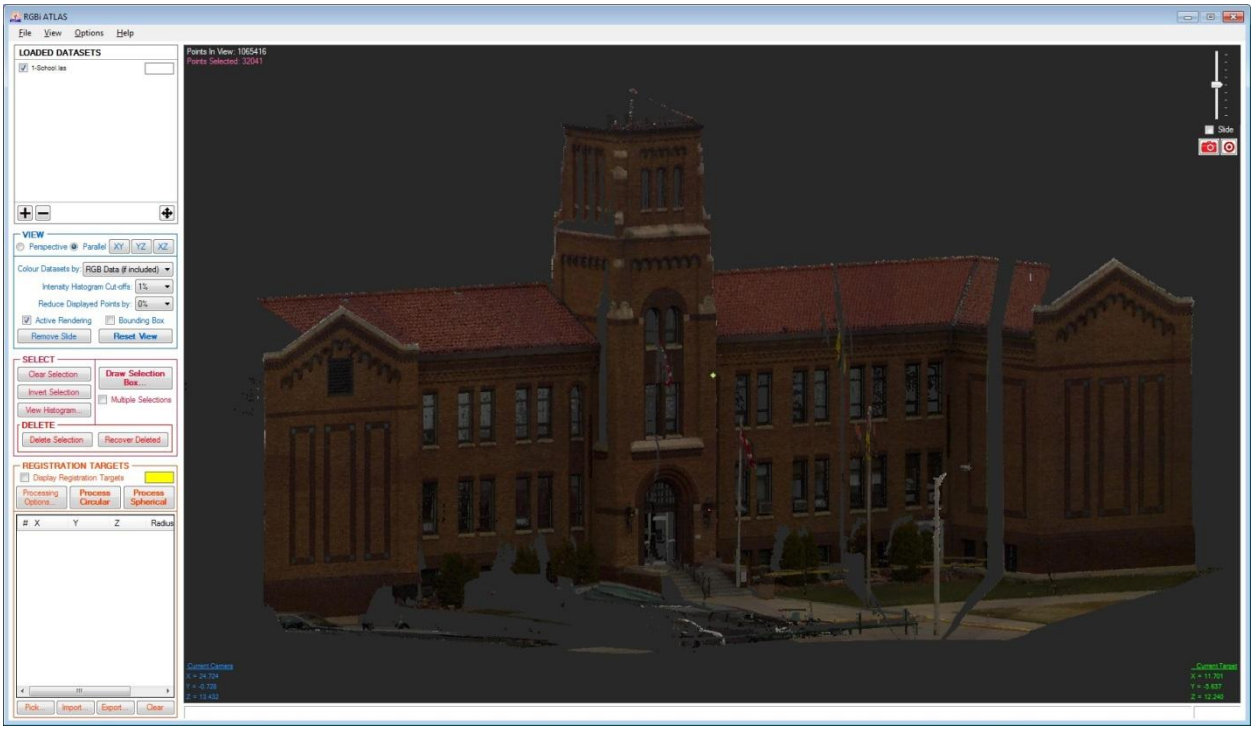
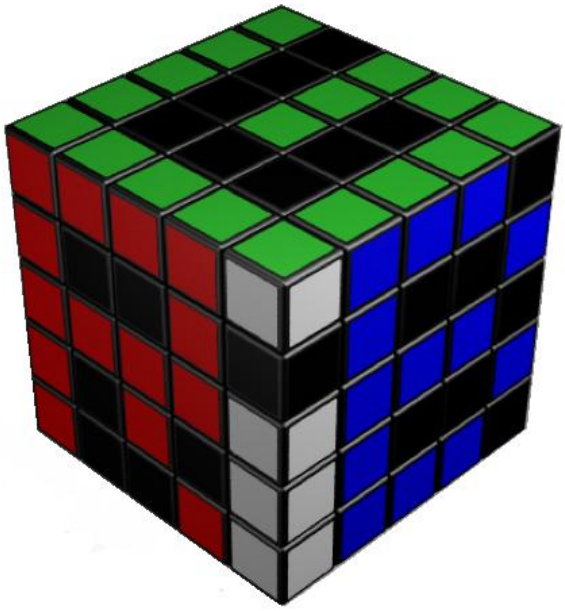
RGBi ATLAS v1.0

LiDAR Point Cloud Processing Software



User's Manual



RGBi Engineering

RGBi ATLAS v1.0
User's Manual

August, 2013

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NOTATIONS AND COMMANDS

This manual will use the following notations and commands to assist the reader in understanding the instructions as well as saving on the amount of text that the reader must comprehend.

Example Notation	Description
File → Exit	Click the File Menu (at the top left of the screen) and from the proceeding menu click the Exit command.
Clear	Indicates a specific control of interest within the application that has this text written on for identification.
Datasets	Indicates the title of a section area within an interface element of the application (including dialog boxes).
IMPORTANT	Indicates that the following textual statement may have adverse effects on the performance of the application if not adhered to.

Commands	Description
CLICK	Instructs the reader to single click the left button on a standard 3 button mouse.
RIGHT-CLICK	Instructs the reader to single click the right button on a standard 3 button mouse.
MIDDLE-CLICK	Instructs the reader to single click the middle button (commonly the middle button will be the wheel of the mouse that can be clicked) on a standard 3 button mouse.
ROLL IN/OUT	Instructs the reader to roll the mouse wheel in (towards the top of the mouse) or out (towards the rear of the mouse).
ESC	Instructs the reader to press the escape (ESC) key on the keyboard.
ENTER	Instructs the reader to press the Enter key on the keyboard.

CHAPTER 1 – INTRODUCTION

RGBi ALTAS (hereinafter simply referred to as ATLAS) is a Light Detection And Ranging (LiDAR) point cloud processing software designed for Microsoft® Windows® operating systems. ATLAS allows a user to import, view, analyze, process and export point clouds. The major functions of ATLAS include:

- Importing point cloud datasets using a variety of industry standard formats
- Viewing point cloud datasets three dimensionally within a computer
- Centroid determination of planar circular targets and spherical targets
- Registration/georeferencing of multiple point clouds using tie-points/ground control points (GCP)
- Exporting point clouds datasets using a variety of industry standard formats

This manual is designed to assist the reader in getting started using ATLAS and provides all the steps necessary to utilize the full potential of ATLAS for processing point cloud datasets.

Installing RGBi ATLAS

Installing ATLAS has been designed to be as simple as possible via the use of a standard windows setup wizard. Before installing ATLAS the user should be sure to close any currently running applications on their computer. First, double **CLICK** the compressed installation folder that was downloaded from www.rgbi.ca and select to extract all the contents of this folder to a location on your computer. Then, from within the extracted folder, double **CLICK** the setup.exe file to begin the installation wizard.

IMPORTANT ATLAS does not support Windows 7 (and above) User Account Control (UAC) notifications which means that a user may have to have Administrator permissions in order to install ATLAS properly. Alternatively, a user could lower their UAC notification level in order to have ATLAS run properly (**this is NOT advised and if performed is done so at the user's own risk)**.

The setup wizard consists of three dialogs in which the user must read and agree to the stated terms in order for ATLAS to install. The default installation location for ATLAS (C:\Program Files\RGBi Engineering) is displayed on the second dialog of the wizard and can be changed if desired but for the remainder of this manual it is assumed that the default installation location was used. Once the installation has been completed the user should notice that a shortcut icon to the ATLAS executable has been added to the user's desktop display and an RGBi Engineering folder within the Windows Start Menu. Opening either of these shortcuts will launch ATLAS on the user's computer.

IMPORTANT Once again, depending on the user's UAC settings, the user may need Administrator permissions in order to launch ATLAS properly. If a point cloud dataset fails to import into ATLAS properly this commonly indicates that Administrator permissions are required to launch ATLAS. This is performed by **RIGHT-CLICKING** on the ATLAS executable file (.exe) and selecting 'Run as administrator' provided a user's current permissions allow for this elevated authority.

Minimum System Requirements

ATLAS has been designed and tested on 32bit and 64 bit Microsoft® Windows® 7 operating systems. The ATLAS application itself utilizes only 32 bit references and components. In order for ATLAS to perform properly the following suggested minimum system requirements should be present within a user's computer.

Component	Suggested Minimum Requirement
Operating System	Windows 7 - 32bit or 64 bit
CPU (Processor)	1 GHz or higher
RAM (Memory)	1024 MB (1 GB)
Monitor	1280 x 900(min) up to 1920 x 1200(max)
Mouse	3 button with scroll wheel

Table 1 - Minimum system requirements

CHAPTER 2 – GRAPHICAL USER INTERFACE

ATLAS has been designed with simplicity in mind in order to enable the user to quickly become productive. The ATLAS interface consists of 4 primary elements:

1. ***Menu***
2. ***Command Areas***
3. ***Map Panel***
4. ***Additional Dialogs***

Menu

The menu at the top of the application contains commands that can be performed by a user. The menu does also contain submenus so be sure to fully explore the menu to see all the commands that are available.

