



VICON NEXUS USER GUIDE



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Email: support@vicon.com Web: <http://www.vicon.com>





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About this guide

About this guide

This guide contains instructions for using Vicon Nexus. It explains configuring your Vicon system within Nexus and the basic tasks that make up the everyday Nexus workflow. It assumes you have already installed and licensed Nexus and set up your Vicon system hardware. If you need information about these procedures, see *Installing and licensing Vicon Nexus* and/or the Vicon documentation that was supplied with your hardware.

For help with how to connect up your Vicon system, see *Vicon system setup information* in the [Setup and connectivity documentation](#)¹. You can also contact [Vicon Support](#)².

- [Introducing Vicon Nexus, page 7](#)
- [Prepare a Vicon system, page 50](#)
- [Calibrate a Vicon system, page 137](#)
- [Prepare a subject, page 152](#)
- [Capture movement trials, page 182](#)
- [Review trials and fill gaps, page 205](#)
- [Modeling with Plug-in Gait, page 248](#)
- [Work with digital video files, page 279](#)
- [Work with Vicon IMUs, page 305](#)
- [Export trial data, page 338](#)
- [Further resources, page 346](#)

 Videos of many of the procedures described in this guide, including additional tips and examples, are available from the [Nexus 2 How To playlist](#)³ and the [Vicon Nexus 2 Tutorials playlist](#)⁴ on YouTube, beginning with system calibration.

1 <https://help.vicon.com/space/Connect>

2 <mailto:support@vicon.com>

3 https://www.youtube.com/playlist?list=PLxtdgDam3USVhGs9b3LTgX2YH_VQqlcDM

4 <https://www.youtube.com/playlist?list=PLxtdgDam3USUSleuO6UloG3ogPsFNtEJS>

About this guide



Note

As the videos were recorded using an earlier version of Nexus 2, you may notice small differences in the user interface.

About this guide

About Vicon Nexus documentation

The following documentation is available for Nexus from help.vicon.com⁵:

Document	Description
<i>What's New in Vicon Nexus</i>	Information about the main features that are new in the current version of Nexus.
<i>Vicon Nexus Quick Start Guide for Blue Trident</i>	Introductory information on connecting and using Vicon Blue Trident (IMU) sensors with Nexus (print/PDF only).
<i>Installing and licensing Vicon Nexus</i>	Step-by-step instructions for installing and licensing Nexus.
<i>Vicon Nexus User Guide (this guide)</i>	Information about how to use Nexus.
<i>Vicon Nexus Reference Guide</i>	Reference information about less frequently used or more complex procedures, background information to provide you with a better understanding of Nexus, and further details about the Nexus user interface.
<i>FLIR Video Cameras Setup Guide</i>	Guidance on how to set up the cameras and other hardware needed to include FLIR video cameras in your Nexus system.
<i>Creating labeling skeleton templates (VSTs)</i>	Instructions on how to create your own custom labeling skeleton templates for use with Nexus.
<i>Plug-in Gait Reference Guide</i>	Detailed information on the Plug-in Gait model.

Regulatory information

For regulatory documentation relating to Vicon Nexus and your Vicon hardware, see the Vicon [Regulatory Information](https://help.vicon.com/space/regs)⁶.

⁵ <https://help.vicon.com>

⁶ <https://help.vicon.com/space/regs>

Introducing Vicon Nexus

Introducing Vicon Nexus

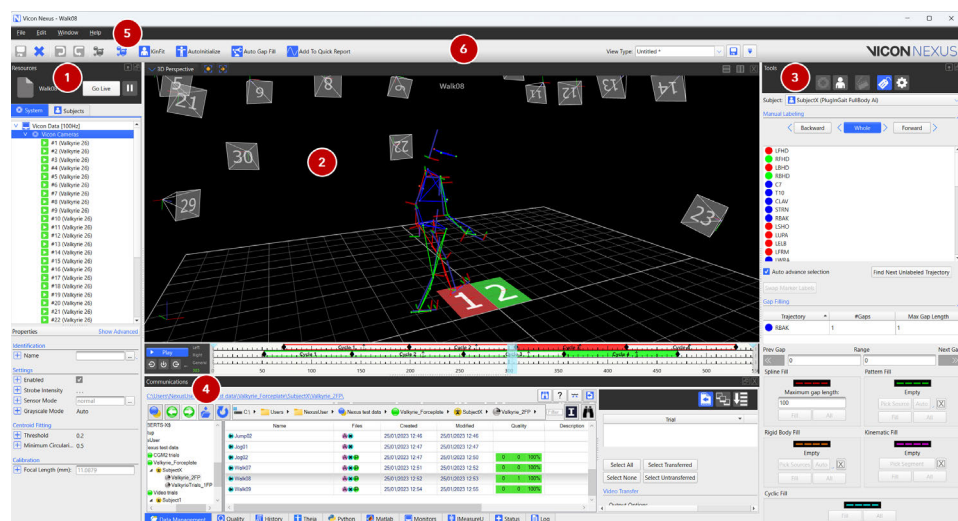
The following topics will help you to become familiar with the basics of using Nexus:

- [Get to know Vicon Nexus, page 8](#)
- [Vicon Nexus motion capture workflow, page 34](#)
- [Hot keys and shortcuts, page 35](#)

Introducing Vicon Nexus

Get to know Vicon Nexus

The Nexus user interface enables you to access the tools you need quickly and easily. Within the primary panes (**Resources, View, Tools, and Communications**), you use the tabs and buttons to open secondary panes containing tools and options for specific parts of the motion capture workflow.



- 1 **Resources pane:** Manage the different components of your Vicon system, and the subjects whose motion is to be captured, on the **System** tab and the **Subjects** tab. See [Manage system and subjects in the Resources pane, page 13](#).
- 2 **View pane:** Set up the way you want to visualize the capture data from one or more cameras (or supported third-party devices) either live in real time or offline, from a saved file. See [Display data in the View pane, page 17](#).
- 3 **Tools pane:** Work through the main stages of the motion capture workflow, using the tabs in the Tools pane from left to right: **System Preparation**, **Subject Preparation**, **Capture**, **Label/Edit** and **Pipeline** (this last tab enables you to group and run operations that you use throughout the workflow). See [Manage the motion capture workflow in the Tools pane, page 19](#).

Introducing Vicon Nexus

- 4 **Communications pane:**
 - **Data Management tab:** Store and manage all data associated with your motion capture trials (see [Manage mocap data on the Data Management tab, page 12](#))
 - **Quality tab:** Assess trial health (see [Review data quality, page 208](#))
 - **History tab:** View stored processing history (see [Review processing history, page 206](#))
 - **Theia tab:** Select and process video files through Theia3D (see [Run Theia processing on video files, page 289](#))
 - **Python tab:** Set the path to your Python installation, and run Python scripts (see Modeling with Python in the *Vicon Nexus Reference Guide*)
 - **Matlab tab:** Run MATLAB scripts and launch MATLAB (see Modeling with MATLAB in the *Vicon Nexus Reference Guide*)
 - **Monitors tab:** Set up and control monitors for your trials (see Using monitors)
 - **IMeasureU tab:** Use Vicon IMUs with Nexus (see [Work with Vicon IMUs, page 305](#))
 - **Status tab:** View system status information
 - **Log tab:** View a log of Nexus system activity since start up
- 5 **Menu bar:** Access menu options. See [Access menu options from the Nexus menu bar, page 21](#).
- 6 **Toolbar:** Access frequently used commands and create and select view types. See [Access common commands from the Nexus toolbar, page 22](#).

Introducing Vicon Nexus

Basic keyboard shortcuts and mouse actions

You can use the mouse to manipulate items and manage the way data is visualized in Nexus, and you can combine standard mouse actions with keyboard keys. The following mouse and keyboard combinations are used most frequently in Nexus.

Navigate in the 3D Perspective view:

- Zoom: Right-click + drag forward or backward
- Orbit: Click + drag
- Translate/Move: Click wheel button (or left-and-right-click) + drag



Tip

To open files in Nexus, in addition to loading files as described in [Play back data with the time bar, page 20](#), you can drag and drop Nexus files onto a **3D Perspective** view (or any other view). File types that you can load in this way include: C3D, ENF, VSK/VST, X1D, X2D, and XCP.

Select objects in the view pane:

- Select a single item: Click
- Select multiple consecutive items: SHIFT + click
- Select multiple non-consecutive items: CTRL + click
- Select items within a bounding outline: ALT + click and drag

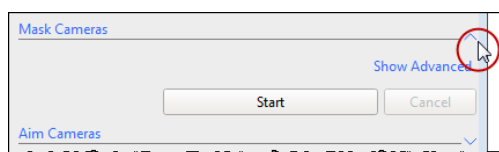
Introducing Vicon Nexus

Display/hide a section within a pane:

- Click the Display Section arrow on the right



- Click the Hide Section arrow on the right




For lists summarizing more Nexus shortcuts and mouse actions, see [Hot keys and shortcuts, page 35](#).

Introducing Vicon Nexus

Manage mocap data on the Data Management tab

The **Data Management** tab of the **Communications** window enables you to create a hierarchical structure in which to store and manage all the data associated with your motion capture trials. For information on how to do this, see [Prepare a data storage location, page 134](#).

 **Tip**
To toggle the display of the **Data Management** tab, press F2.

It also enables you to:

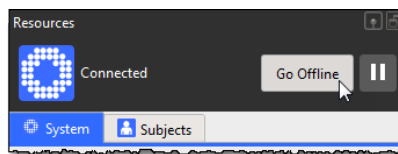
- Assess trial health with the tools on the **Quality** tab. For more information, see [Review data quality, page 208](#).
- View processing history on the **History** tab. For more information, see [Review processing history, page 206](#).
- Set up and control monitors for your trials with the **Monitor** tab.
- Interact with MATLAB.
- View system status information on the **Status** tab.
- View a log of Nexus system activity since start up on the **Log** tab.

Introducing Vicon Nexus

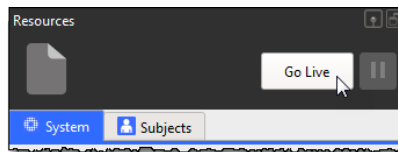
Manage system and subjects in the Resources pane


To manage Nexus system connection and real-time data-streaming, click the system connection buttons at the top of the **Resources** pane:

- **Go Live:** Connect the system and start real-time data streaming. The button's label changes to **Go Offline**.

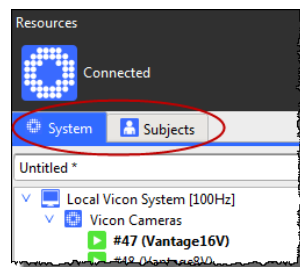


- **Go Offline:** Disconnect the system and stop real-time data streaming. The button's label changes to **Go Live**.



- **Pause:** Pause real-time data streaming. When you click the Pause button while the system is in Live mode, the button turns blue and a pause symbol  is displayed in the view pane. When the system is in Offline mode, the button is unavailable.

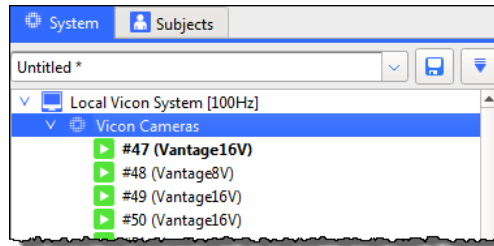
At the top of the **Resources** pane, click the tab for the resources you want to manage:



- **System:** View and configure Vicon system components
- **Subjects:** Load and manage files for mocap subjects

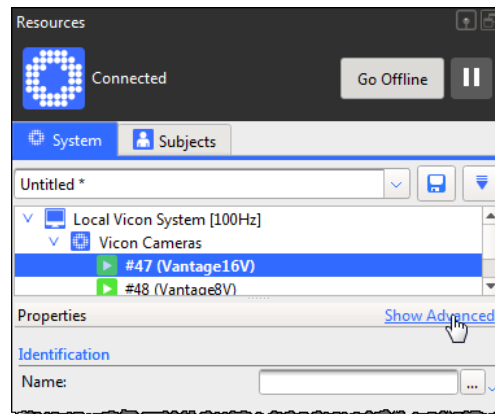
Introducing Vicon Nexus

In the **System Resources** tree or **Subjects Resources** tree, select the item(s) you want to configure.



Depending on whether you are in Live mode, you can then:

- Right-click a node to display a context (shortcut) menu of commands that can be applied to that item, if one exists.
- In the **Properties** pane below the **Resources** tree, view the settings for the item(s) selected in the tree. To view all of the available properties, click **Show Advanced**.



For more information, see [Set properties in Vicon Nexus, page 15](#).

Introducing Vicon Nexus

Set properties in Vicon Nexus

You can configure certain aspects of the Nexus system, such as system components and motion capture subjects, by configuring settings in the corresponding **Properties** section of the user interface.

Required properties for which you must specify a value are indicated in the Nexus user interface with a shaded background.

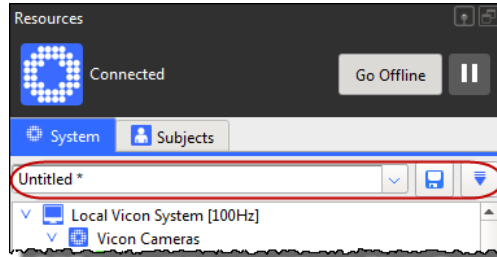
Some properties settings automatically persist, so Nexus remembers them in subsequent sessions. You must explicitly save other settings using the relevant configuration management controls for that area of the Nexus window.

To set properties in Nexus:

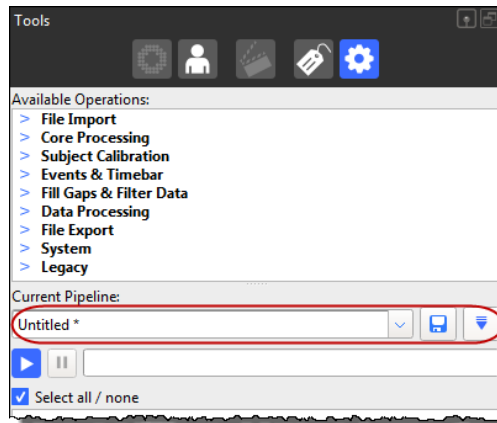
1. In the Nexus window, open the pane or dialog box containing the properties whose settings you wish to configure. For example:
 - System components - **System Resources** pane
 - Motion-capture subjects - **Subjects Resources** pane
 - Camera calibration process - **System Preparation Tools** pane
 - Subject calibration process - **Subject Preparation Tools** pane
 - Data processing operations - **Pipeline Tools** pane
 - Monitor and event actions - **Monitors** tab in the **Communications** pane
 - Data visualization - **Options** dialog box
2. To view all of the available properties, click the **Show Advanced** link. To show only the basic properties, click the **Hide Advanced** link.
3. View or change the setting for the desired properties using its entry field or control.
4. When you are working in the following areas of the Nexus window, you can save any changes you have made to the settings, using the configuration management controls (indicated in the following images). Your settings are saved to a configuration file, so that you can re-use them later.

Introducing Vicon Nexus

- System Resources pane



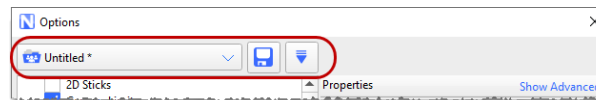
- Pipeline Tools pane



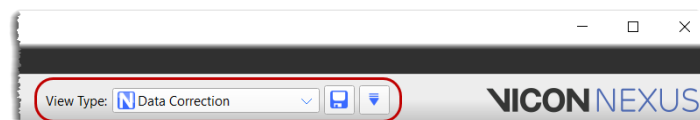
- Monitors tab in the Communications pane



- Options dialog box (press F7 to display)



- Nexus toolbar (working with the layout of the view panes)

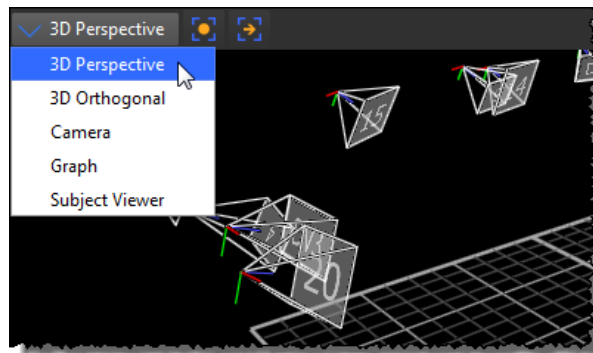


For more information on configuration files, see [Manage configurations in Vicon Nexus](#), page 24.

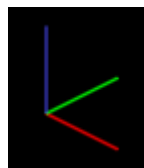
Introducing Vicon Nexus

Display data in the View pane

At the left of the View pane toolbar, click the drop-down list and select one of the available views:



- **3D Perspective:** Display 3D reconstructions of Vicon camera data.
- **3D Orthogonal:** Orthogonal views of 3D data: -Z, +Z, +X, -X, +Y, or -Y

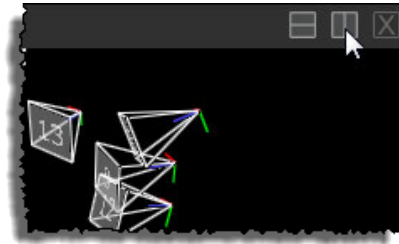


RGB = XYZ

- **Camera:** Display 2D optical data from Vicon cameras or video streams from connected video cameras.
- **Graph:** Display variables (model outputs), or system components such as force plate or EMG activity.
- **Subject Viewer:** Display the base (default) pose for the labeling skeleton template (VST) of the currently selected subject. This is useful when you are calibrating and manually labeling a labeling skeleton, which are explained in [Prepare a subject, page 152](#).

Introducing Vicon Nexus

At the right of the View pane toolbar, click the buttons to specify the number and arrangement of views displayed:



- Horizontal
- Vertical
- Close

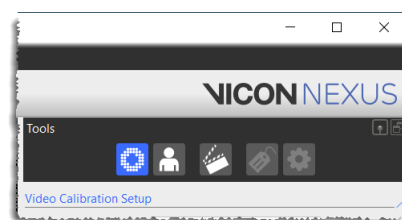
Depending on the view selected, additional lists and buttons are available to manage the display options.






✓ **Tip**
To display multiple Camera views, in the System Resources tree, SHIFT+click to select multiple cameras and in the View workspace, select Camera view.

Introducing Vicon Nexus

Manage the motion capture workflow in the Tools pane

At the top of the Tools pane, click the buttons for tools relating to the stage in the workflow that you want to display. The buttons are displayed in the order of a typical Nexus workflow (from left to right) and are enabled appropriately, depending on whether you are in Live or Offline mode (the following image is in Live mode).




-  System Preparation: Prepare your Vicon system for motion capture.
-  Subject Preparation: Prepare subjects whose motion is to be captured.
-  Capture: Collect motion data.
-  Label/Edit: Label and fill any gaps in trial data.
-  Pipeline: Create and manage sequences of operations to process trials.

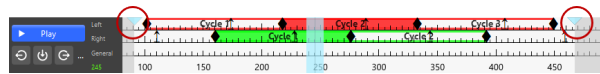
To find out more about the motion capture workflow, see [Vicon Nexus motion capture workflow, page 34](#).

Introducing Vicon Nexus

Play back data with the time bar

To explore the time bar:

1. Ensure a 3D Perspective view is displayed (see [Display data in the View pane, page 17](#)).
2. On the **Data Management** tab at the bottom of the Nexus window, navigate to an existing database. You can do this by expanding the displayed hierarchy and using the **Go forward to the next node**, **Go back to the last node**, and **Move up one folder level** buttons .
3. In the **Name** column, double-click the trial that you want to load. Nexus opens the trial.
4. On the time bar, click the **Play** button or drag the current time indicator (blue vertical line) to play back offline capture data. To crop a trial (restrict playback to a range of frames), you can drag the **Start and End Range** indicators (the blue triangles at the top of the timeline) along the time bar.



5. To hide or display the **Data Management** window, double-click the **Data Management** tab at the bottom of the Nexus window.



Tip

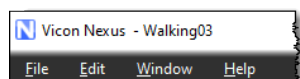
In addition to using the time bar to view and navigate trials, you can also use it to:

- View data quality as a heat map. For more information, see [Review trial data using the time bar, page 211](#).
- Create and manage events (for example, a foot striking a force plate, or a joint attaining a specified angle, etc). For more information, see [Add events to trials, page 240](#).

Introducing Vicon Nexus

Access menu options from the Nexus menu bar

The Nexus menu bar enables you to access common commands.



For more information, see Menu bar in the *Vicon Nexus Reference Guide*.







Introducing Vicon Nexus

Access common commands from the Nexus toolbar

Access frequently used commands from the Nexus motion capture workflow from the Nexus toolbar.

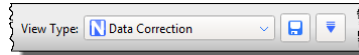




The Nexus toolbar contains buttons that enable you to save the current trial, close the current trial, and undo and redo actions. In addition it contains the following controls:

- 
Reconstruct Runs the **Reconstruct** pipeline defined in the **Pipeline Tools** pane. (Reconstruction is the process by which Nexus calculates the position of markers in three-dimensional space and links these points frame-by-frame into a trajectory.) For examples of using this pipeline, see [Calibrate a labeling skeleton, page 157](#).
- 
Reconstruct and Label Runs the **Reconstruct and Label** pipeline defined in the **Pipeline Tools** pane. (The Label process is where labels defined in the labeling skeleton template for the subject are applied, either manually or automatically, to a point in the trajectory of a marker.) Normally used when processing trials. For an example of using this pipeline, see [Reconstruct and label movement trials, page 203](#).
- 
KinFit Runs the **Kinematic Fit** pipeline defined in the **Pipeline Tools** pane. This pipeline is often used before running a **Fill Gaps - Kinematic** operation for filling gaps in trajectories, and for visualizing or graphing segment- or joint-based data in realtime.
- 
AutoInitialize Runs the **Auto Initialize Labeling** pipeline defined in the **Pipeline Tools** pane. Often used as part of calibrating a labeling skeleton. For an example of using this pipeline, see [Calibrate a labeling skeleton, page 157](#).
- 
Auto Gap Fill Runs the **Auto Intelligent Gap Fill** pipeline defined in the **Pipeline Tools** pane. This enables you to quickly fill gaps in your trial, without having to choose which fill method is best for each gap. For good results, you must configure the relevant pipeline operations for your particular trials. For information on using this command, see [Automatically fill gaps in trial data, page 236](#).
- 
Add To Quick Report Adds the current trial to a Quick Report. For more information, see Quick Reports in the *Vicon Nexus Reference Guide*.

Introducing Vicon Nexus

- **Any user-customized buttons** If required, you can create your own additional buttons and configure them to run a specified pipeline or load a previously created view configuration. You can create or change toolbar buttons in the **Customize Toolbar** dialog box.



- **View Type list** Lists any saved view types. The adjacent configuration buttons enable you to create  and save  custom view types.

Clicking a button on the toolbar executes the defined action for the button. A button is dimmed if it is not available, for example, if it cannot be run at that stage of the workflow or if a customized button has been deleted or renamed.



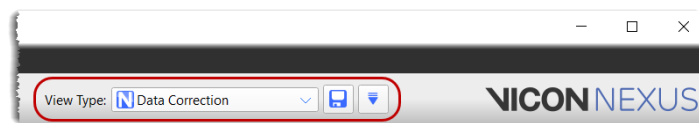
Tip

To display a tooltip that explains why a button is unavailable, hover the mouse pointer over the button.

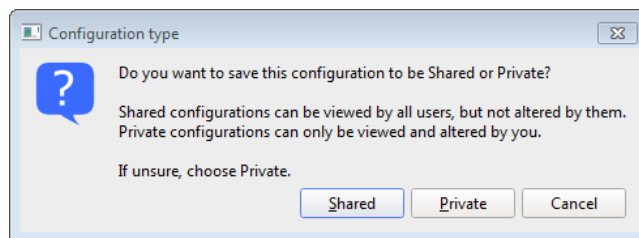
Introducing Vicon Nexus

Manage configurations in Vicon Nexus

You can determine how Nexus looks and behaves by creating and editing configurations in the configuration management controls in the Nexus window. To view and select any default configurations that were installed with Nexus, click the dropdown list in the relevant configuration management controls, for example, for View Types:



You can create different configurations to suit different types of motion capture applications and then select the appropriate configuration when required. You can also save configurations for use by multiple users (Shared) or for a specific user (Private), to suit your organization:



- **Shared** These configurations can be viewed by all users; they can be changed only by the user who was logged on when the file was first created and saved. Shared configuration files are stored in the appropriate folder, by default under:
C:\Users\Public\Documents\Vicon\Nexus2.x\Configurations
- **Private** These configurations can be viewed and changed only by the user who was logged on when the file was first created and saved. Private files are stored in the appropriate folder under the logged-in user's Application Data files folder, by default under:
C:\Users*<UserName>*\AppData\Roaming\Vicon\Nexus2.x\Configurations\
- **System** These configurations are the default configurations that are installed with Nexus and are stored in the Nexus configurations folder, by default:
C:\Program Files\Vicon\Nexus2.#\Configurations

For more information, see [Recognize Shared, Private, and System files, page 27](#).


Introducing Vicon Nexus



Important

The default Nexus toolbar is stored in the *Standard.toolbar* configuration file in the **Shared** Nexus configuration folder *Toolbars*. If you add, delete, or reposition buttons on the Nexus toolbar using the **Customize Toolbar** dialog box, these customizations are stored in your **Private** configuration folder.

To manage configurations in Nexus:

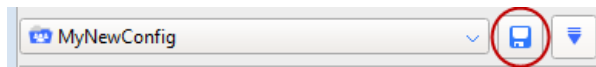
1. In the Nexus window, open the pane or dialog box containing the type of Nexus configuration file you want to manage (see [Where to find configuration files, page 28](#)).
2. Depending on whether you want to create a new configuration or change the current configuration either:
 - Leave the currently loaded configuration file. (If no configuration file has been created yet, **Untitled*** is displayed and no other options are available.) or
 - Select another configuration file from the dropdown list. If you have made changes to the current configuration file, Nexus prompts you to save these before changing the configuration file.
3. In other areas of the Nexus pane or dialog box, make any desired changes to settings, such as those in a **Properties** section.
4. Click the configuration menu button  and select the required command from the displayed list:
 - **New:** Create a new configuration in which to save the current settings. The name **Untitled*** is displayed in the **Choose configuration** list.
 - **Save As:** In the **Save As** dialog box, enter a name to overwrite the default new configuration file name **Untitled*** or to create a new system configuration file in which to save a copy of the current configuration file and click OK.

Additional options include:

- **Rename:** In the **Rename** dialog box, enter a new name for the currently loaded configuration file and click OK.
- **Delete:** At the **Delete** prompt, click Yes to delete the current file displayed in the configuration dropdown list.
- **Mark Read-Only:** Select to protect the current configuration file from further changes.

Introducing Vicon Nexus

- **Set Defaults:** Returns values to their default settings.
 - **Import:** Enables you to select and import a configuration file. This is useful when you want to copy a configuration file from another machine.
 - **Reload:** Reload or delete an automatically saved configuration file. You can select from the list of timestamped files or, if required, delete all the saved configurations.
 - **Refresh List:** Re-display the contents of the configuration dropdown list. This is useful if you copy a file into one of the **Configurations** sub-folders, enabling you to update the options displayed in the relevant list, without having to re-start Nexus.
5. In the **Configuration type** dialog box, select the user permissions for the configuration: **Shared** or **Private**.
The new file name is displayed in the configuration dropdown list.
 6. Click the Save button to store the settings in the configuration displayed in the configuration dropdown list.






For more information, see [Manage system and subjects in the Resources pane, page 13](#).

Introducing Vicon Nexus

Recognize Shared, Private, and System files

When pipelines, view types, monitors, labeling skeleton templates, and configurations are displayed in Nexus (ie, listed in menus, etc), you can immediately recognize whether they are Private, Shared, or System files:

Icon	File type	Description
	Shared	Can be viewed by multiple users; can be changed only by the user who was logged on when the file was first created and saved. Shared files are stored in subfolders in: C:\Users\Public\Documents\Vicon\Nexus2.x
	Private	Can be viewed and changed only by the user who was logged on when the file was first created and saved. Private files are stored in subfolders in: C:\Users\ <i><username></i> \AppData\Roaming\Vicon\Nexus2.x
	System	Cannot be changed (Read-Only) and are upgraded when the next version of Nexus is installed. Stored in subfolders in the Nexus installation folder, whose default location is: C:\Program Files\Vicon\Nexus2.#

Introducing Vicon Nexus

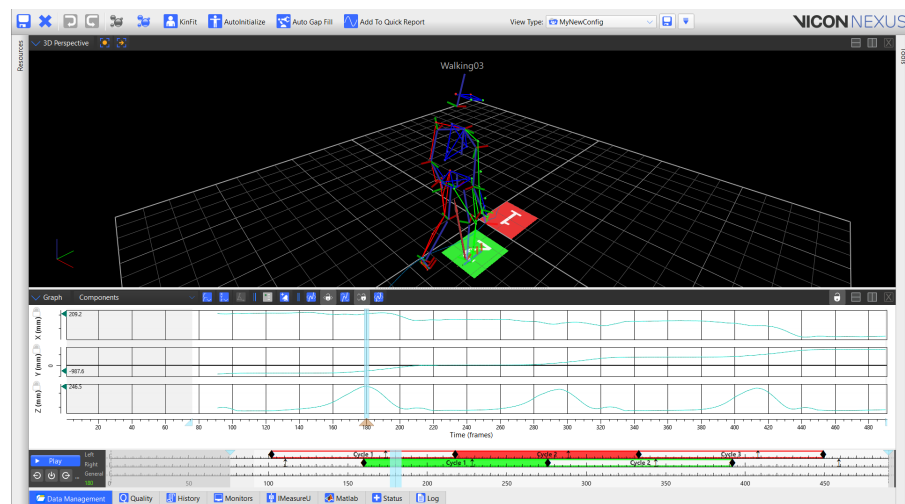
Where to find configuration files

Configuration type	Nexus UI area	Configurations folder\file
Motion capture settings	Capture Tools pane	TrialTypes*.TrialTypes
Biomechanics workflow	Biomechanics Workflow area of Communications pane	CaptureWorkflows*.CaptureWorkflow
Sounds settings	Sounds dialog box	AudioSchemes*.AudioScheme
Event monitors and actions	Monitors tab in Communications pane	Monitors*.Monitors
Data view options	Options dialog box	Options*.Options
Automated processing operations	Pipeline Tools pane	Pipelines*.Pipeline
System settings	System Resources pane	Systems*.System
Toolbar buttons	Toolbar	Toolbars*.Toolbar (see Important note above)
View options and layouts	View pane	ViewTypes*.ViewType

Introducing Vicon Nexus


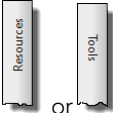

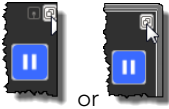
Customize the Vicon Nexus user interface

In addition to the usual resize and close window options, you can slide the Resources and Tools panes to either side of the Vicon Nexus window and or minimize the Communications pane, to give you a larger workspace area.



Introducing Vicon Nexus

The following table lists further customizations that you can make to Nexus:

Customization	Action	Button
Hide the Resources and/or Tools panes	At the top of the Resources or Tools pane, click the UnPin button.	
Hide the Communications pane	Double-click a tab within the Communications pane; or To hide the pane whenever you load a trial, on the Window menu, select the Close Communications Pane on Trial Load option.	
Reveal the Resources and/or Tools panes	Click the text at the top of the tab at the side of the Nexus window.	
Reveal the Communications pane	Double-click a tab within the Communications pane; or To make the pane visible whenever you load a trial, on the Window menu, clear the Close Communications Pane on Trial Load option.	
Return a pane to being locked into place	At the top of the pane, click the Pin button.	
Undock (float) and dock a pane	At the top of the (pinned) pane, click the Undock or Dock button.	

Introducing Vicon Nexus

Customize a View pane

The View pane cannot be undocked, repositioned, or resized in the Nexus window. However, you can open a separate floating view pane by selecting the **New floating workspace** command from the **Window** menu. This floating workspace can be repositioned and resized.

The width of the View pane is affected by resizing panes to the left and/or right of it. The height of the View pane is affected by resizing the panes below it.

Introducing Vicon Nexus

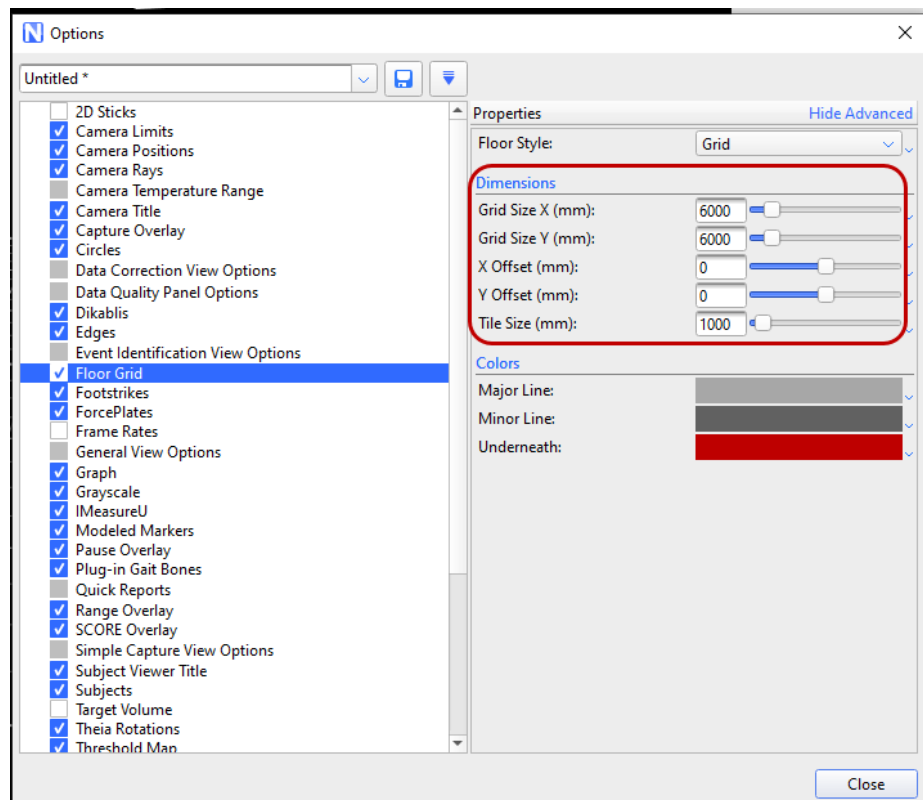
Customize floor grid dimensions and offsets

In addition to the standard square volume layout, Nexus lets you use non-square layouts and offset the center of floor grids.

- A new maximum of 50 m now applies to both the x and y axes.
- You can save customized floor grids for future use.
- Old saved options files will load correctly and transfer their settings to the new parameters.

To change the floor grid:

1. In the Options dialog box (click **Window > Options**, or press F7), select **Floor Grid** and in the **Properties** pane on the right, click **Show Advanced**.
2. In the **Dimensions** section, change the grid size and/offset in X and Y as required.



Introducing Vicon Nexus



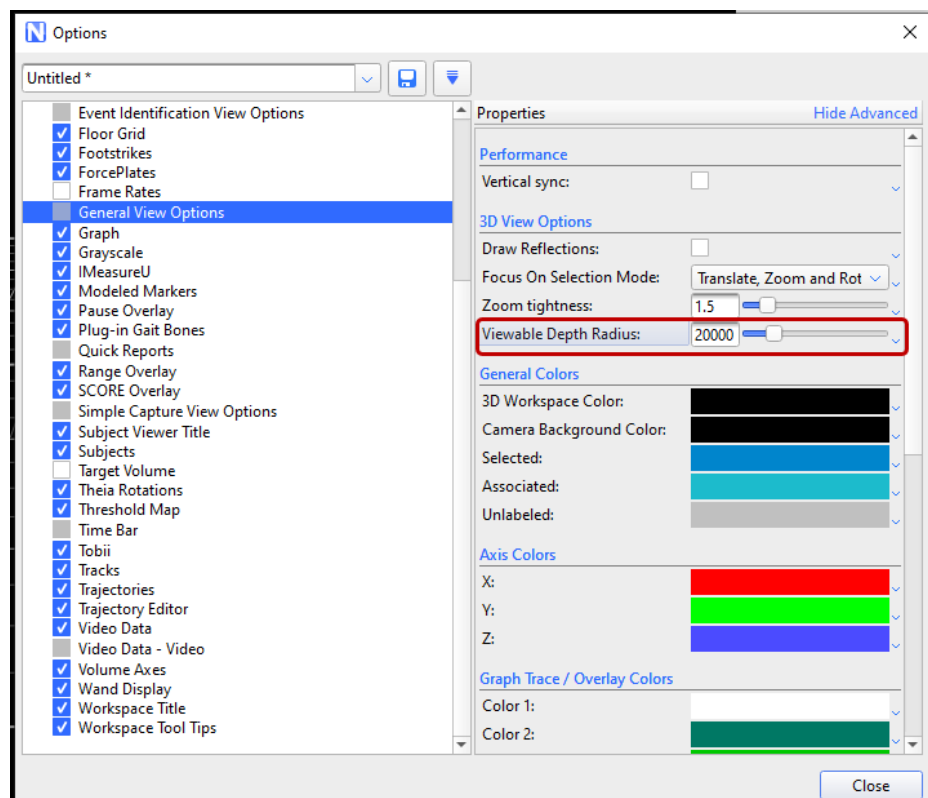
Note

This functionality is available only in Nexus 2.12 and later. Earlier versions of Nexus 2 do not read the files correctly and the floor grid returns to the default size.

If you make the floor grid so large or extend the offsets so far that the grid doesn't render at the far end, you can increase the viewable depth.

To increase the viewable depth:

1. In the Options dialog box (click **Window > Options**, or press F7), click **General View Options**.
2. In the Properties pane on the right, click **Show Advanced**.
3. Under **3D View Options**, change the **Viewable Depth Radius** value (default is 20000 mm).



Vicon Nexus motion capture workflow

In Vicon Nexus, you can capture and analyze the movement of live subjects (such as human beings or animals) and of inanimate objects (such as sports equipment or other rigid objects) for a variety of motion capture applications. You can either stream motion data in real time or capture it for offline processing, depending on your requirements.

The stages involved in the typical workflow for the operation of Nexus are:

- [Prepare a Vicon system, page 50](#), when you first set up or significantly change your motion capture system.
- [Calibrate a Vicon system, page 137](#), when you first set up your system and regularly afterwards (eg, every day, before you begin motion capture), to ensure any changes (eg, slight movement of cameras or other equipment) are accounted for. Also do this if you change the system.
- [Prepare a subject, page 152](#), when you have a new subject, or want to make changes to an existing subject. This stage includes calibrating a labeling skeleton for your new subject or re-calibrating when you have made changes to an existing subject.
- [Capture movement trials, page 182](#), after you have calibrated the labeling skeleton, to collect the data needed for your trials.
- [Review trials and fill gaps, page 205](#), after you have captured, reconstructed and labeled movement trials, to fill any gaps in the data.
- After you have filled any gaps and cropped the data as necessary, you can perform any required modeling (for example, you can run the dynamic Plug-in Gait model, or perform custom modeling) to generate the required model outputs (such as angles, forces, moments, powers, or bones). For information, see [Modeling with Plug-in Gait, page 248](#).
- [Export trial data, page 338](#), which is usually the final stage in motion capture, and lets you use captured data in third-party applications.

To speed up some of the above processes, you can use the supplied pipelines, consisting of one or more operations that are supplied with Nexus, or you can create your own custom pipelines. To use pipelines on a large number of trials, you can run them as batch processes. For more information, see [Work with pipelines, page 177](#).

Hot keys and shortcuts

You can use the mouse to manipulate items and manage the way data is displayed in the Vicon Nexus window. Standard mouse actions can also be combined with keyboard keys.

To help you use Vicon Nexus efficiently, this section provides lists of shortcuts:

- [Common hot keys and shortcuts, page 36](#)
- [Shortcuts for navigating in Vicon Nexus, page 38](#)
- [Shortcuts for managing real-time data, page 39](#)
- [Shortcuts for selecting items, page 40](#)
- [Shortcuts for moving the camera view, page 41](#)
- [Shortcuts for viewing data in 3D views, page 41](#)
- [Shortcuts for viewing data in the Graph view, page 42](#)
- [Shortcuts for visualizing graph data, page 43](#)
- [Shortcuts for working with the time bar, page 44](#)
- [Shortcuts for gap-filling, page 48](#)
- [Shortcuts for using the Quality tab, page 49](#)

Introducing Vicon Nexus

Common hot keys and shortcuts

The following mouse actions and hot keys are available throughout Nexus, where applicable/available:

Task	Keys and mouse
Start/stop capture	CTRL+Enter
Select individual items	Click
Select items within a bounding outline	ALT+click and drag
Select multiple non-consecutive items	CTRL+click
Rotate/orbit	Click and drag
Zoom	Right-click and drag
Translate/Move	Click wheel button (or left-and-right-click) and drag
Scroll forward or backward through a list	Rotate mouse wheel
Undo	CTRL+Z
Redo	CTRL+Y
Save currently enabled subject data to the current trial's .c3d file (equivalent of clicking Save on the File menu)	CTRL+S
Reset Core Processor	CTRL+R
Esc	Exit current mode (labeling, etc)
Unset all cameras' Bumped status	CTRL+SHIFT+B

Introducing Vicon Nexus

i Note

The behavior of the ALT GR key depends upon the regional settings specified for your keyboard in the Windows operating system. In some regions, the behavior of this key is identical to that of the ALT key, while in other regions the ALT GR key functions as if the ALT+CTRL keys were pressed together. Nexus assumes the latter behavior.

If you want to use the ALT GR key as if it was the ALT key, you must change the regional settings for your keyboard to use the US layout, which assumes identical behavior for these two keys. You change your keyboard language settings in the **Text Services and Input Languages** dialog box, accessed from the **Languages** tab in the **Regional and Language Options** dialog box in Windows Control Panel. For more information, see the Microsoft Windows help.

Introducing Vicon Nexus

Shortcuts for navigating in Vicon Nexus

Use the following hot keys to navigate to the different areas of the Vicon Nexus user interface.

Task	Keys
Display the Vicon Nexus online help	F1
Display/Close Data Management tab	F2
Display/Close the Quick Reports window	F4
Enter/Exit full screen mode	F5
Display/Close Sounds dialog box	F6
Display/Close Options dialog box	F7
Go to System Preparation Tools pane	F8
Go to Subject Preparation Tools pane	F9
Go to Capture Tools pane	F10
Go to Label/Edit Tools pane	F11
Go to Pipeline Tools pane	F12

The behavior of function keys is dependent upon the area of the Nexus window that has focus when the key is pressed. Click anywhere in the window to set the focus before using the function keys to navigate to a different part of the user interface.

Introducing Vicon Nexus

Shortcuts for managing real-time data

Use the following hot keys to manage real-time data streaming and offline data processing in Vicon Nexus.

Task	Keys
Start/stop capture	CTRL+Enter
Switch between Live and Offline mode	CTRL+TAB
Pause/Restart real-time data streaming (Live mode)	SPACE (or middle mouse button)
Play/Stop offline data (Offline mode)	SPACE (or middle mouse button)
Toggle Simple Capture mode (Live mode)	CTRL+H

Introducing Vicon Nexus

Shortcuts for selecting items

Use these hot keys and mouse actions to select items in the Vicon Nexus window. To cancel a selection, left-click again in the view pane.

Task	Keys and mouse
Select single item	Click
Select multiple non-consecutive items	CTRL+click
Select multiple non-consecutive items maintaining the order of selection	SHIFT+CTRL+click
Select multiple consecutive items	SHIFT+click, SHIFT and drag, or drag
Select next optical camera]
Select previous optical camera	[
Select next video camera	CTRL+]
Select previous video camera	CTRL+[
In a Camera view, sweep select for manual masking	ALT+drag

Introducing Vicon Nexus

Shortcuts for moving the camera view

Use the following mouse actions to move the camera view in the 3D Perspective, 3D Orthogonal, and Camera views.

Task	Keys and mouse
Zoom: Move the camera viewpoint closer to or further away from the focal point	Right-click + drag forward or backward
Orbit: Move the 3D viewpoint around the focal point	Left-click + drag left, right, forward, or backward
Translate: Move the 3D viewpoint along a horizontal or vertical axis	Click wheel button + drag left, right, forward, or backward
Zoom to window (for all windows). Applies in Camera, 3D Overlay and Rotated views.	CTRL+SHIFT+Z
Zoom camera view to fit	CTRL+SHIFT+F

Shortcuts for viewing data in 3D views

Use the following hot keys to view data in the 3D Perspective and 3D Orthogonal views:

Task	Keys
Toggle display of labels	CTRL+space bar
Reset footstrike counters (see Automatically assess foot strikes, page 198).	CTRL+SHIFT+R

Introducing Vicon Nexus

Shortcuts for viewing data in the Graph view

Use the following hot keys and mouse actions to view data in the Graph view. For more information, see [Shortcuts for visualizing graph data, page 43](#).

Task	Keys and mouse
Select range of frames to zoom	ALT and right-click + drag across frames
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

Introducing Vicon Nexus

Shortcuts for visualizing graph data

The way the graph that is displayed in a **Graph** view depends on whether the system connection is live or offline and whether an individual point or a range has been selected for plotting.

- [Zoom an axis \(x or y\), page 43](#)
- [Zoom selected range of frames, page 44](#)
- [Pan across an axis \(x or y\), page 44](#)
- [Open a Quick Reports window, page 44](#)

When zooming into or out of graph data, the display of grid lines in the view pane 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, open the **Options** dialog box (F7) and under **General View Options**, select **Graph**. In the **Properties** pane on the right, ensure **Show Minor Grid Lines** is selected.

Zoom an axis (x or y)

All component graphs 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-axes may show different ranges, but represent the same number of values.

- **Offline:** The portion of the specific component trace displayed in the view pane is centered around the point where the mouse was clicked. All other component views are scaled by the same amount, with the vertical range centered on the median value of the visible portion of all the selected traces.
- **Live:** The x-axis, the workspace is centered around zero, keeping zero on the right edge of the workspace and changing the values displayed on the left.

Introducing Vicon Nexus

Zoom selected range of frames

- Offline: The y-axis displays only the selected area of the specific trace and the x-axis displays only the selected frames.
- Live: This type of zooming in the x-axis is disabled to ensure that the live frame is always on the right of the graph.

Pan across an axis (x or y)

- Offline: Each component in the y-axis can be panned independently.
- Live: Panning in the x-axis is disabled to ensure that the live frame is always on the right of the graph.

Open a Quick Reports window

In addition to displaying a Graph view, you can also open a **Quick Reports** window (press F4), which enables you to display multiple graphs of model outputs normalized over the gait cycle. For more information, see **Quick Reports** in the *Vicon Nexus Reference Guide*.

Shortcuts for working with the time bar

Use the following hot keys and mouse actions to work with the time bar at the bottom of a view pane:

- [Timescale displayed in timeline, page 45](#)
- [Time bar data displayed in view pane, page 46](#)
- [Event identification mode in timeline, page 47](#)

Introducing Vicon Nexus

Timescale displayed in timeline

Task	Keys and mouse
Slide timeline left	Middle-click + drag left
Slide timeline right	Middle-click + drag right
Select range of frames to zoom	ALT and right-click + drag across frames
Zoom scale in	Right-click and drag right or up
Zoom scale out	Right-click and drag left or down

Introducing Vicon Nexus

Time bar data displayed in view pane

Task	Keys and mouse
Start/Stop data playback	Middle-click
Jog forward/backward through data playback	Rotate mouse wheel forward/backward
Move Current Time Cursor to specific frame	Click frame in the timeline
Move Start Range Frame Cursor back to zero frame of trial	Click cursor
Move End Range Frame Cursor back to last frame of trial	Click cursor
Go to the previous frame	LEFT ARROW
Go to the next frame	RIGHT ARROW
Go to the first frame	HOME
Go to the last frame	END
Go forward 10 frames	PAGE UP
Go backward 10 frames	PAGE DOWN
Go to frame <number>	CTRL+G
Set Region of Interest	CTRL+D

Introducing Vicon Nexus

Event identification mode in timeline

Task	Keys
Enter/exit event identification mode (where the time cursor follows the mouse)	CTRL+E
Go to the previous event	CTRL+LEFT ARROW
Go to the next event	CTRL+RIGHT ARROW
Lock/unlock event context (In event identification mode, select desired Left, Right, or General event context on timeline; subsequently moving the mouse forward or backward does not change context.)	UP ARROW or DOWN ARROW
Display context menu (after event context locked)	ENTER
Highlight command from context menu	UP ARROW or DOWN ARROW
Select highlighted command from context menu	ENTER
Move event to next frame	ALT+RIGHT ARROW
Move event to previous frame	ALT+LEFT ARROW

Introducing Vicon Nexus

Shortcuts for gap-filling

Use the following hot keys to speed up gap-filling and correcting swapped marker labels:

Task	Keys
Select next gap	CTRL+8
Select previous gap	CTRL+7
Spline fill	CTRL+U
Spline fill all	CTRL+I
Pick source for pattern filling	CTRL+9
Pattern fill	CTRL+O
Pattern fill all	CTRL+P
Pick source for rigid body fill	CTRL+J
Rigid body fill	CTRL+M
Rigid body fill all	CTRL+,
Pick segment for kinematic fill	CTRL+K
Kinematic fill	CTRL+L
Kinematic fill all	CTRL+.
Cyclic fill	CTRL+;
Cyclic fill all	CTRL+'
Swap marker labels	CTRL+T

Introducing Vicon Nexus

Shortcuts for using the Quality tab

Use the following hot keys to speed up working on the **Quality** tab, when using the **Data Correction** view type:

Task	Keys
Show/hide unlabeled trajectories	CTRL+F3
Show/hide trajectory names	CTRL+F4
Move to next gap for selected trajectory	CTRL+8
Move to previous gap for selected trajectory	CTRL+7
Move to previous trajectory	CTRL+PgUp
Move to next trajectory	CTRL+PgDown

Prepare a Vicon system

Prepare a Vicon system

Before you can use your Vicon Nexus system, you must configure the system for motion capture. After this, you prepare a hierarchy of folders in which to store all the files associated with your motion capture trials.

These procedures are explained in the following topics:

- [Configure Vicon hardware in Nexus, page 51](#)
- [Prepare a data storage location, page 134](#)

Before you begin to configure your Vicon system, ensure that:

- Your Vicon system hardware (including the Vicon cameras, Vicon connectivity units, and any supported third-party devices) is set up and connected and Nexus is installed and licensed. Your Vicon system may have been professionally installed by a Vicon Support engineer.
 - If you are installing the system yourself, for full details on installing system hardware, see the Vicon documentation that was supplied with your hardware, and for installing and licensing the software, see *Installing and licensing Vicon Nexus*.
 - If you are using a FLIR video camera as part of your Nexus system, see also the FLIR Video Cameras Setup Guide.
- Vicon Nexus software is licensed using Safenet licensing and the Vicon Product Licensing tool. Ensure that the licensing drivers are installed on the host PC, and that the dongle is plugged into an appropriate port (parallel or USB) on the computer while you are running the application software.
- The IP address for the Ethernet card on the host PC is set to 192.168.10.1 using the default IP address range (for details, see *Configuring network card settings* in the [Setup and connectivity documentation](#)⁷).

⁷ <https://help.vicon.com/space/Connect>

Prepare a Vicon system

Configure Vicon hardware in Nexus

The first time you use your Vicon Nexus system, you must configure the Vicon cameras, connectivity units, and any supported third-party devices such as digital video cameras, force plates, or EMG devices. After this, you only need to change the system setup in Nexus if you change your hardware configuration or if you need different system settings, for example, a different camera frequency.

You can save your system settings in a configuration file so that you can re-use or modify them later. You can create any number of system configuration files. You can then load the appropriate file for a particular type of motion capture application. For more information, see [Manage configurations in Vicon Nexus, page 24](#).

When you start Nexus, it automatically detects all the hardware currently connected to your Vicon system, and groups them into several different categories. You configure the Vicon system hardware and system-wide parameter and data processing settings on the **System** tab in the **Resources** pane (referred to as the **System Resources** pane).

Basic setup information for each type of hardware that is likely to be present in a Vicon Nexus system is included in the following topics:

- [Connect devices running the Vicon Control app, page 55](#)
- [Configure system settings, page 59](#)
- [Configure Vicon optical cameras for data capture, page 62](#)
- [Configure video cameras for digital video capture, page 76](#)
- [Configure and calibrate FLIR cameras, page 79](#)
- [Configure Vicon connectivity units, page 87](#)
- [Configure supported devices, page 91](#)

If your system contains more than one Vicon Lock, or if you want to change the automatically assigned synchronization source, also see [Change the synchronization source, page 52](#).

If you are not sure whether your firmware is up-to-date or if you have received an email from Vicon Support about updating your firmware, see the instructions on how to [Update firmware, page 53](#).

Prepare a Vicon system

Change the synchronization source

The node for the device designated as the Vicon system synchronization source, which is responsible for providing the main synchronization signal to the system, is highlighted in bold in the **System Resources** tree. Depending on the age of your Vicon system and the connectivity devices it includes, Vicon Nexus automatically designates the synchronization source:

- If a Vicon Lock is included in the system, it is automatically designated as the synchronization source.
- If the system does not contain a Lock, then a Vicon camera is automatically designated as the synchronization source.
- If the system contains more than one Lock, you must ensure that the connectivity unit that is connected to the PC (known as the primary unit) is the synchronization source. However, because Vicon software cannot detect which connectivity unit is connected to the PC, you may need to change the automatically selected source.

To change the synchronization source:

1. At the top of the **System** tab, click **Local Vicon System** to select it.
2. At the top of the **Properties** pane, click **Show Advanced**.
3. In the **System** section of the **Properties** pane, click the **Preferred Sync Source** list and then choose the required synchronization source from the list.

