Veesus
Arena4D
Data Studio

User Guide

Software Version 7.0

June 2020
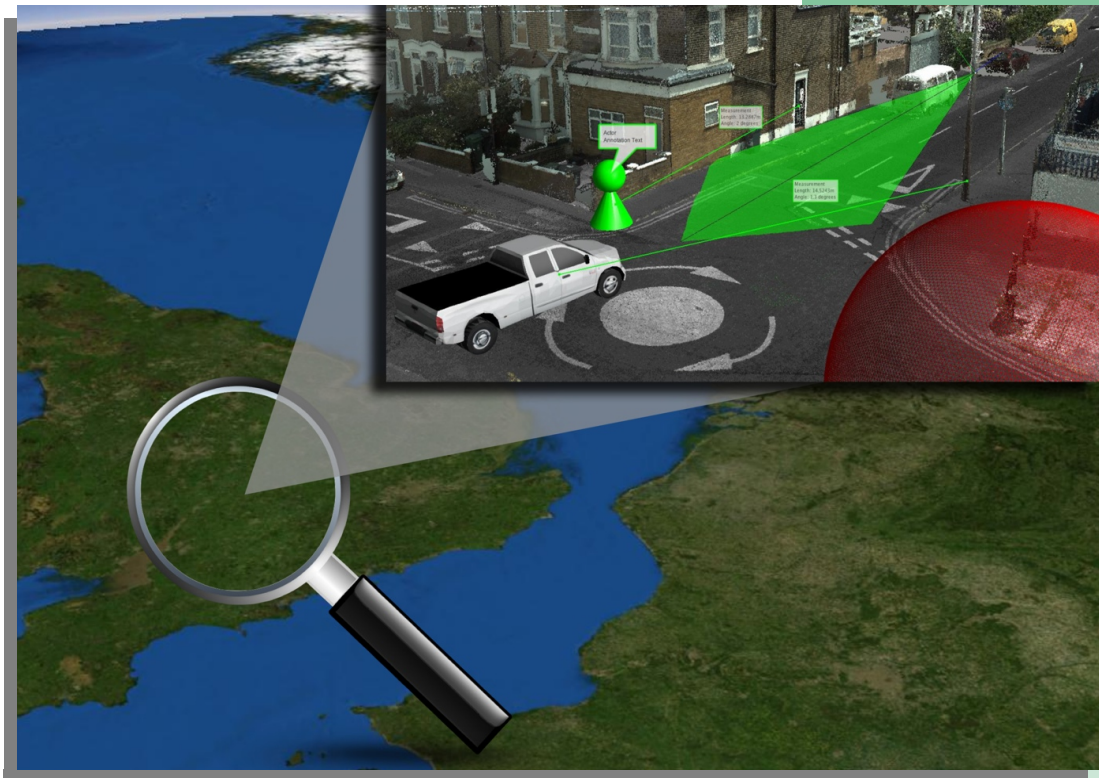
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1 Introduction

1.1 *About*

Welcome to the User Guide for the Veesus Ltd Arena4D Geographic Information System (GIS) 3D visualisation tool.

Arena4D is a true 3D GIS tool, that incorporates a point rendering engine at its core, that allows the rapid loading and visualisation of massive point cloud data sets. It is multi-platform and has been designed to be as simple and intuitive. The core premise behind Arena4D was to take Light Intensity Direction And Ranging (LIDAR) data, make it easy to use and accessible to non-expert users (and on commodity grade PC's), and add context to the 3D LIDAR data, by provided the ability to load many other data types to the same 3D view (Panoramic images, documents, photos, audio, etc). Adding the forth dimension of time allows all of this combined data to be presented in a manner that can be purely analytical or to allow the user to "tell a story". The software has the ability to export all visualisation data into other formats, such as Powerpoint, PDF, Image Files and 4K video including 360 Panoramas, for presentation and reports.

Conceptually, any projects that are saved in Arena4D are termed "Arenas".

1.2 *Installation*

Installing on Windows the install process is straight forward. Arena4D ships with all dependencies and is a self contained application. No DLL's are installed in system folders and no registry entries are created.

Configuration files that are generated by Arena4D to tailor your installation and save your user preferences are stored within your default User area (e.g. C:\Users\Joe Bloggs\Arena4D).

1.2.1 Windows

Simply run the provided installation executable and follow the on screen prompts. The installer will create an uninstaller file and place an entry in the Windows Control Panel should you wish to delete Arena4D.

1.3 *Licensing*

Arena4D runs in **Free** mode without any license allowing limited functionality. Also available in **Standard** and **Professional** versions each featuring increased functionality.

See Veesus website for pricing and features.

With the exception of **Free** always shown in green throughout this document, all additional features are in the **Standard** and **Professional** version.

Note: *some of the screen shots throughout this manual may or may not be representative to every install.*

2 Getting Started

2.1 *Screen Layout*

The Arena4D application uses a docking framework allowing you to arrange windows as you please. The default layout features five main windows. The **Project Window** (on the Left), **View Window** (in the middle), **Tool Window** (on the right), **Status Window** (on the bottom left) and the **Output**, **Animator** or **Status Window** (on the bottom middle).
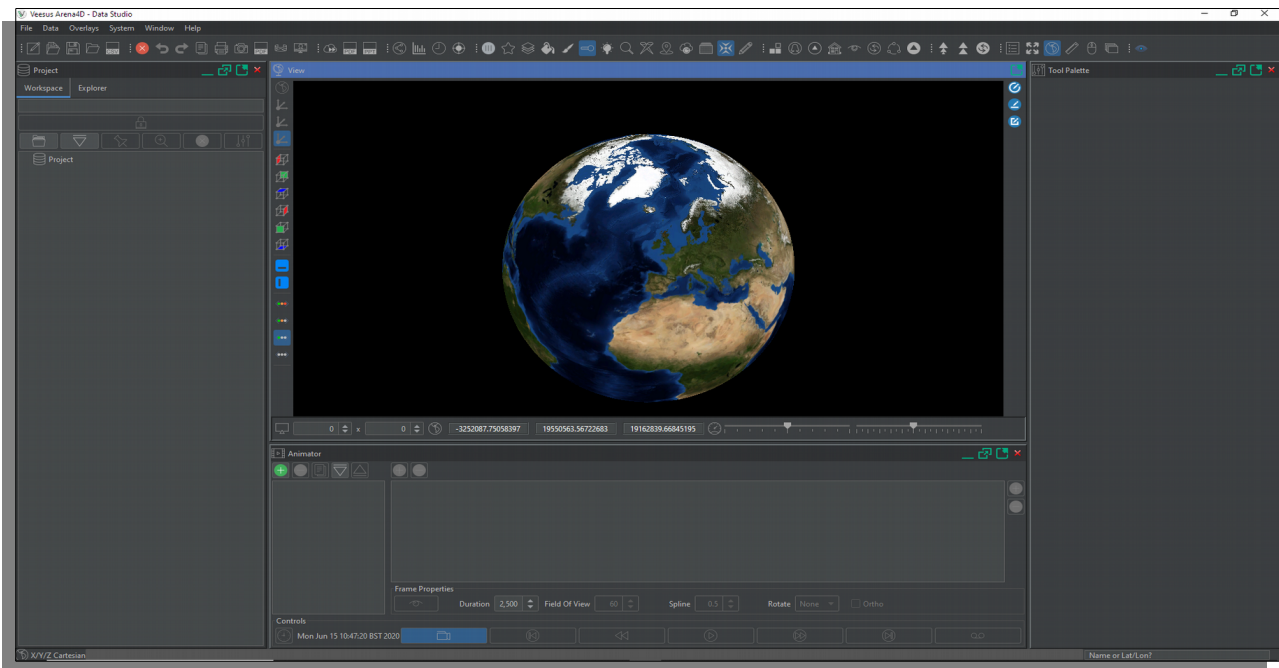
All windows can be resized, stacked or reordered by simply dragging them around. The window toolbars allow you to minimize, restore, maximize, externalize or remove windows. Minimized windows appear to the left of the application.

All Windows can be quickly reset back to default position clicking the restore windows icon
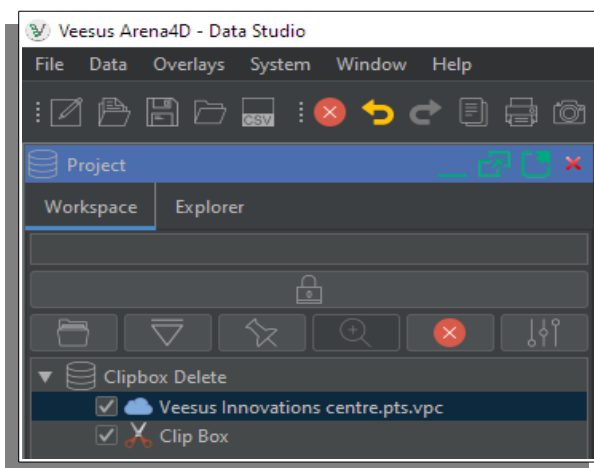
2.1.1 Workspace Tree

Shows any data loaded in an Explorer tree like structure, any description that has been saved with the current Project and the properties of any selected object within the tree.

Double clicking any item in the Workspace Tree will "zoom" the view to that data object.

2.1.2   Workspace Tool Bar

Featuring icons for commonly used features.

Password projects.

Folder, Import, Georeference, Zoom, Remove, and Properties.

2.1.2.1   *Password*

If password protected the project will need the correct password entered to reload or open in a package. Select the project to password protect, click the password icon and enter the password. If a password already exits this will need entering first.

2.1.2.2   *Folder*

Folders have no real properties but represent folders in the Workspace Tree to allow grouping of data into sub folders and separate categories. Folders can added to the Animator tool see section 15.1.2 Adding Data Objects

2.1.2.3   *Import*

Import "Data Studio" data objects that have been exported from "Data Studio". The Imported .xml files retain all the properties ie. position, rotation, etc.

2.1.2.4   *Georeference*

The data object currently selected in the Workspace Tree window will be Georeferenced by clicking on the globe where you would like the data to appear or by dragging the position pin using the mouse. Finalise the position pressing the enter key.

2.1.2.5   *Zoom*

Will zoom the view to the data object currently selected in the Workspace Tree, distance from object will be dependant upon data type etc.

2.1.2.6   *Remove*

Removes the data object currenly selected in the Workspace Tree.

2.1.2.7   *Properties*

Properties for each data object can be edited as per section 4.2 Object Properties.

2.1.3   Project Explorer

Arena4D stores Projects in a special area called a **Repository**. This is simply a folder that is accessible by your current computer, therefore it may be on your local hard drive *or* a network area. *Note: It is strongly recommended that this is on a local drive and preferably an SSD (Solid State Disk) for performance reasons.*

When you save a Project, the external data (Point Clouds, 3D Models, CAD, Maps, Panoramas etc.) that you have added are **not** copied to the repository.

Projects can be managed from the **Explorer Window** with the following features:

- **Search** your Repository via a filter box.
- **Add** Projects.
- **Remove** Projects.
- *** Open** a Project.
- **Export** Projects.
- **Rename** a Project.
- **** Package** a Project.
- ***** Verify** a Project
- **Location** repository physical disk location for projects.
- **Server** List of servers for served network projects.
- **Refresh** Explorer List.
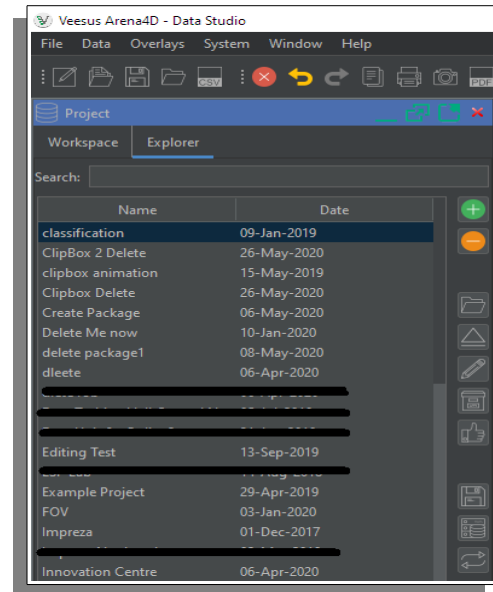
2.1.3.1   **Package**

Creates a self launching executable with all the Data contained within or references to the data (selectable option). This allows simple distribution and limited exploitation without the need to install Data Studio, import/load data etc. Select the project to package, click the package icon, choose destination folder and whether to include files. Once complete a directory with the name of the project will have been created.

2.1.3.2   * Open

Opens the selected project, but if additional Data Object File(s) are not found, notification will be given and the option to find the files(s). Once all files have been located the project is saved corrected and opened.

2.1.3.3   *** Verify

Verifies the selected project can find all of the additional Data Object files. If they are not found, notification will be given and the option to find the files(s). Once all files have been located the project is saved corrected.

Note: if a Project will not load for any reason select it, then press the Verify option.

2.1.4   Output Window

The **Output Window** shows the progress of any long running tasks, such as exporting movies or importing point clouds. It also features a cancel button allowing termination any of these tasks.

2.1.5   Animator Window

The **Animator Window** is used to generate animations that can be run in real-time and also to create movies and static pictures of each frame etc. All data objects can be used in the animator. See section 15 Animator Tool for details.

2.1.6   View Window

The **View Window** features the globe visualisation window with an image of the earth and the local viewer. This is the 3D viewing area where your data will be visualised.

Above the 3D viewing area is the application **Tool Bar** that features all the menu options available in Arena4D.

The **Tool Bar** has nine distinct sections:

File: used to Open/save Projects, data files and import raw CSV data.
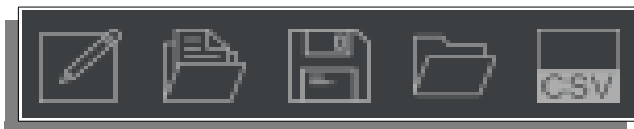
System: commonly used features such as Clear, Undo, Redo Copy, Print, Screen Grab, Generate PDF, Panorama Generation and Presentation mode.

Export: tools to export Point Cloud(s) as different formats, PDF and Power Point formats.

Exploitation: features that enhance the operation of Arena4D, such as 2D map, Live Feed, Measure Terrain, Time and View from Point.

Point Cloud: specific Point Cloud tools such as Alignment, Clash Detection, Classification, Colouring, Editing, Filling, Lighting, Magnify, Point Cloud ID, Point Survey, Register, Shader, Snap to Point and Vector Drawing.

Navigation: control and view related options such as Align, First Person, Nudge, Orthogonal, Reorientate, Reset, Rotate, Rotate View.

Terrain: tools to perform Exaggeration, Offset and Reset the Terrain.
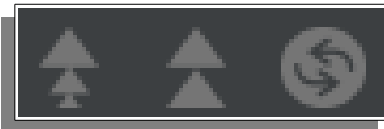
Controls: features that control interactive functions Annotation De-clutter, Full Screen, GIS mode, Imperial Units, Position Tool and Restore Windows.

Annotation Declutter – Displays the annotation either side of the screen with a line to the correct annotation area.

OSX Retina – The monitor button enables/disables retina mode on OSX.

Fullscreen Mode – Displays the view in full screen. Press "Shift" + "Esc" to return.

GIS – Enable disable GIS mode.

Imperial Mode – Displays on screen unit in Imperial or Metric.

Position – Enables/Disables positioning tool.

Restore Windows – Restores all the window panes back to default position and size.

Peripherals: control device Oculus Rift for VR Virtual Reality.

At the bottom of the screen is a progress bar which is active whenever any long running disk based operation is running, such as loading or saving of large files.