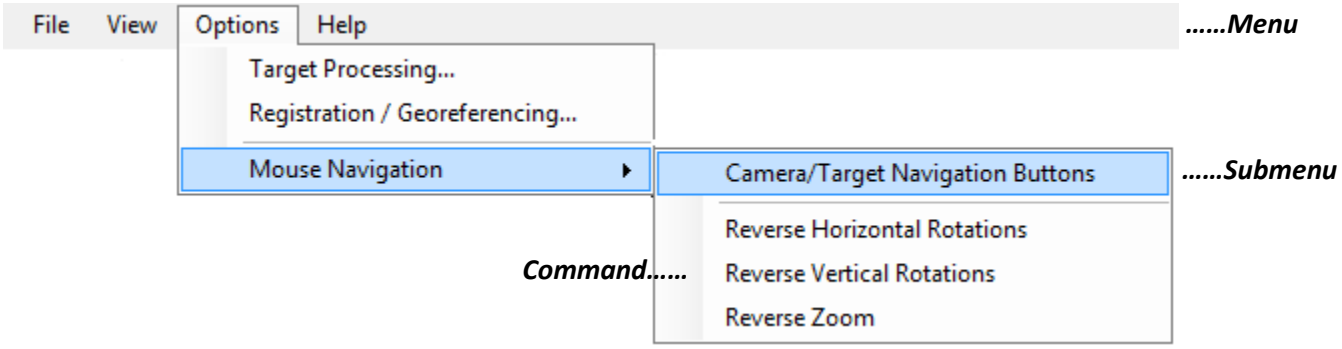

Figure 1 - Options Menu

Within the ***Menu*** there are some commands that are duplicated within the ***Processes*** element of the interface. Primarily the commands in the ***Menu*** provide the only means of executing these commands within ATLAS and as such it is vital to recognize where these commands are located. A summary of each command is provided in the table of the following page.

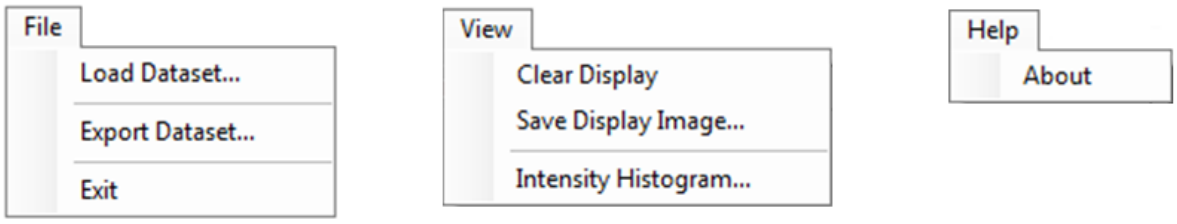

Figure 2 - File, View and Help Menus

Menu Command	Description
File→Load Dataset…	Opens the *Import* point cloud dialog where a user can specify the dataset to open inside of ATLAS. This command is duplicated in the *Loaded Datasets* area of the interface.
File→Export Dataset…	Opens the *Export* point cloud dialog where a user can specify the computer location and file format for the currently loaded point cloud to be exported. All visible points from the datasets within ALTAS will be exported.
File→Exit	Closes the ALTAS application.
View→Clear Display	Clears the current display of all points. Loaded datasets still remain within ATLAS but need to be re-activated in order to become visible again.
View→Save Display Image…	Opens the *Save Image* dialog where a user can specify the computer location for the .jpg image of the current *Map Panel* view to be saved.
View→Intensity Histogram…	Opens the *Intensity Histogram* dialog where a user can view the histogram of intensity values for ALL the loaded datasets within ATLAS.
Options→Target Processing…	Opens the *Target Processing Options* dialog where a user can enter the processing specifications to use when processing plane circular targets and spherical targets from a point cloud.
Options→Registration/Georeferencing	Opens the *Registration/Georeferencing Options* dialog where a user can enter the information necessary to register/georeference any of the loaded point clouds.
Options→Mouse Navigation→ Camera/Target Navigation Buttons	This command acts as a switch to either turn on/off the display of the manual buttons for navigating the camera and aiming target with respect to the point cloud(s).
Options→Mouse Navigation→ Reverse Horizontal Rotations	This command acts as a switch to either use normal or reverse horizontal rotations of the point cloud by **RIGHT-CLICKING** and holding the mouse and moving it left/right.
Options→Mouse Navigation→ Reverse Vertical Rotations	This command acts as a switch to either use normal or reverse vertical rotations of the point cloud by **RIGHT-CLICKING** and holding the mouse and moving it up/down.
Options→Mouse Navigation→ Reverse Zoom	This command acts as a switch to either use normal or reverse zooming in/out of the point cloud by **ROLLING** the mouse wheel in/out.
Help→About	Opens the *About* dialog where a user can see more information about the developmental reasons and creator of ATLAS.

Table 2 - ATLAS menu commands

Command Areas

The *Command Areas* within ALTAS refers to the left side column within the Interface that contains the individual *Command Areas*. These individual *Command Areas* contain the majority of the regular commands that a user will utilize to perform point cloud processing using ATLAS. The individual *Command Areas* include:

1. *Loaded Datasets*
2. *View*
3. *Select and Delete*
4. *Registration Targets*

Loaded Datasets Command Area

The *Loaded Datasets* command area contains the commands for loading (importing), unloading and resetting the display view to the extents of all the datasets. This command area also displays the names of the individually loaded datasets within ATLAS. For each dataset that is loaded an additional set of commands become available within the *Loaded Datasets* command area. The ***Dataset Colour*** command can be **CLICKED** to access a colour dialog that allows a pre-defined and custom colour to be selected for the respective dataset. Each ***Dataset*** and ***Dataset Colour*** command also has a shortcut menu of commands assigned to them, these shortcut menus can be accessed by **RIGHT-CLICKING** on the respective commands. The following figures illustrate the commands within the *Loaded Datasets* command area and the applicable shortcut menus.