Prepare a Vicon system

Update firmware

Each Vicon camera and connectivity unit is programmed with firmware to control its operation. Periodically, Vicon supplies firmware updates to correct or improve device functionality. You apply these firmware updates to your Vicon devices via the Vicon Ethernet network using the Vicon Firmware Manager, as described below.

Note that in versions of Nexus earlier than Nexus 2.15, the Vicon Firmware Update Utility performs the same function as Vicon Firmware Manager and is used in the same way.

For versions of Nexus 2.8 and later, you are automatically notified when any component of your Vicon system is running out-of-date firmware, and given the opportunity to update to the latest version. (For information about updating firmware for earlier versions of Nexus, see the earlier Nexus documentation.)



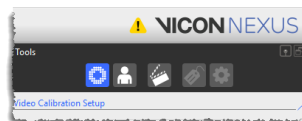
Important

To ensure optimum performance and access to all the latest functionality, Vicon recommends that you upgrade to the latest firmware whenever it becomes available.

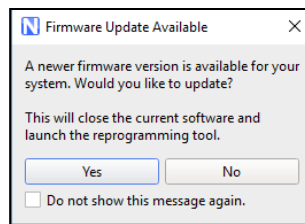
Prepare a Vicon system

To monitor and/or upgrade system firmware:

1. When you start Nexus or connect any Vicon devices into your system, Nexus checks to see whether the firmware for all your devices is up-to-date. If your devices aren't using the latest firmware, Nexus displays an icon in the toolbar to let you know that a more up-to-date version of the firmware is available:



2. Click on the icon to display more information. Nexus displays a prompt that enables you to open the Vicon Firmware Manager (reprogramming tool).



3. Click Yes to open the Vicon Firmware Manager. Note that you can also open the Vicon Firmware Manager from the **Start** menu (select **Vicon > Vicon Firmware Manager**) and the Nexus **Help** menu (**Help > Check for firmware updates**). Nexus closes and the Vicon Firmware Manager is displayed, showing all the connected devices and their current firmware version. By default, all devices are selected.

For information on using the Firmware Manager, see the *Vicon Firmware Manager Quick Start Guide*.

Prepare a Vicon system

Connect devices running the Vicon Control app

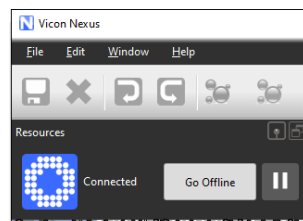
To make it easy for a single operator to set up Vicon cameras, you can use the Vicon Control app, which runs on compatible iOS and Android devices. For more information, see the [Vicon Control app](#)⁸ on the Vicon website. If you are using the Vicon Control app, connect it to your Vicon Nexus system so that you can use it to configure Vicon cameras.

The following procedure describes how to connect Vicon Control to your Vicon Nexus system.

Before you can use your phone or tablet with Nexus, you must pair it with the PC that is running Nexus (the Vicon host PC).

To connect a device running the Vicon Control app to Nexus on a Vicon host PC:

1. Ensure that your 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 Nexus is running, and the system is connected.



3. On the device, open the Vicon Control app.

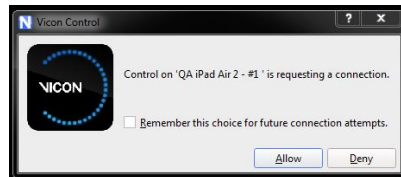
⁸ <https://www.vicon.com/products/software/vicon-control>

Prepare a Vicon system

The connection to Nexus is displayed on the initial Control screen:



4. Tap the Nexus icon. You are alerted that you must authorize the connection on the Vicon host PC before you can continue. In Nexus 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 Nexus, click **Allow**.

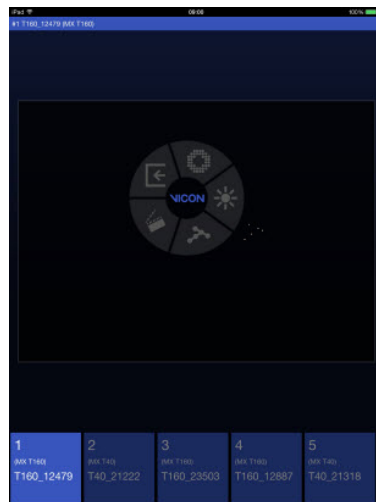
Prepare a Vicon system

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



If you later need to revoke authorizations, see the [following tip, page 58](#).

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.



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

Prepare a Vicon system



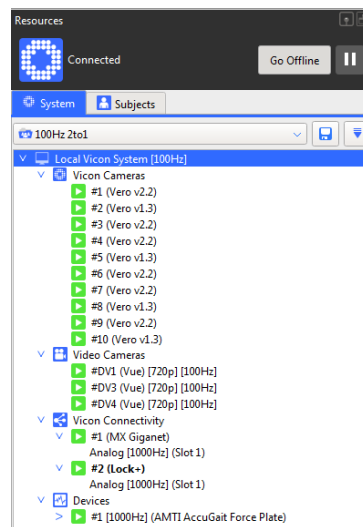
Tip

If later you need to revoke authorizations for Vicon Control, either right-click the node for the device in the **System Resources** tree and then click **Revoke Authorization**, or on the **Window** menu in Nexus, click **Manage Control Authorizations** and click **Forget Device** (for a single device) or **Forget All** (for all connected devices).

Prepare a Vicon system

Configure system settings

You specify system-wide settings in the **System Resources** pane, by clicking on the top-level node called **Local Vicon System**. This node is displayed when Nexus is in Live mode (if necessary, click the **Go Live** button to see this node). It contains sub-nodes for each device connected to your Vicon system.



If you have saved any system configurations (.system files), before changing **Local Vicon System** settings, ensure the required configuration is selected at the top of the **System Resources** pane (see [Manage configurations in Vicon Nexus, page 24](#)).

The **Local Vicon System** node provides access to system-wide properties, enabling you to:

- Configure the Vicon system capture rate and the amount of memory allocated to Nexus for motion capture.
- Manage the way Nexus produces real-time 3D representations of the subjects whose motion is being captured.
- Specify the identification and connection settings for the Nexus host PC.
- Specify video standards and timecode options.

Prepare a Vicon system

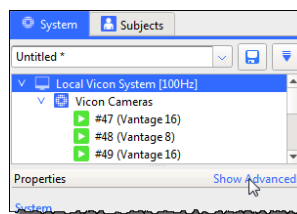
To change Vicon system settings:

1. If Nexus is currently offline, in the **Resources** pane, click **Go Live**.
2. On the **System** tab, click the **Local Vicon System** node.
3. In the **Properties** pane at the bottom of the **System** tab, view or change the settings to suit the needs of your motion capture application.

When you set up your Vicon system, ensure that the **Requested Frame Rate** value in the **System** section is appropriate.

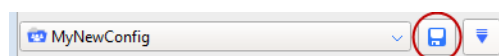
The **Requested Frame Rate** is the rate (in Hz) at which to synchronize the Vicon cameras. Depending on whether you use an external video signal, select the required setting:

- If you don't use an external video signal (and therefore haven't set the **Genlock Standard** (an Advanced property: see Step a. below), the default setting of 100 Hz is suitable for a range of common applications, so unless you have a specific requirement for a different value, don't change it.
- If you use an external video signal:
 - i. To view all the available properties for **Local Vicon System**, at the top right of the **Properties** pane, click **Show Advanced**.



- ii. From the **Genlock Standard** list (an Advanced property), ensure the correct video standard (PAL, NTSC, Film, VESA, SDI, etc) is specified.
 - iii. From the **Requested Frame Rate** list, select one of the displayed values (multiples of the base frame rate, up to a maximum of 2,000).
4. Configure additional properties as required. For detailed information about each of the properties, see *Local Vicon System node* in the *Vicon Nexus Reference Guide*.

When you have finished specifying the properties, at the top of the **System** tab, click the **Save** button to save your system configuration settings to a .system file in the Systems configurations folder (see [Manage configurations in Vicon Nexus](#), page 24).



Prepare a Vicon system



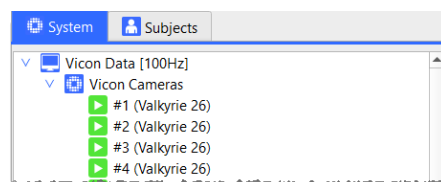
Tip

The node for the device designated as the Vicon system synchronization source is displayed in bold in the **System Resources** tree. For more information, see *Change the synchronization source* in [Configure Vicon hardware in Nexus, page 51](#).

Prepare a Vicon system

Configure Vicon optical cameras for data capture

As part of setting up your Vicon system, you must specify the required settings for Vicon optical cameras. To do this, you use the **Vicon Cameras** node in the **System Resources** pane. You can configure the settings for an individual camera, several cameras, or all cameras at once.



The **Vicon Cameras** node is displayed under the **Local Vicon System** node when Vicon Nexus is connected to a Vicon system and is in Live mode. It is displayed under the **Vicon Data** node when Nexus is in Offline mode. It lists each Vicon optical camera connected to your Vicon system. For each camera, the node name includes the device position number, any display name specified in the **Identification** property, and the camera type in parentheses, for example, **#1 Over Door (Valkyrie 16)**.



Important

Before making changes to your Vicon camera settings, ensure that:

- You have set your cameras' focus and aperture.
For how to set up Vicon Vero and Vantage cameras, see:
 - [Vicon System Setup - Mounting and Optimizing a Vero Camera](#)⁹
 - [Vicon System Setup - Mounting and Optimizing a Vantage Camera](#)¹⁰.
 For more information, see the [Vicon System Setup playlist](#)¹¹.
- The required system configuration has been selected in the **System Resources** pane (see [Manage configurations in Vicon Nexus](#), page 24).
- Your calibration device (wand) is available.
- You have some markers with which to outline the capture volume. This will also assist with camera setup.

⁹ <https://youtu.be/ml93qqpQpO4>

¹⁰ <https://youtu.be/VR3oVQFR0Pg>

¹¹ https://www.youtube.com/playlist?list=PLoL-MR-_fJaAT8h15VSCJuxS9kNuGIVs8

Prepare a Vicon system

If you are setting up a mixed camera system (that is, a system that includes Vicon MX T-Series cameras as well as current Vicon cameras), note that using T-Series cameras with Nexus 2.15 or later is not supported or tested. For information on using these cameras, see [Set up mixed Vicon camera systems](#) in the documentation for earlier versions of Nexus. Also note that if you add Valkyrie cameras to a system that includes T-Series cameras, the T-Series cameras will not work.

Check camera setup (optional step)

Preview mode enables you to display a video image from an optical camera. This mode helps you to aim cameras more quickly and easily and to check volume coverage by the cameras during setup.

To display a video image:

- Right-click on the **Vicon Cameras** node and select **Enable Preview Mode**.

Preview mode is for system setup purposes only. You cannot use Preview mode when you are calibrating, auto masking, capturing, or reviewing data.

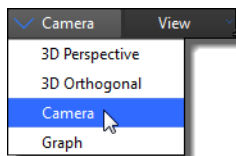
✓ **Tip:** If the image produced by Preview mode is too dark, adjust the aperture to maximize the light. After you've finished setting up the cameras, return the aperture to its required setting.

Check camera lens focus

You can check the image of the markers from the camera you are focusing in real time.

To check camera focus in Nexus:

1. Ensure Vicon Nexus is in Live mode. If it is not, in the **Resources** pane, click **Go Live**.
2. In the **View** pane, select the **Camera** view type.



3. In the **Resources** pane, ensure **Live mode** is activated (ie, that **Connected** is displayed).

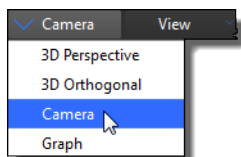
Prepare a Vicon system

4. On the **System** tab, expand the **ViconCameras** node and select the required camera.
5. In the **Properties** pane at the bottom of the **System Resources** tab, go to the **Settings** section and set **Grayscale Mode** to **All**.
6. Right-click and drag in the **Camera** view pane to zoom in on the target marker pair.
7. If the image of the markers is not bright enough to allow confidence in the level of focus achieved, increase the intensity of the grayscale from the camera. To do this, in the **Properties** pane, ensure **Advanced** properties are displayed and in the **Settings** section, increase the value for **Gain** to a level above x1.
8. In the **Camera** view pane, observe the sharpness of the image of the markers.
9. After focusing the lens, return Nexus to its default capture settings. In the **Properties** pane at the bottom of the **System Resources** tab, set **Grayscale Mode** to **Auto**.

Prepare a Vicon system

Specify properties for Vicon optical cameras

1. Ensure Vicon Nexus is in Live mode. If it is not, in the **Resources** pane, click **Go Live**.
2. To visualize your capture volume, from the view pane menu, select **Camera**.



3. In the **System Resources** tree, select the node(s) for the camera(s) whose properties you wish to configure, either:
 - **Vicon Cameras** node for all Vicon cameras
or
 - A sub node for a specific Vicon camera. The camera sub-nodes on the **System** tab correspond to the **Names** you set in the **Properties** pane (see below).
Note that If no Lock is present in the Vicon system, the sub-node for the Vicon camera acting as the synchronization source is displayed in bold.
When a camera is selected, a blue status light on its strobe unit lights up.

✔ **Tip:** In many cases, it is best to start by selecting all of the cameras, to find a common baseline. You can then adjust individual cameras as required.
4. In the capture volume, have someone wave the calibration wand and ensure that you can see marker images moving in the **Camera** view.

Prepare a Vicon system

- In the **Properties** pane at the bottom of the **System** tab, click **Show Advanced** to show additional properties.

When you first set up your Vicon system, configure the following camera properties in the order shown. (If you are not sure what a particular setting means, hover over the relevant field or control to display a tooltip.):

Identification section:


- **Name** (If you wish to distinguish it from the other cameras)

Settings section:

- **Strobe Intensity** In most cases, keep its default setting (1).
- **Gain** Only adjust this setting if the markers appear too faint or the cameras have trouble distinguishing them; otherwise, leave at its default setting (x1). Vicon does not recommend using a setting higher than x2.
- **Grayscale Mode** This setting determines what data is sent from the camera to the computer. Ensure this is set to the default setting (**Auto**) for capturing data. If the camera recognizes a blob as a circle, only centroid data is sent. If the camera cannot distinguish the blob as a circle, full grayscale data is sent so that Nexus can attempt to circle-fit the blobs. Circle fitted markers are displayed as crosshairs in the **Camera** view.

Centroid Fitting section:

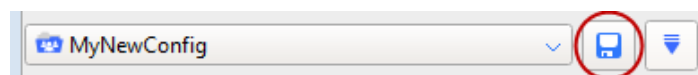
- **Threshold** This setting differentiates between markers and ambient light. A value in the region of 0.2 (the default) to 0.5 is usually appropriate, but Vicon strongly recommends that you view static markers in the volume to establish an appropriate setting. If cameras are evenly spaced around the volume, the same **Threshold** value is usually sufficient for all cameras.
- **Minimum Circularity Ratio** The circularity threshold used by the centroid-fitting algorithms in a Vicon camera to fit centroids to grayscale blobs. The higher the value, the more stringent the centroid fitter is. For camera calibration, you may wish to apply higher settings to ensure that the Vicon system selects the best markers and thus provides the best possible calibration. For data capture, a lower value may be appropriate. When a blob is fitted with a centroid, it is represented by crosshairs. The default setting is 0.5.

 **Tip:** If adjusting these 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. For information on masking, see [Mask unwanted reflections, page 71](#).

Prepare a Vicon system

Centroid Tracking section:

- **Enable Centroid Tracking** Tracking 2D camera centroids provides extra information that maintains marker labels in real time when only one camera can see a marker. When enabled, the 2D track calculations are performed by a camera's onboard sensors. When disabled, the 2D track calculation is performed by the PC (in Nexus). The default is off.
 - **Marker Velocity** Maximum velocity at which a marker will be tracked, expressed as the percentage of image width per second. The default is 5.
6. When you have finished adjusting the **Vicon Cameras** settings, in the **Settings** section, ensure that **Grayscale Mode** is set to **Auto**.
 7. At the top of the **System** tab, click the **Save** button to save your system configuration settings to a .system file in the Systems Configurations folder (see [Manage configurations in Vicon Nexus, page 24](#)).



Important

The camera properties described above affect the quality of the motion capture data. You cannot adjust them after data capture, so it is important to optimize these before you collect data intended for analysis. In subsequent sessions, you may wish to configure additional properties to suit the needs of your motion capture application. For further details about each of the **Vicon Camera** properties, see *Vicon Camera properties* in the *Vicon Nexus Reference Guide*.

Prepare a Vicon system

Aim Vicon cameras



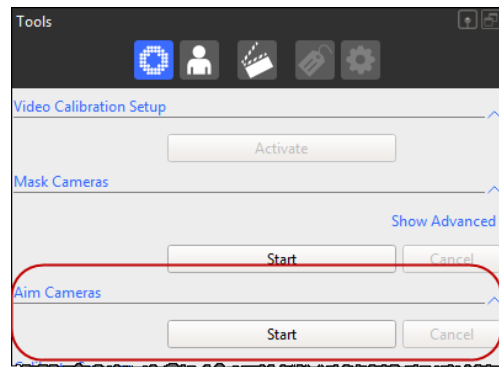
Note

Aiming cameras is useful for providing an initial, approximate calibration, before you fully calibrate the cameras as described in [Calibrate Vicon cameras, page 138](#).

Before you aim your Vicon cameras, ensure that they are displayed in the **3D Perspective** view.

Vicon camera positioning changes in real time. When you physically move a camera in the capture volume, you should be able to see that its representation moves correspondingly in the **3D Perspective** view. If you can't see the cameras in the **3D Perspective** view, or if you want to change the way the cameras are displayed, press F7 to open the **Options** dialog box, and on the left, ensure **Camera Positions** is selected. If required, change the **Properties** on the right.

When you have roughly positioned the cameras in the volume, you can use the **Aim Cameras** section of the **System Preparation Tools** pane to optimize their positions, before running a full camera calibration.



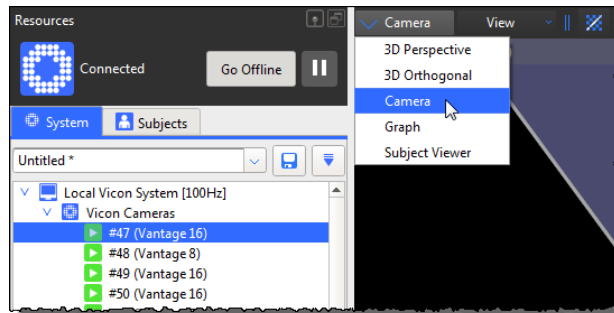
Important

To aim Vicon cameras, you must use the calibration device supplied with your Vicon system. To aim digital video cameras, you must use an Active Wand.

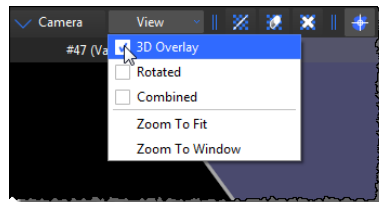
Prepare a Vicon system

To optimize the position of Vicon cameras:

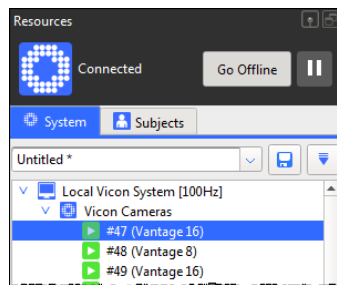
1. In the **Resources** pane, ensure Nexus is in Live mode.
2. In the **Options** dialog box (press F7), under the **General View Options** section, select the **Target Volume** option.
3. On the right side of the dialog box, update the properties of the target volume to reflect the dimensions of your capture volume.
4. View the Vicon camera feedback by doing the following:
 - a. In the view pane, select the **Camera** view.



- b. In the **Camera** view toolbar, on the **View** drop-down list, select **3D Overlay**.



- c. In the **System Resources** tree, click the cameras that you want to aim to select them.



A virtual representation of your target volume is overlaid on the 2D data from the camera image.

Prepare a Vicon system

5. In the **System Preparation Tools** pane, expand the **Set Volume Origin** section and from the **L-Frame** drop-down list select the **Active Wand** or **5Marker Wand & L-Frame** calibration object.
6. In the capture volume, place the calibration object flat on the floor in the center of the capture volume at the desired origin position.
In the **Aim Cameras** section, click **Start** to begin the camera-aiming process. Nexus starts attempting to identify the calibration object in each camera view, and the **Start** button switches to its **Stop** setting.
7. In the **System Resources** tree, select the camera you want to position and ensure that you can see the calibration object in the **Camera** view.
8. Physically move a Vicon camera in the capture volume and check its coverage against the target volume.
9. Repeat steps 7–8 for each Vicon camera, until they are all correctly aimed at the calibration object.

Prepare a Vicon system

Mask unwanted reflections

Masking enables grayscale blobs that are generated from reflections of objects other than markers (eg, reflections from floor or furniture, or opposing camera strobe rings) to be ignored by the Vicon cameras. In capture volumes where this spurious data is present, camera masking improves calibration robustness and reconstruction quality.

In Nexus, masking is shown as a grid of small blue tiles superimposed over the camera image in a **Camera** view, each cell of which can be set to obscure unwanted reflections that are seen by a camera.

Vicon Nexus offers both automatic masking and tools for manual masking. If you have a large number of reflections in your capture volume, it is a good idea to create camera masks automatically first. You can then eliminate any remaining reflections by creating masks manually.

For more information, see:

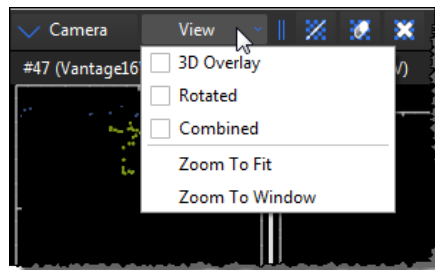
- [Automatically create Vicon camera masks, page 72](#)
- [Manually create Vicon camera masks, page 74](#)

Prepare a Vicon system

Automatically create Vicon camera masks

To automatically create camera masks:

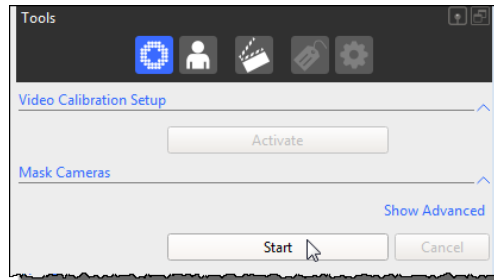
1. Remove from the capture volume any unnecessary objects, such as calibration objects. For best results, the capture volume should be entirely free from objects likely to cause background interference.
2. In the **Resources** pane, ensure Nexus is in Live mode.
3. From the **System Resources** tree, select all Vicon cameras.
4. From the view pane toolbar, select **Camera** to display the 2D data being captured by each selected camera in a separate **Camera** view.
5. From the **View** drop-down list at the top of the view pane, ensure that the **3D Overlay** and **Combined** options are cleared.



6. In the **Options** dialog box (F7), under the **General View Options** section ensure that the **Threshold Map** option is selected.
7. Ensure you have adjusted camera settings as described in [Configure Vicon optical cameras for data capture, page 62](#). Any reflections are clearly visible in the **Camera** view, typically as non-circular areas of grayscale or edge data. Note that as reflections can severely affect the camera data rates, you may find that the camera overloads. In this case, the camera automatically sends edge data instead of full grayscale.

Prepare a Vicon system

- In the **System Preparation Tools** pane, in the **Mask Cameras** section, click **Start**.



If you are using a FLIR camera and a warning is displayed informing you that the DV camera is not set to a valid frame rate, note that this is expected behavior and you may ignore it.

- The **Start** button switches to its **Stop** setting. Nexus starts recording the data visible to each of the cameras connected. Any camera masks created are displayed as blue cells in the **Camera** views for affected cameras. If there is no data visible to a particular camera, Nexus does not create any masks for it. About 30 seconds of recording is generally sufficient to enable Nexus to collect the data visible to the cameras.
- After about 30 seconds, click **Stop**. If you still see unwanted reflections, you can start and stop the **Mask Cameras** option again until you have hidden the reflections, or mask any remaining reflections manually.
If you are using a FLIR camera and a warning is displayed informing you that the DV camera is not set to a valid frame rate, note that this is expected behavior and you may ignore it.

Prepare a Vicon system

Manually create Vicon camera masks

You can manually create masks to 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 create camera masks automatically first (see above).

To manually create camera masks:


1. From the capture volume, remove any unnecessary objects, such as calibration objects. For best results, ensure the capture volume is entirely free from objects likely to cause unwanted reflections.
2. From the **System Resources** tree, select all Vicon cameras.
3. From the view pane toolbar, select **Camera** to display the 2D data being captured by each selected camera in a separate **Camera** view.
4. From the **View** drop-down list at the top of the view pane toolbar, ensure that the **3D Overlay** and **Combined** options are cleared.
5. In the **Options** dialog box (F7), under **General View Options**, ensure that **Threshold Map** is selected.

✔ **Tip:** The **Threshold Map** default color is blue, but you can change the color in the **Options** dialog box. In the following descriptions, the masking tiles are described as blue.


6. Ensure you have adjusted camera settings as described in **Configure Vicon optical cameras for data capture**, page 62. If reflections are present, they should be clearly visible in the **Camera** view, typically as non-circular areas of grayscale or edge data. Note that as reflections can severely affect the camera data rates, you may find that the camera overloads. In this case, the camera automatically sends edge data instead of full grayscale.

Prepare a Vicon system


7. From the view pane toolbar, use the following buttons to obscure any unwanted reflections visible to the selected Vicon cameras. (When you click any of these buttons, a grid of small blue tiles is superimposed over the camera image in each **Camera** view.)

- Paint a mask onto the camera 

Click an individual tile, click and drag across multiple 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 blue cells obscuring unwanted reflections.
- Erase a mask from the camera 

Click an individual tile, click and drag 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

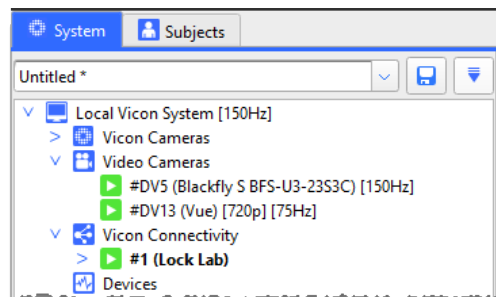
To zoom in on the images, right-click and drag the mouse forward (to zoom in) or backward (to zoom out). To pan the image, click both mouse buttons and drag.

The camera masks are applied in real time and are saved along with your camera calibration.

Prepare a Vicon system

Configure video cameras for digital video capture

You manage the identification and configuration settings for each digital video camera connected to your Vicon system with the **Video Cameras** node in the **System Resources** pane. Using this node, you can also remove or reorder video cameras.



Note

References to "Vicon video camera" apply to the use of Vicon Vue cameras.

For details about configuring the settings for a FLIR camera, see [Configure and calibrate FLIR cameras, page 79](#).

For details of how to set up a Vicon system that includes FLIR cameras, see the *FLIR Video Cameras Setup Guide*.

For details of how to set up a Vicon system that includes video cameras, see *Vicon system setup information* in the [Setup and Connectivity documentation](#)¹².

The **Video Cameras** node is displayed under the **Local Vicon System** node when one or more video camera is connected to the Nexus host PC and Vicon Nexus is in Live mode, or when a previously saved file containing video cameras is loaded. It lists each video camera connected to your Vicon system. For each camera, the node name includes the camera number, the camera type in parentheses and the frame rate in brackets, for example, **#DV1 Over Door (Vue) [120Hz]**.

¹² <https://help.vicon.com/space/Connect>

Prepare a Vicon system

You can connect supported video cameras to the GigE port on the Nexus host PC and then capture reference video for use with your optical motion capture data. You can overlay the Vicon optical motion data onto the digital video images from the video cameras in the **Camera** view using the **3D Overlay** option, from the **View** menu. If required, you can burn this information into the digital video image and export the video file (.mp4 or .avi) for viewing in another application using the **Export 3D Overlay Video** operation.

To configure video cameras for digital video capture:

1. Ensure Nexus is in Live mode (in the **Resources** pane, click **Go Live**).
2. In the **System Resources** tree, select the node whose properties you wish to configure:
 - **Video Cameras** node, for all digital video cameras
 - A sub-node, for a specific video camera

Note that if you are configuring a Vicon video camera, the node will not become green until you specify the **Destination IP Address**.

Also note that cameras with gray icons are connected to the network but are not contributing data. For example, if you have connected Vicon Vue video cameras, but your Vicon connectivity device does not support jumbo packets, the icons for the Vicon video cameras will remain gray. For more information and help with upgrading your system, contact [Vicon Support](#)¹³.

3. In the **Properties** pane at the bottom of the **System Resources** pane, view or change settings for the required properties.

When you first set up your Vicon system, you must configure at least the properties listed in [Initial properties setup, page 78](#) in the order shown. In subsequent sessions, you may want to configure additional properties to suit the needs of your motion capture application.
4. For further details about each of the **Video Camera** properties, see **Video Cameras** node in the *Vicon Nexus Reference Guide*.
5. At the top of the **System** tab, click the **Save** button to save your system configuration settings to a .system file in the **Systems** configurations folder (see [Manage configurations in Vicon Nexus, page 24](#)).

¹³ <mailto:support@vicon.com>

Prepare a Vicon system



Tip

When you plug a video camera into the Vicon system, the system automatically assigns it a number. To reorder video cameras, select the camera in the **Reorder Devices** dialog box and click **Move Up** or **Move Down**. Then click **OK**.

Initial properties setup

Section	Property name
Hardware	Destination IP Address (Vicon video cameras)
Settings	Capture Path (enter a separate HDD or an SSD drive for each camera) Video Gain and Brightness Offset (Vicon video)
Frame Rate	Requested Frame Rate
Settings	Shutter Duration
Calibration	Focal Length (mm) (if you will be using Aim Cameras)

Prepare a Vicon system

Configure and calibrate FLIR cameras

Vicon Nexus 2.13 and later supports using FLIR Blackfly S cameras to provide synchronized, calibrated video captures.

The following information applies to configuring FLIR Blackfly S cameras in Nexus.

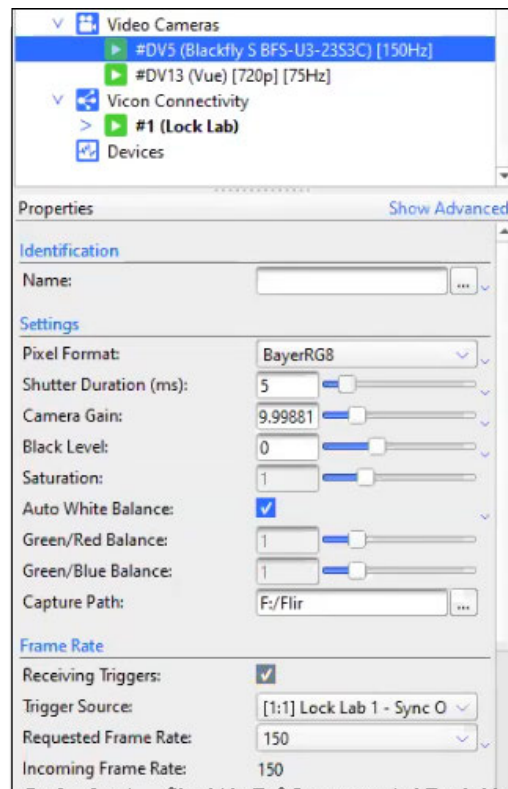
For additional information, see also [Calibrate FLIR Blackfly S cameras, page 85](#).

For information on hardware setup, see the FLIR Video Cameras Setup Guide.

Configure FLIR cameras in Nexus

To access the settings for a FLIR camera in Nexus:

- In the System Resources tree, select the relevant node and in the Properties pane, view the current settings.



Prepare a Vicon system

If the FLIR camera isn't displayed in the System Resources tree, or if it's displayed with a yellow warning triangle, or if you haven't already set the system frame rate, see [Set up the software for a FLIR Blackfly S system in the *FLIR Video Cameras Setup Guide*](#).

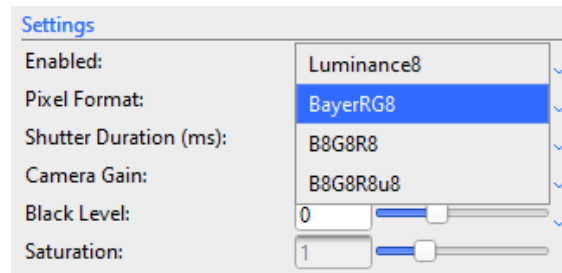
You can then configure the FLIR camera settings as described in the following topics.

- [Choose the pixel format, page 81](#)
- [Choose the frame rate, page 82](#)
- [Set appropriate video image parameters, page 83](#)
- [Set area of interest and binning, page 84](#)

Prepare a Vicon system

Choose the pixel format

The camera performs better when it is providing data in its native pixel format. This is a Bayer format, such as BayerRG8.



No bandwidth is saved by selecting Luminance8. B8G8R8 and B8G8R8u8 use three and four times as much bandwidth, so are not generally recommended.

If you choose another format, the camera may be restricted to lower frame rates, for the following reasons:

- Time is taken for onboard processing from one pixel format to another (eg, converting 8-bit Bayer to 8-bit grayscale).
- The new format results in larger images and therefore uses more bandwidth to transmit (eg, converting 8-bit Bayer to 24-bit RGB results in an image 3 times larger).

Occasionally, a different pixel format may be appropriate, for example, in these cases:

- Camera's onboard conversion may be better in some circumstances than the software conversion.
- Camera is running at a low frame rate and there is plenty of spare bandwidth.

However, these cases are unusual and we recommend selecting the native BayerRG8 format if you're in any doubt.

Prepare a Vicon system

Choose the frame rate

We recommend choosing the frame rate after you set the pixel format. The frame rates available in the drop down menu are determined by these factors:

- The frame rate of the Vicon system (see Set the system frame rate in the *FLIR Video Cameras Setup Guide*). The video rate must exactly divide into the system rate.
- The limits of the camera/sensor. These are fixed and cannot be changed.
- The current pixel format of the camera.
- The Area of Interest (window) set on the camera.

	15
	18.75
	25
	30
	37.5
Frame Rate	50
Receiving Triggers:	75
Trigger Source:	150
Requested Frame Rate:	

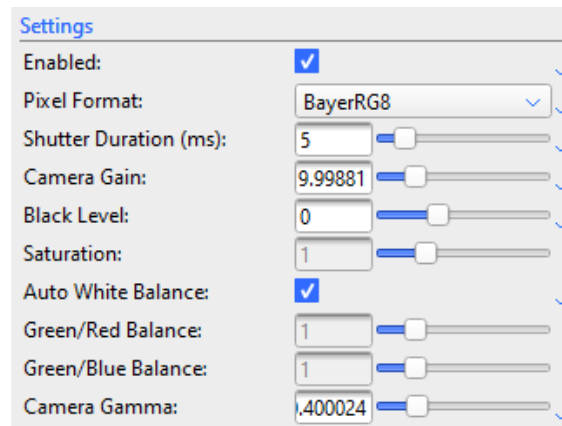
Usually it is desirable for the system rate to be the same as or higher than the video frame rate. For example, if the system frame rate is 120 Hz, the permitted video frame rates will include 30 Hz, 60 Hz and 120 Hz.

If the system frame rate is changed, the camera will stop streaming and a new frame rate must be selected from the drop-down list.

Prepare a Vicon system

Set appropriate video image parameters

Ensure you set the video image parameters appropriately.

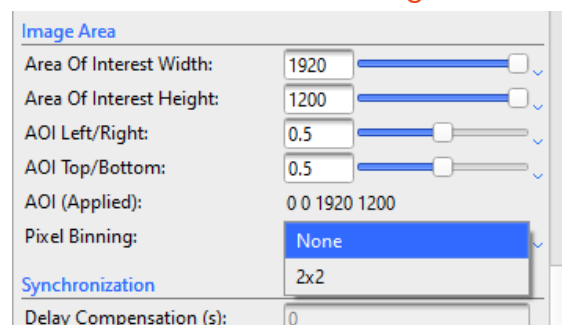


- **Shutter duration** The shutter duration time is given in microseconds. The exposure is limited to the length of the frame period. If it is set too high, the camera might not be ready for the next frame before the trigger is received and the software inserts black frames to maintain synchronization. This is usually undesirable behavior, so to avoid this, decrease the exposure slightly until the warning disappears.
- **Camera Gain** If the image is too dark, adjust the gain to compensate. Avoid using too much gain when a longer exposure time or better lighting is needed instead. Excessively high gain results in a noisy image.
- **Black Level** This property controls how dark the darkest areas of the image appear. Adjust this as desired.
- **Saturation** The gamma property affects the *actual data* sent from the camera, not just the display. It is only enabled when the camera converts from its native pixel format to 24-bit or 32-bit RGB. It is disabled when using the camera's native Bayer format. By default the camera uses the Bayer format, so this option is disabled by default.
- **Auto White Balance** This property uses an algorithm on the camera to improve the appearance of color in the image. If you require more predictable color, you can disable it and set the green/red and green/blue balance manually.
- **Green/Red Balance** When auto white balance is disabled, allows the green/red balance to be adjusted.

Prepare a Vicon system

- **Green/Blue Balance** When auto white balance is disabled, allows the green/blue balance to be adjusted.
- **Camera Gamma** The gamma property affects the gamma level of the *actual data* sent from the camera, not just the display.

Set area of interest and binning



There are two supported ways of reducing the image size: setting an area of interest (AOI) or enabling binning.

- **Area of Interest Width** Desired width of the AOI in pixels.
- **Area of Interest Height** Desired height of the AOI in pixels.
- **AOI Left/Right** Horizontal position of the area of interest: 0 means to the far left, 0.5 means centered, and 1 means to the far right.
- **AOI Top/Bottom** Vertical position of the area of interest: 0 means at the very top, 0.5 means centered, and 1 means at the very bottom.
- **AOI Applied** This is the AOI as applied by the camera. It might not be exactly the one requested because of limitations of the camera and pixel format.
- **Pixel Binning** The binning options are None (no binning) or 2x2 (a square of 4 pixels are reduced to 1 pixel). Binning reduces the bandwidth and consequently the capture file sizes by a factor of 4, by effectively halving both the horizontal and vertical resolution.

Prepare a Vicon system

Calibrate FLIR Blackfly S cameras

When you calibrate a FLIR Blackfly S camera, the default settings usually result in a good calibration. These notes are provided to help you to understand FLIR Blackfly S camera parameters and behavior.

- [Set a large enough Area of Interest window, page 85](#)
- [Set an appropriate frame rate, page 85](#)
- [Check warnings, page 85](#)
- [Use Video Calibration Mode, page 86](#)
- [Adjust the threshold if required, page 86](#)
- [Check camera masks, page 86](#)
- [Carry out wand wave, page 86](#)
- [Check the calibration, page 86](#)

Set a large enough Area of Interest window

We strongly recommend setting the Area of Interest window at least as large during calibration as will be used during capture. If in doubt, use the default setting of the whole image for both calibration and capture.

Set an appropriate frame rate

We recommend calibrating using at least the video rate that will be used for capture. The calibration of FLIR cameras in Nexus does not check for timing offsets (unlike say, calibrating an SDI camera in Shogun Live), as the timing of the camera is controlled directly using the Vicon Lock unit. This means you can change the frame rate and exposure of the video camera after calibration or decrease the Area of Interest window size. However, do not alter the aperture of the lens without re-calibrating.

Check warnings

A known issue results in warnings being briefly generated when you change camera parameters, including when you enter and exit calibration mode. If continual warnings about timing, missing triggers or black frames being inserted occur, calibration is unlikely to be successful, so ensure that the video is stable before continuing.

Prepare a Vicon system

Use Video Calibration Mode

1. To tune the video threshold and calibration shutter duration, from the **Calibration** panel, select **Video Calibration Mode**.
This activates a number of parameters in the **System** panel. In video calibration mode, the image becomes much darker, ideally so that only the strobes can be seen.
2. Power on the wand in **Strobe** mode.
3. Check that centroids can be seen in the video image.
If not, you may need to adjust the parameters until the centroids become visible.

Adjust the threshold if required

In most cases, the default threshold usually works well. However, in extreme circumstances, you can adjust this setting if the wand LEDs are not reliably detected.

Check camera masks

Check that masks are sensible (ie, covering any bright objects, but not covering a very large portion of the image). If masks are too large, it is likely that the calibration settings are inappropriate.

Carry out wand wave

Calibrate the system as normal (see [Calibrate Vicon cameras, page 138](#)), making sure that the video camera receives sufficient wand waves. The best way to do this is to leave the **Auto Stop** option selected with the default settings.

Check the calibration

After calibrating, you can carry out a quick check.

1. Start a capture.
2. Wave the wand quickly in front of the video camera.
3. Stop the capture.
4. Transfer the capture to video (MP4 or AVI) so it can be played back and stepped through.
5. Step through and verify that reconstructions are shown in the correct place. (They will still be very slightly offset, owing to the difference between the physical position of the visible and IR strobe LEDs on the wand.)

Prepare a Vicon system

Configure Vicon connectivity units

Vicon connectivity units are 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 Vicon system.

As part of setting up your Vicon system, you configure your Vicon connectivity unit(s) for system communications and any GPO or remote triggering.

The **Vicon Connectivity** node is displayed under the Local Vicon System node when Vicon Nexus is connected to the Vicon system and is in Live mode. It is displayed under the Vicon Data node when Nexus is in Offline mode. It lists each connectivity unit connected to your Vicon system.



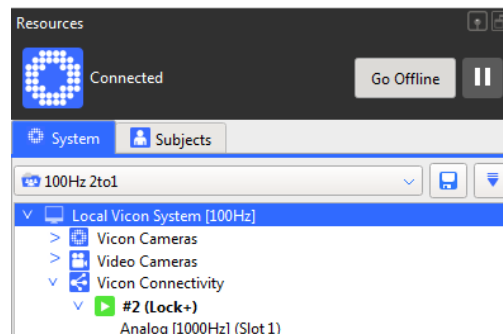
Note

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 Studio and Vicon Lock Lab).

Prepare a Vicon system

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

- **Vicon Lock unit:** Facilitates the integration of synchronous third-party equipment with Vicon Valkyrie, Vicon Vantage, and Vicon Vero cameras by providing or receiving synchronization and/or timecode. Also provides connectivity for third-party analog capture sources, such as force plates and EMG equipment. Connects to a UPoE or PoE+ switch to which Vicon cameras and the host PC are connected.



- If your Vicon system includes UPoE or PoE+ switches, note that although they do not appear as connectivity nodes in the **System Resources** tree, the cameras that are connected to them are displayed.



Important

Before managing Vicon connectivity units, ensure that the desired system configuration has been selected in the **System Resources** pane (see [Manage configurations in Vicon Nexus, page 24](#)).

Prepare a Vicon system


Set up Vicon connectivity units


The **Vicon Connectivity** node lists each Vicon Lock unit connected to your Vicon system. For each unit, the node name includes the device position number, any display name specified in the Identification property, and the device type listed in parentheses, for example **#1 Name (Lock Lab)**. For Lock Lab, the sample rates are displayed in brackets, and an Analog Card (Slot 1) sub node is displayed as appropriate. If no analog source is selected, [No Source] is displayed after the device name.


The Lock node enables you to manage the identification and configuration settings for each connectivity unit included in your Vicon system architecture. The node is displayed under the **Vicon Connectivity** node in the **System Resources** pane when Vicon Nexus is connected to a Vicon system with at least one Lock unit and is in Live mode (click the **Go Live** button).

To configure connectivity units for analog data acquisition:

1. In the **System Resources** pane, click the **Go Live** button.
2. In the **System Resources** tree, select the node whose properties you want to configure:
 - **Vicon Connectivity** node for all Vicon connectivity units
 - A sub node for a specific connectivity unit – the sub nodes in the **System Resources** tree correspond to the IDs assigned by Nexus. If a connectivity unit has automatically been designated as the source of synchronization for the Vicon system, its node name is displayed in bold. The colored icon beside a connectivity node identifies the status of the device:

 Green play button: Component OK (active). 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 Status section of Properties.

 Gray play button: Component connected but not contributing any data.

 Red stop button: Component down (unavailable or disconnected).

In the **Properties** section at the bottom of the **System Resources** pane, view or change settings for the desired properties.

Prepare a Vicon system

When you first set up your Vicon system, you must configure at least:

- **Name** A name you supply, to enable you to identify this unit easily
- **Sync Out** (if you are using synchronization functionality) The general purpose output driver (*.gpo file) you specify here determines the output frequency of the synchronization pulse. You can select a driver for each of the sync outputs. For further details, see the *Vicon Systems Setup Guide*.)

In subsequent sessions, you may wish to configure additional properties to suit the needs of your motion capture application. For details about all the properties for Vicon connectivity units, see Vicon Lock properties in the *Vicon Nexus Reference Guide*.

3. In the **System Resources** pane, click the **Save** button to save your system configuration settings to a .system file in the Systems configurations folder (see [Manage configurations in Vicon Nexus, page 24](#)).

Prepare a Vicon system

Configure supported devices

As part of setting up your Vicon system, you configure supported devices using the **Devices** node in the **System Resources** pane.

The **Devices** node is displayed under the **Local Vicon System** node when Vicon Nexus is connected to a Vicon system with at least one Vicon or supported third-party analog or EMG device and is in Live mode. It is displayed under the **Vicon Data** node when Nexus is in Offline mode. The **Devices** node lists each supported device connected to your Vicon system.

For each device, the node name includes any display name specified in the **Name** property, its approximate sample rate in brackets, and the device type in parenthesis, for example, **Name [2000Hz] (Analog EMG)**. The default name property displayed is **Name [1000Hz] (Analog EMG)**.

For analog devices, if no analog source is selected, **[No Source]** is displayed after the device type. **Channel** sub nodes are displayed for any analog channels. Predefined configurations for some devices are supplied with Vicon Nexus.



Tip

To add new device entries to this node, Vicon Nexus must be in Live mode (click the **Go Live** button). Before managing other devices, ensure that the desired system configuration has been selected in the **System Resources** pane (see [Manage configurations in Vicon Nexus, page 24](#)).

To view a graph of one or more device output or component signals:

1. In the **System Resources** tree, expand the **Devices** node to show the devices connected to your Nexus system
2. Select one or more devices, outputs or components.
3. From the view pane toolbar, select **Graph**.
4. If necessary, in the **Graph** view toolbar, from the **Graph Type** drop-down list, select **Components**.
5. The **Graph** view displays a graph of the selected components.

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For more information on configuring supported devices, see:

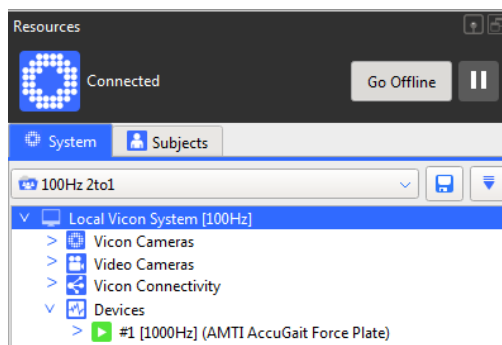
- [Configure force plates, page 93](#)
- [Configure EMG devices, page 116](#)
- [Configure Vicon IMUs, page 123](#)

Prepare a Vicon system

Configure force plates

As part of setting up your Vicon system, you manage the connection and configuration settings for supported force plates in your Vicon system with the appropriate force plate node. You can select the required force plate node under the Devices node in the **System Resources** pane when Vicon Nexus is connected to a Vicon system with at least one force plate unit and is in Live mode. When Nexus is in Offline mode, the force plate node is displayed under the Devices node of the Vicon Data node.

The **Devices** node lists each force plate connected to your Vicon system. For each device, the node name includes any display name specified in the Name property, its sample rate in brackets, and the force plate type in parentheses, for example, **Name [1000Hz] (AMTI AccuGait Force Plate)**. If no analog source is selected, **[No Source]** is displayed after the device type. **Channel - #** sub nodes are displayed for each channel. Predefined configurations for some supported force plates are supplied with Vicon Nexus.



Important

To add new force plate entries to the **Devices** node, Nexus must be in Live mode (click the Go Live button). Before managing force plates, ensure that the desired system configuration has been selected in the **System Resources** pane (see [Manage configurations in Vicon Nexus, page 24](#)).

Force plates data can be acquired through the analog capture functionality of a Vicon connectivity device (Vicon Lock). This topic describes the analog connection only. If your force plate has a digital output, it is possible that this data stream can also be captured, but this depends on the data stream's format

Prepare a Vicon system


and the equipment's manufacturer. For information on the digital data streams that can be used with Vicon systems, contact [Vicon Support](#)¹⁴.


Before attempting to add a specific force plate model as a device in Nexus, also see the following information:

- **AMTI force plates:** Ensure you have updated the device drivers (see [Set a hardware trigger for AMTI force plates](#), page 105).
- **Bertec instrumented treadmills:** See the PDF *Set up a Bertec instrumented treadmill*, available from [PDF downloads for Vicon Nexus](#)¹⁵.
- **Motekforce Link treadmills:** See [Usage recommendations for Motekforce Link treadmills](#), page 115.

To configure force plates for analog data capture:

1. In the **System Resources** pane, click the **Go Live** button.
The first time you use Nexus, the **Devices** node is empty. You must add and configure a new force plate device before it will be displayed in the **System Resources** tree.
2. In the **System Resources** tree, right-click the **Devices** node, point to **Add Analog Device** and from the context menu select the type of force plate that is integrated in your Vicon system. The selected force plate node automatically expands to display the newly created device. (For Motekforce Link treadmills, two new device nodes are displayed, one for each plate.) If the appropriate type is not displayed, contact Vicon Support. The colored icon beside a force plate node identifies the status of the device and of any connected analog source:

 Green play button: Component OK (active or connected); if an analog device is connected, the analog source is selected and all channels are configured.

 Yellow pause button: Component is not fully set up (eg, not all channels have been assigned a pin or the calibration matrix has not been configured).

 Gray play button: Component connected but not contributing any data.

 Red stop button: Component down (unavailable or disconnected).


These colored icons correspond to those used for the device summary in the **Status Communications** pane.

¹⁴ <mailto:support@vicon.com>

¹⁵ <https://help.vicon.com/space/Nexus216/11611993/PDF+downloads+for+Vicon+Nexus>

Prepare a Vicon system

3. In the **Properties** section at the bottom of the **System Resources** pane, view or change settings for the following properties:
 - a. In the **General** section, enter a Name.
 - b. In the **General** section, go to the **Calibration File** field, and load the manufacturer's calibration file:
 - If the calibration file is not listed in the drop-down list, click the ellipsis (...) next to the **Calibration File** field to browse to the relevant location, and select it. The file becomes available in the drop-down list.
 - Select the calibration file. (For Motekforce Link treadmills, note that a single calibration file is used for both plates.)
 - If not supplied by the manufacturer's calibration file, you can set the device **Dimensions**, **Position**, **Orientation**, and **Origin** in those **Properties** sections.
 - c. If there is no calibration file, click **Show Advanced** at the top right of the **Properties** section and enter the **Calibration Matrix 6x6 Matrix** values manually.

 **Important:** For the force plate to become active, you must enter the **Matrix** values, either via a calibration file or by manual entry.
 - d. In the **Source** section, select a **Source** (the Vicon connectivity device to which the device is attached) from the drop-down list.
The **Source** drop-down list contains all connected Vicon connectivity devices; a USB force plate will have its **Source** drop-down list populated with connected USB devices of the required type.
 - e. In the **Source** section, use the **Fill** button to populate the input connections sequentially (if these are consecutive on the Vicon connectivity device).
 - f. In the **Source** section, select the **Gain** for the Source from the choice of gains available for the Vicon connectivity device.
4. In the **System Resources** tree, if necessary, expand the force plate node to expose the **Force**, **Moment** and **CoP** (Center of Pressure) channels.
The colored icon beside the output node identifies the analog channel status:
 - Green arrow: Analog channel connected to source device.
 - Yellow arrow: Analog channel has not been assigned a pin.

Prepare a Vicon system

5. To tare the force plate at zero load, in the **General** section, click the **Zero Level** browse button and enter the matrix properties.
 - ✔ **Tip:** You can also tare the force plate by right-clicking on the force plate name in the **System Resources** tree and selecting **Zero Level**.
6. In a **3D Perspective** view, ensure that a gray or colored rectangle with the number 1 on it, representing the force plate, is displayed in the capture volume where you have positioned it. If you have multiple force plates configured, they will be numbered in the order they appear in the **System Resources** tree.
7. In the capture volume, have someone step onto the force plate. You should see the force vector being displayed in real time.
8. At the top of the **System Resources** pane, click the Save button to save your system configuration settings to a `.system` file in the **Systems** configurations folder (see [Manage configurations in Vicon Nexus, page 24](#)).
9. From the **System Resources** tree, expand the force plate node and select the **Force** output.
10. Switch to a **Graph** view.
11. If necessary, select **Components** from the **Graph Type** drop-down list. A real-time graph of the **Force** output is displayed.
12. Verify that the vertical (F_z) force component is equal to [known mass * 9.81].

For more information, see:

- [Force plate minimum setup requirements, page 97](#)
- [Change force plate display options, page 98](#)
- [Visualize and record Force Threshold, page 101](#)
- [View combined output from multiple force plates, page 102](#)

See also Force plate properties in the *Vicon Nexus Reference Guide*.

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Force plate minimum setup requirements

For a force plate to appear in a **3D Perspective** view, you must configure at least the following properties:

- Source
- Calibration Matrix
- Position (X, Y, Z)
- Name: Assigning a force plate name is recommended, especially if you are setting up more than one force plate.

