VICON ENGINEERING

BEYOND MOTION

VICON TRACKER USER GUIDE

WHAT'S INSIDE

Vicon Motion Systems is an Oxford Metrics plc company.
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About this guide

The *Vicon Tracker User Guide* provides product information, user assistance, and operational expertise to help you capture and analyze motion data. It will help you confirm your basic understanding of any steps; investigate a process, step, or option in more detail; try more advanced features; or pick up best practice tips.

About Vicon Tracker documentation

The following documentation is available for the current Tracker release:

Document	Description
What's new in Vicon Tracker	Describes the latest release of Tracker, including details of how to use the new features. PDF available from the Vicon documentation website[1] and as online help.
Vicon Tracker User Guide	Explains how to use Tracker with Vicon camera systems. PDF installed with Tracker and available as online help.
Installing and licensing Vicon Tracker	Step-by-step instructions for installing and licensing Tracker. PDF available from the Vicon documentation website and as online help.
Vicon Tracker Python API Quick Start Guide	Introductory information to help you to start using the Vicon Tracker Application Programming Interface (API).

The *User Guide* PDF is installed as part of your Tracker software installation.

1 https://docs.vicon.com

Regulatory information

For Vicon Tracker regulatory details, see Vicon Tracker regulatory information in the Tracker documentation area of the Vicon website[2].

2 https://docs.vicon.com

Introducing Vicon Tracker

Vicon Tracker is a powerful object-tracking solution, providing unrivaled data accuracy for integration into 3D applications. It enables you to use Vicon camera hardware for tracking rigid bodies, accurately streaming 6 Degrees of Freedom data in real time with very low latency.

To get started with Vicon Tracker, you set up your Vicon system and then prepare the objects for motion tracking.

The user interface guides you through the various tasks. When you are familiar with the basics, you can customize Tracker to look and behave as you want.

For more information, see the following topics:

Finding information about Tracker

You can find information about your Tracker installation by using the relevant options on the **Help** menu.

Check your licensed Tracker options

To check your currently licensed Tracker options:

1. From the **Help** menu, click **About Vicon Tracker**.
2. In the window, click the **Feature Details** button.
   The currently licensed options are listed in the **Licensed features** dialog box.
3. When you have checked the options, click **Close**.

Find Tracker version information

To check the version number of Tracker, from the menu bar, select **Help** > **About Vicon Tracker**.

The version number is displayed in the bottom left of the window that is displayed. This information may be requested if you contact Vicon Support with questions about Vicon Tracker.

Prepare the capture environment

Before you begin connecting up and using your Vicon system, to ensure its precision and accuracy:

- Choose an optimal measurement volume for a given experiment
- Place cameras to achieve uniform precision in all directions
- Consider the mechanical stability of the cameras and their mountings.

As the resolution of Vicon cameras has increased, mechanical stability has become increasingly important, because a very small shift in position can have an impact on system measurements, as shown in the following example.

Example of the effect of camera position on system precision

A Vicon T160 camera with a standard 18mm lens has a horizontal field-of-view of 54°. Each pixel subtends an angle of 0.0115° or 200 micro-radians.

In other words, a change of 200 micro-radians in the angular position of the camera and its sensor represents a one pixel shift in the system's measurements. This shift is equivalent to about a quarter of the diameter of a 12mm marker at a range of 16m.

> **Note**
> This is a 2D shift. All 3D measurements are estimated from the intersection of several 2D rays, so the resulting 3D shift may be smaller.

Maximizing data quality

The most common causes of imprecision of 3D data are:

Mounting creep

Scenario: Cameras are often clamped onto a framework that allows their position and orientation to be easily adjusted. The framework is commonly cylindrical tube and the clamps depend on friction.

Problem: If a camera is cantilevered so that its weight may rotate the clamp, the amount of slippage or creep at the clamp/frame junction needed to introduce 200 micro-radians of angular change is tiny: about 5 microns or about 1/50th of the diameter of a human hair. This slippage is far too small to be seen.

Solution: To minimize the risk of movement, mount cameras so that their weight does not rotate their mounting point either by bending the mounting frame or by causing a clamp to slip or creep.

Vibration

Scenario: Many buildings are of steel-frame construction. A steel framework can transmit vibrations caused passing footsteps, elevators, and passing vehicles. Most building vibrations are locally translational and, while undesirable, have little direct effect on camera rotation.

Problem: If a camera is mounted on a bracket or cantilever, building vibration combined with the cantilevered mass of the camera can cause a rotational oscillation of the camera mount.

Solution: Ensure that camera mounting brackets, and the structure to which they are attached, are extremely stiff and cannot wobble if there is any vibration in the building frame. This applies whether the camera mounting is vertical or horizontal.

Temperature

Scenario: Thermal expansion and contraction in large structures such as a building can be very large but the temperature changes that drive them tend to be relatively slow compared with the duration of a Vicon calibration/trial cycle.

Problem: One part of the system that changes temperature much more quickly is the camera itself. The inside of a Vicon camera reaches a steady temperature of around 50° Celsius. While the camera is warming up from the ambient

temperature of its surroundings, its internal components inevitably change dimension. However, when the components reach operating temperature, their dimensions remain stable.
Vicon measures the effects of warm-up and ambient temperature changes on all its cameras. All current camera models reach their steady operating temperature in approximately 30 minutes. This time is relatively independent of ambient temperature over the normal operating range of 0°–30°C. During warm-up, the equivalent positional change varies between 0.25 pixel for lower resolution cameras to approximately 1 pixel for the T160.

Solution: Allow Vicon cameras to warm up for at least 30 minutes before calibration and measurement.

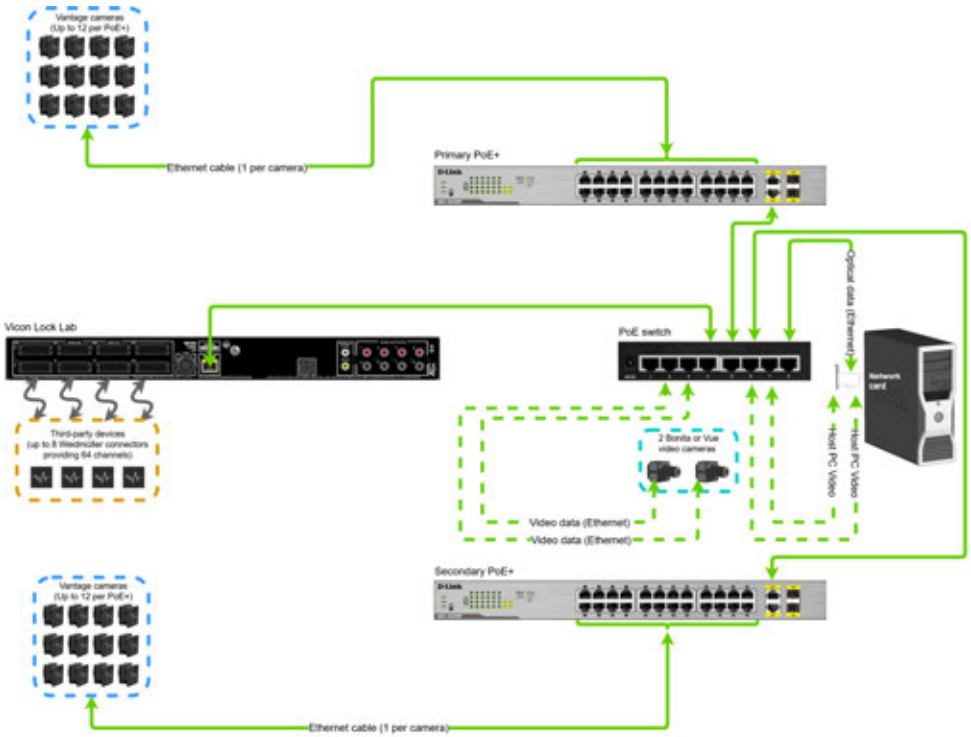
Tracker system components

Tracker is part of the fully integrated and expandable Vicon system that lets you build an architecture best suited to your motion capture application.

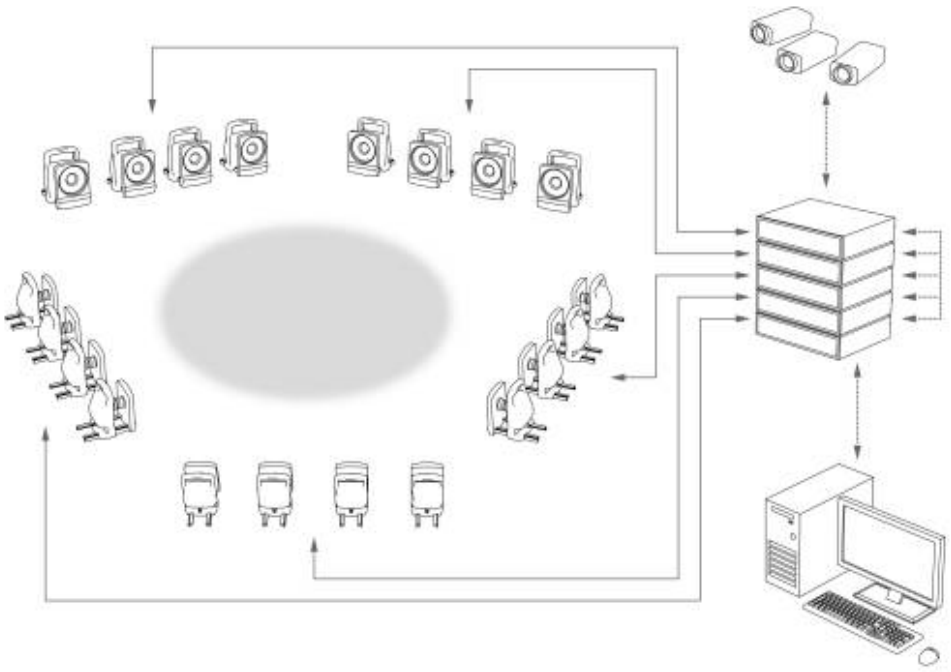
In the following architecture diagrams, Tracker is installed on the host PC.

For further information on how to set up a Vicon system, see Vicon system configuration and connection examples on the Vicon documentation website (docs.vicon.com).

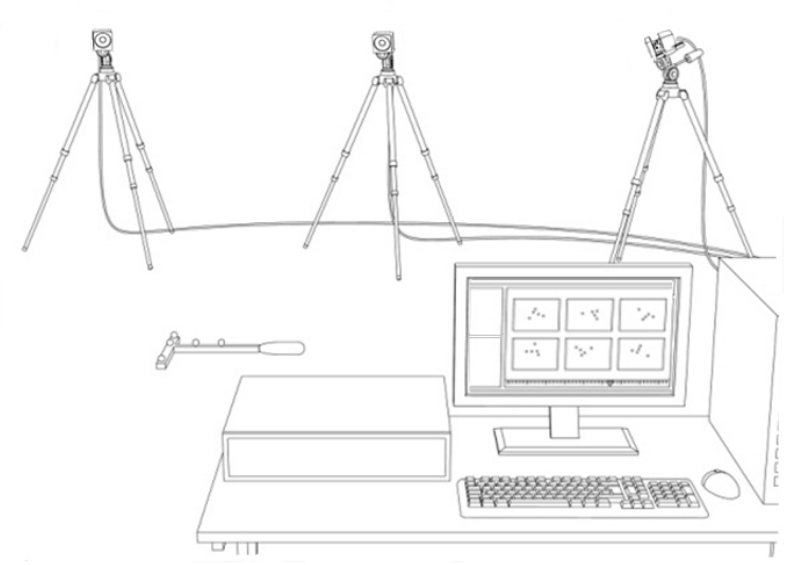
Vicon Vantage system architecture



T-Series system architecture



Bonita system architecture



About Tracker system components

> **Note**
> Except where noted, references to Vicon Lock, Lock units, and Lock apply to all current models of the Vicon Lock unit (at the time of publication, this includes Vicon Lock+, Vicon Lock Studio and Vicon Lock Lab).

You can include the following components in a Vicon Tracker system architecture:

Component	Description
Vicon Viper and ViperX cameras	Viper cameras and ViperX cameras can be used with Tracker. You can use Viper and ViperX cameras in systems running Tracker 3.8 and later.
Vicon Vero cameras	Vicon Vero cameras (v1.3 and v2.2) can be used with Tracker. You can use Vicon Vero cameras in existing systems consisting of Bonita cameras, Vantage cameras, and/or MX T-Series cameras, but note that they cannot be connected to a Giganet.
Vicon Vantage cameras	Vantage cameras (V16, V8, and V5) can be used with Tracker. You can integrate existing systems consisting of Bonita cameras and/or MX T-Series cameras into a Vantage system. See also What's New in Vicon Tracker, *Vicon Vantage Quick Start Guide* and the *Vicon Vantage Reference*.
Bonita cameras	Bonita Optical cameras can be used with Tracker. From Tracker 2.2 and later, your Tracker system can include both Vicon Bonita Optical cameras (B3, B10) and MX T-Series cameras (T10, T20, T40, T160). See also Connecting cameras on page 16 and Setting up a mixed Vicon camera system on page 17. **Caution**: The use of mixed systems that include Vicon cameras older than T-Series and Bonita is not supported and is at your own risk.
MX T-Series cameras	MX T-Series cameras (T160, T40-S, T20-S, T10-S, T10) can be used with Tracker See also Connecting cameras on page 16.

Component	Description
Vicon Connectivity units	Smart boxes that can be combined to create a distributed architecture, enabling you to customize the number of Vicon cameras: • Vicon Lock: Facilitates the integration of synchronous third-party equipment with Vicon Vantage and Vicon Bonita cameras by providing or receiving synchronization and/or timecode. Lock+ and Lock Lab also provide connectivity for third-party analog capture sources, such as force plates and EMG equipment. Connects to a PoE switch to which Vicon cameras and the host PC are connected. • MX Giganet: Link between Vicon cameras (Bonita and T-Series) and the host PC, with a 5-port Ethernet switch for connection to the host PC, and other client PCs. Can be integrated into a Vantage system. Vicon Lock+, Vicon Lock Lab, Vicon Lock Studio, and the T-Series hardware units are RoHS-compliant. See also About Vicon connectivity units on page 73.
Host PC	The main PC in the Vicon system, with at least one dedicated Ethernet port to enable Vicon system communications (in addition to any other network ports on the PC). Vicon Tracker application software is installed on this PC. Remote PCs may be used for other Vicon application software or third-party applications connected to the host PC via Ethernet.
Vicon cables	Proprietary Vicon cables plus commercially available Ethernet cables connect Vicon system components, providing a combination of power, Ethernet communication, synchronization signals, video signals, and data.
Vicon Apex	Hand-held tracking device that enables you to interact with virtual objects in a 3D environment. See also About Vicon Apex devices on page 99.
Vicon calibration device	Specialized device used to accurately calibrate the Vicon system.
Vicon accessories	Supplies for the Vicon system, including markers, tape, and Velcro.
Vicon engineering software	Vicon Tracker software, DataStream SDK and Vicon Virtual System.

Component	Description
Additional analog devices	Depending on your licensing options, your Vicon system may also include one or more additional devices, such as LVDTs, accelerometers, and load cells. See also Set up analog devices on page 85.

For further details on these components, see the *Vicon Vantage Reference Guide*, *Go Further with Vicon MX T-Series* reference book and/or the *Vicon Bonita Quick Start Guide*, which can be downloaded from the Vicon documentation website (docs.vicon.com).

Connecting cameras

To connect cameras into your Vicon system, you must specify the correct IP address for the network card that is connected to the PoE switch or Giganet.

To watch how to set up Vicon Vero cameras with Vicon Tracker software, see the Tracker Installation and Training Guide[3] on YouTube.

To connect the cameras:

1. Connect the PoE switch or Giganet to the PC.
2. Access the Windows network connections:
   - Open the **Control Panel**, then click **Network and Internet** and on the right side of the panel, under **Network and Sharing Center**, click **View Network Status and Tasks**; or
   - Click the **Network and Sharing Center** icon on the right of the Windows toolbar and then click **Open Network and Sharing Center**.
3. Right-click on the network card connected to PoE or Giganet and then click **Properties**.
4. In the **Properties** window, select **TCP/IP**.
5. Click the **Properties** button.
6. In the **Properties** window, click the **Use the Following IP Address** radio button.
7. Enter the following **IP address**: – **192.168.10.1**.
8. Enter the following **Subnet Mask** – **255.255.255.0**.
9. Click **OK**.

3 http://youtube.com/watch?v=2QRl2zzwhRk

Setting up a mixed Vicon camera system

Tracker enables you to capture with mixed Vicon camera systems consisting of Vicon Vero cameras (v1.3 and v2.2), Vicon Vantage cameras (V5, V8, V16) and/or Vicon MX T-Series cameras (T10, T20, T40, T160, or S Edition), and Bonita Optical cameras (B3, B10).

For systems involving only Vero, Vantage and Bonita cameras, the shutter period characteristics for all cameras match exactly. Irrespective of individual cameras' strobe (shutter) settings, the center alignment of these periods in any Vantage/Vero/Bonita camera in the same system align exactly. You do not need to make any adjustments to ensure that this alignment occurs.

However, for systems that include Vicon MX T-Series cameras, depending on your requirements (see When are differences in strobe timings important? on page 18), you may need to make some manual adjustment.

For more information, see:

- Understanding strobe timings on page 18
- Strobe timings in mixed MX T-Series camera systems on page 18
- When are differences in strobe timings important? on page 18

> **Important**
> Support for mixed systems' center strobe alignment requires Vicon firmware 700 or later. (Vicon recommends that you always update to the latest firmware.)

Understanding strobe timings

To obtain optimum performance from a mixed camera system that includes Vicon MX T-Series cameras, it is important to remember that there is a difference in strobe duration between the larger T-Series cameras and other current Vicon cameras.

For all current Vicon optical motion capture cameras, the strobe 'on' period and sensor exposure period (the length of time that the sensor gathers data) are coincident. Strobe intensity actually controls strobe duration and results in variable strobe and sensor exposure periods across the cameras in the system. This therefore produces small changes in timing between cameras. If your system includes MX T-Series cameras, these differences can result in slight discrepancies in the times of the middle of the pulses.

Strobe timings in mixed MX T-Series camera systems

When you are setting up a mixed camera system that includes MX T-Series cameras, you may need to consider the effect of strobe timings. A single reconstruction is the result of two or more camera sensors recognizing the same marker. If two cameras with significantly different strobe timings are used to track an object or marker, small differences in the absolute timing of this data can occur. Depending on the speed and type of motion being captured, these differences may or may not be a setup consideration.

To obtain consistent strobe timing and sensor exposure:

1. In the System tree, select the MX T-Series camera(s).
2. In the selected camera's **Properties** pane, in the **Settings** section, ensure the **Strobe Intensity** is set to its maximum setting.

This ensures that the center of the strobe pulse and shutter period for the Vicon Vero/Vue/Bonita cameras matches that of the Vicon MX T-Series cameras.

When are differences in strobe timings important?

In situations where very small timing differences are considered to be relevant and greater than other accepted limitations, set the **Strobe Intensity** for the MX T-Series cameras to its maximum value, as described above. Situations that may warrant this treatment include studies where very fast ballistic movements are expected and/or where very small markers are likely to be in close proximity.

Vicon file types used in Tracker

During the motion capture workflow, you create and edit a number of configuration files, Vicon Tracker generates a number of data files, and you can import files from and export files to other Vicon applications or supported third-party software.

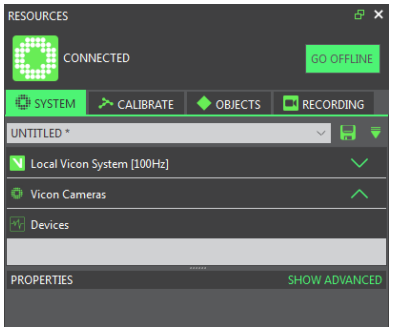
You create and edit the following Vicon configuration file types during motion capture and analysis:

File type	Saved using configuration controls in	Description
.options	**Options** dialog box	Data view options
.system	**Resources** pane, **System** tab	System settings
.ViewType	**View** pane	View options and layouts
.vsk	**Resources** pane, **Objects** tab	Vicon skeleton file
.xcp	**Resources** pane, **Calibrate** tab	Calibration parameters file. You can create, reset, and load an .xcp file but the .xcp file cannot be edited. You can export an .xcp created in Tracker to other Vicon application software and supported third-party software.

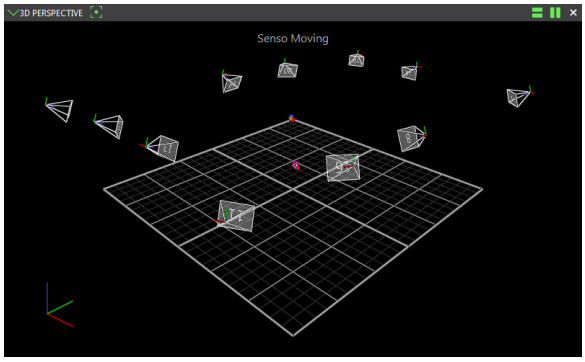
About the Tracker user interface

The Tracker user interface is laid out so you can locate buttons, menus, and controls where you expect to find them.

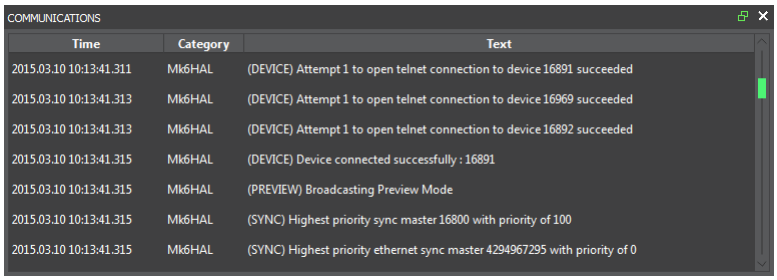
- **Resources** pane: Enables you to manage the different components of your Vicon system architecture and the objects whose motion is to be captured. See About the Resources pane on page 32.



- **View** pane: Enables you to set up the way you want to visualize the capture data from one or more cameras. See Viewing camera data on page 165.



- **Communications** pane: Enables you to view log information. See About the Communications pane on page 162.



- Menu bar: Enables you to exit Tracker, undo/redo, open close panels, view help, software version, and licensing information. See About the menu bar on page 191.

In the **Resources** pane and view pane, you use the tabs and buttons to access the tools and options for a specific workflow.

Customizing the Tracker user interface

You can customize the appearance of the Tracker window to suit your preferences, using any of the following procedures. The Tracker window maintains these settings until you adjust them again.

Undock and dock Resources or Communications panes

To undock Resources or Communications panes:

- Click the **Dock Pane**  button on the right side of the pane title bar.

To dock Resources or Communication panes:

- Double-click the pane title bar. The pane is docked in its last fixed position.

Move the Resources or Communications panes

1. Click and hold the pane title bar and drag the pane to the desired location in the Tracker window.
2. Drop the pane anywhere in the window to change it into a floating pane.

Resize the Resources or Communications panes

1. Hover the mouse pointer over the inside edge of the pane or the top edge of a section so that the pointer becomes a double-headed arrow and drag to resize as needed.
2. Click and drag the arrow to move the split line left or right to resize the pane width, or up and down to resize the section height.

Hide or display the Resources or Communications panes

1. Click the **Close Pane**  button on the right side of the pane title bar.
2. From the **Window** menu, clear the required option to hide the **Resources** or **Communications** pane and select the appropriate option to display the required pane.

Hide or display sections within the Resources panes

- Click the **Hide Section**  arrow or the **Display Section**  arrow to the right of the section heading.

> **Tip**
> The view pane cannot be undocked or repositioned in the Tracker window. You can open a separate floating view pane by selecting the New floating workspace option from the **Window** menu. This floating workspace can be repositioned and resized.

Setting properties in Tracker

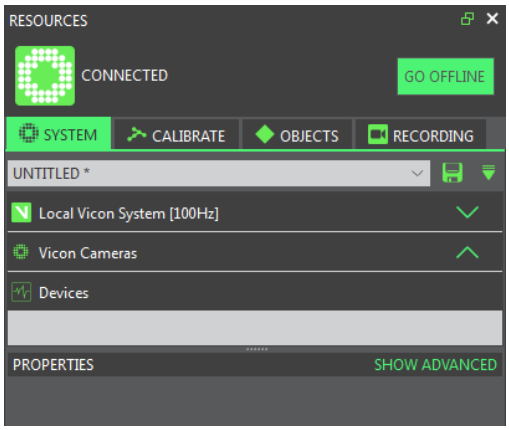
You can configure the way certain areas of Tracker look and behave by configuring settings in the **Properties** pane. The properties you can configure depend on what is selected in the **Resources** pane or the **Options** dialog box.

Some properties settings are automatically saved, so Tracker remembers them in subsequent sessions. You must explicitly save other settings using the configuration management controls for the relevant area of the Tracker window.

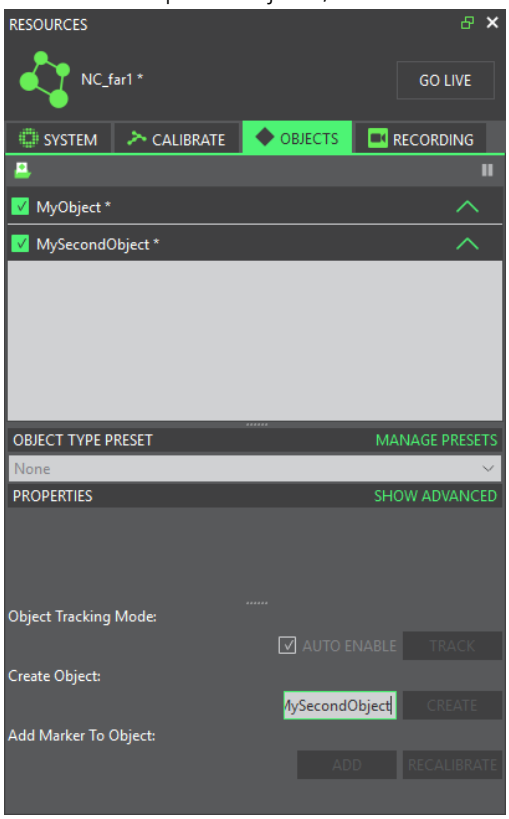
To configure Properties settings:

1. In the Tracker window, click on the relevant tab or open the dialog box containing the properties you want to configure:

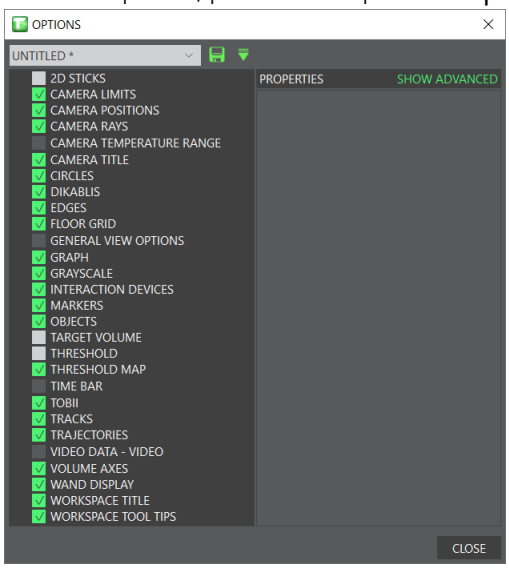
- For system components, in the **Resources** pane, click the **System** tab.



- For motion capture objects, in the **Resources** pane, click the **Objects** tab.



- For view options, press F7 to open the **Options** dialog box.

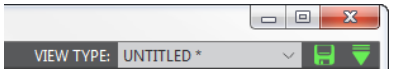


- In the **Properties** pane, click the **Show Advanced** link to view all of the available properties.

- Click the **Hide Advanced** link to show just the basic properties.

- In the **Properties** pane, view or change the setting for the required property using its entry field or control:
  - Select or clear a check box to switch the property on or off.
  - Click the current color in the entry field to display the **Select color** dialog box. In the **Basic colors** area, click the square for the required color, or in the **Custom colors** area, define a new color.
  - Click the drop-down arrow and select an entry from the list.
  - Move the slider to the left to decrease the value or to the right to increase the value displayed in the entry field.
  - Overtype the existing value.
- If you are working in the following areas of the Tracker window, save your settings to the appropriate configuration file using the configuration management controls:
  - System tab

  - View pane



  - Options dialog box

Mouse and keyboard shortcuts

You control Tracker using the mouse and keyboard.

> **Tip**
> To see a list of all current hot keys, on the **Help** menu, click **Hotkeys**.

Controlling Tracker's appearance and behavior

Use the following keys to control the way Tracker looks and behaves.

Task	Keys
Display the installed Vicon Tracker User Guide (PDF)	F1
Display full screen view for the selected view pane	F5
Display/Close **Sounds** dialog box	F6
Display/Close **Options** dialog box	F7
Create named object from selected reconstructions	CTRL+E
Reboot Core Processor	CTRL+R
Resynchronize the system	CTRL+SHIFT+R
Save All	CTRL+S
Pause Live/Play Offline	Space
Redo	CTRL+Y
Undo	CTRL+Z
Select previous camera	[
Select next camera	]
Unset all cameras' Bumped status	CTRL+SHIFT+B

Task	Keys
Translate object	T
Rotate object	R

Moving between frames

Task	Keys
Go to frame	CTRL+G
Move to next frame	Right arrow
Move to last frame	Left arrow
Move to first frame	Home
Move to last frame	End
Move forward 10 frames	PgUp
Move backward 10 frames	PgDown

Moving the camera viewpoint

Use the mouse and keyboard to move the camera viewpoint in 3D Perspective, 3D Orthogonal, and Camera view panes.

Action	Description	Mouse/Keyboard
Dolly/Zoom	Move camera viewpoint closer to or further away from the focal point	Right-click + drag forward or backward
Orbit	Move camera viewpoint around the focal point	Left-click + drag left, right, forward, or backward
Truck/Translate	Move camera viewpoint along a horizontal or vertical axes	Click wheel button + drag left, right, forward, or backward
Zoom to sensor window	Zoom the camera viewpoint to the sensor window	CTRL+SHIFT+Z

Viewing the X- and Y-Axis

Use the mouse to view the x- and y-axis in a Graph view pane.

Action	Keys and mouse
Slide x-axis left	Click wheel button + drag left
Slide x-axis right	Click wheel button + drag right
Slide y-axis up	Click wheel button + drag forward
Slide y-axis down	Click wheel button + drag backward
Zoom x-axis in	Right-click + drag left
Zoom x-axis out	Right-click + drag right
Zoom y-axis in	Right-click + drag backward
Zoom y-axis out	Right-click + drag forward

Zooming an axis (x or y)

All graph components in a single workspace maintain the same scale for both the x-and y-axes. The x-axis is shared across all components, but each component has its own y-axis. The y-axis may show different ranges, but represent the same number of values.

On the x-axis, the workspace is centered around zero, keeping the zero on the right edge of the workspace and changing the values displayed on the left.

Managing resources with Tracker

You manage the system components, calibration, objects, and recordings/ playback of your Vicon Tracker system in the Resources pane.