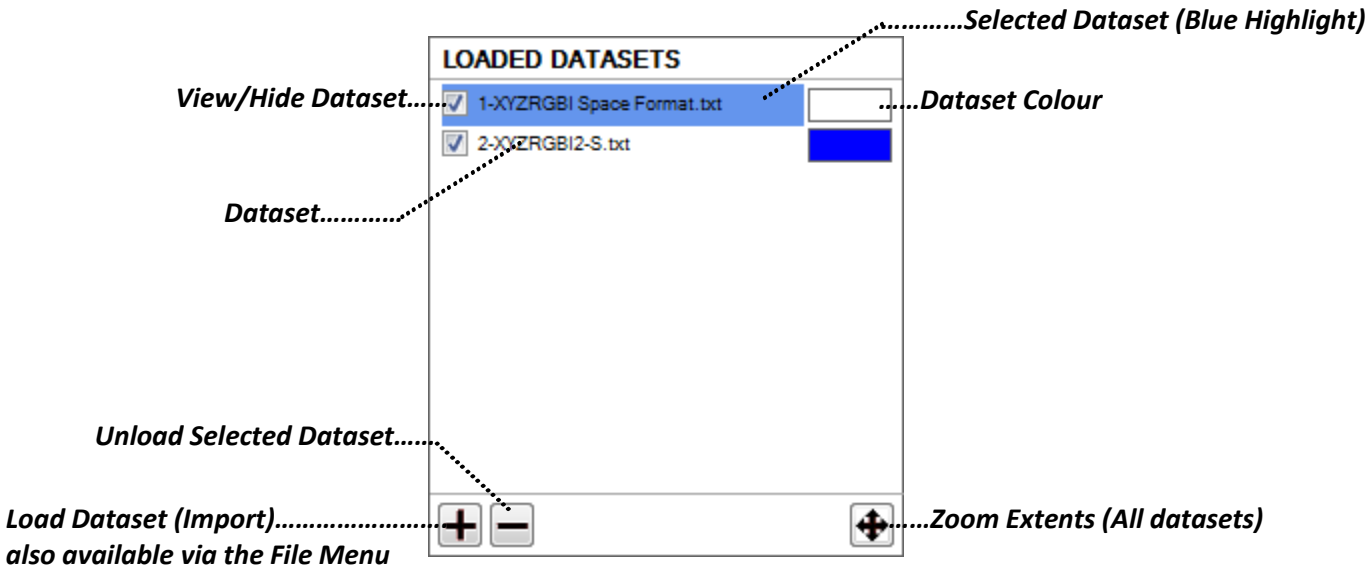

Figure 3 - Loaded datasets command area

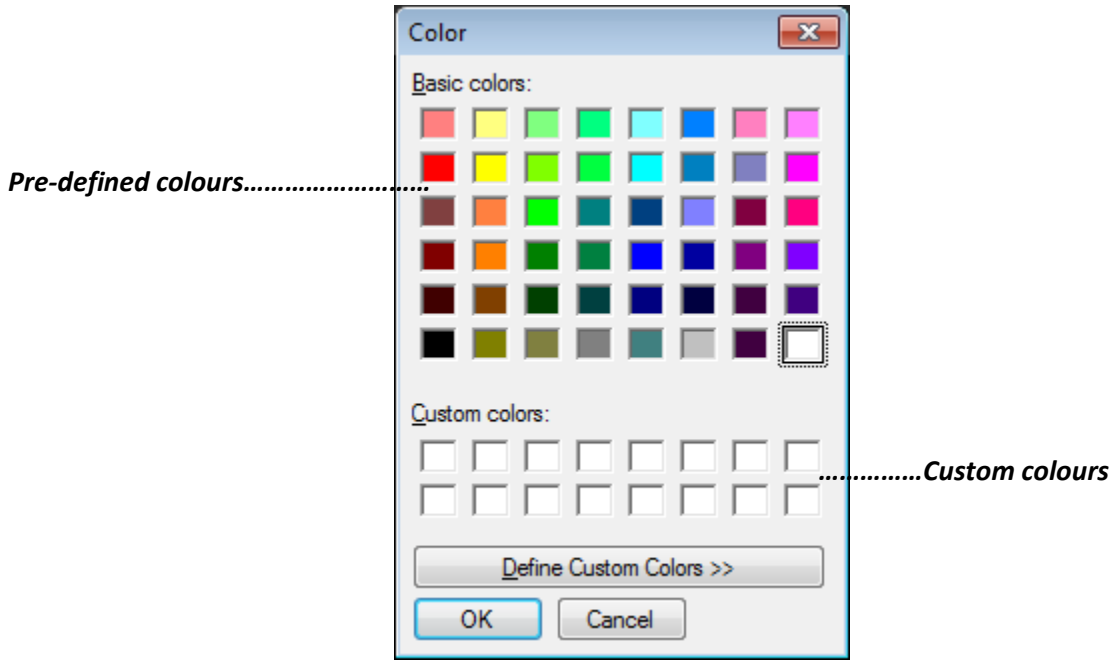

Figure 4 – Colour dialog (accessed by CLICKING the Dataset Colour command)

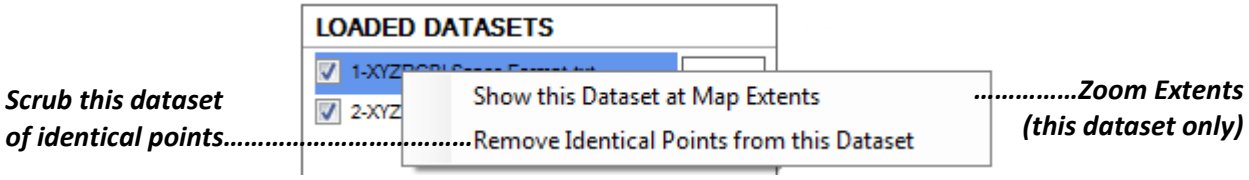

Figure 5 - Loaded dataset's shortcut menu

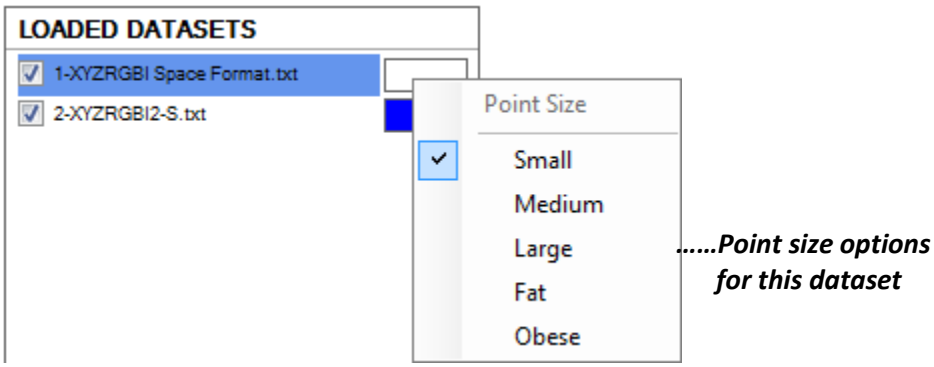

Figure 6 - Dataset Colour's shortcut menu

View Command Area

The *View* command area contains the commands pertaining to the different point cloud viewing options that are available in ATLAS. The viewing options generally involve the colouring options and density for the point cloud(s). The following figure illustrates the commands within the *View* command area. There are NO shortcut menus for any of the commands in this area.

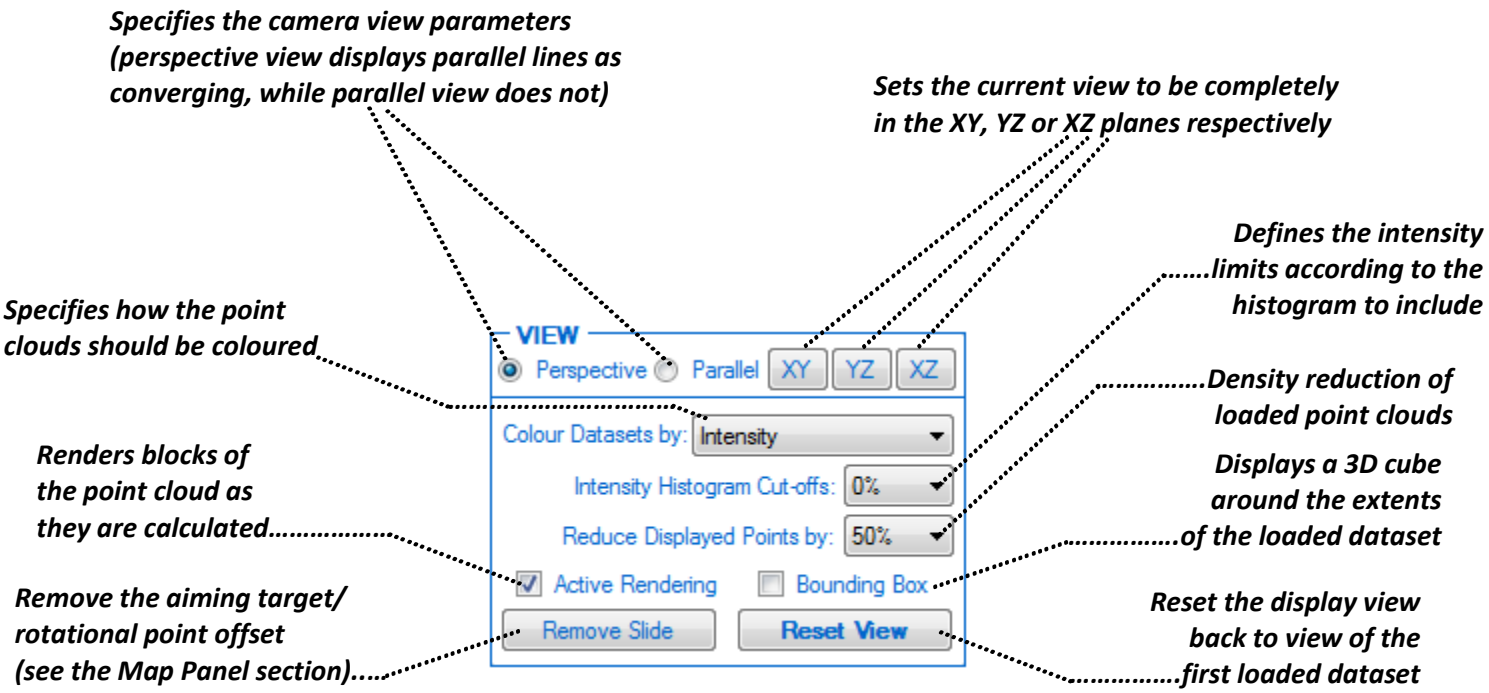

Figure 7 - View command area and respective commands

Select and Delete Command Area

The *Select* command area contains the commands allowing the user to select and manage a subset of all the loaded and visible point cloud datasets. A single or combined selection set can be created by the user and used along with point cloud management options, such as deleting points or viewing an intensity histogram, or with processing options (discussed in the next section). The following figure illustrates the commands within the *Select and Delete* command areas. There are NO shortcut menus for any of the commands in these areas.