For a force plate to appear in Live mode in the **3D Perspective** view, you must fully configure:

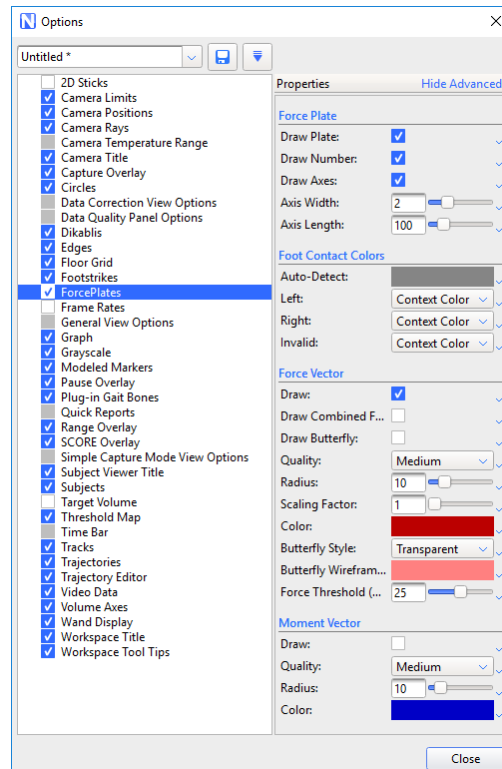
- Source
- Calibration Matrix
- Dimensions (X, Y)
- Origin

The **Position** and **Orientation** are necessary for the **CoP** (Center of Pressure) and **Force** vector to be represented correctly, but they can be changed according to the setup. In subsequent sessions, you may wish to configure additional properties to suit the needs of your motion capture application.

Prepare a Vicon system

Change force plate display options

You can configure colors and other force plate display options in the Options dialog box (F7).



You turn a display option on or off by selecting or clearing the corresponding check box.



Tip

You can set colors for some of the display options. If a default color is listed as Context Color (this indicates the color is set to the system default) and you want to change it, click the down arrow to the right of the drop-down list, and clear the Macro check box. You can then activate the color picker.

Prepare a Vicon system

To view force plates in a **3D Perspective** view, ensure the **Force Plates** check box on the left side of the **Options** dialog box is selected. You can change the following options:

- [Force Plate section, page 99](#)
- [Foot Contact Colors section, page 100](#)
- [Force Vector section, page 100](#)
- [Moment Vector section, page 100](#)

Force Plate section

Property	Description
Draw Plate	When selected, the force plate appears in the View pane.
Draw Number	By default, each force plate displays a number (e.g., 1, 2, 3). The number corresponds to the order in which the force plates appear in the System Resources tree. You can turn off the number display by clearing the check box.
Draw Axes	You can configure how the force plate axes appear in the 3D Perspective view by selecting the Draw Axes check box. The axes appear below the floor plane of the volume.
Axis Width	Width of the axis. Set the axis width by typing a value or by moving the slider.
Axis Length	Length of the axis. Set the axis length by typing a value or by moving the slider.

Prepare a Vicon system

Foot Contact Colors section

If you have designated a force plate to be a left or right foot contact, by default Nexus displays a left-foot contact force plate in red in the **3D Perspective** view, a right-foot contact force plate in green. An auto-detect force plate is displayed in light gray, and an invalid force plate (neither left, right nor auto-detect) is displayed in dark gray.

To change the default colors for the force plate display, in the **Options** dialog box, select the **Force Plates** option, and in the **Properties** pane on the right, click on a color in the **Foot Contact Colors** section to activate the color picker.

Force Vector section

You can visualize the force vector by selecting the **Draw** and **Draw Butterfly** check boxes. Then you can set the quality of the vector display, as well as the radius and scaling factor (length), the butterfly style (whether the butterfly is represented as transparent, as a wireframe or both), and color.

Setting a **Scaling Factor** value causes the vector to be displayed as an arrow originating from the force plate in the direction of the force.

Values below the **Force Threshold (N)** are not visualized as force vectors on the plate. This setting does not affect the value for **Force Threshold** that is written into a recorded trial (see [Visualize and record Force Threshold](#), page 101).

Moment Vector section

You can select whether the moment vector is visually represented in the **3D Perspective** view, as well as the quality, radius and color of the moment vector display.

You can see the results of your settings in the **3D Perspective** view as you configure an option.

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Visualize and record Force Threshold

The **Force Threshold** of a force plate specifies the noise floor value in Newtons. Forces below this value are assumed to be noise and are clamped to zero.

An **Options** setting for force plates enables you to specify a different value for the **Force Threshold** depending on whether you are recording data or displaying a trial.

- The value for the **Force Threshold** that is set in the **System Resources** pane for the force plate affects the values that are written into a recorded trial. For example, if the **Force Threshold** is set to 25 N, all values below this are considered noise and values of zero are recorded.
- The value for the **Force Threshold** that is set in the **Options** dialog box ensures that values below this threshold are not visualized as force vectors on the plate. This prevents very small values, which are simply noise, from creating a distracting 'flickering' force vector on the plate. If you are distracted by flickering while viewing a trial, raise this value to remove the flickering. This does not affect the value for **Force Threshold** that is written into a recorded trial.

To specify the **Force Threshold** that is recorded for a force plate:

1. Ensure the system is in Live mode.
2. In the **System Resources** tree, select the force plate.
3. In the **Properties** pane, ensure the **Advanced** properties are displayed.
4. In the **General** section, change **Force Threshold (N)** from the default (25 N) to the required value.
Values below this magnitude are ignored and are recorded as zero.

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To specify a value for visualizing the force vector:

1. Press F7 to open the **Options** dialog box.
2. On the left click **ForcePlates**.
3. In the **Properties** pane on the right, in the **Force Vector** section, change the **Force Threshold (N)** to the required value (the default is 25 N).
Regardless of the setting of the **Force Threshold** in the **System Resources** pane, the force vector that is displayed in the view pane is below the threshold that is set in the **Options** dialog box. For example, if you set the value to 10 in the **System Resources** pane, but left it at 25 in in the **Options** dialog box, a value of 15 would be prevented from causing flickering, but would be recorded in saved trials.

View combined output from multiple force plates

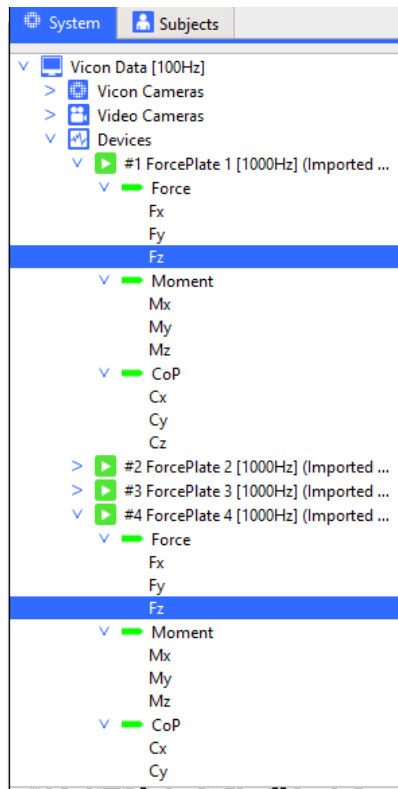
You can combine selected outputs from multiple force plates, both in Live mode and when reviewing captured trials in Offline mode. For example, in trials where the subject's feet land on separate force plates, you can examine the combined landing force or overall CoP from both feet.

To view combined output from multiple force plates:

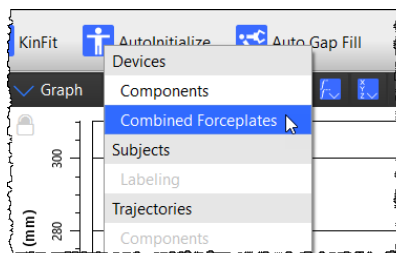
1. In the **Options** dialog box (press F7), on the left, click **ForcePlates** and in the **Properties** pane on the right, in the **Force Vector** section, ensure **Draw Combined Force Vector** is selected.
2. In the **System Resources** tree, CTRL+click to select the required outputs from each force plate.

Prepare a Vicon system

Ensure you select identical outputs from each force plate.

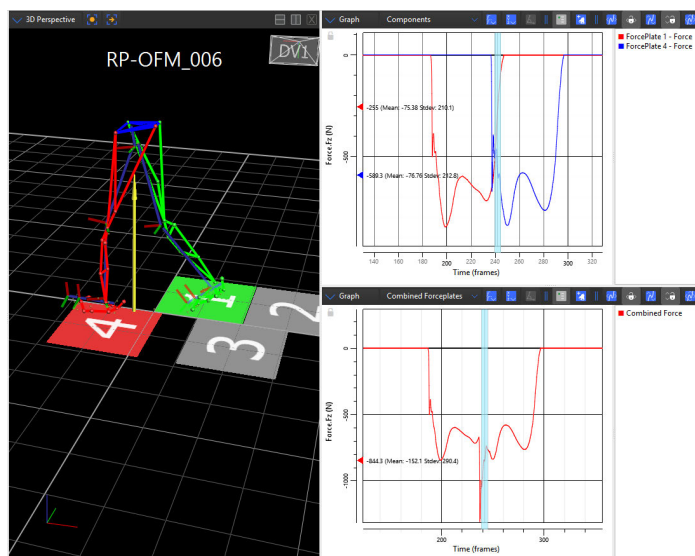


3. In a Graph view, in the Graph type list, select Combined Forceplates.



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4. In the Graph view, the combined output you selected is displayed.



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Set a hardware trigger for AMTI force plates

In Nexus 2.16 and later, to set a hardware trigger for AMTI force plates, you must ensure that the AMTI amplifier that receives the sync signal is amplifier 1 in the AMTI Netforce software, as described in the following procedures.

- [Update the device drivers, page 106](#)
- [Set the AMTI hardware trigger, page 108](#)



Note

Device drivers for your force plates are installed when the force plates are initially set up. To enable the AMTI Netforce software and Vicon Nexus to recognize the drivers, you must update them when you first connect the force plates to the PC. To do this, follow the instructions in

[Update the device drivers, page 106](#).

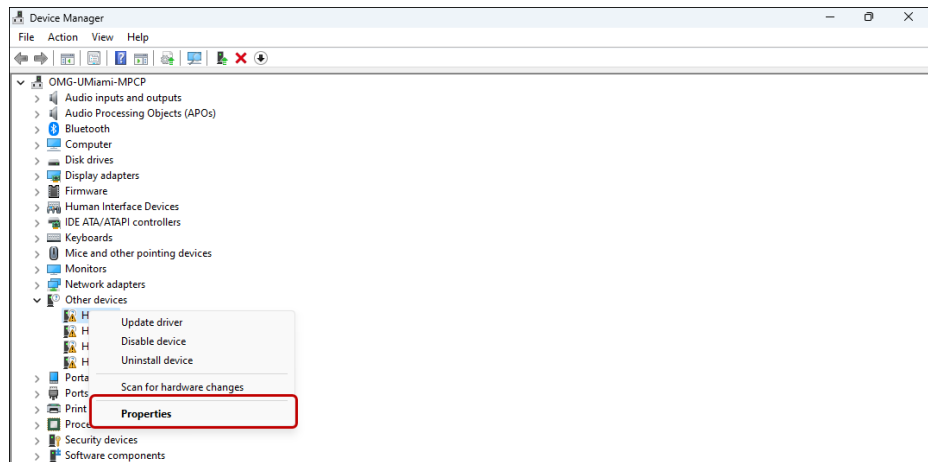
After you have updated the device drivers, you can proceed to [Set the AMTI hardware trigger, page 108](#).

Prepare a Vicon system

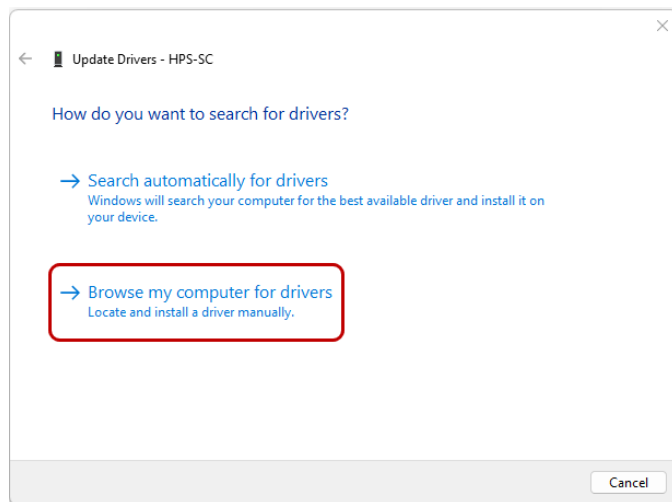
Update the device drivers

When you first connect AMTI force plates to the PC, to enable the AMTI Netforce software and Vicon Nexus to recognize the force plates, you must update the relevant device drivers. To do this:

1. In the Windows Device Manager, right-click on the device that belongs to one of your force plates and click Properties.

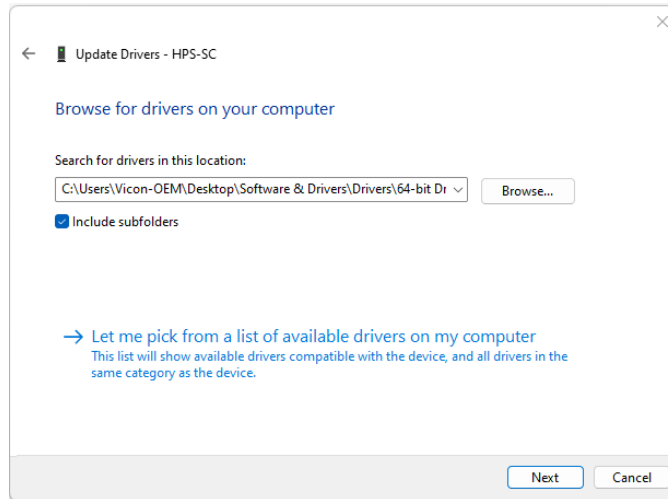


2. On the Driver tab, click Update Driver and select Browse my computer for drivers (not the automatic search).

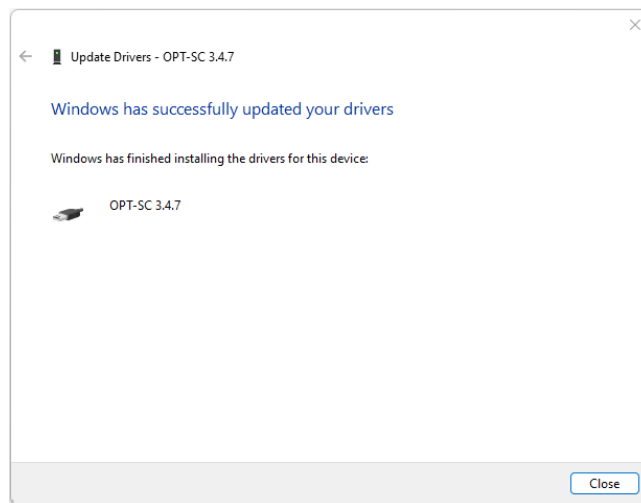


Prepare a Vicon system

3. Locate the required drivers for your force plate and click Next.



When Windows finishes updating the drivers, a message similar to the following is displayed:



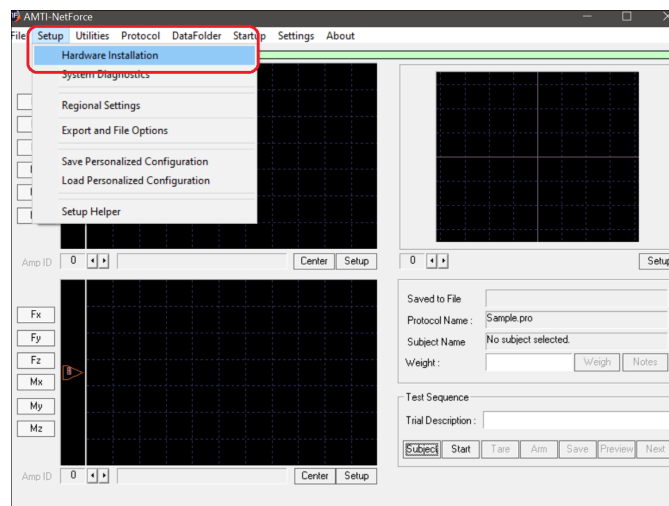
4. Repeat this procedure for every AMTI force plate that is included in your system.

Prepare a Vicon system

Set the AMTI hardware trigger

To set the AMTI hardware trigger, complete the following steps:

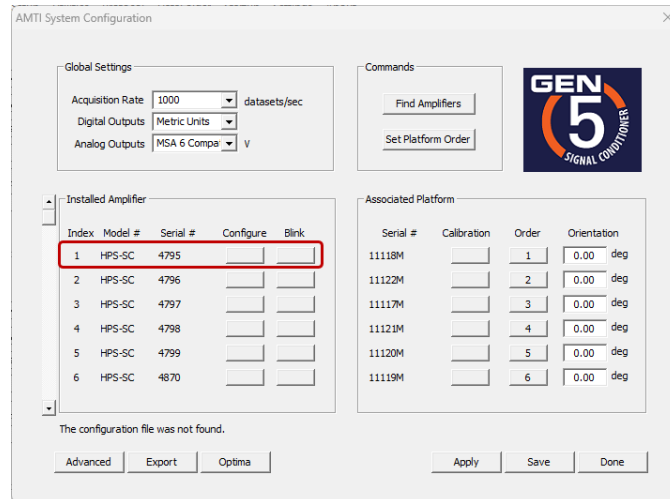
1. Ensure all AMTI amplifiers are connected to the PC and Nexus is closed.
 - Note:** Ensure each amplifier is channeled through a single powered USB hub provided by AMTI.
 - If you are using a single force plate, go straight to [Step 3, page 110](#).
2. If you are using multiple force plates, identify the correct amplifier to receive the sync signal as follows:
 - a. Open the AMTI NetForce software and from the Setup menu, select **Hardware Installation**.



- b. In the **Hardware Installation** dialog, check that all the force plates are displayed in the platform list and then click **Modify**.

Prepare a Vicon system

- c. In the list of AMTI devices, find the first amplifier in the list and make a note of its serial number.



Close the dialog by clicking Done and close the AMTI NetForce software.

- d. In the volume, find the amplifier you identified in the previous step (using its serial number).



Prepare a Vicon system

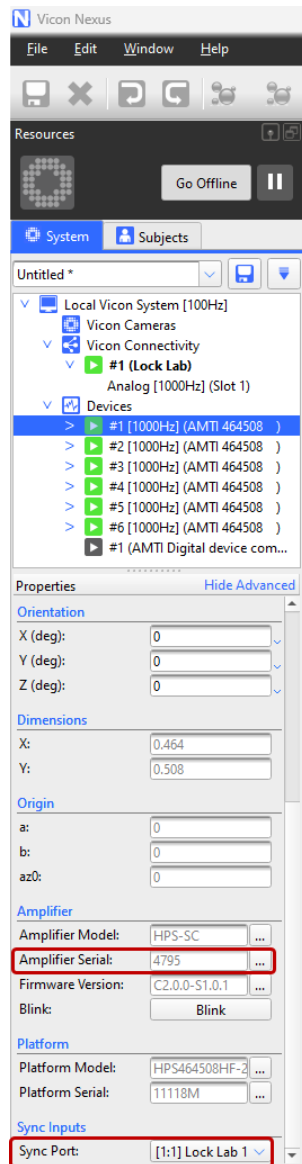
3. Connect the amplifier to one of the GPO ports (Sync Outputs) on the Lock, noting the port number on the Lock.



4. Open Nexus and wait for the force plate(s) to connect.

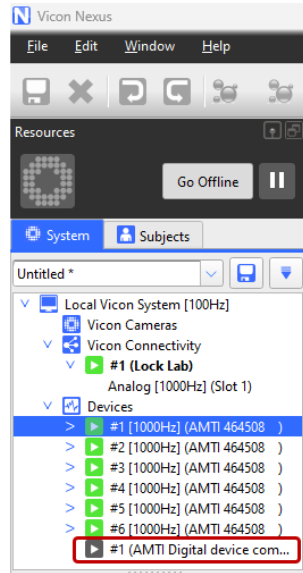
Prepare a Vicon system

5. To find the required amplifier, display the advanced settings of each amp, identify the amp by its serial number and in the Sync Inputs, select the Sync Port that you noted previously.

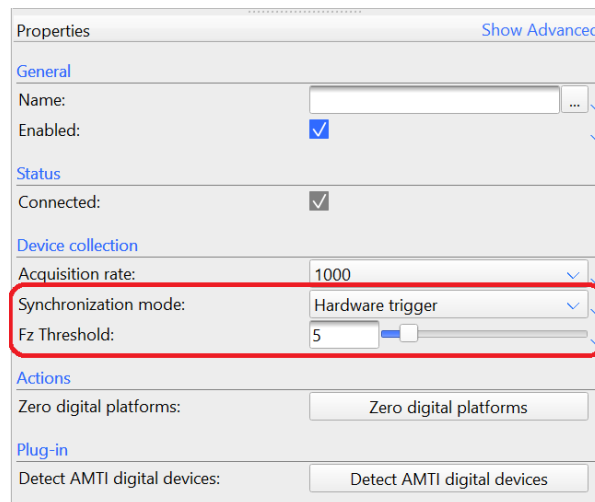


Prepare a Vicon system

- In the System tree, select the AMTI digital device common settings node.



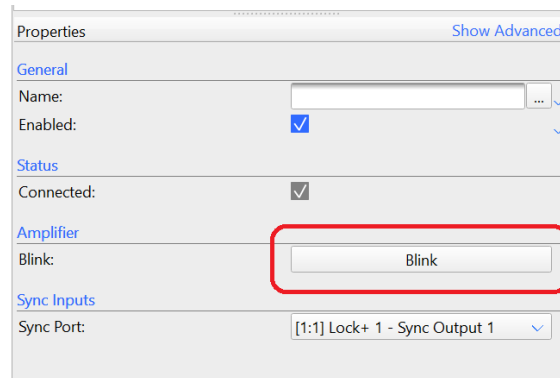
- Go to Properties below and under Device Collection, change the Synchronization mode to Hardware trigger. If required, you can also set the force plate threshold (Fz Threshold).



In the System tree above, the node for the force plate turns gray.

Prepare a Vicon system

- To reconnect the force plate, select the force plate node again, go to its **Properties** and under **Amplifier**, click **Blink**.



The force plate now reconnects and in the **System tree**, its icon turns green.



Tip

During initial setup of your system, to ensure all digital devices (force plates, EMGs, IMUs) are correctly synchronized, when you have connected them all to your system and configured them correctly, in **System Resources**, right-click on **Local Vicon System** and select **Resynchronize**. You can then 'Blink' the force plates as described in Step 11 above.

Prepare a Vicon system

Set up Bertec instrumented treadmills

For information on integrating a Bertec instrumented treadmill in Nexus 2 (both 64- and 32-bit versions), see the PDF *Set up a Bertec instrumented treadmill*, available from [PDF downloads for Vicon Nexus](#)¹⁶.



Note

Currently, you can only integrate a Bertec treadmill as an analog device in Nexus.

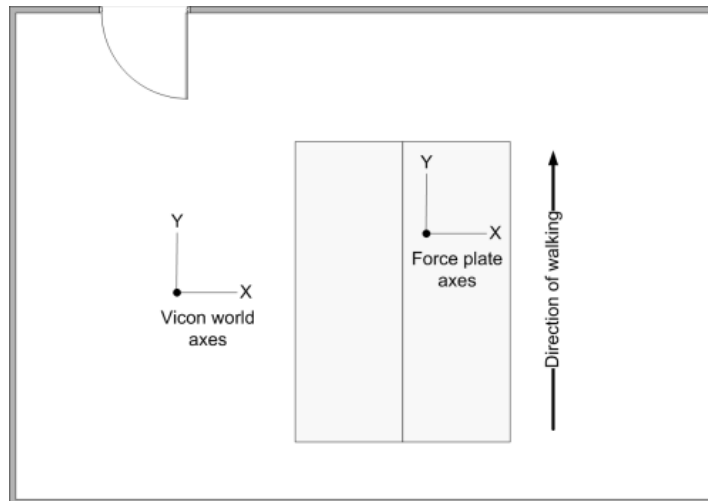
¹⁶ <https://help.vicon.com/space/Nexus216/11611993/PDF+downloads+for+Vicon+Nexus>

Prepare a Vicon system

Usage recommendations for Motekforce Link treadmills

Note the following recommendations for setting up and using a Motekforce Link treadmill with Nexus:

- For ease of use, align the Vicon world Y-axis with the direction of walking on the treadmill. To achieve this, you can either move the treadmill in the laboratory to align with the Vicon world axes in Nexus, or change the Vicon world axes to align with the position of the treadmill. You can then set the incline of both plates of the treadmill by adjusting the X Orientation property of the force plate.



- Assuming you follow this advice so that the direction of walking on the force plates aligns with the Vicon Y-axis, and the left-right (medial-lateral) direction aligns with the Vicon X-axis, inclination of the force plate will correspond to a rotation of the plate about its X-axis. For example, to set a 10 degree inclination of the treadmill, you would set a 10 degree X (deg) rotation in the plate's Orientation properties.
- Each capture must use only one inclination of the treadmill. If you need to capture multiple inclinations, to enable you to switch easily between different inclinations, create a number of separate system files: one for each required inclination.

Prepare a Vicon system





Configure EMG devices

EMG data can be acquired through the analog capture functionality of a Vicon connectivity device. If your EMG device has a digital output, it is possible that this data stream can also be captured, but this depends on the data stream's format and the equipment's manufacturer. For more information on the digital data streams that can be used with your Vicon system, contact Vicon Support.

To configure EMG devices for data capture:

1. If Vicon Nexus is not in Live mode, in the **System Resources** pane, click the **Go Live** button.
The first time you use Nexus, the **Devices** node is empty. You must add and configure a new EMG device before it will be displayed in the **System Resources** pane.
2. In the **System Resources** tree, right-click **Devices**, point to **Add Analog Device** or **Add Digital Device** and from the context menu select the type of EMG device that is integrated in your Vicon system.
The **Devices** node automatically expands to display the newly created EMG device with its attendant output:
 - An analog Accelerometer will have an **Acceleration** output
 - An analog EMG will have a **Voltage** output
 - A ZeroWire EMG will have a **Voltage** and a **Foot Switch** output
3. In the **System Resources** tree, select the node whose properties you wish to edit:
 - **Generic Analog Device** sub node for all devices
 - A sub node for a specific device

The colored icon beside a device node identifies the status of the device and of any connected source:

-  Green play button: Component OK (active or connected); if an analog device is connected, the source is selected and all channels are configured.
-  Yellow pause button: Component is not fully set up (e.g., not all channels have been assigned a pin or the calibration matrix has not been configured).
-  Gray play button: Component connected but not contributing any data.
-  Red stop button: Component down (unavailable or disconnected).

Prepare a Vicon system

4. In the **Properties** section at the bottom of the **System Resources** pane, view or change settings for the following properties:
 - a. In the **General** section:
 - Enter a **Name** to enable you to identify the device.
 - Set the **Delay Compensation** (in frames). All devices have a delay compensation value which adjusts the synchronization offset between the device and the Vicon data. The **Delay Compensation** slider bar enables you to correct this difference. Values can be set between -10 and 10 (the default is 0). Note that analog data collected with a Vicon Lock is already synchronized, so in this case, set this value to 0.
 - Set the **Amplifier Gain**. The voltage gain scale factor. Can be set between 1–1000. The default setting depends on the device.
 - b. In the **Source** section, select a **Source** (the Vicon connectivity device to which the accelerometer or EMG is attached) from the list.

When you first set up your Vicon system, you must configure at least the **Name** and **Source** properties, add channels and designate the **Source** for each channel. In subsequent sessions, you may wish to configure additional properties to suit your needs.

5. In the **System Resources** tree, expand the device node you added and select a device output sub node which corresponds to an output from the device (such as **Acceleration** for an accelerometer, or **Voltage** for an EMG device).

Prepare a Vicon system

6. Right-click the device output and add an output component or components:

For an accelerometer or analog EMG, choices are:

- Add Component (or 2, 4, or 8 Components)

For a ZeroWire EMG, choices are:

Under Voltage:

- Add EMG (numbered 1–16)
- Remove Channels (if you have added channels)
- Enable Auto Populate (or Disable Auto Populate if the AutoPopulate Properties box is selected)

Under Foot Switch:

- Add FSW (designated A1–A4 and B1–B4)

A new component node (or nodes) is added to the tree.

The colored icon beside the device output node identifies the analog channel status:

- Green arrow: Analog channel connected to source device.
- Yellow arrow: Analog channel not fully set up (e.g., not all channels have been assigned a pin or the calibration matrix has not be configured).

7. In the **Properties** pane under the **General** section, specify a **Name** for the node or nodes you have added.

For the ZeroWire EMG, **Name** is the only property setting necessary.

8. In the **Properties Source** section:

- Assign the **Pin** to one of the available pins on **Source** device. After you have assigned a pin, the status icons will turn green.
- Specify the **Gain (V)**.
- Set the **Zero Level**.

9. At the top of the **System Resources** pane, click the **Save** button to save your system configuration settings to a .system file in the **Systems Configurations** folder (see [Manage configurations in Vicon Nexus, page 24](#)).

For more information on the properties for EMG and other devices, see *System Resources nodes* in the *Vicon Nexus Reference Guide*.

Prepare a Vicon system



Note

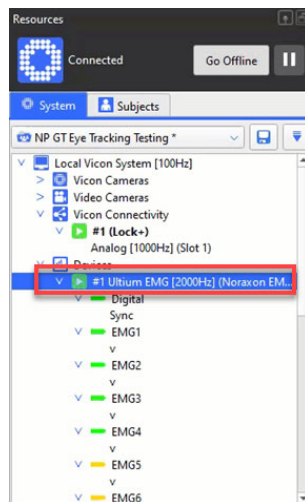
Due to an issue with the Noraxon VDD, deactivating EMG channels in Nexus is not supported and if attempted, a summation of all the channels is produced. For information on how to turn off EMG channels, see [Deactivate Noraxon EMG channels, page 120](#).

Prepare a Vicon system

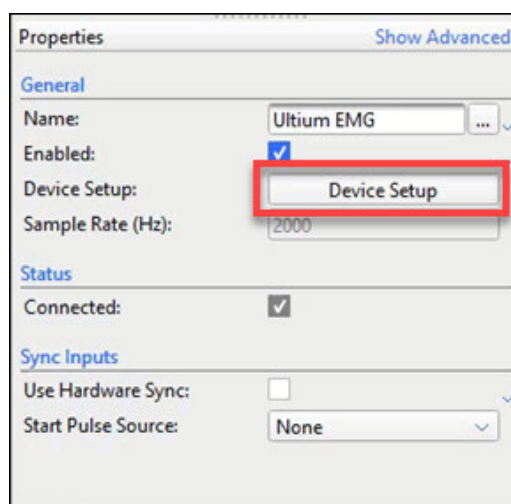
Deactivate Noraxon EMG channels

Due to an issue with the Noraxon VDD, deactivating EMG channels in Nexus is not supported and if attempted, a summation of all the channels is produced. If some sensors are not needed for the measurement, do not deactivate EMG channels in Nexus, but go to the Device Setup and turn them off by deleting the relevant EMG channels from the hardware list. To do this, complete the following steps.

1. Under Local Vicon System, expand Devices and select the Ultium EMG.

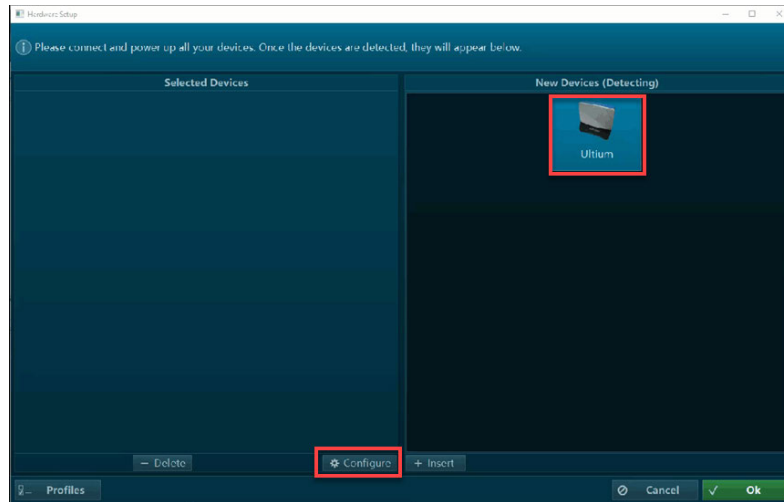


2. In the Properties below, click Device Setup.

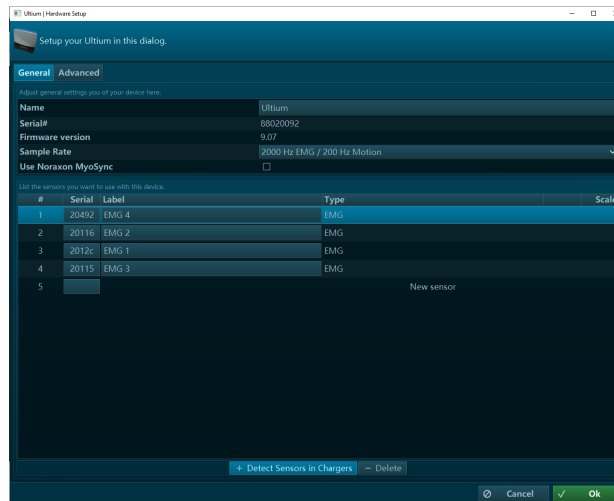


Prepare a Vicon system

- In the Hardware Setup dialog, select the Ultium in the pane on the right and then click Configure.

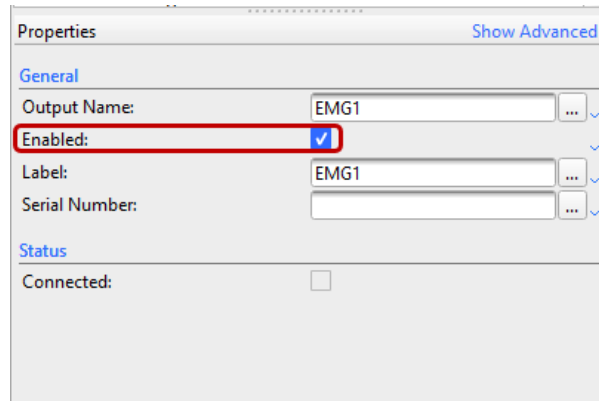


- In the next dialog, ensure the required sensors have been detected, select the ones you want to deactivate, click Delete and then click OK.



Prepare a Vicon system

5. In the **Properties** pane for the relevant sensors, ensure the sensors remain selected in Nexus (ie, do not clear **Enabled**).



Prepare a Vicon system

Configure Vicon IMUs

To enable you to capture data from Vicon IMUs (Inertial Measurement Units) and optical markers simultaneously, you can use IMUs as digital devices in Nexus to stream and capture data. You can use IMUs to preview data in real time and to capture data onto the IMUs' internal memory. You can then plug the IMUs into your PC via USB and use Nexus to download the captured data.

Important

- Vicon IMUs are supported for use with Nexus for research purposes only. For full sensor safety and regulatory details, see the Vicon Blue Trident Model V2 Safety and Regulatory Information.

Blue Trident sensors

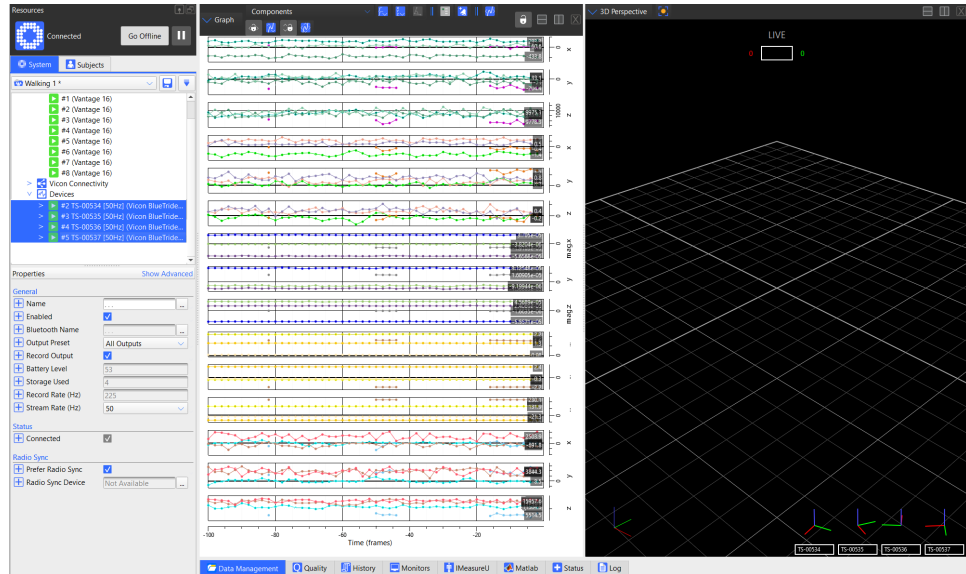
- Windows 10 and later only is supported. Ensure the latest Windows 10 updates are installed.
- The firmware for Blue Trident sensors that are to be used with Nexus 2.10 or later must be updated to version 9.0.2 or later, using Capture.U Desktop 1.1 or later, which is available from the [Capture.U page](#)¹⁷ on the Vicon website.
- Second-generation Blue Trident sensors are supplied with Firmware 10 – do **not** downgrade their firmware. If you have first-generation Blue Trident sensors, you can safely downgrade their firmware, if necessary. However, as Capture.U 1.3.1 Desktop is not compatible with firmware earlier than 10.#, if you downgrade the firmware from version 10, you must uninstall Capture.U 1.3.1 and use an earlier version of Capture.U.

Blue Thunder sensors

- Blue Thunder IMU sensors are not supported in Nexus 2.10 or later. If you want to capture Blue Thunder data, use Nexus 2.9.x.
- You can load existing processed trials with Blue Thunder data into Nexus 2.10 or later and view the captured IMU data.
- The IMeasureU plug-in is not available in Nexus 2.10 or later.

¹⁷ <https://www.vicon.com/software/capture-u/>

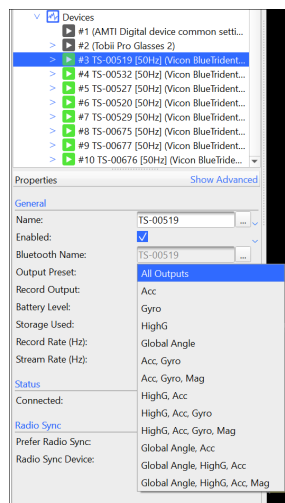
Prepare a Vicon system



Prepare a Vicon system

Before you begin using IMUs with Nexus, note the following points:

- Windows 10 and later only is supported. Ensure the latest Windows 10 updates are installed.
- IMUs have a variety of collection modes, including 15-axes (Acc, Gyro, Mag, HighG Acc, Global Angle):



If Global Angle is selected, the capture rate is 225 Hz. If Global Angle is cleared, the capture rate is 1125 Hz. If HighG only is selected, the capture rate is 1600 Hz.

- Nexus supports the use of up to 18 current Vicon IMUs, dependent on the chosen axes and stream rate.
For example:
15 axes (all outputs) at 30 Hz preview rate;
9 axes at 50 Hz preview rate;
3 axes at 100 Hz preview rate.
- You can transfer the data that is collected and stored on your IMUs onto your PC using the IMU Transfer pane in Nexus (see [Download Vicon IMU data, page 320](#)).

For more information, see these topics:

- [Connect Vicon IMUs to Nexus, page 126](#)
- [How is Vicon IMU data synchronized to your Vicon system?, page 131](#)
- [Understand Vicon IMU status, page 133](#)

Prepare a Vicon system

Connect Vicon IMUs to Nexus

The following are brief notes on using Vicon IMUs with Nexus.

 For an introduction to the latest Vicon IMUs, watch the Vicon video [Capture.U Tutorial - Unboxing Blue Trident¹⁸](#), available on YouTube.

For information on the status indicated by the LEDs on the Vicon IMUs, see [Understand Vicon IMU status, page 133](#).

Prepare your hardware

1. Ensure that the supplied Bluetooth[®] (BLE) dongle is plugged into the Windows PC and that its drivers are up-to-date.
2. Ensure your Vicon IMUs are charged and within Bluetooth range.

¹⁸ <https://youtu.be/Rs71f9behFo>

Prepare a Vicon system

Connect Vicon IMUs

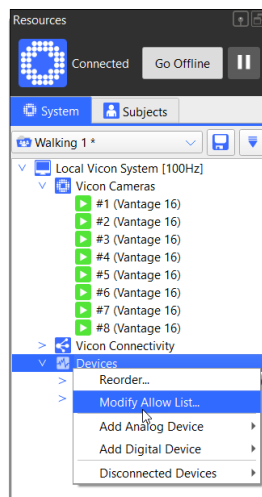
Nexus enables you to connect Vicon IMUs to Nexus so that you can capture IMU data alongside your optical data.

To connect Vicon IMUs:

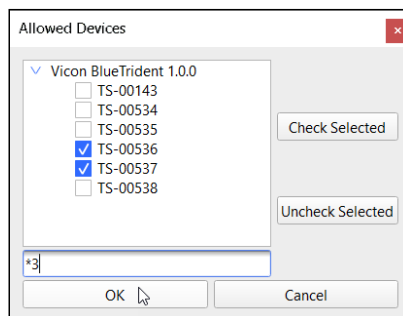
1. Start Nexus.
2. Select the Vicon IMUs that you want to be detected by Nexus.
To do this, you modify a list of all available IMUs to select only those that you want to allow to connect.

To modify the list of allowed IMUs:

- a. In the System Resources tree, right-click Devices.
- b. Click Modify Allow List.

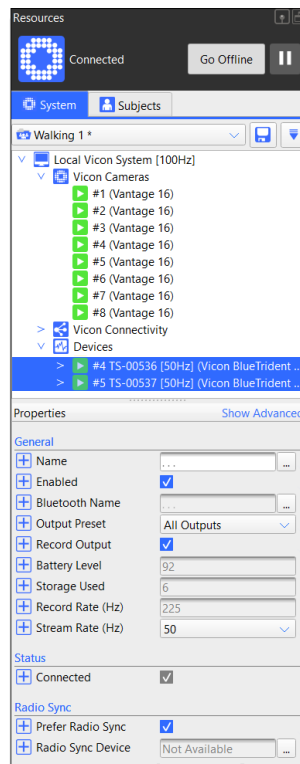


- c. In the **Allowed Devices** dialog box, select only the names of the IMU sensors that you want to connect (to find names from a long list, use the filter with standard wildcards, such as asterisk * and question mark ?), then click **Check Selected** and click **OK**.



Prepare a Vicon system

In the **System Resources** tree, under **Devices**, all the Vicon IMUs that you selected in the **Allowed Devices** list are displayed as connected devices, with a green Play icon next to each IMU name.



When Vicon IMUs are connected into Nexus, in the **Properties** pane in the **Status** section, their status is displayed as **Connected** and the sensor coordinate system is displayed in the bottom right of the 3D Perspective view (if the **Global Angle** axis is enabled – see [Select the required axes, page 311](#)).

Nexus stores your selection of connected sensors in a configuration file, so that they are remembered when you next use Nexus.

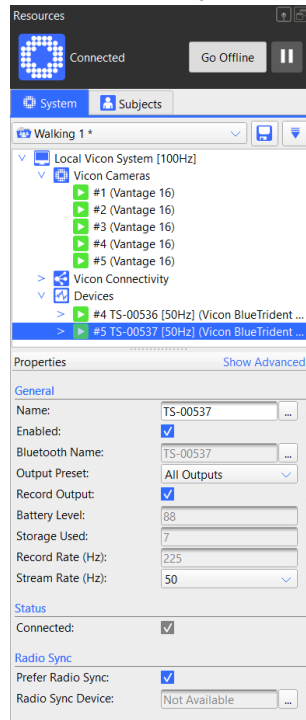
If you need to add or remove sensors, you must modify the allow list again.

Tip: If you need to update IMU firmware (indicated by gray icons next to the sensor names in the **System** tree, and messages in the **Log**), download and install **Vicon Capture.U Desktop** and perform the update.

- To view the settings for a connected IMU, in the **System Resources** tree, select it.

Prepare a Vicon system

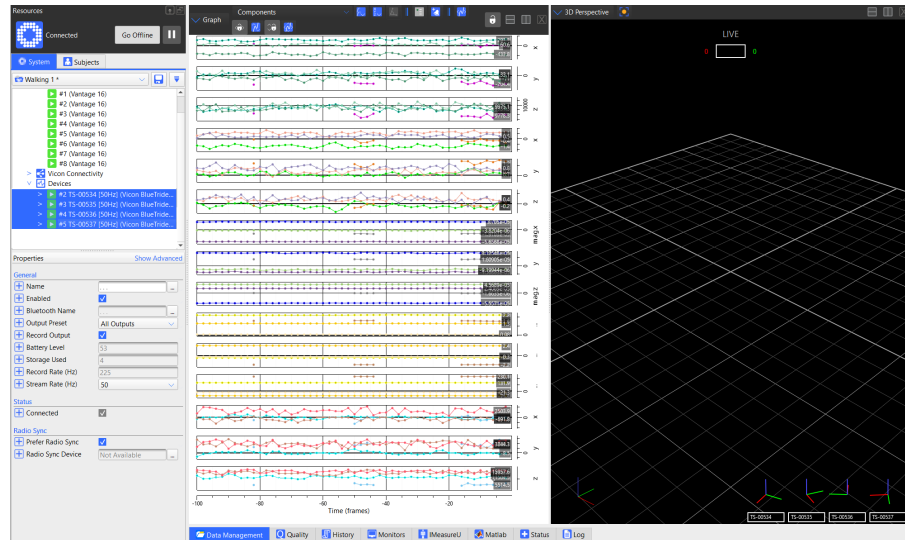
Its settings are displayed in the **Properties** pane, for example, its name, which is initially assigned by Nexus as its serial number (found on the back of the IMU), and battery level.



For more information on the available properties, see Vicon IMU node in the *Vicon Nexus Reference Guide*.

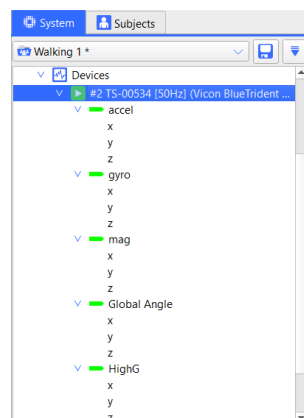
Prepare a Vicon system

The following example shows IMUs connected to Nexus.



When a Vicon IMU is connected, all available axes stream data:

- Low-G accelerometer (16 G) (x, y, z)
- Gyroscope (x, y, z)
- Magnetometer (x, y, z)
- Global Angle (x, y, z)
- High-G accelerometer (200 G) (x, y, z)



You can now attach the IMUs to the subject and set up and start capture (see [Work with Vicon IMUs, page 305](#)).

Prepare a Vicon system

How is Vicon IMU data synchronized to your Vicon system?

Nexus automatically synchronizes your IMU sensor data to your Vicon system so that the IMU data is aligned with the optical data.

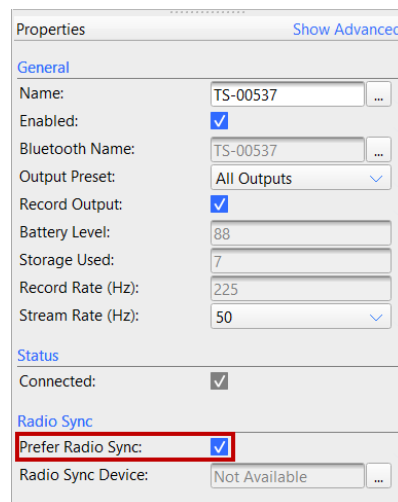
Depending on your system setup, IMU data is synchronized in one of these ways:

- If a Vicon Beacon is present in the Nexus system, it is used by default (hard sync).

If you are using a high number of sensors and/or need a high degree of precision in the synchronization of your data, Vicon recommends that you use hard sync.

⚠ Note: Nexus supports the use of only 1 Vicon Beacon in a Vicon Nexus system.

To confirm that the Vicon IMU sensors can automatically detect the Beacon, ensure **Prefer Radio Sync** is selected in the **Properties** for the Vicon IMU sensors (this is its default setting):



- If no Beacon is present in the system, connection is established via Bluetooth® (soft sync).

If you are using a low number of sensors and/or you don't have a need for precise synchronization of sensor data to optical data (eg, if you're capturing to sensors only), use soft sync. If a Beacon is present in your system, clear **Prefer Radio Sync**.

Prepare a Vicon system



Note

To ensure synchronization of IMU data to the Vicon system, synchronization data is stored on the sensor while IMU sensor data is streaming in Nexus. As soon as the sensor connects to Nexus, whether it is streaming or capturing data, the sensor synchronizes to the Vicon Nexus system.

Prepare a Vicon system

Understand Vicon IMU status

The LEDs on each Vicon IMU display information about its status.

LED display	Vicon IMU status
Both LEDs slow blink (50% duty)	Charging
Both LEDs on steady	Charged
Both LEDs blink 1–4 times, pause; pattern repeats 3 times. For example, full battery: LEDs blink 4 times, pause; pattern repeats 3 times.	Battery indication
Single or both LEDs brief blink (<10% duty); single or both, depending on left or right	Sampling
Single LED on steady	Bootloader waiting*
Both LEDs on steady	Bootloader connected*
Both LEDs twinkle	Bootloader exiting*
Rapid blinking LEDs	Error during a session <ul style="list-style-type: none"> • Error overrun • Error storage • Error sync timeout • Error sync

* To enter bootloader mode, hold down the USB adapter button for at least 10 seconds, then release the button. To exit bootloader mode, wait 60 seconds.

Prepare a Vicon system

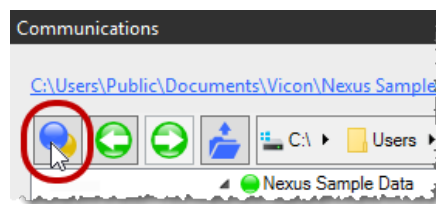
Prepare a data storage location

Before you capture and process a trial, you must create a hierarchical structure for storing and managing all the data associated with the motion capture trial. You do this in the Communications pane, on the Data Management tab.

For a video guide to database management, see the Vicon video, [proEclipse: Preparing and managing your database](#)¹⁹, which is available on YouTube.

To prepare a location for your trial data:

1. In the Communications pane, click the Data Management tab.
2. On the toolbar, click the Show main proEclipse menu button.



3. Click **Manage Eclipse Databases**, and in the **Manage Eclipse Databases** dialog box, click the **Add New** button to enable you to locate and register a database folder. (Registering a folder enables you to select it in the **Currently Registered Eclipse Databases** list and from the recently used files that are displayed when you click the **Show main proEclipse menu button**.)

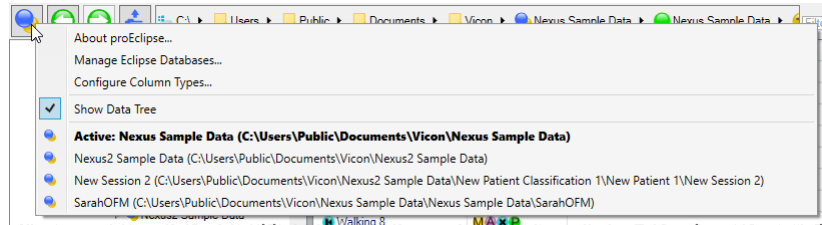
✓ **Tip:** A database is just a folder structure where your Nexus files will be saved. Generally, you can create a database in any unrestricted location.




4. Select a location on your local hard disk for the database folder, or if required, click **Make New Folder** and enter a name for your folder. Click **OK**.
5. In the **Manage Eclipse Databases** dialog box, the folder that you just selected or created appears in the **Currently Registered Eclipse Databases** list. Click **Close**.

¹⁹ <https://www.youtube.com/watch?v=rZh-R7eHwgc&feature=youtu.be>

Prepare a Vicon system

All registered databases are also available when you click the Show main proEclipse menu button.



6. On the **Data Management** tab, click on name of the folder you just created, ensuring its name appears in the live link at the top left of the tab.
 - ✔ **Tip:** To check that your hierarchy of folders appears as expected, click the live link to open an instance of Windows Explorer, where you can see the folder you created.
7. Ensure the folder name is still selected in the hierarchy displayed on the left of the **Data Management** tab, and create a hierarchy of data folders in which to store your data. A good practice is to make sure all your data goes into a session folder. To do this:
 - a. Add a top-level folder by clicking the green **New Patient Classification** button . You can change its name as required. Generally, this classifies a group of subjects such as Men/Women, Old/Young, or Target Population/Controls.
 - b. In the left hand panel, click the new patient classification that you just added and then add a patient folder by clicking the yellow **New Patient** button . Again, you can rename it as required.
 - c. In the left-hand panel, click the patient folder that you just added and then add a session folder by clicking the gray **New Session** button . Rename it as required.
8. Select the new session folder by clicking it on the **Data Management** tab.

You now have an active session, ready to store your preliminary capture.

For more detailed information, see *Data management with Nexus* in the *Vicon Nexus Reference Guide*.

Prepare a Vicon system



Naming sessions and trials

When you name trials (see Capture the required movement), do not give them the same name as the session as this can cause confusion when selecting files in Data Management and may also cause issues if your Vicon Nexus system includes FLIR cameras.

Calibrate a Vicon system

After you have configured your system (see [Prepare a Vicon system, page 50](#)), the next step is to calibrate the Vicon cameras and define the origin of the capture volume. Calibration enables Nexus to determine the positions, orientations, and lens properties of the Vicon cameras and to produce accurate 3D data.



Important

Vicon recommends that you calibrate your Vicon cameras after any changes to your system and each day, before you capture any data. This ensures that any accidental changes in your setup (such as a camera being knocked while the system was unsupervised) does 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.

The following topics cover calibrating the Vicon system for motion capture:

- [Calibrate Vicon cameras, page 138](#)
- [Set the volume origin, page 142](#)
- [Calibrate the floor plane, page 146](#)
- [Manage camera calibrations, page 148](#)

A [Vicon Nexus 2 Calibration video](#)²⁰ is available on YouTube.