After you have prepared your Vicon system and selected the objects for motion capture in the Resources pane, you use the view pane to view the data.

For more information, see the following topics:

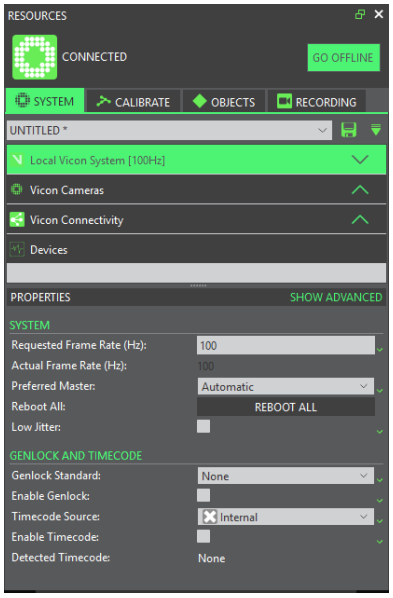
- About the Resources pane on page 32
- About the System tab on page 36
- About the Calibrate tab on page 105
- About the Objects tab on page 127
- About the Recording tab on page 147

About the Resources pane

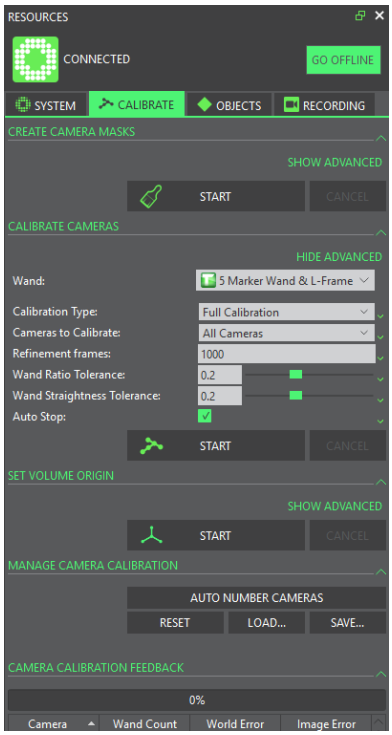
The **Resources** pane enables you to manage the system components, calibration, objects, and recordings/playback of your Vicon Tracker system.

The **Resources** pane contains the following components:

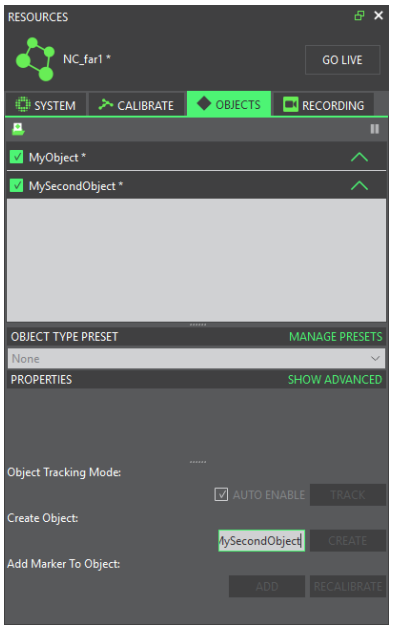
- **System** tab: Enables you to configure the components of your Vicon system. See About the System tab on page 36.



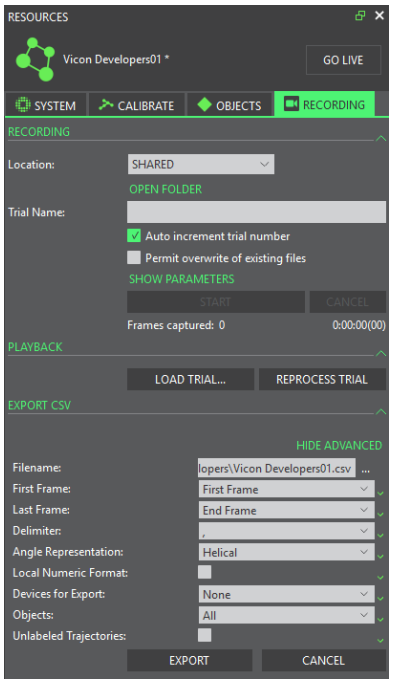
- **Calibrate** tab: Enables you to calibrate your Vicon cameras. See About the Calibrate tab on page 105.



- **Objects** tab: Enables you to manage object files for the objects whose motion data you want to track. See About the Objects tab on page 127.

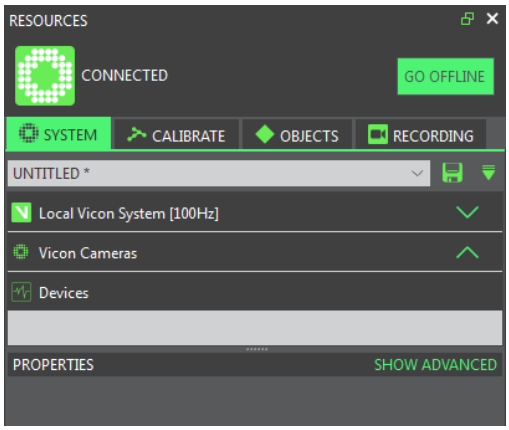


- **Recording** tab: Enables you to save and play back recordings of trial data. See About the Recording tab on page 147.



- **Resources** lists: Enables you to select the nodes and any sub-nodes to be configured. The components of this list depend on whether you are using the **System** or **Objects** tabs.
- **Properties** pane: Enables you to view and change settings for the item selected in the **Resources** list. See Setting properties in Tracker on page 24. The contents of this pane depend on the node selected in the **Resources** list.

About the System tab



You manage the components of your Vicon system on the **System** tab. The **System** tab may contain the following components:

Component	Description
System configuration management	You create, save, and manage configurations for the settings in the **System Resources** pane using the configuration management controls at the top of the pane.
System list	You select the node for the system component you want to configure in the System list: • **Local Vicon System** The Vicon system capture rate and the Tracker memory buffer size; real-time processing settings; and the identification and connection settings for the Tracker host PC. • **Vicon Cameras** The identification and configuration settings for each Vicon camera connected to your Vicon system. • **Vicon Connectivity** The identification and configuration settings for each Vicon Lock or MX Giganet unit attached to your Vicon Tracker system.

You can perform commands specific to a type of system component node or sub-node by right-clicking on a node in the System list and selecting a command from the displayed context menu.

You view or modify system components in the **Properties** pane. The properties displayed depend upon the node selected in the System list.

Reorder Devices dialog box

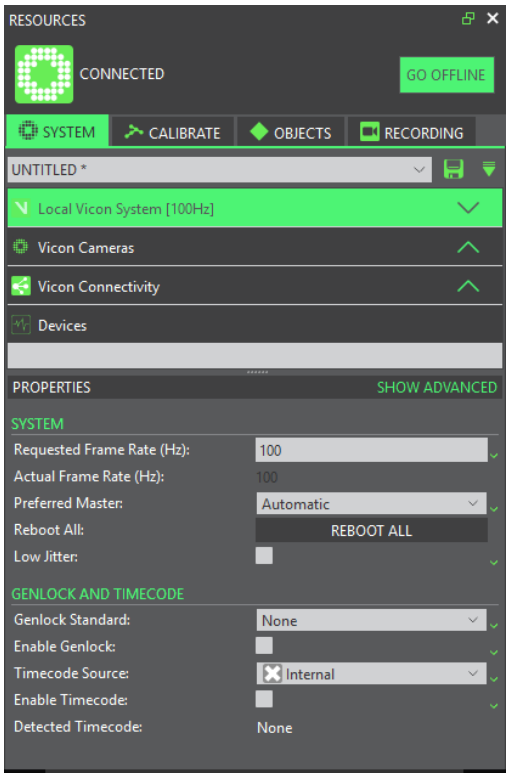
To use the **Reorder Devices** dialog box to change the order in which Vicon devices are displayed:

- On the **System** tab, right-click the **Vicon Cameras** node or **Devices** node and then click **Reorder**.

In the **Reorder Devices** dialog box, choose from the following options:

Option	Description
Move Up	Moves the selected item up one position in the list
Move Down	Moves the selected item down one position in the list
Sort	Sorts the list of devices according to name and type. Remembered devices are at the bottom of the list.
Clean	Removes the entries for the devices that are not used or referred to (Remembered devices) in the current session.
Revert	Undoes all the changes you have made in this dialog box since you last clicked OK.

About the Local Vicon System node



The **Local Vicon System** node enables you to configure the Vicon system capture rate and the amount of memory allocated to Tracker for motion capture, manage the way Tracker is to produce real-time 3D representations of the objects whose motion is being captured, and specify the identification and connection settings for the Tracker host PC.

The **Local Vicon System** node is the top-level node that is displayed for the Tracker host PC. This node contains sub-nodes for each device connected to your Vicon system under the following nodes:

- Vicon Cameras
- Vicon Connectivity
- Devices

The node for the device designated as the Vicon system synchronization master is highlighted in bold on the **System** tab in the **Resources** pane.

Set up Local Vicon System properties

To configure the Local Vicon System:

1. On the **System** tab, click the **Local Vicon System** node.
2. In the **Properties** pane, view or change settings for the desired properties to suit the needs of your motion capture application.

   When you first set up your Vicon system, you must configure at least the **Requested Frame Rate** (Hz) property.
3. In the configuration management section at the top of the tab, enter a name and click the **Save current configuration** button  to save your system configuration settings.

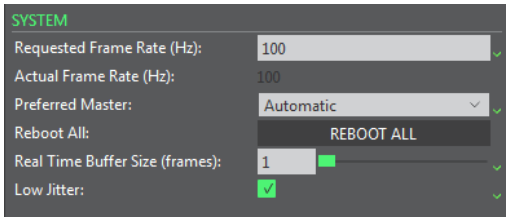
Properties pane for Local Vicon System

The **Properties** pane for **Local Vicon System** contains the following sections.

You can also access related options from the Local Vicon System context menu on page 52.

> **Note**
> Some settings are available only when advanced properties are displayed (at the top right of the **Properties** pane, click **Show Advanced**).

System section

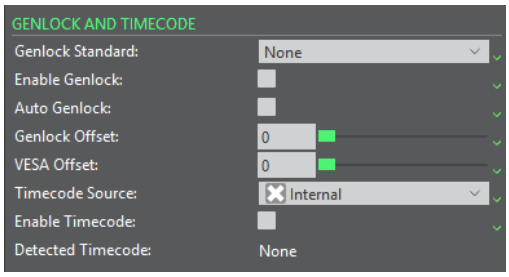


On the **System** tab, when you click the **Local Vicon System** node, you can access the following system-wide settings in the **System** section of the **Properties** pane. These settings affect all the connected cameras and devices:

Setting	Description
Requested Frame Rate	The rate (in Hz) at which to synchronize the Vicon cameras and the external video signal. Select from displayed values (multiples of the base frame rate of the **PAL**, **NTSC**, or **Film** video standard specified in Standard) up to a maximum of 2,000. The configured Vicon system capture rate is displayed in square brackets beside the Local Vicon System node. For example, if the Vicon system frame rate is set to 100 Hz, the node title is displayed as **Local Vicon System [100Hz]**.
Actual Frame Rate	Displays the frame rate (in Hz) currently used by the system, as constrained by the limits of the camera frame rate.
Preferred Master	If multiple connectivity devices are present in the system, enables you to select your preferred master connectivity device. (If your system contains a Vicon Lock connectivity device, this is automatically selected as the master.)
Reboot All	Resets all the Vicon hardware devices in the Vicon system. Click this button if a camera has failed to boot, or if you need to reset the whole system. Alternatively, select **Reboot Hardware** from the context menu.
Real Time Buffer Size (frames)	The number of frames (between 1 and 100) that make up the buffer between the Vicon hardware and the processing engine. If set to 1, latency is minimized. If set to a higher value, throughput is improved, but latency is higher.
Low Jitter	When selected, sets the **Grayscale Mode** for all cameras to **Only**, which applies advanced centroid fitting and jitter reduction algorithms to reduce data noise. Note that running in this mode increases sensitivity to bandwidth limitations and its effectiveness is related to system size. For more information, contact Vicon Support[4].

4 mailto:support@vicon.com

Genlock and Timecode section

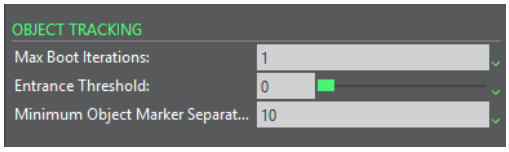


On the **System** tab, when you click the **Local Vicon System** node, you can access the following settings in the **Genlock and Timecode** section of the **Properties** pane.

Setting	Description
Genlock Standard	The type of video standard supported by the connected video source: None, PAL, NTSC, Film, 30Hz and VESA (for a complete list, click the Genlock Standard list in Tracker). The icon to the left of each option provides additional information about the availability of that standard. Note: The 30Hz option enables you to run the Vicon system at multiples of 30 frames per second (above 50 fps), with timecode and genlock capability at true 30 fps, and works with both Vicon Locks, and with Giganets and MX T-Series systems. However, note that for 30 fps support to work with Tracker, you must upgrade the Vicon firmware to Bundle 500. Caution: Running at 30 fps with Vicon systems older than MX T-Series is not supported and is at your own risk.
Enable Genlock	Select to enable synchronization.
Auto Genlock	When selected, Tracker automatically selects a genlock standard and enables synchronization based on currently detected signals.
Genlock Offset	Specify the system offset relative to the genlock signal (expressed as a fraction of the genlock frame period). Values are in the range 0–1 Note: For VESA modes, use **VESA Offset** (see below).
VESA Offset	Specify the system offset relative to the VESA signal (expressed as a fraction of the VESA frame period). The camera timing can be offset by up to one VESA frame. Note: Only applies when you have selected one of the VESA standards from the Genlock Standard list.

<table>
<tr><th>Setting</th><th>Description</th></tr>
<tr><td>Timecode Source</td><td>Enables you to select the required timecode source. The Internal Drop option determines whether the internal timecode source generates a drop-frame timecode when the Genlock Standard is NTSC.
Note: VITC and LTC always display a flat line if the system is not genlocked. This is because these signal types can only be detected by a master device that is genlocked.
The icon to the left of each option provides additional information about the availability of that standard:
<table><tr><th>Icon</th><th>Meaning</th></tr><tr><td>  Cross</td><td>The standard is not supported by the hardware (that is, no connected device supports locking to a signal of that type). If you select an unsupported standard, it restricts the available frame rates as it does in the previous version of Tracker.</td></tr><tr><td>  Flat line</td><td>No device in the system is detecting that standard.</td></tr><tr><td>  Blue square wave</td><td>The master device is detecting that signal and can genlock to it.</td></tr><tr><td>  Green square wave</td><td>If you select a mode with the blue wave icon and then select the Enable Genlock check box, the icon turns green.</td></tr><tr><td>  Red square wave</td><td>A device in the system is detecting the mode but a problem prevents it from being used, for example, if the signal is being detected by a device that is not the master device in the system.</td></tr></table></td></tr>
<tr><td>Enable Timecode</td><td>Select to enable timecode to be displayed in the Title bar when a live system is connected.</td></tr>
<tr><td>Detected Timecode</td><td>Displays the currently detected timecode standard as the number of timecode frames per second.</td></tr>
</table>

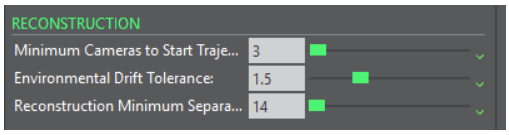
Object Tracking section



On the **System** tab, when you click on the **Local Vicon System** node, the following settings are available in the **Object Tracking** section of the **Properties** pane.

Setting	Description
Max Boot Iterations	The maximum number of iterations allowed for the booting algorithm. Increasing this parameter improves booting quality, but has a (small) performance cost.
Entrance Threshold	Minimum proportion of markers that must be visible to the cameras before the object is booted. If it is less than this value, the object is not booted.
Minimum Object Marker Separation	The minimum distance allowed between marker positions in order for them to be tracked separately.

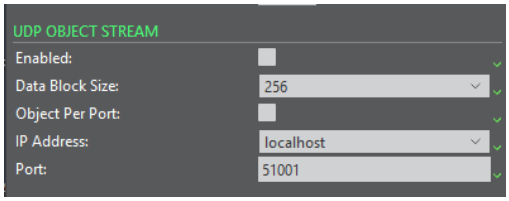
Reconstruction section



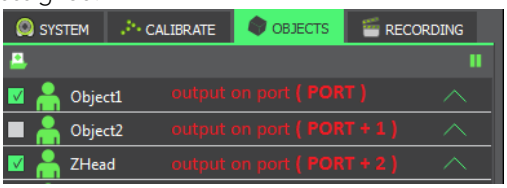
On the **System** tab, when you click on the **Local Vicon System** node, the following settings are available in the **Reconstruction** section of the **Properties** pane.

Settings	Description
Minimum Cameras to Start Trajectory	Controls how many cameras (rays) must see the same marker (centroid) to create a new reconstruction and potentially form a new trajectory. The minimum value that can create a reconstruction is two cameras. The maximum value of this parameter is 50 camera rays. If there are a large number of unlikely reconstructions being created, increase this value. Tip: In Tracker 3, the default value for this property is 3 (ie three cameras), so if you are using a two-camera system, ensure you change the value to two before starting to work with Tracker.
Environmental Drift Tolerance	An uncertainty applied (in mm) to camera calibration to take into account environmental factors such as temperature change, that may cause drift in the calibration. For larger volumes, increase this value; for smaller volumes, decrease this value. For advice about reducing the effect of environmental factors, see Prepare the capture environment on page 8.
Reconstruction Minimum Separation	The minimum distance, specified as a value in the range 0–100 mm, allowed between 3D marker positions in order for them to be considered for reconstruction. If two candidate reconstructions are closer than this minimum separation, only the most likely reconstruction (in terms of the number of cameras contributing) will be reported. The other will be discarded. A higher value decreases the likelihood of creating spurious reconstructions, but increases the possibility that some genuine markers will not be reconstructed. To disable this feature, set the value to 0.0.

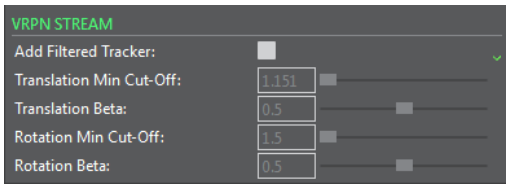
UDP Object Stream section



On the **System** tab, when you click on the **Local Vicon System** node, the following settings are available in the **UDP Object Stream** section of the **Properties** pane.

Setting	Description
Enabled	If selected, starts the UDP streaming of data. Unlike the data stream, the UDP stream does not maintain client connection information. If selected, data is output whether or not there are any connected clients.
Data Block Size	The size of the UDP datagrams (data blocks). Ensure the value selected matches the expected value for the datagram size in the client program. Options are 256, 512, and 1024.
Object Per Port	If cleared, all objects are output on the same port. If selected, each object is output on its own UDP port. Port assignments are made whether or not the object is active. The following image shows how port numbers are assigned: 
IP Address	The network address used to broadcast the data.
Port	The starting port for UDP streaming. If **Object Per Port** is selected, this is the starting port number. If **Object Per Port** is cleared, this is the output port for all objects.

VRPN Stream section



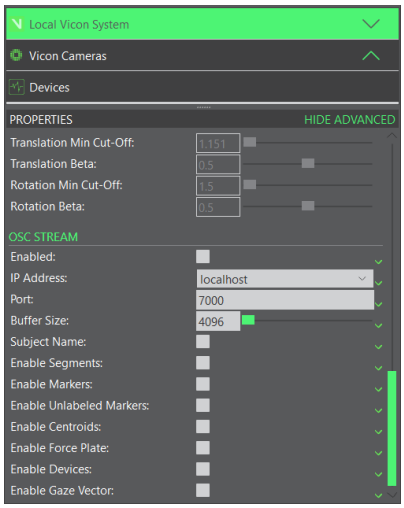
On the **System** tab, when you click on the **Local Vicon System** node, the following settings are available in the **VRPN Stream** section of the **Properties** pane:

Settings	Description
Add Filtered Tracker	If selected, adds a tracker (named <object>_2), with One Euro filtering applied, to each object.
Translation Min Cut-Off	Enables you to specify the frequency (Hz) below which noise (translation motion) will not be filtered.
Translation Beta	To avoid lag, you can set a value between 1 and 0 to reduce filtration applied to the position of the object where there is greater motion. 0 = filtering on all translation motion; 1 = filtering on very slow translation motion only.
Rotatation Min Cut-Off	Enables you to specify the frequency (Hz) below which noise (rotation motion) will not be filtered.
Rotation Beta	To avoid lag, you can set a value between 1 and 0 to reduce filtration applied to the rotation of the object where there is greater motion. 0 = filtering on all rotation motion; 1 = filtering on very slow rotation motion only.

OSC Stream section

To access the OSC data streaming options:

- On the **System Resources** tab, select **Local Vicon System** and in the **Properties** pane, ensure the **Advanced** properties are displayed.
  The data available for output is a subset of the data available using the DSSDK.



Important:
To stream device data, you must give the device a name.

OSC Stream properties

This table lists the OSC Stream properties.

Property	Description
Enabled	Turns streaming on/off
IP Address	Address used to create the outbound socket
Port	Port number used to create the outbound socket
Buffer Size	Size of the buffer to allocate to store a frame's worth of data
Subject Name	If a single subject is loaded, this option enables you turn on/off the subject name in the message address (see Packet contents on page 50). If multiple subjects are loaded, the subject name is always included as part of the message address.
Enable Segments, Markers, …	Turn on/off specific data types

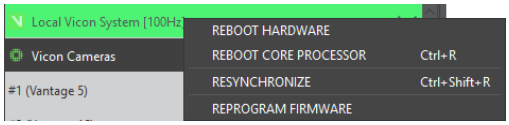
Packet contents

Each packet consists of a bundle containing one or more messages. Each message has an address associated with it to identify its contents. The **/vicon/frame** message is always generated; other messages may or may not be present, depending on the output data types selected.

Full address (Base in bold)	Tracker property	DSSDK type	Data values	Description
/vicon/frame	NA	Output_GetFrameNumber Output_GetFrameRate Output_GetTimecode	long - Frame Number float - Frame Rate int32 - Timecode Hours int32 - Timecode Minutes int32 - Timecode Seconds int32 - Timecode Frames int32 - Timecode Subframes int32 - Timecode Field Flag int32 - Timecode Standard int32 - Timecode SubframesPerFrame int32 - Timecode UserBits	Always present in the bundle. Timecode values are only present if the application has timecode enabled.
/vicon/seg/ SUBJECT/ SEG_NAME /vicon/seg/ SEG_NAME	Enable Segments	Output_GetSegmentGlobalTranslation Output_GetSegmentGlobalRotationMatrix	float(3) - Translation float(9) - Rotation matrix	SUBJECT: Subject Name SEG_NAME: Name of the segment If the Subject Name property is cleared and a single subject is loaded, the SUBJECT portion of the address is omitted. In all other cases it is present.

Full address (Base in bold)	Tracker property	DSSDK type	Data values	Description
/vicon/marker/ SUBJECT/ MARKER_NAME /vicon/marker/ MARKER_NAME	Enable Markers	Output_GetMarkerGlobalTranslation	float(3) - Translation	SUBJECT: Subject Name MARKER_NAME: Name of the marker If the Subject Name property is cleared and a single subject is loaded, the SUBJECT portion of the address is omitted. In all other cases it is present.
/vicon/unlabeled /N	Enable Unlabeled Markers	Output_GetUnlabeledMarkerGlobalTranslation	float(3) - Translation	N: A number starting at 0 Unlabeled marker numbers are arbitrary so you can't assume that the same unlabeled marker will be given the same number frame-to-frame.
/vicon/2D/ CameraID	Enable Centroids	Output_GetCentroidPosition	int32 - Number of centroids For each centroid: float(2) - Position float - Radius	
/vicon/fp/N	Enable Force Plate	Output_GetGlobalForceVector Output_GetGlobalMomentVector Output_GetGlobalCentreOfPressure	int32 - Number of samples For each sample: float(3) - Force float(3) - Moment float(3) - CoP	N: Force plate index number
/vicon/device/ NAME/OUTPUT/ COMPONENT	Enable Devices	Output_GetDeviceOutputValue	int32 - Number of samples For each sample: float - Device output value	NAME: Device name OUTPUT: Device output name COMPONENT: Device output component name
/vicon/gaze/N	Enable Gaze Vector	Output_GetEyeTrackerGlobalGazeVector Output_GetEyeTrackerGlobalPosition	float(3) - Gaze vector float(3) - segment position	N: Eye tracker index

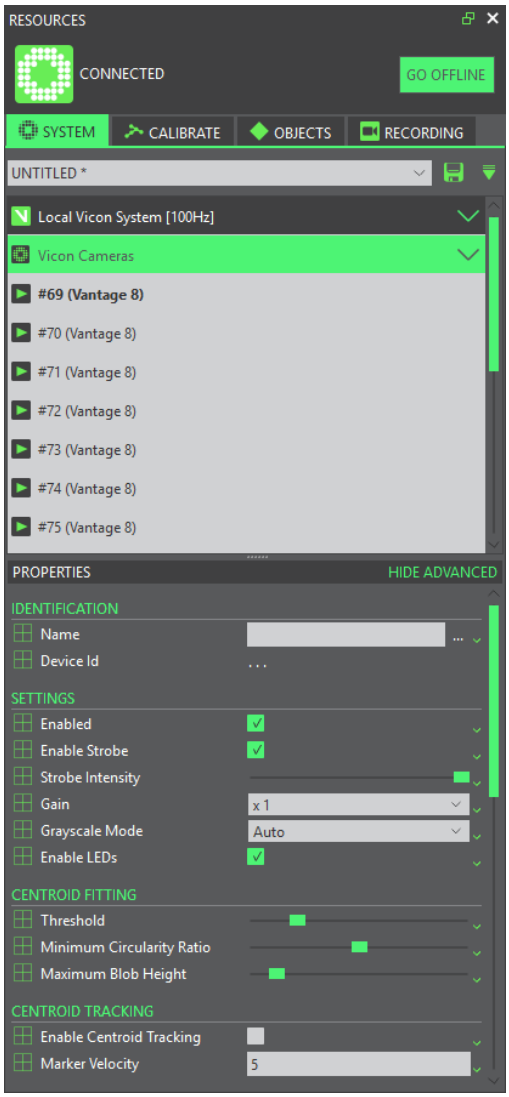
Local Vicon System context menu



On the **System** tab, when you right-click on the **Local Vicon System** node, you can select the following options from the context menu:

Option	Description
Reboot Hardware	Reset all of the Vicon hardware devices in the Vicon system. Use this command if a camera has failed to boot, or if you need to reset the whole system for other reasons. Alternatively, use the **Reboot All** button in the **System** section of the **Properties** pane.
Reboot Core Processor	Restarts the Core Processor and resets the labeler. Alternatively, press CTRL+R.
Resynchronize	Forces the Vicon system synchronization master to resynchronize the frame rate for all connected cameras and third-party devices.
Reprogram Firmware	Display the **Reprogram Firmware** dialog box in which you can view and update firmware for certain Vicon devices present in your system.

About the Vicon Cameras node



> **Note**
> If your system includes only Vicon Vantage and/or Bonita cameras, the **Gain** property is not displayed.

You manage the identification and configuration settings for each Vicon camera connected to your Vicon system with the **Vicon Cameras** node.

Configuring Vicon cameras ensures that all the camera settings are correct and appropriate for your motion capture application. You can configure the settings for an individual camera, several cameras, or all cameras at once.

This node is displayed under the **Local Vicon System** node. The **Vicon Cameras** node lists each Vicon camera connected to your system. For each camera, the node name includes:

- The device position number
- Any display name specified in the Identification property
- The camera type listed in parentheses, for example, #1 Over Door (T160)

Set up Vicon cameras

To configure Vicon cameras for optical data capture:

1. From the view pane tool bar, select **Camera**. The 2D data being captured by each Vicon camera selected in the **Resources** pane in the **System** list is shown in a separate **Camera** view pane.
2. View your capture volume in either of the following ways:
   - In the **Options** dialog box, under the **General View Options** section, select the **Target Volume** option. In the **Camera** view pane tool bar, from the **View** drop-down list, select **3D Overlay**. A virtual representation of your target volume is overlaid on the 2D data from the camera image.
   - In the capture volume, place a selection of static markers on the floor to roughly outline your target capture volume.
3. In the **System** list in the **Resources** pane, select the Vicon camera node whose properties you want to configure.
4. In the **Properties** pane, view or change settings for the relevant properties. When you first set up your Vicon system, you must configure at least the following properties in the order shown:

> **Important**
> These properties affect the quality of the motion capture data. Therefore, it is important to optimize them before you collect data intended for later analysis. In subsequent sessions, you may want to configure additional properties to suit the needs of your motion capture application.

Section	Property	Notes
Identification	Name	Only needed if you want to distinguish it from the others
Settings	Strobe Intensity	If adjusting these two settings does not easily enable you to eliminate reflections, create camera masks to eliminate reflections and other unwanted light sources that occur in parts of the capture volume.
Centroid Fitting	Threshold	
Settings	Gain	(MX T-Series only) Normally, leave at the default x1 setting, but if the markers seem faint or if the cameras have trouble distinguishing them, adjust this setting as required.
	Grayscale Mode	Normally, leave at the default Auto setting. However, during focusing, it can be helpful to change this setting to All, then change it back to Auto as soon as the camera is focused.

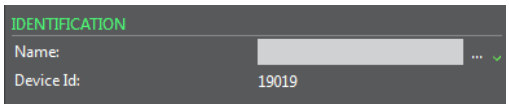
6. When you have finished adjusting the **Vicon Camera** properties, in the **Settings** area, ensure that **Grayscale Mode** is set to **Auto**.
7. At the top of the **System** tab, click the **Save current configuration** button  to save your system configuration settings to a .system file in one of the following folders:
   - If you select **Shared** the file will be saved in *C:\Users\Public\Documents\Vicon\Tracker3.x\Configurations\Systems*
   - If you select **Private** it will be saved in *C:\Users\UserName\AppData\Roaming\Vicon\Tracker3.x\Configurations\Systems*

Properties pane for a Vicon Cameras node

The **Properties** pane for a **Vicon Cameras** node or an individual camera node contains the following sections.

You can also access related options from the Vicon Cameras context menu on page 72.

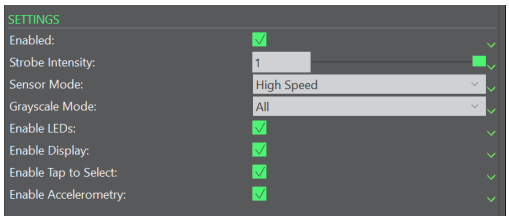
Camera Identification section



On the **System** tab, when you click on a **Vicon Cameras** node or an individual camera node, the following controls are available in the Identification section of the **Properties** pane:

Control	Description
Name	A user-defined display name for the entire set of Vicon cameras or for each individual Vicon camera. For example, if a camera is placed over a door, you could name it Over Door.
Device ID	The unique identification number Vicon assigns to each Vicon camera during manufacture. The top-level entry for all Vicon cameras is read-only.

