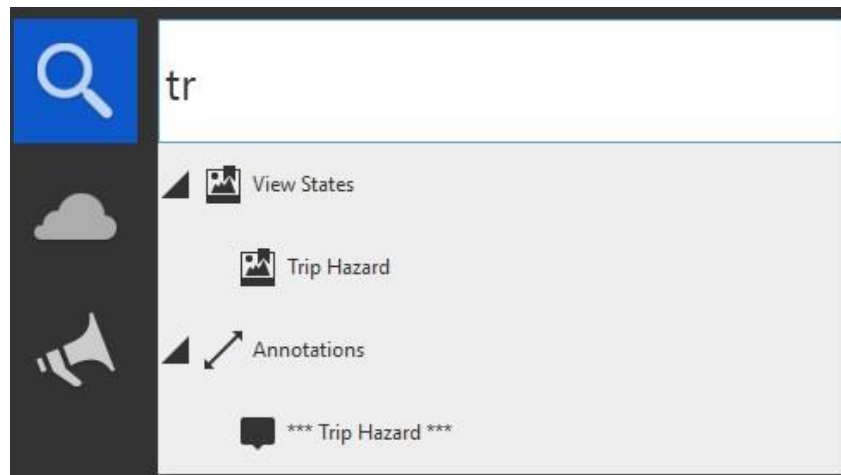- View/Edit details of an annotation

FIGURE 61: SEARCH