Note

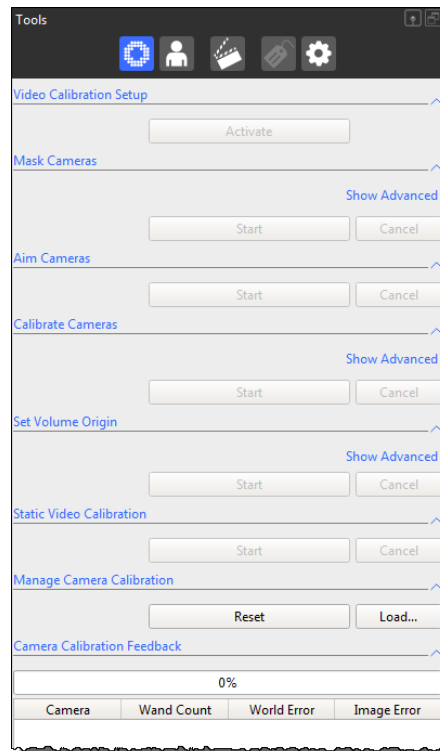
As the videos were recorded using an earlier version of Nexus 2, you may notice small differences in the user interface.

²⁰ <https://youtu.be/KwtSIRgS7u8>

Calibrate a Vicon system

Calibrate Vicon cameras

To calibrate Vicon cameras, you use the relevant sections of the **System Preparation Tools** pane.



To perform a camera calibration, you need a Vicon calibration device, which is supplied with your Vicon system. Note that, to use the following process to calibrate supported digital video cameras, as well as optical cameras, you must use an Active Wand, which must be set to Strobe mode. (If you are not using an Active Wand, you can calibrate any supported video cameras using the legacy **Static Video Calibration** section of the **System Preparation Tools** pane. For more information, contact Vicon Support.)


Camera calibration describes the capture volume to the system, enabling Nexus to produce accurate 3D data. During camera calibration, Vicon Nexus creates a calibration parameters (.xcp) file. This file contains the calibration settings and threshold data specified for the Vicon cameras (as well as any supported video cameras) in your Nexus system and is used when data from these cameras is processed.


Calibrate a Vicon system

Important

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 (such as someone accidentally knocking a camera slightly out of position) 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.

To calibrate Vicon cameras in Nexus:

1. Ensure you have aimed and masked the cameras (see [Aim Vicon cameras, page 68](#) and [Mask unwanted reflections, page 71](#)).
2. 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 in a Camera view.
3. In the **Resources** pane, ensure Nexus is in Live mode.
4. Display a Camera view.
5. In the **System Resources** tree, expand the **Vicon Cameras** node and select all Vicon cameras.
6. In the **System Preparation Tools** pane , expand **Calibrate Cameras** and from the **Wand** list, select the calibration device that you are using.
7. If your Vicon system includes video cameras, in the **Video Calibration Setup** section, click **Activate** to start video calibration mode. If your system does not include video cameras, go straight to the next step.
If you have not already saved the current configuration, you will be prompted to save it. Ensure its name is recognizable as a calibration and then choose whether it will be **Shared** or **Private** (see [Manage configurations in Vicon Nexus, page 24](#)).

 **Tip:** The settings for some video camera properties may differ in video calibration setup mode from those in live capture mode. For these properties, any changes made after you click **Activate** only apply during video calibration setup mode. The properties revert to their live capture settings after you click **Deactivate**.

Calibrate a Vicon system


8. In the **Calibrate Cameras** section, view or change settings for the required parameters:
 - a. Select the appropriate **Calibration Type: Full Calibration** or **Calibration Refinement**.
 - ✔ **Tip:** If you have not already calibrated all cameras, you cannot perform a calibration with the **Calibration Refinement** option. For more information on calibration refinement, see *Understand camera calibration refinement* in the *Vicon Nexus Reference Guide*.
 - b. To automatically stop calibration when sufficient information has been acquired, ensure **Auto Stop** is selected.
9. In the **Calibrate Cameras** section, click **Start**. The camera calibration process starts, and the **Start** button switches to its **Stop** setting.

If you are using a FLIR camera and a warning is displayed informing you that the DV camera is not set to a valid frame rate, note that this is expected behavior and you may ignore it.
10. 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 Nexus begins to capture wand wave data.
11. Monitor the calibration progress and status:
 - In each **Camera** view, ensure that the colored lines that identify wand frames indicate that sufficient wand frames are spread across the intended 3D capture volume. Also check the colored triangle in the lower right of each view pane. The triangles change from red to green as the collection of calibration information progresses, and then vanish when the cameras are calibrated.
 - ✔ **Tip:** If no cameras are visible in the **Camera** view, ensure that the **Show Uncalibrated Cameras** option is selected in the **Camera Positions** section of the **Options** dialog box (press F7). Also, if you are not using the Vicon Control app, you may find it helpful to display the Nexus window on a large screen where the person in the capture volume can see the feedback in the **Camera** view while they are waving the calibration wand, so they can see the area that they have covered.
 - In the **System Preparation Tools** pane, under the **Camera Calibration Feedback** section check **Wand Count** values returned for each camera.
 - On the strobe unit on the front of each camera, the status light flashes while the camera registers valid frames where the whole wand is visible.

Calibrate a Vicon system

When the status light turns a solid green, the camera has collected enough data to be calibrated successfully, usually 1,000 frames of valid wand data.

12. If **Auto Stop** was not selected, in the **Calibrate Cameras** section, click **Stop**. Nexus starts processing the calibration information.
If you selected the **Auto Stop** option, Nexus automatically stops collecting calibration information and starts processing it when sufficient calibration information has been acquired.
If you are using a FLIR camera and a warning is displayed informing you that the DV camera is not set to a valid frame rate, note that this is expected behavior and you may ignore it.
Note that, for a system that includes video cameras, calibration is done in two passes, so the **Camera Calibration Feedback** bar progresses from 0% to 100% twice.
13. 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, Nexus typically takes 15–60 seconds to complete its calculations for a typical Vicon system setup, but this can take longer for a very large system or low-specification PC. When the camera calibration has successfully completed, it is automatically saved to an .xcp file. For more information on the controls in this section, see *Camera Calibration Feedback* section in the *Vicon Nexus Reference Guide*.

 **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.
14. If you have calibrated video cameras, to exit video calibration mode and return to your settings for live captures, click **Deactivate** in the **Video Calibration Setup** section.

When you have finished calibrating the Vicon cameras, you are ready to **Set the volume origin**, page 142.

Calibrate a Vicon system

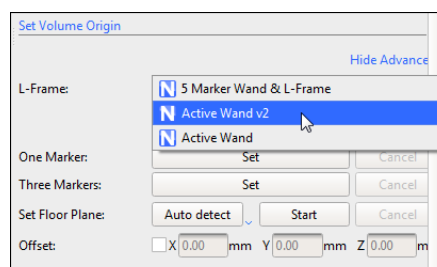
Set the volume origin

Setting the volume origin (global coordinate system) 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 Nexus view pane and so that you can change the way data is visualized. You normally set the volume origin immediately after the previous step, [Calibrate Vicon cameras, page 138](#).

To set the volume origin, you need a calibration device, normally an Active Wand, which is supplied with your Vicon system.

To set the global coordinate system:

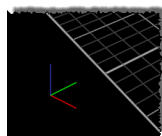
1. Remove from the capture volume all markers and the sources of any unwanted reflections that have not been accounted for by camera masks previously created in a Camera view (see [Mask unwanted reflections, page 71](#)).
2. In the Resources pane, ensure Nexus is in Live mode.
3. Display a 3D Perspective view.
4. In the System Preparation tools pane, expand the Set Volume Origin section and from the L-Frame list, select the type of calibration device you are using to set the volume origin. (This is normally the calibration device that was supplied with your Vicon system.)



If it is impractical to place the wand in the required position, you can instead use the **One Marker** or **Three Markers** options to set the origin. (The **Three Markers** option creates two vectors that determine the orientation of the volume.) To use these options, position the marker(s) in the volume and then click **Set** next to the chosen option. You can then select the required marker(s) in the 3D Perspective view. If you selected **Three Markers**, you are prompted to select an origin marker, a primary (X-axis) marker, and secondary (Z-axis) marker.

Calibrate a Vicon system

5. 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 coordinates system (often a force plate corner or another clearly marked area of the volume).
6. In the **Set Volume Origin** section, click **Start**.
The calibration object tracking process starts, Nexus identifies the calibration object in the capture volume, displays a 3D representation of it in the **3D Perspective** view, and changes the **Start** button to **Set Origin**.
7. Click **Set Origin** to complete the calibration object tracking process. Nexus 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, the floor grid is aligned with the capture volume floor and the cameras are distributed in the position and orientation in which the physical cameras are located. When the global coordinate system has been successfully set, it is automatically saved to an .xcp file. The latest calibration (.xcp) file is saved to the default location. This file is automatically copied to every subsequent trial captured.
8. Verify that the global coordinate system was successfully set by checking that the system tracks the calibration object.
If it does not, check that you selected the correct calibration object from the **L-Frame** drop-down list at the top of the **Tools** pane. If not, repeat this procedure from step 4, ensuring that you select the correct entry for your calibration device. After you have set the global coordinate system, you can display the volume axes marker in the bottom corner of the **3D Perspective** view.



9. Turn the display of the volume axes on or off in the **Options** dialog box (F7) by selecting or deselecting **Volume Axes** under **General View Options**.

Calibrate a Vicon system

Improve the calibration volume reproducibility

After you have set the volume origin (see [Set the volume origin, page 142](#)), to achieve maximum positional reproducibility of the Vicon coordinate system, you can create a large custom L-Frame object from markers permanently placed around the edge of the volume. You can then use this L-Frame object for subsequent setting of the system origin.

This provides a high degree of precision of the coordinate system across the camera calibration, which is particularly useful in larger volumes.

To help with this, select the **Auto Scale** option when you set the origin, as described below.

This improves the consistency of the volume size, further improving the positional reproducibility.



Note

The following procedure describes how to create a custom L-frame in Nexus. You can instead create an L-frame object in Tracker and export it for use in Nexus, but remember to first copy it from your Tracker *CalibrationObjects* folder:

`C:\Users\Public\Documents\Vicon\Tracker3.x\CalibrationObjects`

to your Nexus *CalibrationObjects* folder:

`C:\Users\Public\Documents\Vicon\Nexus 2.x\CalibrationObjects`

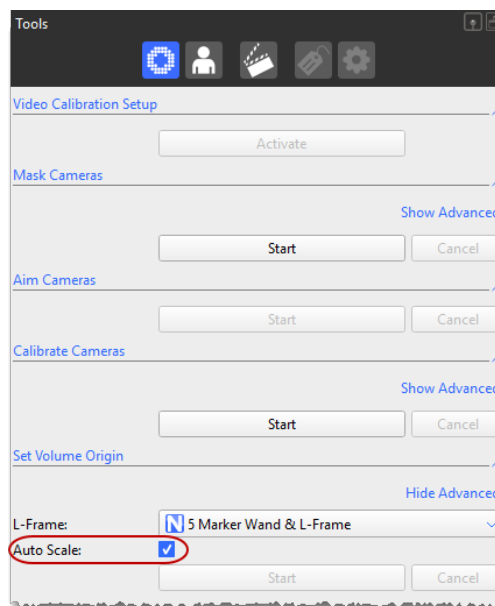
To perform a camera calibration with rescale:

1. With Nexus in Live mode, mask and calibrate the cameras (see [Mask unwanted reflections, page 71](#) and [Calibrate Vicon cameras, page 138](#)).
2. Using an Active Wand, set the volume origin (see [Set the volume origin, page 142](#)).
3. Place the markers that you want to use to create the L-Frame subject around the edges of the volume. Use at least four markers that span the whole volume.
4. In the **Capture Tools** pane, click **Start** to capture a short (eg, 5-second) trial.
5. With Nexus in Offline mode, on the **Data Management** tab at the bottom of the Nexus window, load the trial that you just captured.
6. Run the **Reconstruct** pipeline (see [Reconstruct and label movement trials, page 203](#)).

Calibrate a Vicon system

7. In the **Subject Preparation Tools** pane, go to the **Create L-Frame Subject** section and in the **Create L-Frame** field, enter a suitable name (eg, My L-Frame), and click **Create**.
8. In the view pane, select the markers that you want to use to create the L-Frame subject.
9. When you have selected all markers, click **Create** again.
10. In the **Subjects Resources** pane, right-click on the subject and then click **Save Subject**.
11. Right-click again on the subject, click **Export to L-Frame List** and click **Yes** when prompted.
12. With Nexus back in Live mode, in the **System Preparation Tools** pane, in the **Set Volume Origin** section, ensure **Show Advanced** is selected.
13. Click on the **L-Frame** menu to select the new L-frame and ensure **Auto Scale** is selected.

This ensures that the marker distances in the new L-frame are used for volume scaling.



14. Click **Start**.
The system scale is adjusted to provide improved positional reproducibility.

Calibrate a Vicon system

Calibrate the floor plane

To ensure that your coordinate system is accurately aligned with the floor of the capture volume, which is particularly useful if the floor is uneven, you can adjust the position of the floor plane using markers in the volume to automatically define it.

To calibrate the floor plane:

1. Complete the camera calibration procedure (see [Calibrate Vicon cameras, page 138](#)) and set the origin (see [Set the volume origin, page 142](#)).
2. Turn off the calibration object or remove it from the volume.
3. Scatter a quantity of the same size Vicon markers across the floor of your capture volume. If you want Vicon Nexus to automatically recognize these markers as floor plane markers, ensure that they outnumber any other groups of markers (e.g, markers on a wand or markers that were used to focus cameras, etc).
4. In the **System Preparation Tools** pane, expand the **Set Volume Origin** section, click **Show Advanced**, and ensure that the options relating to **Set Floor Plane** are as required:
 - **Auto detect:** Markers are automatically detected, based on the marker group that defines the plane with the most markers. (If, when you click **Auto detect**, the wrong markers are selected in the **3D Perspective** view, you can add or remove markers in the volume until selection is as required.) To ensure that the tolerance setting (in mm), which specifies the height of the group of markers that define the floor plane, is as required, click the drop-down arrow next to **Auto Detect**, and set the tolerance to a value that prevents a large variance in height (2mm is often enough).
 - **Start:** Enables you to manually select the markers that will determine the floor plane by clicking the required markers in the **3D Perspective** view.
 - **Offset:** Select the check box and set the amount (in mm) by which to adjust the floor plane (default is zero) in X Y and Z planes. Because Nexus finds the centers of the markers, set a Z-offset that accounts for the size of the markers plus their bases (for example, for 14mm markers on 2mm bases, the Z-offset is -9mm).
5. If you clicked **Start**, when you have selected the required markers, click the **Stop** button.

Calibrate a Vicon system

In the **3D Perspective** view the cameras shift as a group slightly along one or more rotation axes to better reflect an average of the markers scattered across the floor, taking into account any offsets that you specified. The latest calibration (.xcp) file is updated. This calibration file is automatically copied to every subsequent trial captured.

Your Vicon cameras are now calibrated and ready to capture data.

Calibrate a Vicon system

Manage camera calibrations

In the **Manage Camera Calibration** section of the **System Preparation Tools** pane, you can click **Auto number cameras** to automatically number the cameras number in ascending order, according to their position in the capture volume.

The **Manage Camera Calibration** section also enables you to reset or load camera calibrations that define settings for Vicon cameras.

- [Automatically number cameras, page 148](#)
- [Reset and load camera calibrations, page 150](#)

Automatically number cameras

The **Auto number cameras** button 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.



Tip

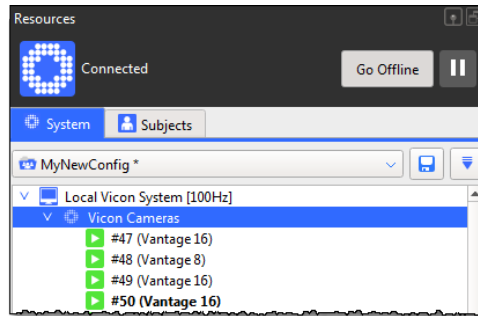
You can auto-number the cameras at any point after you have performed the **Aim Cameras** operation (see [Aim Vicon cameras, page 68](#)): you do not need to perform a complete camera calibration to auto-number the cameras.

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.

Calibrate a Vicon system

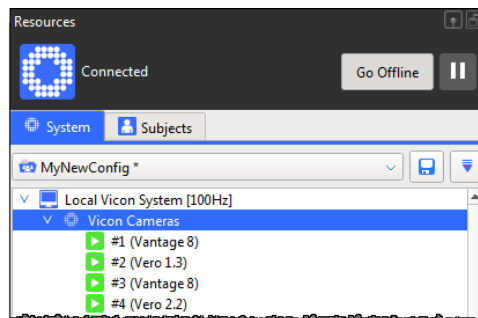
To automatically number Vicon cameras:

1. Ensure Nexus is in Live mode and that you have aimed the cameras.
2. On the **System Resources** tab, ensure you can see a list of Vicon cameras.



3. On the **System Preparation Tools** pane, in the **Manage Camera Calibration** section, click **Auto number cameras**.

The cameras are automatically numbered in ascending order, according to their position in the volume.



4. In the volume, check that the cameras are now numbered as required.

Calibrate a Vicon system

Reset and load camera calibrations

During camera calibration, Vicon Nexus creates a calibration parameters (.xcp) file. When you change the currently loaded .xcp file, either by calibrating cameras or by setting the global coordinate system, Nexus stores the calibration state before the changes. This enables you to revert to the previous calibration or load a different calibration at any time while using Nexus (for example, you would normally want to load a different calibration when you connect your Nexus PC to a different system).

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

- To undo a poor calibration
- To compare calibration changes

To manage camera calibration files in Nexus:

In the **System Preparation Tools** pane, under the **Manage Camera Calibration** section, click the desired button:

- **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** Enables you to load a previously saved calibration file. In the **Choose a file** dialog box, navigate to and select the desired camera calibration (.xcp or .cp file) and click **Open**.

If a camera is not calibrating well or has been bumped after calibration, you can remove it from the current calibration prior to data capture.

Calibrate a Vicon system

To remove a camera from an existing system calibration:

Use any of the following methods:

- In the **System Resources** pane, right-click on the node for the camera you want to remove and select **Reset Calibration**; or
- In the **System Resources** pane, select the node for the camera you want to remove and in the **Properties** pane, scroll down to the **Calibration** section and click **Reset Calibration**; or
- In a **3D Perspective** view, right-click the camera that you want to remove and then click **Reset Calibration**.

Prepare a subject

Prepare a subject

After you have configured and calibrated your Vicon system, and prepared a data management hierarchy in which to store your data, you can prepare the subject whose motion is to be captured.

To start with, you may find it easiest to use the standard Plug-in Gait marker set and in Vicon Nexus, create a subject that is based on one of the Vicon-supplied labeling skeleton templates (VSTs), as described in the following topics. If you are planning on processing your captured data with Plug-in Gait, then you must use one of the supplied Plug-in Gait VST files. For more information, see [Modeling with Plug-in Gait, page 248](#).


Later, if required, you may want to create your own custom labeling skeleton template. The labeling skeleton template that you use is determined by your particular application and your marker set. For information on how to create a custom labeling skeleton template, see *Creating labeling skeleton templates (VSTs)*.

Prepare a subject

Having chosen your marker set, you can prepare the subject data in Nexus. To do this, you use the **Subjects Resources** pane and the **Subject Preparation Tools** pane to create a new subject from a template and to calibrate the labeling skeleton. These and other procedures that you may find useful while creating and calibrating your labeling skeleton are described in the following topics:

- [Create a new subject from a template, page 154](#)
- [Calibrate a labeling skeleton, page 157](#)
- [Correcting swapped labels, page 172](#)
- [Manually label a trial, page 174](#)
- [Work with pipelines, page 177](#)

If you have problems calibrating your labeling skeleton, also see *Troubleshooting labeling skeleton templates in [Creating labeling skeleton templates \(VSTs\)](#)*.

 **Important**

A Nexus .vst file is used only to define the marker set and to enable Nexus to perform automatic labeling. It is not a biomechanical model that will output valid joint angles or other kinematic/kinetic variables. To derive valid kinematics or kinetics, use either a predefined model (such as Vicon Plug-in Gait, as described in this documentation) or create your own model with Vicon BodyBuilder, MATLAB or Python.

Prepare a subject

Create a new subject from a template

Before you calibrate a labeling skeleton, you must create a new subject node for your subject. The following instructions explain how to create a new subject node in the **Subjects Resources** tree, and base it on an existing Vicon labeling skeleton template (.vst file) in the **Subjects Resources** pane.

Sample .vst files, including those for Plug-in Gait, are provided in the Nexus model templates folder (by default, *C:\Program Files\Vicon\Nexus2#\ModelTemplates*). If you are using a standard Vicon marker set, you can base a new **Subject** node on one of these templates. You subsequently scale the template to fit your particular subject when you calibrate the labeling skeleton (.vsk file).

 **Note**

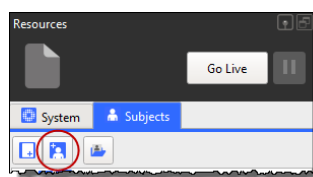
If you want to use a Hybrid CAST Visual3D model with Nexus, use the Hybrid CAST Visual3D model that is included with Nexus 2.9 and later, so that the marker set is automatically labeled when you use the **Auto Initialize Labeling** pipeline.

If you are not using a standard marker set, or need to modify a standard set, you must create a custom labeling skeleton template. For information, see *Creating labeling skeleton templates (VSTs)* or contact Vicon Support.

Prepare a subject

To create a new subject based on a Vicon labeling skeleton template:

1. Ensure that you have created or opened a session in a database in which you want to store the trial data, and that it is the active session (see [Prepare a data storage location, page 134](#)).
2. In the Subjects Resources pane toolbar, click the Create a new Subject from a Labeling Skeleton button.



A list of all Vicon labeling skeleton templates (.vst files) in the *Nexus ModelTemplates* folder and a **Browse** link are displayed.


✓ **Tip:** The supplied templates, whose names end in *Ai*, enable you to autolabel static frames.

3. Select or browse to the desired .vst file. (For details of Plug-in Gait templates, see *Plug-in Gait models and templates* in the *Plug-in Gait Reference Guide*.)
4. In the **Enter Subject Name** dialog box, specify the name for your new subject (of no more than 32 characters) and click OK.
5. If you used the **Browse** link rather than selecting a .vst file from the list, the **Choose a Subject file** dialog box is then displayed. Navigate to and select the .vst file on which the Vicon labeling skeleton (.vsk file) is to be based. The new subject node is added in alphabetical order to the **Subjects Resources** tree. The node automatically includes any sub nodes and data for the elements defined in the selected .vst file: **Markers, Segments, Joints, and Model Outputs**.

✓ **Tip:** Marker names are displayed in gray if they are defined in the template but the markers are not yet labeled.

Prepare a subject

6. In the **Properties** pane for the newly created subject, enter values for all the measurements that are required for this template. For information on the measurements required to run the supplied Plug-in Gait model, see [Take subject measurements for Plug-in Gait, page 256](#).

 **Tip:** Required measurements are highlighted in pink until you supply a value for them; optional measurements are not highlighted. These measurements are required to run the relevant model; they do not affect labeling.

7. In the **Subjects Resources** pane, right-click the subject name and click **Save Subject**.

 **Note**

When you save a labeling skeleton (VSK), Vicon Nexus automatically creates an accompanying `.mp` file, which is saved into the same folder as the VSK. If required, you can import this data by running an **ImportMP** pipeline operation. This is only necessary in particular circumstances (for example, if you are using Vicon BodyBuilder or Vicon Polygon), and is not part of the normal Nexus workflow.

You can now place the appropriate marker set on your subject, (for information on attaching the Plug-in Gait marker set, see [Attach Plug-in Gait markers to a patient, page 263](#)) and calibrate its labeling skeleton (`.vsk` file).

Prepare a subject

Calibrate a labeling skeleton

Calibrating a Vicon labeling skeleton (VSK) enables Nexus to recognize the subject and automatically determine which labels belong to its reconstructions.

Having chosen a labeling skeleton template (VST) for your subject (see [Create a new subject from a template, page 154](#)), you then capture a short subject calibration trial (see below), run the required calibration operations on it and save the trial and the labeling skeleton (VSK). The calibration process applies the general information contained in the VST to your particular subject, who is wearing the marker set described in the VST. When you save the calibration, a labeling skeleton (VSK), containing information that is specific to your particular subject is saved.

You can then use that VSK to automatically label all the trials in an entire capture session. You only need to recalibrate if the subject changes, for example, if a different subject wears the same marker set, or if the markers are moved. For more detailed information about VSKs and labeling skeleton templates (VSTs) see *Creating labeling skeleton templates (VSTs)*.

Nexus provides a number of processes and multiple calibration options for calibrating a labeling skeleton. The factors that affect which process and which options are best for your situation, include:

- Whether your subject is able to perform a full ROM (Range of Motion) trial
- The type of movement you are studying
- Whether obtaining results quickly or labeling accuracy is more important

Prepare a subject

The following types of trial can be used to calibrate a labeling skeleton:

- **ROM trial** In a ROM trial, the subject completes a series of movements that exercises all of their joints. To produce the best calibration (and auto-labeling), the subject moves all of their joints through as full a joint range as possible. For the best results, ensure that each joint moves through a range that represents what the subject is likely to do during capture of trial data (ie, movement trials). Full ROM calibrations provide the most information of any of the calibration methods and therefore often provide the best labeling. For this reason Vicon recommends using a full ROM calibration whenever possible. For step-by-step instructions on using this type of trial to calibrate a labeling skeleton, see [Calibrate a labeling skeleton using a ROM trial, page 160](#).
- **Static trial** This is a short trial where the subject stands in a base pose. A base pose is a static pose that is used when the VST (labeling skeleton template) file is first created. For Plug-in Gait, this is a T-pose or 'motorbike' pose. (To view images of the motorbike pose, see [Calibrate a labeling skeleton using a ROM trial, page 160](#).) This operation requires the least processing time, but provides less information than functional calibration (which is often used as part of ROM calibration, described above), as it operates on only a single frame of data. Consider using this type of calibration if:

 - A subject's ability to perform a ROM trial is limited; and/or
 - You want to obtain results as quickly as possible.

For step-by-step instructions on using this type of trial to calibrate a labeling skeleton, see [Calibrate a labeling skeleton using a static trial, page 170](#).

- **Movement trial** This trial type is similar to a ROM trial, but focuses on only joint movements that are expected and specific to the activity being studied. For example, a gait laboratory might use a walking trial for this type of calibration. Movement trials are not normally used for an initial or full subject setup, but can be used in combination with some pipeline operations to improve labeling. They may be of benefit if the motion of the subject during movement trials is not similar enough to what is captured when using a static or ROM trial. For more information on this type of labeling skeleton calibration, see *Labeling skeleton calibration in detail* in the *Vicon Nexus Reference Guide*.

Prepare a subject

Whichever type of calibration you choose, note the following requirements for your calibration trial:

- Aim to produce a trial (ROM, static, or movement) that is as fully labeled as possible.
- The trial must contain only raw reconstructions; leave any gaps unfilled. (Unlabeled reconstructions have no influence on subsequent operations.) However, if necessary, you can manually label any missing markers (see [Manually label a trial, page 174](#)) or correct any swapped markers (see [Correcting swapped labels, page 172](#)).
- Do not perform multiple calibrations on the same subject as this may result in an increasingly poor quality calibration.

For information on creating custom labeling skeleton templates (VSTs), see *Creating labeling skeleton templates (VSTs)*.

Note

This topic assumes that you are using a Vicon-supplied PlugInGait Ai VST, although you could instead use a custom VST, providing it conforms to the requirements listed in Requirements for custom labeling skeleton templates in *Creating labeling skeleton templates (VSTs)*.

Prepare a subject

Calibrate a labeling skeleton using a ROM trial

The recommended workflow for Nexus 2, which is described below, is to use a ROM trial and dynamic calibration to calibrate a labeling skeleton, as this is likely to produce more accurate automated labeling. However, if you need to use a static frame to calibrate your labeling skeleton (for example, if your subject cannot perform a full ROM, or you are capturing simple movement and/or want to obtain some results quickly), see [Calibrate a labeling skeleton using a static trial, page 170](#).

After you have prepared a subject for capture (see [Prepare a subject, page 152](#)), to enable Nexus to provide correct automatic labeling for your subject, you capture a ROM (Range of Motion) trial that starts with a few frames where the subject is static, as described in the following steps.

Vicon Nexus then uses the information from the ROM trial to automatically label the subject in subsequent movement trials.

The following workflow is just one approach that you can adapt to suit your particular circumstances. For a detailed explanation of all the methods of subject calibration, see Labeling skeleton calibration in detail in the *Vicon Nexus Reference Guide*.

The workflow for calibrating a labeling skeleton based on a ROM trial can be divided into the following stages:

- [Perform an initial calibration of a labeling skeleton using a ROM trial, page 161](#)
- [Review & finalize calibration of a labeling skeleton using a ROM trial, page 165](#)

Prepare a subject

Perform an initial calibration of a labeling skeleton using a ROM trial

1. Ensure you have obtained any subject measurements required to run the model (required measurements are highlighted in pink in the Subjects Resources pane): for Plug-in Gait Lower Body, these are the body weight and height as well as measurements of both left and right leg lengths, knee widths, and ankle widths. These are used to calculate joint center positions, and must be measured and entered into Nexus before any modeling can take place can begin. Optionally, you can also measure tibial torsion, the inter-ASIS distance, the ASIS-to-greater trochanter distance, and the sole delta if the subject is wearing shoes. For more information on the measurements needed to run the Plug-in Gait model, see [Take subject measurements for Plug-in Gait, page 256](#).
2. In the **Communications** pane, on the **Data Management** tab, ensure that you have created or opened the required database in which to store the data you will be capturing and that the required session is active. (For a reminder of how to do this, see [Prepare a data storage location, page 134](#).)
3. In the **Resources** pane, ensure Nexus is in Live mode.
4. In the **System Resources** tree, select the **Local Vicon System** node and then in the **Properties** section under **General**, check that the **Processing Level**, which sets the amount of real-time processing that is performed on the source data, is set appropriately. If you are not sure, set it to at least the **Labels** level.
5. Display a **3D Perspective** view.
6. In the **Subjects Resources** tree, ensure the required PlugInGait Ai (Auto Initialize) labeling skeleton template (VST) file is specified for the subject (see [Create a new subject from a template, page 154](#)) and that the subject node you created from the template is the only entry enabled for capture. (When enabled, the check box contains a check mark.)
7. If required by your model, in the **Properties** section at the bottom of the **Subjects Resources** pane, enter any subject measurements you obtained in step 1.

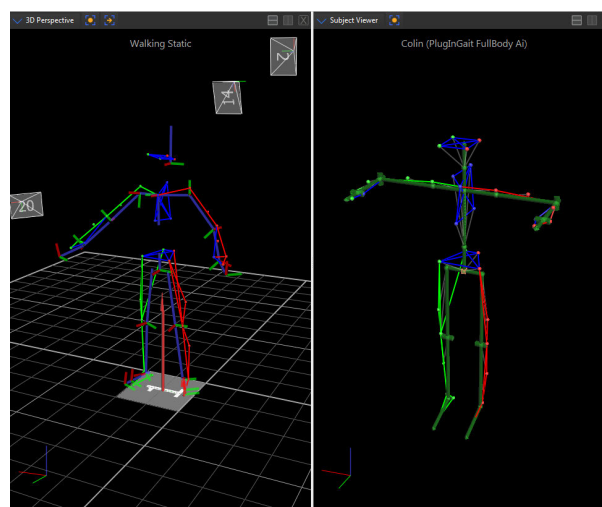
Prepare a subject

- In the **Subject Preparation Tools** pane, ensure that the subject you created is selected in the **Subject** list.

✔ **Tip:** If you want to capture video or if you want to avoid automatically switching to **Offline** mode as soon as you have captured a trial, instead of clicking the **Subject Preparation** button, click the **Capture** button and on the **Capture** tab, ensure the settings are as required (for example, to capture video, ensure that in the **Data Source Setup** section, **Video Camera Data** is selected).

- To enable Nexus to automatically label the key trajectories, in the capture volume, have the subject stand in the stationary neutral pose that was selected when the labeling skeleton template was created. If you are using a Vicon-supplied PiG template, ensure the pose is as described in step 12.

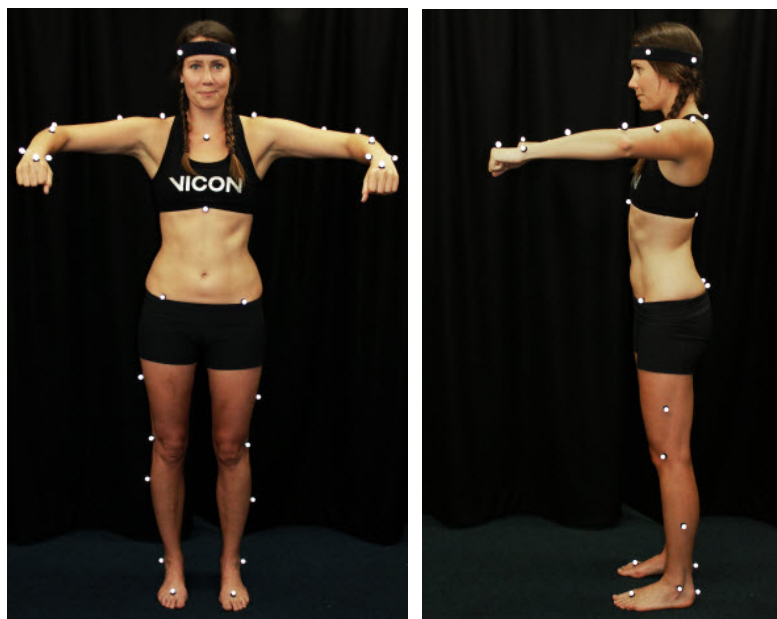
✔ **Tip:** To help you to ensure that the subject adopts the correct base pose, on the view pane toolbar, click the **Split vertically** button and in the second pane, open a **Subject Viewer**. This displays the base pose for the current labeling skeleton template (VST).



- To make sure all the markers are visible, count the number of markers under the **Markers** node in the **Subjects Resources** tree, and make sure the same number of markers is visible in the **3D Perspective** view.
- On the **Capture Tools** pane, in the **Capture** section, click **Start**. The **Start** button switches to its **Stop** setting.

Prepare a subject

12. Capture a ROM trial where the first 1–3 seconds are of the subject in the 'motorbike' pose, as shown in the following image, in which:
 - Arms are outstretched, held level or slightly lowered, with elbows bent and further forward than the shoulders (so that they don't hide any of the body markers).
 - Rest of body is straight.
 - Feet point forward





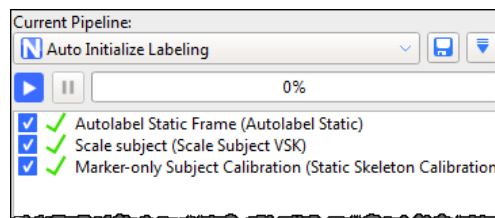
For the rest of the ROM trial, have the subject go through the required range of motion.


✓ **Tip:** If the subject is not able to attain the base pose, they can use any pose where all of the markers are visible to the cameras. This ensures that the markers can be reconstructed, but is unlikely to produce good autolabeling when **Autolabel Static Frame** (part of the **Auto Initialize Labeling** pipeline) is run. If this is the case, you will need to manually label the trial (see [Manually label a trial, page 174](#)) and then run the two remaining operations from the **Auto Initialize Labeling** pipeline. (For information on running pipelines, see [Run a pipeline, page 178](#).)

If the chosen base pose proves unattainable by many subjects, consider substituting a different, attainable pose by specifying a different frame. To do this, on the **Pipeline Tools** pane, expand the **Subject Calibration** section and double-click the **Set Autolabel Pose** pipeline operation to add it to the current pipeline. In the **Properties** pane, ensure the frame with the required pose is selected and then run the **Set Autolabel Pose** pipeline.

Prepare a subject

13. When enough data has been captured, click **Stop** to end the trial. For a ROM trial, this is typically 1–3 seconds of static data capture, followed by the required ROM.
14. If you are using the **Subject Preparation** tab, Nexus automatically switches to **Offline** mode.
15. Reconstruct the trial either by clicking **Reconstruct**  on the Nexus toolbar or, if you need to change the reconstruction settings, by clicking the **Pipeline** button  in the **Tools** pane and configuring and running the **Reconstruct** pipeline to create a 3D image of the captured markers. (For information on how to run a pipeline, see [Run a pipeline, page 178.](#))
16. View the subject data in a **3D Perspective** view and ensure that all the markers are clearly visible to the Vicon cameras. (If they are not, check your camera settings, system setup steps, system calibration, etc. Also check that clothing isn't causing markers to move, and the condition (age, etc) of the markers themselves.)
17. From the **Pipeline Tools** pane, run the supplied **Auto Initialize Labeling** pipeline (or if preferred, you can manually label the trial):

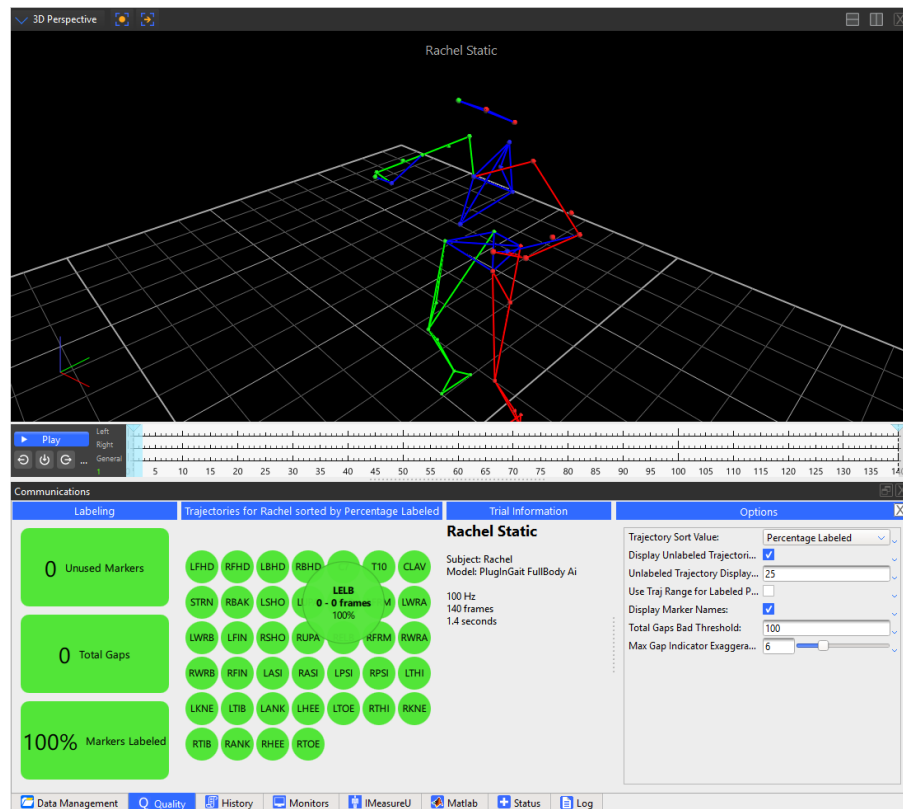


18. Nexus labels the trajectories based on the marker set defined in the `.vst` file.
19. Save the trial and the labeling skeleton (VSK) by pressing CTRL+S or by clicking the **Save** button  on the Nexus toolbar. If an asterisk is displayed to the right of the the subject name in the **Subjects Resources** pane, this means that you have also made changes that affect the labeling skeleton template (VST). To save the VST, right-click on the subject name and click **Save Subject**.

Prepare a subject

Review & finalize calibration of a labeling skeleton using a ROM trial

1. After you have saved your initial calibration (see above), assess the results by looking at the labeling of the frame that contains the static base pose in the 3D Perspective view. Ensure that all markers are connected by sticks and that the sticks on the left side of the subject are red and those on the right side are green. For a more detailed check, look at the information on the data Quality tab.



✓ Tip: To see all the assigned marker labels in the 3D Perspective view, press CTRL+space bar. This enables you to check that all the required markers are present and correctly labeled.

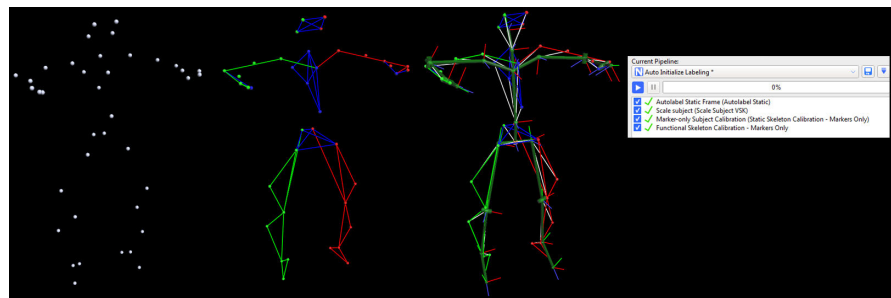
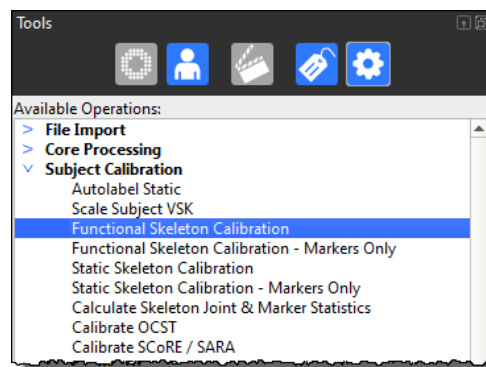
Prepare a subject

2. Depending on the results of the labeling, take the appropriate action:
 - If the static frame is correctly labeled and the labeling skeleton fits well, any further processing of your first movement trial (see [Capture movement trials, page 182](#)) will give you an indication of the level of labeling that this subject calibration will provide for your specific trial type. Based on these results, you can decide whether they meet your requirements. For example, for walking trials, the quick calibration produced by the **Auto Initialize Labeling** pipeline is likely to produce good labeling of movement trials. When the subject has been calibrated, segments of the labeling skeleton are fitted to the labeled markers in the **3D Perspective** view, and your subject is automatically labeled. To verify that the subject has been calibrated successfully, switch Nexus to **Live** and ask your subject to move around in the capture volume. You should see that the markers are labeled and the subject is tracked. If the results are satisfactory, go straight to step 4 (set a range).
 - If the results are not satisfactory, this may be because your movement trials include more challenging or complex movement and therefore require a further level of labeling reliability. To provide this enhanced reliability you will need to run a functional calibration, which calibrates the subject's bone lengths and joint and marker locations from the whole ROM trial, as described in step 3. To ensure the best results, first consider the following factors:
 - If any markers are labeled incorrectly, fix them (see [Correcting swapped labels, page 172](#) and [Manually label a trial, page 174](#)) and from the **Auto Initialize Labeling** pipeline, re-run the **Scale subject** and **Marker-only Subject Calibration** operations; or
 - If all the labels are correct but there is a large distance between a marker and the corresponding reconstruction, the labeling skeleton cannot accurately represent the configuration of labeled reconstructions. This is an indication that you may get poor labeling results and may need to improve your labeling skeleton template (see [Requirements for custom labeling skeleton templates in Creating labeling skeleton templates \(VSTs\)](#)).


Note that **Functional Skeleton Calibration** takes more processing time to complete than the **Auto Initialize Labeling** pipeline.

Prepare a subject

3. (Optional step) Run a Functional Skeleton Calibration by completing the following steps:
 - a. Verify that the trial is correctly labeled for every frame.
Note that **Autolabel Static Frame** only labels the trajectories that are present on the static frame(s).
 - b. Visually check for any markers that get occluded and manually re-label them (see [Manually label a trial, page 174](#)) when they re-appear.
 - c. On the Pipeline Tools pane, expand the Subject Calibration operations section, add the Functional Skeleton Calibration operation to the current pipeline and run it.

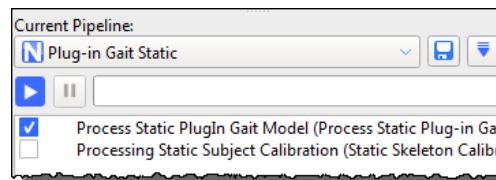


- d. When the Functional Skeleton Calibration has completed, in the Options dialog box (F7), click **Subjects** (on the left) and in the **Properties** pane, go to the **Markers** section, and select **Draw Covariance**.
If you can see any large covariance ellipsoids around a marker, check for mis-labeling of a small number of frames for that marker and fix any mislabels. Note that some markers, such as the ASIS markers, will naturally have a larger covariance, due to skin motion.

 **Tip:** The size of covariance ellipsoids vary, depending on how a marker is defined in a skeleton, the amount of marker movement possible, and the quality of the subject calibration. Very large covariance ellipsoids may indicate a poor calibration.

Prepare a subject

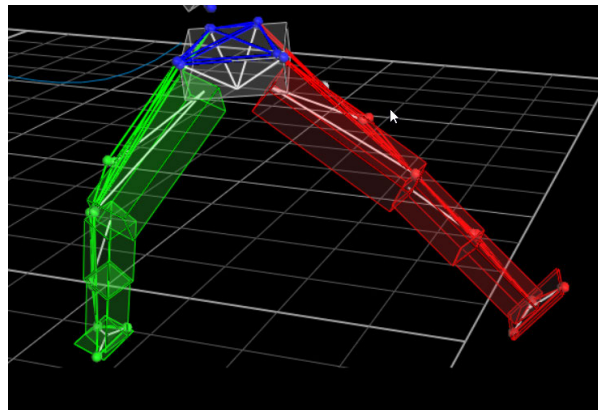
4. On the Time Bar, move the **Start Range** indicator and **End Range** indicator (the blue triangles) along the timeline to set a range of frames to select only the first few seconds of the static pose at the beginning of the trial.
5. Run any further processing needed to achieve the required modeling. For example, if you are using Plug-in Gait, to make the necessary calculations and calibrate the static subject, run the **Plug-in Gait Static** pipeline:
 - a. In the **Current Pipeline** list, select the **Plug-in Gait Static** pipeline, and ensure that you leave the check box for **Processing Static Subject Calibration** cleared (its default setting).




- b. Click on the **Process Static Plugin Gait Model** operation and ensure that in the **Properties** pane, the **First Frame** is set to **Selected Start** and **Last Frame** is set to **Selected End** (the default settings).
 - c. Run the **Plug-in Gait Static** pipeline.
6. To check that your model has been processed correctly:
 - Ensure that in the **Pipeline Tools** pane, a green check mark is displayed to the left of the operation in the **Current Pipeline** list.
 - Ensure that **Plug-in Gait** bones are visible in the **3D Perspective** view. If they are not, press **F7** to open the **Options** dialog box and select **Plug-in Gait Bones**.
 - In the **Subjects Resources** pane, ensure that you can expand **Model Outputs** to see all the calculated components of variables for a kinematic model (such as **Angles**, **Forces**, **Moments**, etc).

Prepare a subject

To verify that Nexus has successfully created a labeling skeleton and that it is automatically labeling, ensure that, as shown in the following image, the bounding boxes for Plug-in Gait model segments are displayed in the **3D Perspective** view. (The bounding boxes that Nexus draws around each segment that is defined in the template are for visualization purposes only.)



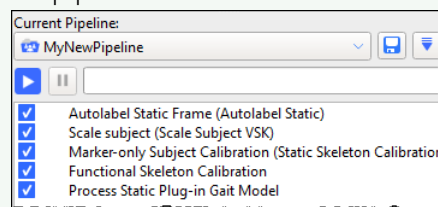
7. Save the ROM trial and the labeling skeleton (VSK) by pressing CTRL+S or clicking the Save button  on the Nexus toolbar.

When you have a fully labeled and processed trial (containing only raw reconstructions and no gap-filling), you can proceed to capture and process your movement trials (see [Capture movement trials, page 182](#)).



Tip

To save time in future, you may want to save all the relevant pipeline operations to one customized pipeline. To do this, add the relevant operations to the end of the **Auto Initialize Labeling** pipeline and save the pipeline under a new name.




Prepare a subject

Calibrate a labeling skeleton using a static trial


The recommended workflow for Nexus 2 is to use a ROM trial and dynamic calibration as this offers the benefits of the more efficient, automated labeler (for more information on this workflow, see [Calibrate a labeling skeleton using a ROM trial, page 160](#)). However, if you need to use a static frame to calibrate your labeling skeleton (eg, if you are capturing simple movement, or your subject cannot perform a full ROM, and/or you want to obtain results quickly), you can instead use the following workflow.

To perform a static calibration:

1. Ensure you have obtained and entered any subject measurements required to run the model (required measurements are highlighted in red in the **Subjects Resources** pane): for Plug-in Gait, these are the body weight and height as well as measurements of both left and right leg lengths, knee widths, and ankle widths. These are used to calculate joint center positions, and must be measured and entered into Nexus before any processing can begin. Optionally, you can also measure tibial torsion, the inter-ASIS distance, the ASIS-to-greater trochanter distance, and the sole delta if the subject is wearing shoes.
2. In the **Communications** pane, on the **Data Management** tab, ensure that you have created or opened the database in which to store the data you will be capturing, and that the required session is active. (For a reminder of how to do this, see [Prepare a data storage location, page 134](#).)
3. In the **Resources** pane, ensure Nexus is in Live mode.
4. Display a 3D Perspective view.
5. Capture a static trial. For more details, see [Perform an initial calibration of a labeling skeleton using a ROM trial, page 161](#).
6. Reconstruct the trial either by clicking **Reconstruct** on the Nexus toolbar or, if you need to configure the reconstruction settings, by clicking the **Pipeline** button  in the **Tools** pane and changing and running the **Reconstruct** pipeline to create a 3D image of the captured markers. (For information on how to run a pipeline, see [Run a pipeline, page 178](#).)
7. In the **Subjects Resources** tree, right-click on the subject node and attach the required PlugInGait Ai (Auto Initialize) labeling skeleton template (VST) file (see [Create a new subject from a template, page 154](#)) to the subject.

Prepare a subject

✔ **Tip:** To use a workflow prior to Nexus 2.x, ensure you use the required old labeling skeleton template, (PlugInGait.vst, PlugInGait Fullbody.vst, etc). If you chose to import old settings files when you first installed Nexus 2.x, you can select it from the list of available templates. If you didn't import the old settings files when you installed Nexus 2, copy the old VST files from ... \\Vicon\Nexus\ModelTemplates to ...\\Vicon\Nexus2.#\ModelTemplates.

8. Ensure that the subject node is the only entry enabled for capture. (When enabled, there is a check mark in the check box.)
9. In the **Pipeline** tools pane, select and run the **Auto Initialize Labeling** pipeline or if necessary, manually label the trial (see [Manually label a trial, page 174](#)). Nexus labels the trajectories based on the marker set defined in the .vst file.
10. Assess the results by looking at the labeling in the **3D Perspective** view. Ensure that all markers are connected by sticks and that the sticks on the left side of the subject are red and those on the right side are green.
11. Save the trial and the labeling skeleton (VSK) by pressing CTRL+S or clicking the Save button  on the Nexus toolbar.
12. You can now run any further processing needed to achieve the required modeling and finalize the calibration (see steps 5–7 of [Review and finalize a calibration of a labeling skeleton using a ROM trial, page 165](#)).

When you have saved a fully labeled trial (containing only raw reconstructions and no gap-filling), you can proceed to capture and process your movement trials (see [Capture movement trials, page 182](#)).

Prepare a subject

Correcting swapped labels

To obtain error-free auto-labeling, before running any calibration operation, ensure that the labels are present and correct in your .vst file and that you have labeled your ROM or static trial. If the markers in your ROM or static trial are not labeled, the calibration operation will fail. If your markers are incorrectly labeled (for example, if left and right markers are swapped), calibration will succeed, but when the Vicon Skeleton (.vsk file) is used to automatically label your movement trials, it will continue to produce the erroneous labels.

To address this, check your labeling carefully. You can correct any swapped markers with the **Swap Marker Labels** button in the **Label/Edit Tools** pane.



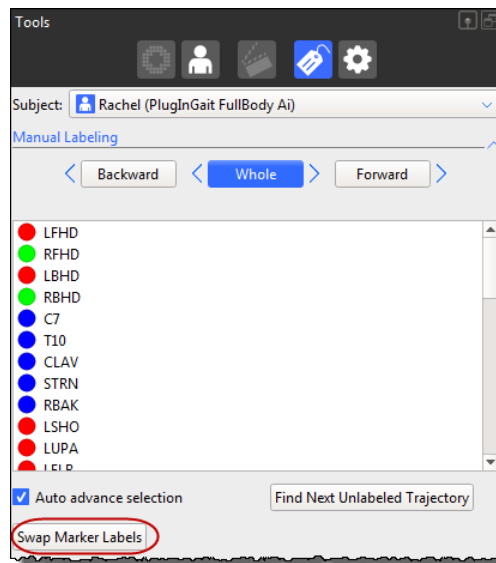
Tip

To see all the assigned marker labels in the **3D Perspective** view, press **CTRL+space bar**.

Prepare a subject

To correct swapped markers:

1. Select the two swapped markers in either the 3D Perspective view or in the Subjects Resources pane.
2. In the Label/Edit Tools pane, in the Manual Labeling section, click the Swap Marker Labels button.



Prepare a subject

Manually label a trial

The recommended workflow for Nexus 2 is to use a ROM trial and dynamic calibration as this enables the use of automated labeling (for more information on this workflow, see [Calibrate a labeling skeleton using a ROM trial, page 160](#)). However, on occasions, you may need to supplement automated labeling with manual labeling, or to use manual labeling where automated labeling gives insufficiently accurate results.

You manually label reconstructed trial data using the tools in the **Label/Edit Tools** pane.