At the left side of the perspective view a set of position axis controls exist.

Non GIS mode or Non Georeferenced Data: position X up, position Y up, position Z up (default).

GIS mode or Georeferenced Data: these are greyed out as axis is via the georeferenced data or perspective GIS mode.

At the bottom of the tool bar a set of view position controls exist allowing positional view along each axis.

Look Horizontal and Look Vertical are the first two icons, Super Sampling of the point cloud data are the last four icons. First icon being the highest quality sampling.

At the right side of the perspective view a set of drawing tools exist.

Circle simply draws a circle.

Pen draws a continuous line until the '**Esc**' key is pressed.

Rectangle select the two points along an axis and drag the rectangle along the next axis.

Note: the above shown horizontally, but is vertical within the software.

At the bottom of the perspective view in the middle a set of position X,Y,Z coordinates for the eye position exist along with:

Disk drive activity,

Network activity

Perspective data movement control speed via the mouse can be increased or decreased via the slider. The second slider controls the FOV from minimum to maximum.

Perspective view aspect ratio settings, enter 16 & 9 for a 16X9 aspect ratio or any require values. Enter 0 x 0 for full no aspect ratio and fill available space.

2.2   Viewer

The standard viewer is provided to assist working with data that is not georeferenced. Arena4D was originally a GIS solution which worked best with data georeferenced on the globe. The standard viewer allows you to edit point cloud data without worrying about georeferencing it on to the globe.

To view georeferenced data in the standard viewer, simply double click it in the **Workspace Tree** chapter **2.1.1**

2.3 *System Settings*

Arena4D has a number of user configurable attributes. These can be found under the **System Settings** from the System drop down menu.

Selecting the System Settings will bring up a system panel in the **Tool Window** where can select and edit the System Settings.

2.3.1 Angle Precision

Number of decimal places to show for an Angle.

2.3.2 AutoSave

Sets the time out for automatically saving the currently open Arena.

2.3.3 Background Colour

The application background colour of the 3D viewing window. The default is black to represent space.

2.3.4 Data Processing Folder

Arena4D requires a temporary storage area to process data. This defaults to your user home folder. If you would like to change this to a larger or faster drive area then set the folder here.

2.3.5 Elevation Model

Sets how Arena4D should report "Altitude" at any given point. The options are Mean Sea Level (default), Above Ground Level or above Earth Gravitational Model 1996.

2.3.6 Font Background Colour

Sets the background colour of fonts for any overlays on the globe, such as annotations.

2.3.7 Font Foreground Colour

Sets the font colour for any overlays on the globe, such as annotations.

2.3.8 Font Size

Sets the size of fonts for any overlays on the globe, such as annotations.

2.3.9 Full Screen

Sets the full screen stereo options, such as mode, eye separation and swap eyes.

2.3.10 Language

Sets the language of Arena4D.
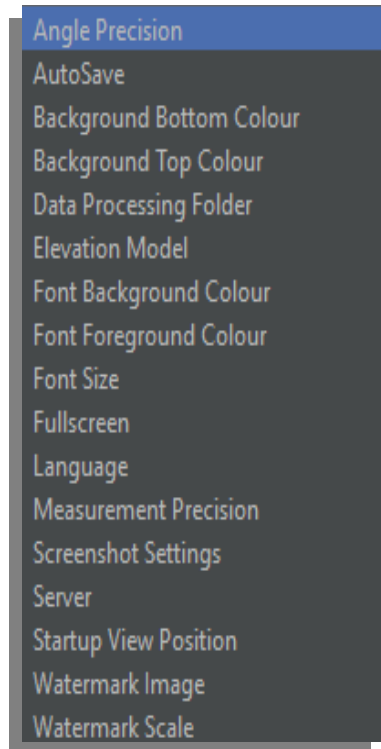
2.3.11   Measurement Precision

Number of decimal places to show for a Measurement.

2.3.12   Screenshot Settings

Sets resolution in width/height, orthographic ratio and the folder where screen shots and PDFs will be stored. The orthographic ratio option "1:X.XX" allows the resulting output file resolution (pixels) to be scaled accordingly. Default value of "0.01" will produce a conversion to centimetres/per pixel. The scale bar accurately reflects scaling

Note: orthographic ratio only happens if the view is in Orthogonal View and width and height values are ignored instead replaced with actual window size.

2.3.13   Server Settings

User name and password for connecting Veesus Point Server.

2.3.14   Startup View Position

Sets the viewing position at which the software will start each time. Default is a zoomed out view of the earth.

2.3.15   Watermark Image

Sets the image that is to be used by the watermark overlay.

2.3.16   Watermark Scale

Sets the size of the image to be used by the watermark overlay.

2.4   *Coordinates*

Arena4D is capable of displaying coordinate information in hundreds of different coordinate system formats. The default is the well known decimal degrees of Latitude and Longitude. However, if you prefer to work in a different coordinate system, this can be configured from the System menu.

Search: 4326	
EPSG Code	Description
4326	WGS 84
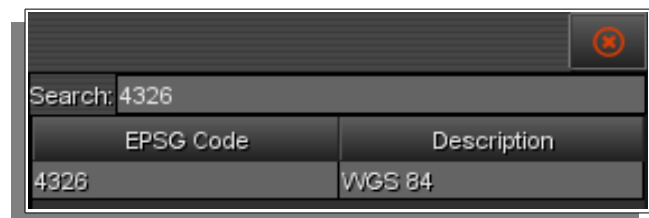
The Coordinate setting screen provides a list of available coordinate systems and their associated EPSG codes. These can be filtered using the filter box at the top.

2.5   *Overlays*

The Overlays menu provides numerous different visual options for the 3D viewing area. The on/off state of each of the visual options is remembered by Arena4D each time you close it; therefore restarting in the state which you left it.

2.5.1   Animator

Shows the position and orientation of Key Frames.

2.5.2   Anti-Aliasing

Smooths jagged edges of screen graphics.

2.5.3   Compass

An animated on screen compass showing current heading and tilt.

2.5.4   Cross hairs

Places a set of cross hairs in the centre of the screen.

2.5.5   Cursor Location

Displays the current location in the 3D world of the cursor. Also displays the distance from the current eye view to the cursor location. This provides a simple distance measuring tool.

2.5.6   EGM96 Offsets

Similar to Cursor Location but instead displays the current eye view position.

2.5.7   Eye Location

Similar to Cursor Location but instead displays the current eye view position.

2.5.8   Globe

Enables and disables the globe.

2.5.9   Navigation

Shows the on-screen Head Up Display (HUD). This shows the current view mouse movement and keyboard operations to assist in navigating the view.

2.5.10   Open Street Map

Street level mapping *(Internet connection required)*

2.5.11   Scale Bar

Simple scale bar that dynamically changes on zoom.
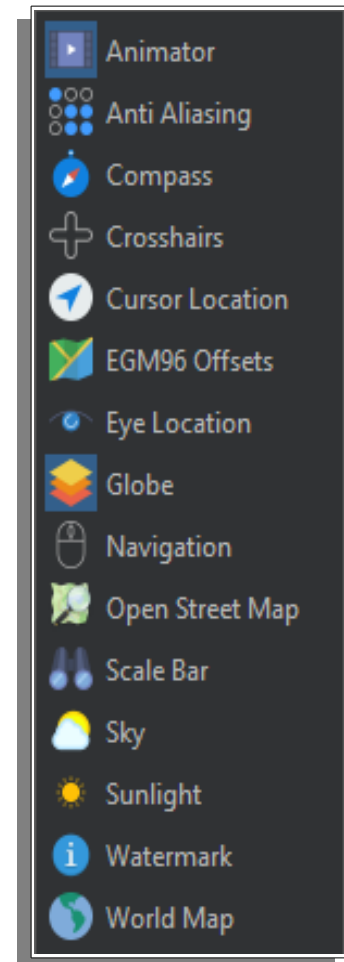
2.5.12   Sky

Provides realistic looking sky and horizon.

2.5.13   Sunlight

Provides real time lighting.

2.5.14   Watermark

Overlays a semi transparent image on the bottom left of the screen. This is useful for incorporating branding into generating screenshots and videos.

2.5.15   World Map

A small map indicating where the eye view position is over the globe.

2.6   *Keyboard Shortcuts*

Arena4D has a number of keyboard shortcuts for experienced users. These are all configurable using the Keyboard Shortcut Manager on the System menu.

Shortcut keys can feature any combination of the available keys in the Settings list plus Shift, Ctrl and Alt keys.

Conflicting shortcuts will be caught and brought to your attention.

Note: *Shortcuts are only active when the main viewing window is selected. This is shown by a white highlighted border around the main viewing window.*
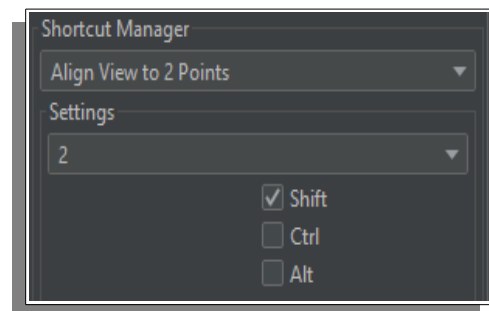
2.7   *Controller Settings*

Arena4D allows you to tailor the controller controls to your own personal preference. These are all configurable using the Controller Settings function on the System menu.

Typical usage is, for example, to invert the Y-Axis of the mouse/space navigator when in first person mode, set the sensitivity of joypad etc.

3 Navigation

3.1 *Navigation & Controls*

Arena4D provides two different navigation modes for the GIS or Viewer: *Orbit and First Person.* These are switchable from the **Navigation tool bar** icon
Orbit controls:

- The left mouse button will tilt the view in all directions.

- The left mouse button with **Ctrl** key is used for editing/selection actions. To unselect an area use the **Ctrl** and **Shift** key at the same time.

- Dragging the mouse with the middle button (wheel) will translate the view horizontally and vertically.

- Dragging the mouse with the right mouse button will pan horizontally and move in/out.

- GIS vertical movement press both the left and right buttons together.

- Scrolling the wheel will cause the view to zoom in and out. In GIS mode pressing the "**C**" key at the same time will zoom in and out at the cursor position.

- Default short cut key **"X"** will centre view on your cursor as does double clicking the **left mouse** button.

First Person controls:

Places you in a typical game like control and view mode:

- "**W**,**S**,**A**,**D**" keys are used to walk forwards, backwards and strafe left and right.

- Dragging with the middle mouse (wheel) button will allow you to freely look around.

- Scrolling the wheel will cause you to go up and down in altitude.

- Holding the "**Shift**" key whilst moving will increase movement speed.

- Default short cut key **"Space"** will toggle view modes Orbit/First Person.

- **Default short cut key "X" will centre view on your cursor as does double clicking the left mouse button.**

The view can also be centred by right clicking on the GIS/Viewer and choosing Centre View.
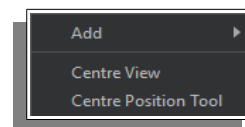
3.1.1 Align View

The align view controls allow you to orientate the view to be tangential to a surface. There are 3 different Align View controls: *2 Point, 3 Point* and *Tangent*.

In *2 Point or 3 Point* modes simply click on 2 or 3 points of the screen to align your view to look directly at the object you clicked on.

Tangent mode works in a similar manner to *3 Point*, however the order of the points you click is important. The first 2 points describe the "path" or vehicle direction you want to calculate from. The final point selects the object you want to be looking at. The view will then be positioned so that your eye point is 90 degrees to the path described, whilst looking at the object you selected with the final point.

Align Views all have short cut keys associated with them.

3.1.2   First Person

See 3.1 Navigation & Controls for more information.

3.1.3   Nudge View

Nudge view shows an overlay with four direction arrows. These direction arrows allow you to shift the view slightly in each direction. The amount the view shifts is controlled by the panel on the right of the display. The default value is 1m. Rotation tick box alters the direction arrows for rotation in X and Y axis.

3.1.4   Orthogonal View

Orthogonal view on the navigation tool bar removes all perspective from the main viewing window and is useful for doing line drawings. However it can be disorientating when moving around. If in doubt check that this is disabled when moving.

3.1.5   Reorientate

Used when you have got lost in your data. It will raise you up slightly, place your view at the ground and return you to Orbit view mode.

3.1.6   Reset

Returns you to a standard globe view.

3.1.7   Rotate

Places you in Orbit mode and automatically orbits around the object in the centre of the screen.

3.1.8   Rotate View

Rotate view allows you to flip your view by 90 degrees left, right or up and down. You can also flip by 180 degrees to view an object from the other side.

Rotate View has default short cut keys associated with each direction.

4   Data Objects

Data Objects are items that can be placed in the 3D world of your Arena. Some, such as *point clouds* and *images* require additional files to load; others such as *annotations* require no additional files as they are purely graphical markups.

4.1   *Adding/Removing Data*

Data can be added to your Project in three ways *(with the exception of Viewpoints, Measurements, Plumb Lines and Polylines which all have keyboard short cuts associated with them).*

1. Right clicking on the GIS/Viewer and choose the Data Object you wish to add.

2. Using the Data Open toolbar/menu option.
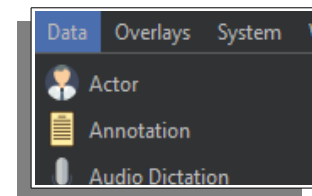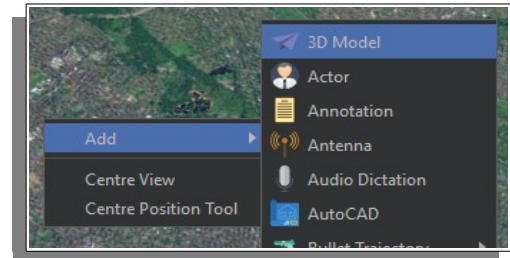
If the data to be added has Geo-reference information associated with it (e.g. EXIF tags on pictures), the data will be placed exactly where the Geo-reference information describes the location. If there is no Geo-reference data available, the data will be placed where the user "dropped" it on the globe.

Data is removed from your Arena by simply right clicking on the object in the **Workspace Tree**, right clicking, and selecting **Remove** or select

4.1.1   File Open

The file open button on the tool bar (orange folder icon) is used to open data objects which require raw files such as 3D models and images.

4.1.2   Data Menu

The data menu is used to add data objects which require no raw files, such as annotations and measurements.

4.2   *Object Properties*

Each Data Object added to an Data Studio has a number of properties which can be edited by the user. All of these properties are accessible via the **Workspace Tree**. Select an object within the tree, right click and select **properties** or select the properties icon.

When an objects properties is selected, the lower half of the **Workspace Tree** window shows a table with all the properties listed.

The properties are typically broken up into sections:

Nearly every data object has the same first four sections, with only the **Advanced** sections changing depending on the capabilities of a Data Object.

Properties – this shows the **Name**, **Minimum**/**Maximum Altitude.**

Position – This is the current location of the Data Object. **Lock Position** locks the object that stops you from accidentally moving the Data Object on the screen.

Earth Align – will rotate the objects up axis to the globe up axis.

Time (Start/End) – When enabled, this is the time at which the Data Object will automatically enable/disable itself. Please see chapter **5 Time** of this User Guide for more information.

Advanced – This controls how points will be displayed within a point cloud. **Version** displays import generation version number, **Point Count** the number of points in the cloud, **Point Size** the visual displayed size of a single point, **Point Ratio –** the visual displayed point adjusted for distance if **Point Filling** is on, **Quality –** controls how many points Arena4D will attempt to hold in RAM and draw at any one time. The higher the number the better the quality of the point cloud but the lower the performance and **Opacity –** renders the image with transparencies on the points. The more opacity will also lower the performance.