Camera Settings section



> **Note**
> The above illustration shows the **Settings** section for a Vicon Vantage camera. The **Settings** section for other Vicon cameras displays slightly different options.

On the **System** tab, when you click on a **Vicon Cameras** node or an individual camera node, the following controls are available in the **Settings** section of the **Properties** pane.

Control	Description
Enabled	Whether or not the Vicon camera is currently enabled for use. Default is selected.
Enable Strobe	Whether or not the strobes on the camera are used (does not affect the shutter period). Default is selected.
Strobe Intensity	The amount of light emitted by camera strobe units. This value can be set between 0-1 to minimize reflections and obtain clear marker images. The higher the setting, the brighter the markers appear, but this may cause blobs to be produced from reflections from other strobes. Lower settings make the markers themselves less visible to the cameras. In almost all circumstances, you will want to keep the intensity at its maximum level because the system works by recording light from the strobes that is reflected from the markers, thus the more light the strobes send out the more light the markers reflect. However, if you are capturing a very fast moving object you may achieve better results by reducing the strobe intensity. The strobe intensity affects the time the strobe is on for each camera frame. The full strobe intensity corresponds to 1ms (0.5ms with Bonita) for normal frame rates. Lower strobe intensities mean that the markers are captured with the strobes on for less time and, therefore, have less time to move during the frame. Tip: It is advisable to use full strobe intensity and deal with reflection problems by closing the camera lens aperture. Adjust this setting and the **Threshold** setting until reflections are minimized or gone. For further tips on setting **Strobe Intensity**, see Setting up a mixed Vicon camera system on page 17.
Sensor Mode	Tracker 3.9 and later supports the use of the Vantage+ firmware upgrade, e nabling you to use **High Speed** mode on your Vantage cameras without having to change the field of view (FOV) or lens. When you capture optical data, subsampling (selectively reducing the pixel count) enables you to run at high camera frame rates without reducing the FOV (frame size). In **High Speed** mode, you can run your Vantage cameras at higher frames rates while maintaining the FOV. You can change frame rates during capture and you do not need to set up your cameras again when you increase the frame rate, as the FOV is unchanged.Because the higher speeds are achieved through subsampling (removing some pixels from the frames), some reduction in resolution is incurred. For details, see High-speed mode in the *Vicon Vantage Reference Guide*.

Control	Description
Gain	(Vicon MX T-Series only) The amplification of the pixel value. Select a displayed value to determine the intensity of the grayscale from the Vicon cameras: x1, x2, x4, or x8. (Note that the available values are those supported by the camera.) This setting is applied to the camera to change the dynamic range of the recorded image. Increasing the **Gain** means that the marker has less variation in grayscale intensity between its center and its edge, but in certain circumstances, using a higher gain yields markers that are easier for the camera to distinguish. Adjust this setting if the markers appear too faint or if the cameras have trouble distinguishing them; otherwise, leave the this property at the default x1 setting.
Grayscale Mode	The type of data for processed grayscale blobs that the Vicon cameras send to Vicon Tracker. (Note that this mode is disabled if **Low Jitter** mode is selected.) The Vicon cameras perform data processing to create 2D data for Vicon markers. They generate grayscale blobs for reflections from objects in the capture volume and then use centroid-fitting algorithms to determine which of these are likely to be markers by comparing the shape of the grayscale blobs to the **Minimum Circularity Ratio** and **Maximum Blob Height** settings. During this processing, Vicon cameras can produce the following types of data for grayscale blobs: centroids data (x, y coordinates and the radius of the centroid calculated), grayscale data (pixel and line information), or coordinates data (line information, that is, grayscale data without pixel values). However, Bonita cameras do not perform centroid fitting. You can specify which type of processed data Vicon cameras send to Tracker:

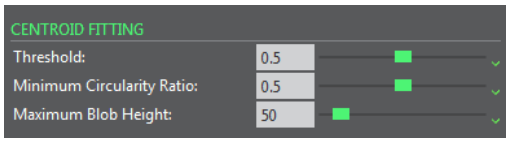
Auto	Send grayscale data only of the grayscale blobs for which centroids were not generated, that is, those below the threshold specified for **Minimum Circularity Ratio**. Send coordinates data of grayscale blobs for which one or more line segments, or the total number of lines in the blob, exceeds the value set for **Maximum Blob Height**. If a marker can be centroid fitted by the camera, the centroid is passed to the capture PC. If it cannot, the full grayscale of the image is sent, allowing the data to be post-processed on the PC. This is the default and recommended mode. Tip: If any optical camera does not capture wand data during a wand wave, select the relevant camera on the **System** tab and look in the **Settings** section of the **Properties** pane to ensure you have set the **Grayscale Mode** to **Auto**.

Control	Description	
	None	Send no grayscale data; send only centroid data (i.e, x, y, and radius data). Any ambiguous grayscale data will be discarded.
	All	Send grayscale data both of grayscale blobs for which centroids were generated and of those for which centroids were not generated, that is those below the threshold specified for **Minimum Circularity Ratio**. Send coordinates data of grayscale blobs for which one or more line segments, or the total number of lines in the blob, exceeds the value set for **Maximum Blob Height**. Select this setting if you need to see exactly where the camera calculates the centroid with respect to the grayscale marker image, for example when adjusting parameters. This setting results in much larger data rates and files; it may be useful for diagnostic purposes, but do not use it in normal capture situations.
	Only	Send all grayscale and coordinates data; send no centroid data. This setting is useful when focusing or making other adjustments to the cameras themselves as you see exactly the image recorded on the sensor.
	Edges	Send only edge coordinates data; send no centroid or grayscale data. If data rates are very high, for example when there are too many reflections, the camera automatically enters this mode. Use this setting to manually force the camera into this mode.
	No Edges	Send grayscale data both of grayscale blobs for which centroids were generated and of those for which centroids were not generated; send no coordinates data. Use this setting to prevent the Vicon camera from sending edge coordinates. Caution: Even if you have not specified a **Grayscale Mode** setting that would have coordinates data sent to Tracker, a Vicon camera automatically sends coordinates data – either temporarily or permanently – if it is overloaded with data (e.g., too many markers, too many reflections, hand or reflective objects immediately in front of the camera, too low a threshold or too high a gain). If a camera automatically starts to present coordinates data, identify the source of the overload and attempt to remedy it.

Control	Description
Enable LEDs	When selected, the status lights on the Vicon camera strobe unit provide feedback on the status of the camera. (Bonita cameras do not have status LEDs.) For more information, see the documentation that was supplied with your Vicon camera.
Enable Display	(Vicon Vantage only) When selected, the OLED display on the camera provides feedback on the status of the camera. For more information, see the **Vicon Vantage Reference** PDF, supplied with your Vicon Vantage cameras and available from the Vicon documentation website[5].
Enable Tap to Select	(Vicon Vantage only) When selected, you can lightly tap the camera in the volume to select it (and deselect the other cameras). Note that when **Enable Accelerometry** is selected (see below), if you tap a calibrated camera too hard, its status LEDs and OLED display (if enabled) indicate that it has been 'bumped'. You can remove the camera's bumped status in Tracker. If this is a frequent occurrence, you can change its sensitivity to being tapped by reducing the **Bump Detection Sensitivity**. For information on removing a camera's bumped status and changing Bump Detection Sensitivity, see Camera Status section on page 66.
Enable Accelero metry	(Vicon Vantage only) When selected, the OLED display on calibrated cameras changes to alert you when they have moved from their calibrated positions, eg, if a camera has been knocked. In Tracker, the camera's **Bumped** check box (in its Status properties) displays a check mark. For information on removing a camera's bumped status and changing Bump Detection Sensitivity, see Camera Status section on page 66. (This setting also turns on or off the auto-rotation of the display on Vantage cameras.) For more information on Vicon Vantage accelerometers, see the **Vicon Vantage Reference** PDF, supplied with your Vicon Vantage camera and available from the Vicon documentation website[6].

5 https://docs.vicon.com
6 https://docs.vicon.com

Centroid Fitting section



On the **System** tab, when you click on a **Vicon Cameras** node or an individual camera node, the following controls are available in the **Centroid Fitting** section of the **Properties** pane:

Control	Description
Threshold	The minimum brightness (intensity) for markers; pixels of an intensity lower than this threshold are ignored. This value can be set between 0-1 to determine the pixels to be considered for centroid fitting onboard the Vicon cameras. Lower settings enable the camera to detect lower light levels, thus making the markers appear larger, but may pick up unwanted reflections and other light sources. Higher settings reduce the noise, but make the markers themselves less visible. This setting differentiates between markers and ambient light. A Vicon camera records 10-bit grayscale data, which for each sensor pixel is a measure of how much light fell on that pixel during a given amount of time. However, the cameras will almost always pick up some ambient light in the volume. To enable the cameras to distinguish between light that comes from markers and light that does not, a threshold is applied. Anything above this threshold is deemed to be a marker, anything below is deemed to be ambient light. A value in the region of 0.2 to 0.5 is usually appropriate, but Vicon strongly recommends that you use static markers in the volume in order to establish an appropriate setting. If cameras are evenly spaced around the volume, the same threshold value is usually sufficient for all cameras. Adjust this setting, the **Strobe Intensity**, and the camera's aperture until reflections are minimized or gone. Tip: To help you to determine the most effect threshold setting for grayscale blobs, you can set the background color of the **Camera** view pane to the value of the **Threshold** control in the **Centroid Fitting** section of the **Properties** pane. To do this, open the **Options** dialog box (F7), and in the **General View Options**, select **Threshold**.

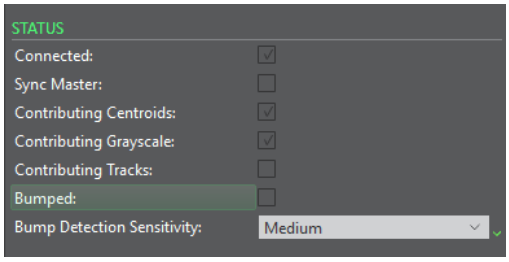
Control	Description
Minimum Circularity Ratio	The circularity threshold used by the centroid-fitting algorithms in a Vicon camera. (Note that this mode is disabled if **Low Jitter** mode is selected.) This value can be set between 0-1 to determine how similar a grayscale blob must be to the internal model of a marker – that is a radially symmetric object that has smooth, sharp edges and whose pixel intensity is brightest at the center and gradually fades towards the edges. The Vicon cameras consider grayscale blobs with circularity equal to or greater than this threshold to be well-formed, circular marker images. The higher the value, the more stringent the centroid fitter is; the lower the value, the less stringent the centroid fitter is. You may want to apply higher settings for camera calibration to ensure that Tracker selects the best markers and thus provides the best possible calibration. A lower value may be appropriate for data capture.
Maximum Blob Height	The maximum number of pixels per line that a grayscale blob can contain in a horizontal line. If the number of pixels exceeds this value, the Vicon camera determines that the grayscale blob is not a marker, stops processing it, and discards the pixel values (it preserves just the coordinates data, which can be sent to Vicon Tracker, depending on the **Grayscale Mode** setting). Set this value between 0–77500 to determine how large a grayscale blob can be for a Vicon camera to consider it a candidate marker. The Vicon cameras consider grayscale blobs with horizontal lines containing this number or fewer pixels to be good-sized, circular marker images. The higher the value, the larger a grayscale blob can be; the lower the value, the smaller a grayscale blob must be.

Centroid Tracking section

On the **System** tab, when you click on a **Vicon Cameras** node or an individual camera node, the following controls are available in the **Centroid Tracking** section of the **Properties** pane:

Control	Description
Enable Centroid Tracking	When selected, enables the camera's onboard centroid tracking algorithm. **Note:** Applies only to Vicon cameras that have the ability to process this information on board the camera. Default: Off
Marker Velocity	Maximum velocity at which a marker is tracked, expressed as the percentage of image width per second. Default: 5

Camera Status section

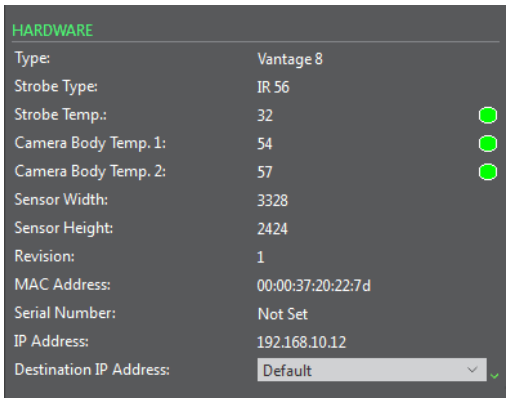


> **Note**
> The above illustration shows the **Status** section for a Vicon Vantage camera. The **Status** section for other Vicon cameras displays fewer options.

On the **System** tab, when you click on a **Vicon Cameras** node or an individual camera node, the following controls are available in the **Status** section of the **Properties** pane.

Control	Description
Connected	Whether or not the Vicon camera is currently connected to the Vicon system.
Sync Master	Whether or not the Vicon camera is designated as the synchronization master for the Vicon system. (Not relevant for MX T-Series cameras or systems containing a Vicon Lock)
Contributing Centroids	Whether or not the Vicon camera is contributing centroid data during the current motion capture.
Contributing Grayscale	Whether or not there is a socket open to the Vicon camera capable of receiving grayscale. This socket may be dropped when the system is under heavy load, therefore this property is useful as a system status monitor. It is not related to **Grayscale** property in **Settings**.
Contributing Tracks	Whether or not the Vicon camera is contributing tracks (that is, labeling centroids between frames) during the current session.
Bumped	Indicates the whether the Vicon Vantage camera has moved from its calibrated position. You can remove the **Bumped** status for: • A selected camera: Clear the **Bumped** check box. • All cameras: Press Ctrl+Shift+B
Bump Detection Sensitivity	Enables you to change the sensitivity of the Vicon Vantage camera's accelerometer (also see **Enable Accelerometry** in Camera Settings section on page 59).

Camera Hardware section



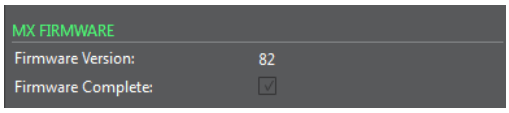
> **Note**
> The above illustration shows the **Hardware** section for a Vicon Vantage camera. The **Hardware** section for other Vicon cameras displays fewer options.

On the **System** tab, when you click on a **Vicon Cameras** node or an individual camera node, the following controls are available in the **Hardware** section of the **Properties** pane.

Setting	Description
Type	The type of Vicon camera (Vantage, Bonita, T160, T40 or T20). The **Vicon Cameras** node is read-only.
Strobe Type	The type of strobe unit attached to the front of the Vicon camera: Visible Red (VR), Near Infrared (NIR), or Infrared (IR). MX T-Series T160, T40, and T20 cameras support only VR and NIR strobe units. Bonita cameras support NIR. For a **Vicon Cameras** node, this setting is read-only.

Setting	Description
Strobe Temp	Displays data from Vicon Vantage strobe onboard sensor both as a numeric indicator (in degrees Celsius) and a colored temperature indicator. The color of the indicator changes to reflect a change in temperature: yellow (warming up to the temperature specified by the lower bounds), green (between the specified upper and lower bounds) or red (overheated above the upper bounds). To set values that are representative of your laboratory environment, you can change the upper and lower bounds of the temperature range. To do this, select the **Camera Temperature Range** option in the **Options** dialog box (F7).
Camera Body Temp 1	Displays data from Vicon Vantage camera body onboard sensor. See **Strobe Temp** above.
Camera Body Temp 2	Displays data from Vicon Vantage camera body onboard sensor. See **Strobe Temp** above.
Sensor Width	The width (in pixels) of the Vicon camera sensor.
Sensor Height	The height (in pixels) of the Vicon camera sensor.
Revision	Camera revision number.
MAC Address	The **Media Access Control** (MAC) address assigned to the Vicon camera during manufacture. This is a hexadecimal value in the format ##.##.##.##.##.##. For a **Vicon Cameras** node, this setting is read-only.
Serial Number	Vicon Vantage camera's serial number (if set)
IP Address	The **Internet Protocol** (IP) address assigned to the Vicon camera on the Vicon Ethernet network. For a **Vicon Cameras** node, this setting is read-only.
Destination IP Address	The network adapter IP address to which data from this camera will be sent.

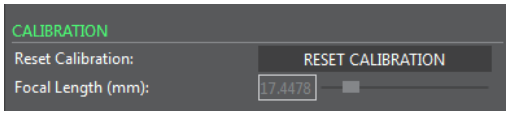
Camera Firmware section



On the **System** tab, when you click on a **Vicon Cameras** node or an individual camera node, these controls are available in the **Firmware** section of the **Properties** pane:

Control	Description
Firmware Version	The version number of the Vicon firmware currently installed on the Vicon camera.
Firmware Complete	Whether or not the currently installed Vicon firmware is complete. If not, you can reprogram the firmware.

Camera Calibration section



On the **System** tab, when you click on a **Vicon Cameras** node or an individual camera node, the following controls are available in the **Calibration** section of the **Properties** pane:

Control	Description
Reset Calibration	Reset calibration of selected camera(s)
Focal Length (mm)	The camera lens focal length value of the selected camera(s) in mm.

Camera Commands section

On the **System** tab, when you click on a **Vicon Cameras** node or an individual camera node, the following command is available in the **Commands** section of the **Properties** pane:

Command	Description
Reboot	Stop and restart all cameras or the selected Vicon camera.

Vicon Cameras context menu

When you right-click on the **Vicon Cameras** node on the **System** tab, you can select from the following options on the context menu:

Option	Description
Reorder	Display the **Reorder Devices** dialog box. This enables you to change the order in which Vicon cameras are displayed in the **System Resources** list.
Reboot All Cameras	Stop and restart all the Vicon cameras in the system.
Remove Vicon Cameras	Displays a choice of **Disconnected** or **Missing**: • **Disconnected** - removes cameras that are currently unplugged. • **Missing** - removes cameras that are unplugged, but were previously used in a calibration.
Enable Preview Mode	Displays a 'video' image from the optical sensor of an MX T-Series camera. This enables you to aim cameras more quickly and easily during setup. Note: This preview feature is for system setup purposes only. You cannot capture camera data in **Preview** mode.

When you right-click on a node for a specific Vicon camera, you can select the following option from the context menu:

Option	Description
Reset Calibration	Resets the camera calibration
Reboot	Stop and restart the selected Vicon camera.

About Vicon connectivity units

You configure Vicon connectivity units — smart boxes that can be combined to create a distributed architecture, enabling you to customize the number of Vicon cameras and supported third-party devices in your Tracker system — with the **Vicon Connectivity** node on the **System** tab.

The **Vicon Connectivity** node is displayed under the **Local Vicon System** node when Vicon Tracker is connected to the Vicon system. The **Vicon Connectivity** node lists each Vicon connectivity unit connected to your Vicon system.

Depending on the type of Vicon system under which you are running Vicon Tracker, your Vicon system architecture will contain one or more of the following Vicon connectivity units:

- Vicon Lock – connectivity unit that facilitates the integration of synchronous third-party equipment with Vicon Vantage and Vicon Bonita cameras by providing or receiving synchronization (Lock+ and Lock Lab) or timecode (Lock+ and Lock Studio). Lock+ and Lock Lab also provide connectivity for third-party analog capture sources, such as force plates, EMG equipment, and generic devices.
- MX Giganet – the primary connectivity unit in an MX T-Series and/or Bonita system.

You can incorporate units and components from MX T-Series systems into your Vicon Vantage system. For details on configuring a combined architecture, see the **Vicon Vantage Reference** or **Go Further with Vicon MX T-Series** reference, or contact Vicon Support[7].

> **Note**
> Except where noted, references to Vicon Lock, Lock units, and Lock apply to all current models of the Vicon Lock unit (at the time of publication, this includes Vicon Lock+, Vicon Lock Studio and Vicon Lock Lab).

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About Vicon Lock units

Vicon Lock provides synchronization (Lock+ and Lock Lab) and timecode (Lock+ and Lock Studio) to Vicon Vantage and Vicon Bonita cameras. Lock+ and Lock Lab also provide connectivity for third-party analog capture sources, such as force plates, EMG equipment, and generic devices.

The use of Vicon Lock is supported for Vicon Vantage and Vicon Bonita camera systems and in integrated T-Series and Vantage systems.

This node is displayed under the **Local Vicon System** node when Vicon Tracker is connected to a Vicon system with at least one Vicon Lock unit. The **Vicon Connectivity** node lists each Vicon Lock unit connected to your Vicon system.

For more information about Vicon Lock units, see:

- Properties pane for Vicon Lock units on page 75
- Vicon Lock context menu on page 77
- *Vicon Lock+ Quick Start Guide* (PDF), *Vicon Lock Lab Quick Start Guide* (PDF), *Vicon Lock Studio Quick Start Guide* (PDF), available from the Vicon documentation web site (docs.vicon.com).

> **Note**
> Except where noted, references to Vicon Lock, Lock units, and Lock apply to all current models of the Vicon Lock unit (at the time of publication, this includes Vicon Lock+, Vicon Lock Studio and Vicon Lock Lab).

Properties pane for Vicon Lock units

The **Properties** pane for Vicon Lock nodes contains the following sections.

- Vicon Lock Identification section on page 75
- Vicon Lock Status section on page 75
- Vicon Lock Sync Out section on page 76

You can also access related options from the Vicon Lock context menu on page 77.

> **Note**
> Except where noted, references to Vicon Lock, Lock units, and Lock apply to all current models of the Vicon Lock unit (at the time of publication, this includes Vicon Lock+, Vicon Lock Studio and Vicon Lock Lab).

Vicon Lock Identification section

If a Vicon Lock is connected to your Vicon system, when you click on the relevant **Vicon Connectivity** node on the **System** tab, the following controls are available in the Identification section of the **Properties** pane:

Setting	Description
Name	A user-defined display name for the Vicon Lock.
Type	The Lock type is read-only.
Device ID	The Device ID is read-only.

Vicon Lock Status section

On the **System** tab, when you click on a Lock node, the following controls are available in the **Status** section of the **Properties** pane:

Setting	Description
Enabled	Whether or not the Vicon Lock is currently enabled for use.

Setting	Description
Sync Master	The Vicon Lock automatically becomes the synchronization master for the Vicon system.

Vicon Lock Sync Out section

General Purpose Outputs (GPO) enable you to configure your system to trigger external equipment on or around each camera frame sync pulse. Other GPO functionality, available with other Vicon software, is not implemented with Vicon Tracker.

For further information, see the relevant *Vicon Lock Quick Start Guide* (PDF). For up-to-date information about the types of GPO triggers that are supported, contact your local Vicon Support office (for Vicon contact details, see Contact Vicon on page 219).

Vicon Lock context menu

> **Note**
> Except where noted, references to Vicon Lock, Lock units, and Lock apply to all current models of the Vicon Lock unit (at the time of publication, this includes Vicon Lock+, Vicon Lock Studio and Vicon Lock Lab).

If a Vicon Lock is connected to your Vicon system, when you right-click on the **Vicon Connectivity** node on the **System** tab, you can select the following options from the context menu:

Option	Description
Reorder	Display the **Reorder Devices** dialog box in which you can change the order in which Vicon Lock units are displayed on the **System** tab.
Reboot All Vicon Locks	Stop and restart all of the Vicon Lock units in the Vicon system.

When you right-click on a node for a specific Vicon Lock, you can select the following options from the context menu:

Option	Description
Reboot	Stop and restart the selected Vicon Lock.
Reset Timecode	Reset the Timecode to 00:00:00:00.

About MX Giganet units

For information on MX Giganet nodes, see the following topics:

- Set up MX Giganet units on page 79
- Properties pane for MX Giganet nodes on page 80
- MX Giganet context menu on page 83

You can incorporate components from MX T-Series systems into a Vicon Vantage system by connecting the MX Giganet to the primary PoE+ unit of the Vantage system. For details of cameras and units that can be incorporated in an integrated Vantage and MX T-Series system, see Tracker system components on page 11.

Set up MX Giganet units

The Vicon Connectivity node is displayed under the **Local Vicon System** node when Vicon Tracker is connected to a Vicon system with at least one MX Giganet unit. The **Vicon Connectivity** node lists each MX Giganet unit connected to your Vicon system. For each MX Giganet, the node name includes the device position number, any display name specified in the Identification property, and the device type listed in parentheses, e.g, #1 Name (MX Giganet).

To configure MX Giganet units for analog data acquisition:

1. On the **System** tab, select the node whose properties you want to configure:
   - **Vicon Connectivity** node for all MX Giganet units.
   - A sub node for a specific MX Giganet unit — For Vicon MX systems, the MX Giganet sub-nodes in the **System** list correspond to the IDs assigned by Tracker. If an MX Giganet unit has automatically been designated as the synchronization master for the Vicon system, its node name is displayed in bold.
     The colored icon beside an MX Giganet node identifies its status:
     - Green play button: Component OK (active or connected). If an analog device is connected, this status does not reflect the analog device's status.
     - Yellow pause button: Component is not fully set up or device has been disabled in the **Status** section of **Properties**.
     - Red stop button: Component down (unavailable or disconnected).
2. In the **Properties** section, view or change settings for the required properties. When you first set up your Vicon system, you configure at least the **Name** property and, if you are using synchronization functionality, the **Sync Out** properties. In subsequent sessions, you may want to configure additional properties to suit the needs of your motion capture application.
3. In the configuration management area at the top of the **System** tab, click the save button  to save your system configuration settings to a .system file.

Properties pane for MX Giganet nodes

The **Properties** pane for MX Giganet nodes contains the following sections.

- MX Giganet Identification section on page 80
- MX Giganet Status section on page 81
- MX Giganet Sync Out section on page 81
- MX Giganet Hardware section on page 82
- MX Giganet Firmware section on page 82
- MX Giganet Commands section on page 82

You can also access related options from the MX Giganet context menu on page 83.

MX Giganet Identification section

If MX Giganets are connected to your Vicon system, when you click on the **Vicon Connectivity** node on the **System** tab, the following controls are available in the Identification section of the **Properties** pane:

Setting	Description
Name	A user-defined display name for the entire set of MX Giganets.
Type	The Vicon Connectivity node is read-only.
Device ID	The Vicon Connectivity node is read-only.

When you click on an individual **MX Giganet** node on the **System** tab, the following controls are available in the Identification section of the **Properties** pane:

Setting	Description
Name	A user-defined display name for the selected MX Giganet.
Type	The MX device type.
Device ID	The unique identification number Vicon assigned to the MX Giganet during manufacture.

MX Giganet Status section

On the **System** tab, when you click on an **MX Giganet** node, the following controls are available in the **Status** section of the **Properties** pane:

Setting	Description
Connected	Whether or not the MX Giganet is currently connected to the Vicon system.
Enabled	Whether or not the MX Giganet unit is currently enabled for use.
Sync Master	Whether or not the MX Giganet is designated as the synchronization master for the Vicon system.

MX Giganet Sync Out section

General Purpose Outputs (GPO) allow you to configure your system to trigger external equipment on or around each camera frame sync pulse.

Other GPO functionality, available with other Vicon software, is not implemented with Vicon Tracker.

For further information, see the hardware manual for your Vicon Giganet. For up-to-date information about types of GPO triggers that are supported, contact your local Vicon Support office (for Vicon contact details, see Contact Vicon on page 219).

MX Giganet Hardware section

On the **System** tab, when you click on the **Vicon Connectivity** node or on an **MX Giganet** node, the following controls are available in the **Hardware** section of the **Properties** pane:

Setting	Description
MAC Address	The Media Access Control (MAC) address assigned to the MX Giganet during manufacture. This is a hexadecimal value in the format ##.##.##.##.##.##. The **Vicon Connectivity** node is read-only.
IP Address	The Internet Protocol (IP) address assigned to the MX Giganet on the Vicon MX Ethernet network. The **Vicon Connectivity** node is read-only.

MX Giganet Firmware section

On the **System** tab, when you click on an **MX Giganet** node, the following controls are available in the **Firmware** section of the **Properties** pane:

Setting	Description
Firmware Version	The version number of the firmware currently installed on the MX Giganet.
Firmware Complete	Whether or not the currently installed firmware is complete. If not, you can reprogram the firmware.

MX Giganet Commands section

On the **System** tab, when you click on an **MX Giganet** node, the following command is available in the **Commands** section of the **Properties** pane:

Command	Description
Reboot	Stop and restart the MX Giganet.

MX Giganet context menu

If MX Giganets are connected to your Vicon system, when you right-click the **Vicon Connectivity** node on the **System** tab, you can select these options from the context menu:

Option	Description
Reorder	Display the **Reorder Devices** dialog box in which you can change the order in which MX Giganets are displayed on the **System** tab.
Reboot All MX Giganets	Stop and restart all of the MX Giganets in the MX system.

When you right-click a node for an MX Giganet, you can select the following options from the context menu:

Option	Description
Reboot	Stop and restart the selected MX Giganet.
Reset Timecode	Reset the timecode to 00:00:00:00.

About the Devices node

The **Devices** node is displayed under the **Local Vicon System** node when licensed additional devices (that is, connected devices that are not cameras or connectivity devices) are connected to the Vicon system. The **Devices** node lists each additional type of device that is connected to your Vicon system.

You can only use an additional device if you have the required license. To check your current licensing options, from the **Help** menu, click **About Vicon Tracker** and in the window, click the **Feature Details** button. After a few seconds, the currently licensed options are listed. To change your licensing options, contact Vicon Support[8].

Depending on the type of additional licenses you are using with Tracker and your Vicon system, it may contain one or more of the following additional devices:

- Analog device such as accelerometers (see Set up analog devices on page 85).
- Eye tracking devices (see About eye tracking on page 86).
- Vicon Apex (see About Vicon Apex devices on page 99).

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Set up analog devices

The **Devices** node is displayed on the **System** tab under the **Local Vicon System** node when Vicon Tracker is connected to a Vicon system with at least one additional device (a device that is not a camera or a connectivity unit).

Analog devices such as accelerometers are connected to the Vicon system via an MX Giganet or Vicon Lock+ or Lock Lab. You add analog devices to the Vicon system by right-clicking on the **Devices** node and selecting **Add Generic Analog**.

The **Generic Analog** node lets you select the options for your device.

You can only use an analog device with Tracker if you have the required license. For more information, contact Vicon Support[9].

To use an analog device with Tracker:

1. Ensure that the analog device is connected to your Vicon system through a Giganet or a Vicon Lock+ or Lock Lab.
2. In Tracker, on the **System** tab, right-click **Devices**, point to **Add Analog Device**, and then click **Add Generic Analog**. A **Generic Analog** device appears beneath **Devices**.
3. Right-click **Generic Analog** and from the list, select your analog device.
4. To add outputs for the device, on the **System** tab, right-click the device and click the number of components to add.
5. To change the properties of the output, edit the appropriate property in the **Properties** pane, for example:
   - Name
   - A scaling factor from the voltage input to desired output
   - Analog input pin
   - Channel gain
6. To change the options for viewing data in the **Graph** view, in the view pane, select **Graph** and then choose the appropriate option from the menu.

> **Tip**
> You can receive the raw analog data and relevant device information through the DataStream SDK.