Manual labeling involves associating the markers defined in a Vicon labeling skeleton template (.vst file) with reconstructed markers displayed in the 3D **Perspective** view. Manual labeling is then used when the .vst file is scaled to fit the subject wearing the marker set described in the .vst file, during subject calibration. In subsequent movement trials, Nexus uses the resulting subject-specific Vicon labeling skeleton (.vsk file) to automatically label the subject wearing the same marker set.

Important


Before manually labeling markers, ensure that you have already:

- [Created or opened a session in the database, page 134](#) in which you want to store the trial data, and ensured that it is the active session.
- [Obtained an existing .vst, page 152](#) file corresponding to the type of subject whose motion is to be captured, or created a custom Vicon labeling skeleton template.
- [Created a new subject node, page 154](#) from the template in which the manual labeling is to be stored.
- Attached the Vicon markers to the subject in accordance with the marker set defined in the associated template. For information on how to do this for Plug-in Gait markers, see [Attach Plug-in Gait markers to a patient, page 263](#).
- [Captured a brief ROM trial including static frames, page 160](#), or a [static trial, page 170](#), or obtained a single frame of live data with reconstructed markers corresponding to the marker set specified in the associated .vst file.

Prepare a subject

To manually label 3D marker reconstructions:

1. In the **Communications** pane, on the **Data Management** tab, open the trial file that contains reconstructed markers.
2. On the time bar, move the current time indicator (vertical blue line) to the first frame of the trial in which the subject is standing in a stationary neutral pose. This is typically a T-pose or 'motorbike' pose, in which the subject stands in the basic neutral pose and raises the arms out straight to the sides with palms facing down in a position in the shape of a T. If the subject is not able to attain the T-pose, they can use any neutral pose where all of the markers are visible to the cameras so that they will be able to be reconstructed.
3. In the **Subjects Resources** tree, ensure that the subject node you created from the template is the only entry enabled for capture. (When enabled, there is a check mark in the check box.)
4. At the top of the **Label/Edit Tools** pane, from the **Subject** list select the subject to be manually labeled.
Labels for the markers defined in the .vst file are displayed in the list in the **Manual Labeling** section.
5. By default, the **Whole** button is selected, so trajectories are labeled in both directions. This ensures that, when you label a marker at the current frame, the same marker is labeled throughout the trial. However, if you want the marker to be labeled from this point forward (or backward) only, for example, if you are resolving an overlapping trajectory, click the **Backward** or **Forward** button before proceeding.
6. In the **Manual Labeling** section, ensure **Auto advance selection** is selected to have Nexus automatically select the next label in the list after you have assigned a label to a marker.
7. In the list in the **Manual Labeling** section, click on the label you want to use. The shape of the pointer changes to include a tooltip that identifies the selected label to guide you in assigning labels to markers in the **3D Perspective** view.

 **Tip:** To help you apply labels to the correct markers, on the view pane toolbar, click the Split vertically button and in the second pane, open a Subject Viewer. Any marker you select in the Label/Edit Tools pane is highlighted in the Subject Viewer, so that you can see where to place it on the figure in the 3D view.
8. In the **3D Perspective** view click on the marker to which you want to assign the label.
The next label in the list is selected and the tooltip changes to indicate that

Prepare a subject

label. As you label more markers, a colored line is drawn between each marker until a stick figure appears.

✔ **Tip:** If you move the mouse to another area of the Nexus workspace while a marker is selected in the **Manual Labeling** section, the cursor retains the tooltip, indicating that Nexus is still in labeling mode. If you need to do something else in Nexus before marker labeling is complete, you can turn off labeling mode in one of these ways:

- Press the ESC key.
- Click on the **Label/Edit** icon, or any of the other icons in the **Tools** pane toolbar.

9. Repeat steps 7-8 until you have assigned all of the labels to markers. The stick figure in the **3D Perspective** view should resemble a skeleton of the subject type defined in the .vst file.
10. To verify that the manual labeling was successful, check that all the markers are connected by sticks and that the sticks on the left side of the subject are red and those on the right side are green.

✔ **Tip:** To find the next unlabeled marker, you can also use the **Find Next Unlabeled Trajectory** button. Nexus searches from the current frame forward until it finds an unlabeled marker. When found, the marker is selected and centered in the view pane.
11. To save the labeling information with the trial, on the Nexus toolbar, click the **Save** button.

Prepare a subject

Work with pipelines

Pipelines enable you run one or more operations that you use frequently or on a large number of trials, from import, through reconstruction and labeling and various other types of processing, to export.


You can set up pipelines to run automatically immediately after capture or as required on one or more saved trials.


You can use any of the pipelines supplied with Vicon Nexus or create your own by grouping a particular sequence of operations to suit your particular needs. Each operation within a pipeline can have a unique set of options and parameters.



Tip

If you are working with large numbers of files, to further speed up your work, you can set up and run pipelines as batch processes, using **Show**

File Transfer/Batch Processing interface  and then the **Batch**

Processing button  on the **Data Management** tab.

The following topics describe how to run existing pipelines and how to create new pipelines.

Prepare a subject

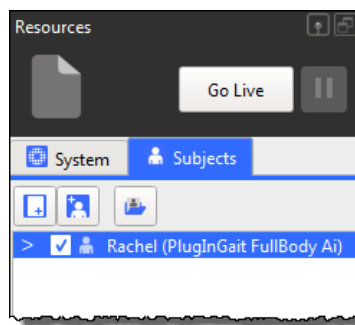
Run a pipeline

This topic describes how to run a pipeline. For information on creating your own pipelines, see [Create a pipeline, page 180](#).

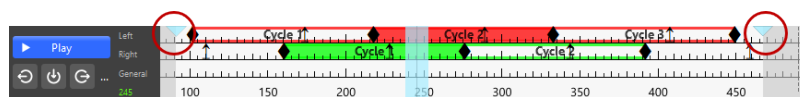
The procedure for running a pipeline is the same, whether you want to run a pipeline supplied with Vicon Nexus or your own custom pipeline.

To run a pipeline:

1. In the **Subjects Resources** pane, ensure that the subject whose trial data you want the pipeline to operate on is enabled. (When a subject is enabled, there is a check mark in the check box next to it.)



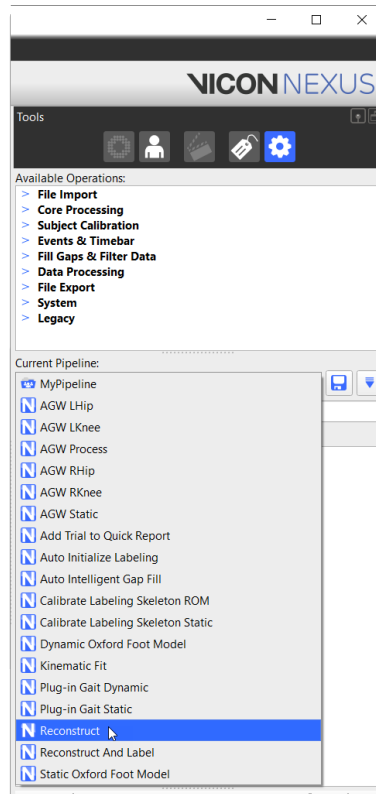
2. If you want the pipeline to operate only on a part of the trial rather than the whole trial, on the time bar, move the blue triangles that represent the start and end of a range of frames along the time line to set the required range.



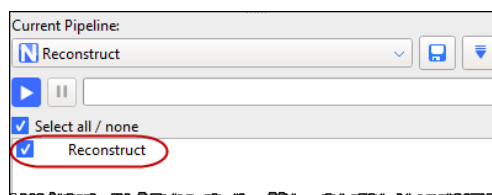
- ✓ **Tip:** To change the view of the timeline so that it shows only the selected range, right-click on the timebar and then click **Zoom to Region-of-Interest**.

Prepare a subject

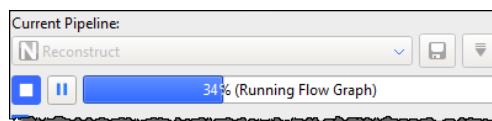
- In the Pipeline Tools pane, from the Current Pipeline list, select a pipeline.



- In the Current Pipeline operations list, ensure that the operation(s) to be run is selected.







- Click the Run button to start the pipeline process. Each operation is run in the order it appears in the list from top to bottom. The progress bar displays the results of the pipeline processing, and gives an indication of the percentage of processing completed for each operation.



Prepare a subject

The **Current Pipeline** operations list may contain the following information for each operation (to the right of the check box):

-  **Processing** The operation is being processed.
-  **Processed** The operation was completed successfully.
-  **Failed** The operation was not completed successfully.
-  **Stopped** The operation processing was stopped.

Create a pipeline

To save time, you can save and run sequences of frequently used processing operations using tools in the **Pipeline Tools** pane. Some pipelines can also be selected and run in the **Subject Preparation Tools** pane and the **Capture Tools** pane.

The following instructions describe how to create your own pipeline. For information on how to run an existing pipeline, see [Run a pipeline, page 178](#).

To create a pipeline:

1. If you want to modify an existing pipeline, in the **Pipeline Tools** pane, in the **Current Pipeline** area, select an existing pipeline. If you want to create a new pipeline, go straight to the next step.
2. In the **Available Operations** list, expand (>) or collapse (V) the pipeline type to display or hide the operations you can use for that type of automatic processing of trial data:
 - **File Import Operations** for automating the import of trial files into Vicon Nexus from third-party software packages.
 - **Core Processing Operations** for automating reconstruction, labeling, and kinematic fitting to produce 3D trajectories from raw marker data.
 - **Subject Calibration Operations** for automating the processing of system and labeling skeleton calibration.
 - **Events & Timebar Operations** for automating events and operations that can be carried out using the timebar.
 - **Fill Gaps & Filter Data Operations** for automating the post-processing of data, such as gap-filling and data-filtering.
 - **Data Processing Operations** for automating the production of model outputs (forces and moments, joint angles, etc).
 - **File Export Operations** for automating the export of trial files from Vicon Nexus to third-party software packages.

Prepare a subject

- **System Operations** for automating offline camera calibration, applying a codec to video, resetting force plate offsets and setting the camera calibration origin.
- **Legacy Operations** for automating access to legacy labeling and fit motion.

For further details of each of the pipeline operations, see Pipeline tools in the *Vicon Nexus Reference Guide*.

To view a tooltip describing an operation's function, hover the pointer over its name in the list.

3. Double-click each operation that you want to include in your pipeline. The operation is displayed in the list in the **Current Pipeline** section. The operations are run in the order they appear in the pipeline; to rearrange the order, drag operations into the required position in the list.
 - ✓ **Tip:** To automatically save the trial you are processing, add the **Save Trial - C3D + VSK** operation (located in the **File Export** pipeline operations) to your pipeline. As a general rule, you will want to save the trial as a last step after the other pipeline operations have been run, so position the **Save Trial - C3D + VSK** operation at the required point in the **Current Pipeline** operation list.
4. In the **Current Pipeline** list of operations, click on the operation you added in the previous step, then in the **Properties** pane at the bottom of the **Pipeline Tools** pane, view or change the settings as required.
5. To save your pipeline settings to a *.pipelines* file in the **Pipelines** folder (see [Manage configurations in Vicon Nexus, page 24](#)), click the **Save** button to the right of the **Current Pipeline** list.
6. In the **Save As** dialog box, supply a name for your new pipeline. An asterisk * is displayed next to the pipeline name if there are unsaved changes.

Capture movement trials

Capture movement trials

Before you collect your trial data, you must first have calibrated the labeling skeleton (see [Calibrate a labeling skeleton, page 157](#)) and ensured your subject is wearing the appropriate marker set.

When you have calibrated the labeling skeleton, you are ready to capture movement trials for the specified subject, during which the patient performs the motion that is to be analyzed. You then reconstruct and label the trial data, and run any further processing required.

For detailed instructions on these steps, see:

- [Capture the required movement, page 183](#)
- [Reconstruct and label movement trials, page 203](#)

You capture motion data using the tools in the **Capture Tools** pane, and process trial data using tools on the Nexus menu bar or in the **Pipeline Tools** pane.

Capture movement trials

Capture the required movement

After you have calibrated the labeling skeleton for your subject (see [Calibrate a labeling skeleton, page 157](#)), you can capture the required trials.


You can stream motion data in real time and/or capture raw camera data for offline processing. You can capture a trial manually (see below), or configure Nexus to start/stop capture automatically (see [Automatically start and stop capture, page 186](#)).

To quickly capture sequences of trials using the same setup information for each trial, see [Use Simple Capture Mode, page 201](#).

Note

For clarity, reconstruction and labeling are described as separate steps. However, if you want to run reconstruction and labeling as soon as each trial has been captured, you can add these operations (and any others that you want to run automatically) to a post-capture pipeline that runs as soon as capture finishes. For more information see step 7 below.

Before capturing a movement trial, ensure that you have already:

- Created or opened a session in the database in which you want to store the trial data, and ensured that it is the active session. For more information, see [Prepare a data management hierarchy to store your files, page 134](#).
- Loaded an existing .vsk file for the subject whose motion is to be captured. If you have just created your VSK (see [Calibrate a labeling skeleton, page 157](#)), the correct VSK is already loaded. If not, in the **Subjects Resources** pane, click the **Load an existing subject** button  and open the required .vsk file.
- Attached the Vicon markers to the subject in accordance with the marker arrangement used in the labeling skeleton (.vsk) file (if you are using Plug-in Gait, see [Attach Plug-in Gait markers to a patient, page 263](#)).

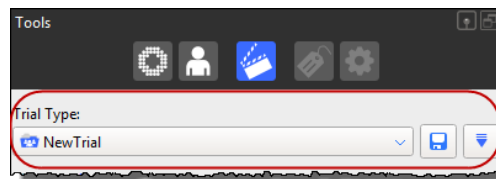
Tip

If you are using Plug-in Gait, Vicon recommends that you do not remove the heel markers for the movement trials. Their presence does not affect the calculated output from Plug-in Gait, but it does improve the reliability of the automatic labeling in Nexus.

Capture movement trials

To capture movement trials:


1. In the **Resources** pane, ensure Nexus is in Live mode.
2. Display a 3D Perspective view.
3. In the **Capture Tools** pane, select an existing capture configuration for the trial from the **Trial Type** list or save as a new one.



4. In the **Next Trial Setup** section, complete the details for storing your trial data in the active session.
 - ⚠ **Naming sessions and trials:** When you enter a name in the **Trial Name** field, do not give the trial the same name as the session as this can cause confusion when you select files in Data Management and may also cause issues if your Vicon Nexus system includes FLIR cameras.
5. In the **Data Source Setup** section, ensure **Optical Camera Data**, **Video Camera Data**, and **Device Data** are selected as required.
6. If you want capture to start and/or stop automatically, specify the required settings in the **Auto Capture Setup** section. (For more information, see [Automatically start and stop capture, page 186.](#))
7. If you are conducting clinical gait trials for kinetic analysis involving one or more force plates and want Nexus to automatically assess whether the foot is correctly positioned and is producing valid data for your live trials, ensure that in the **Options** dialog box (F7), **Footstrikes** is selected. For more information, see [Automatically assess foot strikes, page 198.](#)
8. In the **Post-Capture Pipeline Setup** section, specify any pipelines containing operations to be run automatically on the trial data when the capture is complete. (For example, if you are using Plug-in Gait, you could select **Run pipeline after capture** and then select the **Reconstruct And Label** and **Plug-in Gait Dynamic** pipelines. This automatically reconstructs and labels the data and then runs filtering, event detection, modeling and export operations.) However, to start with, you will probably prefer to leave this option cleared, so that you can run each operation separately and observe their effects.
9. In the **System Resources** tree, select **Local Vicon System** and then in the **Properties** pane, in the **General** section, set **Processing Output Level** to **Labels**.


Capture movement trials

10. In the capture volume, have the subject perform the movement that is to be captured.
Nexus automatically reconstructs, labels, and fits the Vicon labeling skeleton created in the previous stage (see [Prepare a subject, page 152](#)) to the subject in real time.

 **Tip:** If a labeling error is obvious or persistent, restart the labeler by right-clicking **Local Vicon System** node and then clicking **Reboot Core Processor (CTRL+R)**.

If the subject steps on the force plates, the force vector is also shown in real time.

11. On the **Capture Tools** tab, unless you have specified a time or trigger on which to start capturing (see step 5), in the **Capture** section, click **Start** to begin capturing and in the capture volume, have your subject wearing the appropriate marker set for your VST perform the required motion.
12. Unless you have specified a time or trigger on which to stop capturing in the **Auto Capture Setup** section, when the subject has completed the required motion, click **Stop**.
If you specified a post-capture pipeline (see step 7), Nexus automatically switches to **Offline** mode, displays the subject data in the **3D Perspective** view, and automatically performs any operations contained in any pipelines selected in the **Post-Capture Pipeline Setup** section. Otherwise the system remains Live, ready to capture the next trial.

 **Tip:** If events are not automatically detected, or are only partially detected, you will need to add them manually (see [Add events to trials, page 240](#)). You will probably need to do this in situations such as: trials without force plates; movements that are not on a flat surface, such as stepping up/down/over, climbing, etc; pathological or non-cyclical gait movement.

13. Repeat steps 9–11 until you have obtained the required number of trials.

You can now reconstruct and label the trials. For more information, see [Reconstruct and label movement trials, page 203](#).

Capture movement trials

Automatically start and stop capture

If required, instead of having to manually start and stop capture (see [Capture the required movement, page 183](#)), you can trigger data capture using an external device or based on a specified period of time.

Configure Vicon Nexus to automate data capture with these options:

- [Automatically record data before capture is triggered, page 186](#)
- [Stop data capture after elapsed time, page 187](#)
- [Trigger data capture on labeling percentage, page 187](#)
- [Trigger data capture using a remote control device, page 189](#)
- [Trigger data capture using timecode, page 190](#)
- [Trigger data capture over a network, page 191](#)

Automatically record data before capture is triggered

The **Capture before start** option enables you to specify the number of seconds of data to record prior to capture being triggered either manually (with the **Start** button) or automatically (based on timecode or a remote control device).

To automatically record before capture is triggered:

1. Ensure you have prepared for capture as described in [Capture the required movement, page 183](#), and completed steps 1–4.
2. In the **Capture Tools** pane, expand **Auto Capture Setup**, select **Capture Before Start (secs)** and specify the number of seconds to record data prior to capture being triggered.
3. Trigger the capture manually or using one of the remote capture methods described in this section.
The Vicon cameras capture the subject moving in the capture volume.
4. Stop the capture manually or using one of the remote capture methods described in this section.
Nexus automatically switches to Offline mode and displays the subject data in the 3D Perspective view.

Capture movement trials

Stop data capture after elapsed time

The **Stop after duration (secs)** option enables you to specify a time period after which Nexus is to automatically stop a capture.

To stop data capture after a specified time period:

1. Ensure you have prepared for capture as described in [Capture the required movement, page 183](#), and completed steps 1–4.
2. In the **Capture Tools** pane, expand **Auto Capture Setup**, select **Stop After Duration (secs)** and specify the number of seconds after which to automatically stop motion capture.
3. Capture a trial manually or using one of the remote capture methods described in this section.

The Vicon cameras capture the subject moving in the capture volume. Nexus automatically stops the capture after the specified number of seconds, automatically switches to Offline mode, and displays the subject data in the **3D Perspective** view.

Trigger data capture on labeling percentage

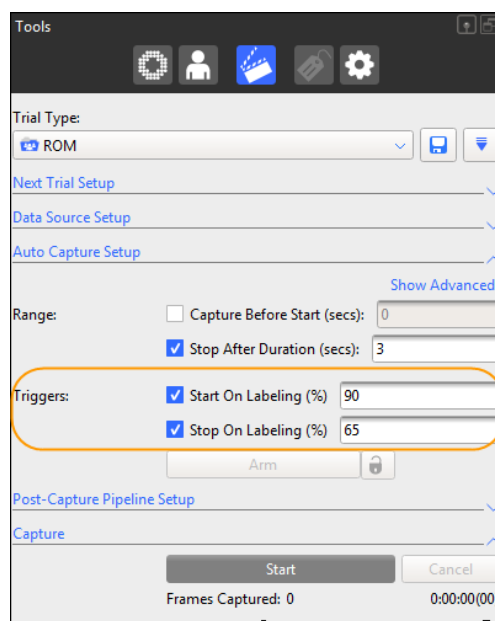
With the **Start on Labeling (%)** option selected, captures automatically start when a subject first fully enters the volume. If the **Stop on Labeling %** option is also selected, captures automatically stop when the subject leaves the volume.

You can set the labeling percentage (ie, the percentage of markers expected from the total number of markers in your subject's labeling skeleton) that needs to be recognized by Nexus within the capture volume for the subject to be considered as fully in the volume or to have left the volume and therefore to trigger capture start/stop.

Capture movement trials

The following procedure describes how to set up data capture to automatically crop live trials, based on labeling percentages. For information on how to automatically crop trials that you have already saved based on labeling percentages, see [Crop trials](#), page 223.

1. Ensure you have prepared for capture as described in [Capture the required movement](#), page 183, and completed steps 1–4.
2. In the **Capture Tools** pane, expand **Auto Capture Setup** and select **Start on Labeling (%)** and/or **Stop on Labeling (%)**.
3. The default values for this operation start capture when at least 90% of a subject's markers are recognized and stop when less than 65% remain (volume exit). You can adjust these percentages to suit your capture type.



4. Have a subject wearing the required marker set enter the volume.
 - ✓ **Tip:** To check data quality, you can display the labeling percentage by selecting the subject and in a **Graph** view choosing **Labeling** to show how many labels are present on each frame.

Capture movement trials

Trigger data capture using a remote control device

The **Start/Stop on remote trigger** option enables you to use an external remote control device to trigger data capture. The remote control device must be connected to a Vicon Lock unit in your Vicon system (for details, see either the *Vicon Systems Setup Guide* or the documentation for your Vicon Lock). Both start and stop ports require the signal to be grounded (ie, falling edge TTL) to trigger the desired action within Nexus.

To trigger data capture using a remote control device:

1. Ensure you have prepared for capture as described in steps 1–4 of [Capture the required movement, page 183](#).
2. In the **Capture Tools** pane, expand **Auto Capture Setup**, ensure the **Advanced** options are displayed, and select **Start/Stop On Remote Trigger**.
3. To set the system to a state where it is ready to accept a trigger signal for automatic capture based on a remote control device, click the **Arm** button. If you want to enable the system to remain ready to receive subsequent remote capture signals after the capture is stopped, click the **Lock** button to the right of the **Arm** button.
4. Trigger the start of the capture from your remote control device. The Vicon cameras capture the markers on the subject moving in the capture volume and the **Start** button switches to its **Stop** setting.
5. After you have acquired the data you need, trigger the stop of the capture from your remote control device. If you clicked the **Lock** button, the **Arm** button is re-enabled and the **Stop** button switches to its **Start** again, ready for a subsequent remote capture.
6. When you have finished your capture session, to review your subject data, manually load the trial.

Capture movement trials

Trigger data capture using timecode

The **Start On Timecode** and **Stop On Timecode** options enable you to use an external timecode source to trigger data capture in your Vicon system. The timecode source must be connected to a Vicon Lock in your Vicon system (for details, see either the *Vicon Systems Setup Guide* or the documentation for your Vicon Lock), and the corresponding timecode options must be configured under the **Vicon Lock** node in the **System Resources** pane.

1. Ensure you have prepared for capture as described in steps 1–4 of [Capture the required movement, page 183](#).
2. In the **Capture Tools** pane, expand **Auto Capture Setup**, ensure the **Advanced** properties are displayed and select one or both of the following options and specify the required timecode:
 - **Start On Timecode**
 - **Stop On Timecode**
3. Specify the start and stop values in the standard timecode format:
`hh:mm:ss:ff`
 where:
`hh` = hours (0-23), `mm` = minutes (0-59), `ss` = seconds (0-59), `ff` = frames (0-24 for PAL/SECAM, 0-29 for NTSC)
 For NTSC, the separator character changes between a colon (:) for non-drop frames and a semicolon (;) for drop frames.
 For details on the use of timecode functionality in Vicon systems, see the *Vicon Systems Setup Guide*.
4. To set the system to a state where it is ready to accept a trigger signal for automatic capture based on a timecode, click the **Arm** button.
5. If you want to enable the system to remain ready to receive subsequent timecode signals after the capture is stopped, click the **Lock** button to the right of the **Arm** button.
6. If you selected the **Start On Timecode** check box, start the timecode source from which the data capture is to be triggered; otherwise, under the **Capture** section click the **Start** button.
 When the specified timecode is reached, the Vicon cameras capture the subject in the volume and the **Start** button changes to **Stop**.
7. If you selected the **Stop On Timecode** check box, when the specified timecode is reached capture stops; otherwise, after you have acquired the data you need, click the **Stop** button.

Capture movement trials

Nexus automatically switches to **Offline** mode and displays the subject data in the **3D Perspective** view.

Trigger data capture over a network

You can broadcast a UDP message over an intranet or direct network cable connection to or from another application (or instance of Nexus) to trigger capture start and stop. Note that Nexus can send or receive the messages, but it cannot send and receive them simultaneously.

To trigger data capture over a network:

1. Ensure you have prepared for capture as described in steps 1–4 of [Capture the required movement, page 183](#).
2. In the **Capture Tools** pane, expand **Auto Capture Setup**, ensure the **Advanced** options are displayed, select **Start/Stop Over Network** and from the adjacent drop-down list, select **Send** or **Receive**.
3. In the **Address** field, 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.
4. 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, click the **Arm** button.
5. 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.
6. Start the capture from the remote software. You can start the capture using a timecode or immediately.

For information on the format of the packet, see [UDP capture broadcast/trigger, page 192](#).

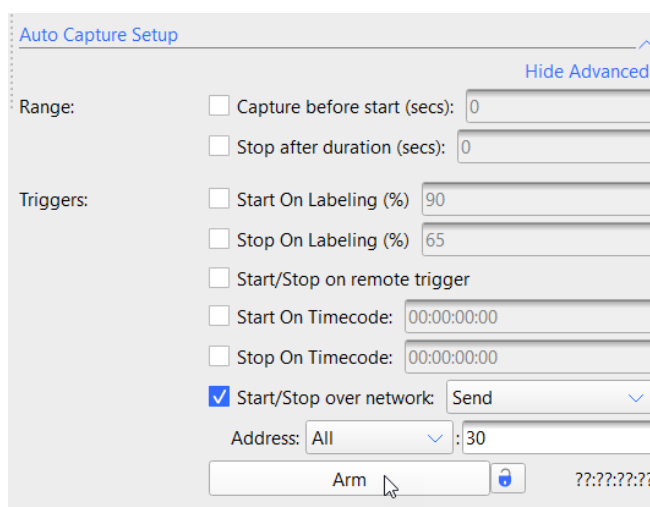
Capture movement trials

UDP capture broadcast/trigger

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

The port for broadcast and trigger is configurable and defaults to 30.

Note that the packet contents are null terminated.



The XML file contains the following notifications:

- [Start notification, page 193](#)
- [Stop notification, page 194](#)
- [Complete notification, page 194](#)
- [Timecode Start notification, page 195](#)
- [Timecode Stop notification, page 196](#)
- [Duration Stop notification, page 197](#)

Code examples (C++) are provided (see [Example code, page 197](#)).



Important

In all cases, ensure PacketIDs are unique to each packet.

Capture movement trials

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. The name must be unique for the given DatabasePath.
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	When Nexus sends packets, DatabasePath automatically uses the current session folder as the path for the capture files, even if it is left empty. When Nexus receives packets, DatabasePath is not supported.
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 unique 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.)

Capture movement trials

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>
```

Capture movement trials

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

Capture movement trials

- 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, page 195](#).

Capture movement trials

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" />
```

Example code

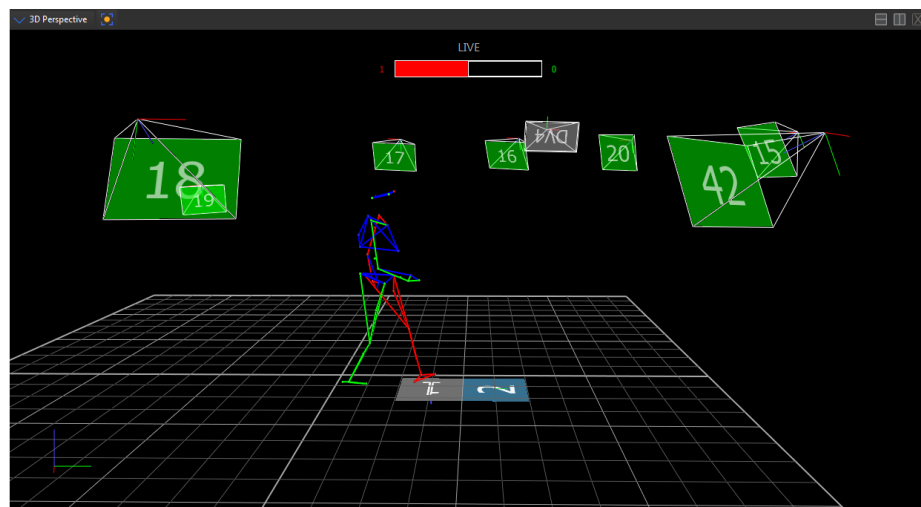
The examples are provided in C++ and require the *boost* library for communications.

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

Capture movement trials

Automatically assess foot strikes

In clinical gait trials for kinetic analysis involving one or more force plates, Vicon Nexus can automatically provide an indication of whether or not the foot is correctly positioned and is producing valid data for your live trials. Nexus displays this information on screen. This can save you time when you are assessing each foot strike to decide whether it is valid.



As each strike is detected or is determined to be invalid, the box representing the force plate in the 3D Perspective view or in the Camera view for a video camera, turns the appropriate color:

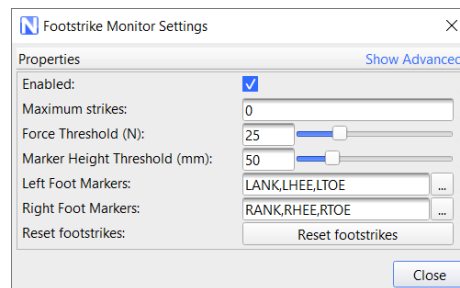
- **Red:** left foot strike
- **Green:** right foot strike
- **Dark gray:** invalid strike

Counters on either side of the force plate box show how many valid strikes have been detected for each foot during the current session.

Capture movement trials

To auto-detect foot strikes:

1. Before you begin, ensure that you have:
 - Calibrated the Vicon system.
 - Applied the appropriate marker set to the subject.
 - Ensured that you have a valid subject in Nexus.
 - Connected and configured one or more force plates.
2. On the **Window** menu, click **Footstrike Monitor Settings** and in the dialog box, ensure the options for foot strikes are as required:
 - a. **Maximum strikes:** Maximum number of foot strikes per side that are added to the count in a single trial
 - b. **Force Threshold:** Minimum force required on force plate to produce foot strike
 - c. **Marker Height Threshold:** Minimum height of foot marker above force place for foot to be recognized for foot strike
 - d. **Left and Right Foot Markers:** Comma-separated list of names of one or more markers that define the segment (i.e. foot) that will strike the plate.
 - e. **Reset footstrikes** button: Enables you to reset the foot strike counters.



3. In the **Options** dialog box (press F7), ensure that **Footstrikes** is selected and that the options for **Show in 3D Perspective** (for optical cameras) and **Show in Video Cameras** (for video cameras), **Font Size**, **Opacity**, and **Background Color** are as required.

To reset foot strike counters:

- Right-click anywhere in the workspace and then click **Reset**.

or

- Press CTRL+SHIFT+R

Capture movement trials

Using multiple foot plates

If your trial requires multiple force plates, they are laid out in the order of the force plate IDs (that is, FP1 is furthest left/uppermost depending on the position of the force plate box).

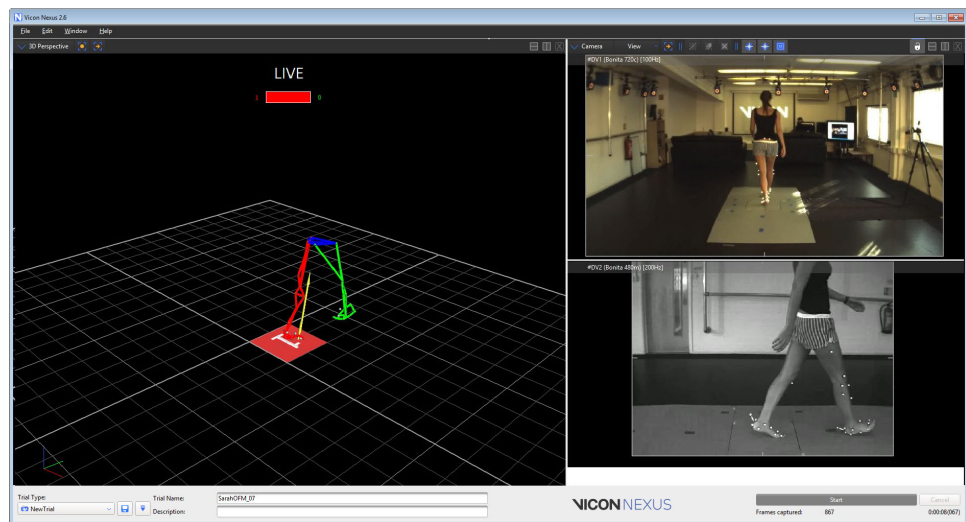
Strikes straddling two force plates are marked invalid. However, if required they can be processed by the **Process Dynamic Plug-in Gait Model** pipeline operation, by selecting the **Allow cross-plate strikes** option.

Capture movement trials

Use Simple Capture Mode

Simple Capture Mode enables you to use a workspace that maximizes your view of the capture volume and exposes a focused subset of controls required for repeated captures, allowing you to concentrate on the movement you are capturing.

In Simple Capture Mode, only the currently selected view type is displayed, together with controls that enable you to specify the trial type, name, and description, and to start and stop (or cancel) captures.



Capture movement trials

To display a simplified capture view:



1. Ensure that you have set up your Vicon system as required, that Nexus is in Live mode, and that you have set up your trial types, including any post-capture pipeline required, auto-start triggers, etc. (For information on setting up trials, including pipelines and triggers, see [Capture the required movement, page 183](#) and [Automatically start and stop capture, page 186](#).)
By default, Simple Capture Mode displays the same view as the current workspace. You can customize the view to include other panes (eg, a video pane alongside the 3D Perspective), as described in the following steps.
2. Associate a custom view type with **Simple Capture Mode**. To do this:
 - a. Open the **Options** dialog (press F7) and on the left click **Simple Capture Mode View Options**.
 - b. On the right, from the **View Type** list, select **On**.
 - c. From the **User Specified Simple Capture Mode View** list, select one of the following:
 - To use the Vicon-supplied **Simple Capture** view type (which displays the view pane with a **3D Perspective** view on the left, and **Camera** views with video cameras selected on the right, as shown above), ensure **Simple Capture** is selected; or
 - To use your own view type (for a reminder of the controls that enable you to define and save a view type, see [Manage configurations in Vicon Nexus, page 24](#)), select the required option.
3. Turn on Simple Capture Mode. To do this:
 - On the **Window** menu, select **Simple Capture Mode**; or
 - Press CTRL+H

The simplified capture view that you selected in the **Options** dialog box is displayed.
4. To capture trials, at the bottom right of the Simple Capture view, click **Start**.
5. To exit Simple Capture Mode, either press Esc, or press CTRL+H again. (You can also click the **Window** menu and clear **Simple Capture Mode**.)

Reconstruct and label movement trials

After you have calibrated a labeling skeleton for your subject (see [Prepare a subject, page 152](#)) and captured the required movement of the subject in a trial or series of trials (see [Capture movement trials, page 182](#)), you must reconstruct and label the raw camera data to create 3D markers. You can do this as a separate step, as described below, or you can specify a pipeline that includes **Reconstruct** and **Label** in the **Post-Capture Pipeline Setup** (see [Capture the required movement, page 183](#)), so that these operations run straight after capture.

Note

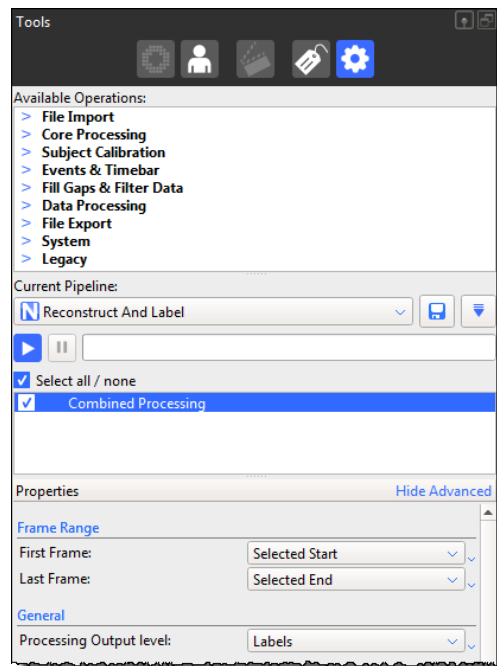
You can choose to reconstruct and then label separately, or run both operations together, by clicking either the **Reconstruct** button  or the **Reconstruct and Label** button  on the Nexus toolbar, or by configuring and running the equivalent pipeline operations. Normally, you would use **Reconstruct** alone if you are working on a labeling skeleton template (VST), but **Reconstruct and Label** if you are processing movement trials.

To reconstruct and label trial data:

1. Display the subject whose data is to be reconstructed in either of the following ways:
 - If you have just captured a trial, ensure that the raw marker data for the subject in the capture volume is still visible in a **Camera** view and in the **Resources** pane, ensure Nexus is in **Offline** or **Pause** mode; or
 - On the **Data Management** tab, open the desired trial file containing raw trial data for the subject.

Capture movement trials

2. Do one of the following, depending on whether you need to adjust the reconstruct and labeling settings:
 - To run the operations without viewing and changing their settings, on the Nexus toolbar, click the **Reconstruct and Label** button.
This runs the **Reconstruct and Label** operation defined in the Pipeline Tools pane.
Or
 - To view and/or change the operations, on the **Pipeline Tools** pane, from the **Current Pipeline** list, select **Reconstruct And Label**. In the list of current operations, click on **Combined Processing** to select it. set the **Processing Output level** to the required level, for example, **Labels**, and specify any other required properties.



The pipeline progress bar indicates when the operation is complete.

You can now review the results and fill any gaps in the trial data. For information, see [Review trials and fill gaps, page 205](#).

Review trials and fill gaps

Review trials and fill gaps

When you have reconstructed and labeled your movement trials (see [Capture movement trials, page 182](#)), you can review the results and fill any gaps in the trial data.

1. If other Nexus users may have worked on your trial data, you may first want to check on any processing that has been performed on the files (see [Review processing history, page 206](#)).
2. Review data quality by playing through the trial using the **Time Bar** and/or looking at the information on the data **Quality** tab (see [Review data quality, page 208](#)).
3. If necessary, crop any large gaps at the beginning and/or end of the trial, either manually or automatically (see [Crop trials, page 223](#)).
4. Fill any gaps using either automatic or manual gap-filling (see [Fill gaps in trial data, page 227](#)).
5. If required, you can add events to trials (see [Add events to trials, page 240](#)).

After you have filled any gaps in your trial data, you can run the required modeling operations. For more information on modeling, see [Modeling with Plug-in Gait, page 248](#).

Review trials and fill gaps

Review processing history

You can review all processing that has been performed on a loaded trial file on the **History** tab in the **Communications** pane. This ensures that, even if you have not worked with the data before, you can work on the trial without missing or duplicating processing steps. For example, if you work as part of group, when you open a trial that someone else has worked on, you can immediately see what processing has occurred (eg, filtering, gap-filling) and what settings were used.

Being able to view processing history helps you to understand your data, prevents errors introduced by running certain operations more than once (eg, filtering), and reduces the need to reprocess data because its current state is not well known.



Note

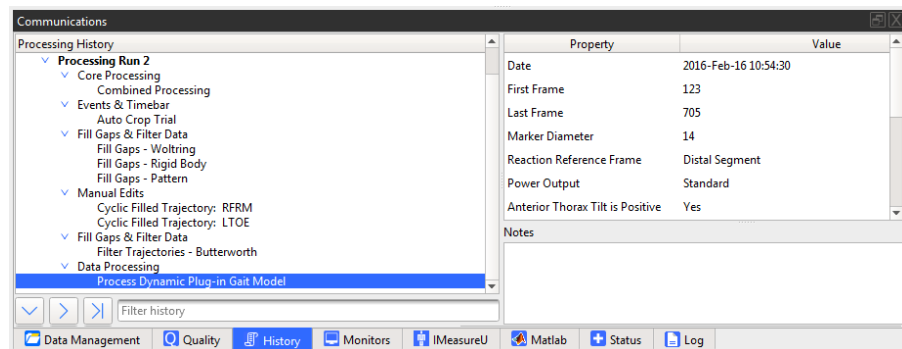
Processing history is available only for files processed in Nexus 2.3 and later.

Review trials and fill gaps

To view processing history:

1. Open a trial.
2. In the **Communications** pane, click the **History** tab.
A summary of the data processes and major events is displayed.
3. To display information about a particular event, click the event.

Details about the settings used to run the event are displayed in the **Property** and **Value** columns on the right.



In the **Notes** field, you can add notes that will be useful to you or anyone else working with the same trial. Your notes are saved with the trial.

Review trials and fill gaps

Review data quality

To enable you to review the data you captured in your movement trials (see [Capture movement trials, page 182](#)), Vicon Nexus offers a number of tools. You can use the time bar to manually scrub through the trial, or to assess your trials quickly and easily, you can use the automated data quality features of Nexus.

For more information, see:

- [Review trial data on the Data Management tab, page 209](#)
- [Review trial data using the time bar, page 211](#)
- [Assess trial health with the data Quality pane, page 213](#)
- [Detect gaps in the Graph view, page 216](#)
- [View gaps with the Data Correction view, page 217](#)
- [View data quality across a trial, page 219](#)
- [Navigate to gaps using the data quality features, page 221](#)

Review trials and fill gaps

Review trial data on the Data Management tab

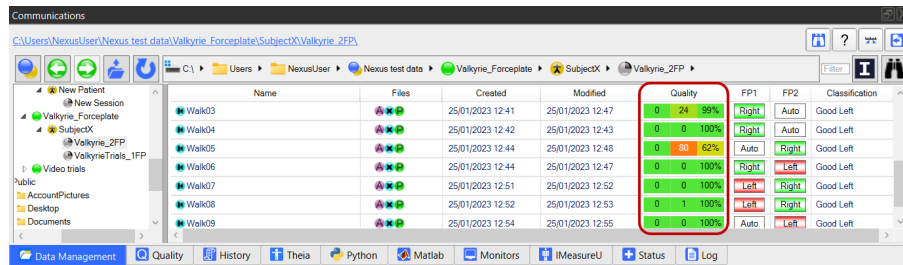
You can quickly obtain feedback on the data quality of all your trials on the Data Management tab.

Note

To display quality information:

- If your trials were captured in versions of Nexus earlier than Nexus 2.9, save the trial in Nexus 2.9 or later (eg, by running the Save Trial - C3D + VSK pipeline operation, found in the File Export pipeline operations).
- If your trials include multiple subjects, select a single subject only.

On the default Data Management tab, the Quality column displays data quality information about each trial.



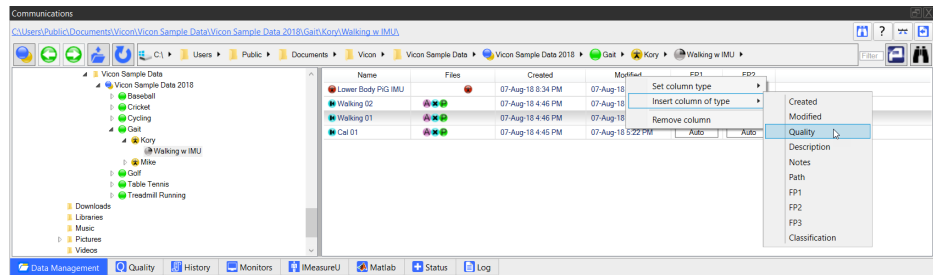
The information displayed (from left to right in the Quality column) is:

- Number of unused markers
- Number of gaps in this trial.
- Percentage of markers in this trial that are labeled.

Review trials and fill gaps

If you are using a custom scheme for the Data Management tab, to display a Quality column, you can either revert to the default layout or, to add a Quality column to your custom scheme:

- Right-click on a column and then click **Insert column of type** and select **Quality**.



Review trials and fill gaps

Review trial data using the time bar

To review trial data using the time bar:

1. Display reconstructed and labeled markers in either of the following ways:
 - Ensure that a trial you have just captured has been reconstructed and labeled.
 - From the **Data Management** tab, open a previously captured and labeled trial.
2. In the **Resources** pane, ensure Nexus is in **Offline** mode.
3. Display a **3D Perspective** view and optionally a **Graph** view.

✔ **Tip:** To automatically display both views, in the **View Type** list on the Nexus toolbar, select **Data Correction**. Using a split layout with both a 3D Perspective and a Graph view enables you to display the results of your editing actions and to select specific trajectories, frame ranges, and gaps in trajectories. Since the graphs indicate what changes have been made to the data and by which tool, you can immediately see the results of any edits you have made and determine if you want to change it again or adjust the data, using a different tool in the **Gap Filling** section.
4. Play back the desired portion of the trial:
 - **Full trial:** In the controls at the left end of the time bar, click **Play** to start playing the trial data. The data plays through to the end and restarts at the beginning if you do not click **Stop**.
 - **Range of frames:** Do one of the following:
 - To manually adjust the range, move the blue triangles that indicate the start and end of the selected range of frames (also known as the region of interest) along the timeline; or
 - On the time bar, right-click and then click **Set Region-of-Interest**. In the **Set Region of Interest** dialog box, specify the **Start Frame** and **End Frame**.
 - **Individual frame:** Move the blue vertical line that indicates the currently selected time along the timeline to manually locate the desired frame, or right-click on the time bar, click **Set Current Frame** and enter the number of the required frame.

Review trials and fill gaps



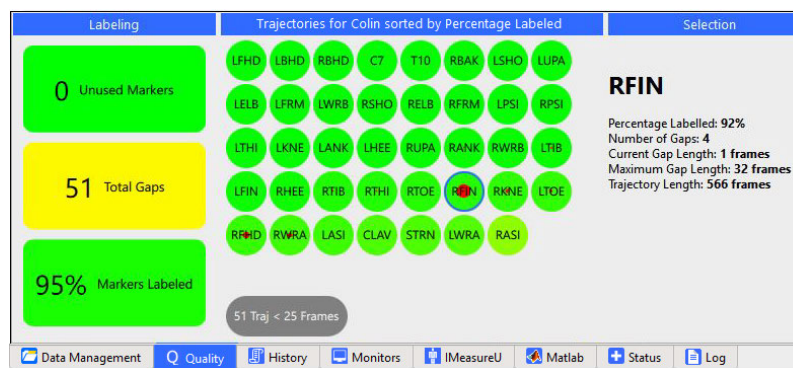
Tip

To display a context menu in which you can reset the timescale on the timeline, set the playback speed, or specify the length of trajectory tails, click the ellipsis (...) in the time bar controls, or right-click the time bar.

Review trials and fill gaps

Assess trial health with the data Quality pane

The data Quality pane, a tab in the Communications window, provides both a broad overview of data quality for a subject across the entire trial and a way to examine the health of individual trajectories. It also enables you to navigate to the highlighted issues.

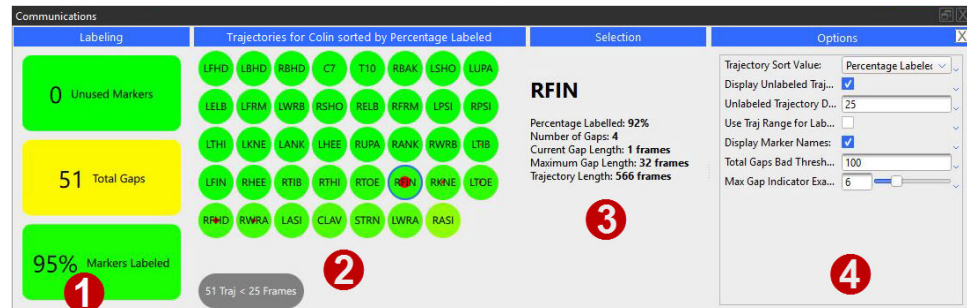


The three most common data issues that you need to find and resolve are:

- Missing markers (usually knocked off before capture)
- Unlabeled or incompletely labeled trajectories
- Gaps in trajectories

Review trials and fill gaps

The Quality tab helps you to find this information:

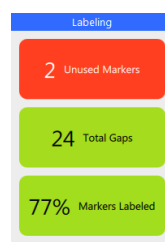


- 1** Overview of the health of the whole trial (Labeling column) The text in each rectangle indicates the number of unused markers, any gaps, and the percentage of markers labeled. As a quick indicator, to enable you to assess whether to continue working with the trial, the color green indicates good health, red indicates probable major issues, and colors between the two (yellow, amber, orange) indicates that the overall health of the trial lies somewhere between these extremes.



For example, a good trial, worth further work, would be indicated by:

- No missing markers
- A high percentage of labeled markers
- Only a small number of gaps.



A low quality trial, which would probably have to be re-run, would be indicated by:

- Missing markers, and/or
- A high number of gaps, and/or
- A lower percentage of labeled markers.

In this example, two required markers are completely absent from the trial, so, without further work, you would know that you would have to either re-reconstruct or (more likely) re-capture the trial.

- 2** Individual trajectories. If you hover the mouse over a blob, the blob displays information about the trajectory. If you click on it to select it, information about the trajectory is displayed in the Selection column on the right. For more information, see [Navigate to gaps using the data quality features, page 221](#).

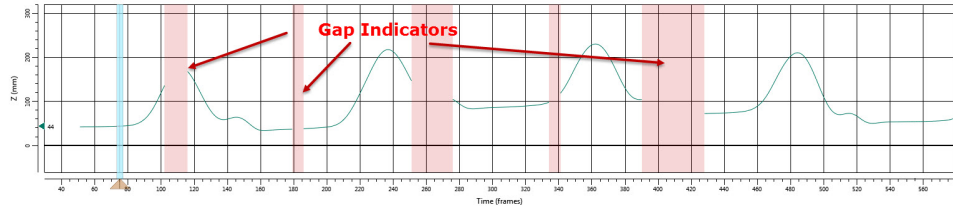
Review trials and fill gaps

-
- 3** **General trial information/selected trajectory Information (Selection column).** If no blob is selected, general information about the currently loaded trial is displayed. If a blob is selected, information about the trajectory is displayed.
-
- 4** **Display options (Options column):** Enables you to configure the display options for the data Quality tab. Alternatively, you can open the **Options** dialog box (F7), click **Data Quality Panel Options** on the left, and change the properties as required. To save any changes to these settings, click the **Save current configuration** button in the **Options** dialog box.
-

Review trials and fill gaps

Detect gaps in the Graph view

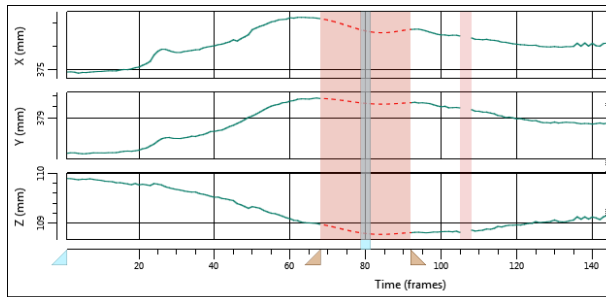
The Graph view enables you to view and fix gaps for a selected trajectory.



To display gaps:

1. On the Quality pane, click a trajectory blob that is reporting a gap.

Gap indicators are displayed in pink in the Graph view.

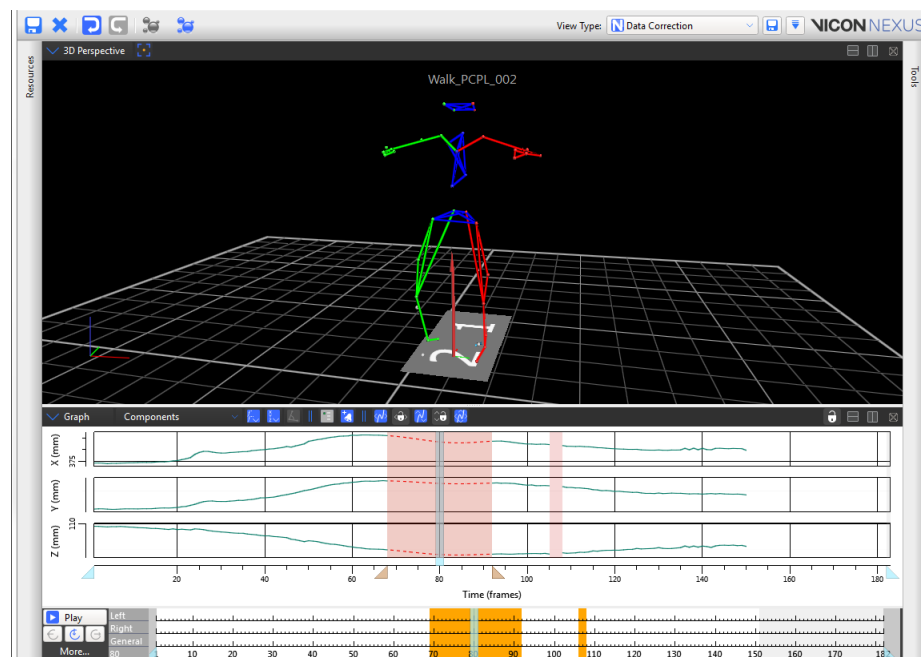


2. To zoom in and out, CTRL+double-click on a gap indicator (the pink area) on the graph.

Review trials and fill gaps

View gaps with the Data Correction view

The default Data Correction view type displays a 3D Perspective view above a Graph view.



You can turn Data Correction view on or off in the Options dialog box, as described below.