EPSG – moves the point cloud to the georeferenced position if not done so at VPC Creator time.

Colour – This controls how points will be coloured within a point cloud. Colour changes between Intensity and Colour (result on screen will depend on colourisation icon setting and imported data), Properties changes the brightness, contrast and RGB (results on screen will depend on the colour option and colourisation icon setting), Colourise Intensity displays RGB values for each point based on intensity values within the cloud and Classifications displays colours dependent on the Classification settings.

Server – This shows where the files is being served from, if not Local File is display.

4.3 *Moving Objects*

Objects can be moved about the globe in three ways. The first is simply by typing the new position into the **Properties** window. The second is by using the Position Tool *(this method only works if the **Lock Position** property is disabled).*
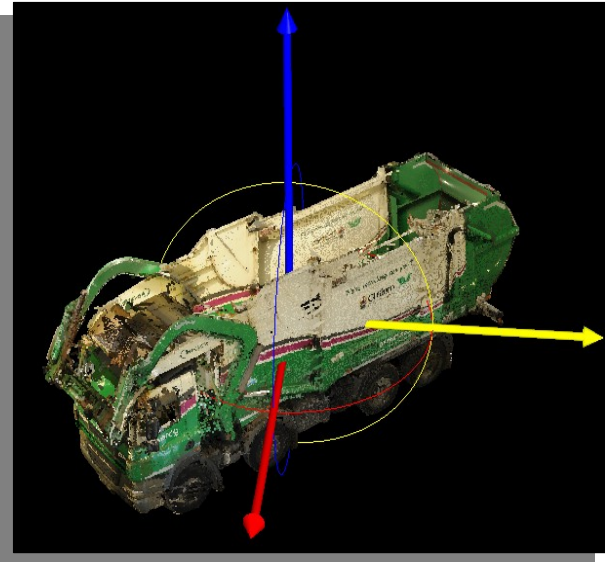
You can use the arrows and axis to drag and rotate your data.

The centre ball allows full free movement of the data when dragged.
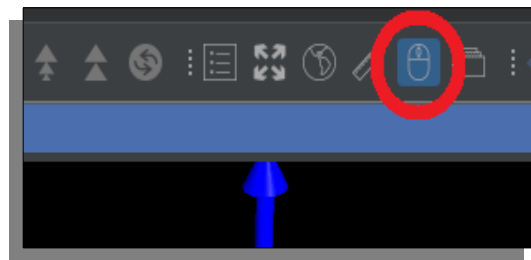
The position tool can also be moved independently of the data if you wish to reposition it into view, or rotate around a specific part of your data. Press the **Shift** key whilst moving the position tool (sphere will turn blue) or by right clicking on the GIS/Viewer and choosing **Centre Position Tool**. Likewise to enable/disable the **Position** tool use the icon on the toolbar.

Finally geolocate an object by right clicking it within the Workspace Tree window selecting Georeference, then click on the globe where you would like the data to appear or by dragging the position pin using the mouse. Finalise the position pressing the enter key. Clicking icon described in section 2.1.2.4 Georeference.

4.4 *Exporting Data*

The system task bar provides four export options for the currently displayed view in the main **View Window**. Also the option to export any data type to an .XML file for reloading into another project whilst maintaining it's properties.

All four task bar options are WYSIWYG *(What You See Is What You Get)* tools that provide an exact export of whatever is displayed on the screen.

*Note: The output folder is selected via the **Screenshot Folder** icon in the System Settings.*

Print – Prints the View Window to an available printer.

Clipboard – Puts an image of the View Window into the computers clipboard.

Screenshot – Saves a JPEG image of the View Window.

PDF – Creates a PDF with an image of the View Window.

Exporting Data into an .XML file for simple loading back into Data Studio see section 2.1.2.3 Import allows reuse for data that may have many properties set and need retaining.

The export task bar provides more advanced features for viewpoints and point clouds which are discussed later in the user guide.

4.5   *Supported Data Types*

Arena4D supports numerous different data types. 2D, 3D, audio and visual data types are all supported to provide a superb contextual view of the combined data types.

4.5.1   3D Model

3D textured models in most common formats.

Scale – change scale size of model.

Transparent – render the model with transpancency.

Lighting – render the model with or without lighting.

Flip Y/Z – flip the model 90º. Only applicable to 3D models having non-georeferenced selected during initial loading.

4.5.2   Actor

Draws a generic 3D person on the globe.

Double clicking the Actor places you at their eye view position.

Pressing **Escape** exits from the Actor view.

Height – height of Actor from base of feet to top of head.

Eye Offset – offset of eyes from top of head.

Field Of View – set the FOV of the Actor in degrees.

Image – image to display alongside Actor.

Annotation – text to display alongside Actor.

Colour – colour of Actor model.

4.5.3   Annotation

Text annotation displayed in either 2D or 3D.

3D – change from 2D to 3D.

Size – size of the 3D font in meters and visible distance from creation point in 2D.

Note: 3D annotation supports the position tool features for rotation, positioning etc.

4.5.4   Antenna

Supports the import of STK antenna models in text format. The models are then drawn in 3D and the radiation pattern of the Antenna clearly visualised.

4.5.5   Audio Dictation

Audio Dictation allows you to record from your PC's microphone. The recorded sound file is represented as an icon on the globe.

Double clicking the icon on the globe will play back the sound file.

To record a sound file, simply click on the record button under the **Properties** window.

4.5.6   AutoCAD

The CAD data type supports **DXF** CAD files in either 2D or 3D format.
Heading rotates the CAD image.
Scale resizes the CAD image.

4.5.7   Bullet Trajectory

The trajectory of a bullet with automatic angles and distances using compass point and origin.

Colour – change the colour of the cone.

Length – change the length of the cone.

Width – change the width of the cone.

Flip – flip the cone start end points.

Move Source – which end point to move with the position tool.

Compass – select compass.

Origin – select origin.

4.5.7.1   *Compass*

Set a heading from a single point.
Size – change the size of the compass.

4.5.7.2   *Origin*

Can be used to reference a witness or any required reference position.
Size – change the size of the origin sphere.

4.5.8   Clip Box

Allows you to "clip" the visible data down to a smaller size. For example if the roof of a house needs to be removed a Clip Box can be drawn around just the lower parts of the house.

Click and drag the corners of the Clip Box to reshape it.

Click and drag the centre arrows of the Clip Box to adjust the height and width.

The Clip Box can also be position using the position tool.

4.5.9   Drawing

4.5.9.1   *Circle*

Draws a circle between two points.

Colour – change the colour of the circle.

Width – change the width of the circle.

Radius – change the radius of the circle.

Filled – Fill the circle.

4.5.9.2   *Line*

draws a continuous line until the '**Esc**' key is pressed.

Colour – change the colour of the line.

Width – change the width of the line.

4.5.9.3   *Rectangle*

select the two points along an axis and drag the rectangle along the next axis.

Colour – change the colour of the circle.

Width – change the width of the circle.

Filled – Fill the circle.

4.5.10   Environmental Audio

Environmental Audio allows you to draw an area on the globe and specify a sound clip with that area. Whenever the user's viewpoint enters that area the audio clip will start to play back. This is useful for adding extra atmospherics to a scene.

To draw the area, simply click on the globe where you would like to draw the outline of the area. Once you have finished choosing the outline positions of the Area, press the **Esc** key.

The Environmental Audio data type supports standard **WAV** files. Select your **WAV** audio file by clicking on the **Audio File** property.

4.5.11   Event

Displays a flashing event icon. Used mainly in conjunction with Arena4D time capabilities and maintenance records.

4.5.12   Field of View (FOV)

The FOV data type shows the field of view of an item, such as a camera, in 3D. If there is a network **MJPEG** feed of the camera available, it will also display that camera feed.

Click on the FOV to toggle drawing of the available camera feed. *Double Clicking* the FOV will place you in **First Person View** mode in the Field of View object location.

Stream URI – network address of MJPEG stream.

Field Of View – set the FOV of the item in degrees.

Change View – places you in First Person View mode in the viewpoint of the FOV object. When you change the view in the Presentation Screen, the viewpoint of the FOV object. will be updated. Click the Change View button once again to exit and save.

Range – the maximum distance visible by the FOV object.

4.5.13   Flood

Renders a flood plain that interacts with the terrain to simulate the impact of high waters in an area.

Radius – sets the size of the flood area.

4.5.14   GPS

Displays **GPX** (GPS eXchange format) files as a path on the globe.

Clamp To Offset – typically the GPS data includes elevation information. However, in built up areas this can be very inaccurate. Enabling this function will ignore elevation data and instead keep the track at a constant offset above the ground.

Track Offset – the height in meters to offset the track from the ground.

Colour – colour of the track.

4.5.15   Hyperlink

Hyperlink lists are used for data types not natively supported by Arena4D, or those that don't translate well to 3D. For example Word documents and PDF files. These files are shown as a list of hyperlinks which can be clicked in the 3D view.

When clicked, the files are loaded by the operating system into the tool best suited for visualising the selected file type.

Files – select files to add to list.

4.5.16   Image

All typical image formats are supported.

4.5.16.1   *Aligning*

Whether the image is aligned to the camera (always facing you).

4.5.16.2 *Size*

The scale of the image displayed.

Double clicking the image will open the image up full size in a separate window.

4.5.17 Map

Map Files update the mapping or aerial imagery with higher fidelity data. Arena4D supports **GeoTiff** mapping data.

4.5.18 Measurement

Contains a selection of measuring Data Types all with properties:

Colour – change the colour of the circle.

Width – change the width of the circle.

4.5.18.1 *Angle*

Angles allow you to draw two lines from clicking 3 points and will measure the angle between the two lines.

4.5.18.2 *Distance*

Distance allows you to measure between any two points in the **Presentation Screen**. The cursor will change to a cross hairs when measurement is active. Simply click on the two points you wish to measure between. Property option "**Polyline**" will create a new Data Object of type Polyline contouring to the elevation changes along the original measurement length. Entering a higher number of "**Components**" increases the resolution of contouring.

4.5.18.3 *Pin*

A single point measurement.

4.5.18.4 *Plumb Line*

Vertical distance measurement data type.

4.5.18.5 *Polyline*

Draw a simple multi point poly line within the 3D data. Property option "**Polyline**" will create a new Data Object of type Polyline contouring to the elevation changes along the original measurement length. Entering a higher number of "**Components**" increases the resolution of contouring.

4.5.18.6   *Width*

Width objects allow you to measure accurately between two points, ensuring the measurement is parallel to a described line. The width object requires you to click three times on the screen. The first two mouse presses select the line to which you will measure at a tangent (e.g. the curb line). The third press will select the other side of the gap you width to measure (e.g. curb on other side of road).

4.5.19   Mirror

The view of a reflection with automatic angles and distances using projector and reflector positions.

4.5.19.1   *Projector*

Set a source from a single point.

4.5.19.2   *Reflector*

Set a reflector surface.

Width – change the width of the reflector

Height – change the height of reflector

Curve – change the curve of the reflector (mirrors on vehicles can be convex) in Degrees

Colour – change the colour of projection

Distance – change the distance of projection

Clip – clip all content except projection

4.5.20   Mobile Imagery

Trajectory visualises the extra data captures from mobile *LiDAR* capture vehicles.

The navigation data and imagery collected during a capture is overlaid on the globe in 3D.

Play Trajectory – visualises the animated path of the vehicle, updating the displayed imagery as appropriate.

Follow Trajectory – when in **Vehicle View** mode it ensures the view camera keeps pointing in relation to the direction of travel, rather than in a constant heading.

Vehicle View – places your viewpoint to that of the vehicle and see the captured imagery overlaid on to the point cloud data.

Hide Panorama – turn off imagery.

Frame Number – the current frame number.

4.5.21   NCTech Panorama

NCTech files **nctmd** and **nctrm** can be loaded supporting iSTAR Measurement.

To enter the Panorama hover the mouse cursor over the Green sphere until it turns orange, then click the left mouse button twice. **Use the centre mouse button to rotate around inside the sphere and the mouse wheel to zoom in and out**.

*Note: Make sure the movement "**Position**" tool is not enabled (no movement arrows).*

Measurement   icon can be used to make multiple measurements within the NCTech Panorama. Select he measure icon and click the first measurement point, now perform another click on the second measurement point. The right hand split window will now become available and perform the same measurement operation here followed by "Enter" key. A line and annotation will be presented representing the measurement.

Measurements can be cleared using the "Clear Measurements" option with in the properties for the NCTech data object.

Exit the Panorama sphere by pressing "**Esc**" on the keyboard.

4.5.22   Panorama

Panoramas support the same image formats as Image data types. However, the panoramas are shown as wire spheres rather than icons.

To enter the Panorama hover the mouse cursor over the Green sphere until it turns orange, then click the left mouse button twice. **Use the centre mouse button to rotate around inside the sphere and the mouse wheel to zoom in and out**.

*Note: Make sure the movement "**Position**" tool is not enabled (no movement arrows).*

Projection Type – allows you to specify Spherical or Cylindrical panorama types.

Perspective Ratio – allows you to fine tune width x height ratio of the image to correct for distortions.

Radius – the size of the panorama within the 3D world.

Eye Offset – depending on the instrument used to capture the Panorama, the ideal viewing position may not be the centre of the Panorama. This allows you to offset the viewing position vertically to cater for different capture tools.**Texture File** – The texture (graphical representation) of the inside of the Panorama.

Exit the Panorama sphere by pressing "**Esc**" on the keyboard.

4.5.23   Path

Paths are like multipoint measurements. Instead of measuring between two points you can measure the length of several connected points.

Paths also give you the ability to "walk" the path by playing back a trajectory along the path you have created.

There are two ways to generate a path, first using the Path data type clicking the points positions with the left mouse button (press the escape "**ESC**" key to stop adding new positions), additional points can be added anywhere along the displayed path by hovering the mouse until the path turns orange, then whilst pressing the "**Shift**" key click the left mouse button. The second method is right clicking on a Viewpoint(s) and select **Generate Path**. This second method give great accuracy.

Show Annotation – enable/disable visualisation of annotations.

Width – size of path line to draw.

Colour – colour of path line.

Offset – height above clicked point to draw path line.

Play – animate viewpoint along the trajectory of path.

Speed – speed of playback in meters per second.

4.5.24   Point Cloud

Arena4D has a high performance Point Cloud engine that allows it to render almost limitless amounts of data. However, for this to be possible, any Point Cloud data must be pre-processed as Arena4D's own **VPC** file format. This is done using the **Point Cloud Creator;** please see **VPC Creator** User Guide for more information.

Point Count – simply shows number of points in file.

Point Size – size of point used to render this cloud.

Point Ratio – size of point used to render this cloud when viewed close to point position.

Quality – load points dependant on value. Reduce value to increase performance.

Opacity – With the Quality set to 100, reduce this value (1 – 10) to make the cloud transparent.

Colour – renders with RGB or Intensity data.

Properties – adjust the RGB, Contrast and Brightness values of the selected Colour band.

Colourise Intensity – applies a contrasting colour ramp to intensity data.

Classifications – if LAS classification is available, the point data will be coloured according to its LAS classification value.

Server URL – Location of the Point Cloud having two options 1) Local File (file is located on current machine or 2) Sever (name of server location using preferred IP notation).

4.5.25   Shape File

Standard ESRI Shape File. Drawn as line drawing overlay on the globe.

4.5.26   Terrain File

Terrain Files update the elevation model of Arena4D with higher fidelity data. Arena4D supports **GeoTiff** terrain data.

4.5.27 Threat Dome

Renders a sphere representing a threatened area; for example from an explosive device.