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About eye tracking

These eye tracking solutions are available with Vicon Tracker:

- Use Tobii Eye Tracker with Vicon Tracker on page 87
- Use Dikablis Eye Tracker with Vicon Tracker on page 94

Use Tobii Eye Tracker with Vicon Tracker

You can include a Tobii Eye Tracker in your Vicon Tracker system, enabling you to output eye tracker position and gaze direction.

Restrictions:

- Tobii integration for only the Tobii Pro Glasses 2.
- Supports use of only one pair of glasses at a time.

To include Tobii Pro Glasses 2 in your Vicon Tracker system, complete these procedures:

- Set up Tobii Pro Glasses 2 on page 88
- Integrate Tobii Pro Glasses 2 into Tracker on page 89

Before you begin, ensure your Tracker system is calibrated and that you have created a subject.

Set up Tobii Pro Glasses 2

To set up your Tobii Pro Glasses 2 for use with Tracker:

1. Follow the instructions provided by Tobii. The quick start guide provided in the Tobii Pro Glasses 2 box provides instructions on preparing and connecting the glasses.

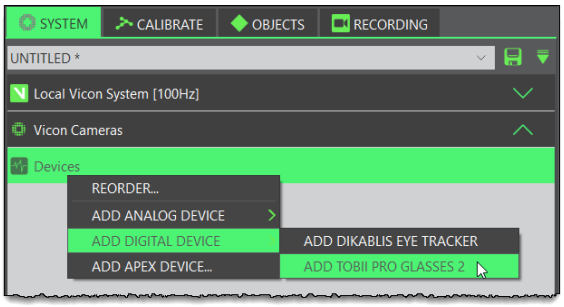
2. To use Tobii Pro Glasses Controller software, connect the Tobii Pro Glasses 2 either through Ethernet or WiFi.
   When setting up networking connection properties for an Ethernet port, ensure that **Internet Protocol Version 6 (TCP/IPv6)** is selected.
3. Calibrate the glasses in the Tobii Pro Glasses Controller software.
   This enables you to check the fit of the glasses before connecting to Tracker.
4. After calibration is complete, close the Tobii Pro Glasses Controller Software.

> **Note**
> Note that the recording unit requires batteries. A battery charger is provided, however, please ensure sufficient charging time. The recording unit requires only one battery, but takes 5+ hours charging time for a full charge.

Integrate Tobii Pro Glasses 2 into Tracker

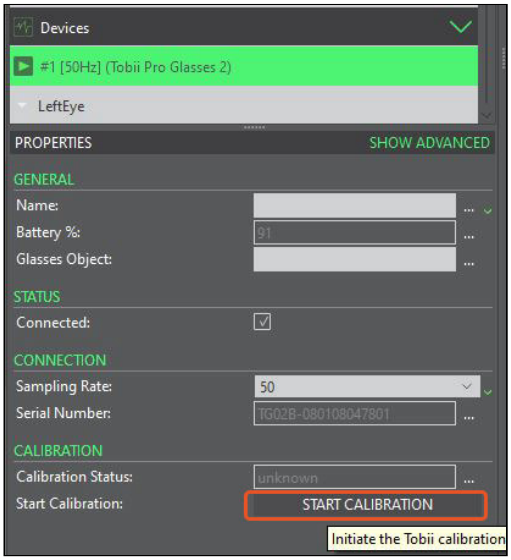
To add the Tobii Pro Glasses 2 device into Tracker:

1. Ensure the Tobii recording unit is connected to the Tracker computer via Ethernet or WiFi.
2. Ensure that the Tobii glasses are being worn by a subject in the volume. (Tobii glasses connect to Tracker only when the glasses are worn: if no eye is detected, the device is gray in the System Resources tree.)
3. In the **System Resources** tree, right-click **Devices**, point to **Add Digital Device** and then select **Add Tobii Pro Glasses 2**.



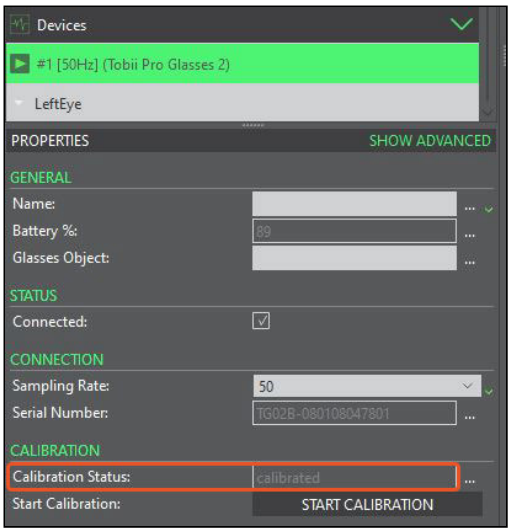
Tracker searches for the glasses on the network. When the glasses are discovered, data begins streaming in Tracker.
Note that this process can take some time.

4. Before capturing data, for each subject, perform a calibration on each subject in the same way as it is done in the Tobii Pro Glasses Controller software.
   a. Instruct the subject to look at the calibration card (for correct placement of the card, see the Tobii documentation).
   b. In the **System Resources** tree, ensure the **Tobii Pro Glasses 2 device** is selected and in the **Properties** pane, go to the **Calibration** section and click **Start Calibration**.



   Ensure the subject continues to look at the calibration card.
   Status information is displayed with a success/fail status at the end of the process.

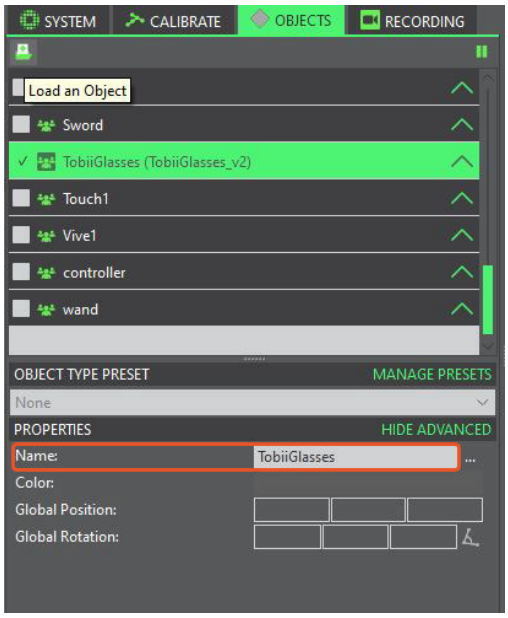
If calibration is successful, the **Calibration Status** changes to **calibrated**.



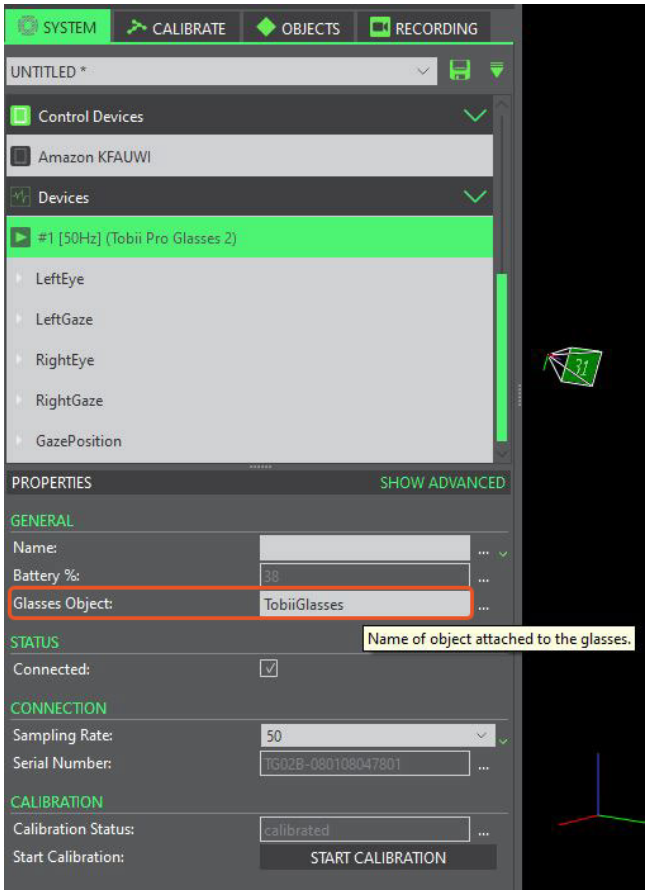
Note that data that is needed for calibration is created on the SD card and is deleted when the device is deleted. If the connection is lost, projects and participants may be left on the SD card.
If no data is received for approximately one second, it is assumed that the connection has been lost and the device reverts to 'discovery' mode to try to re-connect to the device when it becomes available again.

To visualize the gaze data in the Tracker workspace:

1. On the **Objects** tab, add a new object using one of the TobiiGlasses VSK templates.
2. Save the new object by right-clicking it and selecting **Save Object**.
3. With the new TobiiGlasses object selected, in the **Properties** pane, note its name:



4. On the **System** tab, under **Devices**, ensure the Tobii Glasses are selected and in the **General** section of the **Properties** pane, go to the **Glasses Object** field and enter the name you noted in the previous step.
   Note that specification of the Glasses Object is not a requirement for receiving the data from the glasses: it is used for visualization in the Tracker workspace only.

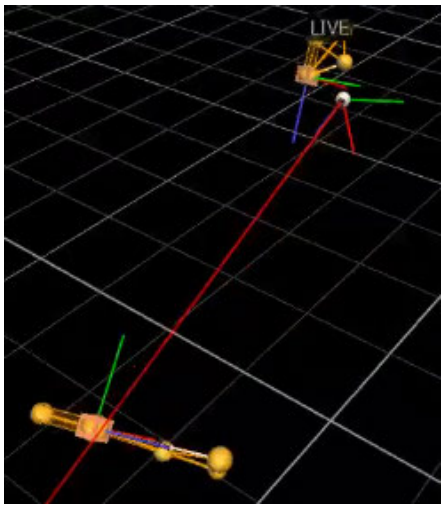


Tobii has an attachment (currently available in the Integration Kit) for the glasses object.

The relevant VSTs (found in *C:\Program Files\Vicon\Tracker3.#\ModelTemplates*) for the version of the Integration Kit provided in your Tobii Pro 2 Glasses box are also supplied.

Use Dikablis Eye Tracker with Vicon Tracker

With Tracker, you can use the Dikablis Eye Tracking System to track movement of the eye's pupil to calculate the gaze vector.



The Dikablis Eye Tracking System is compatible with both T-Series and Bonita cameras. A minimum of two cameras are required for use with the system.

For more information, see:

- Calibrating and integrating Dikablis eye tracking on page 95

> **Note**
> Eye tracking is not available with the evaluation license, but is an optional add-on to the full version of the software and requires an additional license.

Calibrating and integrating Dikablis eye tracking

To calibrate your system and use Tracker with Dikablis to track eye movement, complete the following procedures:

- Calibrate the Dikablis system and connect it to your Vicon system on page 95
- Calibrate your Vicon system and add in your Dikablis device on page 96
- Specify the eye offsets on page 97
- Calibrate the Dikablis eye tracker with Vicon Tracker on page 98
- Save your settings on page 98

Calibrate the Dikablis system and connect it to your Vicon system

1. Connect up the headset, transmitters and receivers that comprise the Dikablis eye tracking system.
2. Ensure the subject is wearing the Dikablis headset and some markers for head tracking.
3. Start the Dikablis Recorder software on the Dikablis system and run the calibration wizard.
4. Connect the Dikablis laptop directly to your Vicon system PC with an Ethernet cable.
5. Set the IP addresses of the Network Interface Cards to an appropriate value. These instructions use 10.0.0.1 on the Dikablis laptop and 10.0.0.2 on the Vicon system PC. (For instructions on how to set IP addresses, see the online help for Windows.)

Calibrate your Vicon system and add in your Dikablis device

1. Aim your Vicon cameras to capture the required volume.
2. Calibrate the cameras in Tracker (see Calibrate Vicon cameras on page 107).
3. Set your origin pointing forwards by positioning the T of the wand with the flat part (the top of the T) facing towards the front of the capture volume.
4. When you have a calibrated system, create an object in Tracker from the wand markers. To do this:
   a. In the **Resources** pane, click the **Objects** tab and ensure that in the **Object Tracking Mode** section at the bottom of the tab, **Track** mode is not selected. This enables you to see unlabeled reconstructions in the **3D Perspective** view pane.

      > **Tip**
      >
      > Viewing unlabeled reconstructions requires additional processing, so for lowest output latency, when you have finished creating objects, click the **Track** button to change to Track mode. When Track mode is selected, the **Track** button is green.

   b. In the **3D Perspective** view pane, ALT+click and drag to select the markers.
   c. In the **Resources** pane, click the **Objects** tab and in the **Create Object** box, type Wand and then click **Create** .
5. Adjust the wand's origin so it is on the center marker on the cross of the T.
6. With your subject looking straight ahead, create an object from the head markers and give it a suitable name, such as Head. (You can give it any suitable name, but ensure you use the same name in the following steps.)
7. On the **System** tab, right-click **Devices**, point to **Add Digital Device**, and then click **Add Dikablis Eye Tracker**.
8. Select **Dikablis Eye Tracker** and in the **Properties** pane, enter the values:
   - **Name**: Eye
   - **Head Object**: Head
   - **IP Address**: 10.0.0.1 (or the address of the PC running the Dikabilis software if different from 10.0.0.1)
   - **Calibration Object**: Wand

9. Make sure the Eye Tracker remains selected on the **System** tab, change the view pane to **Graph** view and in the **Components** list, select **Components**. Two graphs are shown: X and Y, representing the 2D coordinates for the eye's gaze. The values are pixel values from the eye camera.
10. Check that the eye's gaze is accurately represented by the X and Y values. To do this:
    a. Get your subject to look left. The X value decreases.

    > **Tip**
    >
    > To see all the data, you may need to click the **Scale the graph to fit the horizontal and vertical ranges of data** button  at the top of the **Graph** view pane.

    b. Get your subject to look right. The X value increases.
    c. Get your subject to look up. The Y value increases.
    d. Get your subject to look down. The Y value decreases.

    > **Tip**
    >
    > The X values should not go above 640 or below 0. The Y values should not go above 480 or below 0.

11. Specify the eye offsets.

Specify the eye offsets

1. With the Eye Tracker selected on the **System** tab, in the **Properties** pane, enter appropriate values. The following offsets are normally suitable:
    - X (mm): -20
    - Y (mm): -40
    - Z (mm): -25
2. Change the view pane to **3D Perspective** and look at the **Head** object. The eyeball should be approximately where the eye is, relative to the **Head** markers.
3. Calibrate the Dikablis eye tracker with Vicon Tracker.

Calibrate the Dikablis eye tracker with Vicon Tracker

1. Get the subject to stand with the wand in their hand so the Head and Wand objects are clearly and consistently visible in the **3D Perspective** view.
2. Get the subject to look at the marker at the center of the T on the wand.
3. In the **Calibration** area of the Eye Tracker **Properties** pane, click **Add**.
   The Samples box displays 1.

   > **Tip**
   >
   > If an error is made during calibration, you can remove the last sample you added by clicking the **Remove** button.

4. Get the subject to move the wand and repeat step 3.

   The number of samples goes up to 2.
5. Repeat step 4.

   The number of samples goes up to 3 and an eye with an eye vector coming from it appears in the **3D Perspective** view pane.
   In the **Calibration** area of the **Properties** pane, a **Residual** value is displayed.
6. Get your subject to keep their head still and move the wand around, following the marker at the center of the T with their eyes.

   In the **3D Perspective** view pane, the eye vector now follows the wand.
7. On the **System** tab, select the Eye Tracker. Change the view pane to **Graph**.

   Ray X, Ray Y and Ray Z values are displayed, as well as X and Y values.
8. Save your settings.

Save your settings

1. On the **System Resources** pane, click the **Configuration** menu button  and select **Save As**.
2. Enter the name **DikablisTest.**
3. When prompted, select **Shared** or **Private**.

About Vicon Apex devices

You can only use an Apex with Tracker if you have the required license. To check your current licensing options, from the **Help** menu, click About **Vicon Tracker** and in the window, click the **Feature Details** button. After a few seconds, the currently licensed options are listed. To change your licensing options, contact Vicon Support[10].

To add an Apex to your Vicon system:

1. Complete the following steps in the order shown:
   a. Ensure the Apex is sufficiently charged (see the **Vicon Apex User Guide**) and switch it on in the capture volume.
   b. Plug the Apex's Bluetooth® dongle into the relevant computer.
   c. Start Tracker.
2. After a few seconds, on the **System** tab, right-click the **Devices** node, click **Add Apex Device**, and in the **Add Apex Devices** dialog box, select the required device and click **Add**.
   On the **System** tab, the selected Apex is displayed under the **Apex Device** node.
3. To display all the Apex settings, ensure the Apex is selected on the **System** tab and if necessary, at the top right of the **Properties** pane, click **Show Advanced**.

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The following controls are available in the **Properties** pane:

Section	Control	Description
General	Name	A name that uniquely identifies the selected Apex. The default name is of the format ViconAP_nnn. If required, you can change the name of the Apex.
	Delay Compensation (s)	An adjustment (in seconds) to allow for any delay in the datastream. The default is 0.
	LED Intensity	Enables you to change the brightness of the LEDs. The default is 2; the brightest setting is 3.
	Continuous Mode	Enables you to change the LEDs to be on continuously, instead of being strobed. If you select this setting, to reduce power consumption, the LED Intensity is automatically set to 1. For further reduction of power consumption, see also **Sleep** and **Sleep Timeout** (below).
	Sleep	When selected, enables the device to turn off the tracking LEDs after the number of minutes of inactivity specified in the **Sleep Timeout** box.
	Sleep Timeout (min)	If **Sleep** is selected, enables you to specify the number of minutes of inactivity by the joystick or buttons after which the tracking LEDs are turned off. To reactivate the LEDs, touch the joystick or buttons.
	Status Indicators	If cleared, the two flashing status LEDs on the top of the Apex are switched off. Requires updated device firmware 3RC.
	Identify	Causes the selected Apex to vibrate, enabling it to be easily identified.
	Orientation	Enables you to select from orientation options for the device coordinate system.

Section	Control	Description
	Haptic Feedback	If selected, every time you press any of the five buttons on the Apex device, it vibrates briefly. Requires updated device firmware 3RC.
	Filtering Type	Enables you to specify the filtering type for the selected Apex device. For more information on filtering types, see Creating an object on page 130.
Information	**Serial Number**	The four-digit serial number of the Apex. This number is also visible on a sticker on the device.
	Bluetooth® Identity	The Bluetooth serial number of the Apex.
	PCB Revision	The hardware revision number of the Apex.
	Mechanics Revision	The mechanics code of the Apex.
	Firmware Revision	The firmware revision number of the Apex.

For more information, see:

- Set up Vicon Apex devices on page 102
- Using multiple Vicon Apex devices on page 104

Set up Vicon Apex devices

To start the Apex, ensure it is sufficiently charged (see the Vicon Apex User Guide) and its Bluetooth® dongle is plugged into the relevant computer, then switch it on in the capture volume. The LEDs on the Apex flash until it is synchronized with the cameras.

You will only be able to use an Apex with Tracker if you have the required license. For more information, contact Vicon Support[11].

To set up an Apex to work with Tracker:

1. Ensure Tracker is booted up, the Apex's bluetooth dongle is plugged in and the Apex is charged and switched on.
2. To add the Apex to the current configuration, on the **System** tab in the **Resources** pane, right-click **Devices** and then click **Add Apex Device**.
3. In the **Add Apex Devices** dialog box, select the device to add and click **Add**. After a few seconds, the Apex appears on the **System** tab. Its name is displayed in the **General** area of the **Properties** pane.
   In the capture volume, the tracking LEDs on the device illuminate and object tracking begins.
4. To check that the Apex is working correctly, in the view pane, select **Graph** view and operate the joystick and buttons. The graphs show the current status of the joystick (the top two graphs are the x and y views) and the buttons.

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5. To change the way the Apex works, use the relevant control in the **Properties** pane:

To do this	Use this control
Make the LEDs brighter or dimmer	LED Intensity
Change the LEDs to be on continuously	Continuous Mode
Turn on or off the tracking LEDs after the number of minutes specified in the Sleep Timeout box.	Sleep
If Sleep is selected, specify the number of minutes of inactivity by the joystick or buttons after which the tracking LEDs are turned off. To reactivate the LEDs, touch the joystick or buttons.	Sleep Timeout (min)
Turn the status indicator LEDs on or off	Status Indicators*
Change the orientation of the device's coordinate system	Orientation*
Use haptics to identify an Apex in the capture volume	Identify
Cause the Apex to vibrate briefly whenever one of its buttons is pressed	Haptic Feedback*
Change the filtering that is applied to the selected Apex device. For more information on filtering types, see Creating an object on page 130.	Filtering Type*

* Requires updated device firmware 3RC

6. To enable Tracker to remember the device that you have added in future sessions, save the current configuration, using the configuration management controls at the top of the **System** tab.

Using multiple Vicon Apex devices

You can use up to seven Apex devices simultaneously: each device comes with a unique name and color that identifies it within Tracker. If required, you can change this name. When the device is selected on the **System** tab, the name appears in the **General** section of the **Properties** pane.

You can also use the **Identify** button in Tracker to quickly identify a selected Apex.

To quickly identify an Apex:

1. Ensure that the Apex is switched on and connected in the capture volume.
2. In Tracker, on the **System** tab, click one of the Apex devices to select it.
3. In the **Properties** pane, go to the **General** section and click Identify.
   The selected Apex vibrates, enabling you to identify it.

About the Calibrate tab

Calibration is a two-stage process by which Vicon Tracker calibrates the cameras based on specialized calibration objects (whose dimensions and relative marker positions are known):

1. **Calibrating cameras** During the first stage, the Tracker camera calibration process calculates the physical position and orientation of each Vicon camera in the capture volume based on the movement of the calibration object. Tracker uses this information to determine each camera's physical position and orientation in the capture volume and correct for any lens distortion.

2. **Setting volume origin** During the second stage, you set the volume origin in Tracker. Tracker measures the position of the calibration object and uses this information to identify the origin of the world and its horizontal and vertical axes. These volume origin and axes are referred to as the global coordinate system. The global axes coordinates are given in the form (x, y, z), where x is a horizontal axis, y is the horizontal axis perpendicular to x, and z is the vertical axis.

The **Calibrate** tab contains the following sections:

Section	Description
Create Camera Masks	Automatically create cameras masks to obscure all reflections visible to the Vicon cameras. For more information, see Creating camera masks automatically on page 179 and Creating camera masks manually on page 180.
Calibrate Cameras	Calibrate the Vicon cameras to determine their positions, orientations, and lens properties, which enables Tracker to produce accurate 3D data from motion data captured throughout the capture volume. For more information, see Calibrate Vicon cameras on page 107.
Set Volume Origin	Define the global origin and the axes of the world (in the context of the capture volume). For more information, see Calibrate Vicon cameras on page 107.
Manage Camera Calibration	Reset, load, or save camera calibration defining settings for the Vicon cameras in your Tracker system. For more information, see Calibrate Vicon cameras on page 107.
Camera Calibration Feedback	View system calibration processing progress and status information. For more information, see Calibrate Vicon cameras on page 107.

Calibrate Vicon cameras

You specify settings for the calibration of Vicon cameras on the **Calibrate** tab, in the **Calibrate Cameras** section.

The Vicon camera calibration process describes the capture volume to the system, enabling Tracker to determine the positions, orientations, and lens properties of all the Vicon cameras. Tracker uses this information to produce accurate 3D data. During the camera calibration process, Vicon Tracker creates a calibration parameters (.xcp) file. This file contains the calibration settings and threshold data specified for the Vicon cameras in your Tracker system and is used when data from these cameras is processed. An .x2d file containing the latest calibration data, of the format LatestCalibration *yyyymmddnnnnnn*.x2d, is also saved in the same location as the .x2d containing the recorded trial data.

> **Important**
> As part of the first stage of the daily Tracker motion capture workflow, Vicon recommends that you calibrate your Vicon cameras each day before you capture any data. This ensures that any unexpected changes in your setup that may have occurred when the system was unsupervised will not influence the quality of your data. You can perform the level of camera calibration that suits your requirements: a full camera calibration or a calibration refinement (for more information, see Understanding calibration types on page 111).

To perform a Vicon camera calibration, you need a dynamic calibration object, which is supplied with your Vicon system.

To calibrate Vicon cameras in Tracker:

1. Do one of the following:
   - If you want to calibrate only some of the cameras, on the **System** tab in the **Resources** pane, expand the **Vicon Cameras** node and select the Vicon cameras that you want to calibrate;

   or

   - If you want to calibrate all cameras, go straight to the next step.
2. On the **Calibrate** tab, expand the **Calibrate Cameras** section and from the **Wand** drop-down list select the type of dynamic calibration object you are using.

3. View or change the settings for the required parameters (if required, click **Show Advanced** to reveal additional settings), ensuring that you select the appropriate option from the **Calibration Type** list: **Full Calibration** or **Calibration Refinement**.

   > **Tip**
   > If you have already performed a full calibration, **Calibration Refinement** is selected by default, as this will normally be the most appropriate option. (For more information, see Understanding calibration types on page 111.)

4. In the **Calibrate Cameras** section, click **Start**.
   All Vicon cameras are selected and a separate **Camera** view pane is displayed for each one. The camera calibration process starts, and the **Start** button switches to its **Stop** setting.
5. In the capture volume, wave the calibration wand throughout the area where you intend to capture 3D data, ensuring that the markers on the calibration object are visible to the cameras. Vicon Tracker begins to capture wand wave data.
6. In each Camera view pane, check the display of colored lines identifying wand frames, ensuring that a good number of wand frames are spread across the intended 3D capture volume.

   > **Tip**
   > If no cameras are visible in the **Camera** view pane, make sure they are selected on the **System** tab in the **Resources** pane.
   > If any optical camera does not capture wand data during a wand wave, select the relevant camera on the **System** tab, look in the **Settings** section of the **Properties** pane, and ensure you have set the **Grayscale Mode** to **Auto**.

7. On the **Calibrate** tab, in the **Camera Calibration Feedback** section, check the **Wand Count** values returned for each Vicon camera.
8. In the **Calibrate Vicon Cameras** section, click **Stop**. Vicon Tracker automatically starts processing the camera calibration data.

   (If you selected the **Auto Stop** option in the **Parameters** section, Tracker automatically stops the calibration process when sufficient calibration information has been acquired.)

9. In the **Camera Calibration Feedback** section, monitor the progress bar until the camera calibration process is complete and review the **Wand Count** and **Image Error data**. As a general guideline, Tracker typically takes 15-60 seconds to complete its calculations for a typical Vicon system setup. When the Vicon camera calibration has successfully completed, it is automatically saved to an .xcp file.

   > **Tip**
   > Because calibration feedback values are based on factors such as the size of the capture volume and the camera lens type, it is not possible to provide general guidelines on typical or acceptable ranges. Therefore, to determine the optimal values for your Vicon system, shortly after the system is installed establish a baseline against which you can compare future daily calibration values.

For more information, see:

- Camera calibration parameters on page 110
- Camera calibration feedback on page 112
- Setting the volume origin on page 113
- Changing the volume origin on page 115
- Managing camera calibrations on page 116
- Improve volume scaling and set a fixed origin on page 117

Camera calibration parameters

On the **Calibrate** tab, in the **Calibrate Cameras** section, you can change the following settings:

Control	Description
Wand	Calibration object to be used during the camera calibration process.
Calibration Type	The level of camera calibration to be performed when the camera calibration process is started: • **Full Calibration** A full camera calibration process enables the Vicon system to determine each camera's physical position and orientation in the capture volume and to correct for any lens distortions, and to set internal camera parameters. You must perform a full camera calibration when the system is first installed and set up or if your camera setup has changed significantly. • **Calibration Refinement** A camera calibration refinement process enables you to correct a simple problem with a camera calibration. The Vicon system recalculates the previous calibration data based on the current location of the cameras. You can refine an existing calibration only if the camera positions have not changed significantly. For more information about calibration types, see Understanding calibration types on page 111 below.
Cameras To Calibrate	A list of cameras to be included in the camera calibration process. Cameras not included in this list are not calibrated. If this field is blank, all cameras are calibrated. The selection of cameras is applied when you click the **Stop** button in the **Calibrate Cameras** section.
Refinement Frames	With auto stop selected, the minimum coverage (in number of frames) required per camera in the final phase of refining a camera calibration.
Wand Ratio Tolerance	Tolerance of the distance between the markers on the wand (expressed as a ratio), to enable it to be labeled in 2D. Default is 0.2.
Wand Straightness Tolerance	Tolerance in alignment of wand markers (relating to the maximum angle allowed between markers) to enable it to be labeled in 2D.
Auto Stop	Whether or not Tracker is to automatically stop the camera calibration process when sufficient data has been collected.

Understanding calibration types

Full Calibration consists of an initialization phase, followed by a multi-pass process to optimize the camera positions.

Calibration Refinement uses exactly the same process as full calibration, but without the initialization phase. It provides a reliable way to refine existing calibration data to produce a calibration that is as good as a full calibration of the same system, but is much faster.

Because **Calibration Refinement** operates on existing data, you must have loaded a full calibration into Tracker before running the refinement calibration.

To save time while maintaining accuracy, you can perform both full and refinement calibration on any selected camera(s), as well as on all cameras.

Note that the value specified for **Refinement Frames** affects the number of frames used:

- By **Auto Stop**
- In the refinement phase of a **Full Calibration**
- When running a **Calibration Refinement**

The following table gives examples of using each type of calibration:

Scenario	Type of calibration
A full calibration of all cameras has recently been performed, but since then, several cameras have been repositioned to another part of the volume.	**Full Calibration** on just the moved cameras, with a short wand wave that concentrates on the moved cameras,
A full calibration of all cameras has recently been performed, but during capture, one camera was accidentally slightly bumped.	**Full Calibration** on the bumped camera, with a short wand wave that concentrates on the bumped camera.
Since yesterday's full calibration, environmental factors may have caused small changes in the camera positions and it is necessary to re-calibrate them accurately and quickly.	**Calibration Refinement** of all cameras, with a normal length wand wave that includes all cameras.

Camera calibration feedback

On the **Calibrate** tab in the **Camera Calibration Feedback** section, you can view the camera calibration processing and status information. **Camera Calibration Feedback** contains the following components:

Component	Description
Progress bar	This bar displays a percentage indicating the progress of the overall camera calibration process.
Camera	This column contains the device ID for each Vicon camera being calibrated.
Wand Count	For each Vicon camera, this value identifies the number of frames it has captured containing the calibration object. Initially, the entry for the number of wand frames is displayed in red; the entry turns green when Vicon Tracker has acquired enough wand data to calibrate that camera (by default 1000 frames). Because **Auto Stop** is not selected by default, the calibration process only stops when you click the **Stop** button. If you have selected **Auto Stop**, the calibration process stops when the Vicon camera with the lowest frame count reaches the number of frames specified in the **Refinement Frames** field in the **Calibrate Cameras** section.
World Error	Displays the calibration error in millimeters. World error is calculated per camera from the **Image Error** in pixels and the distance of the camera to the center of the volume. Cameras further away, with the same image error, display a larger world error.
Image Error	This value (in RMS distance in camera pixels) indicates the accuracy of the 3D reconstruction of the markers. This value represents the difference between the 2D image of each marker on the camera sensor and the 3D reconstructions of those markers projected back to the camera's sensor. Acceptable values depend on factors such as camera type. the size of the capture volume, and the camera lens type.