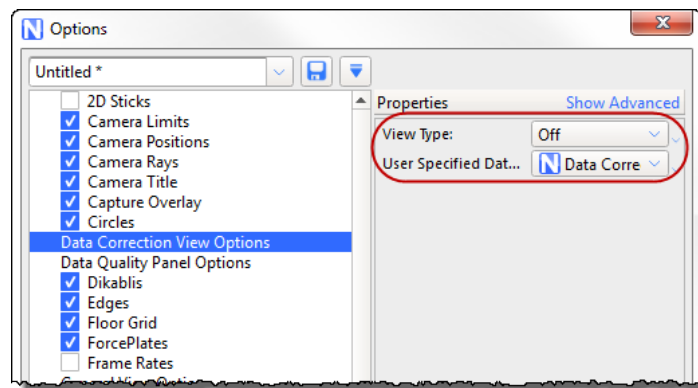
When the Data Correction view is turned on, it is automatically displayed when you navigate using the data Quality pane.

If you would prefer the Data Correction view to appear differently (for example, displaying the Graph above the 3D Perspective view), you can save your own preferred view and select this instead.

Review trials and fill gaps

To configure the Data Correction view:

1. Open the Options dialog box (F7).
2. Click on Data Correction View Options on the left and change the properties as required on the right:
 - a. If you want to display this view type automatically when you are navigating via the Quality tab, ensure View Type is set to On.
 - b. If you have saved a different view type to be displayed when you are using the Quality tab, ensure it is selected in the User Specified Data Correction View field.



Review trials and fill gaps

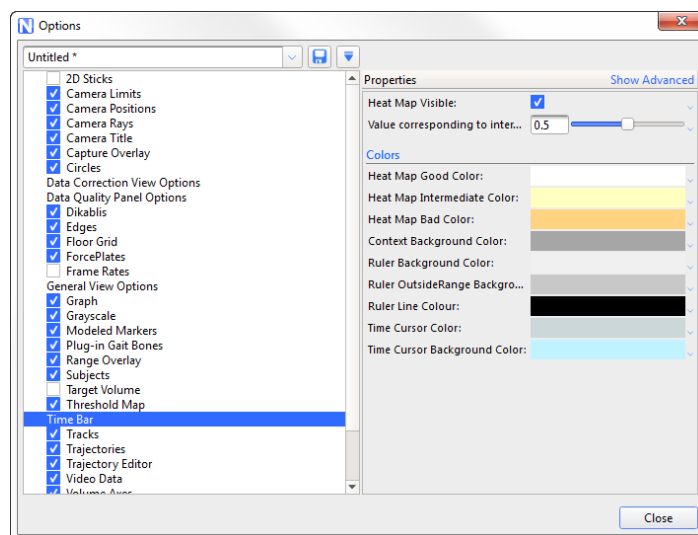
View data quality across a trial

In addition to viewing data quality on the Quality tab and Graph and Data Correction views, you can also view data quality as a heat map on the time bar, to get an overall picture of the current trial.

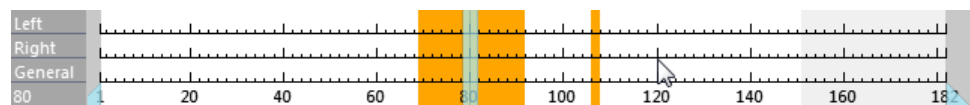


To turn on the heat map overlay:

1. In the Options dialog box (F7), click on **Time Bar** on the left, and select the **Heat Map Visible** check box on the right.
2. If required, change the colors of the heat map.



When you click on a trajectory on the **Quality** tab, the time bar shows gaps for the selected trajectory.



Review trials and fill gaps

Viewing data quality for multiple trajectories

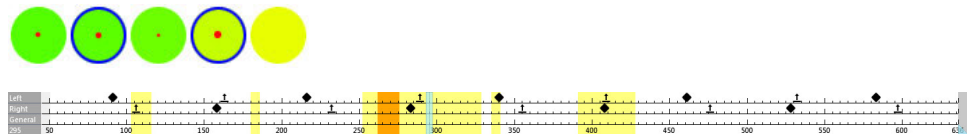
To select multiple trajectories, on the **Quality** tab, CTRL+click the required blobs.

When multiple trajectories are selected, the heat map's color gradient system is activated.

Lighter colors show where one of the trajectories has a gap but other selected trajectories do not. Darker areas show where a number of selected trajectories has a gap.

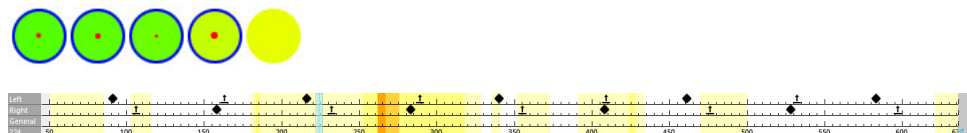
Two trajectories selected

The following images show two trajectories selected. The darker area indicates gaps in both trajectories.



More trajectories selected

As more trajectories are added the view starts to morph from individuals gaps for one or two trajectories, to areas in the volume/time where there are issues.



Review trials and fill gaps

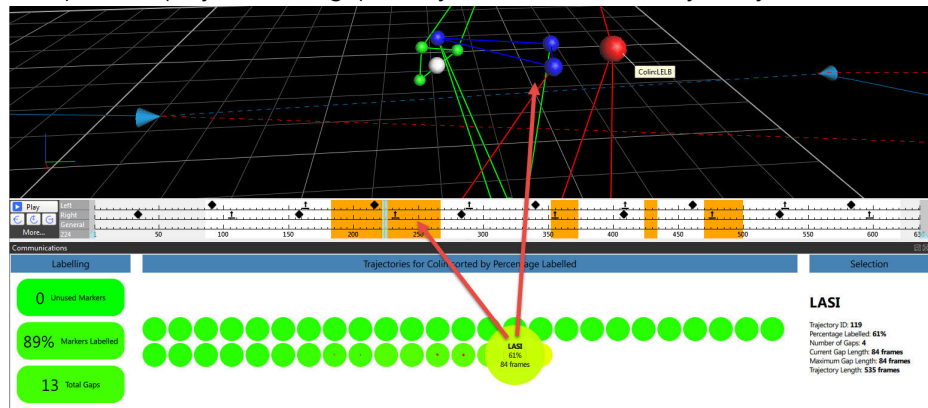
Navigate to gaps using the data quality features

Using the Quality tab and the Data Correction view type, you can quickly navigate to gaps in data, and use the Zoom, Translate, and Rotate options for a better view.

Quick navigation to gaps

To quickly navigate to gaps:

1. On the Quality tab, click on a trajectory blob. Immediately, the time bar and view pane displays the first gap (if any) for the selected trajectory.



2. To move to the next gap or previous gap for the selected trajectory, press the hot keys CTRL+8 and CTRL+7 respectively.
 - ✔ Tip: On the data Quality tab, you can move to the next trajectory and previous trajectory by pressing CTRL+PgUp and CTRL+PgDown.

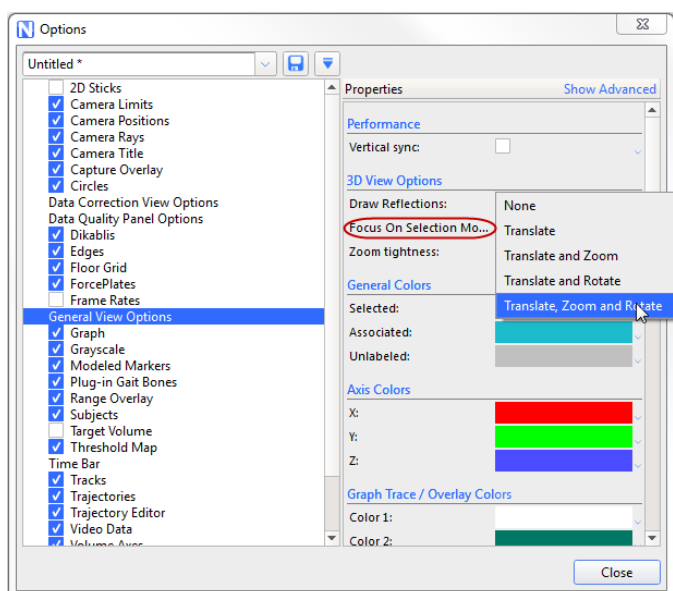
Review trials and fill gaps

Get a better view of gaps

The Zoom, Translate and Rotate options for viewing a gap make it easier to zoom in on and fix selected gaps.

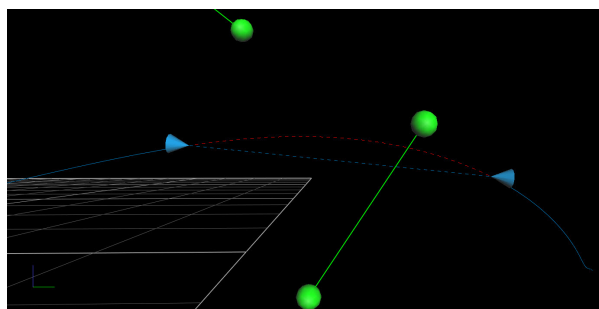
To view gaps more clearly:

1. In the Options dialog box (F7), click **General View Options** on the left.
2. In the Properties pane on the right, in the **3D View Options** section, click the **Focus on Selection Mode** list.
3. To display a zoomed view that rotates the workspace to a flat perspective of the gap, click **Zoom, Translate and Rotate**.



4. On the **Quality** tab, click the blob for the trajectory whose gaps you want to examine.

The **3D Perspective** view zooms in and rotates as necessary to clearly show the selected trajectory's first gap.



Review trials and fill gaps

Crop trials

For trials where the subject starts outside the volume, moves into the volume and then exits, cropping the start and end of the trial removes unwanted frames where the subject was not fully in the volume.

Before you fill gaps in your trial data, it's a good idea to remove these start and end frames as they are likely to contain large gaps and other invalid data. You can do this automatically while capturing (see [Trigger data capture on labeling percentage, page 187](#)), or for trials that have already been saved, you can crop trials manually or run a pipeline operation to do this automatically.

Cropping a trial affects only the .c3d file. The raw files remain unchanged.



Tip

If you add gait cycle events and then crop a trial, you will probably also want to delete events that are outside the cropped region. For information on how to do this, see [Delete events that are outside the region of interest, page 244](#).

For more information, see the following topics.

- [Manually crop a trial, page 224](#)
- [Automatically crop a trial, page 225](#)

Review trials and fill gaps

Manually crop a trial

You can use tools on the time bar to remove unwanted frames at the start and end of your trials.

To manually crop a trial:

1. Ensure the required trial is reconstructed and labeled (see [Reconstruct and label movement trials, page 203](#)).
2. On the time bar, do one of the following:
 - Move the range indicators (blue triangles) to exclude the unwanted frames at the beginning and/or end of the trial; or
 - Right-click and then click **Set Region-of-Interest**. In the **Set Region of Interest** dialog box, specify the **Start Frame** and **End Frame**.

The gray shaded area represents the cropped frames of the trial.

3. Right-click on the time bar and click **Zoom to Region-of-Interest**.

You can now fill any remaining gaps.

Review trials and fill gaps

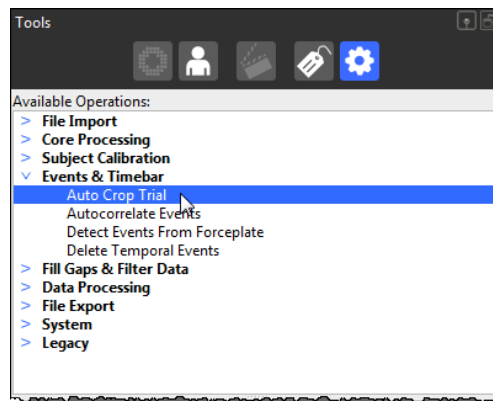
Automatically crop a trial

Nexus can save you time and effort by automatically determining the first and last frame where the subject is fully in the volume

When you run the autocrop operation, Nexus automatically zooms the time region of interest to the points where the subject first fully enters and then leaves the volume.

To set up auto-cropping:

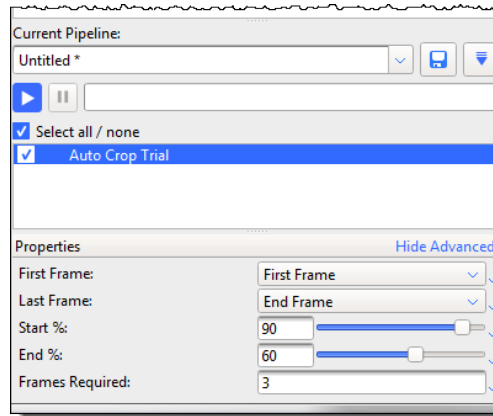
1. Ensure the required trial is reconstructed and labeled (see [Reconstruct and label movement trials, page 203](#)).
2. In the Tools pane, click the Pipelines tab and in the Available Operations list, expand Events & Timebar.
3. Double-click the Auto Crop Trial pipeline operation to add it to the current pipeline.



4. In the Current Pipeline list, click Auto Crop Trial and in the Properties pane, ensure that the First and Last Frame options are set to the beginning and end frames during which the subject enters and leaves the volume.

Review trials and fill gaps

5. Set the **Start** and **End (%)** options to the required minimum percentage of markers (ie, the percentage of markers expected from the total number of markers in your subject's labeling skeleton) that must be labeled in each case.



6. If necessary, adjust the **Frames Required** to set a minimum number of frames where the **Start %** criterion must be met. This is helpful if early single frames of data meet the %, but the point at which the trial is intended to start (ie, the point at which the % is maintained over a number of frames) is later in the trial.
7. Run the **Auto Crop Trial** operation.
The trial is automatically cropped to the frames you have selected.

You can now fill any remaining gaps.

Review trials and fill gaps

Fill gaps in trial data

When Nexus reconstructs each marker on a subject, ideally it produces a smooth trajectory throughout the trial. Realistically, there may be frames with breaks in trajectories due to some markers that could not be reconstructed or spurious data.



Tip

Auto Gap Fill attempts to fill all gaps in the trial data. For the best results, you are likely to need to change the default property settings, including the gap size. For data containing large gaps, review and manually fill the large gaps first, using the tools in the Label/Edit Tools pane, and/or by cropping out any unwanted frames with large gaps that occur at the start or end of the trial.

For information on cropping frames at the start and end of the trial data, see [Crop trials, page 223](#).

For more information, see:

- [Manually fill gaps in trial data, page 228](#)
- [Automatically fill gaps in trial data, page 236](#)
- [Example of creating a custom pipeline for gap-filling, page 239](#)

In addition, a Vicon [Nexus 2 tutorial video](#)²¹, showing gap-filling operations, including many additional tips and examples, is available on YouTube.



Note

As the videos were recorded using an earlier version of Nexus 2, you may notice small differences in the user interface.

For additional tips, see Improve manual labeling in the *Vicon Nexus Reference Guide*.

²¹ [https://www.youtube.com/watch?](https://www.youtube.com/watch?v=Km9ZKkDfVXg&list=PLxtgdgDam3USUS1euO6UloG3ogPsFNtEJS&index=2)

[v=Km9ZKkDfVXg&list=PLxtgdgDam3USUS1euO6UloG3ogPsFNtEJS&index=2](https://www.youtube.com/watch?v=Km9ZKkDfVXg&list=PLxtgdgDam3USUS1euO6UloG3ogPsFNtEJS&index=2)


Review trials and fill gaps

Manually fill gaps in trial data

You can manually fill any gaps in the reconstructed and labeled trial data by using the tools in the **Label/Edit Tools** pane.

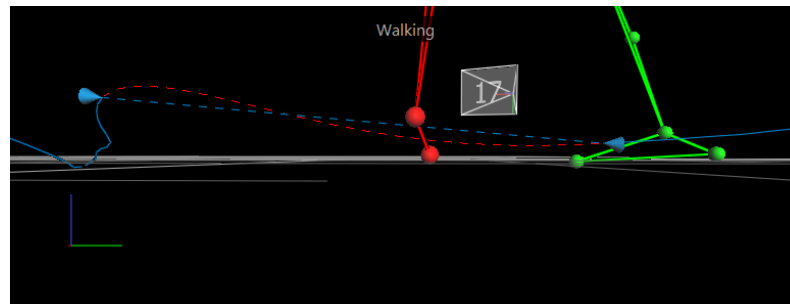
As well as automatically filling gaps (see [Automatically fill gaps in trials, page 236](#)), you can manually fill gaps to correct any errors or inconsistencies in the reconstructed and labeled trial data.

To manually fill gaps in reconstructed and labeled data:

1. Display reconstructed and labeled markers, ensure Nexus is in **Offline** mode, and display a **3D Perspective** view and optionally a **Graph** view, as described in [Review trial data using the time bar, page 211](#).
2. Unless you have already cropped your trial (see [Crop trials, page 223](#)), to simplify cleaning up your data, set the region of interest of the trial that you wish to analyze. For example, if the capture includes the subject entering and leaving the capture volume, Vicon recommends that you set the range of frames to exclude these parts of the capture, as they are likely to include large gaps. To do this, on the time bar, move the blue range indicator triangles to select a range of frames and then right-click and click **Zoom to Region-of-Interest**.
3. In the **Subjects** tree, ensure that the desired subject is selected (when selected, there is a check mark in the check box).
In the **Label/Edit** tools pane, in the **Gap Filling** section, any markers whose trajectories contain gaps within the selected range of frames are listed in the **Trajectory** column, with the number of gaps for each trajectory identified in the **#Gaps** column and the largest gap length in the **Max Gap Length** column.
 **Tip:** To jump to the largest gap for a particular trajectory, double-click in its **Max Gap Length** column. To change the sort order of the columns, click the column headings.
4. In the **Trajectory** column, click the trajectory whose gaps you want to fill. Nexus automatically selects the gap by placing the current time in the middle of the gap and positioning the gap range selectors (blue cones) at the start and end of the gap. A red dotted line is displayed to preview the shape of the trajectory if a spline fill editing operation is run.

Review trials and fill gaps

If you can't see a red dotted line, in the Label/Edit Tools pane, in the Gap Filling section, hover the mouse pointer over the Fill button in the Spline Fill area to display a tooltip.



5. In the **Range** section, view the range values to identify the size of the gap and use the buttons to navigate between the gaps in the selected trajectory:
 - **Prev Gap:** Navigate to the previous gap in the selected trajectory. This button is available only if there are gaps in the trajectory before this point.
 - **Left edit range:** The frame before the start gap range selector, indicating the start of the gap that will be filled in.
 - **Right edit range:** The frame after the end gap range selector, indicating the end of the gap that will be filled in.
 - **Next Gap:** Navigate to the next gap in the selected trajectory. This button is available only if there are gaps in the trajectory after this point.
6. If required (for example, if the data leading up to the gap is noisy), to extend the edit range beyond the gap, in the **3D Perspective** view, drag the gap range selectors (blue cones).
 - ✓ **Tip:** If you need to adjust the size of the cones for easier viewing or selection, open the **Options** dialog box (press F7) and click **Trajectory Editor**. Adjust the value of **Radius** as required (the default is 10 pixels).

Review trials and fill gaps

7. Use the appropriate fill tool to generate data to fill the selected gap.

✓ **Tip:** If your chosen tool is unavailable, hover the mouse pointer over the unavailable button to display a tooltip that explains how to use it.

The fill options are:

- **Spline Fill:** Performs a cubic spline interpolation operation to fill the currently selected gaps. Use it when you have suitable frames with no gaps on either side of the gap. If there are gaps in these frames, the fill is rejected and you will need to choose a different gap-filling method. For more information, see [Fill gaps with Spline Fill, page 232](#).
 - **Pattern Fill:** Uses the shape of another trajectory without a gap to fill the selected gap. Use this tool only if there is a suitable marker with a trajectory similar to the one whose gap you wish to fill. This is typically the case when the trajectories originated from markers attached to the same segment, such as those attached to the ankle or heel. For more information, see [Fill gaps with Pattern Fill, page 233](#).
 - **Rigid Body Fill:** This option is the Nexus equivalent of the Replace 4 option, which is available in BodyBuilder. Use this option when a rigid or semi-rigid relationship exists between markers. For more information, see [Fill gaps with Rigid Body Fill, page 234](#).
 - **Kinematic Fill:** This option uses information about the connection of markers to segments in the labeling skeleton template (VST). For this option to be available, you may first need to run the Kinematic Fit pipeline operation, by clicking the KinFit button on the Nexus toolbar. For more information, see [Fill gaps with Kinematic Fill, page 235](#).
 - **Cyclic Fill:** For trials that contain captured data that is cyclic in nature (for example, when a motion on a treadmill or other repetitive motion is captured), this option uses patterns from a missing marker from earlier or later gait cycles to fill gaps. (If you want to modify the supplied operations, you can change and run the Fill Gaps - Cyclic pipeline operation instead.) For more information, see [Fill gaps with Cyclic Fill, page 235](#).
- ✓ **Tip:** For data with smaller gaps, you could use a processing pipeline containing the **Fill gaps (Woltring)** operation to automatically fill gaps.

8. In the chosen gap fill area, click the appropriate option:

- To have Nexus fill the selected gap, click **Fill**.
- To have Nexus fill all the gaps in the selected trajectory with the currently chosen type of gap filling, click **All**. This feature is particularly useful when, for example, you have 7 gaps in LASI and you want to fill them all with a Rigid Fill from the other pelvic markers (RASI, RPSI, LPSI).

Review trials and fill gaps

- For **Pattern Fill** or **Rigid Body Fill**, you can click **Auto** before clicking **Fill** or **All**.

When a gap is filled, Nexus reduces the entry in the **#Gaps** column by one and selects the next gap.

When all gaps for the selected trajectory have been successfully filled, the entry for the trajectory is automatically removed from the **Trajectory** list and Nexus selects the next trajectory.

9. Repeat steps 4–8 to fill all the gaps for all trajectories.
10. On the Nexus toolbar, click the **Save** button to save the trial. You can then perform any other processing that is required, such as running pipelines.



Tip

To save time, you can create custom pipelines that include the type of gap-filling operations that you commonly perform, such as Rigid fills for Pelvis and Head markers. For more information, see [Example of creating a custom pipeline for gap-filling, page 239](#).

Review trials and fill gaps

Use the gap filling options

The following information provides instructions on how to use the Vicon Nexus gap-filling options. (For detailed information about the Nexus gap-filling algorithms, see the FAQ [What Gap Filling Algorithms are used in Nexus 2?](#)²² on the Vicon website.)

- [Fill gaps with Spline Fill, page 232](#)
- [Fill gaps with Pattern Fill, page 233](#)
- [Fill gaps with Rigid Body Fill, page 234](#)
- [Fill gaps with Kinematic Fill, page 235](#)
- [Fill gaps with Cyclic Fill, page 235](#)

Fill gaps with Spline Fill

1. Ensure the required gap is selected (see [Manually fill gaps in trial data, page 228](#)).
2. Under **Spline Fill**, in the **Maximum gap length** field, specify the maximum number of frames to spline fill (the default is 100 frames).
3. Click the appropriate button:
 - To have Nexus fill the selected gap, click **Fill**.
 - To have Nexus spline fill all the gaps in the selected trajectory, click **All**.

A cubic spline interpolation operation fills the specified gaps.

²² <https://www.vicon.com/faqs/software/what-gap-filling-algorithms-are-used-nexus-2>

Review trials and fill gaps

Fill gaps with Pattern Fill


1. Ensure the required gap is selected (see [Manually fill gaps in trial data, page 228](#)).

2. Under **Pattern Fill**, click **Pick Source** or **Auto**:

If you click **Pick Source**:

- a. The shape of the pointer changes to include a tooltip to guide you in the selection of markers in the **3D Perspective** view. Initially, a tooltip with the text **Pick source marker** hangs from the cursor.
- b. In the **3D Perspective** view, click a source marker whose trajectory is to be used to fill the gap of the target marker.
A green dotted line is displayed to preview the shape of the trajectory if a pattern fill editing operation is run with the selected source model. Nexus displays the name of the source marker at the bottom of the **Pattern Fill** section, so you can confirm that you have selected the desired trajectory.
- c. In the **Pattern Fill** section, click **Fill** to have Nexus fill the selected gap (or **All** to fill all gaps in the selected trajectory), with the shape of the filled-in trajectory being similar to the trajectory of the source marker.

If you click **Auto**:

- a. A suggested donor trajectory is listed in the space above the **Auto** button and the suggested fill is displayed in green in the **3D Perspective** window. You can also view the suggested fill options as colored dotted lines in the **Graph** view.
- b. Do one of the following:
 - To accept the suggested donor, click **Fill** or **All**; or
 - To reject the suggestion and manually pick a source, click the **Clear selected donor** button , click **Pick Source**, then click (or CTRL+click to multi select), the required trajectory, and then click **Fill** or **All**.

Review trials and fill gaps

Fill gaps with Rigid Body Fill

This option is the Nexus equivalent of the **Replace 4** option, which is available in BodyBuilder.

Use it when a rigid or semi-rigid relationship exists between markers. For example:

- Pelvis (LASI, RASI, LPSI, RPSI)
- Head (LFHD, RFHD, LBHD, RBHD)

1. Ensure the required gap is selected (see [Manually fill gaps in trial data, page 228](#)).

2. In the Rigid Body Fill area, click **Pick Source** or **Auto**.

If you click Pick Source:


- a. Click (or CTRL+click to multi select), the required trajectory
- b. Click **Fill** or **All**.

If you click Auto:

a. Three trajectories are listed in the space above the **Auto** button and the suggested fill is displayed in green in the **3D Perspective** window. You can also view the suggested fill options as colored dotted lines in the **Graph** view.

b. Do one of the following:


- To accept the suggested donor, click **Fill** or **All**; or
- To reject the suggestion and manually pick a source, click the **Clear**

selected donor button , click **Pick Source**, then click (or CTRL+click to multi select), the required trajectory, and then click **Fill** or **All**.

Review trials and fill gaps

Fill gaps with Kinematic Fill

This option uses information about the connection of markers to segments in the labeling skeleton (VSK).

1. To provide the required kinematic data, ensure you have clicked the **KinFit** button or run a pipeline operation that includes kinematic fitting.
2. Ensure the required gap is selected (see [Manually fill gaps in trial data, page 228](#)).
3. In the **Kinematic Fill** area, click **Pick Segment** and in the **3D Perspective** view select the segment from which the kinematics will be copied.
The suggested fill is displayed in purple in the **3D Perspective** view. You can also view the suggested fill options as colored dotted lines in the **Graph** view.
4. Do one of the following:
 - To accept the suggested donor, click **Fill** or **All**; or
 - To reject the suggestion and try again, click the **Clear selected donor** button , click **Pick Segment**, then click (or CTRL+click to multi select), the required trajectory, and then click **Fill** or **All**.

Fill gaps with Cyclic Fill

1. Ensure you have captured a trial containing repetitive motion.
2. Select the gap/range that is to be filled (see [Manually fill gaps in trial data, page 228](#)).
3. In the **3D Perspective** view and the **Graph** of the marker component, preview the gap fill solution provided by Nexus.
4. If the suggested solution is acceptable, in the **Label/Edit Tools** pane, ensure **Gap Filling** is expanded.
5. In the **Cyclic Fill** area, select the required option:
 - **Fill** Fills the currently selected range
 - **All Attempts** to fill all gaps in the selected trajectory.

The gap is filled with data based on other cycles of the same movement.

Review trials and fill gaps

Automatically fill gaps in trial data

You can automatically fill gaps using the **Auto Gap Fill** button on the Nexus toolbar or the equivalent **Auto-Intelligent Gap Fill** pipeline in the **Pipeline** tools pane. This enables you to quickly fill gaps in your trial, without having to choose which fill method is best for each gap. You can do this in a one-click operation or, if you want to modify the supplied operations, by changing and running the **Auto Intelligent Gap Fill** pipeline.


**Tip**

Auto Gap Fill attempts to fill all gaps in the trial data. For this operation to work well, you are likely to need to change the default property settings, including the gap size. For data containing large gaps, you are advised to review and manually fill the large gaps first, using the tools in the **Label/Edit Tools** pane (see [Manually fill gaps in trial data, page 228](#)), and/or cropping out any unwanted frames with large gaps that occur at the start or end of the trial. For information on cropping frames at the start and end of the trial data, see [Crop trials, page 223](#).

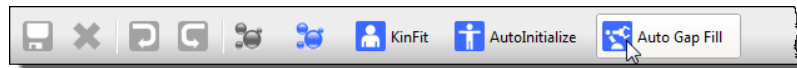
Review trials and fill gaps

To automatically fill gaps in trial data:

1. Display reconstructed and labeled markers in either of the following ways:
 - Ensure that a trial you have just captured has been reconstructed and labeled; or
 - From the **Data Management** tab, open a previously captured, reconstructed and labeled trial.
2. In the **Resources** pane, ensure Nexus is in **Offline** mode.
3. Display a **3D Perspective** view and optionally a **Graph** view.

 **Tip:** Using a split layout with both a **3D Perspective** and a **Graph** enables you to view the results of your editing actions and to select specific trajectories, frame ranges, and gaps in trajectories. Since the graphs indicate what changes have been made to the data and by which tool, you can immediately see the results of any edits you have made and determine if you want to change it again or adjust the data using one of the tools in the **Label/Edit Tools** pane.

4. In the Nexus tool bar, click **Auto Gap Fill**.

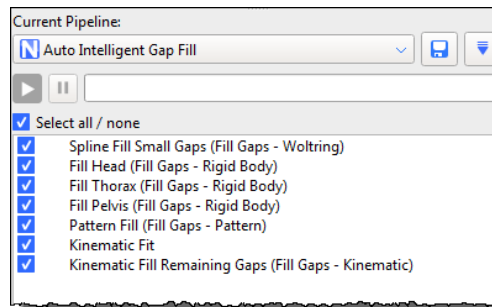


Nexus assesses each gap one-by-one in series and fills all the gaps.

Review trials and fill gaps

To use the Auto Intelligent Gap Fill pipeline:

1. On the Tools pane, click the Pipelines button.
2. From the Current Pipeline list, select the Auto Intelligent Gap Fill pipeline.



3. From the list of operations below, select the gap-filling operations that you want to use. If required, in the Properties pane, modify the relevant settings to suit your particular trial.
For more information on an operation, either view its tooltip by clicking on its name and then hovering the mouse pointer over it or see the FAQ [What gap-filling algorithms are used in Nexus 2?](https://www.vicon.com/faqs/software/what-gap-filling-algorithms-are-used-nexus-2)²³ on the Vicon website.
4. Either click the Run button or use the Auto Gap Fill button on the tool bar, as described above, to run the pipeline with any changes you have made.
5. On the Nexus toolbar, click the Save button to save the trial. This will enable you to load the edited trial data. You can then perform any other processing, such as manually filling any remaining gaps.

You can run the pipeline either on an individual trial in the Pipeline Tools pane or on multiple files using the **Batch Processing Interface**.

²³ <https://www.vicon.com/faqs/software/what-gap-filling-algorithms-are-used-nexus-2>

Review trials and fill gaps

Example of creating a custom pipeline for gap-filling

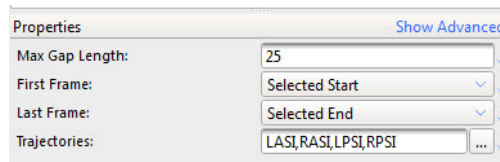
The following steps describe how to make a custom pipeline for speeding up gap-filling operations. (For a reminder of how to create and run pipelines, see [Work with pipelines, page 177.](#))

To create a custom gap-filling pipeline:

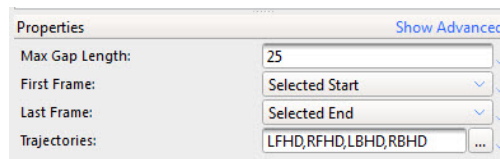
1. Create a new pipeline (for example, called **Head and Pelvis Fill**), which contains two **Rigid Body** fill operations.



2. Click on each operation in turn and in the **Properties** pane, customize the fills so that Pelvis and Head markers will be filled appropriately. For example:
Pelvis Rigid Fill properties



Head Rigid Fill properties



3. Save the pipeline.
4. Add a new button to the Nexus toolbar (**Window menu > Toolbar**) to give quick access to your custom pipeline.



Now, with one mouse click, you can automatically fill any Pelvis and Head gaps.

Review trials and fill gaps

Add events to trials

An event is a single action in the time span of a trial, for example, a foot contacting the floor during a walking trial, or a knee angle exceeding a particular angle.

Events are normally added to your trial data automatically as part of the capture workflow, when you run **Plug-in Gait Dynamic** or other dynamic pipelines that include **Detect Events From Forceplate** and **Autocorrelate Events**. For more information, see step 7 of [Capture the required movement, page 183](#).

However, if events are not automatically detected, or are only partially detected, you will need to enter event identification mode and add them manually. This is likely to be necessary in the following scenarios:

- If you are not using a force plate; or
- The floor is not flat (ie, the movement being captured involves stepping, climbing, etc); or
- The trial includes movement that is not a cyclical gait movement (for example, some sports movements)

If your trial type does not allow the automatic addition of events, you can add them manually, using the timebar as described below.

For more information on working with events, see:

- [Add events to trial data, page 241](#)
- [Delete events that are outside the region of interest, page 244](#)
- [Customize event identification mode, page 244](#)
- [Customize cycle visualization, page 245](#)
- [Calculate step width and limp index, page 246](#)

Review trials and fill gaps

Add events to trial data

To add events to motion capture trial data:

1. From the **Data Management** tab, open the required trial, ensuring that it contains no gaps or other issues (see [Review data quality, page 208](#) and [Fill gaps in trial data, page 227](#)).
2. Display the desired view (3D Perspective, 3D Orthogonal, Camera, or Graph).

✓ **Tip:** To automatically display a specified view type when you enter event identification mode, in the **Options** dialog box (F7), select **Event Identification View Options** on the left, and in the **Properties** on the right, change **View Type** to **On** and in the **User-Specified Event Identification View** field, select the required view type.

3. Enter event identification mode in either of the following ways:
 - On the time bar, click the **Enter Event Identification Mode** button; or
 - Press CTRL+E.

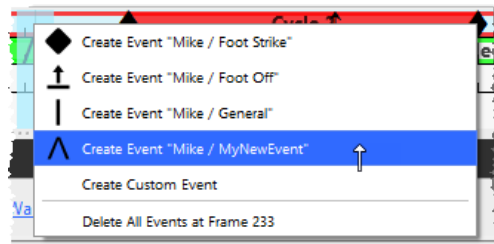
The mouse pointer changes to a vertical arrow, to indicate that you are now in event identification mode.

✓ **Tip:** You can control zooming into the time bar in Event Identification mode:

- In the **Options** dialog box (F7), select **Time Bar** and in the **Properties** pane on the right, scroll to **Event Identification Mode** and select or clear **Zoom to Event**.
 - When **Zoom to Event** is selected, you can specify the **Zoom Range** (the number of frames) either side of the event that you zoomed to in the time bar. The default is 20 frames.
4. On the time bar, zoom in or out on the timescale (right-click and drag) to adjust the time span of data displayed in the view pane and move the current time indicator (blue line) along the time bar to locate the desired frame.
 5. Lock the event context by positioning the mouse pointer over the desired **Left**, **Right**, or **General** line on the selected frame (the line for a context is highlighted when the mouse pointer hovers over it) and pressing the UP ARROW or DOWN ARROW key. When the event context is locked, moving the mouse does not change the context.


Review trials and fill gaps

6. Set a new event in the current context on the selected frame by either left-clicking or pressing ENTER and then selecting the desired command from the context menu
 - **Create Event Foot Strike** Creates a foot strike event at the selected frame.
 - **Create Event Foot Off** Creates a foot strike event at the selected frame.
 - **Create Event General** Creates a general event at the selected frame, represented by a vertical bar on the timeline. You cannot name general events and they are not saved to the event creation menu for future use.
 - **Create Custom Event** Creates a custom event at the selected frame that you can name, represented by a caret (^) on the timeline. When you create and name a custom event, it is added to the event creation menu, so you can select it again in future.



7. Navigate existing events in either of the following ways:
 - In the time bar controls, click the **Jump to the previous event** or **Jump to the next event** button; or
 - Press **CTRL+LEFT ARROW** or **CTRL+RIGHT ARROW** to go the previous or next event.

Review trials and fill gaps

8. If required, you can:
 - Move an existing event to another frame by clicking in it with the left mouse button, holding the button down, dragging it left or right along the timeline.
 - Move the event at the current frame in the current context back or forward one frame by pressing ALT+Left- or Right-arrow key.
 - Delete existing events:
 - **Single event:** On the time bar, click the event or press ENTER, and from the context menu select **Delete Event <Type>**.
 - **All events on current frame:** On the time bar, click the desired event or press ENTER, and from the context menu select **Delete All Events at Frame x**.
 - **All events in trial:** On the time bar, right-click anywhere and from the context menu point to **Clear Events**, then select **Clear All Events**.
 - **All events for one context only** (ie, for left, right, general and custom events): On the time bar, right-click anywhere and from the context menu point to **Clear Events**, then select the required context option.
-  **Tip:** Note that you can also use the **Delete Timebar Events** pipeline operation (available on the **Pipeline Tools** pane, under **Events & Timebar**) to delete events from a selected range of frames and/or a specified context. See *Events & Timebar operations in the Vicon Nexus Reference Guide*.
9. When you have finished editing the current event context, unlock the event context by either moving the mouse over a different context or using the Up/Down arrow keys on the keyboard.
10. Repeat steps 5-9 for each event context you wish to edit.
11. When you have finished editing all events, exit event identification mode in any of the following ways:
 - In the timebar controls, click the **Enter Event identification mode** button again; or
 - Press CTRL+E; or
 - Press ESC

If you add gait cycle events before you crop a trial, you probably want to delete events that are outside the cropped region. (For information on cropping trial data, see [Crop trials, page 223](#).)

Review trials and fill gaps

Delete events that are outside the region of interest

If you crop a trial after you have added events to it, events may be retained in the discarded (cropped) region of the trial. To remove these events, do either of the following:

To delete events that are outside the region of interest:

1. Do either of the following:
 - Right-click on the time bar of the cropped trial and click **Delete Events Outside Region of Interest**; or
 - In the **Pipeline Tools** pane, from the **Events & Timebar** operations, select **Delete Timebar Events** and in the **Advanced Properties**, select whether to delete events inside or outside of the specified region.
2. Run the **Delete Timebar Events** operation to remove the unwanted events.

Customize event identification mode

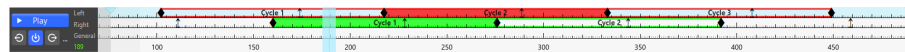
To customize options that affect event identification mode:

1. Open the **Options** dialog box (press F7).
2. On the left of the dialog box, click **Time Bar**.
3. In the **Event Identification Mode** section on the right, select (or clear) **Focus on marker** and enter or select the markers to focus on for **Left** and **Right** contexts.

Review trials and fill gaps

Customize cycle visualization

By default, all the cycles (gait or other) that have been defined by sets of time bar events, are displayed on the time bar.



This provides an easy way to identify:

- How many cycles are defined
- Where they are temporally
- Whether they are associated with force plate activity (indicated by solid color instead of colored outline only)
- How large they are (number of frames)
- Whether the left or right side is indicated:
 - Left = Red
 - Right = Green

To turn the visual display on or off or to change the default color options and other visual indicators, in the **Options** dialog box (press F7), on the left side click **Time Bar** and change the required properties on the right.

To turn on or off the display of the frame count, right-click on the time bar and select or clear **Show Cycle Frame Count**.

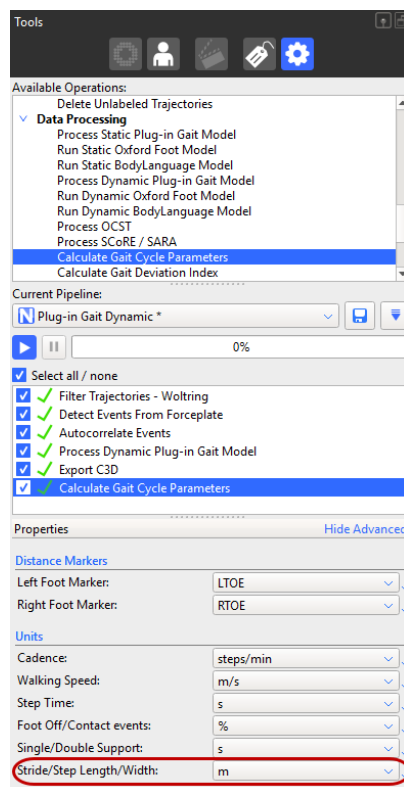
Review trials and fill gaps

Calculate step width and limp index

If your trial includes **Foot Strike** and **Foot Off** events, you can use the **Calculate Gait Cycle Parameters** pipeline operation to calculate step width and limp index.

To calculate step width and limp index:

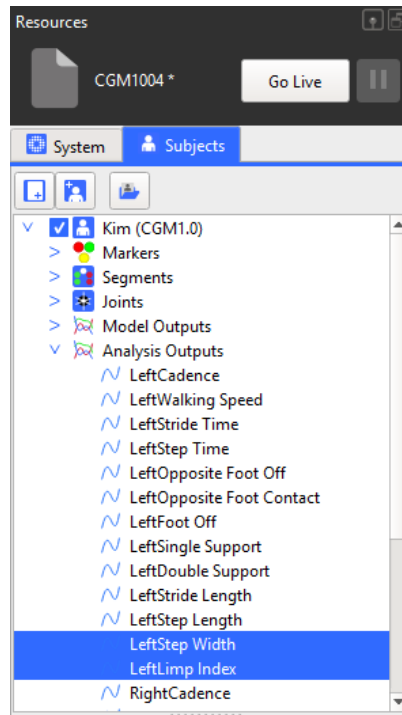
1. Ensure your trial data includes both **Foot Strike** and **Foot Off** events. If it doesn't, either recapture the data or add the missing events.
2. Add the **Calculate Gait Cycle Parameters** operation to your current pipeline in the [usual way, page 177](#).
3. In the **Properties** pane, ensure that the units for the **Stride/Step Length/Width** setting are as required.



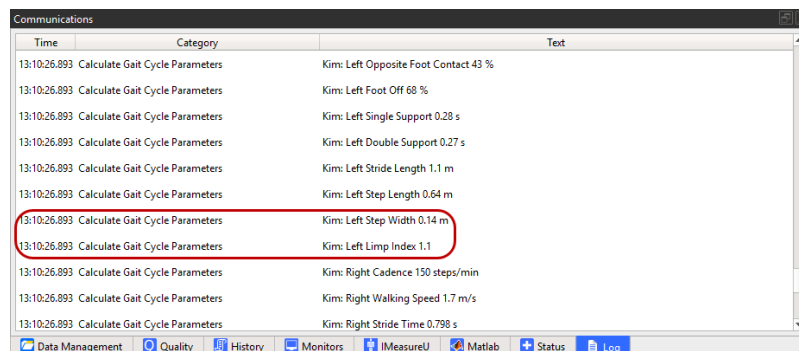
Review trials and fill gaps

4. Run the Calculate Gait Cycle Parameters operation on your data.

In the Subjects Resources pane, the Analysis Outputs include both step width and limp index.



On the Log tab, the step width and limp index data is displayed.



Modeling with Plug-in Gait

Modeling with Plug-in Gait


Vicon Nexus provides you with the following options for modeling:

- [Plug-in Gait and the Oxford Foot Model, page 249](#)
- [MATLAB, page 250](#)
- [Python, page 251](#)

Plug-in Gait and the Oxford Foot Model

If you are new to modeling with Nexus, the Plug-in Gait model provides a good introduction: all the operations necessary to run the model are supplied with Nexus. This option is described in this guide. For details, see:

- [About the Plug-in Gait model, page 252](#)
- [Plug-in Gait files installed with Vicon Nexus, page 254](#)
- [How Plug-in Gait works, page 255](#)
- [Take subject measurements for Plug-in Gait, page 256](#)
- [Attach Plug-in Gait markers to a patient, page 263](#)
- [Plug-in Gait Static pipeline, page 265](#)
- [Plug-in Gait Dynamic pipeline, page 267](#)

 In addition, a [Vicon Nexus 2 tutorial video](#)²⁴, *PlugIn Gait AI: Marker Locations and Subject Measurements*, is available on YouTube.



Note

As the videos were recorded using an earlier version of Nexus 2, you may notice small differences in the user interface.

²⁴ <https://www.youtube.com/watch?v=f17CWDmlaHw&list=PLxtdgDam3USUSleuO6UloG3ogPsFNtEJS&index=7>

Modeling with Plug-in Gait

MATLAB

If you are familiar with MATLAB, you can use the supplied examples to create your own custom models. For more information, see Modeling with MATLAB in the *Vicon Nexus Reference Guide*.

Modeling with Plug-in Gait

Python

If you are familiar with Python, you can use the supplied examples to create your own custom models. For more information, see Modeling with Python in the *Vicon Nexus Reference Guide*.

Note

For simplicity, modeling operations are described as separate steps. However, if you want to run modeling operations automatically, you can add them (and any other operations required) to a post-capture pipeline that runs as soon as capture finishes. For more information see step 7 in [Capture the required movement, page 183](#).

About the Plug-in Gait model

The Plug-in Gait model is Vicon's implementation of the Conventional Gait Model, which provides widely used and reliable full body kinematic and kinetic modeling, without the need for any customizations. It's based on the Newington-Helen Hayes gait model and has been validated through its frequent citation in peer-reviewed publications (see [Plug-in Gait references](#), page 253).

Vicon Nexus includes the required pre-defined Plug-in Gait marker set and pipelines to enable you to produce outputs of the joint kinematics and kinetics for gait analysis patients. Plug-in Gait enables you to examine full, upper, or lower body joint kinematics and kinetics of patients. When you have run the relevant pipeline operations on your trials, you can produce gait analysis reports that conform to established clinical practices and import the resulting kinematic model of your subject (patient) into another software application, such as Vicon Polygon, for gait analysis.

It is assumed that you are familiar with Plug-in Gait, including the way the model works, where the markers are placed, and what the subject parameters mean. For example, Plug-in Gait directly calculates the kinematic model's joint centers from the measured XYZ marker positions on a frame-by-frame basis. Therefore, the lengths and orientations of the modeled segments are directly dependent on the marker positions. Accurate marker placement is therefore paramount. For guidance on marker placement, see [Attach Plug-in Gait markers to a patient](#), page 263.

The model uses three or more points to define each segment. For all segments distal to the pelvis, one of the points used is the joint center that defines the proximal joint for the segment, for example, one of the three defining points for the tibia is the knee joint center.

Operations relating to modeling with Plug-in Gait are available in the **Data Processing** operations in the **Pipeline Tools** pane.

For in-depth descriptions of Plug-in Gait models and templates, and details of the calculations performed by Plug-in Gait, see the *Plug-in Gait Reference Guide*.

Before using Plug-in Gait, be sure to read the [Plug-in Gait disclaimer](#), page 253.

Modeling with Plug-in Gait

Plug-in Gait references

The following research publications provide supporting information on the scientific basis and validation of Plug-in Gait:

- DAVIS R., OUNPUU S., TYBURSKI D., and GAGE J. R. A gait analysis collection and reduction technique. *Human Movement Science*, 10, p575–587, (1991).
- KADABA M. P., RAMAKRISHNAN H. K., and WOOTTEN M. E. Measurement of lower extremity kinematics during level walking. *Journal of Orthopaedic Research*, 8, p383–392, (1990).
- WOLTRING, H. J. A FORTRAN package for generalized, cross-validatorspline smoothing and differentiation, *Advances in Engineering Software*, 8, p104–113, (1986).
- VAN DEN BOGERT, T. *Practical Guide to Data Smoothing and Filtering*. See <http://isbweb.org/software/sigproc/bogert/filter.pdf>

Plug-in Gait disclaimer

You are entirely responsible for the use you make of the software. In particular, the software is not intended to replace the clinical skill of a medical practitioner or his/her independent professional judgment of individual clinical circumstances to make a diagnosis and/or determine a patient's treatment.

The software should only be used by those who have been appropriately trained in its operation, functions, capabilities, and limitations, and in any event should not be relied upon, by itself, as the sole method of making any diagnosis or determining any treatment.

Plug-in Gait files installed with Vicon Nexus

The following table lists the Plug-in Gait files that are automatically installed with Nexus. For more detailed information about the labeling skeleton template (.vst) files, see the *Plug-in Gait Reference Guide*.

File name	Description
<i>PlugInGait FullBody Ai.vst</i>	Full body labeling skeleton template
<i>PlugInGait LowerBody Ai.vst</i>	Lower body labeling skeleton template
Marker set	
<i>PlugInGait FullBody Ai.mkr</i>	Markers defined in full body model
<i>PlugInGait LowerBody Ai.mkr</i>	Markers defined in lower body model

By default, the supplied files are installed in the following folder:

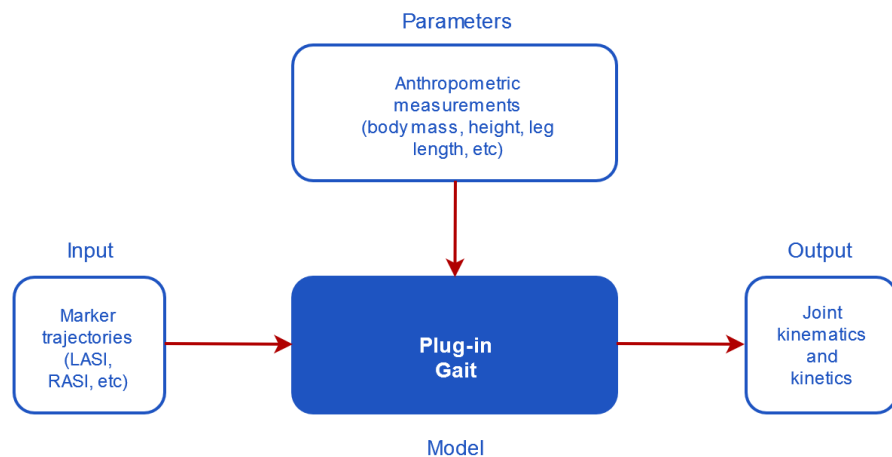
C:\Program Files\Vicon\Nexus2.#\ModelTemplates

Modeling with Plug-in Gait

How Plug-in Gait works

To work with Plug-in Gait, you enter subject-specific measurements into a pre-defined template in Vicon Nexus, place a Plug-in Gait marker set on a patient, capture the required trials, and then use Plug-in Gait pipelines in Nexus to produce outputs of the joint kinematics and kinetics for the patient.

From the real marker trajectories, Plug-in Gait generates virtual marker trajectories that represent kinematic and kinetic quantities (angles, moments, etc) and representations of the modeled segments. The model also outputs data that is used to define the positions of meshes (representing bones) which can subsequently be displayed in Vicon Polygon (for further details, see the Vicon Polygon documentation).



For detailed information about modeling with Plug-in Gait, see *Plug-in Gait kinematic and kinetic calculations* in the *Plug-in Gait Reference Guide*.

Before you begin capturing, make sure you understand the types of outputs that Plug-in Gait produces, so that you can determine the appropriate model to use for your requirements. If you are unsure which is the most appropriate model to use, see *Models and templates* in the *Plug-in Gait Reference Guide*.

Take subject measurements for Plug-in Gait

Plug-in Gait requires a set of subject measurements to enable it to directly calculate kinematics (angles) and kinetics (forces, moments, and powers) from the measured XYZ marker positions. Some of the measurements you must add to the subject node are required for the model to run, and some are optional:

- **Required subject measurements** You must add the required measurements to the subject node for your patient. Required measurements are listed in the following topics and are highlighted in pink in the **Properties** pane for the selected subject in Vicon Nexus.
- **Optional measurements** You can add any optional measurements or leave them for Plug-in Gait to calculate.

The following topics list the measurements needed for each type of model:

- [Subject measurements for Plug-in Gait lower body model, page 257](#)
- [Subject measurements for Plug-in Gait full body model, page 260](#)



Tip

You may find it helpful to take these measurements before you begin the subject preparation process in Vicon Nexus. You can use the **Measure** column in the tables in these sections to record the measurements you take for your patient, so you will have them to hand when you are ready to add them to your chosen labeling skeleton template (.vst file). You may want to photocopy the blank form for each patient before recording your measurements. To avoid the markers getting in the way, take the measurements before attaching markers to your patient.

Modeling with Plug-in Gait

Subject measurements for Plug-in Gait lower body model

The following table identifies the subject measurements that are used as inputs for running a Plug-in Gait lower body model.

Optional measurements (and/or those calculated by the model) are marked with an asterisk in the **Name** column.