Radius – size of threat dome.

Colour – colour of sphere.

4.5.28 TruView

Leica TruView data sets are supported in Arena4D. Simply select the SWPositions XML file and Arena4D will do the rest.

Double clicking the TruView boxes will place you in the view of the panoramic images created by TruView data sets.

Press **Escape** or *Double Click* the TruView imagery to exit the panoramic view mode.

4.5.29 Viewpoint

Viewpoints are very powerful data types and form the basis for presentations and video generation. A viewpoint is a snapshot of your current location and viewing angle in the 4D world (space and time). Viewpoints can be adjusted using the overlay and position tool.

Dwell Time – when used in video generation, how long this view should last before moving to the next viewpoint.

Duration – the time taken to move to this viewpoint.

View Mode – by default Viewpoints are saved as First Person View modes, here you can change this to Orbit or Rotate View modes.

Spline – the amount of spline curve to apply to a view transition when animating a series of viewpoints together. The larger the number the greater the curve (0 – 1.0).

Startup – sets the viewing position at which the project will start each time.

Field Of View – set the FoV of the Viewpoint in degrees.

Enable – activate the fourth dimension. When transferring to this view the Arena4D clock will be set to the time specified in **Time**.

Time – the time to set the Arena4D clock to.

4.5.30 Viewport

The Viewport data type shows the field of view projected through a defined four point area in 3D. Very useful for defining an area around a building window and showing the FOV through this selection. Once created the view position behind the viewport can be adjusted using the position tool.

Length – the maximum distance visible by the viewport object.

4.5.31 WMS

Creates a link to an OGC compliant Web Mapping Server (WMS).

Server URL – Server to connect to.

5   Time

5.1   Object Time

Every Data Type has a Start time and End time that can be enabled.

When enabled, the object listens to the Arena4D system clock and turns itself on or off as appropriate.

Viewpoints can specify the system clock time and can therefore have the power to turn objects on and off.

This powerful feature allows complex videos and Arena walk throughs to be created that show how the scene changes over time.

General	
Name	Actor
Notification	
Lock Position	
Position	
Latitude/Northing	51.53936626648918
Longitude/Easting	–0.032960650192133...
Elevation	13.56183150318506
Time (Start)	
Enabled	
Time	01 Jan 1970 00:59:59 ...
Time (End)	
Enabled	
Time	01 Jan 1970 00:59:59 ...
Advanced	
Height (m)	2
Eye Offset (m)	0.15
Image File	
Annotation	Annotation Text
Colour	R:0 G:255 B:0 – #0...

5.2   Time Controller

The Time Controller can be found on the **Exploitation Tool Bar**.

The time controller has four tab panels associated with it.

System – specifies the current time. Default is to use the current system time.

Slider – slider that allows you to quickly and easily move in between two specified times.

Start – start time to use on slider.

End – end time to use on slider.

Note: The system time also controls the position of the Sun on the sunlight overlay.

System	Slider	Start	End
☐ Use current date/time			
Europe/London			
03-Jan-2020			...
09:00:19			
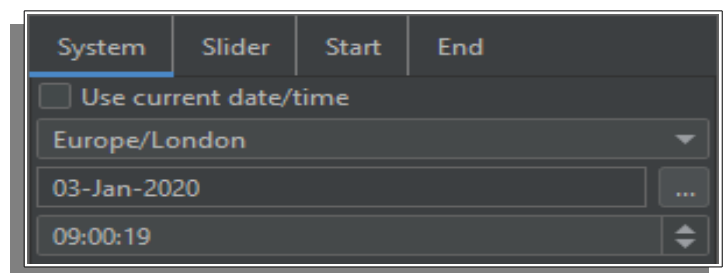
Also the Start and End times will be populated with the lowest and highest values found in any Data Object within a project.

6 Viewpoints

6.1 *Creating Output (Movies, PowerPoint, PDF, Path, Animation)*

Highlighting multiple Viewpoints in the **Workspace Tree** window allows you to make animations etc. These output options can be chosen on the export tool bar, or by right clicking them in the workspace tree and selecting this appropriate output format..

The options provided are:

Generate PowerPoint – each viewpoint is outputted as a new slide with its name and time as the title.

Generate PDF – create a multipage PDF with each page featuring a screenshot of the viewpoint.

Generate Path – create a path through each viewpoint in order.

Generate Animation – create a key frame(s) for each viewpoint and puts them into the animator.
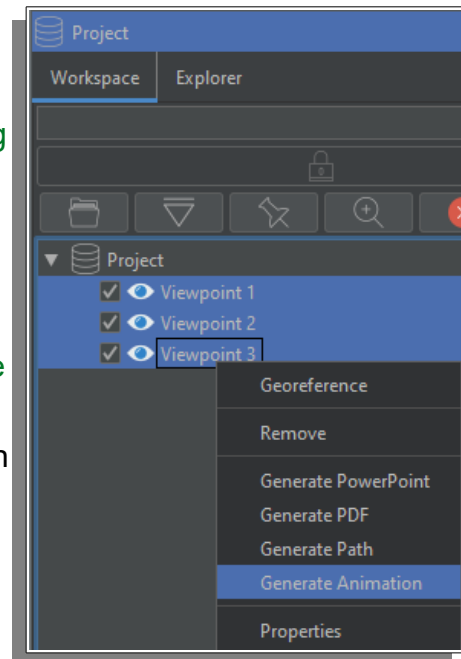

6.2 *Viewpoint Positioning*

Viewpoints have two key attributes, their position and their focal position. This defines where the view will be, and what it is looking at.

Turning on the **Animator** overlay allows you to visualise on the screen the orientation of a viewpoint.

The green sphere represents the location of the viewpoint, and the red sphere the focal position.

*Note: select more then one viewpoint in the workspace tree using the **shift** key whilst selecting to see them all at once as shown in the example picture.*
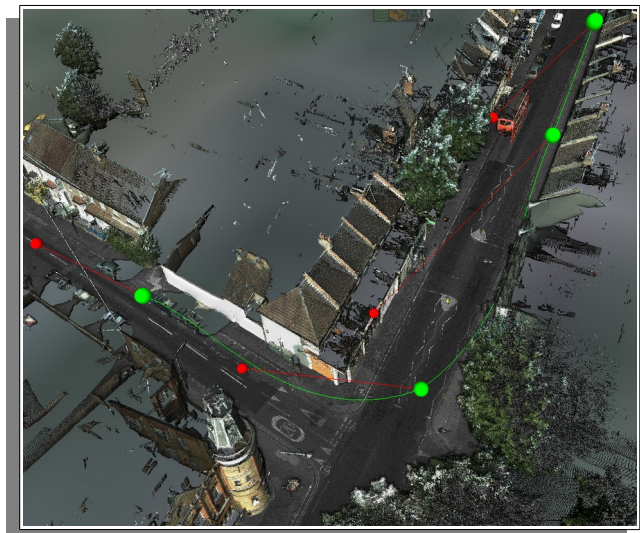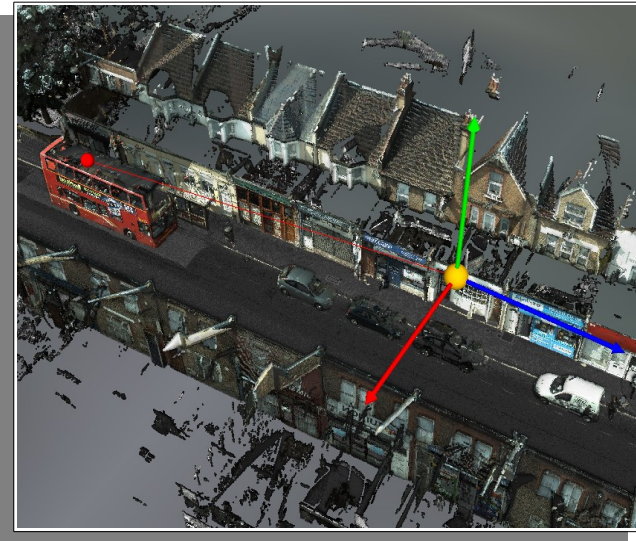
Viewpoints can be moved like any other data object using the Position Tool. To move the focal position use Move Focus option under properties
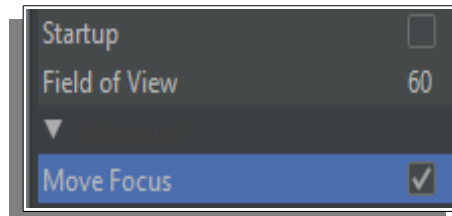
Selecting more than one viewpoint will show the path which the camera will take when animating the selected viewpoints.

7   Shortcuts

7.1   *Shortcut*

Shortcuts allow you to have multiple properties for a single object. Just like having a shortcut to an application on your desktop, a shortcut does not alter the raw data files but allows you to assign different properties such as icon, name, etc.

If you update the raw file pointed to by a Data Object, or any of it's shortcuts, then all shortcuts will reflect this change.

An obvious use of shortcuts for changing the position of data over time. For example an Actor may be on a street corner in the morning, however in the afternoon you may want them to appear on another road. By creating a shortcut that can be easily accomplished with the main object being on the street corner, but the shortcut becoming active in the afternoon and the position being changed.

To create a shortcut to an object simply right click select it in the Arena Tree and choose "Create Shortcut".

When a shortcut is created it is clearly identified with a yellow arrow and it the relationship to its parent.

When a parent object is deleted all shortcuts referring to it are also removed from the Arena.
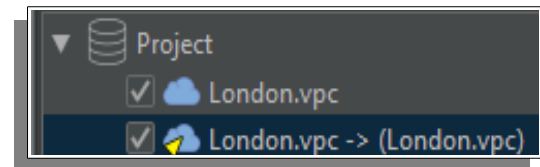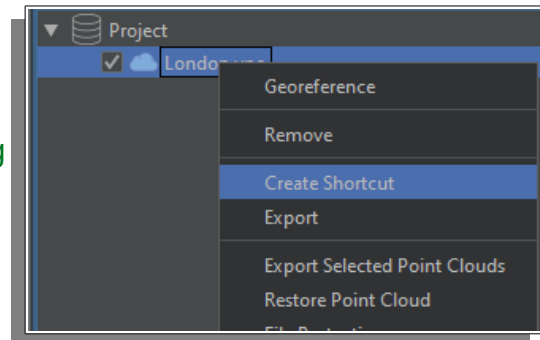
8   Terrain

8.1   *Installing*

Terrain and Map data added via Data Types (Terrain & WMS) is saved on a per Arena basis.

Maps and terrain can be turned on and off via the check boxes associated with each data type.

8.2   *Terrain Exaggeration & Offset*

If you do not have high fidelity terrain available and the default installed terrain is not correct for your area of operation, you can manually adjust the terrain via the Exaggeration and Offset buttons on the **Terrain Tool Bar**.

Exaggeration determines the scaling of the hills. A value of 0 will create a flat earth, the default is 1. A value of 2 will create hills twice as high and valleys twice as deep.

Offset raises and lowers the terrain as a whole.

Reset returns to default values.

Any terrain modifications made under these settings will be saved per Arena allowing different terrain models to be used with different Arenas.

9   Advanced Tools

9.1   *CSV Import*

The CSV Import tool imports large volumes of data as either an **Annotation** or a **Polyline**.

To use the CSV tool click the **Select File** button to specify the CSV file to read in.

then set **Attribute Dictionary.** Arena4D uses the Attribute Dictionary to determine what default size and colour settings it should apply to CSV data based on the **Name Column** of the data.

This is useful when importing lots of different road marking data. For example, anything with name "curb" could be set to a width of 5 and colour of Grey automatically.
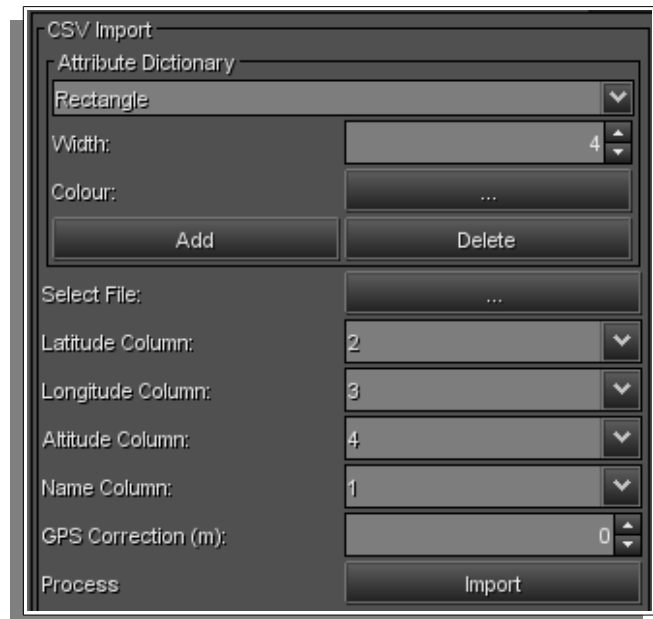
Then use the appropriate drop down boxes to select which columns in the CSV data represent which required data fields.

GPS Correction is used to provide a global offset to all the data being read, to correct for data that is artificially too high or too low.

When all the settings are correct, simply press the import button to read the data in, specifying the Measurement Units and the Data Projection format.

Single entries will be read in as an **Annotation,** whereas multiple concurrent entries with the same name will be read in as a **Polyline**

9.2   *Live Feed*

The live feed creates an accessible Web Server which remote devices can connect to. The server retrieves the location information from the remote device and displays their name and location on the globe.

9.3   *View From Point*

When view from point is active, clicking on any object in the 3D world will place your viewpoint at that position looking back at where you came from.

9.4 *Panorama Creation* ⊞

Create a fully stitched panorama image from the current position including the point cloud data as well as additional data objects.

Position your view in the centre of the panorama to be created making sure any data objects are turned on/off and the point cloud is at the quality and point size etc. required, see section 4.2 Object Properties.

Press the Panorama ⊞ icon and a single stitched panorama image will be created in the file directory specified from the *System Setting → Screenshot Settings → Location*.

Resulting panorama file can be loaded into Data Studio (see section 4.5.22 Panorama) or users own separate application.

10   Point Cloud Tools

Arena4D contains several tools for working with point cloud data. These tools are designed to be simple to use and allow you to quickly perfect your point cloud data visualisation.

When the **Point Editing** tool is selected a palette of capabilities is displayed on the right hand side of the screen.

10.1   *Registration*

Arena4D contains an incredibly fast registration tool that makes aligning point clouds and data objects a painless exercise.

Although you can manually align data objects using Arena4D's built in move manipulation controls, this really isn't a substitute for a proper registration tool.

10.1.1   Coarse Registration

The registration tool works on either one to three matched points between two different data objects not just point clouds.

If you select just a single matching point between the data objects, they will be aligned by movement only and no rotation.

If you select three matching points, they will be aligned by movement and rotation of the register data object.