To sort the columns, click the required column heading.

Setting the volume origin

Setting the volume origin tells the Vicon system where the center of your capture volume is and what its orientation is (x, y, and z axes), so that subjects are displayed the right way up in the Tracker workspace and so that you can change the way data is visualized in the workspace. You set the global coordinate system immediately after you calibrate your Vicon cameras.

> **Important**
> Before starting the set volume origin process, remove from the capture volume all markers and the sources of any unwanted reflections that have not been accounted for by camera masks previously created. To set the volume origin, you need a calibration object, which is supplied with your Vicon system.

To set the global coordinate system:

1. Display a **3D Perspective** view.
2. On the **Calibrate** tab, in the **Wand** drop-down list, ensure that the calibration object that you used when you calibrated the cameras is selected.

> **Tip**
> Tracker determines the unit of length for calculating the volume based on the length of the calibration wand. If you specify a wand that is a different length from the one you used during the Vicon camera calibration, the volume will have the wrong unit of length, so Tracker will be unable to locate the L-frame calibration object.

3. In the **Set Volume Origin** section, from the L-Frame drop-down list, select the type of static calibration object you are using to set the volume origin.
4. In the capture volume, place the calibration object flat on the floor in the position and orientation that you would like to be the origin of the global coordinate system.
5. In the **Set Volume Origin** section, click **Start**.
   The calibration object tracking process starts, Tracker identifies the calibration object in the capture volume, displays a 3D representation of it in the **3D Perspective** view, and switches the **Start** button to its **Set Origin** setting.

6. Click **Set Origin** to complete the calibration object tracking process.
   Tracker sets the global origin and axes to correspond to the position and orientation of the calibration object in the capture volume. In the **3D Perspective** view pane, the floor grid is displayed aligned with the capture volume floor and the representations of the cameras are distributed in the position and orientation in which the physical cameras are located around the capture volume. When the global coordinate system has been successfully set, it is automatically saved to an .xcp file.
7. Verify that the global coordinate system was set successfully by checking that the system tracks the static calibration object.
   If it does not, check the following:
   - Was the correct dynamic calibration object selected from the **Wand** drop-down list at the top of the tools pane?
     If not, repeat this procedure from Step 2, ensuring that you select the correct entry for the calibration wand you used for calibrating the Vicon cameras.
   - Was the correct static calibration object selected from the **L-Frame** drop-down list at the top of the **Calibrate** tab?
     If not, repeat this procedure from Step 3, ensuring that you select the correct entry for the L-frame you are using.

After you have set the global coordinate system, you can display the volume axis marker in the lower-left corner of the **3D Perspective** view pane.

You turn the display on or off in the **Options** dialog box by selecting or deselecting **Volume Axis** under **General View Options**.

From Tracker 3.2 and later, you can also ensure that your coordinate system is accurately aligned with the floor of the capture volume by automatically detecting the floor plane, using markers in the volume to define it. For more information, see Improved floor plane calibration, in What's New in Vicon Tracker 3.2.

From Tracker 3.7 and later, after you have set the volume origin (see Setting the volume origin on page 113), to improve calibration stability and consistency over time (particularly in large volumes), you can create a large custom calibration object from markers permanently placed across the volume. You can then use this object, coupled with using the Auto Scale option, for subsequent setting of the system origin. For more information, see Improve volume scaling and set a fixed origin on page 117.

Changing the volume origin

You can edit an existing calibration object to change the position of the volume origin.

To change the volume origin:

1. After you have completed the usual calibration and setting volume origin procedures, load the calibration object that you used for calibration. To do this, on the **Objects** tab, click the **Load an Object** button  and locate the relevant calibration object. The default location is: **C:\Users\Public\Documents\Vicon\Tracker3.x\Objects**
2. On the **Objects** tab, click the **Pause** button  .
3. Move the calibration object in either of the following ways:
   - On the **System** tab, click the object and in the **Properties** pane ensure **Show Advanced** is selected, then edit the **Global Position** fields and **Global Rotation** fields as necessary; or
   - Drag the object in the view pane.
4. When you are happy with the position of the calibration object, right-click it and click **Save Object As**. Enter a suitable name, and click **Save**.
5. Click the **Calibrate** tab, and in the **Set Volume Origin** section, select your calibration object from the **L-frame** list.
6. In the **Set Volume Origin** section, click **Start**.
   In the view pane, the cameras move to reflect the new position of the origin.

Managing camera calibrations

On the **Calibrate** tab, in the **Manage Camera Calibration** section, you can reset, load, or save camera calibrations that define settings for the Vicon cameras in your Tracker system.

During the Vicon camera calibration process, Vicon Tracker creates a calibration parameters (.xcp) file. The changes in the .xcp file are automatically written to the calibration file, which overwrites the current file. If you want to be able to load the previous calibration in later, you must save it.

Changing a camera calibration can be useful in the following circumstances:

- To undo a poor calibration change.
- To compare calibration changes.

To manage camera calibration files in Tracker:

- On the **Calibrate** tab, go to the **Manage Camera Calibration** section and click the required button:

Button	Description
Auto Number Cameras	Enables you to quickly number the currently connected Vicon cameras in ascending order, according to their position in the capture volume. To obtain useful autonumbering, you normally auto-number the cameras at some point after you have aimed (and calibrated) the cameras. Automatic numbering starts with the camera that is furthest from the volume origin. The cameras are then numbered in a clockwise direction around the volume. If your cameras are positioned at different levels, the cameras in the level that contains the most cameras are numbered first.
Reset	Removes all non-existing cameras, clears the calibrated position for existing cameras, and reverts all calibration parameters to their default settings. This enables you to recalibrate the system from a clean starting point.
Load	Displays the **Choose a file** dialog box, from which you can navigate to and select the required .xcp file and click **Open**.
Save	Saves the current calibration.

Improve volume scaling and set a fixed origin

After you've calibrated the system on page 107 in the usual way, including Setting the volume origin on page 113, for maximum real-world accuracy (particularly in large volumes), you can create a large custom calibration object from markers permanently placed across the volume. You can then use this object, coupled with using the Auto Scale option, for subsequent setting of the system origin. This improves calibration stability and consistency over time.

> **Note**
> If it is impractical to use permanently fixed markers in your volume, you can still benefit from following this procedure, but when you come to recalibrate, substitute a scaled wand object in place of the custom calibration object. Your results will not be as accurate as they would with the custom calibration object, but you will still benefit from the scaling involved. For details, see Step 2 of Recalibrate with the scaled wand and custom calibration object on page 125.

These topics explain how to do this:

- Choose LEDs or markers for your custom calibration object on page 118
- Set up the custom calibration object on page 119
- Scale the Active Wand and the custom calibration object on page 119
- Recalibrate with the scaled wand and custom calibration object on page 125

Choose LEDs or markers for your custom calibration object

To create your custom calibration object, you can use either of the following:

- **An asymmetrical pattern of LEDs** (emitting 850 nm wavelength light)
  If you use LEDs to create your custom calibration object, ensure the LEDs are turned on only during setting the origin, and that they are turned off during the calibration wand wave and while the volume is in use.
  or
- **Reflective markers**
  If you use reflective markers to create your custom calibration object, remember that as passive markers are continually visible, you may need to cover them while the volume is in use.

Set up the custom calibration object

To initially set up the custom calibration object:

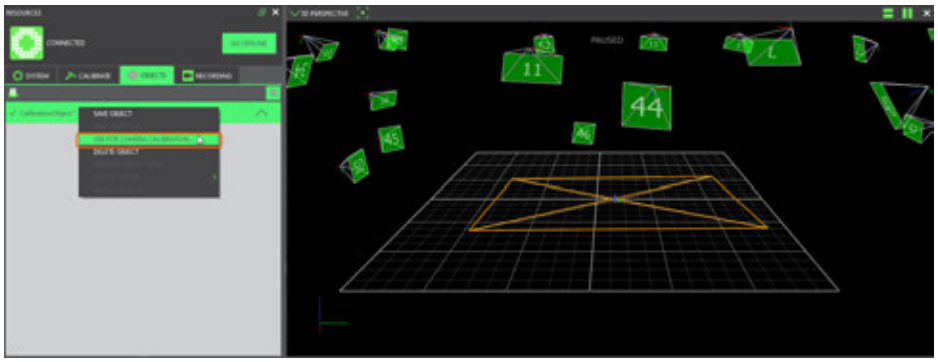
1. In the volume, place permanently static LEDs or markers to create a custom calibration object. Note the following points:
   - For best performance, **fix the LEDs or markers to the floor** (provides both stability and the ability to spread across the volume).
     If this is not possible, position them on a wall or truss.
   - To guarantee a good measurement, locate the custom calibration object in an area of **good camera coverage**.
   - For best scaling performance, position the custom calibration object across the **central two-thirds of the volume** (to avoid variability introduced by gaps in coverage at the volume edges). If this is unfeasible, try to make the custom calibration object as large as possible, and position it towards the center of the volume.
2. As accurately as possible, measure the distances between points at two furthest edges of the object, and record the results. This can be a single measurement (eg, if the object's sides are equal), or two measurements across two different axes (eg, if the volume is not square).

Scale the Active Wand and the custom calibration object

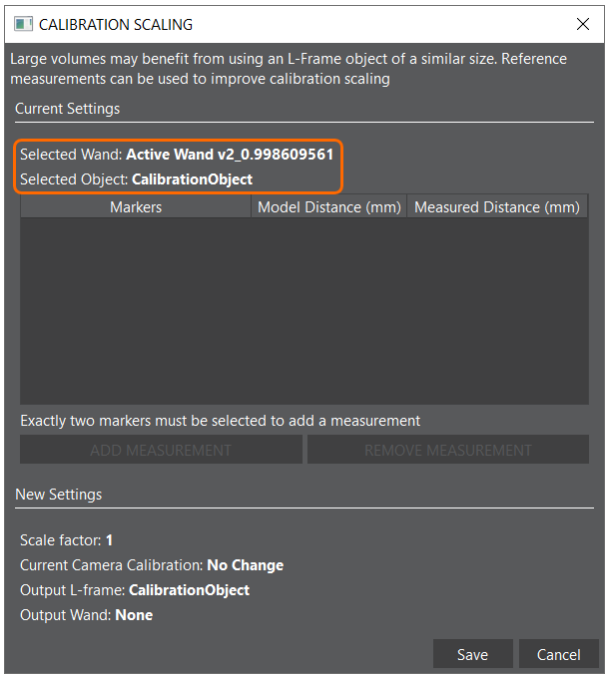
Each time you change the custom calibration object:

1. Calibrate using the normal process and standard *.vsk* files (see Calibrate Vicon cameras on page 107).
2. Set the origin using a standard calibration object (see Setting the volume origin on page 113).
3. In Tracker, create an object for the markers of the custom calibration object (for details, see Creating an object on page 130).
   Do not save this object: it is important that the object that is used for this scaling is created from the current marker observations.

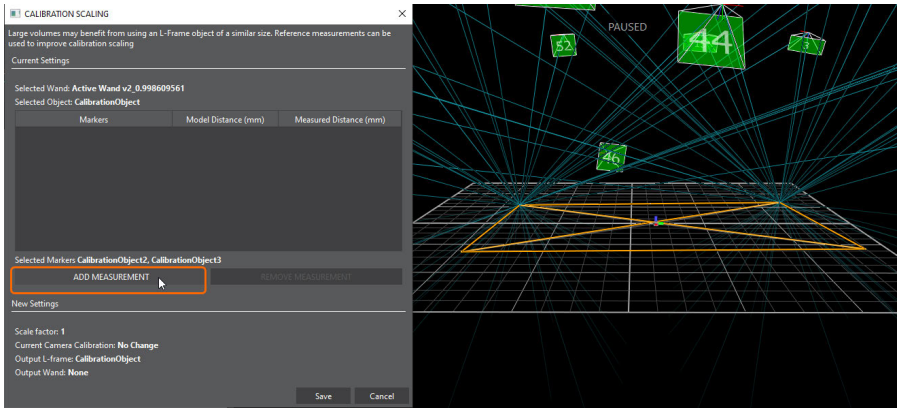
4. On the **Objects** tab, ensure the custom calibration object is selected, right-click and then click **Use for Camera Calibration**.



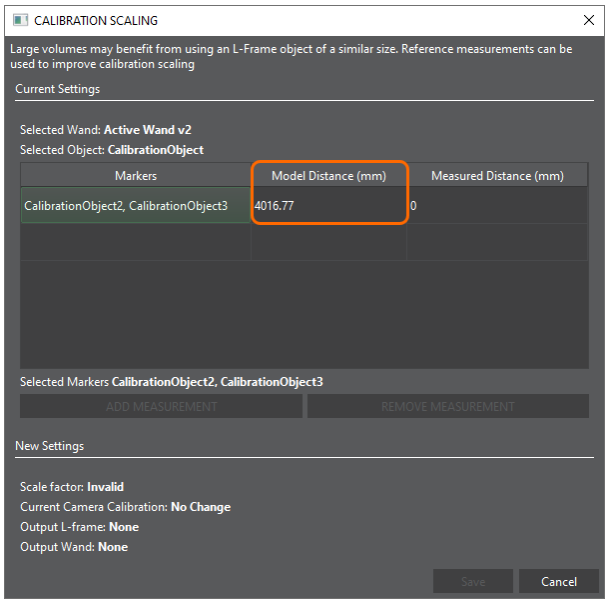
5. In the **Calibration Scaling** dialog box:
   a. In the **Current Settings** section, check that the **Selected Wand** is the correct wand for your calibration, and that the **Selected Object** is correct.



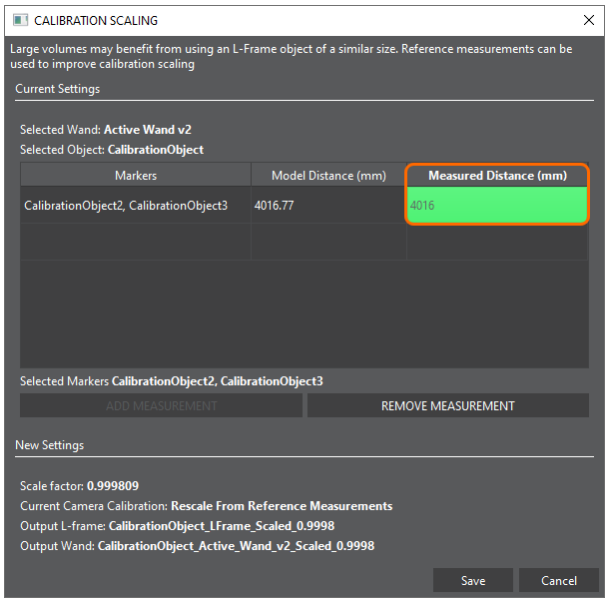
b. Ensure the custom calibration object is enabled, then select a pair of markers that correspond to a measurement that you took earlier, and click **Add Measurement**.



A line is added to the table containing the Model Distance, which is the distance between the markers as measured by the current Vicon calibration.

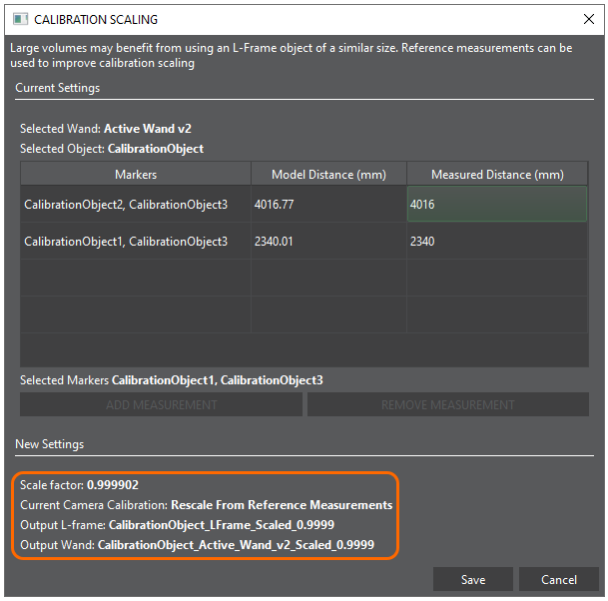


c. In the **Measured Distance** column, enter the distance that you measured in millimeters.

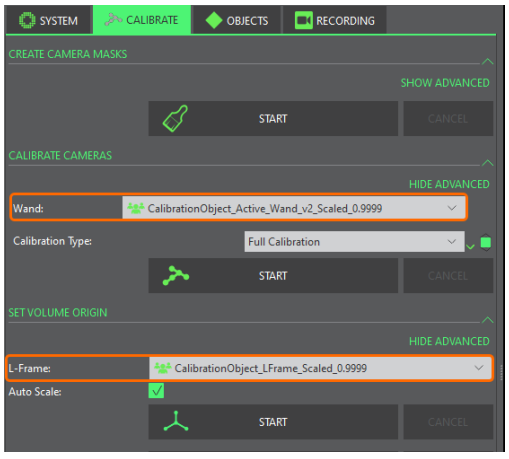


d. For each set of measurements you have taken from the object, repeat steps b and c.

In the **New Settings** section, the scale factor that will be applied is displayed, together with the output names for the scaled wand and calibration objects.



e. If you are happy with this measurement, click **Save** to exit the dialog box. A scaled wand and a calibration object file are saved by default to *C:\Users\Public\Documents\Vicon\Tracker3.x\CalibrationObjects* and are displayed in the Wand and L-Frame lists on the **Calibrate** tab.



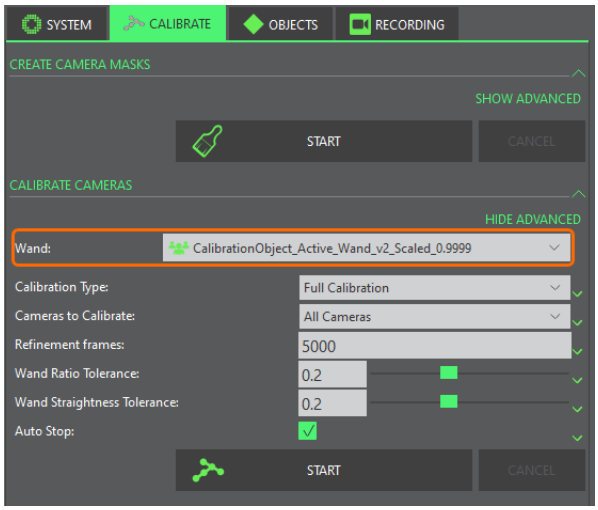
The current calibration is also scaled by the same factor, so you do not need to recalibrate after this operation.

6. In future, to obtain an accurately scaled volume, use the new scaled wand and calibration object when performing the calibration and set object operations (see Recalibrate with the scaled wand and custom calibration object on page 125).

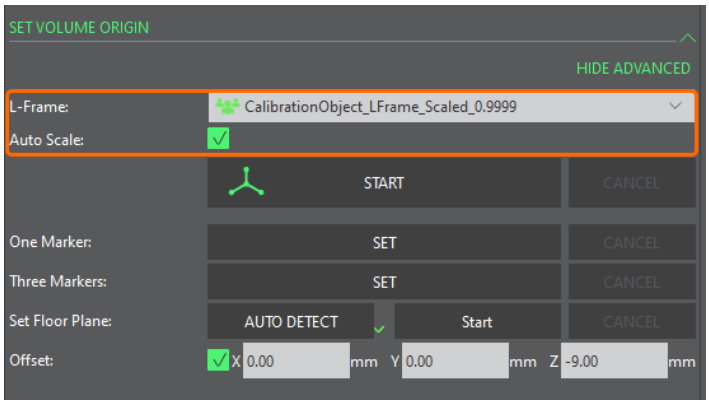
If you do not add measurements, the object is saved as a calibration object with no scaling modification, and no scaled wand is saved. You can still use the new calibration object for set origin operations, including auto-scale. This will provide consistency of scale across set origin operations, but the volume will not be scaled to external measurements.

Recalibrate with the scaled wand and custom calibration object

1. Calibrate using the normal process, but in the **Wand** field, select the new scaled Active Wand *.vsk* file.



2. For the best results, set the origin using the normal process, but:
   - In the **L-Frame** field, select the scaled custom calibration object.
   - Ensure **Auto Scale** is selected.

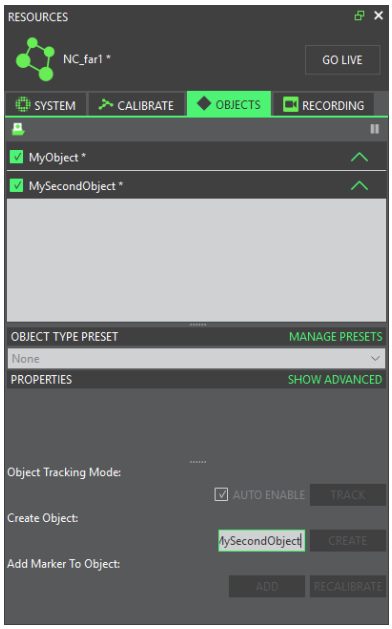


This ensures both a correctly scaled volume according to the measurements that you recorded of the custom calibration object; and also a permanently fixed origin, based on the static markers.

> **Tip**
> If you can't use permanently fixed markers in your volume, in Step 2 above, substitute the scaled wand object in place of the custom calibration object. Your results will not be as accurate as they would with the custom calibration object, but you will still benefit from the scaling of the wand.

3. Validate the new calibration by repeating the measurements from Step 5 of Scale the Active Wand and the custom calibration object on page 119.
   The measurements in Tracker should now closely align to the real world measurements of the fixed markers, as recorded in Step 2 of Set up the custom calibration object on page 119.

About the Objects tab



Prepare and manage the objects whose motion data you want to track in Vicon Tracker on the **Objects** tab. Objects are a rigid, asymmetrical arrangement of at least three markers. Multiple objects can be defined to track many rigid bodies at the same time and different smoothing filtration presets can be applied to each one.

The **Objects** tab contains these components:

Component	Description
Objects list	Lets you enable an object for motion capture and data recording. If a working .vsk file exists for the object, the object symbol is orange and the object name is gray. If the name is red, the .vsk file is not suitable for tracking (this may be due to symmetry in the arrangement of markers, or similarity to another enabled object). To display a tool tip identifying the problem, hover the mouse pointer over the object. To display or hide the model markers defined in the .vsk file, expand (+) or collapse (-) the **Markers** list. **Tips** To manage specific objects, in the **Objects** list, right-click on the relevant node and from the context menu select a command. The **Open Folder** option, at the bottom of the context menu, provides a quick way to locate a relevant file. The color-coded symbols displayed for entries in the **Markers** list correspond to the colors defined for each model marker in the .vsk file.
Object Type Preset section	Enables you to view and manage the type of smoothing applied to a selected object. Smoothing is achieved using a One Euro, low-pass smoothing filter. You can choose from one of the following supplied filters: • **HMD**: Used for head-mounted devices. • **InteractionDevice**: Used for Vicon Apex. • **General**: Used as a general purpose starting point If none of the supplied filter types is suitable for your application, you can also create and save your own custom filter presets, so that you can quickly and accurately apply them to other objects (for more information, see Creating an object on page 130).
Properties pane	Enables you to view or edit object properties.
Object Tracking Mode control	To view unlabeled reconstructions in the view pane (to enable you to create new objects), ensure **Track** is not selected. Viewing unlabeled reconstructions requires additional processing, so for lowest output latency, when you have finished creating objects, click the **Track** button to change to **Track** mode.

Component	Description
Create Object controls	To create a new object, ensure **Track** mode is selected (see above), select at least three trajectories in the view pane, enter a name in the **Create Object** box, and click **Create** or press CTRL+E. For more information, see Creating an object on page 130.
Add Marker to Object controls	To add marker(s) to the selected trajectory of a selected object, click the **Add** button. If a calibrated object becomes distorted due to a marker having been been lost and replaced in a slightly different position from its original location, to update the marker position, select the affected marker and click the **Recalibrate** button.

Creating an object

For motion capture and data streaming recording to take place, you must create objects. Objects are a rigid, asymmetrical arrangement of at least three markers whose motion data you want to track. Multiple objects can be defined to track many rigid bodies at the same time. If necessary, you can apply different levels of filtration to each object to obtain the required smoothing.

To create an object:

1. If you are streaming live, on the **Objects** tab in the **Resources** pane, click **Pause**  .
2. Ensure that in the **Object Tracking Mode** section at the bottom of the tab, **Track** mode is not selected. This enables you to see unlabeled reconstructions in the **3D Perspective** view pane.
3. In the view pane, zoom in (right-click + drag forward or backward) on the markers to be defined as an object.
4. Select the (three or more) markers you want to include by doing one of the following:
   - To select markers individually, press and hold the CTRL key while you left-click on each marker.
   - To select a group of markers, press and hold the ALT key while you drag around the markers to form a box around them.
5. With the markers selected, enter a name in the **Create Object** box and then click **Create**.

> **Tip**
>
> In the **Create Object** text box, the name is automatically incremented by 1 each time you click **Create**, so that, to create another object with the default name of *ObjectName_n*, you can just select the required markers and click **Create**.

6. If required, apply object-specific smoothing (using One Euro filtration) to the selected object. To do this:
   a. Ensure that the newly created object is still selected.
   b. Depending on whether you want to use an existing filtration type for this object, do one of the following:
      - If you want to use an existing filtration type, in the **Object Type Preset** section, select it from the dropdown list and save the object as described in step 9.

      or

      - If the required filtration type does not exist, in the **Object Type Preset** section, click **Manage Presets** and in the **Object Presets** dialog box, enter a name in the **Create New Preset** box and then click **Add**.
   c. In the **Presets** section, ensure the new preset is selected, then in the **Smoothing** section, change the **Translation** and **Rotation** properties as required.
   d. With **Translation Beta** set to zero, change the value of **Translation Min Cut-Off** to eliminate jitter during very slow movements.
   Note that decreasing the value of **Translation Min Cut-Off** reduces jitter but increases lag.
   e. When you have finished adjusting the **Translation Min Cut-Off** value, increase the value of **Translation Beta** by very small increments to eliminate lag during faster movement.
   Note that 0 = filtering on all translation motion; 1 = filtering on very slow translation motion only.
   f. Follow the same procedure for adjusting the **Rotation Min Cut-Off** and **Rotation Beta**.
   For detailed information on the One Euro filter and how to adjust these settings, visit www.lifl.fr/~casiez/1euro/.[12]
   g. If you want Tracker to detect the object as static, select the **Motion Model** check box.
   h. When you have finished adjusting the properties, click **Close**.
7. On the **Objects** tab, make sure that in the **Object Type Preset** section, the required filter is displayed for the selected object.
8. As required, make the following optional changes:

12 http://www.lifl.fr/~casiez/1euro/

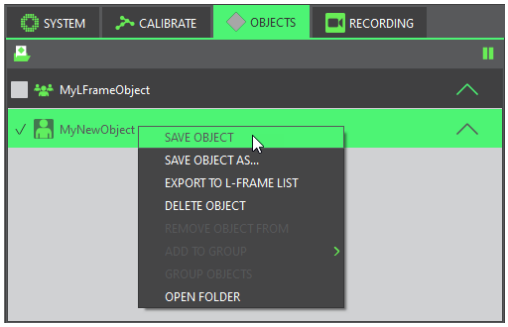
a. Left-click and drag the red, green, or blue axis lines emanating from the center of the object (translation manipulator) to translate the origin of the object to the desired position.

b. Left-click the translation manipulator to toggle to a rotation manipulator.

c. Drag the manipulator axes to orient the object to the desired pose.

d. Modify the object's properties in the **Properties** pane. For more information, see Working with object properties on page 145.

9. Save the object by right-clicking it the **Objects** list and selecting **Save Object** from the context menu.



Tracker saves the contents of the object in a .vsk file in the **Objects** folder.

> **Important**
> Viewing unlabeled reconstructions requires additional processing, so for lowest output latency, when you have finished creating objects, ensure **Track** mode is selected. When **Track** mode is selected, the **Track** button is green.

Loading an existing object

You can open or load an existing .vsk file (object) in Tracker.

To load a .vsk file:

1. On the **Objects** tab tool bar, click the **Load an Object** button.

2. In the **Choose an Object File** dialog box, navigate to an existing .vsk file, select it and then click **Open**.

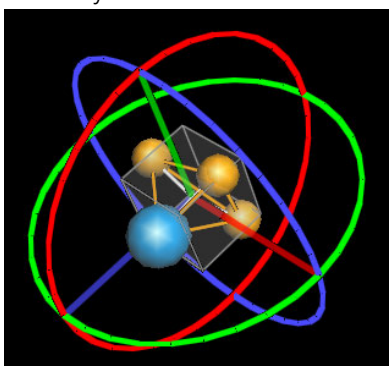
> **Caution**
> If the selected .vsk file has the same name as an object currently loaded in Tracker, the contents of the selected .vsk file replace those in the currently loaded object.

Snapping the rotation of an object to a marker

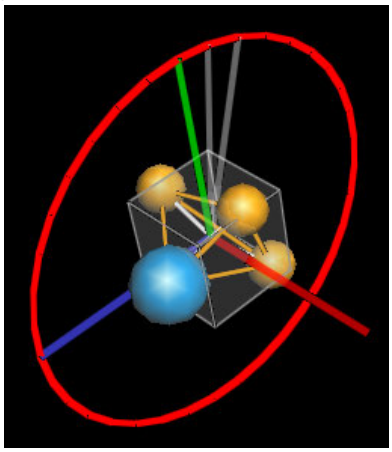
You can change the orientation of an object in real time by snapping the rotation to a marker.

To snap the rotation to a marker:

1. In the view pane, click a marker within an object.
2. Click any axis. Three circles associated with the axes are displayed.



3. Click on a circle and rotate it until you see a gray rectangular shape snap into place.



To snap the position of an object to a marker:

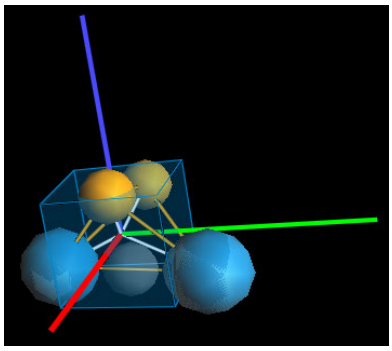
1. In the view pane, click a marker within an object.
2. Click any axis and drag towards the marker until it snaps into place.

Snapping a midpoint between markers

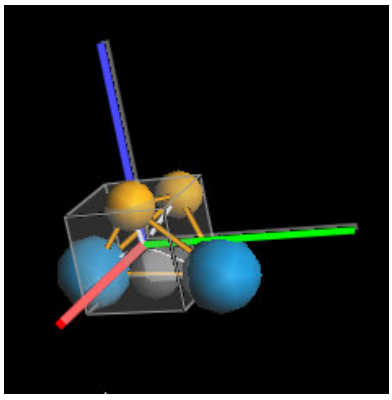
You can snap two markers together to measure the distance between the markers.