Name	Description	Left	Right
Body Mass	Patient mass.	_____ kg	
Height	Patient height.	_____ mm	
*Inter ASIS distance	The model calculates this distance based on the position of the LASI and RASI markers. If you are collecting data on an obese patient and cannot properly place the ASIS markers, place those markers laterally and preserve the vector direction and level of the ASIS. Palpate the LASI and RASI points and manually measure this distance, then input into the appropriate field.	_____ mm	
Leg Length	Full leg length, measured between the ASIS marker and the medial malleolus, via the knee joint. Measure with patient standing, if possible. If the patient is in the crouch position, this measurement is NOT the shortest distance between the ASIS and medial malleoli, but rather the measure of the skeletal leg length, so if a patient cannot straighten his/her legs, take the measurement in two pieces: ASIS to knee and knee to medial malleolus.	_____ mm	_____ mm
*ASIS-Trochanter Distance	ASIS-greater trochanter distance is the vertical distance, in the sagittal plane, between the ASIS and greater trochanter when the patient is lying supine. Measure this distance with the femur rotated such that the greater trochanter is positioned as lateral as possible.	_____ mm	_____ mm
Knee Width	The medio-lateral width of the knee across the line of the knee axis. Measure with patient standing, if possible.	_____ mm	_____ mm

Modeling with Plug-in Gait

Name	Description	Left	Right
Ankle Width	The medio-lateral distance across the malleoli. Measure with patient standing, if possible.	_____ mm	_____ mm
*Tibial Torsion ¹	The angle between the knee flexion and the ankle dorsi-plantar axes. The ankle is usually externally rotated with respect to the knee flexion axis. If you are using a KAD, and the medial malleoli markers are attached to the patient, Plug-in Gait calculates the tibial torsion automatically.	_____ deg	_____ deg
*Sole Thickness Delta ²	The difference in the thickness of the sole at the toe and the heel. A positive sole delta indicates that the patient's heel is raised compared with the toe.	_____ mm	_____ mm
*Thigh Rotation	When a KAD is used, this value is calculated to account for the position of the thigh marker. By using the KAD, placement of the thigh marker in the plane of the hip joint center and the knee joint center is not crucial. If you do not use a KAD, this value is zero as the model assumes that the thigh marker is placed exactly in the plane of the hip joint center and the knee joint center. This value is calculated for you.	_____ deg	_____ deg
*Shank Rotation	Similar to the Thigh Rotation. This value is calculated if a KAD is present and removes the importance of placing the shank marker in the exact plane of the knee joint center and ankle joint center. If you do not use a KAD, this value is zero. It is calculated for you.	_____ deg	_____ deg

1. The tibial torsion measurement is only needed if you are using a KAD.
2. The **Sole Thickness Delta** subject measurement is used if the subject is wearing high-heeled footwear but can keep their foot flat within the shoe. For more information, see [Sole Thickness Delta subject measurement, page 259](#).

After you have recorded the measurements for your patient, you can create a subject node for the patient and enter the measurements into Nexus as described in [Create a new subject from a template, page 154](#).

Modeling with Plug-in Gait

Sole Thickness Delta subject measurement

The Sole Thickness Delta subject measurement is used when the patient is wearing shoes or orthoses so that although the patient achieves foot flat with respect to the footwear, the sole of the footwear introduces a vertical difference between the toe and the heel. When this is the case, you can either:

- Compensate for the sole delta by carefully placing the heel marker with respect to the toe marker and in the **Static Settings** dialog box, ensure the check boxes for **Left Foot** and/or **Right Foot** are cleared.

or

- Measure the difference in the thickness of the sole at the toe and the heel, in the **Static Settings** dialog box, select the check boxes for **Left Foot** and/or **Right Foot** and then in the **Properties** section at the bottom of the **Subjects Resources** pane, enter the delta value in the **SoleDelta (mm)** box. The height of the heel marker used in the calculations will then be adjusted accordingly.

Modeling with Plug-in Gait

Subject measurements for Plug-in Gait full body model

The following table lists the subject measurements that are used as inputs for running Plug-in Gait for full body modeling.

Optional measurements are marked with an asterisk in the Name column.

Name	Description	Left	Right
Body Mass	Patient mass.	_____ kg	
Height	Patient height.	_____ mm	
*Inter-ASIS distance	ASIS-ASIS distance is the distance between the left ASIS and right ASIS. This measurement is only needed when markers cannot be placed directly on the ASIS, for example, in obese patients.	_____ mm	
*Head Offset	Patient head offset in degrees. Only required if head is not level (calculated after running the Plug-in Gait model).	_____ deg	
Leg Length	Full leg length, measured between the ASIS marker and the medial malleolus, via the knee joint. Measure with patient standing, if possible. If the patient is standing in the crouch position, this measurement is NOT the shortest distance between the ASIS and medial malleoli, but rather the measure of the skeletal leg length.	_____ mm	_____ mm
*ASIS-Trochanter Distance	ASIS-greater trochanter distance is the vertical distance, in the sagittal plane, between the ASIS and greater trochanter when the patient is lying supine. Measure this distance with the femur rotated such that the greater trochanter is positioned as laterally as possible. If this value is not entered, a regression formula is used to calculate the hip joint center. If this value is entered, it will be factored into an equation which represents the hip joint center.	_____ mm	_____ mm
Knee Width	The medio-lateral width of the knee across the flexion axis. Measure with patient standing, if possible.	_____ mm	_____ mm

Modeling with Plug-in Gait

Name	Description	Left	Right
Ankle Width	The medio-lateral distance across the malleoli. Measure with patient standing, if possible.	_____ mm	_____ mm
*Tibial Torsion ¹	The angle between the knee flexion and the ankle dorsi-plantar axes. The ankle is usually externally rotated with respect to the knee flexion axis. The sign convention is that if a negative value of tibial torsion is entered, the ankle flexion/extension axis will be adjusted from the KAD's defined position to a position dictated by the tibial torsion value. If you are using a KAD, and the medial malleoli markers are attached to the patient, Plug-in Gait calculates the tibial torsion automatically.	_____ deg	_____ deg
*Sole Thickness Delta ²	The difference in the thickness of the sole at the toe and the heel. A positive sole delta indicates that the patient's heel is raised compared with the toe.	_____ mm	_____ mm
*Thigh Rotation	When a KAD is used, this value is calculated to account for the position of the thigh marker. By using the KAD, placement of the thigh marker in the plane of the hip joint center and the knee joint center is not crucial. If you do not use a KAD, this value is zero as the model assumes that the thigh marker is placed exactly in the plane of the hip joint center and the knee joint center. This value is calculated for you.	_____ deg	_____ deg
*Shank Rotation	Similar to the Thigh Rotation. This value is calculated if a KAD is present and removes the importance of placing the shank marker in the exact plane of the knee joint center and ankle joint center. If you do not use a KAD, this value is zero. It is calculated for you.	_____ deg	_____ deg
Shoulder Offset	Vertical distance from the center of the glenohumeral joint to the base of the marker on the acromion clavicular joint. Some researchers have used the (anterior/posterior girth)/2 to establish a guideline for the parameter.	_____ mm	_____ mm
Elbow Width	Width of elbow along flexion axis (roughly between the medial and lateral epicondyles of the humerus).	_____ mm	_____ mm

Modeling with Plug-in Gait

Name	Description	Left	Right
Wrist Width	Anterior (palm side)/Posterior (back) thickness of wrist at position where wrist marker bar is attached.	_____ mm	_____ mm
Hand Thickness	Anterior/Posterior thickness between the dorsum and palmar surfaces of the hand, at the point where you attach the hand marker.	_____ mm	_____ mm

1. The tibial torsion measurement is only needed if you are using a KAD.
2. The **Sole Thickness Delta** subject measurement is used if the subject is wearing high-heeled footwear but can keep their foot flat within the shoe. For more information, see [Sole Thickness Delta subject measurement, page 259](#).

After you have recorded the measurements for your patient, you can create a subject node for the patient and enter the measurements into Vicon Nexus as described in [Create a new subject from a template, page 154](#).

Attach Plug-in Gait markers to a patient

After adding the patient's measurements to the subject node (see [Take subject measurements for Plug-in Gait, page 256](#)), you attach the markers to the patient.

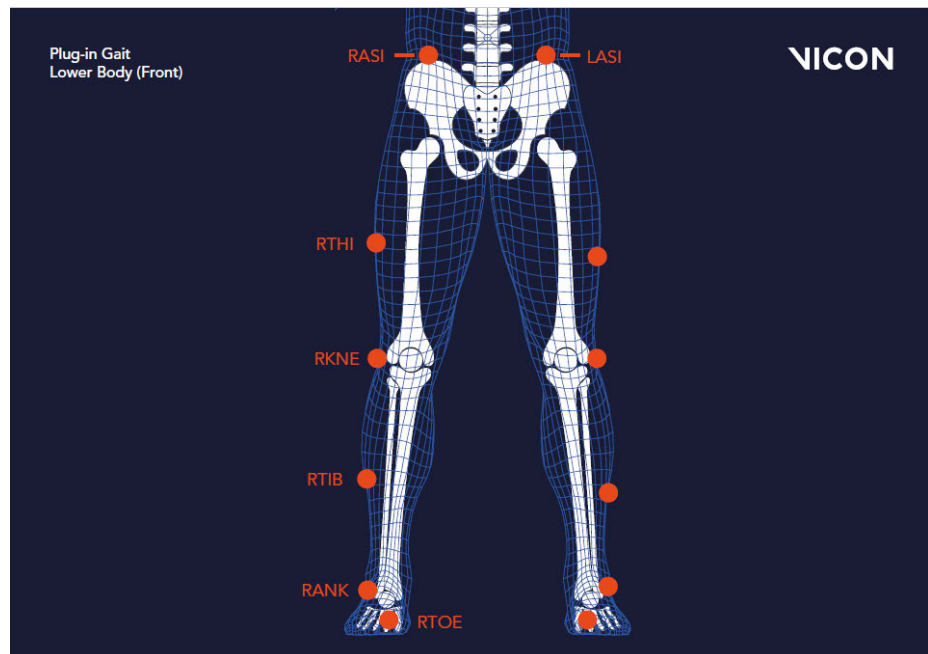
Vicon cameras capture the movement of the retroreflective markers rather than the body to which they are attached. To enable Nexus to determine the movement of the subject's underlying skeleton, ensure that the subject's clothing will not occlude markers or by cause the markers to move excessively. If possible, attach the markers directly to the patient's skin. During capture, ensure that there is nothing else reflective in the capture volume.

To attach markers to a patient:

1. Select the appropriate size and quantity of Vicon markers to be used. Typically, 14mm markers are used for gait analysis studies.
2. Securely attach the Vicon markers to the patient in accordance with the marker arrangement defined in your chosen template. A front view of the most commonly used set (for Plug-in Gait lower body modeling) is shown in the following image. The left lower body markers are not labeled; place markers on the left side in a similar way to those on the right.

⚠ Important: Note that, as shown in the following image, some asymmetry is desirable as it helps the auto labeling routine distinguish right from left. In a lower body marker set, you can place the THI and/or TIB markers asymmetrically. For a full body set, you can place the THI, TIB, UPA and FRM markers asymmetrically. Similarly, avoid symmetrical placement of marker clusters or groups of markers and also ensure markers are asymmetrical within each cluster/group.

Modeling with Plug-in Gait



✓ Tip

- The THI and TIB markers anterior-posterior position is critical for identifying the orientation of the knee and ankle flexion axis.
- If you are using a single sacral marker (SACR) in a Plug-in Gait lower body or full body marker set, attach the SACR marker instead of the two PSIS markers.
- Because you need at least three markers to obtain six degrees of freedom, best practice is to place four markers on the pelvis (LASI/RASI/LPSI/RPSI), so that even if one of the four markers is occluded during motion capture, the required three markers will still be visible to the cameras.

For detailed descriptions and images of marker positions, see *Models and templates* in the *Plug-in Gait Reference Guide*

You can now capture a calibration trial and reconstruct the markers (see [Calibrate a labeling skeleton, page 157](#)).

Plug-in Gait Static pipeline

As described in step 5 of [Review and finalize a calibration of a labeling skeleton using a ROM trial, page 165](#), to enable Plug-in Gait to calculate the static outputs based on the measured marker positions, you can run a **Plug-in Gait Static** pipeline on the reconstructed and labeled static frames of either a ROM trial or a static trial.



Important

The Plug-in Gait Static pipeline is intended to calculate subject-specific offsets for use as inputs to the Plug-in Gait Dynamic pipeline. If joint angles are required, you must run the [Plug-in Gait Dynamic pipeline, page 267](#) in addition to the static pipeline, even for a stationary subject.

Modeling with Plug-in Gait

Process Static Plug-in Gait Model properties

The following table describes the properties you can specify for the **Process Static Plug-in Gait Model** pipeline operation:

Property	Description
First Frame	Specify the first frame to be used for processing.
Last Frame	Specify the last frame to be used for processing.
Marker Diameter	Specify the diameter of the markers used, assuming they are applied to the skin's surface. The default is 14mm.
Anterior Thorax Tilt is Positive	Select this option to specify that the anterior thorax tilt is positive. Clear this option to specify that the anterior thorax tilt is negative.
Output Joint Centers	Select this option to visualize the joint centers that are calculated by Plug-in Gait.
<p>Assume Horizontal</p> <p>In this section, you can configure Plug-in Gait to assume that certain markers are at the same height from the floor during the static trial. Set the appropriate option to enable Plug-in Gait to compensate for your patient's stance during the static trial.</p> <p>Important: Set the appropriate foot option if you specify the Sole Thickness Delta subject measurement because the patient is wearing shoes or orthoses that introduce a vertical difference between the toe and the heel (for details, see Subject measurements for Plug-in Gait lower body model, page 257).</p>	
Left Foot	Plug-in Gait assumes that the LTOE and LHEE markers are level with one another. Select this option if the patient's left foot was flat with the toe and heel in contact with the floor, even if the left toe (LTOE) and heel (LHEE) markers were not level with one another.
Right Foot	Select this option if the patient's right foot was flat with the toe and heel in contact with the floor, even if the right toe (RTOE) and heel (RHEE) markers were not level with one another.
Head	Select this option if the patient's head was held level during the static trial, even if the rear of head markers (LBHD, RBHD) could not be placed level with the front of head markers (LFHD, RFHD).

Plug-in Gait Dynamic pipeline

To enable Plug-in Gait to finalize trial data, including filtering the data, detecting gait events, and producing a .c3d file for export from Nexus, you can run a **Plug-in Gait Dynamic** pipeline on the reconstructed and labeled movement trials.

Before you run the pipeline on your movement trials, ensure you have gap-filled and if necessary cropped the trials (see [Review trials and fill gaps, page 205](#)).

If required, you can change the properties for each of the operations that are included in the **Plug-in Gait Dynamic** pipeline. You can also run them individually, and/or run other operations at this stage too. To help you understand the different operations typically run on Plug-in Gait movement trials and the options available, each operation is described in the following topics, together with the **Delete Unlabeled Trajectories** pipeline operation, which you may also find useful:

- [Run the Dynamic Plug-in Gait pipeline, page 268](#)
- [Delete Unlabeled Trajectories pipeline operation, page 269](#)
- [Filter Trajectories - Woltring pipeline operation, page 269](#)
- [Detect Events From Forceplate pipeline operation, page 270](#)
- [Autocorrelate Events pipeline operation, page 271](#)
- [Process Dynamic Plug-in Gait Model pipeline operation, page 272](#)
- [Cross-plate foot strikes, page 274](#)
- [Export C3D, page 278](#)



Tip

When you are familiar with these operations, you can run all of the data processing in a single step by creating a custom pipeline and adding all the operations described in this section to it, as explained in [Create a pipeline, page 180](#). When you create your new pipeline, be sure to include the operations in the above order.

Modeling with Plug-in Gait

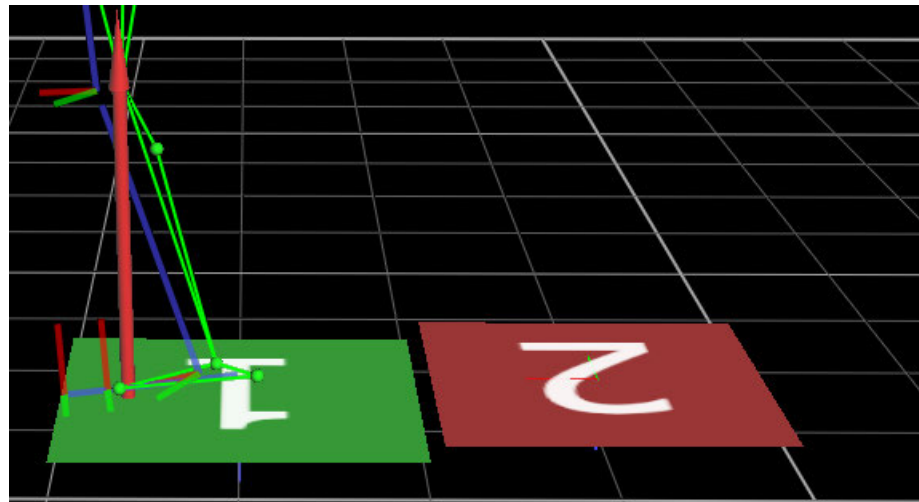
Run the Dynamic Plug-in Gait pipeline

To run the Dynamic Plug-in Gait pipeline:

1. On the **Data Management** tab, ensure the dynamic trial you have gap-filled is open (for details, see [Fill gaps in trial data, page 227](#)).
2. On the **Pipeline** tab of the **Tools** pane, from the **Current Pipeline** list, select **Dynamic Plug-in Gait**.
3. Ensure that the required operations are selected and that you have configured their properties appropriately (see below for details).
4. Click the **Play** button.

A green check mark appears in the list to the left of each completed operation.

In the **3D Perspective** view, the axis for each segment is displayed, together with the **Foot Strike** and **Foot Off**.



5. In the **Subjects Resources** pane, expand the subject's tree and ensure that the model outputs are listed.
6. To save the data in **.c3d** format, on the **Vicon Nexus** toolbar, click the **Save** button.

If you don't need to perform any further processing, you can now export your data. For more information, see [Export trial data, page 338](#).

Modeling with Plug-in Gait

Delete Unlabeled Trajectories pipeline operation

This pipeline operation runs on a fully labeled trial to delete any remaining unlabeled trajectories. To choose the maximum length of unlabeled trajectory to delete, select the **Delete using Max Length** option and specify the **Max Length to Delete**.

Filter Trajectories - Woltring pipeline operation

This pipeline operation filters the data using the Woltring filter to ensure smooth trajectories for calculating kinetics. This routine is based on a fifth-order spline-interpolating function (for details on this function and its filtering algorithms, see [Plug-in Gait references, page 253](#)).

In the **Properties** pane for this operation, you can specify these settings:

Property	Description
First Frame	First frame to which filtering is applied
Last Frame	Last frame to which filtering is applied
Filter mode	Choose between: GCV The filtering routine makes an automatic estimate of the noise to find the optimal smoothing parameter. MSE You can change the level of smoothing by entering a different value for the Smoothing option below.
Trajectories	Enables you to select the trajectories to filter. Can be All trajectories, All labeled trajectories, or Linked trajectories.
Smoothing	Enables you to specify the level of smoothing for the MSE option.

Modeling with Plug-in Gait

Detect Events From Forceplate pipeline operation

This pipeline operation automatically detects gait cycle events such as footstrikes and adds them to the time bar throughout the trial using vertical ground reaction forces (GRFs) measured by a force plate connected to the Vicon system. The operation includes the option to set the force threshold and the label of the markers attached to the front and back of the foot for both sides.

In the **Properties** pane for this operation, you can specify these settings:

Property	Description
First Frame	First frame in which events are detected
Last Frame	Last frame in which events are detected
Force Threshold (N)	The force threshold for automatically detecting heel strike and toe off events. The default is 20.
Left anterior marker label	Marker used for event detection. We recommend that you leave this at the default setting.
Left posterior marker label	Marker used for event detection. We recommend that you leave this at the default setting.
Right anterior marker label	Marker used for event detection. We recommend that you leave this at the default setting.
Right posterior marker label	Marker used for event detection. We recommend that you leave this at the default setting.

Modeling with Plug-in Gait

Autocorrelate Events pipeline operation

This pipeline operation detects the pattern of the tracked marker at the set events and defines these events for the rest of the trial. The available parameters are: marker being tracked; the X, Y, or Z component of the marker; and the position, velocity, or acceleration of the marker. Run this operation after **Detect Events from Forceplate** or manually entering events on the timebar.

In the **Properties** section for this operation, you can specify these settings:

Property	Description
First Frame	First frame in which events are detected
Last Frame	Last frame in which events are detected
Only after existing	If a force plate is used and you select this option, Vicon Nexus automatically correlates force plate data events from the time of the first strike on the force plate and forward. If you do not select this option, Vicon Nexus automatically correlates events both forward and backward from the first force plate strike. If a force plate is not used, you can still select this option, but you must make a thorough visual check of the events placed.
Correlation Method (Advanced property)	Enables you to choose the correlation method to automatically place events at the correct location in the time bar: Legacy , Least Squares or Pearson Coefficient (see Correlation Method parameters in the <i>Vicon Nexus Reference Guide</i>).
Marker (Left and Right)	Enables you to change the marker used for correlation if necessary.
Component (Left and Right)	For walking trials, leave the Left and Right values at the default value (Z). For running and other motor tasks, change as appropriate.
Derivative (Left and Right)	For walking trials, leave the Left and Right values at the default value (Position). For running and other motor tasks, change as appropriate.

Modeling with Plug-in Gait

Process Dynamic Plug-in Gait Model pipeline operation

This pipeline operation runs the dynamic Plug-In Gait model on the active subject of the current trial.

In the **Properties** section for this operation, you can specify these settings:

Property	Description
First Frame	First frame on which the operation is run
Last Frame	Last frame on which the operation is run
Marker diameter (mm)	Ensure the specified value corresponds to the diameter of the markers used (assuming they are applied directly to the skin surface). Note: If your marker has a base, to calculate the correct value, double the base width and add it to your marker diameter in mm.
Reaction reference frame	Determines which reference frame is used for reporting joint moments: Proximal segment: Reports all moments in the reference frame of the proximal segment. Distal segment: Reports all moments in the reference frame of the distal segment (for example, the tibia segment for the knee joint). Global frame: Reports the moment vector relative to the laboratory coordinate system.
Power Output	How Plug-in Gait is to output the power data: Standard: The joint power expressed as a single number (scalar). Individual Contributions from XYZ: The joint power expressed as individual X, Y, and Z planes in the segment's coordinate system
Anterior Thorax Tilt is Positive	Select this option to specify that the anterior thorax tilt is positive. Clear this option to specify that the anterior thorax tilt is negative.
Output Joint Centers	Select this option to visualize the joint centers that are calculated by Plug-in Gait.
Output Segment Centers of Mass	Select this option to visualize the center of mass of each segment that is calculated by Plug-in Gait.

Modeling with Plug-in Gait

Property	Description
Allow cross-plate strikes	<p>Select this option when a foot may be in contact with more than one force plate simultaneously; for example, the heel may land on the far side of one plate and then the toes roll onto the near edge of the subsequent plate. If you select this option, reactions from the two plates are combined during processing, with the plate that is struck first being considered the primary. The forces reported by each plate are added together; the moments are also combined by referring the moment from the secondary plate back to the origin of the primary plate. In effect, the two plates are treated as a single force plate with the same origin as the primary plate. For more information, see Cross-plate foot strikes, page 274.</p> <p>Although every effort has been made to ensure the mathematical combination of forces and moments between two plates is correct, it is the responsibility of the operator / analyst to review the outcomes produced by this process and ensure they are correct. Use of this option in clinical assessments is strictly at the discretion of the operator/ analyst.</p>
Radius of Gyration: Pelvis and Thorax	<p>The default radius of gyration for the specified segments. The number is scaled to the length of the segment.</p> <p>The Plug-in Gait default setting (0.31) means that the radius of gyration is 31 percent of the segment length. Only change this setting if you are sure that the default value is incorrect.</p>
Version	Plug-in Gait version number.

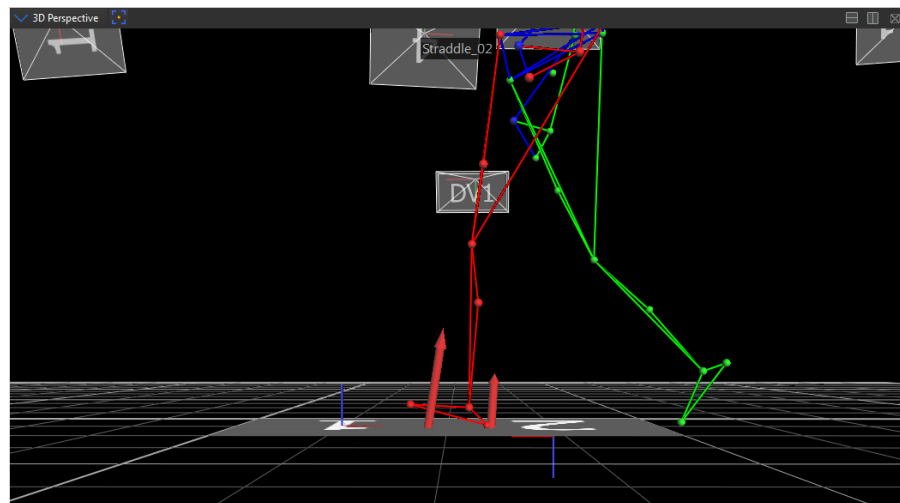
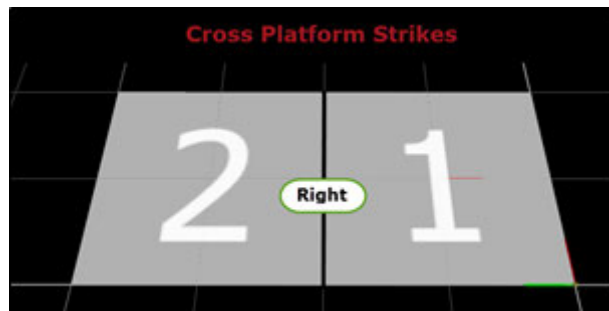
Modeling with Plug-in Gait

Cross-plate foot strikes

To perform an inverse reaction calculation from a foot strike, forces and moments recorded by a force plate must:

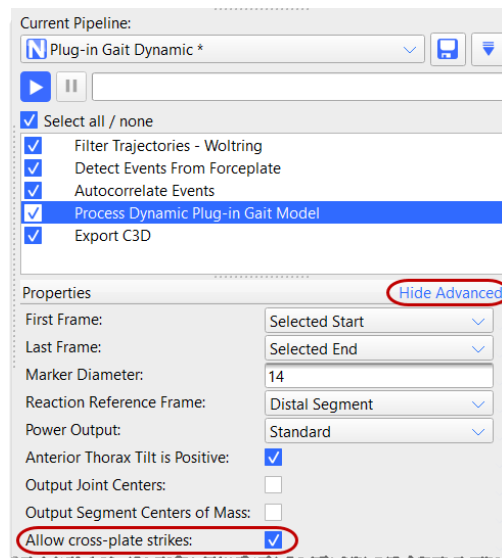
- Be assigned to a single context (left or right)
- Represent the full forces and moments produced by the subject

In some instances, a foot may be in contact with more than one force plate simultaneously; for example, the heel may land on the far side of one plate and then the toes roll onto the near edge of the subsequent plate.



Modeling with Plug-in Gait

Dynamic Plug-in Gait includes an Advanced option to permit calculations based on these cross-plate strikes.

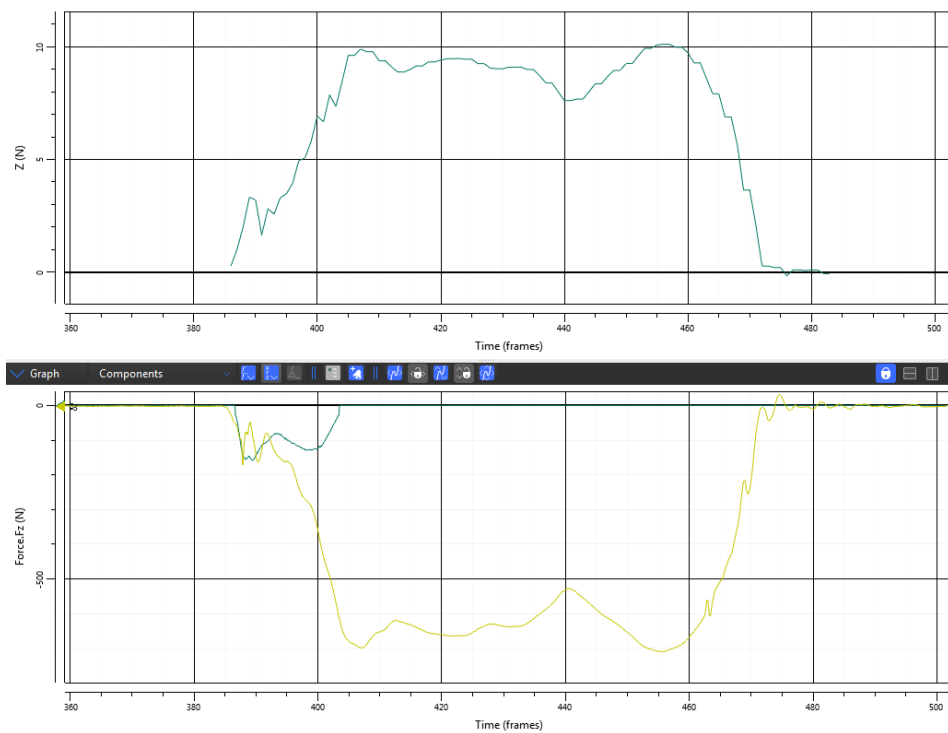


Reactions from the two plates are combined during processing, with the plate that is struck first being considered the primary. The forces reported by each plate are added together; the moments are also combined by referring the moment from the secondary plate back to the origin of the primary plate. In effect, the two plates are treated as a single force plate with the same origin as the primary plate.

Dynamic Plug-in Gait can automatically detect which foot is activating a force plate by checking whether the origin of the segment is above the plate. To account for cross-plate strikes, the activating area is expanded beyond the bounds of the plate by the length of the segment (that is, a foot is considered to be above the plate if the ankle joint center is within a foot-length of the plate boundary).

Modeling with Plug-in Gait

You may also set the foot strike manually (see [Add events to trials, page 240](#) and also [Automatically assess foot strikes, page 198](#)).



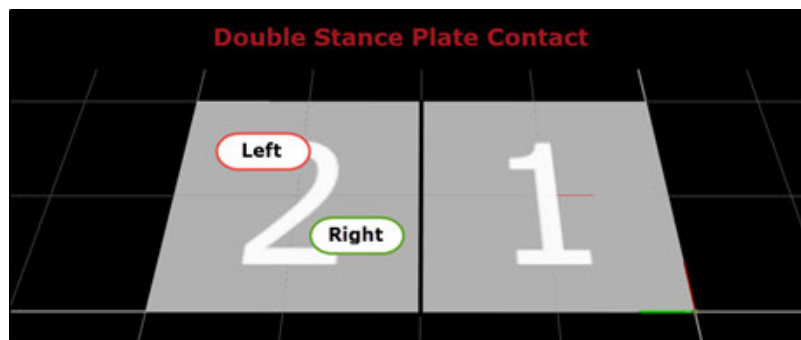
Note that the existing restriction that there must be only a single foot in contact with any given force plate still applies.

Modeling with Plug-in Gait

Invalid strike types that don't benefit from Allow cross-plate strikes

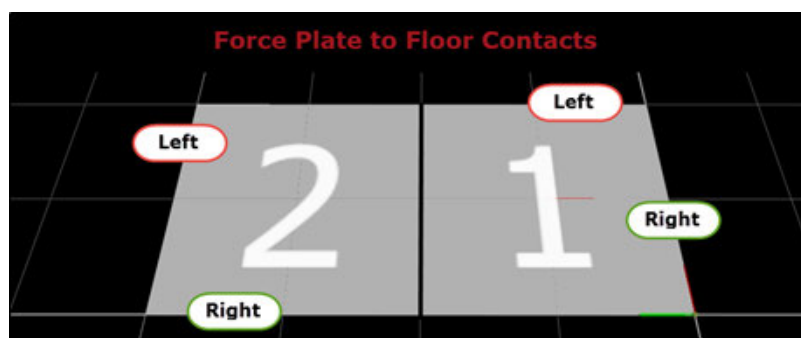
Only cross plate strikes can benefit from the Allow cross-plate strikes option; do not use other invalid strike types for kinetic calculation. The other invalid strike types to which Allow cross-plate strikes does not apply include:

- **Double stance plate contacts** Multiple feet simultaneously in contact with a single plate. In this example, the left and right foot contact Force Plate 1 at the same time.



Problem: An inability to assign forces to context

- **Force plate to floor contacts** A single foot strike that transitions from an initial contact with the force plate to the lab floor or begins on the floor and transitions to a force plate. In this example, the heel strikes the force plate, but the foot rolls forward off the plate, and prior to toe off, the foot is in contact with the floor.



Problem: Full forces/moment are not recorded as some are applied to the floor, not the plate

Modeling with Plug-in Gait

Export C3D

This pipeline operation exports the current state of the processed data to a .c3d file. You can then import the data into other software for further processing or report generation. For example, in Vicon Polygon you can visualize the trajectories, kinematic model elements, and kinetics data. If you manually import the corresponding .vst file into Polygon, it also visualizes the bones. For more information, see [Configure the Export C3D operation, page 344](#).

Work with digital video files

Work with digital video files

If you are using reference video cameras (for example, Vicon Vue cameras or FLIR cameras), data from these cameras is captured simultaneously with optical motion data from the Vicon optical cameras.

As video files are large and can take a lot of time to process, to save time and space on the hard drive, you normally set up the video cameras to save captured video data to separate, dedicated drives on the host PC, as *.vvid* files. (For information on video camera setup, see [Configure video cameras for digital video capture, page 76](#), the *FLIR Video Cameras Setup Guide* or the PDFs *Vicon Vue Quick Start Guide* and *Vicon Systems Setup Guide*). Note that you cannot view the video in Nexus until the files are transcoded.

To view the video files, after you have captured and processed your trials, at a suitable pause in the workflow, you transfer the video files to the host PC, simultaneously transcoding the files to a format that is viewable in Nexus.

For more information, see:

- [About transferring and transcoding, page 280](#)
- [Transfer and transcode digital video files, page 282](#)
- [Compress video files, page 287](#)
- [Run Theia processing on video files, page 289](#)

Work with digital video files

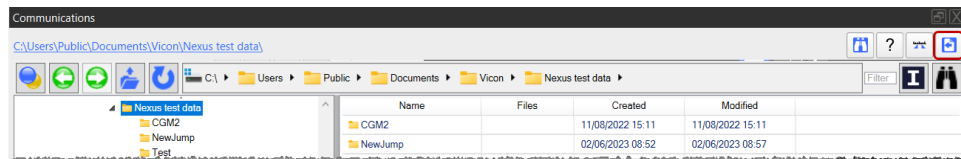
About transferring and transcoding



Tip

Because of the size of video files, transferring and transcoding takes up time and computing resources, so is best done as a batch process on a number of video files during a break or after the day's capture session ends. Ensure you transfer, transcode and then delete the .vvid files regularly to avoid filling up your SSDs.

To enable you to transfer and transcode reference video files, Nexus provides the Show File Transfer/Batch Processing interface, which you access via a button on the Data Management toolbar at the top of the Data Management tab.



You can transcode and transfer reference video files to the Nexus host PC that have been produced by one or more Vicon Vue cameras or FLIR cameras, and recorded to separate drives on the host PC.

Vicon video cameras are easiest to configure and offer higher frame rates than other supported video cameras.

Work with digital video files

Comparison of vvid files and transfer rates

The following table provides a comparison of .vvid files and transfer rates for supported video cameras. All values are approximate and are provided for guidance only.

Camera type	Width	Height	Frame rate	MB/s
FLIR Blackfly BFS-U3-23S3C	1920	1200	150	330
Vue (no windowing)	1920	1080	60	119
Vue (with windowing)	1280	720	120	105

Video files are large, so as part of the transfer process, you normally select a codec (Compressor/Decompressor) format to reduce the video file size. The selection of an appropriate codec and codec settings ensures the maximum reduction in file size, while minimizing any reduction in video quality.

Work with digital video files

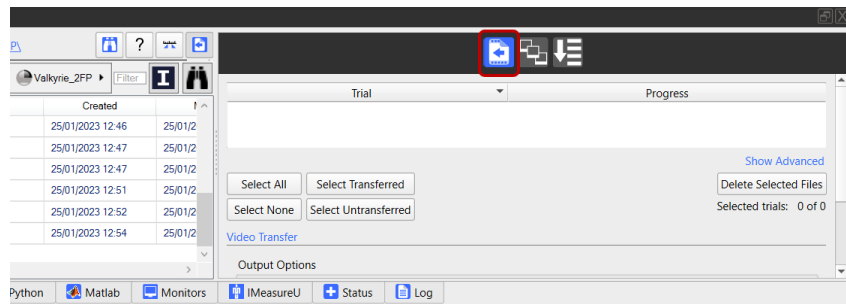
Transfer and transcode digital video files

If a video file within the currently open trial has already been transferred and/or transcoded, Nexus automatically loads the new version of the file.

In Nexus 2.16 and later, if you're moving your video data to a different location from that where it was originally saved, or if the transcode video xml files are accidentally deleted or become corrupted, you can use an advanced option to ensure that any raw video (VVID) files on the capture drives are added to the transcode list. For more information, see [Recover video files, page 285](#).

To transfer and transcode reference video files:

1. On the Data Management tab, in the Show File Transfer/Batch Processing interface (see [About transferring and transcoding, page 280](#)), click the Video Transfer button.



The list in the Trial column includes all digital video capture trials created during video capture.

2. From the list, specify the video files to be transferred in any of these ways:
 - Click the corresponding check box to select a specific trial.
 - Click **Select All**, **Select Transferred** or **Select Untransferred** to select the required trials from the list.
 - Click **Select None** to clear all previously selected trials.
3. In the **Video Transfer** area, from the **Output Options** area select one of the supported codecs (**h.264 MP4** or **h.264 AVI**) for compressing the selected video files prior to transfer or select **Uncompressed**.

In Nexus 2.13 and later, you can select only the H.264 codec to transcode captured video files, and you can choose from five quality options, ranging from **Best Quality/Largest File** to **Lowest Quality/Smallest File**. The H.264 codec is compatible with Theia.

Work with digital video files

For versions of Nexus earlier than 2.13, we recommend that you use the FFDSHOW codec. You can download it from the [Third-Party Plugins page](#)²⁵ on the Vicon website.

For information on installing and setting the correct options for the FFDSHOW codec, see [Install the FFDSHOW codec, page 286](#).

4. Click the **Transfer Video** button to start transferring the video files associated with the selected trials. Any specified transcoding is performed as the first stage of the transfer process.



Caution

Do not attempt to capture data while a file transfer is in process. Interrupting this process may result in problems with the data capture or file transfer. Allow the file transfer process to complete, or click the **Cancel Transfer** button to manually stop the process before starting a new capture.

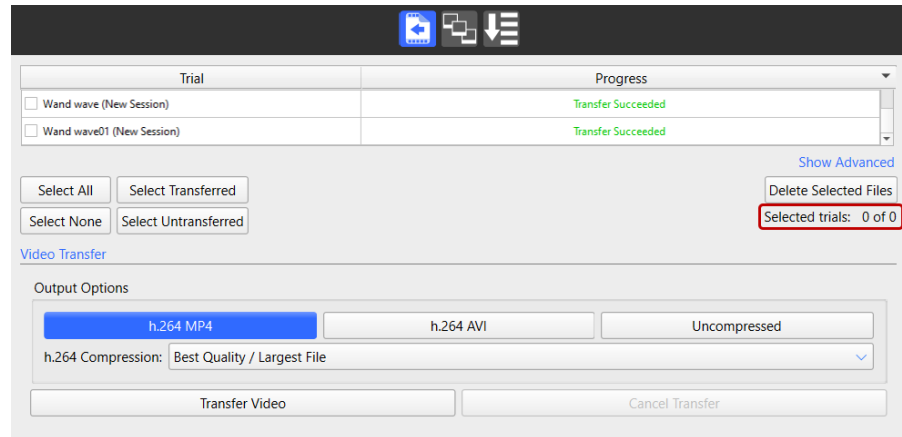
During transfer, the progress column in the trials list indicates the transfer status:

- Blank: File transfer process idle
- Yellow moving bar: File transfer process in progress
- Green static bar: File transfer process successfully completed
- Red static bar: File transfer process failed or canceled

²⁵ <https://www.vicon.com/downloads/third-party>

Work with digital video files

In addition, the **Selected files** counter enables you to check easily on the progress of the transfer of large numbers of video files.



The counter displays both the number of the current video and the total number of videos that are being transferred.

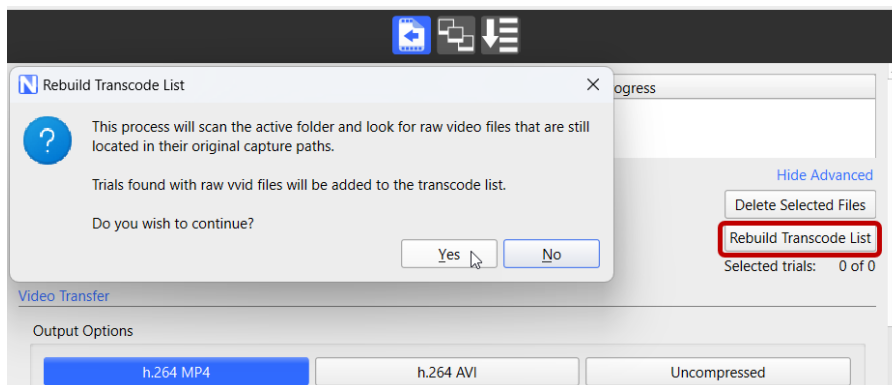
Work with digital video files

Recover video files

In Nexus 2.16 and later, if you're moving your video data to a different location from its original location, or if the transcode video xml files are accidentally deleted or become corrupted, you can use the advanced option, **Rebuild Transcode List** to ensure that any raw video (VVID) files on the capture drives are added to the transcode list.

To use this option:

1. In the **Communications** pane ensure the **Video Transfer** window is displayed.
2. Below the file list, click **Show Advanced** to display the advanced options.
3. To add any files that may still be on the capture drives to the list, click **Rebuild Transcode List**.
4. In the Rebuild Transcode List dialog box, click **Yes** to continue.



Nexus scans the active folder and looks for VVID files that are still located in their original capture paths.

Trials that are found with untransferred video files are added to the transcode list.

Work with digital video files

Install the FFDSHOW codec

Unless you are using Nexus 2.13 or later, we recommend the FFDSHOW codec for transcoding your raw video files. (In Nexus 2.13 and later, you can use only the H.264 codec to transcode captured video files.)

To install this codec:

1. Visit the [Third-Party Plugins page](#)²⁶ on the Vicon website.
2. Click on FFDSHOW Codec and download the file.
3. Install the downloaded FFDSHOW.exe file.
4. Accept the default options, ensuring that on the **Select Components** screen, the **VFW Interface** option is selected.
5. Click **Start > All Programs > ffdshow > VFW Configuration**.
6. On the **Encoder** tab, ensure **Generic** is selected, then select the following options and click **OK**:
 - Encoder: **MPEG-4**
 - FOURCC: **XVID**
 - Mode: **one pass - average bitrate**
 - Bitrate (kbps): **900**
 - Maximum I frame interval: **10**
 - Minimum I frame interval: **1**
7. In Nexus, you can now select the FFDSHOW codec from the list of available codecs in the **File Transfer** area of the **Data Management** tab.

²⁶ <https://www.vicon.com/downloads/third-party>

Work with digital video files

Compress video files

In Nexus 2.16 and later, the **Apply Codec to Video** operation takes a video file as input, compresses it and writes the resulting frames to an output file.

Note

Compressing video that has already been compressed (for example by having transcoded the original video files using either of the current options: **h.264 MP4** or **h.264 AVI**) is not usually recommended as this can result in a noticeable and sometimes even dramatic decrease in quality.

You may occasionally need to use the **Apply Codec to Video** operation to compress video files in the following circumstances:

- If you transcoded your files using the **Uncompressed** option, and then need to apply a codec to the resulting large files. If you have not retained the original (VVID) video files, this pipeline operation enables you to apply the required codec to the uncompressed AVI files.
- If you want to convert from an old DirectShow codec to h.264. Note that to do this, you need the 64-bit version of the DirectShow codec and that the quality of the resulting video will be affected.


Note also that if you have h.264-encoded video:

- If you simply want to change from AVI to MP4 (or MP4 to AVI) you can use the pipeline operation to quickly change the container and transfer the video frame data without modification. For example, you may want to do this if you have existing h.264 AVI files and want to retain the original video quality and to use Nexus Insight as your reporting tool.
- If you select h.264 encoding without changing the container (that is, you choose to convert h.264 MP4 to h.264 MP4 OR h.264 AVI to h.264 AVI) then Nexus alerts you and no action is taken. If you want to force the compression (but see the note above about compressing video that has already been compressed), use the Advanced option, **Force Recompress**.

Work with digital video files

To use the Apply Codec to Video operation:

1. To load a digital video file, with the **Camera** view selected, click on the desired movie file on the **Data Management** tab.
2. In the **Available Operations** section of **Pipeline Tools** pane, expand the **System** pipeline operations list.
3. Double-click the **Apply Codec to Video** pipeline operation.
The operation is added to the current pipeline and is displayed at the bottom of the list in the **Current Pipeline** section.
4. In the **Current Pipeline** section, click on **Apply Codec to Video**, and then in the **Properties** section at the bottom of the **Pipeline Tools** pane:
 - a. From the drop-down **File Output** list, select the codec you want to use for file compression.
 - b. From the **h.624 Compression** list, select the required option.
 - c. If you want Nexus to create a backup of the original video file, ensure the **Keep Backup** option is selected.
 - d. If you want to force compression of files that are already compressed, ensure you've read the Note above, and if still sure you want to further compress your file(s), use the Advanced option, **Force Recompress**.
5. Add any other pipeline operations you want to include in the pipeline.

 **Tip:** The pipeline operations are run in the order they appear in the **Current Pipeline** list; drag to rearrange the order.
6. In the **Current Pipeline** configuration management section, click **Save** to save your settings. (An asterisk (*) is displayed next to the pipeline name if there are unsaved changes.)
7. Run the pipeline.

Work with digital video files

Run Theia processing on video files

Vicon Nexus 2.12 and later enables you to process Nexus video data from within Theia, without having to launch Theia and manually process the data.

You can either use the Theia Batch Interface to run Theia processing on all the video trials in a specified folder or use the supplied pipeline operation to run Theia processing on one or more selected video trials.

After you have run Theia processing on your trial data, you can use an additional supplied pipeline operation to combine it with your Nexus trial to add the rotation data from Theia3D to your Nexus trial. To calculate the joint angles, you can continue to use Nexus with Vicon ProCalc schemes or use ProCalc independently of Nexus. Alternatively, you can use pipeline operations that are supplied with Theia3D to generate the kinematics and kinetics (note that, to calculate joint kinetics, a force plate is required), and use Visual3D to merge the rotation data and perform the data analysis.

- [Capture and transcode video trials in Nexus, page 290](#)
- [Run Theia processing on video trials, page 291](#)
- [Combine processed Theia data with a Nexus trial, page 299](#)
- [Calculate joint angles and kinetics, page 302](#)



Note

Before you begin, in addition to upgrading to Nexus 2.12 or later, ensure you have installed Vicon ProCalc 1.5 or later and are using Theia3D 2020 6 1106 or later.

Work with digital video files

Capture and transcode video trials in Nexus

Before you begin using the Theia functionality within Nexus, capture and transcode the required trials.

1. In Nexus, capture the optical and video trials in the usual way, ensuring your system includes at least two optical cameras, as well as video cameras.
2. Before you compress all the video trials, ensure you are using a recommended Theia video processor with the appropriate settings.
3. Compress and transfer all the required video trials, ensuring that you select the correct video encoder (see [Transfer and transcode digital video files, page 282](#)).

For Nexus 2.13 and later, we recommend using the h.264 and Best Quality/Largest File options.

Work with digital video files

Run Theia processing on video trials

Nexus provides two options for running Theia processing on your video trials. The **Theia Batch Interface** enables you to process all the video trials in a specified session folder. If you want to process only one trial or a few trials, or add Theia processing to an existing pipeline, you may prefer to use the supplied Theia pipeline operation instead.

- [Run Theia processing on all trials in a specified folder, page 292](#)
- [Run Theia processing on one or more selected video trials, page 296](#)

Work with digital video files

Run Theia processing on all trials in a specified folder

From the Nexus Communications pane, you can select the Theia tab to access the Theia Batch Interface. From here you can select the required video files and process them. The files are processed through Theia3D, resulting in the output of C3D file(s) that contain rotation data for each subject.

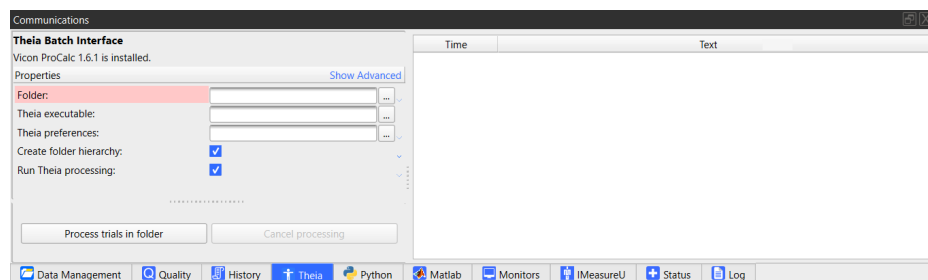


Tip

Unlike the Theia pipeline operation, which loads each trial into Nexus, when you use the Theia Batch Interface, you can process your optical data at the same time in Nexus while Theia runs and processes the video data in the background.

To run Theia processing on all trials in a specified folder:

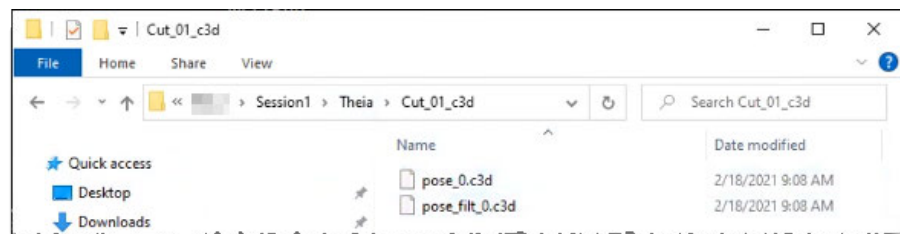
1. Ensure Theia3D is NOT already running on the machine on which you want to process the files
2. In the Communications pane, click the Theia tab, enter the paths in the fields shaded in pink, and set any other properties as required, for example, Theia preferences.



- **Folder:** Enter or browse to the full path of the session folder containing the trials that you want to process in Theia. Theia will attempt to process all trials in this folder.
Note that when you exit and relaunch Nexus, the path is remembered.
- **Theia executable:** Enter or browse to the full path for the *Theia3D.exe* file, for example, *C:\Program Files\Theia\Theia3D*.
Note that when you exit and relaunch Nexus, the path is remembered.
- **Theia preferences:** If you want to use the preferences that you use in Theia, enter the full path to the required Theia preferences file. This must be exported from Theia and saved as a PXT file on the local machine.

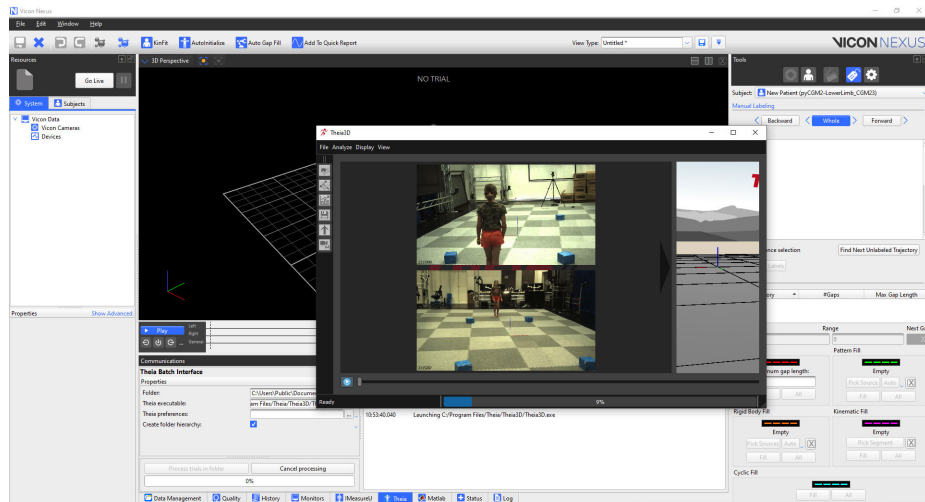
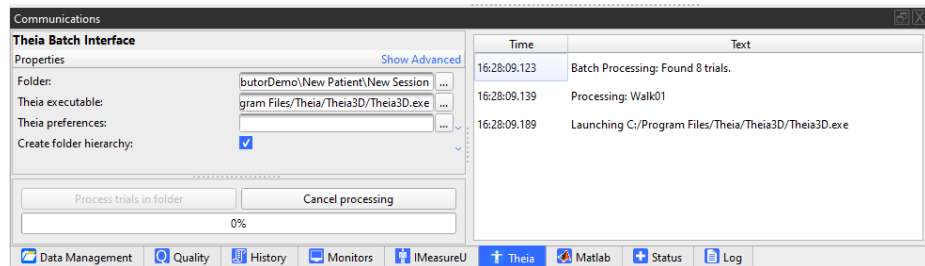
Work with digital video files

- **Create folder hierarchy:** If you want a folder hierarchy to be created in which to store the files, and the necessary video files to be copied into it, ensure that this check box is selected. Unless you have already created the folder hierarchy (eg, if you are re-running the process), you will normally leave this option selected. The folder structure that is created consists of a folder named **Theia** that is a child of the session folder that contains the trials, with subfolders named *Trialname_c3d*, which contain the C3D files (filtered and unfiltered) that are output by Theia processing.



- **Run Theia processing:** When selected, the video files are formatted in the correct Theia3D-readable format and then Theia3D is launched and processes all the detected video files in the Folder location. If you only want to format the files and do not want to launch Theia, clear this option.
3. When you have entered the required information, click **Process trials in folder**. Nexus identifies the number of trials that are found in the folder and starts the process on the first trial, which launches Theia. The right side of the Theia tab displays the progress of the processing and in the Theia window, a percentage progress bar is also displayed.

Work with digital video files



If Theia closes, Nexus relaunches Theia and retries once only to reopen the trial that it attempted to process. If the trial won't open, it moves on to the next trial.

If you want to stop Theia launching, click **Cancel processing**.