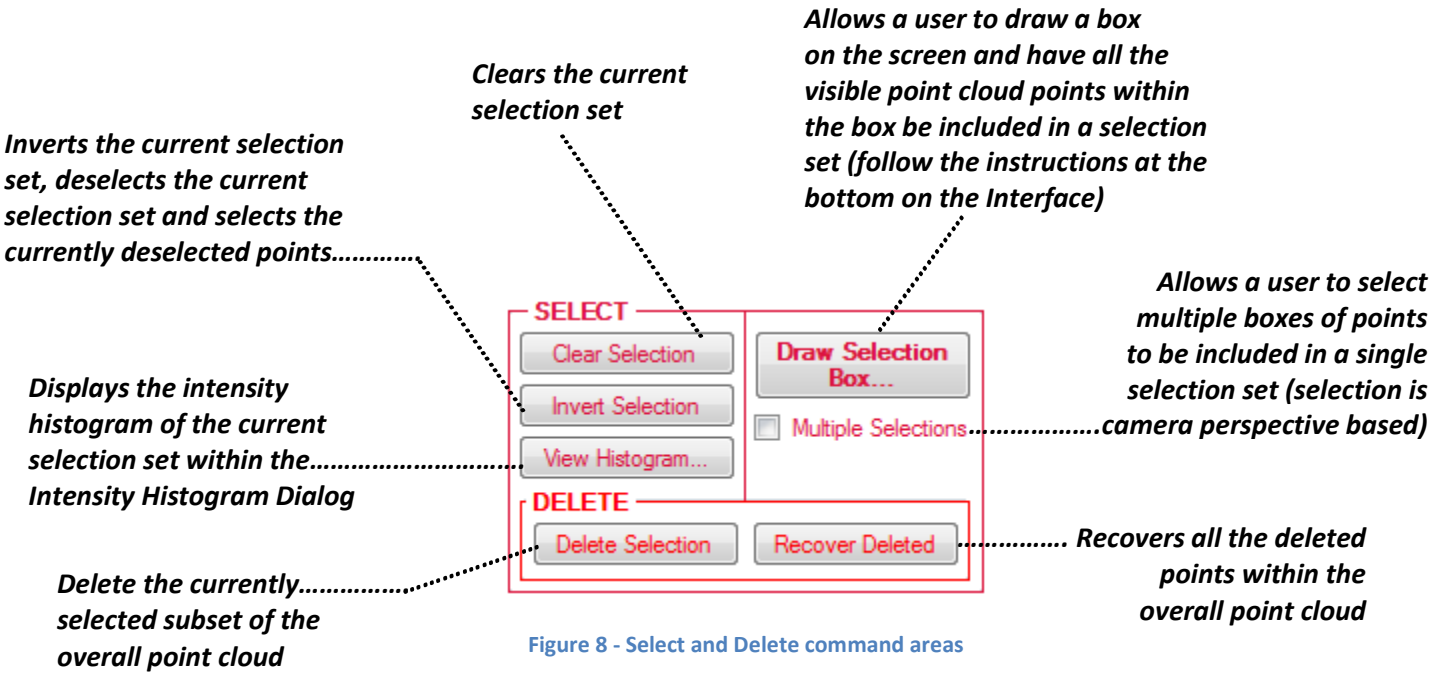

Figure 8 - Select and Delete command areas

Registration Targets Command Area

The *Registration Targets* command area contains the commands allowing the user to process the current selection set of point clouds points for identification of one of two types of registration targets. The two types of targets that are supported within ATLAS are planar targets that contain a solid colour circle on a highly contrasting solid background (see figure 10) as well as a spherical target (see figure 11). ATLAS has been designed to process the current selection set and apply either circular or spherical geometric form fitting in order to determine the best fitting respective shape (using least squares analysis) along with the 3D coordinates of the centroid of the shape. The successfully processed targets will be graphically represented on the screen as well as listed within the *Registration Targets* command area. The processed list of targets can be exported to a .csv text file allowing the processed targets to be later imported back into ATLAS if necessary. Additionally, target points can be manually selected from within the point cloud. The ***Registration Targets Colour*** command serves different purposes which are accessible by **CLICKING** and **RIGHT-CLICKING** the command to access the colour and line weight options, respectively. The following figure illustrates the commands within the *Registration Targets* command areas.

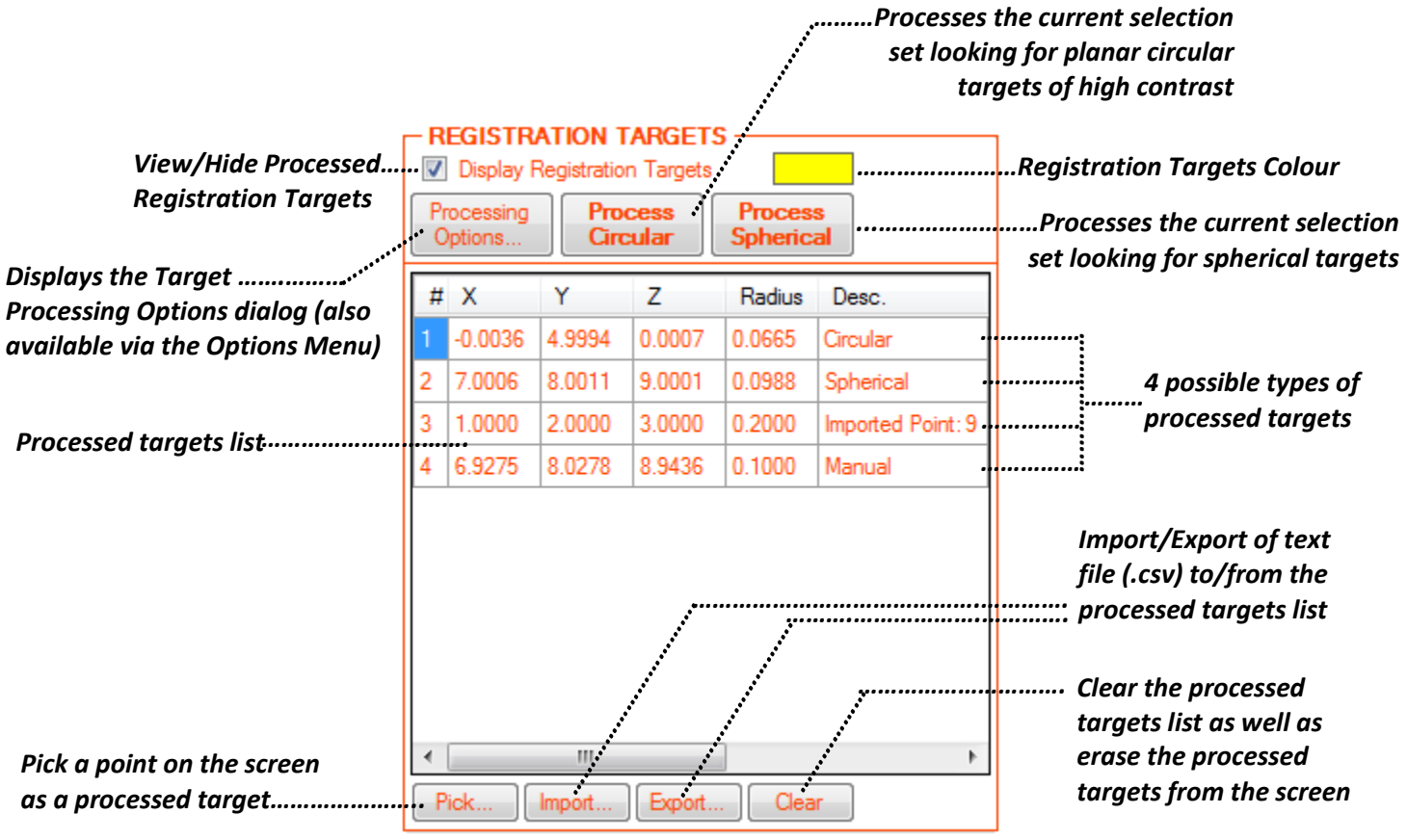

Figure 9 - Registration Targets command area

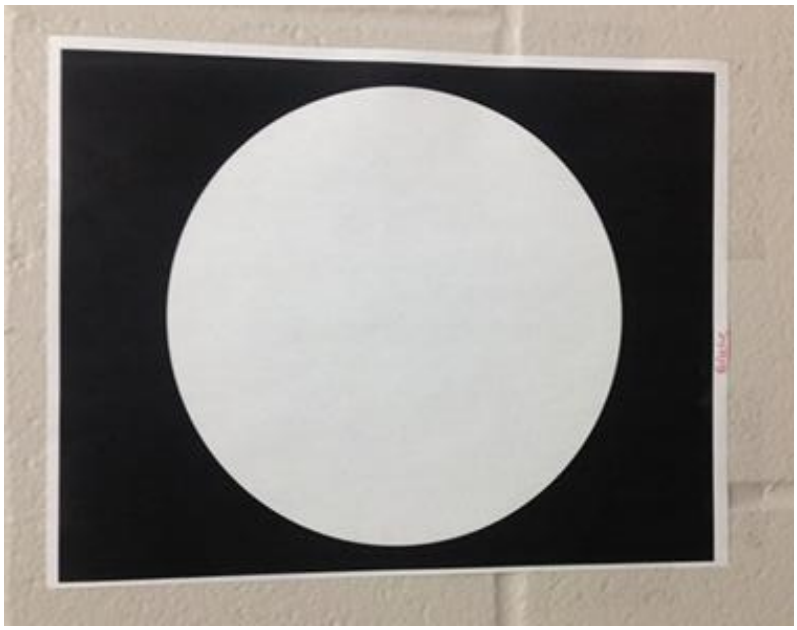

Figure 10 - Planar Circular Target (easily created by a user)