To snap a midpoint between markers:

1. In the view pane, select two markers by pressing CTRL while left-clicking each marker.
   A gray, projected marker is displayed at the midpoint between the two markers.



2. Left-click on the desired axis and move it towards the gray projected marker until it snaps into the midpoint.

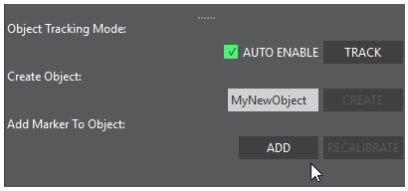


Adding and detaching markers

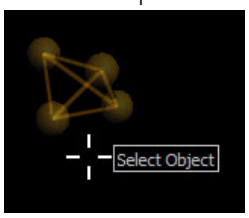
You can easily add an existing marker to an object or detach a marker from an object.

To add a marker to an object:

1. In the view pane, to select the marker that you want to add to the object, click the marker.
2. At the bottom of the **Objects** tab, click the **Add** button.



The mouse pointer now displays **Select Object**.



3. Click in the view pane.
   The marker is now part of the object and is displayed in the **Object** list.

To detach a marker from an object:

1. In the view pane, right-click the marker to detach.
2. Select **Detach Marker** from the context menu.
   The marker becomes disabled and is deleted from the object in the **Object** list.

Managing objects

After you have loaded an existing .vsk file or created a new object, you can save or delete the object, or move its centroid as described in the following steps.

See also:

- Positioning an object in the global coordinate system on page 143
- Working with grouped objects on page 138

To save an object as .vsk file:

1. On the **Objects** tab in the **Resources** pane, right-click the object.
2. Select **Save Object** from the context menu.

Tracker saves the contents of the object in a .vsk file in the **Objects** folder.

To delete an object:

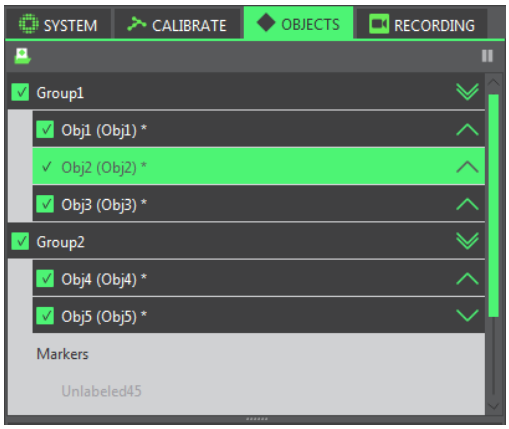
1. On the **Objects** tab, right-click the object and select **Delete Object** from the context menu.
2. In the **Warning** confirmation message, click **Yes** to proceed.
   Tracker deletes the object from the **Objects** tab, unloads the .vsk, removes the labels from the trajectories associated with that object, and permanently deletes it from the **Objects** folder.

To move the centroid of an object:

- In the view pane, click an axis and move along that axis until you reach the location you want. Repeat for the other axis until the required location is reached.

Working with grouped objects

Location: **Resources** pane > **Objects** tab



The ability to act on multiple objects simultaneously is useful when you are working with similar objects, such as the collection of rigid bodies that make up a single subject.

You can group objects and then select the group, so that activation, selection, and deletion applies to all objects in the selected group.

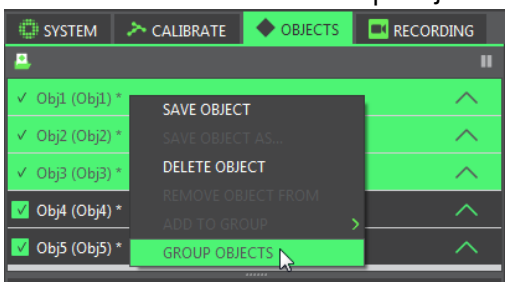
For more information, see:

- Create a group on page 139
- Add objects to a group on page 139
- Activate and deactivate grouped objects on page 140
- Select grouped objects on page 140
- Ungroup or delete grouped objects on page 140
- Change the color of grouped objects on page 141
- Save grouped objects on page 141

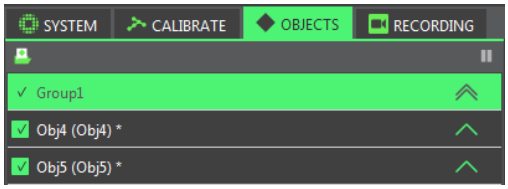
Create a group

To create a group of objects:

1. On the **Objects** tab, click to select the required objects, then right-click and on the context menu click **Group Objects**.

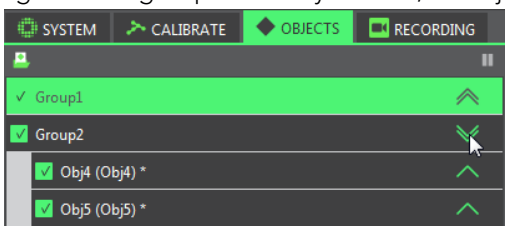


2. Enter a name for your group and click OK.
   The selected objects are grouped under the new group name:



   You can create further groups of objects as required.

3. To see the objects in a group, expand the group by clicking the arrow to the right of the group name. By default, all objects in the group are activated:



Add objects to a group

To add objects to an existing group:

On the **Objects** tab, right-click the name of the object that you want to add to the group, point to **Add to Group**, and then click the name of the required group.

Activate and deactivate grouped objects

To activate/deactivate objects

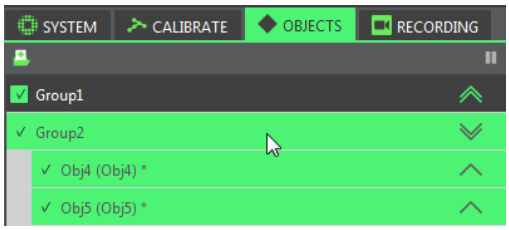
On the **Objects** tab, you can activate/deactivate grouped objects in either of these ways:

- **All objects in a group**: Clear or select the check box to the left of the group name.
- **One or more objects within a group**: Expand the group and clear or select the check box to the left of the object name.
  The check box to the left of the group name changes to reflect the activation status of objects within the group.

Select grouped objects

To select grouped objects

When you select a group (that is, click its name on the **Objects** tab), all the objects in the group are selected by default:



You can also click, SHIFT-click and CTRL-click to select/deselect one or more objects within the group.

Ungroup or delete grouped objects

To ungroup or delete objects

On the **Objects** tab, you can ungroup and/or delete grouped objects in either of these ways:

- **All objects in a group**: Right-click the group name and click the required option:
  - **Delete** permanently deletes the group and all the objects within it.
  - **Ungroup** moves all the group's objects outside the group and lists them separately on the **Objects** tab. The group name is no longer displayed.

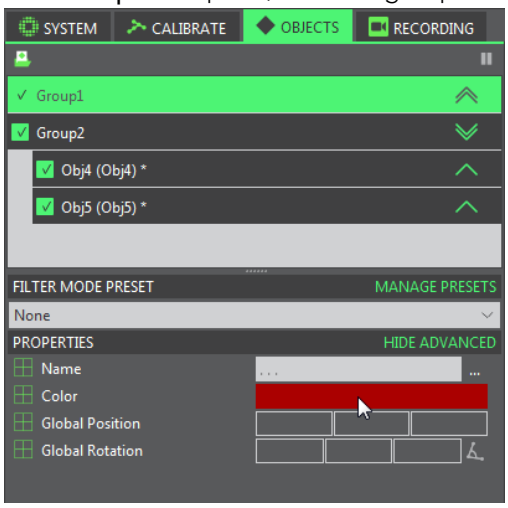
or

- **One or more objects within a group**: Expand the group, right-click the required object(s) and then click the required option:
  - **Delete Object** permanently deletes the object.
  - **Remove Object from *GroupName*** moves the object from within the group to outside the group, so that it is listed separately on the **Objects** tab.

Change the color of grouped objects

To change the color of grouped objects

1. On the **Objects** tab, select a group by clicking its name.
2. In the **Properties** pane, click the group's **Color** box.



3. In the **Select Color** dialog box, choose the required color.
   The color of all the objects in the selected group changes.

Save grouped objects

To save grouped objects:

On the **Objects** tab, expand the group, right-click the object and click **Save Object**.

Snapping an object to the global coordinate system

Tracker enables you to snap an object's axes to the global coordinate system, for accurate positioning and aligning of objects.

To snap an object to the global coordinate system:

1. On the **Objects** pane, click the **Pause** button  .
2. On the **Window** menu, click **Options** and in the dialog box, click **Objects**. Ensure **Snap Global** is selected. If required, you can change the **Snap Distance (mm)**.
3. Ensure nothing is selected and then in the view pane, drag or rotate the object axes to enable them to snap to the grid.

> **Tip**
> To change the distance between the lines of the grid to which objects can snap, in the **Options** dialog box, select **Floor Grid** and adjust as required.

Positioning an object in the global coordinate system

Tracker enables you to view and specify the values that determine the position of an object within the global coordinate system.

To precisely position an object:

1. On the **System** tab, click the object and then in the **Properties** pane, click **Show Advanced**.
2. In the view pane, drag or rotate the object's axes and observe the change in the values in the **Global Position** fields (the location of the object within the global coordinate system in millimeters) and **Global Rotation** fields (the orientation of the object within the global coordinate system in degrees).
3. If required, change the **Global Position** and **Global Rotation** values.
   The position of the object changes in the view pane.

> **Tip**
> To set the current position of the object to the global position of 0, 0, 0 (that is, the origin), click the arrow to the right of the **Global Position** fields and select **Set to Default**.

Reorder Markers dialog box

The **Reorder Markers** dialog box enables you to change the order in which markers are displayed on the **Objects** tab.

To change the order in which markers are displayed:

1. On the **Object** tab, if necessary, expand the node of the object whose markers you want to change.
2. Right-click the **Markers** node and then click **Reorder**.
3. In the **Reorder Markers** dialog box, click to select the marker whose position you want to change and choose from the following options:
   - Move Up
   - Move Down

Working with object properties

In the **Resources** pane, when you click on an object on the **Objects** tab, you can configure the following setting in the **Properties** pane.

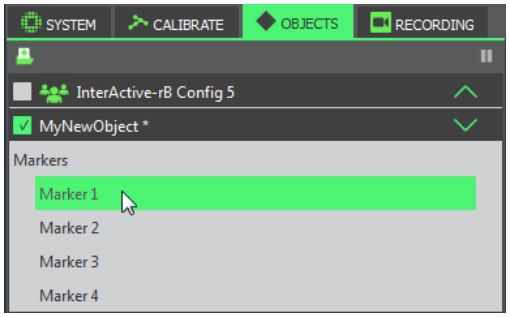
Setting	Description
Name	The name of the selected object. This name is used when the Vicon Skeleton is saved in a .vsk file. To change the name, do any of the following: • In the **Name** box in the **Properties** pane, select the current name and enter a new one; or • Click the button next to the **Name** box to display the **Name** dialog box, select the existing object name and enter a new one; or • On the **Objects** tab, double-click the current name and enter a new one.
Color	The color of the selected object.
Global Position	The global position of the selected object.
Global Rotation	The global rotation of the selected object. To choose the rotation order, click the Rotation Order button  .

Changing marker color

You can change the color of object markers.

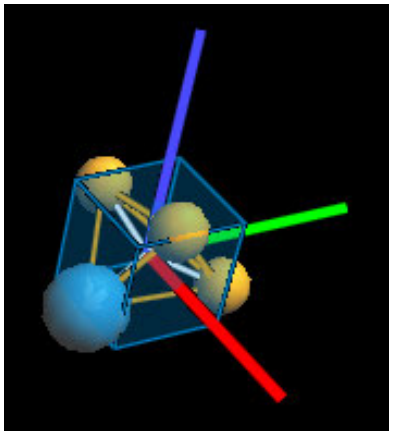
To change color properties:

1. Do one of the following:
   - Select the marker in the **Marker** list.



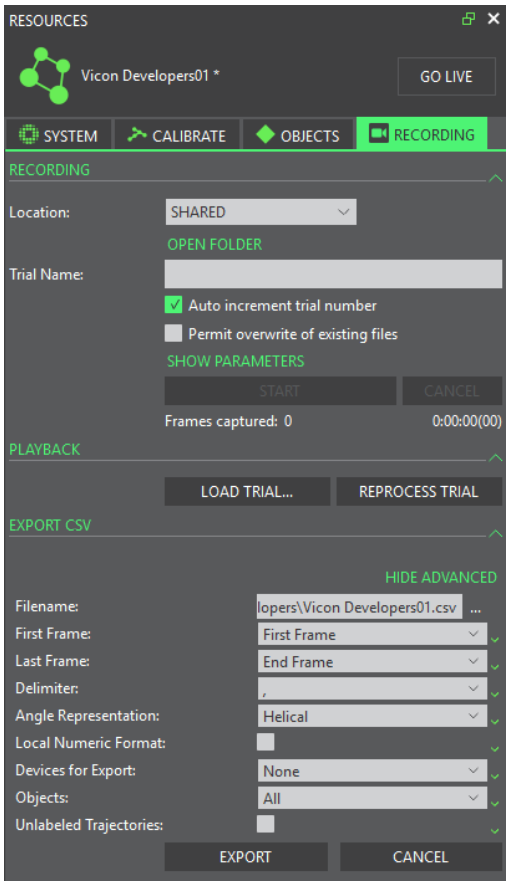
   or

   - Click on the marker in the view pane.



2. In the **Properties** pane, click the currently displayed color in the **Color** box.
3. In the **Select Color** dialog box, assign a color in the **Basic colors** area, or define a new color in the **Custom colors** area and then click **OK**.

About the Recording tab



Save and play back recordings of trial data, using the controls on the **Recording** tab.

> **Note**
> You will only see the **Recording** tab if you have the required license. For more information, contact Vicon Support[13].

13 mailto:support@vicon.com

The **Recording** tab contains the following components:

Component		Description
Recording section		In the **Recording** section, specify your requirements for recording live trials. When you have finished specifying your requirements, click the **Start** button to begin recording.
	Location	Select **Private** or **Shared**, depending on your requirements.
	Open Folder	View the location of the saved files. The default file location depends on whether files are saved as **Shared** or **Private**: • **File type**: Private **File location** (English language version): C:\Users\UserName\AppData\Roaming\Vicon\Tracker3.x\CapturedTrials • **File type**:Shared **File location** (English language version): C:\Users\Public\Documents\Vicon\Tracker3.x\CapturedTrials Note: For each trial recorded, at least three files are saved: .x2d, .system, and .xcp files. In addition, whenever a new calibration is performed, an additional .x2d file, of the format LatestCalibration *yyyy mmddnnnnnn*.x2d, containing the latest calibration data, is saved in the same location as the .x2d containing the recorded trial data. (This can be useful for data analysis and troubleshooting.) If you are using an analog device to capture data, an .x1d file is also saved.
	Trial Name	Enter a name for the new trial.
	Auto Increment Trial Number	When selected, the trial number is automatically appended to the file name.
	Permit Overwrite of Existing Files	When selected, existing captured trial data in the same folder (see above) is overwritten when the new file is saved.

Component		Description
	Show/Hide Parameters	Displays or hides additional controls, such as those for remote triggering.
	Start/Stop on Remote Trigger	When selected, a remote trigger can be used to control capturing start and stop times. The remote device must be connected to your Vicon system.
	Capture Before Start (secs)	To capture data before the capture start is triggered either manually (by clicking **Start**) or automatically (based on a remote trigger), select this check box and enter the required number of seconds.
	Stop after Duration (secs)	To end the trial automatically after a specified number of seconds, select this check box and enter the required number of seconds.
	Start/Stop over Network	To make a UDP broadcast to a third-party application that capture has started or stopped, select this check box and from the adjacent drop-down list, select Send or Receive. In the **Address** list, either select the IP address of the network card that will be used to send or receive the start/stop trigger message, or select **All**. In the adjacent field, specify the UDP port which is to send or receive the message.
	Arm button	To set the system to a state where it is ready to accept a trigger for automatic capture based on a signal broadcast over the network from a remote device, click this button. If you want to enable the system to remain ready to receive subsequent network signals after the capture is stopped, click the **Lock** button to the right of the **Arm** button.
Playback section		In the Playback section, click the **Load Trial** button to select the trial you want to play back.
Export CSV section		In the Export CSV section, select options to save trial data to a CSV file. For more information, see CSV Export, in *What's New in Vicon Tracker*.

Tip
Before attempting to load a trial, in the **Recording** section, ensure that the relevant **Location** setting is selected (**Shared** or **Private**), depending the option chosen for the trial you want to load.

Recording live trials

You specify your requirements for recording live trials on the Recording tab. If you use the same setup each time, you can make subsequent recordings just by clicking the **Start** button.

To record trial data:

1. Ensure your system is connected and calibrated and that Tracker is in **Live** mode.
2. In the **Resources** pane, click the **Recording** tab.
3. In the **Location** area, select whether your trial will be saved as **Shared** or **Private** files.
4. In the **Trial Name** box, enter a name for the new trial. If you want a number to be automatically appended to the file name, ensure **Auto Increment Trial Number** is selected.
5. If you want existing captured trial data in the same folder to be overwritten when a new trial is saved, select the **Permit Overwrite of Existing Files** box.
6. Do one of the following:
   - If you don't want to select any further parameters, go to step 7; or
   - If your trial requires any further setup, for example, if you are using remote triggering, click **Show Parameters** and supply the necessary information:
     - **Start/Stop on Remote Trigger** To use a remote trigger to control capturing start and stop times, select this check box. The remote device must be connected to your Vicon system via a Giganet.
     - **Capture before Start (secs)** To capture data before the capture start is triggered either manually (by clicking **Start**) or automatically (based on a remote trigger), select this check box and enter the required number of seconds.
     - **Stop after Duration (secs)** To end the trial automatically after a specified number of seconds, select this check box and enter the required number of seconds.
     - **Start/Stop over Network** To make a UDP broadcast to a third-party application that capture has started or stopped, select this check box and from the adjacent drop-down list, select **Send** or **Receive**. In the **Address** list, either select the IP address of the network card that will be used to send or receive the start/stop trigger message, or select **All**. In the adjacent field, specify the UDP port which is to send

or receive the message. For information on the format of UDP broadcast and trigger notifications, see UDP capture broadcast/ trigger on page 152.

- **Arm** button To set the system to a state where it is ready to accept a trigger signal for automatic capture based on a signal broadcast over the network from a remote device, click this button. If you want to enable the system to remain ready to receive subsequent network signals after the capture is stopped, click the **Lock** button to the right of the **Arm** button.

7. When you are ready to begin recording, click **Start**.
   The **Frames Captured** number increases as frames are captured.
   If you did not specify a number of seconds in the **Stop after Duration** box or if you decide to end the capture before the specified time, click **Stop** when you have finished capturing.
   To abandon the trial without saving any data, click **Cancel**.

You can play back the captured trial immediately.

UDP capture broadcast/trigger

Vicon Tracker supports a simple UDP protocol to broadcast when capture has started. Tracker can also receive these messages, which can be used to trigger a capture remotely.

For more information, see:

- Example notifications on page 152
- Supplied example code on page 159

For information on how to set up remote triggering in Tracker, see Recording live trials on page 150, and in particular, Step 6.

Example notifications

The XML file contains the following notifications:

- Start notification on page 153
- Stop notification on page 154
- Complete notification on page 155
- Timecode Start notification on page 156
- Timecode Stop notification on page 158
- Duration Stop notification on page 159

Start notification

The following example shows a Start notification. Note that the broadcast must fit into one UDP packet.

The indents in the following example are for clarity: the actual packet is not indented. White space between tokens is removed.

```
<?xml version="1.0" encoding="UTF-8" standalone="no"?>
<CaptureStart>
    <Name VALUE="dance"/>
    <Notes VALUE="The pets ants crime deer jump. "/>
    <Description VALUE="The crowd pencil pets alert fold deer. With welcome
practice representative complete great? Or jolly tiny memorise thread. However
wool insect pipe! "/>
    <DatabasePath VALUE="D:/Jeremy/Susan/Captures/Take"/>
    <Delay VALUE="33"/>
    <PacketID VALUE="33360"/>
</CaptureStart>
```

Where:

`Name`	The name of the trial, which is used as the filename for the capture files, for example `<Name>.x2d`.
`Notes`	Any notes provided
`Description`	Any description provided. Avoid very long description strings as the broadcast must fit into one UDP packet. If it does not, the broadcast is not sent.
`DatabasePath`	The target path for the capture files.
`Delay`	The number of milliseconds that the broadcast is made before the capture starts. This delay enables clients to do any preparation required to respond.
`PacketID`	A number that individually identifies the packet. It is incremented for each packet generated. Use it to discard duplicate packets that are delivered by UDP. (This can happen if there are multiple paths between the broadcasting and listening machines.)

Stop notification

The following example shows a Stop notification. It is a notification that capturing has stopped.

Note that writing the file to disk may not be complete. Wait for the corresponding Complete notification before trying to open the file.

Possible values for the result are:

- SUCCESS - Everything was ok.
- FAIL - Everything was not ok. Perhaps the disk ran out of room, or the system was unplugged. You may get a truncated file.
- CANCEL - The user stopped the capture process. There will not be a Complete notification.

```
<?xml version="1.0" encoding="UTF-8" standalone="no"?>
<CaptureStop RESULT="SUCCESS">
    <Name VALUE="dance"/>
    <DatabasePath VALUE="D:/Jeremy/Susan/Captures/Take"/>
    <Delay VALUE="33"/>
    <PacketID VALUE="33361"/>
</CaptureStop>
```

Complete notification

The following example shows a Complete notification. It indicates that the captured file is ready at the path specified. Note that:

- When capture is complete, buffers have yet to be flushed to disk.
- If the file is on a remote drive, it may be captured locally and then copied to the final location. This may take some time.

```
<?xml version="1.0" encoding="UTF-8" standalone="no"?>
<CaptureComplete>
    <Name VALUE="dance"/>
    <DatabasePath VALUE="D:/Jeremy/Susan/Captures/Take"/>
    <PacketID VALUE="33362"/>
</CaptureComplete>
```

Timecode Start notification

The following example shows a Timecode Start notification. It is generated when the system is armed. Note that:

- Capture starts when the system receives the timecode specified.
- Additional notifications may be generated if the start timecode is updated after the system is armed.

```
<?xml version="1.0" encoding="UTF-8" standalone="no"?>
<CaptureStart>
    <TimeCode VALUE="0 38 10 17 0 0 0 4"/>
    <Name VALUE="slip"/>
    <Notes VALUE="The last ants great blade jump. "/>
    <Description VALUE="The truthful pencil pets ants crime deer. With geese
trail representative complete crowd? Or jolly toothbrush slip thread. However
worried insect nest! "/>
    <DatabasePath VALUE="D:/Captures/Take/DayOne/Final"/>
<PacketID VALUE="33364"/>
</CaptureStart>
```

Where:

`TimeCode` is represented as a sequence of integers delimited with spaces.

- Hours
- Minutes
- Seconds
- Frames
- Sub-Frame (Always zero)
- Field
  - 0 - Even Field
  - 1 - Odd Field
- Standard
  - 0 - PAL
  - 1 - NTSC
  - 2 - NTSC Drop

  - 3 - Film at 24fps
  - 4 - NTSC Film
  - 5 - 30Hz exactly
- Sub-Frames Per Frame (the multiple of the timecode rate that the system is running at)

Timecode Stop notification

The following example shows a Timecode Stop notification. Note that additional notifications may be generated if the Timecode Stop is updated after the system is armed or possibly even capturing.

```
<?xml version="1.0" encoding="UTF-8" standalone="no"?>
<CaptureStop>
    <TimeCode VALUE="0 46 27 15 0 0 0 4"/>
    <Name VALUE="slip"/>
    <DatabasePath VALUE="D:/Captures/Take/DayOne/Final"/>
    <PacketID VALUE="33365"/>
</CaptureStop>
```

The values for `TimeCode` are as listed in Timecode start notification on page 156.

Duration Stop notification

The packet is generated when the system is armed, or immediately prior to the capture being started.

```
<?xml version="1.0" encoding="UTF-8" standalone="no"?>
<CaptureStop>
    <Duration FRAMES="12867" PERIOD="32865" TICKS="5553087"/>
    <Name VALUE="memorise"/>
    <DatabasePath VALUE="D:/Take/DayOne/Final/Susan"/>
    <PacketID VALUE="33367"/>
</CaptureStop>
```

Where:

`Duration` is the number of frames that will be captured.

The packet may contain extra information describing the frame rate:

- `PERIOD` is the number of clock ticks between each frame
- `TICKS` is the number of ticks in each second

The frames per second of the system can be calculated as `TICKS/PERIOD`. This representation of the frame rate avoids rounding errors for rates such as NTSC, which cannot be stored in a double without a loss of precision.

```
<Duration FRAMES="12867" PERIOD="653254" TICKS="135000000" />
```

Supplied example code

The examples are provided in C++ and require the *boost* library for communications.

1. CaptureBroadcastMonitor shows how to monitor for and decode the capture notifications described above.
2. RemoteStartStop shows how to package and send the packets to trigger capture start and stop.

Playing back recorded trials

You load and play recorded trials using the **Recording** tab and the view pane.

To play back recorded data:

1. On the **Recording** tab, in the **Recording** area ensure that the relevant **Location** setting is selected (**Shared** or **Private**), depending on the option chosen for the trial you want to load.
2. In the **Playback** area, click **Load Trial** to access the location of the last saved trial. If you want to load a different trial, browse to the appropriate location. Click **Open**.
   The recorded trial is loaded, a time bar appears beneath the view pane and Tracker automatically enters Offline mode (if this was not already selected).
3. To play the recorded trial, click the **Play** button on the time bar. To stop or pause the replay, click **Stop** or press the space bar on the keyboard. To view a particular part of the trial, drag the slider along the time bar, or to move through the trial, press the forward or back arrow keys.

   To select from further options for examining the recorded data, click the **More** option beneath the **Play** button on the time bar.

   - **Zoom to Trial** – After zooming in to a selected range, resets the time bar scale to include the whole trial
   - **Zoom to Region-of-Interest** – After zooming out, resets the time bar scale to zoom in to the selected range

   > **Tip**
   > To select a region of interest, drag the beginning and end markers (small green triangles) to the start and end of the required range on the time bar. To return the markers to their original positions at the start and end of the trial, double-click them.

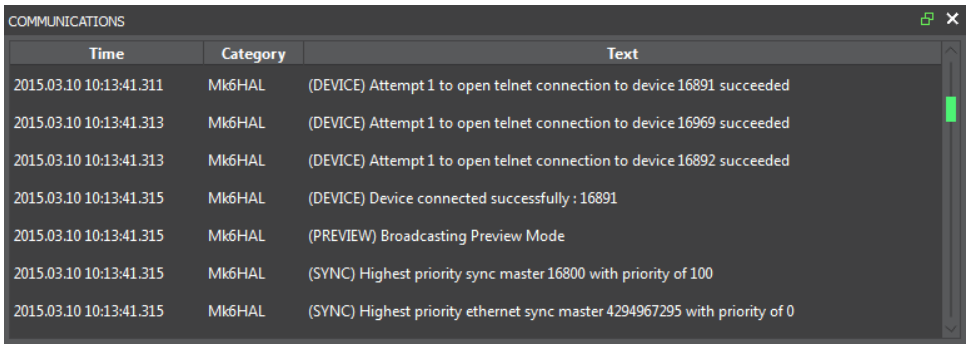
   - **Replay Speed** – Enables you to select from preset options (in multiples of real time) or to specify your own custom speed

Monitoring system activity

You can monitor the activity of your Vicon system in the **Communications** pane. You can view the updates in the **Communications** pane during any stage of the Tracker motion capture workflow. For more information, see:

- About the Communications pane on page 162
- Working in the Communications pane on page 163

About the Communications pane



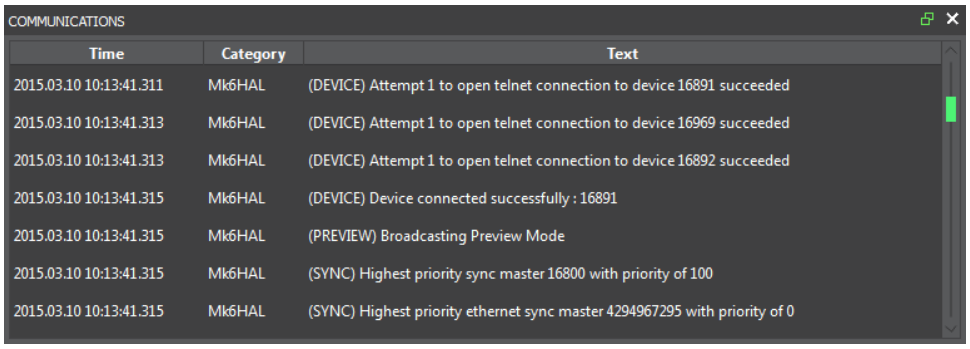
The **Communications** pane contains a single window, which displays a continual update of Tracker system activity since start up as well as feedback on some motion capture and processing operations. Vicon Support may ask you for log information if you contact them to report a system problem.

The default position of the **Communications** pane is at the bottom of the Tracker window. You can resize this pane, detach it from its current location, and move it to another location within the Tracker window.

The **Communications** pane contains the following information:

Information type	Description
Time	The timestamp for the operation being executed in the hh:mm:ss format.
Category	The general Tracker function being performed, for example Calibration Manager.
Text	The specific action and its success or failure.

Working in the Communications pane



You can monitor the activity of your Vicon system in the **Communications** pane. Its default position is at the bottom of the Tracker window.

A new log is written each time you start Tracker. New entries recorded during the current session are appended at the bottom of the log. You can copy all or part of the information in the log and save it to an external file, such as a Rich Text Format (.rtf) or plain text (.txt) file.

To monitor system activity:

1. In the **Communications** pane, view the entries for system activity and processing operations.
2. Use the scroll bar to move down or back up the displayed entries.

To copy entries to external files:

1. Drag the cursor across the required entries.
2. Right-click and in the context menu click **Copy**. Tracker copies the text to the clipboard.
3. Open a text editor, such as Microsoft Notepad, and paste the copied text.

To filter the log, right-click in the **Communications** pane.

You can choose to view or hide the following types of entries:

- **Info** – Information entries
- **Warn** – Warning entries
- **Error** – Error entries

You can also change scrolling behavior and delete and restore entries:

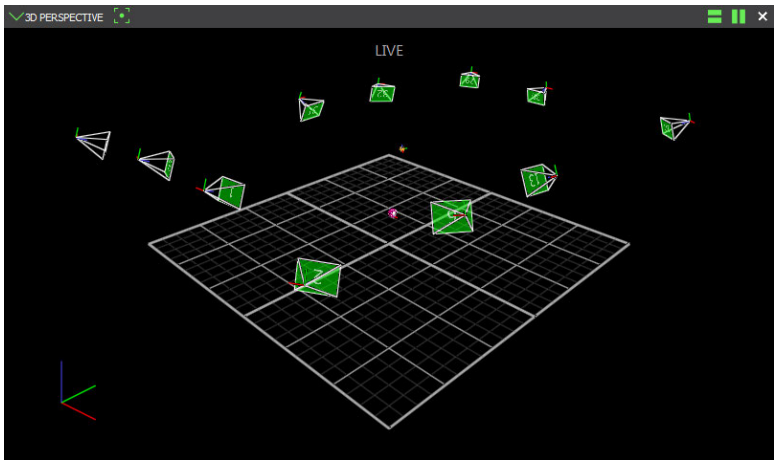
- **Auto-scroll** – Automatically scrolls to the bottom of the list of entries
- **Clear** – Deletes all entries from the **Communications** pane
- **Recover** – Restores previously deleted entries.