Register Object – the data object you want to move and reorientate to match the **Reference** data object.
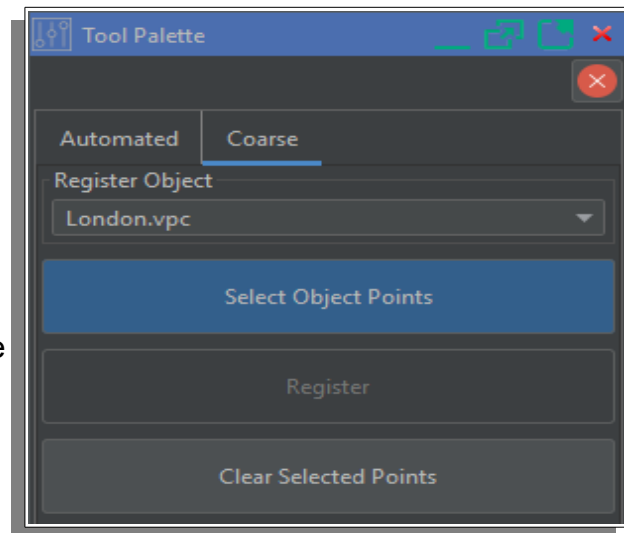
The alignment process typically works like this:

1. Select a **Register Object** from the pull down list (object to be moved).

2. Select the required point on the source data object with the **left mouse button** whilst holding the **Shift key** down. A blue square and '**1**' will appear

3. Repeat the above step for a maximum total of 3 points.

4. Select the **Select Object Points** button (becomes orange in colour) and repeat step 2 but a red square and '**1**' will appear

5. Repeat step 4 for the number of reference points selected in step 2. Once done press **Register** icon to register the two objects together.

6. If you are unhappy with the result click the Undo button on the task bar and repeat the process paying close attention to the point selection.

10.1.2   Automated Registration

Arena4D also includes an automated fine registration tool that uses intelligent analysis of the point cloud data to align overlapping point clouds as accurately as possible.

Note: for the algorithm to work at its best, it is important to have roughly aligned the point clouds either using manual methods or the Coarse Registration tool.

Note: the algorithm works by comparing your chosen point cloud with all other enabled point clouds. If you want to exclude a point cloud from the "reference frame" ensure it is disabled in the Workspace Tree.

With the cloud to register overlapping the reference point clouds press the "Process" button. This will ask you to choose which cloud you want to register. Click on a point that represents a good overlap position where data is most closely aligned.

The algorithm will then run and print a report.

Search Radius – the distance to look beyond the point selected for matching data.

Subsample – the quantity of data to analyse.

Max Iterations – maximum number of iterations to refine the result.

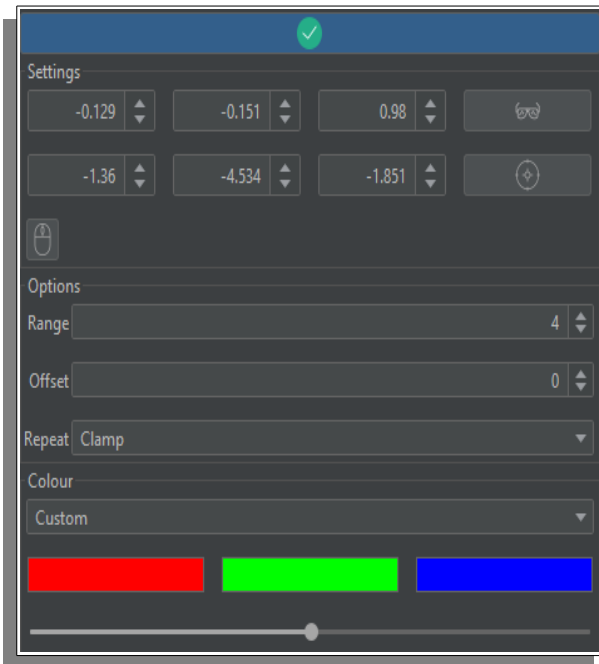**Target Error –** maximum allowable average error in misalignment.
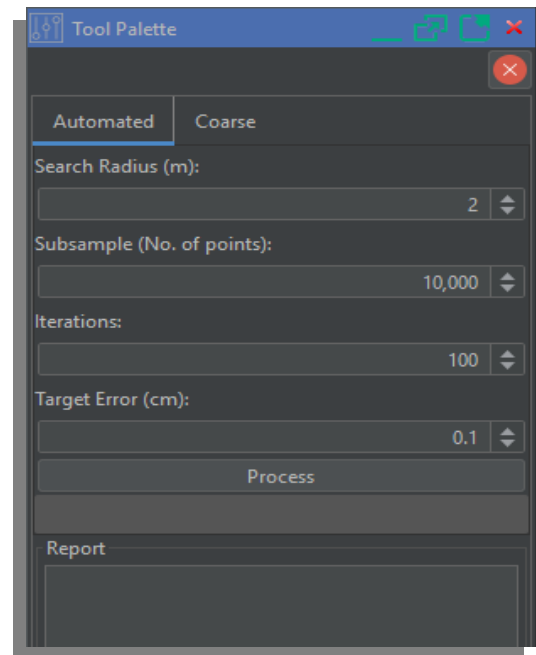
10.1.3   Point Survey

If you know exactly where a point in a point cloud should reside in the real world (e.g. an aerial base) then select this tool and click on that point. Fill in the required location information and the entire point cloud will be moved to the location specified.

10.1.4   Shader

The shader panel provides control over the planar shader. Once enabled you can change the shaders direction by changing the XYZ values or click on ⬦ select plane icon and select plane on point cloud(s).

A simpler option is to align the shader to the view direction. Selecting 👓 the glasses icon will set the XYZ values for you.

Range – The distance over which the shader will calculate values.

Offset – The distance from the shader zero point to start calculating from. Useful for moving the shader along the axis.

Repeat – How the shader should act once it has gone beyond either the start or end location as calculated by Range + Offset:

• *Clamp, continue with first/last colour.*

• *Stop, don't apply colours beyond range.*

• *Repeat, loop through colours again.*

Colours – You can chose between your own custom colour palette in the shader, or to use the entire RGB hue values.

Blend – Slider bar effect of shader on point colours.

10.1.5   Alignment

The alignment tool is used to correct misaligned point clouds. Depending on the capture technique the scan may not enter into Arena4D in a correct vertical, or horizontal, fashion. For example a building may be leaning over at 45 degrees.

Simply select the point cloud you wish to correct in the drop down menu and then click the "Select Plane" button. This will allow you to choose 3 points which represent a vertical, or horizontal, plane. For example the wall of a building. Once the 3 points are selected the software will automatically rotate the point cloud so that the wall is truly vertical, and in doing so the rest of the point cloud.
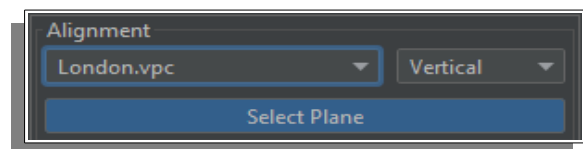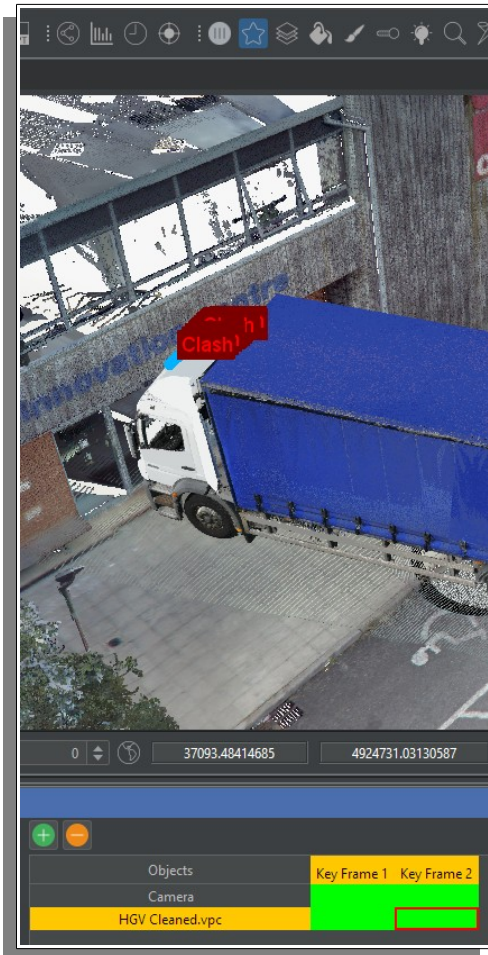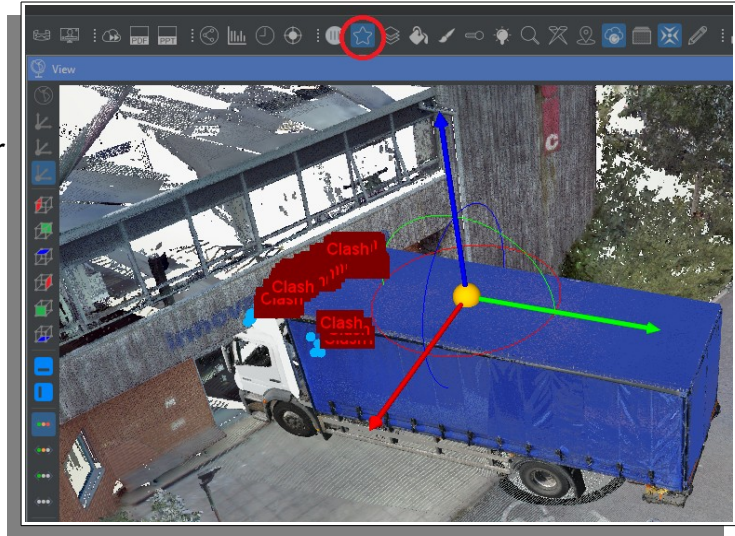
Note: *You must turn off* ***Earth Align*** *property. See section 4.2 Object Properties.*

10.2 *Clash Detection* ⭐

Arena4D allows you to perform clash detection with point clouds and 3D models.

Enable clash and move point clouds or models overlapping each other will show impact point.

These objects can also be placed in an animation and with clash enabled impact point will be shown as the animation progresses.

Note: *real-time movement performance will suffer with Clash Detection enabled due to all the additional processing.*

10.3   *Point Cloud Editing*

Arena4D allows you to perform real time editing on your point cloud data.

Note: Use the **Ctrl** key (shown on screen) whilst using the **Left** mouse button to select points using the armed selection tool, use **Ctrl** and **Shift** keys together to un-select. Brush size can be also be increased & decreased using the mouse wheel.

10.3.1   Selection

The tools provided allow a number of different ways to select points within the point cloud. When a tool is selected the options available for it are presented underneath.

Beneath the tool selection panel there are 6 function buttons.

Select – Arms the current select tool.

Select All – Selects all points in the currently enabled point clouds.

Invert Mode– Invert the current selection mode. For example instead of selecting everything inside the rectangle the tool will now select everything outside the rectangle.

Paint – paint colour onto the data.

Brightness – change brightness of data.

Contrast – change contrast of data.

Patch – create a new section of data.

Invert – Invert the current selection.

Clear – Unselect all points.

Hide – Hide the currently selected points.

10.3.2   Processing

All the point editing tools are a

**Copy** – Generates a new point cloud from the selected points.

Delete – Removes the selected points from their original point cloud(s).

Volume – Generates the volume from the selected points and displays the result in the output window.
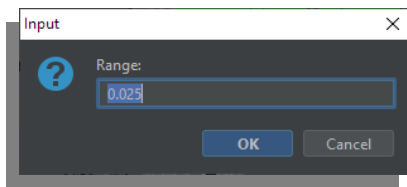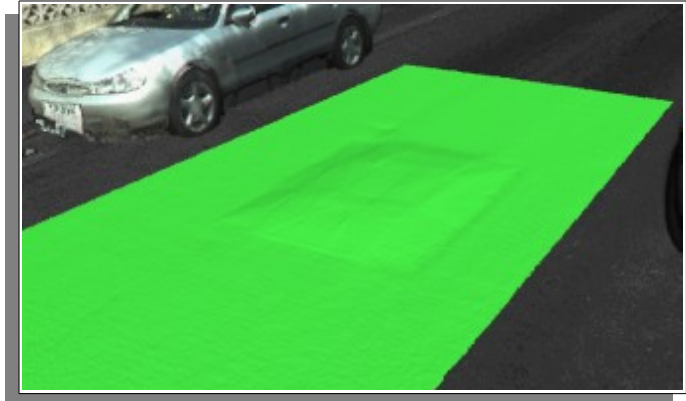
Note: *If **patch** or **copy** options are used you will be asked to specify a location and filename as they create a new VPC file, this file will be opened in the Workspace view.*
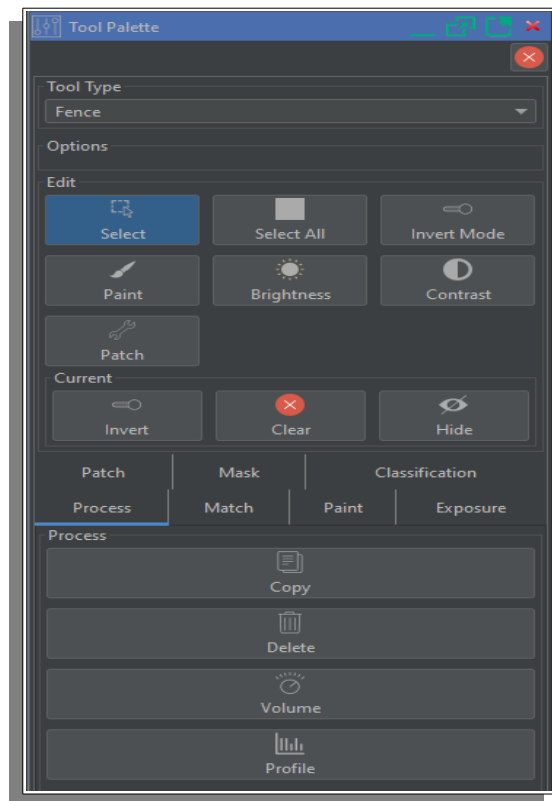
10.3.2.1 *Profile*

Used to show profile changes over a selected area at a specified resolution.

Select the surface to be profiled by selecting the area of interest using .

Enter a resolution in meters to determine the profile distance from the surface selected.

Enter a colourised step value in meters. The default value will display a gradual transition from green to red. Entering a value closer to the profile resolution will reduce the graduation of colours.
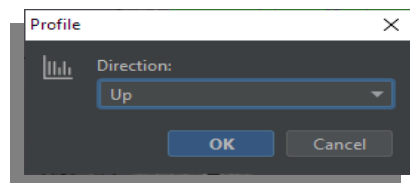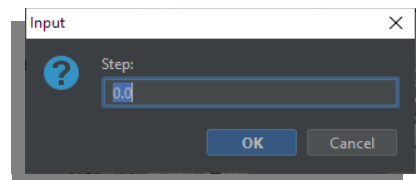
Enter the direction of the profile, choose between **Up** or **Down** from the pull down menu.

Select location and filename to create new profile point cloud.
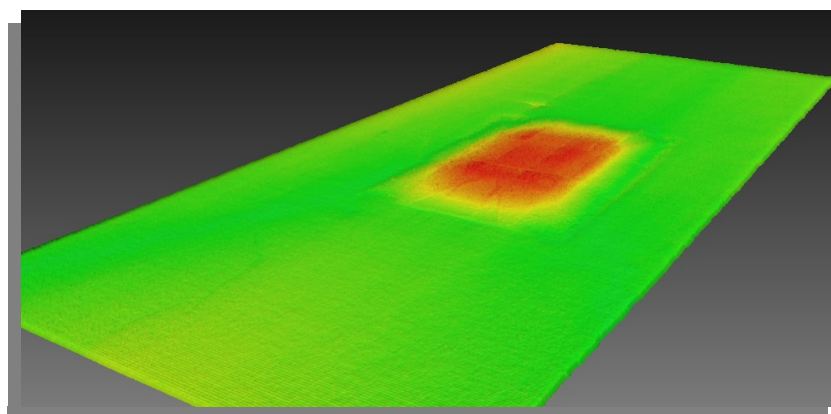
Output is a newly generated point cloud with modified colour values representing the profile.