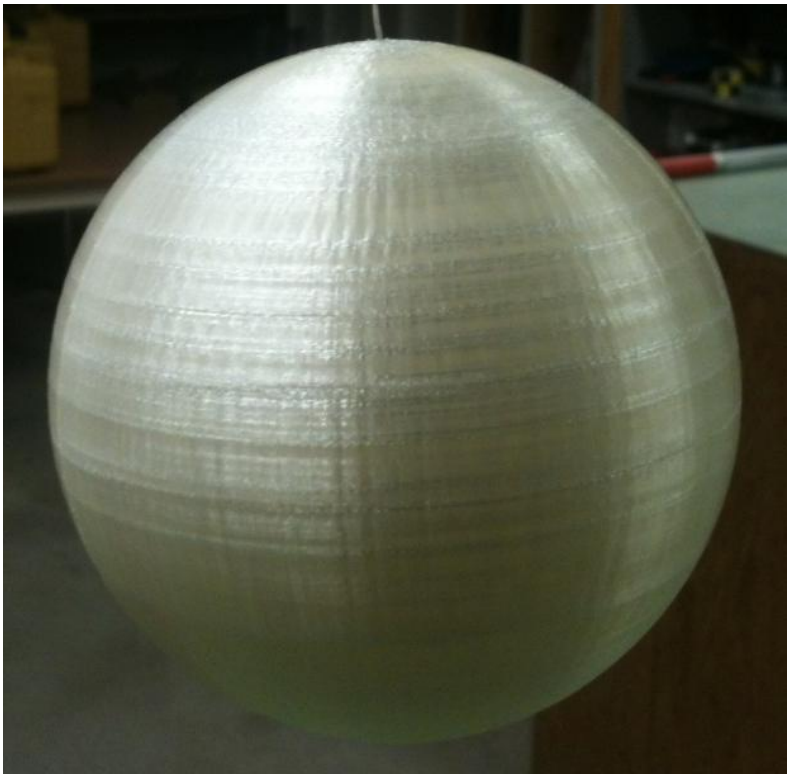

Figure 11 - 3D printed spherical target (more difficult, but can be created by a user)

Map Panel

The *Map Panel* within ALTAS refers to the primary portion of the entire Interface. The *Map* Panel is the area within ATLAS where a user will view and interact with the point cloud datasets. Though the most obvious purpose of the *Map Panel* is for viewing point clouds it does serve another important purpose. The *Map Panel* allows the user to use their mouse to interactively change the vantage point from which the point cloud datasets are viewed. The unique views of point clouds within ATLAS are defined using a **camera** and **aiming target** model where what is displayed within the *Map Panel* is what the camera sees while centering its view on the aiming target. The 3D positions of the camera and aiming target define the scale of the *Map Panel* view along within the orientation of the camera. The aiming target also serves the special purpose of defining the 3D position for which the camera rotations about. The position of the camera and aiming target (and hence the view of the point cloud) can be changed via the following methods:

1. **RIGHT-CLICK** and hold and move the mouse up/down/left/right in order to rotate the camera's position vertically and horizontally with respect to the aiming target (appears to rotate the point cloud).
2. **MIDDLE-CLICK** and hold and move the mouse up/down/left/right in order to shift the camera and aiming target's positions vertically and horizontal (appears to translate the point cloud).
3. **ROLL IN/OUT** using the mouse wheel in order to move the camera's position either closer towards or farther away from the aiming target (appears to increase and decrease the scale of the point cloud, i.e., zoom in and out). The amount of positional change of the camera per mouse wheel turn is a factor of the ***Current Mouse Wheel Zoom Level*** (see figure 12) control that is located in the upper right corner of the *Map Panel*. Sliding the bar lower will slow the amount of positional change per wheel roll while raising the bar will increase the amount of positional change per wheel roll. The default settings is 60%.
4. Turn on the camera/target navigation buttons (**Options→Mouse Navigation→Camera/Target Navigation Buttons**) and click any up/down/left/right button for either the camera or aiming target to have the camera or target rotate 15^0 horizontally or vertically (see figure 12).
5. Using the ***Pick Camera Position*** command or ***Pick Aiming Target Position*** command allows a user to select a point within the point cloud to be used as the position of the camera or aiming target. This is helpful if a user wants to setup a specific field of view (or vantage point) quickly and accurately (see figure 12).
6. The last option for interactively viewing a point cloud using the *Map Panel* is by introducing a ***Slide*** offset into the current *Map Panel* view. A slide offset disconnects the aiming target's 3D position and the camera's rotational point. By default these 2 points coincide but introducing a slide offset allows for the camera to aim at one 3D point while rotating about another point. A slide is introduced by checking the ***Slide*** command box and then **CLICKING** and holding anywhere on the *Map Panel* and then moving the mouse up/down/left/right. This viewing option is not anticipated to be used often but can provide some unique vantage points in which a user can view a point cloud. It should be noted here for completeness that the slide offset is removed using the ***Remove Slide*** command found in the *View Command Area*.

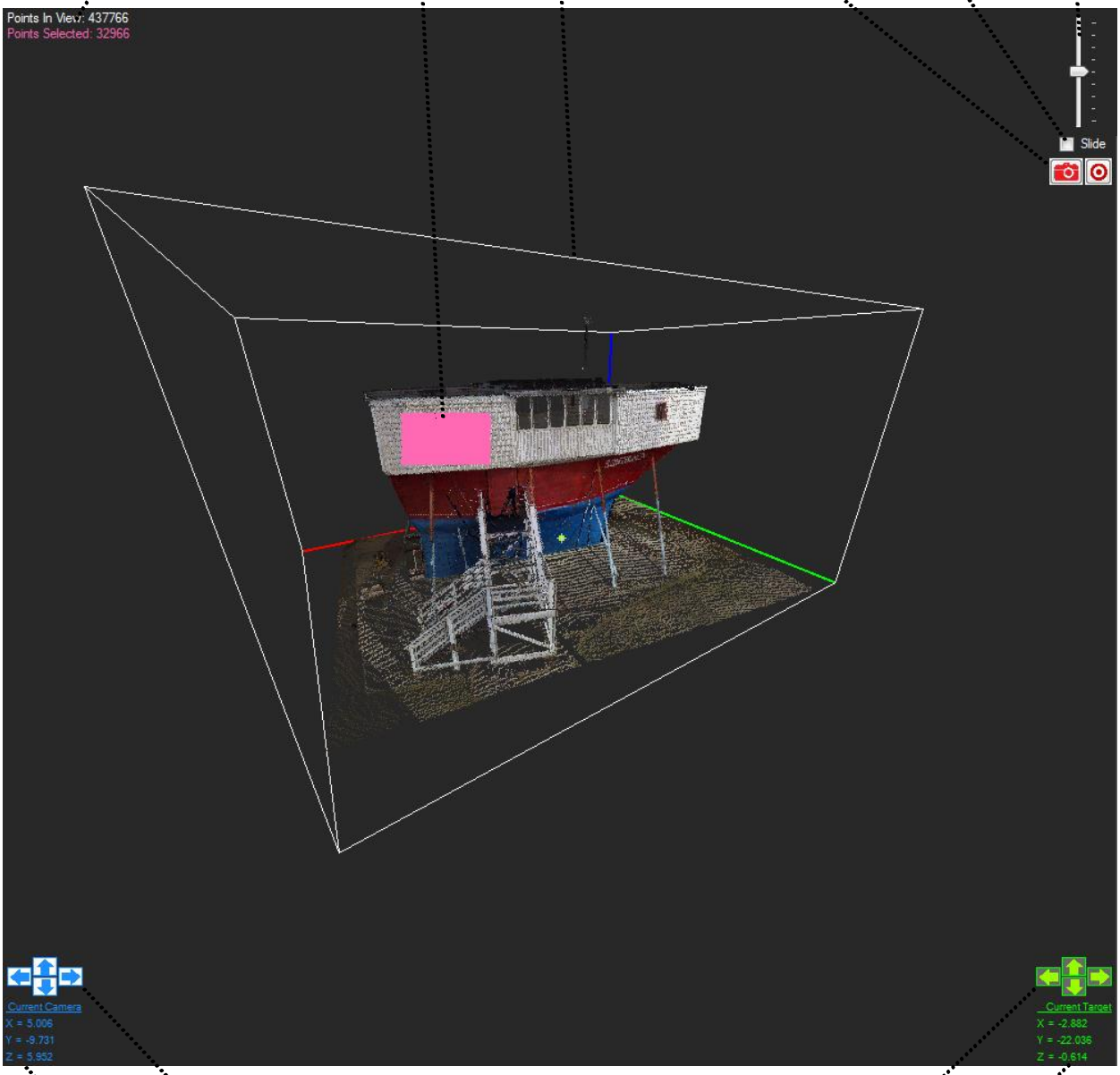

Figure 12 - Map Panel (Perspective View)

Additional Dialogs

In order for specific functions to operate properly within ATLAS, certain additional questions need to be answered or additional selections need to be made. This additional input is queried from the user via the use of *Additional Dialogs*. The *Additional Dialogs* that a user will encounter while using ATLAS are:

1. *Open File Dialogs*
2. *Save File Dialogs*
3. **** Point Cloud Text Format Options Dialog*
4. *Intensity Histogram Dialogs*
5. *Target Processing Options Dialog*
6. *Registration / Georeferencing Options Dialog*
7. *Transformation Parameters Dialog*