Viewing camera data

Vicon Tracker enables you to view camera data in a number of different ways, depending on your selection in the **Resources** pane and the view pane.

For information on viewing camera data, see the following topics:

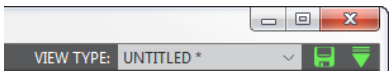
About the view pane

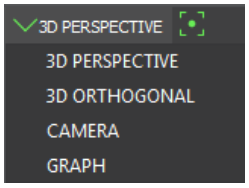
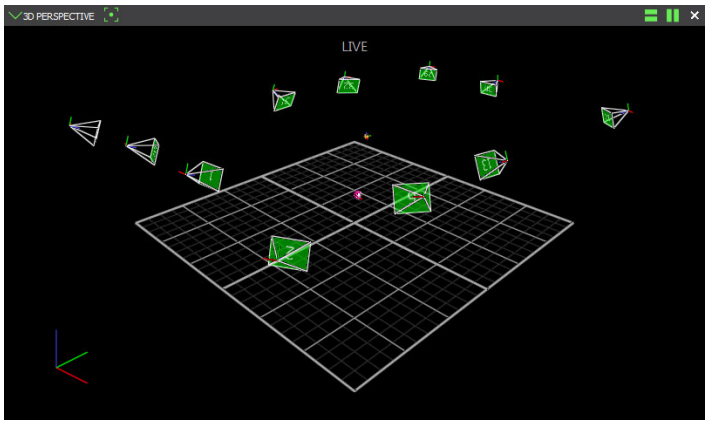
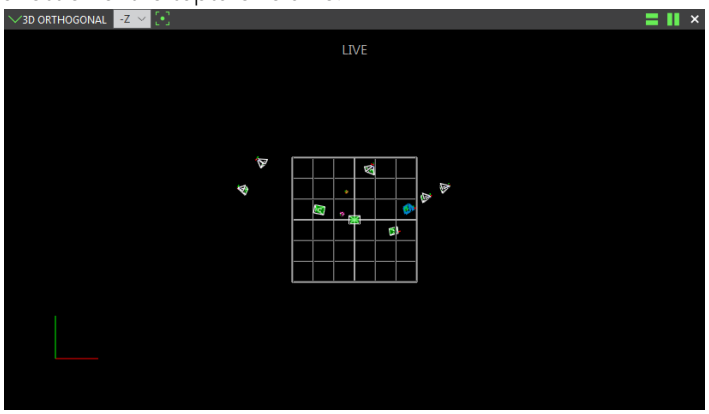


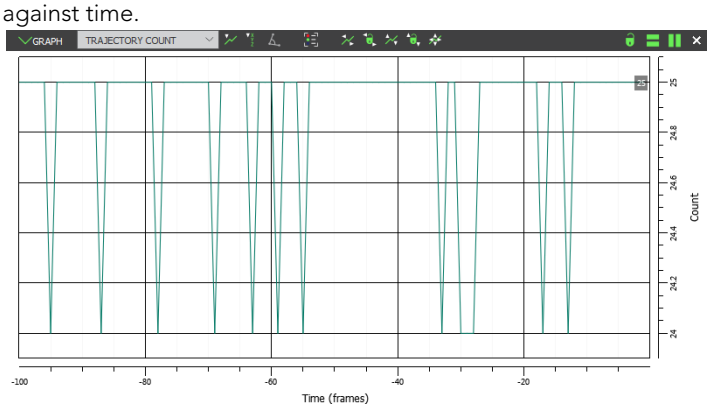
The view pane enables you to view the data of one or more cameras. In the view pane, you view the objects selected in the **Resources** pane during any stage of the Tracker workflow. Depending on the type of view pane selected, there are additional lists and buttons available to you to manage the display options for that type of view pane.

By default, the view pane is above the **Communication** pane and to the right of the **Resources** pane. You cannot detach or change the position of this pane, but you can resize it. In addition, you can open a new floating workspace that can be displayed on a second monitor, if required.

The view pane contains the following components:

Component	Description
Configuration management controls	Enables you manage the configurations that you create in the view pane. Saved configurations include the layout of view panes as well as any cameras, hardware devices, and object components selected in the **Resources** pane, on the **System** tab, the **Calibration** tab, the **Objects** tab, and/or the **Recording** tab when the configuration was created. 

Component	Description
View pane list	The view pane list allows you to configure the way in which you view Tracker data. Select from the following types of view panes:  **3D Perspective** Reconstructed motion capture data from all active Vicon cameras in 3D.  **3D Orthogonal** Motion capture data in 3D viewed from a specified point of sight or direction of the capture volume. 

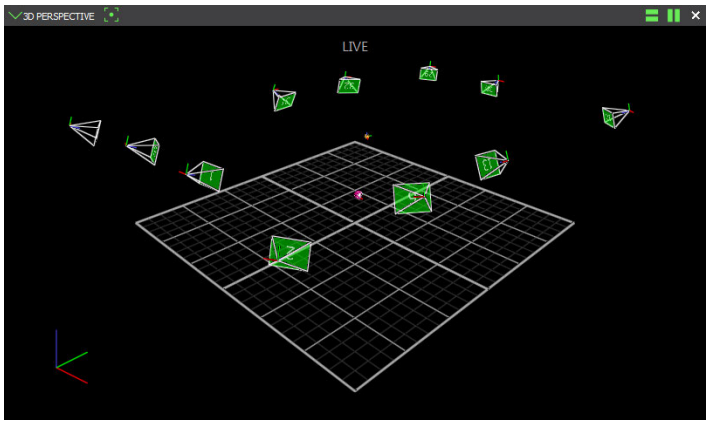
Component	Description
	Camera Raw 2D motion capture data from an individual Vicon camera. 
	Graph Various values of one or more selected items, such as the x, y, and z components of a marker trajectory, plotted against each other or against time. 
	By default, a single view pane is displayed in the workspace. Specify the number of view panes using the following buttons:

Component	Description	
Split view buttons	**Horizontal** 	Split the current view horizontally into two view panes.
	Vertical 	Split the current view vertically into two view panes.
	Close 	Close the current view pane. You cannot close the default view pane in the center of the Tracker window.
View pane time bar	Enables you to play back recorded trials. Click **More** or right-click the time bar to access further options for examining recorded trial data: 	
	Zoom to Trial	After zooming in to a selected range, resets the time bar scale to include the whole trial.
	Zoom to Region-of-Interest	After zooming out, resets the time bar scale to zoom in to the selected range.
	Set Current Frame	Opens the **Go to Frame** dialog box, in which you can specify the required frame. When you click OK, the current time indicator moves to the specified frame.
	Play Every Frame	When selected, the datastream ships all frames. (Rendering is unaffected.) Select this option only if you want to run calculations on datastream data.
	Replay Speed	Enables you to select from preset options or to specify your own custom speed.

To select a region of interest, drag the beginning and end markers (small green triangles) to the start and end of the required range.

To return the markers to their original positions at the start and end of the trial, double-click them.

About the 3D Perspective view



You view the reconstructed motion data from all active Vicon cameras in 3D.

The **3D Perspective** view pane contains the following components.

Component	Description
3D Perspective view pane tool bar	You manage the display of 3D data in the active workspace by selecting the following button: **Center camera on selection**  Positions the currently selected data in the center of the view pane. This option does not automatically zoom in on the selected data. When selecting an object to "follow", the camera also rotates with the object.
3D Perspective view pane workspace	You view and manipulate 3D data in the workspace. For example, the view can be oriented using the mouse and/or keyboard (see Mouse and keyboard shortcuts on page 27), such that you can focus on items of interest.

Viewing data in 3D Perspective view

View reconstructed motion capture data from all active Vicon cameras.

When you have displayed a **3D Perspective** view pane:

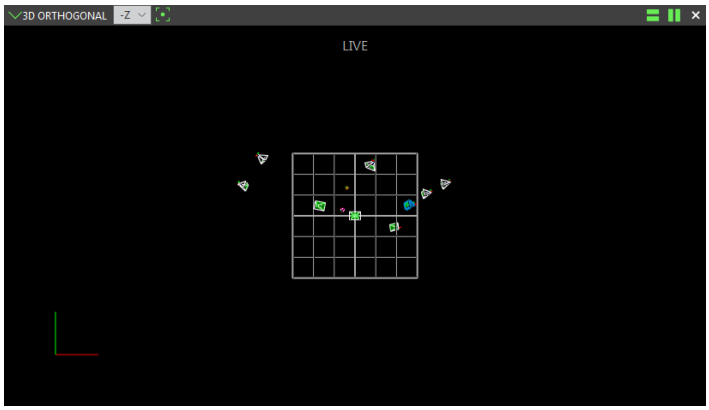
- You can highlight the representations of specific cameras by selecting one or more cameras under the **Vicon Cameras** node on the **System** tab in the **Resources** pane.
- You can configure display options in the **Options** dialog box.

> **Tip**
> To select multiple objects, hold down the ALT key and drag around the objects you want to select.
> To detach a marker, in the **3D Perspective** view pane, right-click the marker and in the context menu, click **Detach Marker**.

To view data in a 3D Perspective view pane:

1. Stream live camera data.
2. From the view pane tool bar, select **3D Perspective**. The reconstructed 3D data from all cameras is displayed in a single **3D Perspective** view pane.
3. Select a marker and perform an action on it in either of the following ways:
   - On the **Objects** tab, examine the reconstruction and labeling and edit any errors or inconsistencies; or
   - Right-click and select an option from the context menu.

About the 3D Orthogonal view



View motion capture data in 3D perspective viewed from a specified point of sight, or direction, of the capture volume.

The **3D Orthogonal** view pane contains the following components:

Component	Description

3D Orthogonal view pane tool bar	Manage the display of data in the active workspace with the following controls in the 3D Orthogonal view tool bar:
	• **Orthogonal** view list
	Set the point of sight by selecting one of the following orthogonal projections (also called orthographic projections):
	  • -Z (default)
	  • +Z
	  • +X
	  • -X
	  • +Y
	  • -Y
	• **Camera Centered on Selection** button
	Position the currently selected data in the center of the view pane. This option does not automatically zoom in on the selected data.

Component	Description
3D Orthogonal view pane workspace	View and manipulate 3D data in the workspace.

Viewing data in 3D Orthogonal view

View motion capture data in 3D perspective viewed from a specified point of sight, or direction, of the capture volume. You can view 3D data from an orthogonal perspective live in real time or from a previously saved trial.

When you have displayed a **3D Orthogonal** view pane, you can:

- Manage the visualization of graph data in the workspace.
- Highlight the representations of specific cameras in **3D Orthogonal** view pane workspace by selecting one or more cameras.

To view data in a 3D Orthogonal view pane:

1. Stream live camera data.
2. From the view pane tool bar, select **3D Orthogonal**. The reconstructed 3D data from all cameras is displayed in a single **3D Orthogonal** view pane, initially from the **Top** view.
3. From the View list in the **3D Orthogonal** view pane tool bar, either leave the default or select another orthogonal projection to set the view to a different point of sight:
   - -Z (default)
   - +Z
   - +X
   - -X
   - +Y
   - -Y

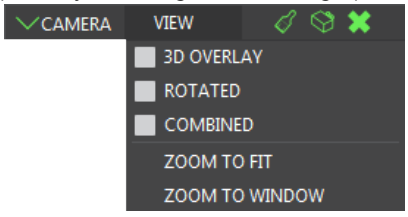
4. In the **3D Orthogonal** view pane, select a marker and perform an action on it in either of the following ways:
   - On the **Objects** tab, check the reconstruction and labeling and edit any errors or inconsistencies; or
   - Right-click and select a command from the displayed context menu.

> **Tip**
> You can select the **Detach Marker** command from the context menu displayed when you right-click on a marker in the **3D Perspective** view pane.

About the Camera view

View raw 2D motion capture data from an individual Vicon camera.

The **Camera** view pane contains the following components:

Component	Description
View	Manage the way camera data is viewed in the active **Camera** view pane by selecting the following options on the **View** drop-down list: 
3D Overlay	Overlay multiple **Camera** view panes on top of each other, so all camera views are displayed in a single view pane. Each camera is rendered in a unique color.

Component	Description	
	Rotated	Rotate the camera view, so it is corrected to the vertical axis defined in the system calibration (which corresponds to the earth's vertical axis). It also enables you to manually rotate the view by dragging the view left or right. Information from the camera calibration is required to present the rotated view.
	Combined	Correctly model lens distortions and display a corrected camera view with the 3D workspace rendered underneath the camera view.
	Zoom to Fit	Zoom the selected **Camera** view pane to fit the full workspace.
	Zoom to Window	Zoom to the displayed sensor window. For more information, see New sensor windowing display, in *What's New in Vicon Tracker*.
Masks	You can create a mask to hide any unwanted reflections and light sources visible to a Vicon camera (such as stray reflections from other objects or surfaces in the capture volume, opposing strobe units, and direct light sources) with the following buttons in the **Camera** view pane tool bar:	
	Paint a mask onto the camera 	Paint over any cells in the camera grid (displayed when the button is clicked) that contain unwanted reflections. When a cell is painted, its background color changes from black to blue. The camera mask consists of all blue cells obscuring unwanted reflections.
	Erase a mask from the camera 	Erase a previously painted cell from a mask. When an individual cell is erased, its background color changes from blue to black, and any reflection that had previously been obscured is visible again.
	Clear the mask from the camera 	Automatically remove a previously painted mask. When the mask is cleared, the background color of any previously painted cells changes from blue to black, and any reflections that had previously been obscured are visible again.

Component	Description	
Toggle display of centroids/ grayscale blobs	**Display grayscale blobs** 	When selected, grayscale blobs are displayed in the Camera view.
	Display centroid circles 	When selected, centroids are displayed in the Camera view.
	Display camera sensor window 	When selected, the windowing of the sensor is represented by a rectangle in the **Camera** view. For more information, see New sensor windowing display, in *What's New in Vicon Tracker*.
Lock / Unlock Selection Set 	Lock the current **Camera** view pane, so that it is effectively detached from the selection set and is not affected by any subsequent selections in other open view panes. This is useful for displaying views from different cameras in multiple **Camera** view panes.	
Camera workspace	You view and manipulate 2D data in the workspace. You can manage the visualization of camera data, for example, you can orbit, truck, dolly, and zoom the displayed data.	

Viewing optical data in Camera view

View 2D optical data from Vicon cameras in the **Camera** view pane.

To view data in a Camera view pane:

1. Stream live camera data.
2. On the **System** tab in the **Resources** pane, select one or more cameras.
3. Expand the **Vicon Cameras** node and then click on the sub-node for one or more specific Vicon cameras.
4. From the view pane tool bar, select **Camera**.

The 2D data from each camera selected on the **System** tab is displayed in a separate **Camera** view.

> **Tip**
> To help you to determine the most effect threshold setting for grayscale blobs, you can set the background color of the Camera view to the value of the **Threshold** control in the **Centroid Fitting** section of the **Properties** pane.
> To do this, open the **Options** dialog box (F7), and in the **General View Options**, select **Threshold**.

Creating camera masks automatically

You can automatically create camera masks using controls on the **Calibrate** tab, in the **Create Camera Masks** section.

The automatic camera mask creation tool automatically creates masks to eliminate any reflections in the capture volume that are visible to the cameras. You can subsequently create masks manually to eliminate any remaining or additional reflections.

> **Important**
> Before using the automatic mask creation tool, ensure that you remove from the capture volume any unnecessary objects, such as calibration objects. For best results, the capture volume should be entirely free from objects likely to cause background interference.

To automatically create camera masks:

1. Press F7 to open the **Options** dialog box and under **General View Options,** ensure that **Threshold Map** is selected.
   Any reflections are visible in the **Camera** view pane, typically as non-circular areas of grayscale or edge data. Note that reflections can severely affect the camera data rates, and you may find that the camera overloads. In this case, the camera automatically sends edge data instead of full grayscale data.
2. On the **Calibrate** tab, in the **Create Camera Masks** section, click **Start**.
   All Vicon cameras are selected and a separate Camera view pane is displayed for each one. The **Start** button changes to display **Stop**. Tracker starts recording the data visible to each of the Vicon cameras connected. Any camera masks that are created are displayed as blue cells in the **Camera** view panes for the affected cameras. If there is no data visible to a particular camera, Tracker does not create any masks for it. About 30 seconds of recording is generally sufficient to enable Tracker to collect the data visible to the cameras.
3. Click **Stop.**

Creating camera masks manually

You can manually create camera masks (a technique used to obscure selectively or hold back parts of an image while allowing other parts to show) with the **Masks** buttons in the **Camera** view pane tool bar, which eliminate any reflections in the capture volume that are visible to the cameras. If you have a large number of reflections in your capture volume, it is a good idea to initially create camera masks automatically.

> **Important**
> Before manually creating any masks, ensure that you remove from the capture volume any unnecessary objects, such as calibration objects. For best results, the capture volume should be entirely free from objects likely to cause background interference.

To manually create camera masks:

1. On the **System** tab in the **Resources** pane, select all Vicon cameras.
2. On the view pane tool bar, select **Camera** to display the 2D data being captured by each selected Vicon camera in a separate **Camera** view pane.
3. From the **View** drop-down list in the **Camera** view pane tool bar, make sure that the **3D Overlay** and **Combined** options are cleared.
4. Press F7 to open the **Options** dialog box and under **General View Options**, make sure that **Threshold Map** is selected.

   > **Tip**
   > The **Threshold Map** default color is blue, but you can change the color in the **Options** dialog box.

5. Remove any unnecessary objects, such as calibration objects, from the capture volume. For best results, the capture volume should be entirely free from objects likely to cause unwanted reflections.

   Any reflections are visible in the **Camera** view pane, typically as non-circular areas of grayscale or edge data. Note that reflections can severely affect the camera data rates, and you may find that the camera overloads. In this case, the camera automatically sends edge data instead of full grayscale data.

6. From the **Camera** view pane tool bar, use the following buttons to hide any unwanted reflections that are visible from the selected camera. (When you click any of these buttons, a grid of small blue tiles is superimposed over the camera image in each **Camera** view pane.)

Button	Usage
Paint a mask onto the camera 	Click an individual tile, click and drag across multiple consecutive tiles, or hold down ALT and click while dragging the mouse across an entire area of unwanted reflections visible in the camera grid. You can drag the mouse horizontally, vertically, or diagonally. When a cell is painted, its background color changes from black to blue. The camera mask consists of all blue cells obscuring unwanted reflections.
Erase a mask from the camera 	Click an individual tile, drag the mouse across multiple tiles, or hold down ALT and click while dragging the mouse across an entire area of blue cells in the camera grid. You can drag the mouse horizontally, vertically, or diagonally. When an individual cell is erased, its background color changes from blue to black, and any reflection that had previously been obscured is visible again.
Clear the mask from the camera 	Click the button to automatically remove the entire mask from the camera. When the mask is cleared, the background color of any previously painted cells changes from blue to black, and any reflections that had previously been obscured are visible again.

Tip

To zoom in on the view pane, right-click and drag the mouse pointer forward (to zoom in) or backward (to zoom out). To pan the image, click both mouse buttons and drag. The camera masks are applied in real time and are saved along with your camera calibration.

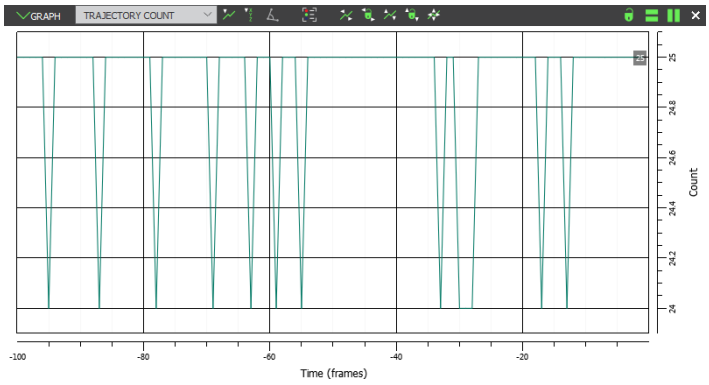
Save a configuration

To save a configuration:

In the configuration management section at the top of the **System** resources pane, click the **Save** button  to save your system configuration settings to a .system file in one of the following systems configurations folders:

- If you select **Shared** the file will be saved in *C:\Users\Public\Documents\Vicon\Tracker3.x\Configurations\Systems*
- If you select **Private** it will be saved in *C:\Users\UserName\AppData\Roaming\Vicon\Tracker3.x\Configurations\Systems*

About the Graph view



You view and manipulate various values of one or more selected items (such as the x, y, and z components of a marker trajectory) against time.

The **Graph** view pane contains the following components.

Component	Description
Graph view pane tool bar	You manage the display of graph data in the workspace with the following controls and buttons on the **Graph** view pane tool bar at the top of the view pane. The **Graph** view pane tool bar is designed to lead you left to right through the normal flow of operations required to plot a graph for the selected elements.
Graph type	You select the type of graph to be displayed in the workspace from under the categories in this drop-down list (graph types that are not available for the current selection are dimmed): DEVICES COMPONENTS TRAJECTORIES COMPONENTS DISTANCE FROM ORIGIN DISTANCE BETWEEN DISTANCE BETWEEN (XYZ) ANGLE BETWEEN TRAJECTORY COUNT METRICS LATENCY OBJECTS GLOBAL ANGLE QUALITY RELATIVE POSE

Devices	**Components** – Displays graphs for the components of signals from analog devices.

Component	Description	
	Trajectories	• **Components** – The X, Y, and Z position of a trajectory over time. • **Distance From Origin** – The linear distance between a trajectory and the origin. • **Distance Between** – The distance between two selected trajectories. • **Distance Between (xyz)** – The absolute distance (as a vector) between two selected trajectories. • **Angle Between** – The angle between three selected trajectories. • **Trajectory Count** – The number of trajectories being reconstructed.
	Metrics	• **Latency** – A measure of the time taken by Tracker to perform some task. As data is received from the hardware and is processed, Tracker takes timestamps that are used to calculate the latency estimate.There are two different kinds of latency that are graphed if you are using Firmware 222. • **Data Delivered** – The amount of time taken between the sync packet being received and the data for that frame being delivered from the hardware. This is the integration period of the camera - the time that it takes the camera to process the sample and any Ethernet overheads. • **Data Processed** – The amount of time between the sync packet being received and the completion of data processing.
	Object	**Quality** – The RMS error of a rigid body compared to its model (VSK).

Component	Description
	Segments • **Global Angle** – The global position and orientation of a rigid body. • **Relative Pose** – The difference in orientation between two objects. The relative pose graph shows the transformation from object A (the first object selected) relative to object B (the second object selected).
Differentiate the Graph 	You specify for the displayed graph the current variable, its first derivative (velocity or angular velocity), or its second derivative (acceleration or angular acceleration) by selecting the desired options from this drop-down list: • **x (none)** • **x' (velocity)** • **x" (acceleration)** A graph of a trajectory will have X, Y, and Z axes, but when differentiated to x' (velocity) will change to X', Y', and Z' axes.
Graph Components 	You specify the components of the selected graph type to be plotted in the active **Graph** view pane by selecting the required options from this drop-down list (only components that you have selected for graph view are available): • **Components** - Dependent on the type of graph you have chosen. For example, the count for the **Trajectory Count** graph. • **Select None** • **Select All** This option enables you to focus on a component of particular interest, which occupies more of the workspace. When multiple components are plotted, each is always shown on a separate axis, and the components shown are applied to all channels visible in the workspace. The number of vertically stacked graphs displayed in the workspace depends on the type of graph selected and the number of components selected from this component list.

Component	Description	
Rotation Order 	If you select an object on the **Object** tab in the **Resources** pane, you can select **Global Angle** from the **Graph** view tool bar. This enables the **Rotation Order** button. Clicking on the **Rotation Order** button lists the angle convention choices of **Helical** (default), **XYZ**, **XZY**, etc. This enables you to choose either a Helical or an Euler angle convention. The Euler angle convention itself has multiple rotation order conventions represented by **XYZ**, **XZY**, etc.	
Show Legend 	This button allows you to show a legend to the right of the graph trace for each component being plotted.	
Scaling	You manage the scale of the graph (to ensure that the desired portions of the selected traces are visible) with these buttons:	
	Fit Horizontally 	Zoom out the x-axis to show the complete range of the trace for 100 frames. This is useful if you have zoomed in a long way and now want to quickly see the entire graph again.
	Lock Horizontal Axis 	Lock the horizontal graph axis so that the current zoom level is maintained.
	Fit Vertically 	Scale the y-axis so that all the data in selected traces for the currently visible x-axis is visible. If there are multiple traces in the selected components, they are all set to the same range required to show all the data for all traces.
	Lock Vertical Axis 	Lock the vertical graph axis so that the current zoom level is maintained.
	Fit Both Horizontally & Vertically 	Scale the x and y axes simultaneously to fit the horizontal and vertical ranges of data.
Lock/Unlock Selection Set 	Lock the current **Graph** view pane, so that it is effectively detached from the selection set and is not affected by any subsequent selections in other open view panes. This is useful for displaying different elements in multiple **Graph** view panes.	

Component	Description
Graph view pane workspace	You view and manipulate graph data in the workspace. The workspace contains rulers and axes along the right and bottom edges and graph traces for the item being plotted. The y-axis vertical ruler is on the right side of the graph and the x-axis horizontal ruler is below the graph. The y-axis represents the selected component. The x-axis represents the time (in frames). It starts on the right side, which is labeled 0 (current frame) and is labeled from right to left with decreasing negative values to reflect the number of frames away from the live frame. Tips: • To change the default number of samples to display when a new real-time graph is opened, press F7 to open the **Options** dialog box, click **Graph** on the left, and on the right side, change the **Default X-axis length** value. • When zooming into or out of graph data, the display of grid lines in the workspace can be set to guide the eye toward the selected area of focus. Major grid lines remain at their normal weight, while any minor grid lines gradually fade. To obtain this behavior, press F7 to open the **Options** dialog box, ensure **Graph** is selected and in the **Properties** area, select **Show Minor Grid Lines**.

Viewing data in Graph view

You can display graphs of motion capture data in the **Graph** view pane.

The **Graph** view pane displays graphs for the types of data that can be produced in a motion capture trial.

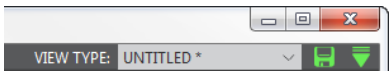
Graphs of trajectories data display three graphs of the X, Y, and Z components of trajectories for two or more selected 3D markers, or a single graph of the trajectory count for all 3D marker trajectories, against time. This is useful for analyzing 3D marker trajectories and identifying gaps to be filled.

To view 3D trajectories in a graph:

1. Stream live camera data.
2. Select the markers to be graphed in either of the following ways. (The number of markers you select depends on the type of graph you want to view, as described in step 3 below.)
   - On the **Objects** tab in the **Resources** pane, expand the required **Object** node, expand the **Markers** node, and then select one or more markers; or
   - In a **3D Perspective** view pane, select one or more markers.
3. From the view pane tool bar, select **Graph**. A single **Graph** view pane is displayed with the default **Components** graph type plotting the X, Y, and Z components of each selected marker.

> **Tip**
>
> When you have displayed a **Graph** view pane, you can select additional markers to add to the **Graph** view pane. Each trajectory is displayed in a different color trace. To identify the color trace used for each trajectory, click the **Show Legend** button  (or hover the mouse pointer over it) in the **Graph** view pane tool bar. If the trace for any additional markers is not visible, use the **Fit Horizontally**, **Fit Vertically**, or **Fit Both Horizontally and Vertically** buttons.

4. From the **Graph Type** list in the **Graph** view pane tool bar, select another option under the **Trajectories** section to plot the selected marker trajectories in a different type of graph:
   - **Distance From Origin:** Plots the distance from the capture volume origin to each selected marker. This is useful for later plotting velocity or acceleration of markers.
   - **Distance Between:** Plots the absolute distance between two selected markers. This is useful, for example, for seeing how the distance between two markers that are assumed to have a rigid relationship, changes over time.
   - **Angle Between:** Plots the angle between the two vectors formed by three selected markers. This is useful for seeing how the group of markers move over time.
   - **Trajectory Count:** Plots the total number of trajectories over time visible to the Vicon cameras (if streaming Live data in real time) or processed in trial (if viewing previously captured data in a file).
5. If you want to save a particular graph view (for example, specific trajectories that you have selected), save your configuration using the view pane configuration management controls.



Using Vicon Tracker menus and options

For information on Vicon Tracker menus and on the controls in the **Options** dialog box, see the following topics:

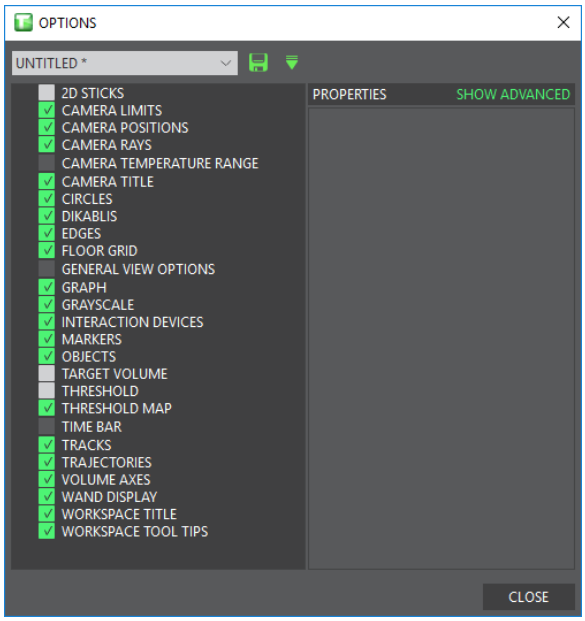
About the menu bar

The Vicon Tracker menu bar contains the following menus.

Menu	Options	Description
Tracker	Undo	Undoes the last action. This command is available only after a relevant action has been performed.
	Redo	Reinstates the previously undone action. This command is available only after an Undo command has been performed.
	Exit	Closes the Tracker application window. If you have not saved any changes, Tracker displays a prompt to enable you to save changes before it closes.
Window	New Floating Workspace	Opens a separate floating view pane.
	Resources	Displays or hides the **Resources** pane in which you manage the components of your Vicon Tracker system and the objects whose motion is to be captured. To display the pane, select the check box next to the option.
	Communications	Displays or hides the **Communications** pane in which you view the state of your Vicon Tracker system. To display the pane, select the check box next to the option.
	Sounds	Displays or hides the **Sounds** dialog box. For more information, see Instant auditory feedback, in *What's New in Vicon Tracker*.
	Options	Displays the **Options** dialog box in which you control the way data is displayed in view panes. The **Options** dialog box can also be displayed by pressing F7.
Help	View Online Help	Opens the online Vicon Tracker Help system.