Note: *turning off the original point cloud in the workspace tree helps display the result.*

Point cloud colour must also be turned on.

10.3.3   Colour Matching

All the point editing tools are able to filter which points to edit by the use of colour and/or intensity matching.

The colour matching capability ensures only points matching the selected attributes are selected or edited. Enable each algorithm by ticking the appropriate "Enable" check box.

The colour or intensity can be selected by either double clicking the colour box, adjusting the intensity spinner or clicking the appropriate "Pick.." toggle button. Selecting the "Pick.." option will allow you to click on a point within the 3D view and select that colour/intensity.

Each matching tool has a tolerance slider that adjust the strictness of the matching.

10.3.4   Painting

Painting allows you to change the colour of the points within your point cloud using all the available **Tool Types** *(Brush, Rectangle, Fence, etc..)*. The colour palette can be adjusted exactly the same as the **Colour Matching** options.

The **Colour Matching** options can also be applied to the paint tools. Therefore allowing you to narrow down the choice of points which will be painted.

The paint tool features two sliders, the **Coverage** slider which allows you to adjust how densely the paint is applied and the **Opacity** slider which adjust the amount of the chosen colour applied to the points.

Note: painting is permanent, you can only undo the changes you have made using the undo option. Once you have exited Data Studio this facility is gone!
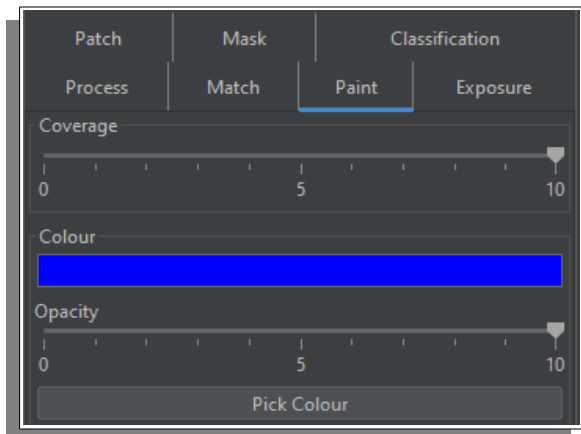
10.3.5   Exposure

The exposure tool works in exactly the same way as the Painting tool. The only difference is that instead of painting the points with a different colour the points current colours are adjusted depending on the settings of the Brightness and Contrast controls.
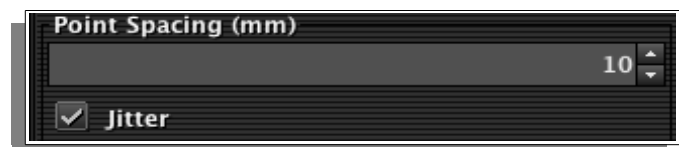
10.3.6   Patching

Patching allows you to create new synthetic points to fill in gaps within your data.

For example pavements or road segments that have not been captured owing to passing cars or people.

Patching works with all the **Select Tools** except the brush tool.

The patching tool has two options, **Point Spacing** and **Jitter**.

Point Spacing determines the minimum gap between any two points.

Jitter applies a noise effect to the generated points to make them look more realistic and less uniform in their layout.

10.3.7   Masking

The Masking capability allows you to determine which point clouds will be effected by any of the edit tools.

Unselecting a point cloud in the list will mean that it will be "invisible" to the select/paint tools.
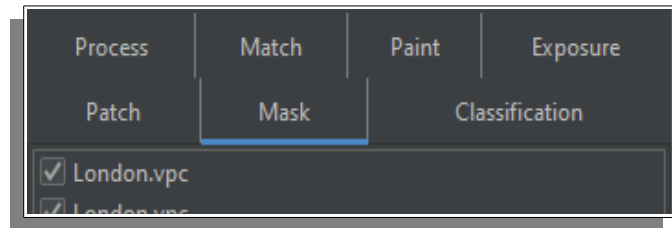
This is useful for example when wanting to match colours between a *Patch* and the master point cloud it is gap filling for. By unselecting the master point cloud you can paint freely on the *Patch* without fear of painting onto the original master cloud.

10.3.8   Classification

This allows you to set the classification of the data you have currently selected in the edit tool. These classifications changes to the data are saved with the project and not the pointcloud.

10.4   *Point Cloud Exploitation*

As well as the built in Point Cloud properties that can be adjusted, Arena4D also provides some extra powerful Point Cloud exploitation tools which can be found on the **Point Cloud Tool Bar**.

10.4.1   Point Cloud Alignment

The option to align a point cloud both horizontally and vertically by selecting three points on a single plane to rotate the point cloud both horizontally and vertically in relation to the globe.

10.4.2   Classifications

The option to edit the classification colours and also add meta data.

10.4.3   Point Colouring

This is a tri-state button, which means it can be in one of three states. The default state means that point clouds will be drawn using what ever colour properties have been set for them; that is either RGB or Intensity. You can mix and match how point clouds are drawn. The first press of the Point Colouring button will switch ALL point clouds to be rendered in RGB mode. Press the button again and they ALL be drawn in intensity. Press it a third time and point clouds will return to their "mixed" mode.

10.4.4   Point Filling

This tool intelligently resizes the points to try and minimise gaps in the point cloud data.

10.4.5   Point Lighting

This is also a tri-state button. The default state means that no special lighting effects are applied to the point cloud. The first press of the button will enable lighting and provide dynamic shading and highlighting to the point cloud. The second press will do the same but remove all colour from the point cloud. This can really help to highlight hard to see features.

10.4.6   Point Magnification

When the cursor is placed over a point it highlights the point for the user. This is useful when trying to click on points in a point cloud as it is generally all too easy to miss a point and click on the background somewhere.

10.4.7   Point Cloud ID

Identifies which point cloud your cursor is currently hovering over.

10.4.8   Point Snap

Snaps the cursor to the closest point near the cursor location.

10.4.9   Vector Drawing

Creates automatic drawings into the DXF format.

Select the Tick box and adjust the Filter to get the objects of interest as clear as possible.
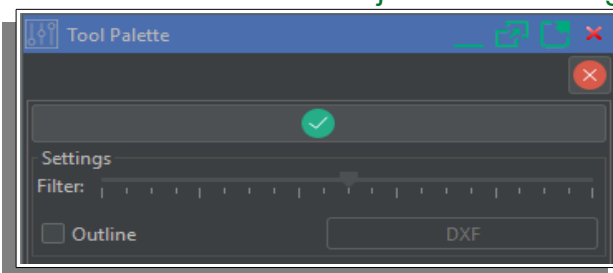
Select the outline if required to produce two lines on defining the outside of the points.

Best Practise is to use the Vertical view and **must be** in Orthogonal view to get a top down look.
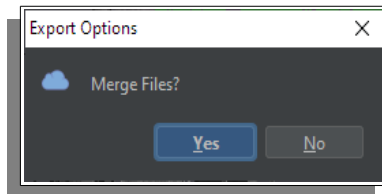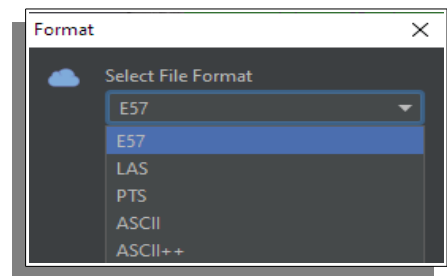
10.5   *Point Cloud Exporting*

Point Cloud(s) may be exported from Arena4D into *LAS, PTS, ASCII or ASCII*++ text files.

Select the cloud(s) you wish to export in the workspace tree and right click and select **Export Selected Point Clouds**.
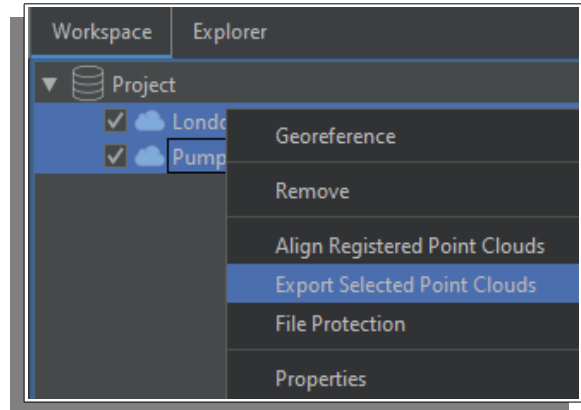
Then select the file format (**E57, LAS**, **PTS**, **ASCII** or **ASCII++**) the exported cloud(s) convert to during export. Selecting ASCII++ will export Meta data in the form of the Classifications set in section 12 Classifications.

Then the option of merging point clouds (if more then one was selected) into one.

The measurement option allows you to scale the point cloud during export. Select the required units from the pull down menu, **m** (meters) being the default.
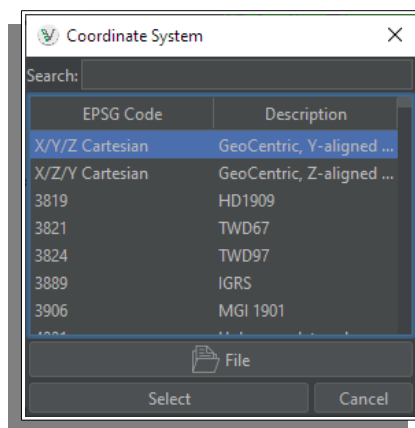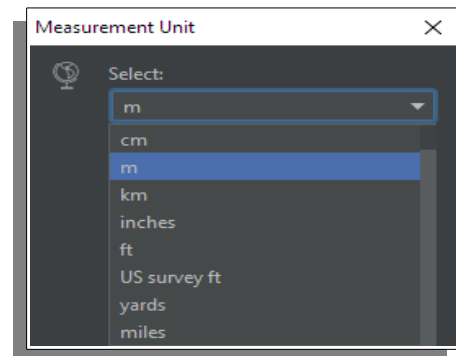
Select the coordinate system require to export to. If not require   or known select **X/Y/Z Cartesian** and press **Select**.   The **File** option allows customised projections to be loaded.

Lastly select the directory for the point clouds(s) to be exported to.
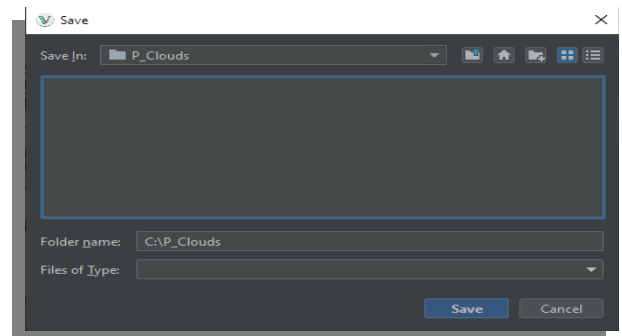
### 10.5.1   Point Cloud Exporting with Meta Data

Select the cloud(s) you wish to export with meta data in the workspace tree and right click and select **Export Selected Point Clouds**.

The exported point cloud will contain any meta data created during exploitation. Section 12 Classifications describes the process for adding meta data.

10.6   *Aligning Pre-Registered Point Cloud Data*

If you bring in a series of point cloud data as individual clouds which have been registered in a 3rd party product, it is now easy to align them all together, if one or more clouds have been moved to a new location on the globe.

Select the clouds you wish to align in the workspace tree and right click and select **Align Registered Point Clouds**.
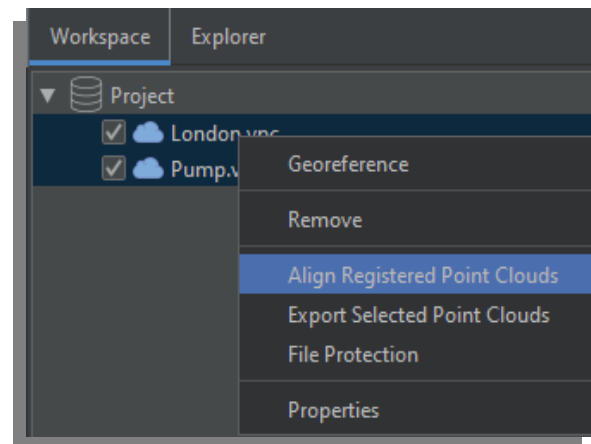
You will then be presented with the option to select which cloud to treat as the **Reference Point Cloud**. This is the cloud which all the others that you have selected will be aligned to. Once chosen, press OK and the data will instantly snap to their registered locations.
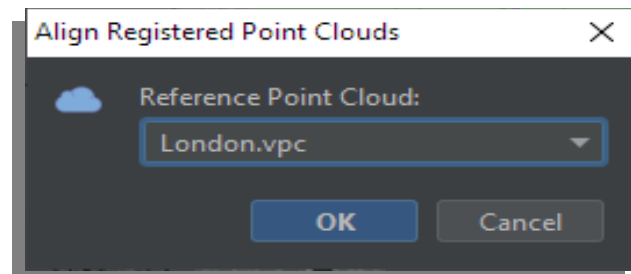
11 VPC File Protection

If working with sensitive data it is now possible to protect your point cloud from 3rd parties.

The VPC file protection mechanism allows you to lock a file from being edited or exported into a raw format from any Arena4D product.

Optionally you can set an expiry date so that the data is no longer visible after that time.

To protect a VPC file open the tool by right clicking on the relevant point clouds selecting **File Protection**.
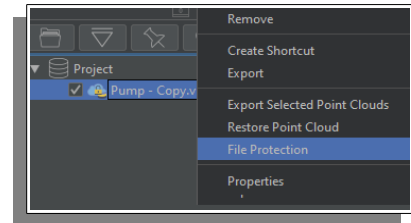
Chose the parameters as desired and the click **Process Files**. Once the process has finished your files will be updated.

Protect Files – Set file to be locked or unlocked.

Set Expiry Date – Encode expiration date into file.

Current Pin – Pin code of current VPC file (default and/or unlocked files are all "0").

New Pin – New pin code of file.

If a file is protected you can only unprotect it if you have the correct pin number.

A progress report of file protection is displayed on the panel once **Process Files** is selected.
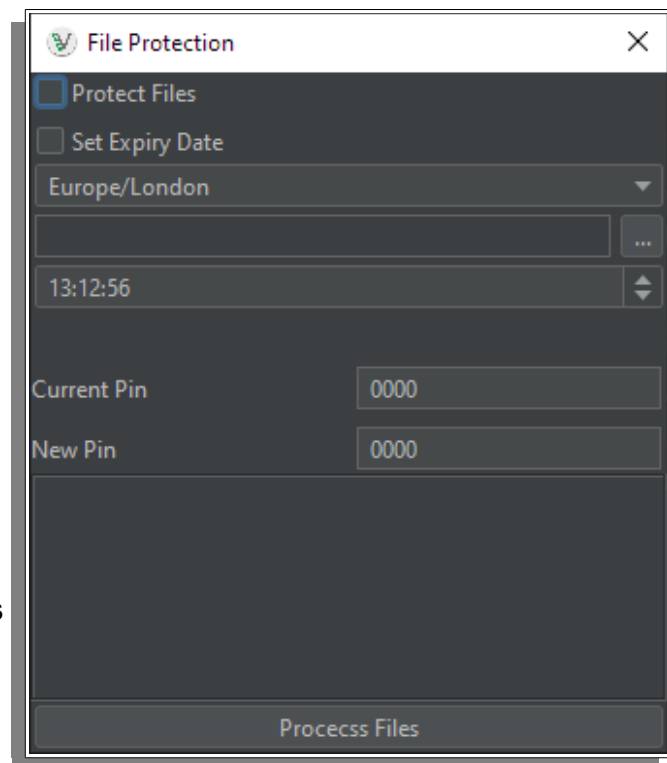
12   Classifications

Under the **Point Cloud Exploitation** tool bar is the Classifications tool. This tool allows you to assign colours and names to Classification numbers. Then when a point cloud is rendered and has "Classifications" enabled under it's properties, it's colours will be replaced by the colours assigned in the Classification table.