Open File Dialogs

Open File Dialogs appear very frequently within ATLAS. They are used to specify a file on a user's computer that is to be read-in to ATLAS. The types of files that can be read-in to ATLAS include:

a) LiDAR Laser Scan files (.LAS)
b) Topcon Raw Scan files (.CLR)
c) Topcon Point Cloud files (.CL3)
d) ASCII Text Point Cloud files (.TXT) ***
e) ASCII Text Survey Points file (.CSV)

Open File Dialogs are used with the following commands:

- ***Load Dataset*** command found in the *File Menu* and the *Loaded Datasets* command area
- ***Import Processed Targets*** command found in the *Registration Targets* command area
- ***Import Control Points*** command found in the *Registration/Georeferencing Options Dialog*

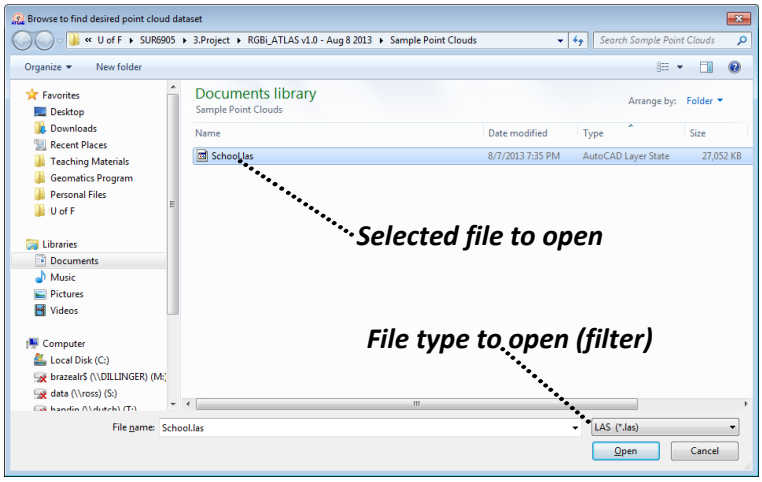

Figure 13 - Open File Dialog

Save File Dialogs

Save File Dialogs also appear very frequently within ATLAS. They are used to specify a filename and location on a user's computer where an output file from ATLAS will be created. The types of files that can be created using ATLAS include:

a) LiDAR Laser Scan files (.LAS)
b) ASTM Point Clouds (.e57)
c) ASCII Text Point Cloud files (.TXT) ***
d) ASCII Text Survey Points file (.CSV)
e) Joint Photographic Experts Group Image files (.JPG)

Save File Dialogs are used with the following commands:

- ***Export Dataset*** command found in the *File Menu*
- ***Save Display Image*** command found in the *View Menu*
- ***Export Processed Targets*** command found in the *Registration Targets* command area
- ***Export Control Points*** command found in the *Registration/Georeferencing Options Dialog*

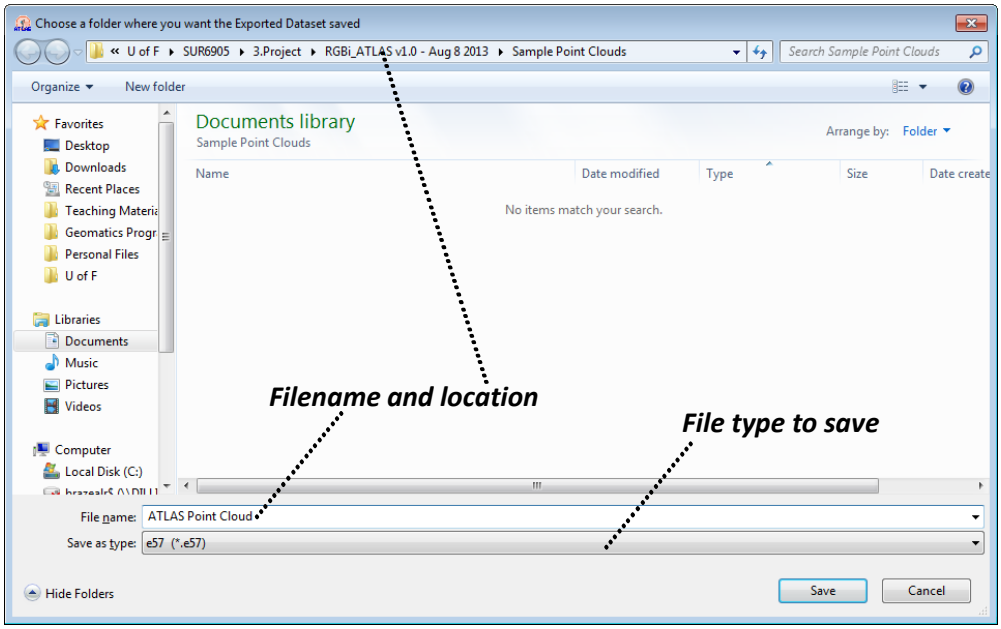

Figure 14 - Save File Dialog

*** Point Cloud Text Format Options Dialog

The *Point Cloud Text Format Options Dialog* appears whenever a user wants to read-in or write-out an ASCII Text Point Cloud file (.TXT). This dialog is used to facility support for a wide variety of format options. The dialog contains a list of common pre-defined point cloud text file formats as well as an input option where the user can define a custom text file format for up to seven delimited columns.

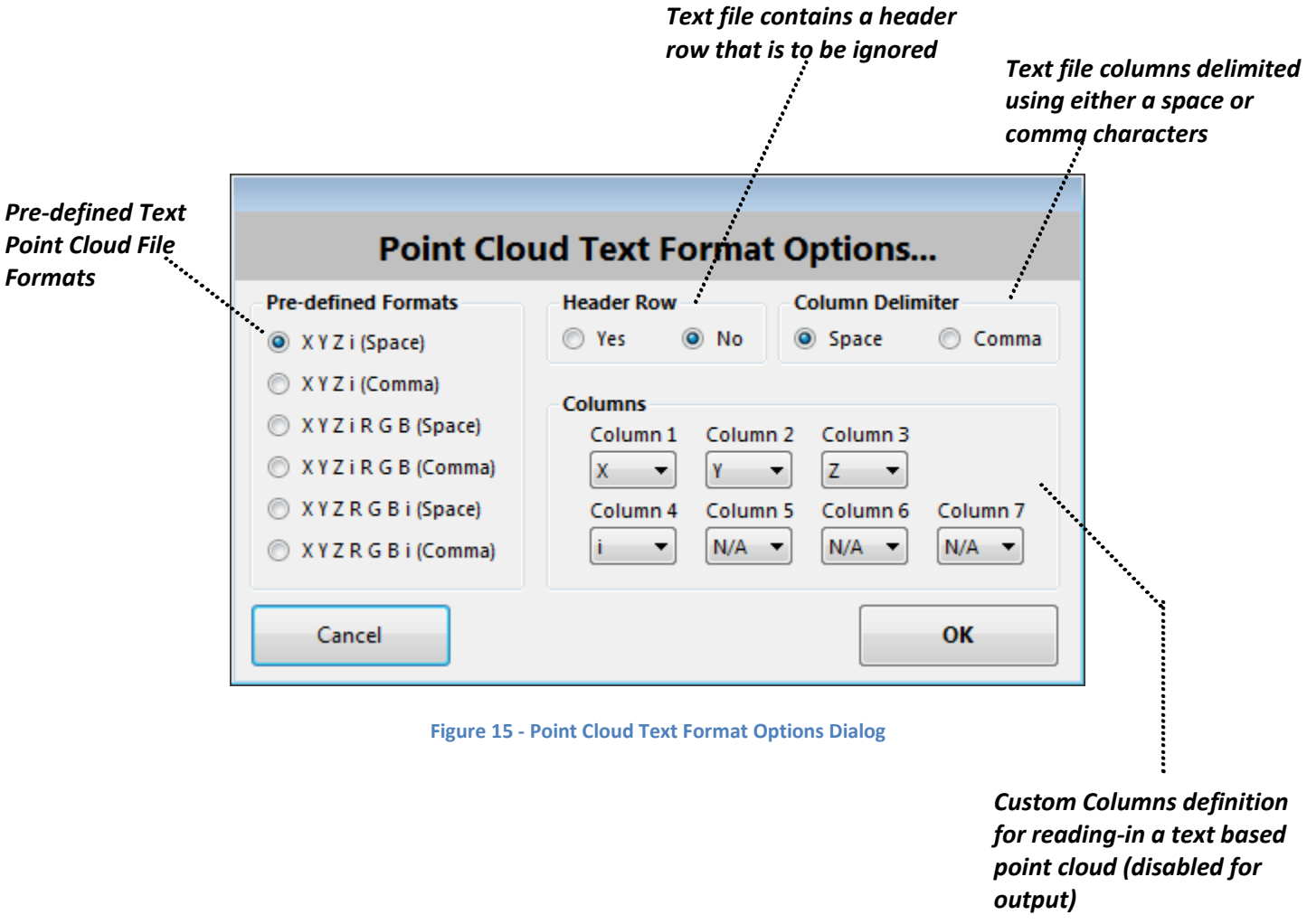

Figure 15 - Point Cloud Text Format Options Dialog

Intensity Histogram Dialogs

The *Intensity Histogram Dialog* is used to display to the user the distribution of the points within either a current selection set or within the overall point cloud according to the range of intensity values. Only points within loaded and visible datasets are included in the histogram data. The colouring scheme used for displaying points according to their intensity is based upon the following colour ramp:

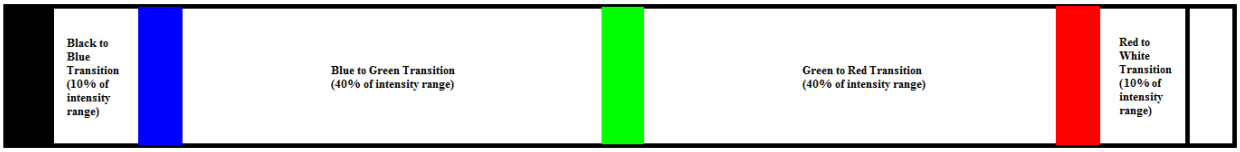

Figure 16 - Intensity Colour Ramp Scheme

End cut-offs can be applied to the histogram data to excluded points within a certain percentage of the overall point count distribution. This cut-off is applied to both the beginning and end of the intensity distributions. The *Intensity Histogram Dialog* displays a transparent mask over these cut-off regions and then re-adjusts the colour ramp based on the new intensity range. The point cloud in the *Map Panel* will also be adjusted to show/hide points only within the intensity limits (if colour by intensity is selected). The intensity cut-offs can be specified within the *View Command Area.* The *Intensity Histogram Dialog* can be viewed from the ***View*** menu (for all points) or from the *Select Command Area* (for only the points within the current selection set). The *Intensity Histogram Dialog* is a unique dialog in that it can remain open while navigating and processing a point cloud within the *Map Panel*. The refresh button on the *Intensity Histogram Dialog* allows a user to refresh the view when a new selection set is selected or an existing selection set is updated.

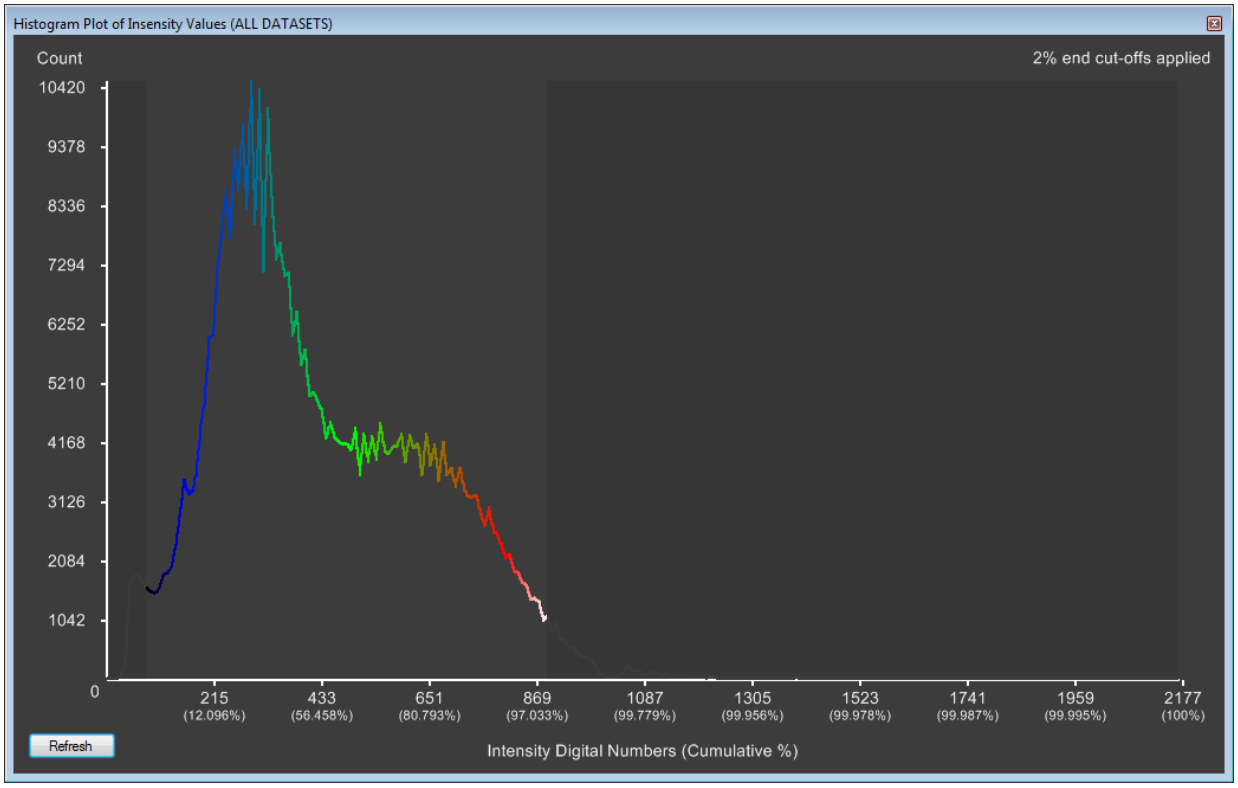

Figure 17 - Intensity Histogram Dialog (for ALL active points within the point cloud)

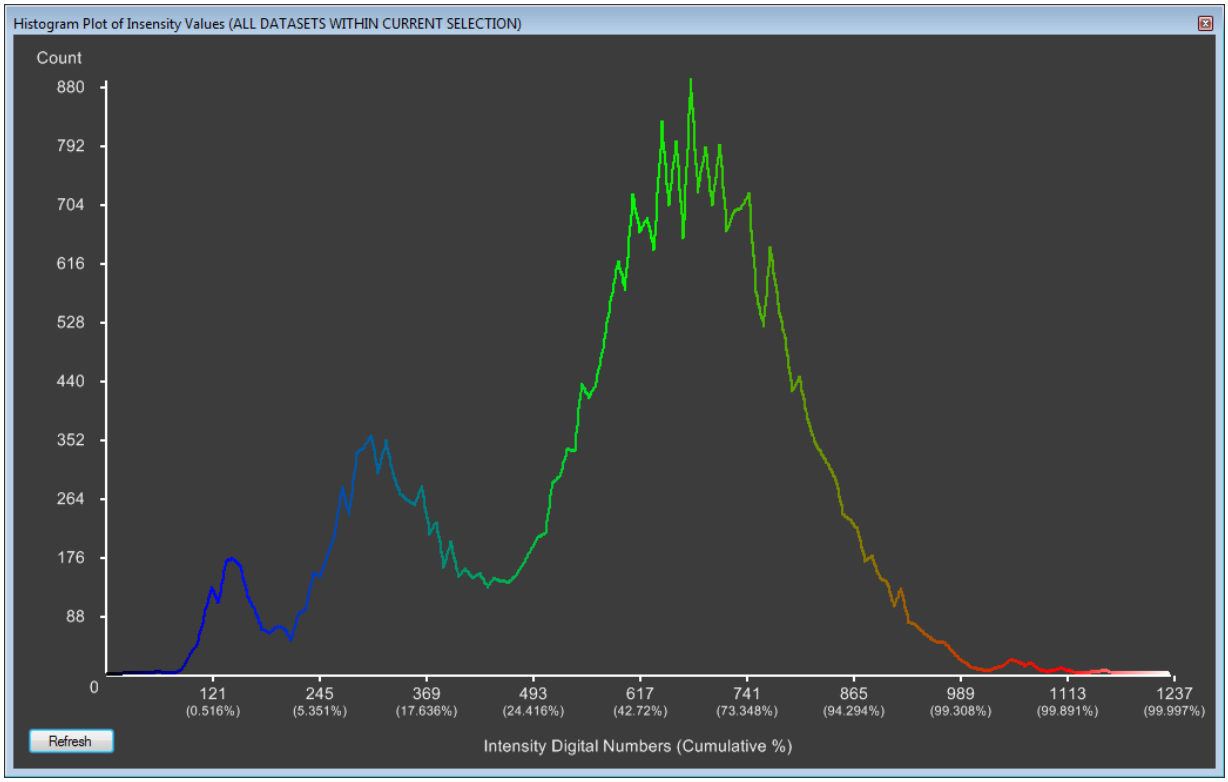

Figure 18 - Intensity Histogram Dialog (for the current selection set)

Target Processing Options Dialog

The *Target Processing Options Dialog* is used by a user to specifically set mathematical procedures and limits for the automated identification of either circular or spherical registration targets. The dialog can be accessed via ***Options→Target Processing…*** or by **CLICKING** the ***Processing Options…*** command within the *Registration Targets command area.* The first option to set applies to both circular and spherical target processing and is the maximum number of iterations that the processing algorithms will attempt to complete while looking for a converging solution for the best-fitting target. The remaining processing options all apply to the processing of circular targets. ATLAS attempts to discover the edge points of the circular target with respect to its high contrast background from intensity data about the representative point cloud. These edge points are determined using one of three ways, as selectable by the user within the *Target Processing Options Dialog*. The three options are:

1. ***Middle 1% of Intensity values for selected points*** option analyzes the intensity histogram for the current selection set and uses 0.5% of the points on either side of the 50% cumulative distribution point. This option assumes a near equal distribution of point cloud points that fall inside and outside of the circular target.