Menu	Options	Description
	View User Guide	Opens a PDF of the *Vicon Tracker User Guide* that was installed with Tracker.
	Check for Updates	Checks the currently installed version of Tracker and enables you to update it if necessary.
	Check for Firmware Updates	Opens the **Checking Firmware Version** dialog box, which displays the number of the latest firmware release.
	About Vicon Tracker	Displays the Vicon Tracker startup screen, in which you can view version information about the installed release of Tracker.
	Hotkeys	Displays a list of Vicon Tracker hot keys.
	Vicon Product Licensing	Opens the Vicon Automated Unified Licensing Tool (VAULT), which enables you to manage licenses. See License Vicon Tracker.
	Show 3rd Party Licenses	Displays the **Third-Party Licenses** dialog box, which shows required third-party license agreements and copyright notices.

Options dialog box



To control the way data is visualized in the view panes, you use the controls in the **Options** dialog box.

You access this dialog box from the **Window** menu or by pressing F7. You can save the settings that you make in this dialog box, which enables you to customize sets of options to use for different types of motion capture projects.

To configure settings in the Options dialog box:

1. Press F7 or from the **Window** menu, select **Options**. The **Options** dialog box is displayed.
2. In the **Options** list on the left, select or clear the relevant check box(es), depending on the functionality you require.
3. To view or change the settings for an option, click on the option to select it. The properties for that option are displayed in the **Properties** section.

   > **Tip**
   >
   > To see any available additional settings, click **Show Advanced**. To show basic settings only, click **Hide Advanced**.

4. In the **Properties** section, change the settings for the properties, as needed.

5. To save the changes you have made in the **Options** dialog box, in the configuration management area, click the save button:

The **Save As** window is displayed.

6. Enter a name for the configuration and click **OK**.

> **Tip**
>
> To indicate that you have made changes to a configuration but the changes have not yet been saved, an asterisk * is displayed after the configuration name in the configuration management list.

Extending your use of Vicon Tracker

In addition to using Tracker as part of a Vicon system as described in Tracker system components on page 11, you can:

- Use Tracker's built-in VRPN server to extend your usage of Tracker (see Working with VRPN on page 196).
- Use the Vicon Control app, to set up, calibrate, and capture with a Vicon Vantage, T-Series or Bonita system (see Using the Vicon Control app with Tracker on page 200).
- Use the Vicon DataStream SDK (or UDP) to access Vicon Tracker data from Simulink (see Accessing Vicon Tracker data from Simulink on page 203).

Working with VRPN

The Virtual-Reality Peripheral Network (VRPN) is a library that provides an interface between 3D immersive applications and tracking systems used for Virtools. Vicon Tracker has a built-in VRPN server that will stream data natively into these applications or will allow for the development of simple interfaces using VRPN.

For more information on working with VRPN, see:

- Using VRPN within Virtools on page 197
- Using dual VRPN outputs on page 199

Using VRPN within Virtools

Virtools, a commercial application, has support for VRPN and can be configured to connect with Vicon Tracker as follows.

A full VRDevice.cfg file is included below.

> **Note**
> Head@TrackerPC is the way Virtools connects to the VRPN server within Tracker. The format is object_name@PC_Name. This configuration file will look for an object called "Head" on the Tracker server called "TrackerPC."

```
=======================================
 vrpnTracker_0           Head@TrackerPC
 neutralPosition_0    0.0 0.0 0.0
 neutralQuaternion_0 0.0 0.0 0.0 1.0
 axisPermute_0 0 2 1
 axisSign_0 1 1 1
 trackerScale_0 1
 TrackerGroup_0 T0:0:6
 =======================================
```

This VRDevice.cfg also contains other directives that:

- Map the Vicon coordinates properly to the Virtools coordinates:
  axisPermute_0 0 2 1
  axisSign_0 1 1 1
- Add a tracker group with:
  TrackerGroup_0 T0:0:6

To complete the process, do the following:

- Add the VRPN settings to a VRPack.cfg file, which is in the same folder as the .cmo. That way it can be tested with Virtools Dev.
- For versions of Tracker before 1.2 in the composition, activate the **Use Scale** option and change the value of trackerScale_0 in your VRDevice.cfg file to 0.001 (converts Vicon mm to Virtools m).

For a full description of any of these configuration options, please refer to the Virtools documentation.

For sample files that use VRPN to connect Virtools to a tracked object within Vicon Tracker, please contact Vicon Support on page 219 or download from the Vicon website[14].

14 https://www.vicon.com/downloads

Using dual VRPN outputs

If you are rendering the same object to different display types (for example, to both a large screen and an immersive environment such as a head-mounted display), to obtain smooth visualization on both display types, you are likely to need to apply different amounts of filtration for each.

To enable you to do this, Tracker provides a second set of VRPN trackers, which are output with the existing ones. For easy identification, the names of this second set of VRPN trackers are suffixed with _2.

To enable second filtered VRPN trackers:

1. On the **System** tab, select **Local Vicon System** and in the **Properties** pane ensure **Show Advanced** has been selected.
2. In the **VRPN Stream** section, select **Add Filtered Tracker**.
   The second set of VRPN trackers includes customizable One Euro filtering. For information on adjusting filtering parameters, see Creating an object on page 130.

Using the Vicon Control app with Tracker

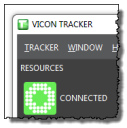
Control connects wirelessly to Vicon Tracker and streams camera data to your mobile or tablet, enabling a single user to change camera settings, calibrate the system, and start or stop capture from anywhere in the volume.

Before you can use your iOS device with Tracker, you must pair it with the PC that is running Tracker (the Vicon host PC).

Connect Vicon Control

To connect an iOS device running the Vicon Control app to Tracker on a Vicon host PC:

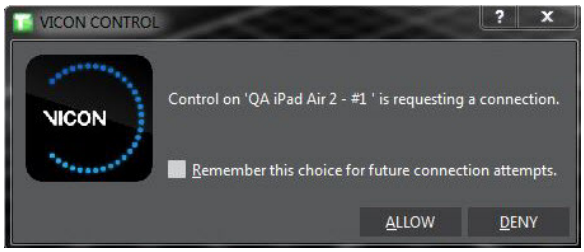
1. Ensure that your iOS device is connected to a Wifi access point that is on the same subnet as the Vicon host PC.
2. On the Vicon host PC, ensure that the required connection is used, that Tracker is running, and the system is connected.



3. On the device, open the Vicon Control app.
   The connection to Tracker is displayed on the initial Control screen:

4. Tap the Tracker icon.
   You are alerted that you must authorize the connection on the Vicon host PC before you can continue.

In Tracker on the Vicon host PC, an authorization request is displayed:



5. To use the same connection in future, select **Remember this choice for future connection attempts**. To permit Control to access Tracker, click **Allow**.

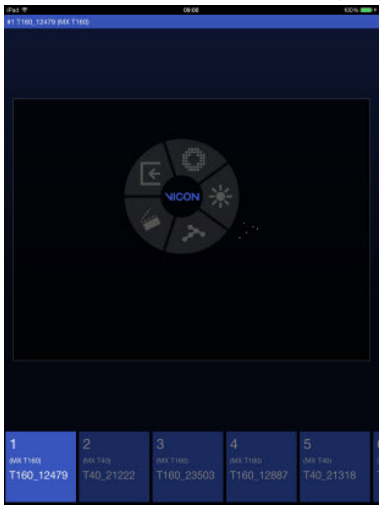
> **Tip**
>
> If later you need to revoke authorizations for Vicon Control, on the **Window** menu in Tracker, click **Reset Control Authorization**. This revokes all stored authorizations.

On the device, a screen similar to the following is displayed:

6. To select a camera and display a camera view, tap at the bottom of the screen.

   You can swipe the camera view right or left to change to the next or previous camera and use stretch and pinch as normal to zoom in and out.

To access the dial control, tap and hold in a selected camera view.



Use the dial to view and change settings, calibrate and capture.

Accessing Vicon Tracker data from Simulink

If you are working in an environment that supports the use of the Vicon DataStream SDK (where TCP/IP is supported), you can use the SDK from within a Simulink block (S-function) to access data streamed from Vicon Tracker.

In addition, Vicon Tracker 3 includes a UDP stream that contains object translation and rotation data. If you are working in an environment that supports only UDP and therefore cannot use the Vicon DataStream SDK to access Tracker object data from Simulink, you can access Tracker positional data from the UDP stream.

> **Important**
> The UDP stream contains only a small subset of the data that is available via the Vicon DataStream SDK, so if possible, use the Vicon DataStream SDK in preference to the UDP stream.

To help you access Tracker data from Simulink, examples of both types of access are installed with Tracker. They can be found in the following default location:

C:\Program Files\Vicon\Tracker3.#\Simulink

For more information, see:

- Prerequisites for using Simulink with Vicon Tracker on page 204
- About the UDP stream on page 204
- About the Simulink examples provided with Vicon Tracker on page 209
- How to run the Simulink examples on page 211

Prerequisites for using Simulink with Vicon Tracker

To use Simulink with Tracker, ensure the following requirements are met:

- You are familiar with Simulink.
- For compiled S-functions, access to and proper configuration of a compiler in MATLAB.

> **Tip**
>
> You can use configurations other than compiled S-functions (such as using MATLAB code within the Simulink block) but there may be a performance disadvantage to using interpreted code. Alternative configurations have not been investigated or tested by Vicon.

- A properly installed C or C++ compiler. Microsoft Visual Studio 2013 was used during the development of the examples.
- Installed and licensed Instrument Control Toolbox. This toolbox is licensed separately (i.e. it is not part of the Simulink license). It is needed for receiving UDP packets only.

About the UDP stream

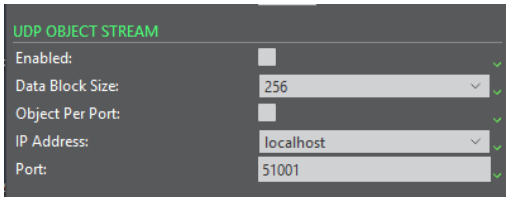
The UDP stream outputs translation and rotation information for active objects in Vicon Tracker.

To access data from this stream you must write a 'client' to access the stream and parse the data block to access its contents. The example clients provided with Tracker illustrate the block parsing and some possible configurations for block outputs.

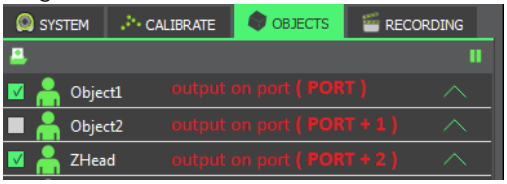
For each frame in Tracker, one or more data blocks are sent. The number of blocks per frame sent is dependent on:

- The data block size setting
- The number of active objects
- The object-per-port setting

The UDP Stream parameters are stored in the *.system* file:



On the **System** tab, when you click on the **Local Vicon System** node, the following settings are available in the **UDP Object Stream** section of the **Properties** pane.

Setting	Description
Enabled	If selected, starts the UDP streaming of data. Unlike the data stream, the UDP stream does not maintain client connection information. If selected, data is output whether or not there are any connected clients.
Data Block Size	The size of the UDP datagrams (data blocks). Ensure the value selected matches the expected value for the datagram size in the client program. Options are 256, 512, and 1024.
Object Per Port	If cleared, all objects are output on the same port. If selected, each object is output on its own UDP port. Port assignments are made whether or not the object is active. The following image shows how port numbers are assigned: 
IP Address	The network address used to broadcast the data.
Port	The starting port for UDP streaming. If **Object Per Port** is selected, this is the starting port number. If **Object Per Port** is cleared, this is the output port for all objects.

Example UDP Packet contents table

The following UDP Packet contents table provides more technical detail about the layout and content of the UDP stream. You may find this useful if, for example, you want to use the UDP stream, but do not want to use it with Simulink. It is taken from *DataBlock.h*, which is one of the Simulink example files.

Byte offset	Content	Comment
0-3	Frame Number	nnnn
4	ItemsInBlock	2
5	ItemHeader:ItemID	0 (0 for object data. Other object types not currently supported.)
6-7	ItemHeader:ItemDataSize	72
8-31	TrackerObject:ItemName	'O''b''j''e''c''t''1'00000000000000000
32-39	TrackerObject:TransX	
40-47	TrackerObject:TransY	
48-55	TrackerObject:TransZ	
56-63	TrackerObject:RotX	
64-71	TrackerObject:RotY	
72-79	TrackerObject:RotZ	
80	ItemHeader:ItemID	0 (0 for object data. Other object types not currently supported.)
81-82	ItemHeader:ItemDataSize	72
83-106	TrackerObject:ItemName	'O''b''j''e''c''t''2'00000000000000000
107-114	TrackerObject:TransX	
115-122	TrackerObject:TransY	
123-130	TrackerObject:TransZ	
131-138	TrackerObject:RotX	
139-146	TrackerObject:RotY	
147-154	TrackerObject:RotZ	

Object data output by the UDP stream

Data that is output matches the Vicon DataStream SDK values for the same frame. The UDP stream contains no axis mapping options.
For each object six values are output:

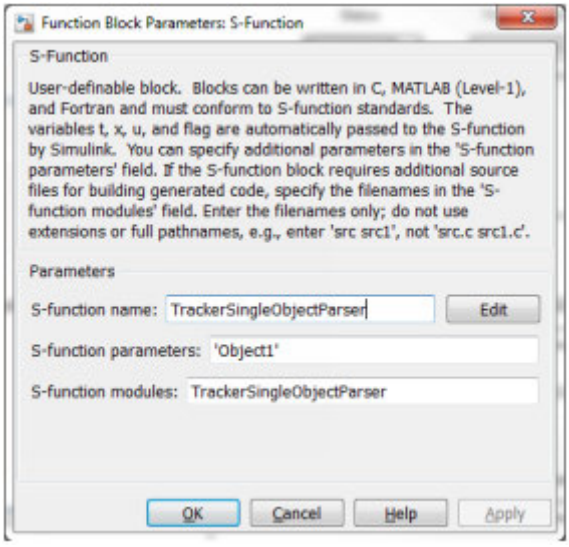
- Translation X, Y, and Z
  The values match the values received from GetSegmentGlobalTranslation through the Vicon DataStream SDK.
- Rotation X, Y, and Z
  The values match the values received from GetSegmentGlobalRotationEulerXYZ through the Vicon DataStream SDK.

About the Simulink examples provided with Vicon Tracker

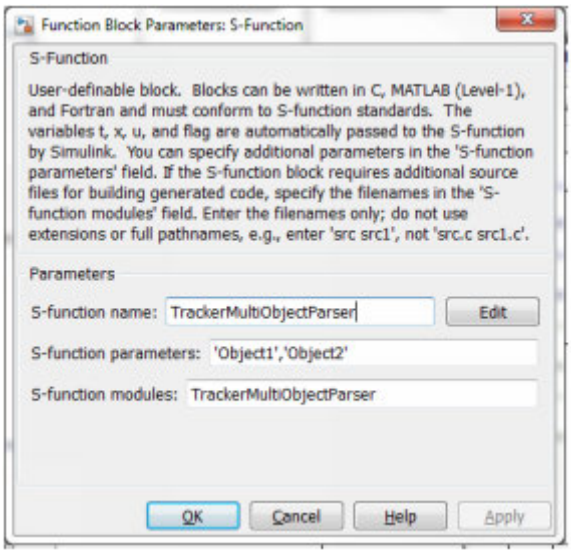
All of the examples consist of an S-function along with a Simulink model showing a block using the custom S-function in a simulation. Note the following points:

- Simulink models are stored in files with a .mdl extension
- Examples were developed and tested using 64-bit versions of MATLAB/ Simulink/Vicon DataStream SDK. (You cannot mix 32- and 64-bit code.)
- Single object and multiple object examples on the same port are provided using the Vicon DataStream SDK as well as the UDP stream. The only difference in these examples is the method of data access.
- An additional example for the UDP stream is provided, which illustrates the Object Per Port functionality. This functionality is not available using the Vicon DataStream SDK.
- The examples use block parameters to specify the object names to be output.
  - String parameters are surrounded by single quotes.
  - Multiple parameters are separated by commas.
  - To access block parameters, double-click on the block in the model.

Single block parameter:



Multiple block parameters:



How to run the Simulink examples

The following steps described how to run one of the Simulink examples provided with Vicon Tracker, which demonstrate how to obtain Vicon Tracker data from Simulink.

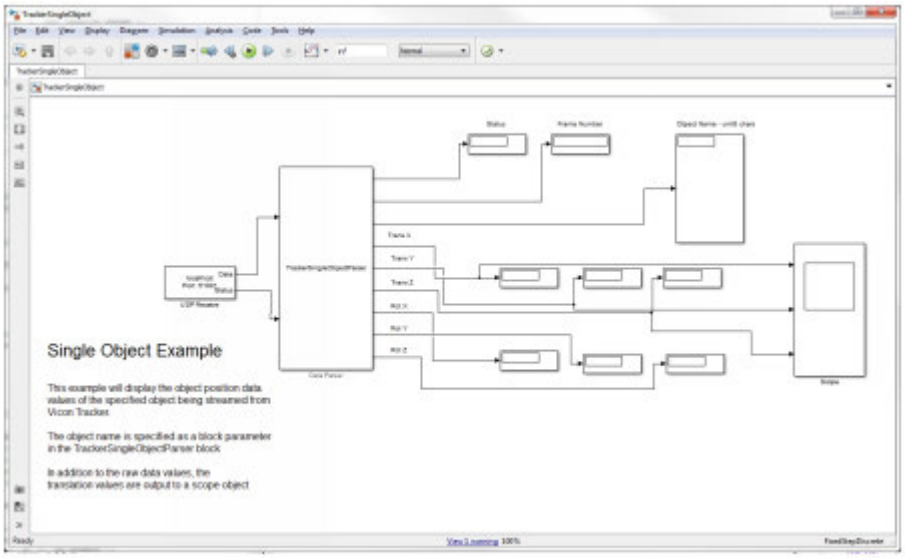
> **Important**
> When you compile the code for the custom blocks, files are created in the same folder as your source file. It is recommended that you copy the example files to a folder other than the Tracker installation folder before compiling, running, or modifying the example files.

To run an example:

1. Ensure Tracker is running and streaming data.
2. The examples reference objects named Object1 and/or Object2. If you need to change the objects that are displayed, modify the block parameters to reference the desired object(s).
3. Open MATLAB.
   A MATLAB window similar to the following is displayed:

4. Change your current folder to one containing the example you want to run.
5. Compile the example file. For more information, see the specific compile information below. Vicon DataStream SDK examples need to link in the proper Vicon DataStream SDK file as well.
6. Load the model by dragging the desired .mdl file from the file listing to the command window.

This issues a uiopen command passing in the file you are dragging and opens the model window.



7. In the model window click the Play button to run the simulation.

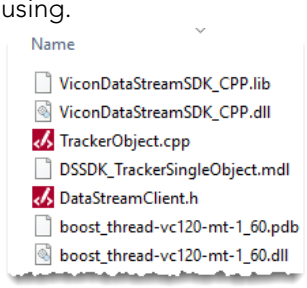
> **Tip**
>
> If the model contains a scope block to draw a graph of the data, you must double-click on the scope to open it – it does not open automatically.

Vicon DataStream SDK examples

Before you use any of the Vicon DataStream SDK examples, they must be compiled and linked with the Vicon DataStream SDK.

To compile and link the Vicon DataStream SDK examples:

1. Copy the CPP files from the Vicon DataStream SDK installation folder to the folder containing the example files.
   Your file names might be slightly different from those in the following illustration, depending on the version of the Vicon DataStream SDK you are using.



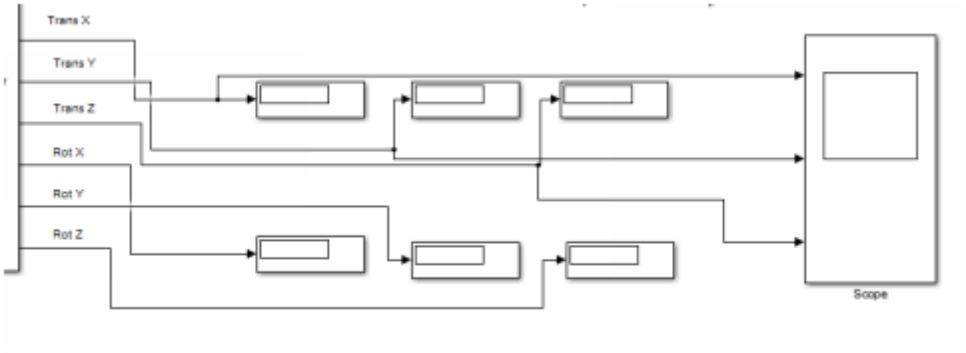
2. To compile and link C++ code, use the mex command. You need to compile the *.cpp* file and then link it with the Vicon DataStream SDK .lib file. You can do this in a single step that looks like this

```
>> mex TrackerObject.cpp ViconDataStreamSDK_CPP.lib
Building with 'Microsoft Visual C++ 2012'.
MEX completed successfully.
>>
```

   Successful compilation results in the creation of a file with a *.mexw64* extension.

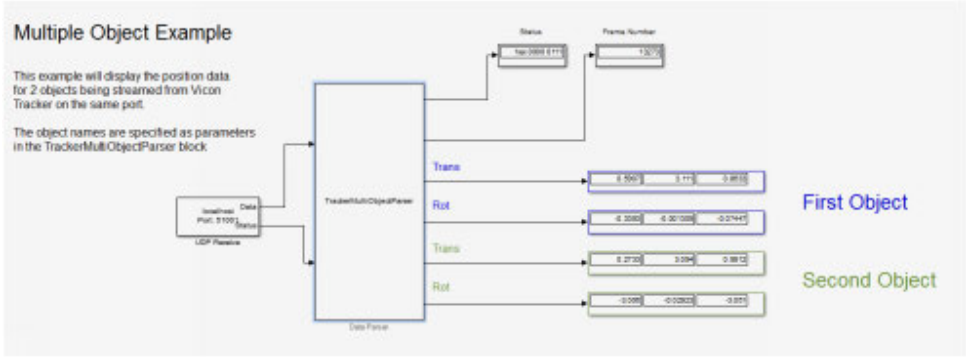
Vicon DataStream SDK SingleObject example

This example displays the positional information for an object (object name specified as block parameter). Each of the translation and rotation values is on a separate output.



Vicon DataStream SDK MultipleObjects example

This example displays the positional information for two objects (names specified as block parameters). Three values are provided for each of the four defined outputs.



UDP stream examples

All examples use the Instrument Control Toolbox receiving UDP packets. This toolbox is licensed separately (i.e. it is not part of the Simulink license).

All of the example S-functions have been written in C. Before using any of these examples, they must be compiled.

To compile the examples:

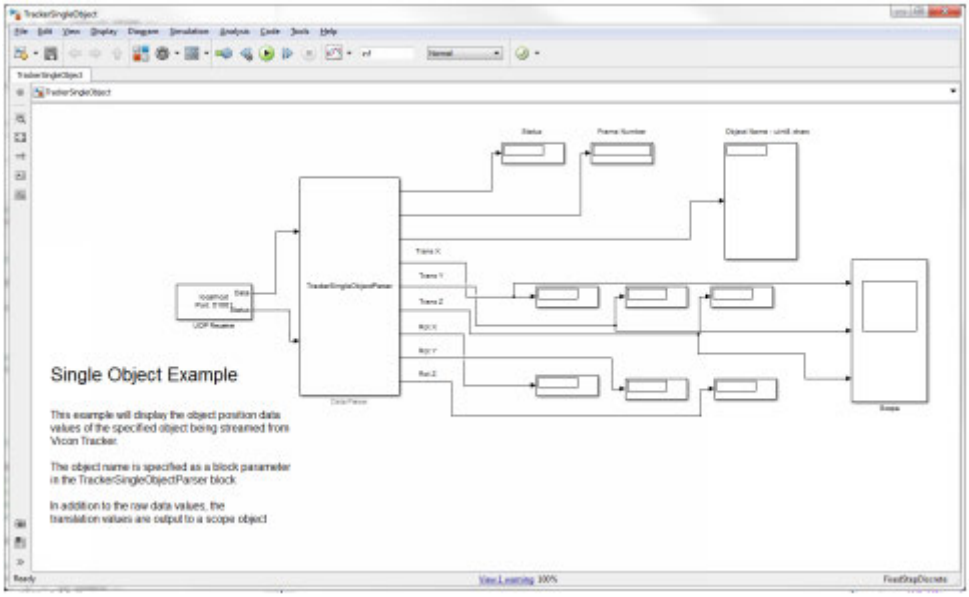
- To compile C code, use the mex command, supplying the name of the .c file as input, as follows:

```
>> mex TrackerSingleObjectParser.c
Building with 'Microsoft Visual C++ 2012 (C)'.
MEX completed successfully.
```

ObjectPerPort folder

This folder contains two models:
TrackerSingleObject.mdl and **TrackerMultipleObjects.mdl**

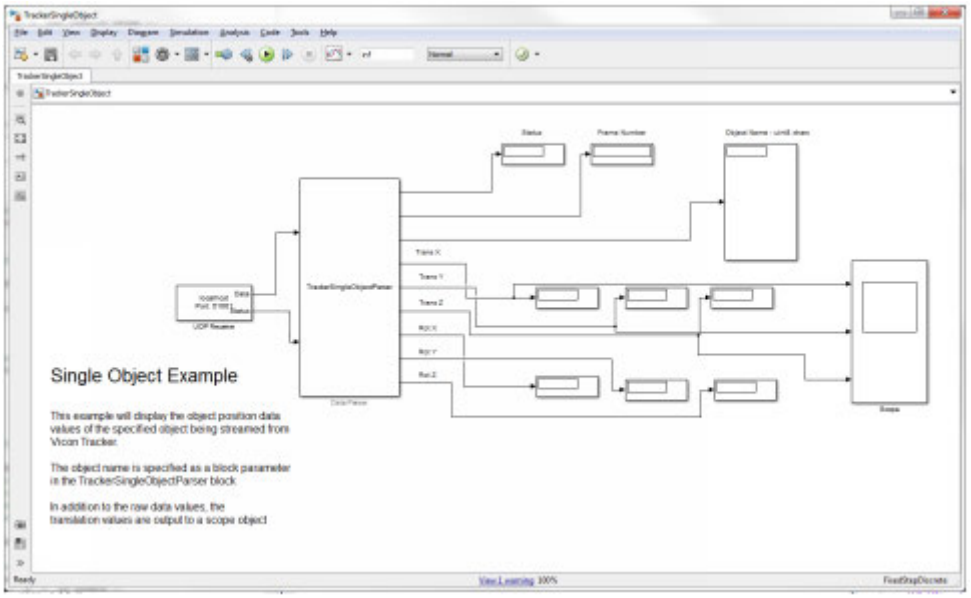
Both models use the same custom S-function, TrackerSingleObjectParser. The object parsing function looks for the object name passed in as a block parameter and displays the positional information for the object. Each of the translation and rotation values is on a separate output.



You must configure the UDP Receive blocks in the models to match Tracker output with regard to data block size and port numbers.

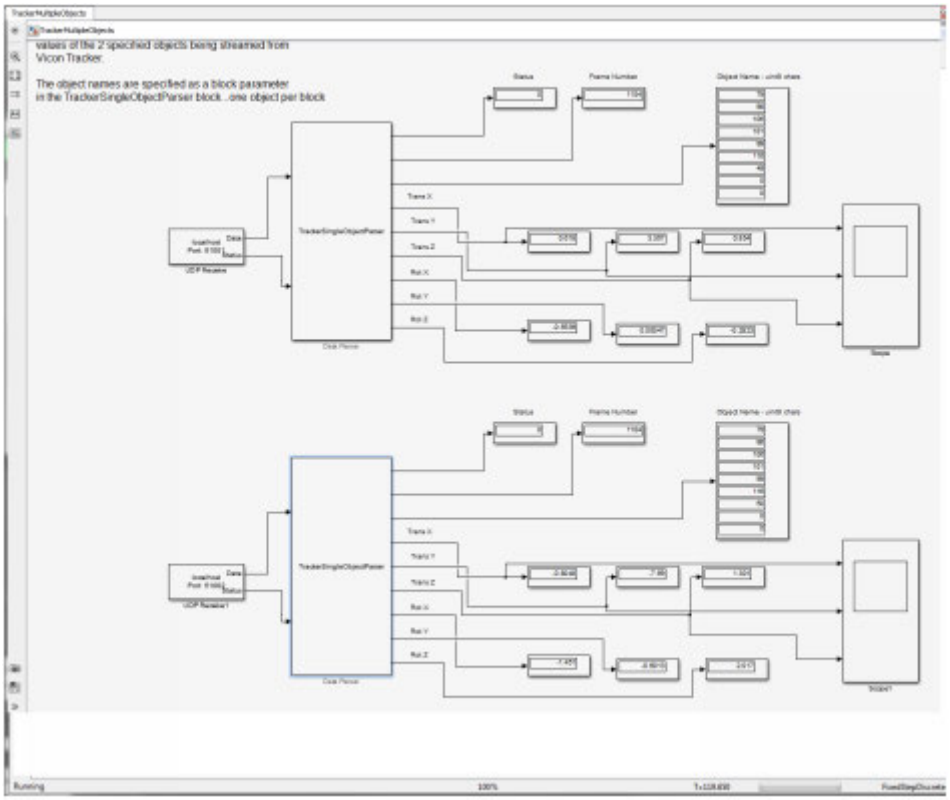
UDP stream TrackerSingleObject example

This example displays the positional information for an object (object name specified as block parameter). Each of the translation and rotation values is on a separate output.



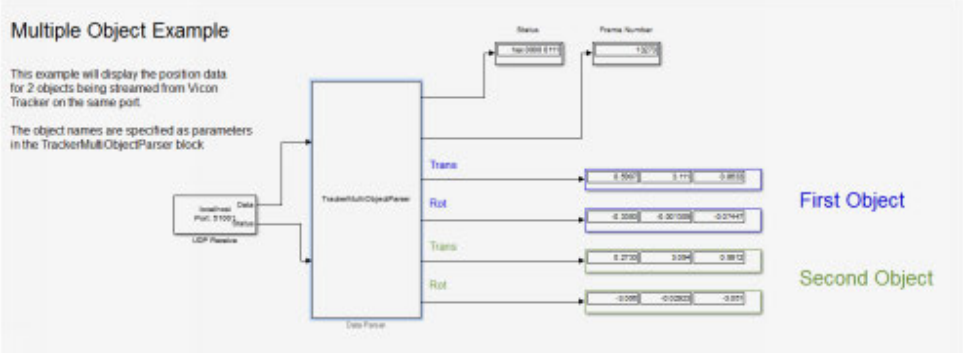
UDP stream TrackerMultipleObjects example

This model has two UDP receive blocks to receive data from Tracker, using the Object Per Port option.



UDP stream MultipleObjectsSamePort example

This example displays the positional information for two objects (object names specified as block parameters). Three values are provided for each of the four defined outputs.



Contact Vicon

If you need more information than that supplied in the documentation or on the Vicon Support web pages[15], please contact Vicon:

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