If a Classification is not enabled in the table then that set of points will not be rendered in the viewer window.

Select All – Sets all classifications to the Enabled state.

**Invert –** Inverts the Enabled state of a Classification.

To change the colour of a classification simply double click the colour field and edit as appropriate.

Name – Names the Classification.

To add Meta data to the Classification which will be selectable during exportation of the cloud data, enter it using the plus button

To remove meta data simply click the minus button. Meta data can also be repositioned using the up and down arrows.
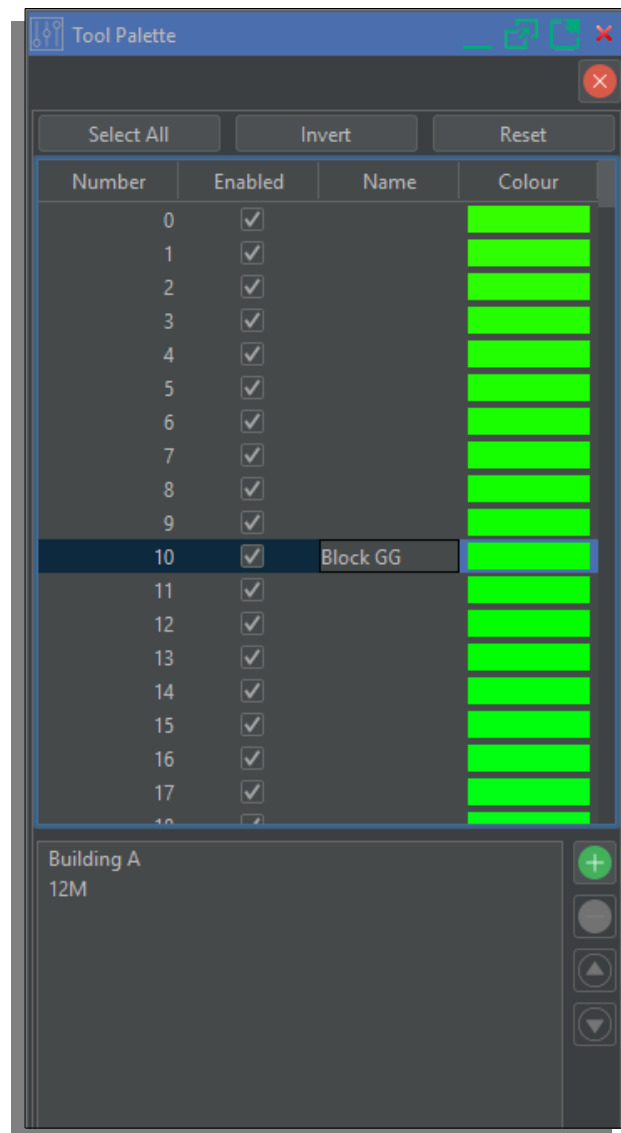
The values set will be saved with the project, also the point cloud(s) applied classification changes are also saved with the project.

13 Presentation Mode

As well as being able to generate videos, live fly-throughs and publications from Viewpoints you can also use them within a live presentation using the *Presentation Mode* of Arena4D.

To access Presentation Mode simply click the Presentation Mode button on the **System Tool Bar**.

Once Presentation Mode is active all windows will minimise, leaving the main viewing window to fill the screen.

At the bottom of the screen there will be two buttons, *Previous* and *Next*. Using these two buttons you can sequentially step through the current Viewpoints. The current Viewpoint number and name is shown in the middle between the two buttons.
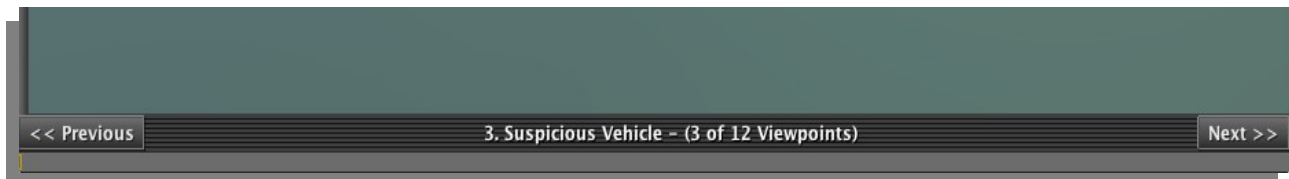
14   Additional Supported Peripherals

14.1   *Joypad Controller Support*

Full support for USB joypad controllers using the buttons and analogue sticks to take control of movement through point clouds and associated Data Objects.

Note: Always make sure the joypad is connected before loading Data Studio or else the controller will not function correctly. Also ensure "Analog" mode if available is turned on (normally LED on).

The left joy stick moves the view forwards, backwards, strafe left and right.

The right joy stick changes tilt up, down, rotate left and right.

Any of the four button on the right side of the controller can be used with a single press to increase movement speed. Which of the four buttons can vary from controller to controller.

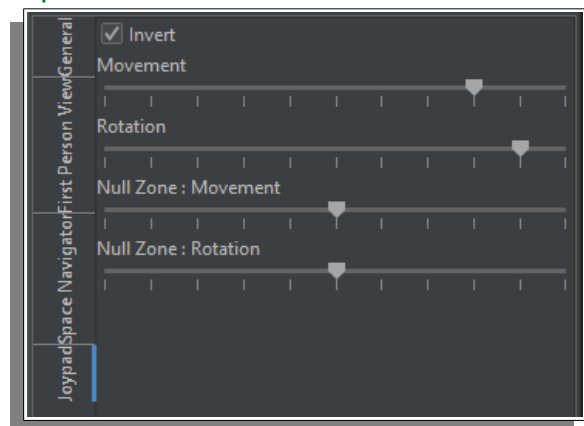Under "**System Settings**" → "**Controller**" options exist for "**Joypad**".

Invert – changes Rotation up/down

Movement – Speed of left stick

Rotation – Speed of right stick

Null Zone: Movement – help prevent drift

Null Zone: Rotation – help prevent drift

14.2   *3D Space Mouse Controller Support*

Full support for 3D Space Mouse to take control of movement through point clouds and associated Data Objects. Consult www.veesus.com FAQ's if the driver for the particular device is not working. New drivers can install an emulator overriding the normal 3D Space Mouse connection. Disabling the HID-compliant game controller solves the issue when the 3D Space Mouse is not connected.
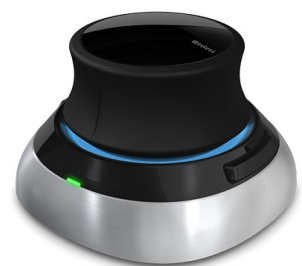
14.3   *VR Support*

Full support for VR head sets creating the most immersive VR experience from point clouds to all Data Studio data objects (not just point clouds).

Selecting the VR icon 👁 from the tool bar changes the Viewer or GIS window to show what the headset view. Putting the headset on at this stage will allow full immersive VR experience with full head tracking support (appropriate hardware required), add the use of a joypad section: 14.1 Joypad Controller Support for increased experience.

Selecting the VR icon from 👁 the tool bar will return back to normal viewing.

Note:

- *For best 3D performance select the local view.*

- *Make sure Steam VR is installed and running correctly.*

14.4   *VR Hand Controllers*

Using the hand controllers allows you to perform movement, jump to location and measurements all within the VR environment.

14.4.1   Oculus Hand Controller operation

14.4.1.1   *Measuring*

Press the "Trigger" button on the right-hand controller to select area for measuring, press the "Middle side" button on the left-hand controller for the first measurement point, press the "Middle side" button a second time to display a line and measurement. To cancel mid measurement press the "Middle side" button on the right-hand controller.

14.4.1.2 *Range Measuring*

Press right hand trigger button and the distance to that point will be displayed.

14.4.1.3 *Jump To Position*

Press and hold the left hand trigger button on the point to move to, as the button is held over a period of 2 seconds the move icon will change from green to blue completing the position move. At any point during the 2 seconds releasing the left hand trigger button will cancel the operation.

14.4.2 HTC Vive Hand Controller operation

14.4.2.1 *Measuring*

Press the "Trigger" button on the right-hand controller to select area for measuring, press the "Middle side" button on the left-hand controller for the first measurement point, press the "Middle side" button a second time to display a line and measurement. To cancel mid measurement press the "Middle side" button on the right-hand controller.

14.4.2.2 *Range Measuring*

Press right hand trigger button and the distance to that point will be displayed.

14.4.2.3 *Jump To Position*

Press and hold the left hand trigger button on the point to move to, as the button is held over a period of 2 seconds the move icon will change from green to blue completing the position move. At any point during the 2 seconds releasing the left hand trigger button will cancel the operation.

Note: if performance is poor and the hardware is "VR ready" make sure your point cloud(s) are filtered and combined where possible (achieved in the VPC Creator). Having lots of point clouds loaded with overlapping point data is going to put extra load of the visual experience. Dropping the point cloud(s) quality even as low as "15" will still result in a quality good enough for the headset which is much lower resolution then the computer monitor.
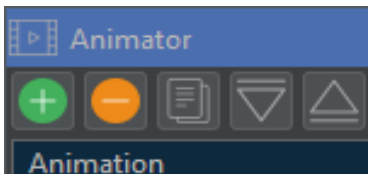
15   Animator Tool

Animation(s) will be saved at the same time as the project. The animator allows multiple animations per project, all the different data objects within the project and their properties, control of time and the ability to output the results into a standalone video.
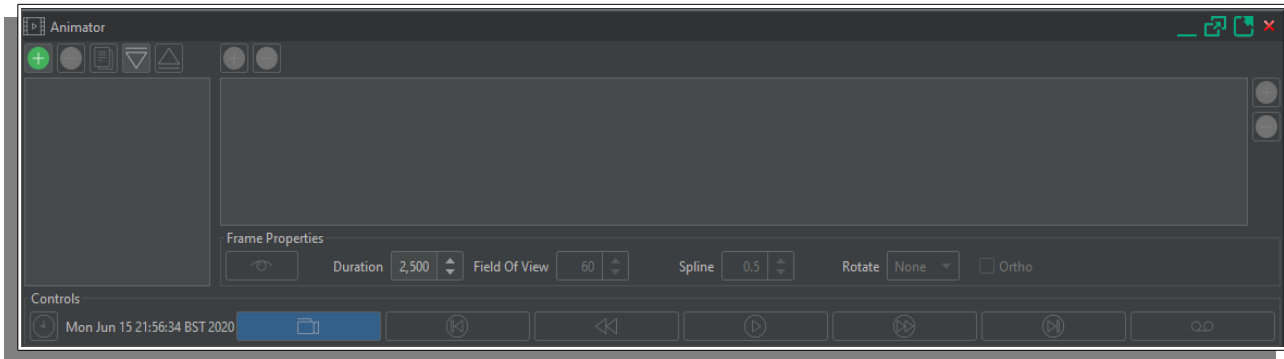
15.1   *Animator Buttons*

15.1.1   Adding Animations

Multiple Animations can exist per project using the Plus button to extend the number of rows. Selected Row can also be removed using the Minus button. You need at least one Animation before creating a Key Frame.

Copy Animation copies the select animation allowing quick view changes for each key frame for the same animation data. Useful if you required more than one view point for a particular animation scenario.

Import Animation to load camera paths from 3D Studio Max which will generate Key Frames along the loaded camera path. Data Studio animation ".a4a" files can also be imported.

Export Animation saves the animation as an .a4a file.

15.1.2   Adding Data Objects

Multiple Data Objects are added using the Plus button to extend the number of rows, more then one Data Object can be selected at the same time from the Workspace tree. Selected row(s) can also be removed using the minus button. Selecting a Data Objects key frame and right mouse clicking gives the option to "Toggle" the Data Objects on/off state.

Note: folders can be added which benefits by making the rows less in the animator frames and that they can all be moved at once simplifying animation movements.

15.1.3 Adding Key Frames

Multiple Key Frames can added using the Plus button to extend the number of columns. Selected column(s) can also be removed using the minus button.

15.2 *Animator Controls*

15.2.1 Key Frame Selection

Select Key Frames clicking (left mouse button) directly with the mouse cursor position or move between Key Frames by clicking on each of the animation tool buttons:

Whether camera position is moved to key frame position or remains as current.

Skip to first Key Frame.

Skip to previous Key Frame.

Play animation from Key Frame selected.

Skip to next Key Frame.

Skip to last Key Frame.

Record animation to a standalone video file.

15.2.2 Time Adjustment

Adjust the Time and Date of the start of each animation.

Select the clock symbol and select adjustment for country/city, date and time.
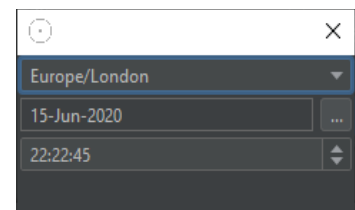
15.3 *Key Frames*

Key Frames are the building blocks of the Animation Tool. Create a Key Frame for each movement, property or position view change.

15.4 *Frame Properties*
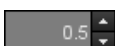
Each Key Frame has its own set of properties:

Use the current screen position/location to set the selected Key Frame.

Duration in milliseconds for the animation to get to this Key Frame.

Field Of View for the selected Key Frame.

Spline for the selected Key Frame.

Rotate (360º) for the Key Frame (Key Frame needs to be the same as previous).

Ortho view for the selected Key Frame.

15.5 *Creating an Animation*

First add an animation clicking on the '+' symbol. The new animation will be created and appear in white, selecting the "Animation" will turn it yellow and the Object "Camera" and the first Key Frame will be displayed.
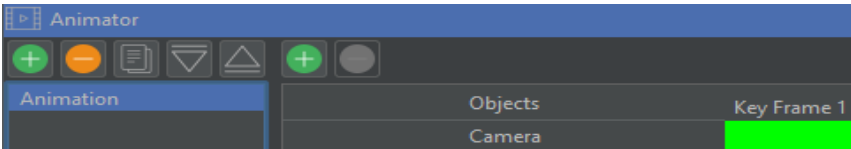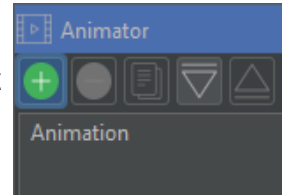
Double clicking on the animation will enable editing of the name.

"Key Frame 1" will have taken the screen position/location from when the animation was created (this is also the same when you add Key Frames) although moving the view window position and clicking the camera icon will assign the new position to the selected Key Frame.

Clicking the '+' symbol adds another Key Frame which has the position/location taken from the current view window.
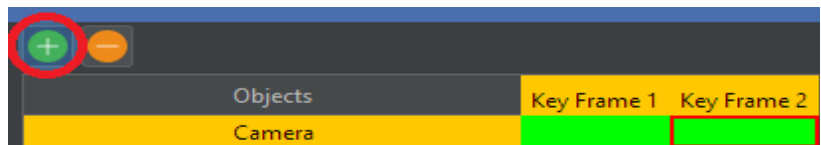
Making sure this new Key Frame is selected (as shown with the red border), then move the position within the view window and selecting the camera icon will change the position. Selecting between Key Frame 1 and 2 the view window will change to reflect the different frames. The view window will not change if the camera is *not* amber.

Pressing the Key Frame controls explained in section 15.2.1 Key Frame Selection demonstrates the animation currently created with two Key Frames.