2. ***Average middle intensity values determined from max. histogram peaks for black and white points*** option analyzes the histogram and attempts to identify the two highest peaks (counts) of intensity values above and below the 50% cumulative distribution point. Once these peak intensity values are identified the 1% of intensity values at the midpoint of these peaks is used as the circular edge points.

3. ***Fixed Range of Intensity Values*** option allows the user to manually set the upper and lower intensity values that are to be used to represent the circular edge points.

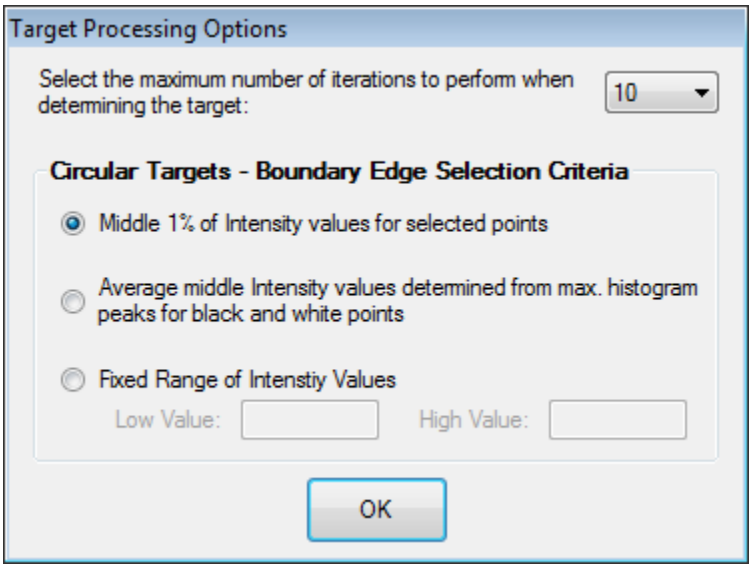

Figure 19 - Target Processing Options Dialog

Registration/Georeferencing Options Dialog

The *Registration/Georeferencing Options Dialog* provides the user with the tools to register/georeference individual point cloud datasets together and create a homogeneous 3D model of the subject or area of interest. The registration process and the georeferencing process both utilize the same process but only different with respect to the control points' coordinate frame. The process involves a user selecting a processed target within a point cloud that represents a known control point. By assigning a processed target's coordinates as being representative of a known control point creates what is referred to as a **tie-point.** Once an individual dataset has at least three tie-points defined, it can be registered/georeferenced using a 3D conformal transformation. The control points can be manually added to the ***Control Points List***, imported from an existing points .CSV file or copied from the ***Processed Targets List***. Control points can also be exported to a points .CSV file for later re-use. Once a dataset(s) is ready to be registered/georeferenced a user **CLICKS** on the ***View Transformation Parameters…*** command to display the seven conformal transformation parameters that were solved within the *Transformation Parameters Dialog* (see the next section for more details).

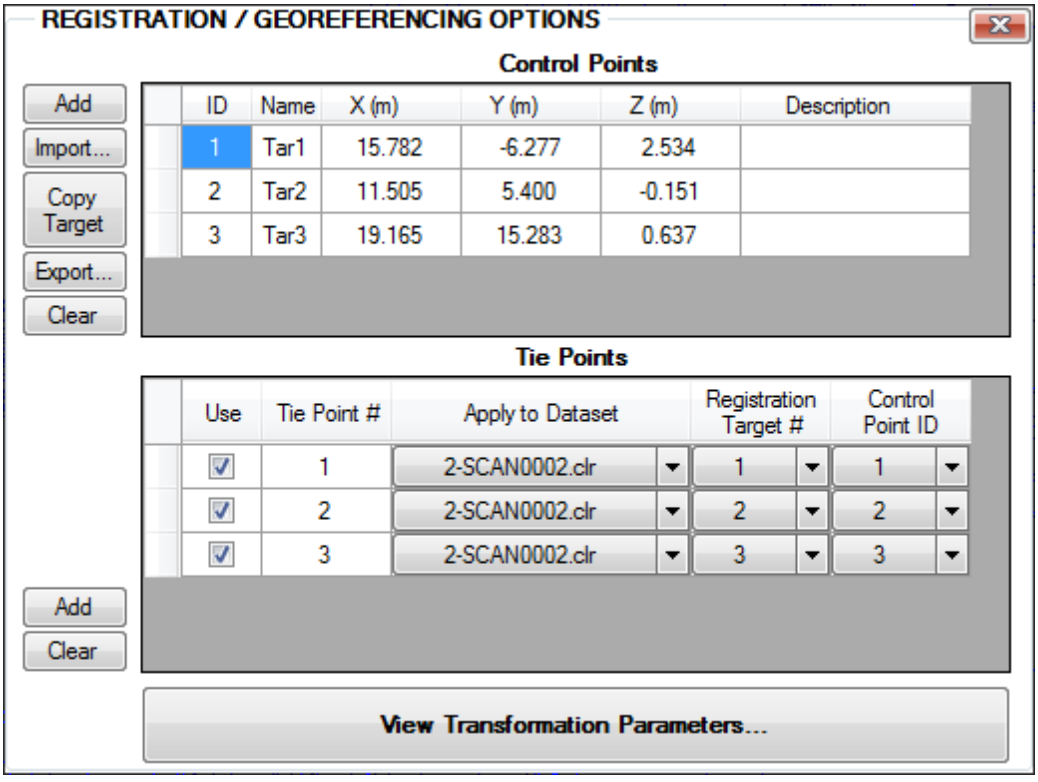

Figure 20 - Registration / Georeferencing Options Dialog

Transformation Parameters Dialog

The *Transformation Parameters Dialog* serves two purposes. First, it provides a consolidated view of the seven parameter conformal transformations for each loaded point cloud dataset. If no transformation has been solved for a specific dataset a user will see no transformation values present. This dialog provides a way for a user to examine the quality of the transformation values by displaying the standard deviation (1 sigma) for each solved transformation parameter when the user cursors their mouse over a respective cell value. The standard deviation for this underlying parameter will be displayed in the bottom left-hand corner of the dialog. Lastly, this dialog allows the user to apply or un-apply a transformation to a respective dataset. If the command button on the right end of a dataset's transformation parameters' line is enabled and states ***Apply*** then a user can **CLICK** this button to have the dataset of interest transformed and re-displayed in the *Map Panel*. If this command button however states, ***Unapply*** then a user can **CLICK** this button to have the dataset of interest un-transformed (i.e., reset) and re-displayed in the *Map Panel.* In order for changes to be made to existing tie-points, that have been used to transform a dataset, the dataset must be first reset. Then changes to the tie-points can be made, a new set of transformation parameters can be solved and applied to the original dataset.

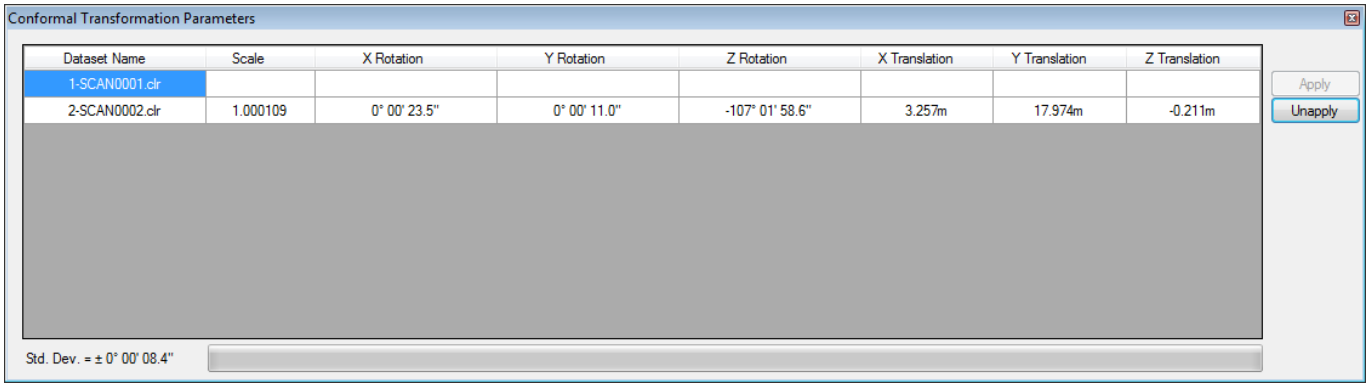

Figure 21 - Transformation Parameters Dialog (Transformation has already been applied)

NOTES