Adding a Data Object(s) select the object(s) in Workspace tree and click on the '+' symbol. The object will appear for each Key Frame.
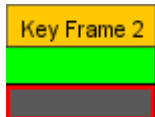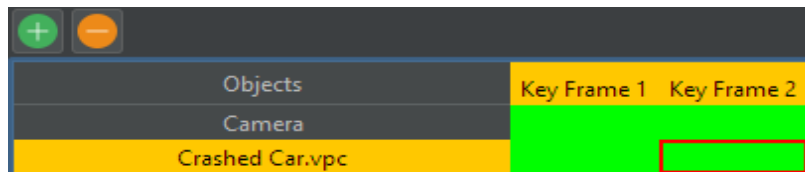
To disable from a particular frame(s) right mouse click selecting "Toggle" and the green stage will appear grey.

For each Key Frame the position and properties of the Data Object are set during the add stage. To move a Data Object or change any of it properties, first select its Key Frame and only then move or adjust the Data Objects properties. This ensures the correct Key Frame is being adjusted.

Note: If a mistake is made use the undo key.

15.6   *Creating a Standalone Video/Picture Animation*

Once the animation creation is complete a video or collection of pictures can be generated for viewing within a standalone picture or video viewer.

Select the Record animation ⬤⬤ icon.

Note: Which ever Key Frame is selected before pressing the Record icon will be first frame in the recording whether it is a Video or Picture(s). Multiple Key Frames can be also be selected using the "Shift key" to avoid unnecessary Pictures or Video lengths therefore creating a Partial Animation. This can be useful for testing correct setting due to quick completion time if only a few frames are selected.

15.7   *Output Settings*

When generating a movie file or multiple picture files you can select a number of options to produce the best output for your requirements.

15.7.1   Settings

Format – Video/Picture format output.

Resolution – number of horizontal and vertical pixels to use per frame. The higher the pixel count the better the quality of video, but the more time taken to process. The default setting is standard High Definition television quality.

Width – number of horizontal pixels to use per frame. Overrides the setting under Resolution.

Height – number of vertical pixels to use per frame. Overrides the setting under Resolution.

Frame Rate – the number of images per second of animation. The higher the number the smoother the video. The default setting is the standard UK television rate of 25 frames per second.

Super Sampling – higher resolution sampling is used to source each frame and then downscaled to produce a better quality of video, but the more time taken to process. *Note: try increasing the point size as result may have smaller more detailed points.*

Panorama – generates a 360º panorama video. *Note: select super high definition 4096 x 2160 for best results, but files sizes will be large so allow time and enough disk space.*

Stereo – generates a *side by side* 3D stereoscopic video file.

Eye Separation – amount of separation when producing 3D stereoscopic video file.

There are also a number of "Override" settings which allow you to tune the viewpoint parameters used in creating the movie.
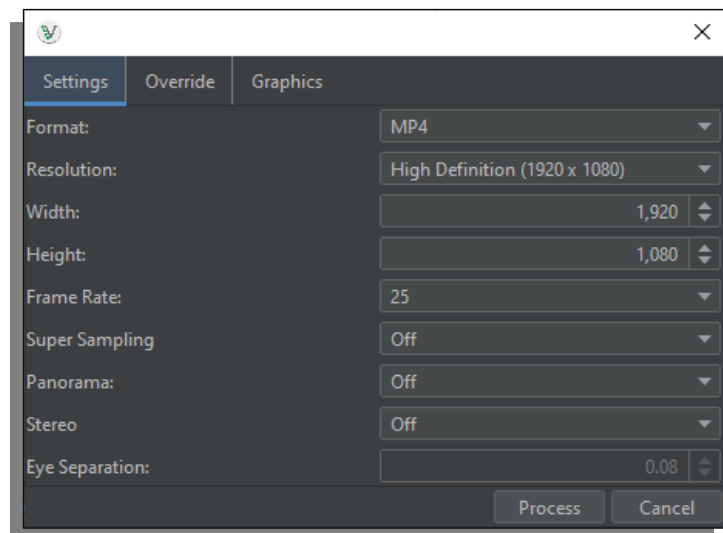
15.7.2   Override

Override options ignore any property settings for each key frame e.g. setting the field of view to 100º will mean the entire production will have that field of view and not any specified in the properties.

Speed – sets a constant fly through path speed. This will ignore all other duration settings.

Duration – forces the video length to a set duration in seconds, therefore increasing or decreasing viewpoint durations as required to match the requested overall duration.

Heading – offsets the viewpoint heading by a set amount.

Pitch – offsets the viewpoint pitch by a set amount.

Field Of View – sets the camera field of view.
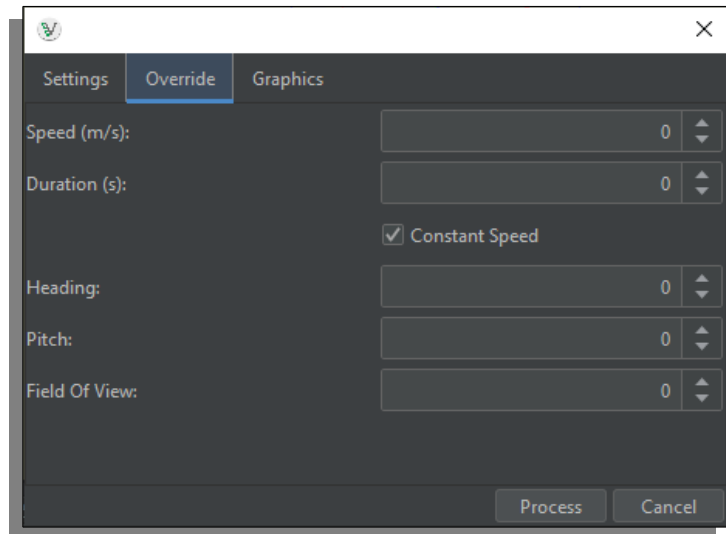
15.7.3   Graphics

Graphics options listed below will multiply by the factor provided any property settings for each point cloud, font and line sizes.

Point Size – Multiply point size by.

Point Ratio – Multiply to point ratio by.

Point Quality – Quality of all points.

Font Size – Multiply font size by.

Line Width – Multiply line width by.

Note: *you can add decimal values to the multiplies.*

16 Arena4D Point Server

For owners of Arena4D Point Server you can stream data from the server to Arena4D Data Studio.

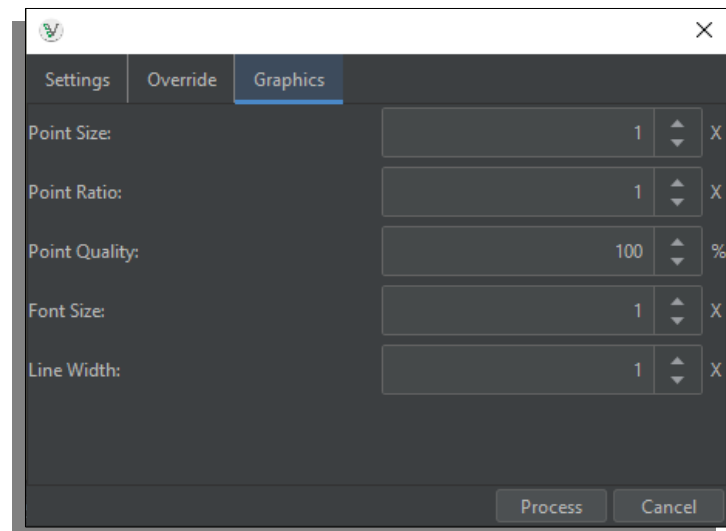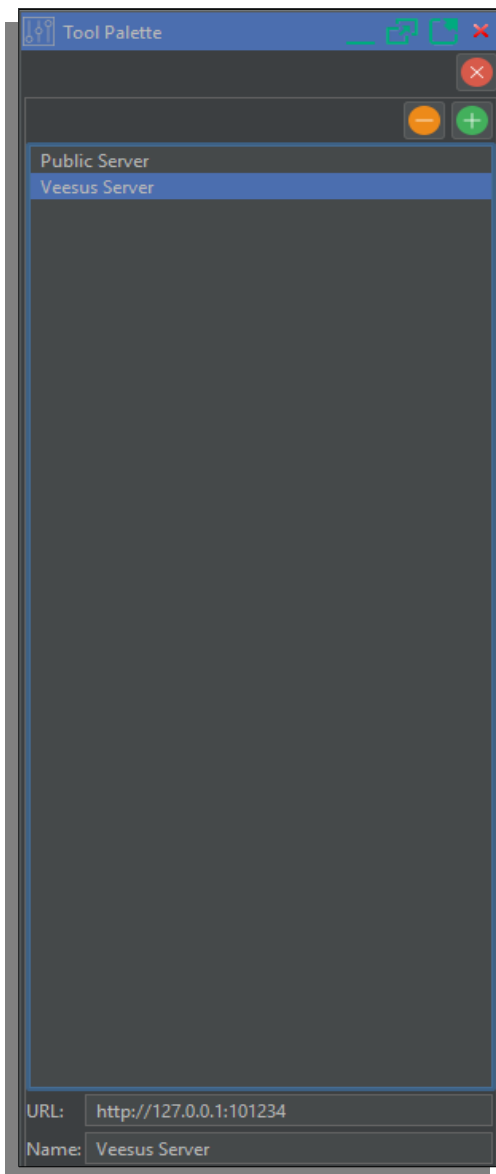To allow access to a Point Server the first thing you must do is add the Point Server to Data Studio as a server object under the **Point Server Manager** under the **System** menu.

The manager will load in the Tool Palette window.

To add a new server click the **Add** button at the bottom of the screen and enter the URL including the port number of the server.

For example *127.0.0.1:10123*

Once the server is added it will appear in the list of available servers. You can change the URL at any time in the top text box.

You can also give a server a "Friendly Name" by editing it in the bottom text box.

Once a server is added to Data Studio it will become available in the File Open dialog window for point clouds.
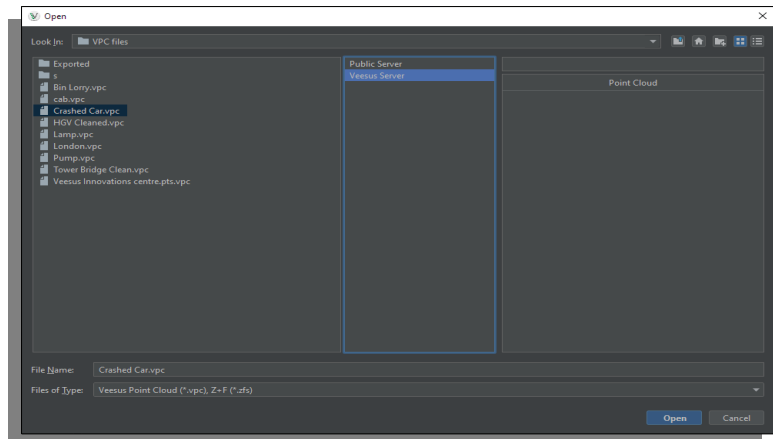
Selecting a server in the middle column will produce a list of point clouds on that server in the right hand side. These can be filtered down using the text box above the list. Once a point cloud is selected from the server simply click **Open** to start streaming that data to your viewer.

Streamed point clouds can be manipulated in anyway a normal point cloud file can be. The only restriction is that points can not be deleted nor have their colour changed.

17 Controls Quick Reference

17.1 *Orbit GIS*

Left mouse drag	–	rotate.
Left mouse drag + SHIFT	–	pan/tilt.
Right mouse drag	–	translate.
Middle mouse drag	–	pan/tilt.
Mouse wheel	–	zoom.
X / Left Mouse double click	–	centre view here.

17.2 *Orbit Viewer*

Left mouse drag	–	rotate around centre point.
Right mouse drag	–	translate.
Mouse wheel	–	zoom.
X / Left Mouse double click	–	centre view here.

17.3 *First Person*

W	–	walk forwards.
S	–	walk backwards.
A	–	strafe left.
D	–	strafe right.
SHIFT	–	run.
Left mouse drag	–	look around.

17.4 *Shortcut Keys (Default)*

SHIFT + ESC	–	Escape Full Screen mode.
R	–	reorientate.
F	–	reset field of view.
G	–	reset view.
X	–	snap to cursor.
T	–	target view.
SHIFT + R	–	rotate.

V	–	create Viewpoint.
M	–	create Measurement.
P	–	create Plumb Line.
L	–	create Polyline.
H	–	create Pin.
Alt + E	–	select – Point Edit.
SHIFT Alt + E	–	unselect – Point Edit.
CTRL + ALT + Space	–	toggle Presentation Mode.
SPACE	–	toggle View type.
CTRL + P	–	print.
CTRL + A	–	PDF.
CTRL + S	–	screenshot.
CTRL + C	–	copy to clipboard.
1,2,3,4,5	–	change point size.
SHIFT + 1	–	align view to tangent.
SHIFT + 2	–	align view to 2 points.
SHIFT + 3	–	align view to 3 points.
Arrow Keys	–	rotate view 90 degrees.
SHIFT + T	–	top down view.

18   Hints and Tips

Arena4D is a very versatile and powerful tool. To get the best experience of the software here are some useful suggestions when working with Arena4D.

18.1   *Setup Arena Data Processing Folder*

Arena4D requires a folder in which it processes data. Mostly this is used by the Point Cloud import wizard when unpacking LAZ files or copying points during editing.

Ensure this folder is placed somewhere where you have ample space for such processes and have write access privileges.

Note: The importation process utilise extensive storage drive access, do NOT use a network drive for importing data and where possible use an SSD (Solid State Drive) for increased performance.

18.2   *Combine Point Filling & Point Magnification*

Use a combination of Point **Filling** and Point Magnification when measuring to ensure you are clicking on the correct point. Point Clouds can be difficult to work with owing to the natural "gaps" in the data. These two modes can reduce the frustration when working with such data and combining them makes you almost forget you are using a Point Cloud at all.

18.3   *Use Point Lighting Mode 2*

Point Clouds are typically coloured using photographs taken at a time different from when the laser scan beam captured the original point. This can be anything from seconds in time to days/weeks/months. This can lead to the data "fooling" the human eye by presenting confusing colour that doesn't relate to the actual object that has been scanned.

By using Point Lighting Mode 2 all the colour is removed from the scene. However the intelligent lighting engine brings out the fine detail such as changes in surfaces, like ripples and cracks. These items normally go unseen in standard visualisation packages.

18.4   *Use Point Filtering*

Scan data often overlaps producing redundant data. Scans can be dramatically reduced in size by using point filtering. This can slow down the processing import stage, but creates a much smaller faster end product. Depending on scan acquisition type a range of between 2mm and 5mm is a good spacing to start experimenting with.
Using the Point Smoothing & Point Lighting function of Arena4D can easily overcome reduced point densities brought about by filtering, and in most cases actually improve the quality of the rendered data over raw unfiltered data.

18.5   *Filling Gaps*

If your point data has some noticeable gaps, try increasing the Point Render Threshold to a larger number in the System Settings. The higher the number, the more points that are loaded but the slower the rendering will become.

The other option is to adjust the Point Ratio values. When Point Filling is turned on it will apply a formula to the points to work out their size on the screen. This formula uses the distance, the point size and the point smoothing factor to calculate the correct size. By adjusting the point size and point smoothing figure in the Point Cloud properties you can adjust this gap filling effect.

18.6   *Workspace Data Object selection and unselecting*

If you have many data objects and have not put them into separate folders you can select them using the "Shift" key to select the last data object after selecting the first one. You can use the "Shift+Alt" keys to select all the data objects except the ones selected.