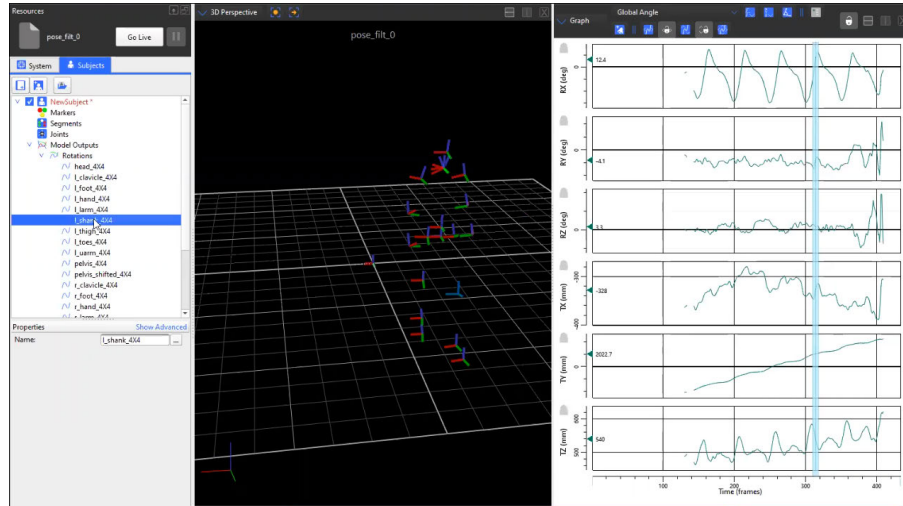
When processing is finished, the right side of the Theia tab displays the text **'Batch Processing: Finished.'** and the Theia data is placed in a subfolder in the specified file path, if you selected **Create folder hierarchy**. The Theia data includes:

- The Theia video format and calibration file
- Theia-generated C3D files. For each video file, Theia generates two C3D files: filtered and non-filtered. (If necessary, you can change the filtering in Theia3D.)

Note that Theia3D remains open after processing is finished.

Work with digital video files

If required, you can view the output rotations in the **Subject tree**, the **3D Perspective view**, and in the **Graph view**.

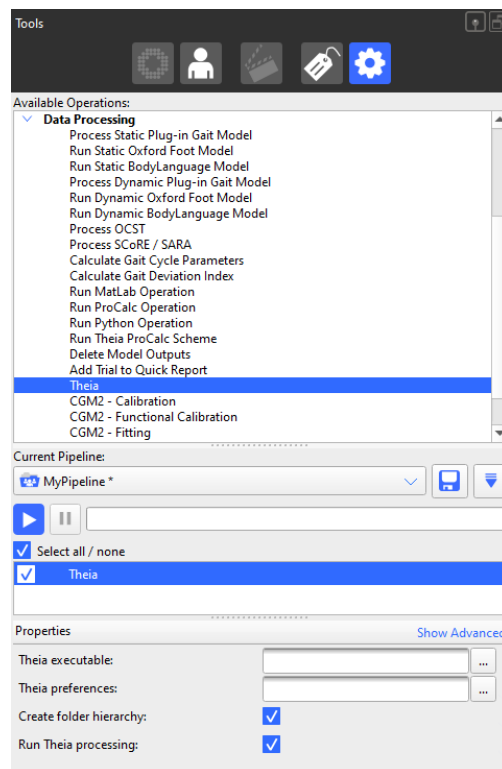


You can now merge this rotation data, which will be used to calculate the joint information, back into the original Nexus trial (see [Combine processed Theia data with a Nexus trial, page 299](#)).

Work with digital video files

Run Theia processing on one or more selected video trials

You can use the supplied pipeline operation to run Theia processing on a single video trial, or multiple trials marked in Data Management, resulting in the output of C3D file(s) that contain rotation data for each subject.

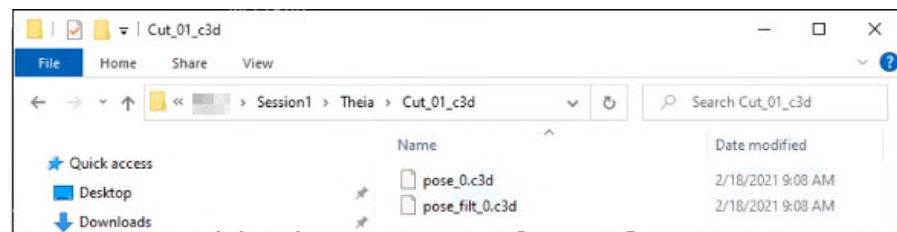


To process one or more selected video trials:

1. Ensure Theia3D is NOT already running on the machine on which you want to process the trial.
2. Load the trial(s) on which you want to run Theia processing and, if necessary, mark them in the usual way, in **Data Management**.
3. In the **Pipeline Tools**, expand the **Data Processing** pipeline operations and then double-click **Theia** to add it to the current pipeline.
4. In the **Properties** pane, specify the required settings:
 - **Theia executable:** Enter or browse to the full path for the *Theia3D.exe* file, for example, *C:\Program Files\Theia\Theia3D*.
Note that when you exit and relaunch Nexus, the path is remembered.

Work with digital video files

- **Theia preferences:** If you want to use the preferences that you use in Theia, enter the full path to the required Theia preferences file. This must be exported from Theia and saved as a PXT file on the local machine.
- **Create folder hierarchy:** If you want a folder hierarchy that is used by Theia to be created, and the necessary video files to be copied into it, ensure that this check box is selected. Unless you have already created the folder hierarchy (eg, if you are re-running the process), you will normally leave this option selected. The folder structure that is created consists of a folder named **Theia** that is a child of the session folder that contains the trials, with subfolders named *Trialname_c3d*, which contain the C3D files (filtered and unfiltered) that are output by Theia processing.

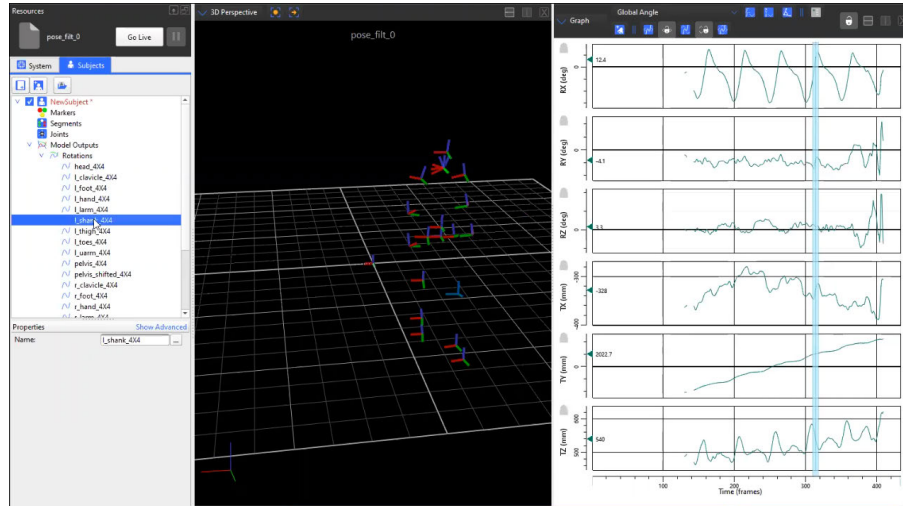


- **Run Theia processing:** When selected, the video files are formatted in the correct Theia3D-readable format and then Theia3D is launched and processes all the detected specified video files. If you only want to format the files and do not want to launch Theia, clear this option.
5. Run the pipeline operation on the video trial data.
Theia launches and the trial is processed.
If Theia closes, Nexus relaunches Theia and retries once only to reopen the trial that it attempted to process. If the trial won't open, it moves on to the next trial.
If you want to stop Theia launching, click **Cancel processing**.
When processing is finished, the Theia data is placed in a subfolder in the specified file path, if you selected **Create folder hierarchy**. The Theia data includes:
- The Theia video format and calibration file
 - Theia generated C3D files. For each video file, Theia generates two C3D files: filtered and non-filtered. (If necessary, you can change the filtering in Theia3D.)

Note that Theia3D remains open when processing is finished.

Work with digital video files

If required, you can view the output rotations in the **Subject tree**, the **3D Perspective view** and in the **Graph view**.



You can now merge this rotation data, which will be used to calculate the joint information, back into the original Nexus trial (see [Combine processed Theia data with a Nexus trial, page 299](#)).

Work with digital video files

Combine processed Theia data with a Nexus trial

When you have run Theia processing on your trial data, you can run a pipeline operation that merges the rotation data with your Nexus trial.

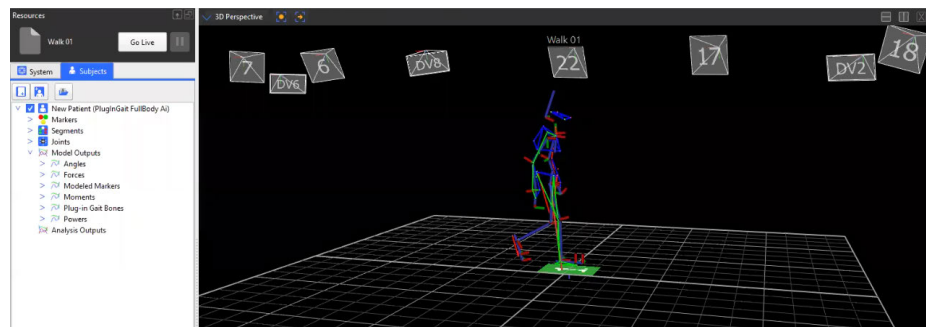


Note

If your trials contain multiple subjects, the workflow is different from that for a single subject in that you cannot merge the Theia data into your Nexus trial using the Add Theia Data operation.

To combine processed Theia data with a Nexus trial:

1. Run Theia processing on your trial data (see [Run Theia processing on one or more selected video trials, page 296](#) or [Run Theia processing on all trials in a specified folder, page 292](#)) and ensure that you have also run any processing needed to give you the required model outputs on the optical data for your trial.
2. Load the trial that you want to combine with your Theia data in the usual way, in Data Management.




3. In the Pipeline Tools, expand File Import pipeline operations, then double-click Add Theia Data to add it to the current pipeline.

Work with digital video files

4. In the Properties pane, specify the required settings:
 - **Theia C3D folder:** The **Standard Folder** location is the default location for Theia data, which is within the folder structure created by the previous Theia processing. The folder structure consists of a folder named **Theia**, which is a child of the session folder that contains the trials, and within this folder, the subfolders, whose names are '*TrialName_c3d*'.



If you didn't save the processed data to the standard location for Theia processing, change the **Theia C3D Folder** to the relevant location by clicking to the right of the **Standard Folder** field and then clearing the **Macro** box. You can then enter or browse to the folder location.

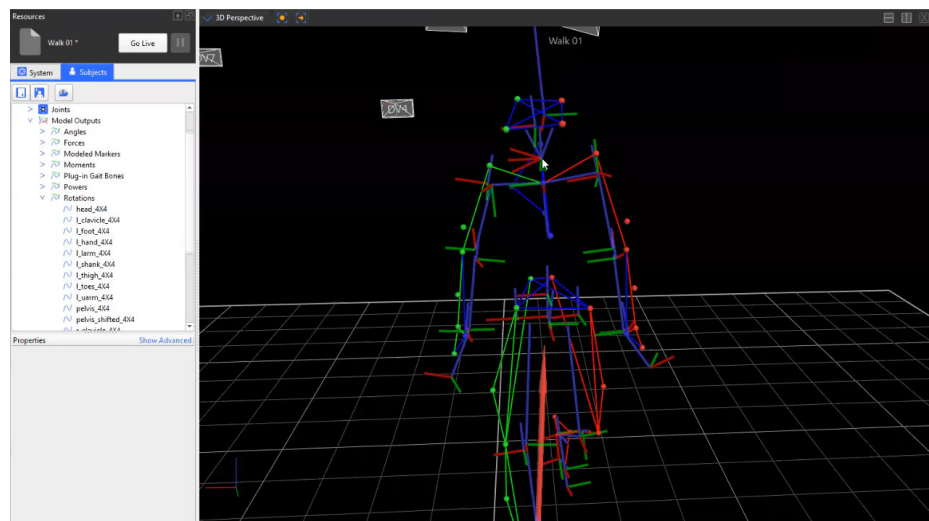
 **Tip:** Ensure the names of the files on which you want to run the Add Theia Data operation conform to the naming convention so that they begin with the trial name, followed by *_subjectNumber.c3d* or **_filt_subjectNumber.c3d*, for example, *walking_100_50_01_0.c3d* or *walking_100_50_01_filt_0.c3d*.

- **Filtered:** Select this option to run the operation on the filtered data. If cleared, the operation runs on the raw, unfiltered data.

Work with digital video files

5. Run the pipeline operation.

On the **Subjects Resources** tab, in the **Model Outputs** for the relevant subject, the rotations are displayed and can also be visualized in the 3D Perspective view. At the top of the Subjects tree, the subject name has an asterisk (*) appended to it, to indicate that the data has changed and can now be saved.



6. Save the C3D to retain the merged rotations in your Nexus trial.

After you have finished merging the rotations into your Nexus trial data, you can use Nexus to calculate the joint information (see [Calculate joint angles, page 302](#)).

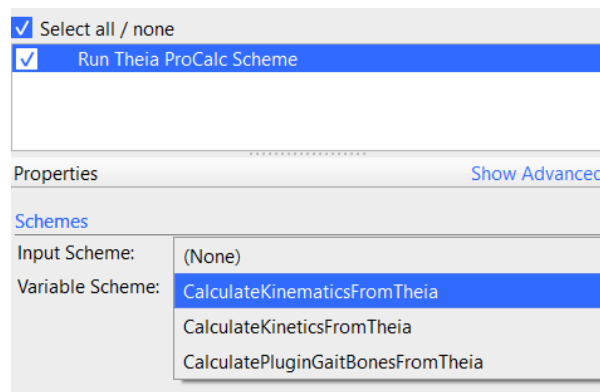
Work with digital video files

Calculate joint angles and kinetics

The Run Theia ProCalc Scheme pipeline operation enables you to generate joint information (ProCalc angles) and kinetics from combined Nexus-Theia trial data.

To calculate the joint angles:

1. Ensure Vicon ProCalc 1.6 is installed.
2. Ensure you have merged the Theia rotation data with your Nexus trial by running the **Add Theia Data** pipeline operation (see [Combine processed Theia data with a Nexus trial, page 299](#)).
3. Ensure the trial for which you want to generate joint angles is loaded in the usual way, in **Data Management**.
4. In the **Pipeline Tools**, expand **Data Processing** pipeline operations, then double-click **Run Theia ProCalc Scheme** to add it to the current pipeline.
5. With **Run Theia ProCalc Scheme** selected, in the **Properties** pane, specify the required settings from the **Schemes** section:
 In the **Variable Scheme** field, select from:
 - **CalculateKinematicsFromTheia**: (Default option) Automatically calculates joint angles from the rotations.
 - **CalculateKineticsFromTheia**: Automatically calculates kinetics. Note that a force plate is required to calculate joint kinetics.
 - **CalculatePluginGaitBonesFromTheia**: Automatically calculates Plug-in Gait bones. This is useful if you want to display meshes in Vicon Polygon. (If you also need to calculate joint angles, first run the **CalculateKinematicsFromTheia** scheme.)

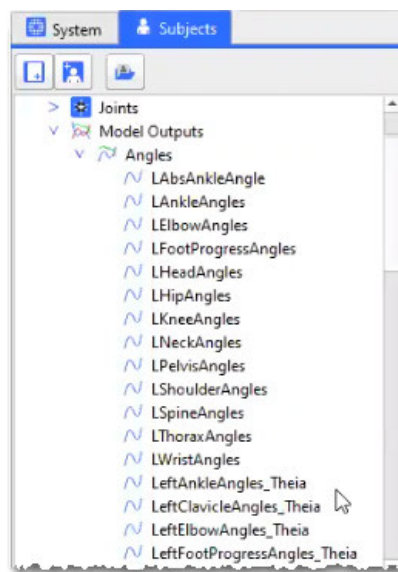


Work with digital video files

Note that the default location for these schemes is *C:\Program Files\Vicon\ProCalc\Resources*. If you make a change in ProCalc that moves or deletes these schemes, they will not be available from this menu.

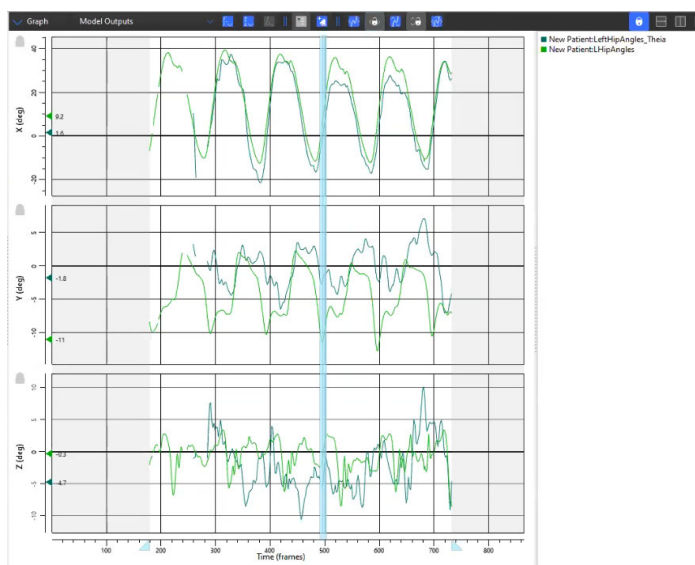
6. Ensure the default option (**CalculateKinematicsFromTheia**) is selected and run the pipeline operation.

The ProCalc joint angles are displayed in the **Model Outputs** for the relevant subject. Their names end in the suffix **_Theia**, for easy identification.



Work with digital video files

- To compare Theia-generated outputs with the Nexus outputs, select equivalent outputs (for example, LHipAngles and LeftHipAngles_Theia), and display them in a Graph view.



Work with Vicon IMUs

If you are using Vicon IMUs (Inertial Measurement Units) with Nexus, first ensure you have set up the IMUs and Nexus as described in [Configure Vicon IMUs, page 123](#).

Important

- Vicon IMUs are supported for use with Nexus for research purposes only. For full sensor safety and regulatory details, see the Vicon Blue Trident Model V2 Safety and Regulatory Information.

Blue Trident sensors

- Windows 10 and later only is supported. Ensure the latest Windows 10 updates are installed.
- The firmware for Blue Trident sensors that are to be used with Nexus 2.10 or later must be updated to version 9.0.2 or later, using Capture.U Desktop 1.1 or later, which is available from the [Capture.U page²⁷](#) on the Vicon website.
- Second-generation Blue Trident sensors are supplied with Firmware 10 – do not downgrade their firmware. If you have first-generation Blue Trident sensors, you can safely downgrade their firmware, if necessary. However, as Capture.U 1.3.1 Desktop is not compatible with firmware earlier than 10.#, if you downgrade the firmware from version 10, you must uninstall Capture.U 1.3.1 and use an earlier version of Capture.U.

Blue Thunder sensors

- Blue Thunder IMU sensors are not supported in Nexus 2.10 or later. If you want to capture Blue Thunder data, use Nexus 2.9.x.
- You can load existing processed trials with Blue Thunder data into Nexus 2.10 or later and view the captured IMU data.
- The IMeasureU plug-in is not available in Nexus 2.10 or later.

²⁷ <https://www.vicon.com/software/capture-u/>

Work with Vicon IMUs

The following are brief notes on using Vicon IMUs with Nexus.

 For an introduction to the latest Vicon IMUs, watch the Vicon video [Capture.U Tutorial - Unboxing Blue Trident²⁸](https://youtu.be/Rs71f9behFo), available on YouTube.

- [Attach IMU sensors to a subject, page 307](#)
- [Stream live data from Vicon IMUs, page 309](#)
- [Calibrate Vicon IMUs, page 315](#)
- [Capture Vicon IMU data, page 317](#)
- [Download Vicon IMU data, page 320](#)
- [Erase data from Vicon IMUs, page 324](#)
- [Restore missing data to a Vicon IMU sensor, page 328](#)
- [Align IMU data with the Vicon world, page 330](#)
- [Export IMU data, page 337](#)

²⁸ <https://youtu.be/Rs71f9behFo>

Work with Vicon IMUs

Attach IMU sensors to a subject

The method you use to attach the sensors to your subject depends on the type of movement you want to collect.

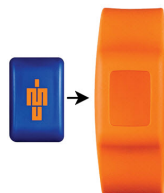
- To collect the movement of a subject's limbs, you can attach the sensors using the supplied straps.
- To collect the movement of other parts of the anatomy (for example, where movement of the vertebrae is of interest), you can attach sensors directly, using suitable tape.

If you would like to assign a name to each sensor before placing it on your subject, see [Manage sensor names](#).

For information on strap sizes and prices, visit the [Blue Trident web page](#)²⁹ on the Vicon website, select **Buy Now** and then select **Straps**.

To attach sensors to a subject using the supplied straps:

1. Insert each sensor into its strap with the IMU symbol facing outwards.



2. Attach the straps to the subject, ensuring that:
 - a. The strap sits snugly against the limb.
 - b. The sensor is oriented with the top (head) pointing in the same direction as the movement of the subject.
 - c. The flashing LED is at the top of the strap.

The following example shows a strap attached so that the sensor sits directly on the medial aspect of the tibia, just above the medial malleolus:

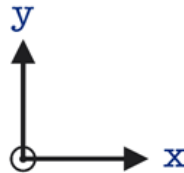
²⁹ <https://www.vicon.com/hardware/blue-trident/>

Work with Vicon IMUs



To attach sensors to a subject where straps are not used:

1. Position the sensor on the subject, depending on the required sensor orientation.



2. Secure the sensors using your preferred type of tape (for example, hypoallergenic, double-sided, micropore surgical tape).

⚠ Important

If you plan to collect global angles, after the sensors are attached to a subject, allow a few seconds for onboard calibration to initiate before starting the movement that is to be collected.

Work with Vicon IMUs

Stream live data from Vicon IMUs

Nexus 2.10 and later enables you to stream live data from your Vicon IMUs so that you can visualize the outputs in real time.

You can use any of the data channels from the IMU:

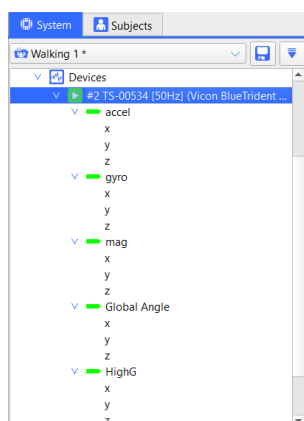
- HighG accelerometer
- LowG accelerometer
- Gyroscope
- Magnetometer
- Global angle (angle-axis from the onboard 9-axis quaternions)

To stream live data from Vicon IMUs:

1. Ensure the required IMUs are connected (see [Connect Vicon IMUs to Nexus](#), page 126).

All the available axes automatically stream data:

- LowG accelerometer (16 G) (x, y, z)
- Gyroscope (x, y, z)
- Magnetometer (x, y, z)
- Global Angle (x, y, z)
- HighG accelerometer (200 G) (x, y, z)



The default stream rate is 50 Hz, but can be 30 Hz, 50 Hz or 100 Hz. While the IMUs are connected to Nexus, a real-time preview of data streaming from the IMUs is displayed (when Nexus is in Live mode). This preview data

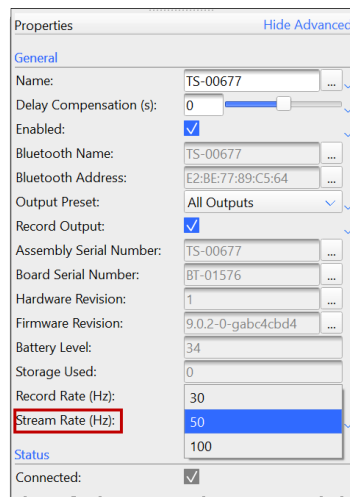
Work with Vicon IMUs

stream is supplied to Nexus at the selected stream rate, regardless of the trial collection rate (225 Hz, 1125 Hz or 1600 Hz).

The preview stream is optimized for low latency data visibility and may therefore have small frame gaps where data does not appear.

- To change the stream rate, select an IMU on the **System** tab, and in the **General** section of the **Properties**, click in the **Stream Rate** field to change its value.

Note that the stream rate that you specify, together with the number of connected IMUs, affects performance.



Work with Vicon IMUs

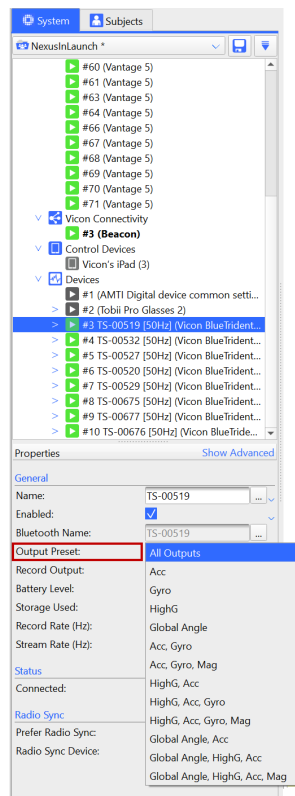
Select the required axes

By default, all axes are enabled.

To select the required output, you choose from a list of presets.

To select the output axes:

1. In the **System** tree, select the required IMU.
2. In the **Properties** pane, click the **Output Preset** menu.
3. From the list, select the required option:



In addition to selecting the output from the Output Preset list, you can select or clear **Enabled** in the Properties for the axes, to customize the output.

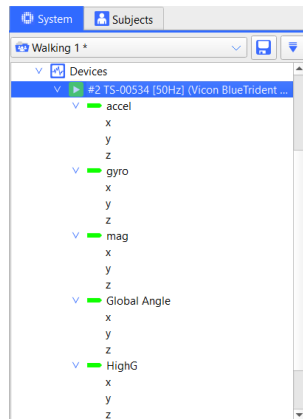
Note

If you plan to capture global angles, first [calibrate the IMUs, page 315](#).

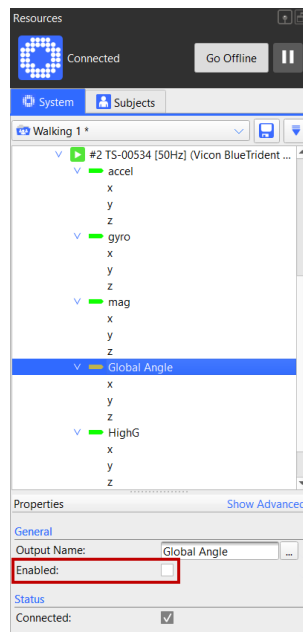
Work with Vicon IMUs

To deactivate an axis:

1. On the **System** tab, select the required IMU and expand its node.



2. To deactivate an axis, click on the required axis and in its Properties, clear the **Enabled** check box.



Work with Vicon IMUs

On the System tab, the color of the cleared axis changes from green to orange and the Graph displays null results for that axis.



If Global Angle is deactivated, the coordinate system for the relevant sensor is no longer displayed in the 3D Perspective view.

Work with Vicon IMUs

Use IMU streamed data with the Vicon DataStream SDK

All Vicon IMU data can be passed to the Vicon DataStream.

For example (using C++):

```
Hardware Frame Number: 100045
Subjects (0):
Unlabeled Markers (0):
Labeled Markers (0):
Devices (8):
Device #0:
Name: TS-00331
Type: Unknown
Device Outputs (15):
Device Output #0:
Samples (1):
Sample #0:
'x' -0.106801 MeterPerSecondSquared False
Device Output #1:
Samples (1):
Sample #0:
'y' -0.052047 MeterPerSecondSquared False
Device Output #2:
Samples (1):
Sample #0:
'z' 9.84246 MeterPerSecondSquared False
Device Output #3:
Samples (1):
Sample #0:
'x' -0.0111593 RadianPerSecond False
Device Output #4:
Samples (1):
Sample #0:
'y' 0.0118077 RadianPerSecond False
Device Output #5:
Samples (1):
Sample #0:
'z' 0.00157432 RadianPerSecond False
Device Output #6:
Samples (1):
Sample #0:
'x' -0.000146159 Tesla False
```

Download the latest version of the datastream SDK from:

<https://www.vicon.com/software/datastream-sdk/?section=downloads>

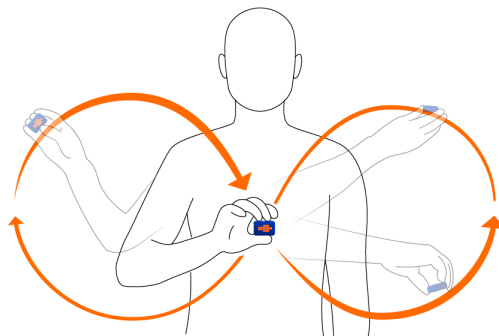
Work with Vicon IMUs

Calibrate Vicon IMUs

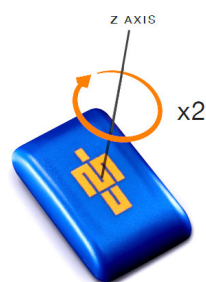
If you plan to capture global angles, to ensure that the IMU sensor data is stable and to minimize drift, you must calibrate the IMUs.

To calibrate Vicon IMUs:

1. Ensure you are streaming global angles (see [Stream live data from Vicon IMUs, page 309](#)).
2. To calibrate an IMU sensor, wave the sensor in a figure-of-eight movement several times for at least 10 seconds, ensuring that it rotates through all three axes during the motion.



3. Put the sensor on a flat surface such as the floor or a table and spin it through two full rotations around the z axis.



✓ **Tip:** To avoid any unwanted influence on the sensor, do not place it in proximity to anything metallic.

4. Wait at least five seconds until the data has stabilized.

Work with Vicon IMUs

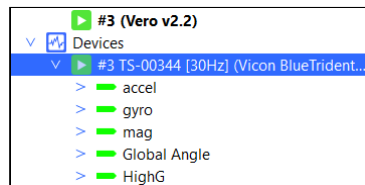
If you want to align the global angle outputs from the IMUs to the Vicon world, you can then perform wand alignment and segment alignment, as described in [Align IMU data with the Vicon world, page 330](#).

Work with Vicon IMUs

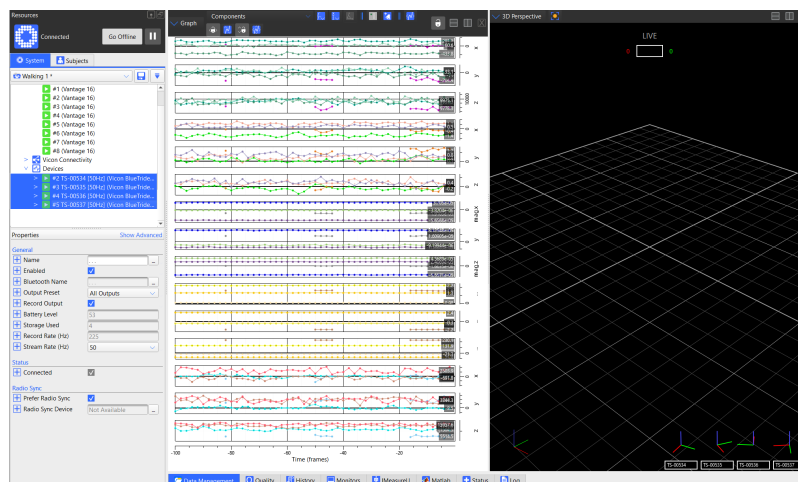
Capture Vicon IMU data

Nexus enables you to capture IMU data so that you can perform offline processing on it.

1. Before capturing data, ensure all required axis channels are enabled and streaming (see [Stream live data from Blue Trident sensors, page 309](#)).
2. To check the axis channels, on the **System** tab, expand a Vicon IMU node. All enabled channels are displayed with a green icon.

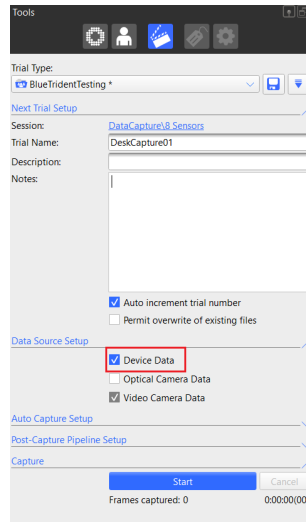


In the Graph view, the selected axes for each selected IMU are displayed.



Work with Vicon IMUs

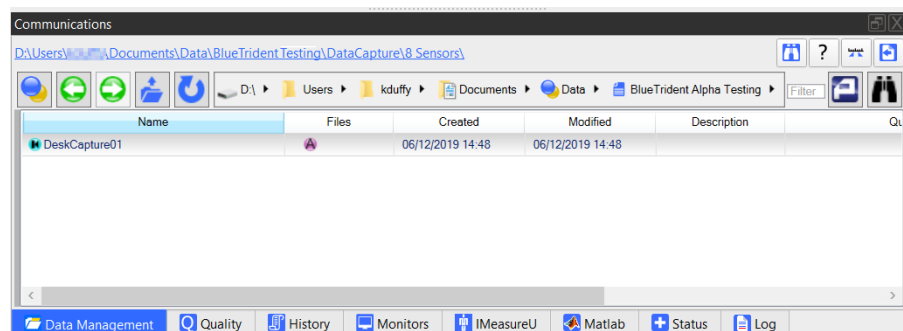
- To capture IMU data, in the Capture Tools pane, enter a trial name and other details and in the Data Source Setup section, ensure Device Data is selected.



The default sample rate is 225 Hz. However, the rate changes to:

- 1125 Hz, if the Global Angle axis is deactivated (see [Select the required axes, page 311](#))
 - 1600 Hz, if only HighG accelerometer is enabled
- Click **Start** to begin capturing and capture your subject's movement in the usual way (see [Capture the required movement, page 183](#)).
 - When you've finished capturing, click **Stop**.

The streamed data is saved into the current Session folder and is displayed as an `.x1d` file in **Data Management**.



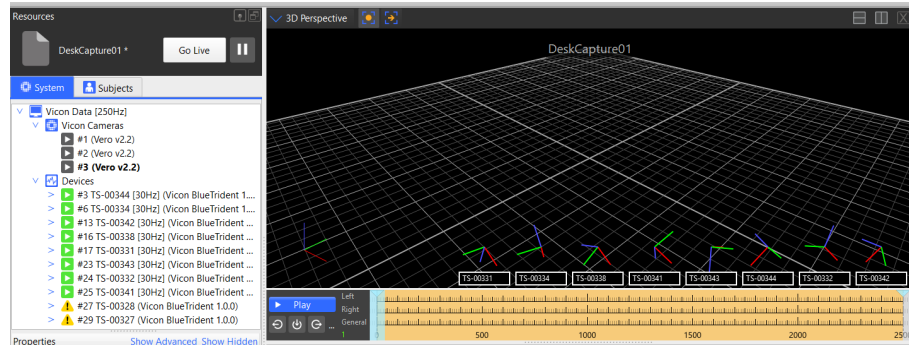
To use the onboard IMU data, you must transfer it (see [Download Vicon IMU data, page 320](#)).

- To view the streamed data, load the X1D.

Work with Vicon IMUs

7. In the 3D Perspective view, the IMU coordinate system is displayed.

Note that the IMU coordinate system is displayed only if the Global Angle axis is enabled (see [Select the required axes, page 311](#)).



To display the streamed data in a Graph view, in the System tree, select the IMUs.



Work with Vicon IMUs

Download Vicon IMU data

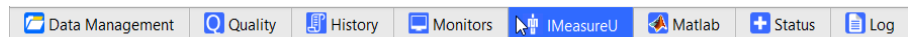
After you've captured the required data, you can download the recorded data from your Vicon IMUs so that you can load it into Nexus.



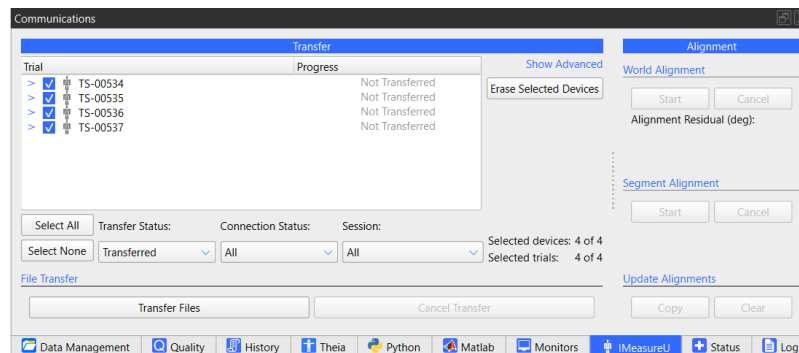
Tip

To help you decide whether to transfer recorded data, you can check the preview data by playing it in Offline mode first.

1. To download IMU onboard data to the current Session folder, in the Communications pane, click the IMeasureU tab.



In the Transfer pane, a list of all the IMUs and trials available to transfer is displayed.



For details of the options, see [Transfer pane options](#), page 322.

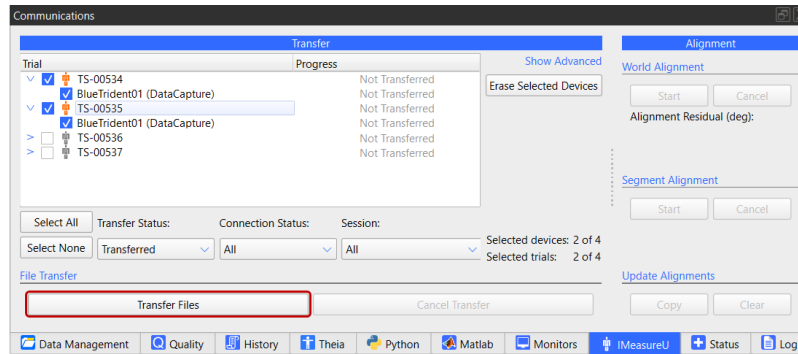
2. To transfer the IMU onboard data, connect the IMU to a USB adapter and using the micro-USB cable, connect it to the PC.



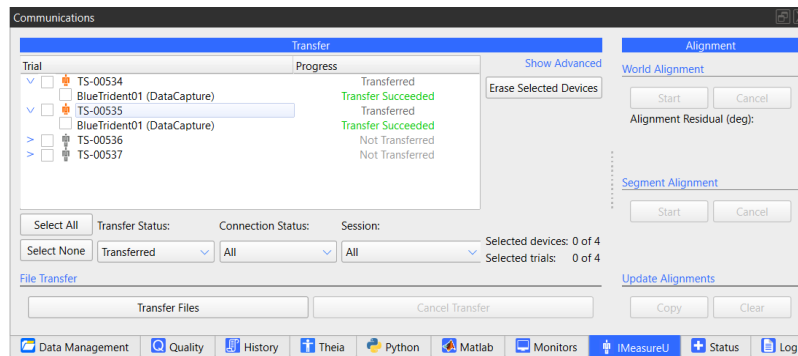
In the Transfer pane, the icons to the left of the IMUs that you plugged in are displayed in orange.

Work with Vicon IMUs

- In the Transfer pane, ensure the required IMU sensor and trials are selected and to start the data transfer, select Transfer Files.



The progress status is displayed when the data transfer starts. During data transfer, the sensor is temporarily disconnected from the Bluetooth®. After a trial is transferred, the progress status changes to Transfer Succeeded.



After the transfer operation, for each trial, you can find the following files in the Session folder:

- An *.x1d* containing the preview data (30 Hz, 50 Hz, or 100 Hz)
- An *.imu* file containing the higher quality data (225 Hz, 1125 Hz, or 1600 Hz) from the IMU

- You can now view and process the IMU data along with the rest of the trial data.

Work with Vicon IMUs

Transfer pane options

On the IMeasureU tab of the Communications pane, in the Transfer pane, you can select or remove the required trials and devices for transfer. The buttons and lists in the Transfer pane enable you to filter the displayed items so that you transfer only the items that are required

This table describes the available options.

Option	Description
Select All	Selects all of the items in the filtered sensor item list.
Select None	De-selects all of the items in the filtered sensor item list.
Transfer Status	Choose from one of: <ul style="list-style-type: none"> • All Selects all trials for each sensor that are listed with both Transferred and Not Transferred progress status • Not Transferred Selects all trials for each sensor that is listed with Not Transferred progress status • Tranferred Selects all trials for each sensor that is listed with Transferred progress status
Connection Status	Choose from one of: <ul style="list-style-type: none"> • All Selects items from all IMU sensors regardless of connection status • Connected Selects items from only IMU sensors that are connected to Nexus • Not Connected Selects items from only IMU sensors that are not connected to Nexus
Session	Choose from one of: <ul style="list-style-type: none"> • All Selects items from all sessions • Selected Selects items from selected sessions only <p>To clear currently selected sessions, choose Clear Selected.</p>
Erase Selected Devices	Erases all data from the selected devices. Successfully cleared trials are removed from the list.

Work with Vicon IMUs

Option	Description
Sync trials with sensor	Removes from the transfer list data that cannot be found on the selected IMU sensor(s). (Advanced option)
Rebuild Transfer List	Adds trials to the transfer list from selected IMU sensor(s), if possible. (Advanced option)
Transfer Files button	Transfers selected trials from connected IMUs to the current Session folder in Nexus.
Cancel Transfer button	Cancels the current transfer operation.

The connection status of each sensor to the PC (via USB) is indicated by the color of the IMU symbol to the left of the sensor name in the Transfer pane:

- Orange: Connected
- Gray: Disconnected

Note that:

- If you have filtered an item from the list, it is automatically de-selected. This is to prevent accidental transfer of items that are not displayed in the list.
- Select All and Select None operate on all items that are visible in the list: an item must be visible in the list for its selection status to be updated.
- The top level sensor item is never filtered out of the list.
- The filtering is dynamic and the list refreshes when:
 - Sensors are connected or disconnected
 - Trials are captured
 - Sensors are erased

Work with Vicon IMUs

Erase data from Vicon IMUs

After you've downloaded data from Vicon IMUs, you can delete the data in Nexus so that the IMUs are ready for re-use.

In addition, if you have erased data from an IMU sensor using Capture.U Desktop or IMeasureU Step, you can update the information displayed on the IMeasureU tab in Nexus so that it does not display the erased data.

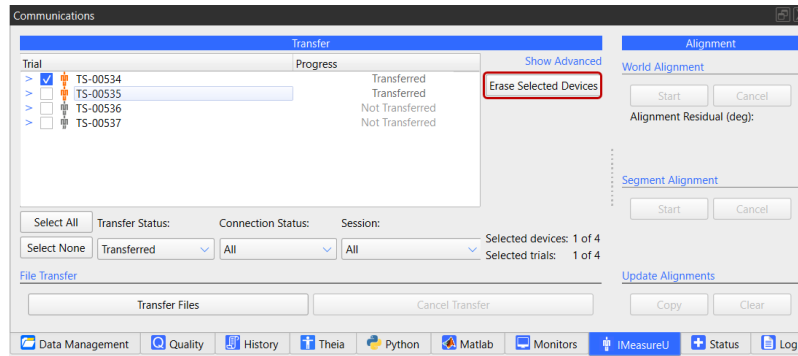
- [Erase onboard data, page 325](#)
- [Remove erased trials from the IMeasureU tab, page 326](#)

Work with Vicon IMUs

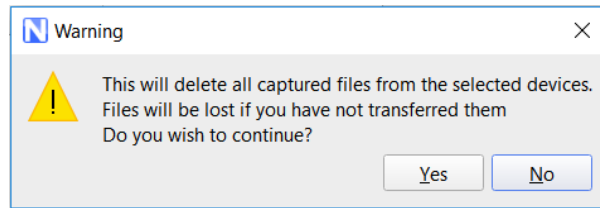
Erase onboard data

To erase the onboard data:

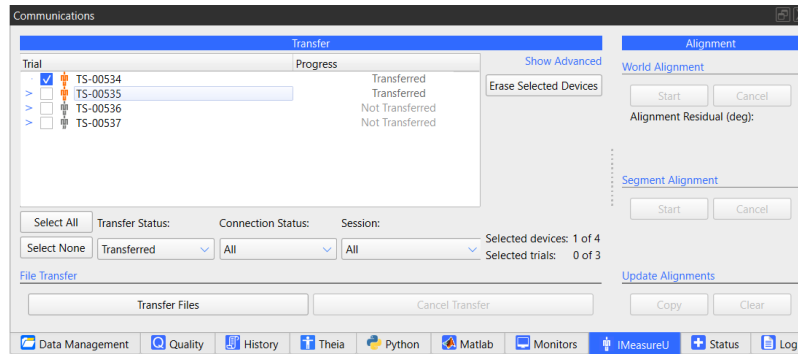
1. In the Transfer pane, select the IMU(s) and then click Erase Selected Devices .



A warning prompts you to confirm that you want to erase the onboard IMU data.



2. If you want to erase the onboard data, click **Yes**. When the data has been erased, the connected IMUs remain on the Transfer list, but their trials are removed from the list and a caret (>) is no longer displayed to the left of the sensor name.



Work with Vicon IMUs

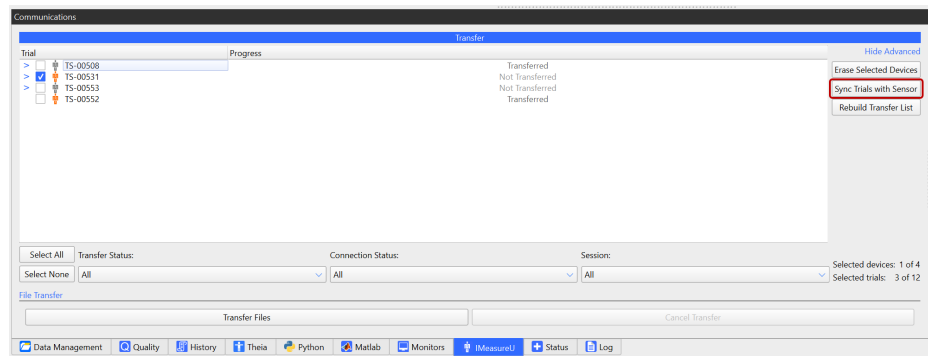
Remove erased trials from the IMeasureU tab

If you have erased data from an IMU sensor using Capture.U Desktop or IMeasureU Step, you can update the information displayed on the IMeasureU tab so that it does not display the erased data.

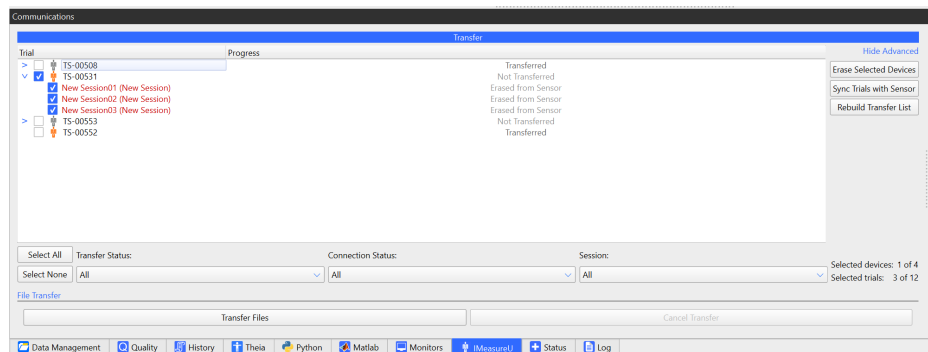
To remove erased trials from the IMeasureU tab:

1. With the IMU from which you have erased data (using Capture.U Desktop or Step) connected to the PC, open Nexus.
2. In the Communications panel, select the IMeasureU tab and click Show Advanced.

The Sync trials with sensor button is displayed.

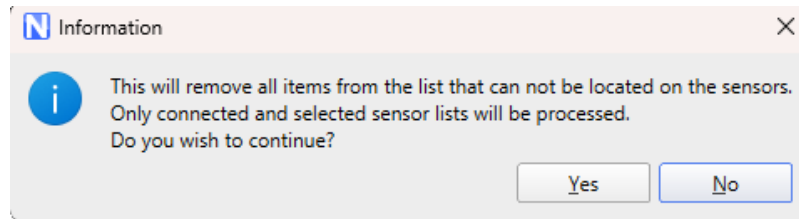


3. On the IMeasureU tab, select the IMU sensor. Erased trials are displayed in red.

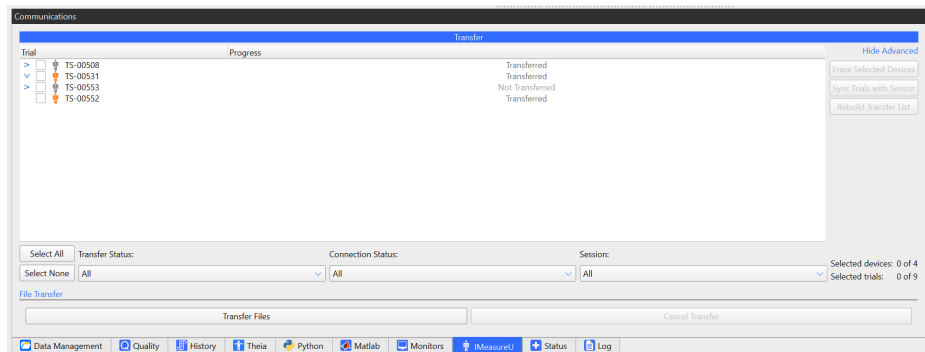


Work with Vicon IMUs

- Click Sync trials with sensor.
Nexus prompts you to confirm that you want to continue to remove the erased trials from the list.



- Click Yes to continue.
In the Trial list on the IMeasureU tab, the red (erased) trials are no longer displayed.



Work with Vicon IMUs

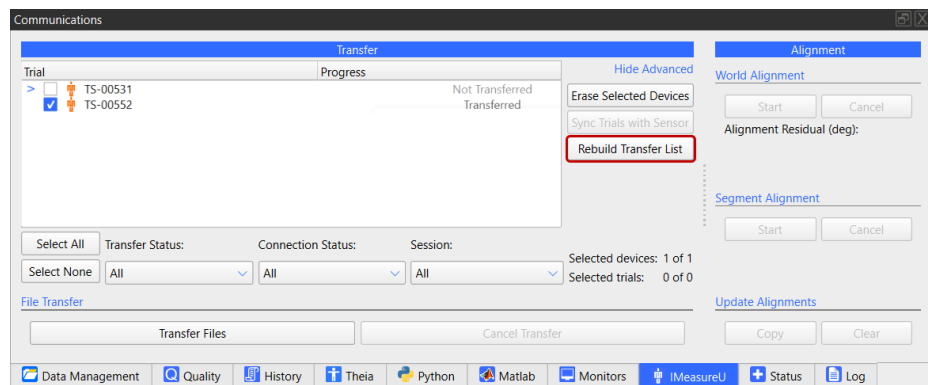
Restore missing data to a Vicon IMU sensor

You can restore accidentally deleted or corrupted information that is needed to download the information from the sensor and store it with the trial it was captured with.

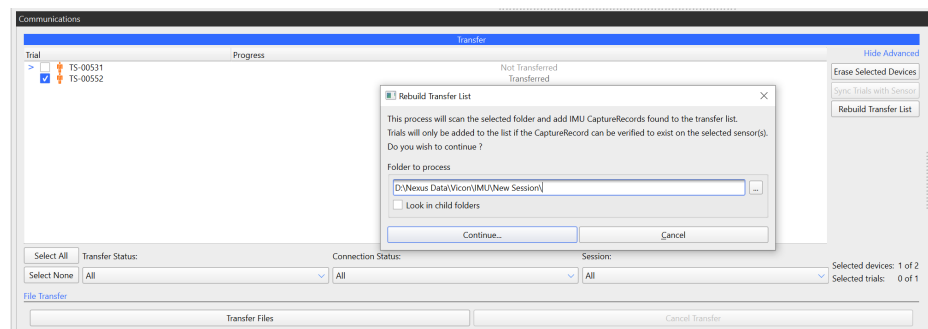
To do this, you can copy the information back from a trial-specific file that is saved at the end of a capture.

To restore missing information to a sensor:

1. Plug in the sensors that have data on them that is deleted or corrupted and that you want to restore.
2. In the Communications panel, select the IMeasureU tab and click Show Advanced.
3. In the Trial list, select the required sensor(s).
4. Click Rebuild Transfer List.



5. In the Rebuild Transfer List dialog, click in the Folder to process box, enter or browse to the folder to process and if required select Look in child folders to process all of its subfolders.

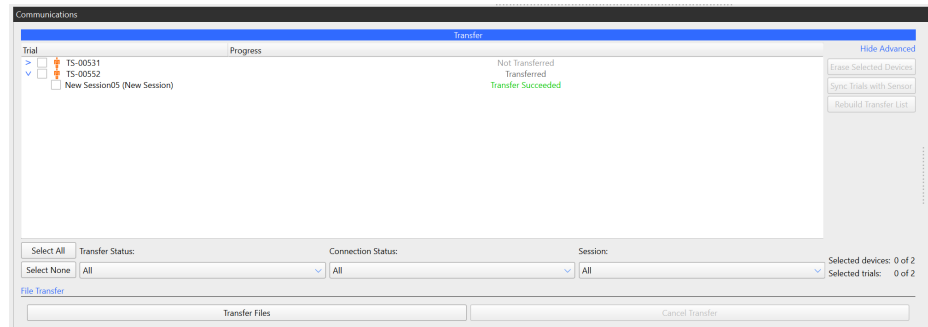


Work with Vicon IMUs

Note that the folder you select does not have to contain the trials, for example, the folder can be the parent of multiple session folders. In this case, you would select **Look in child folders**.

6. Click **Continue**.

The trial-specific data is copied and you can now download the restored information from the sensor.



Work with Vicon IMUs

Align IMU data with the Vicon world

If required, you can align the global angle outputs from IMUs to the Vicon world. This enables global angles from the IMUs to correspond to specific segments within Nexus.

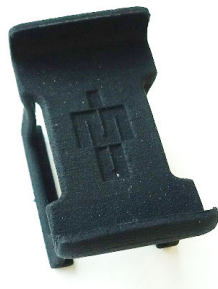
Before you begin, ensure you have calibrated your system in the usual way (see [Calibrate a Vicon system, page 137](#)) and that the IMUs have **Global Angle** output selected (see [Select the required axes, page 311](#)).

To align IMU data with the Vicon world, complete these steps.

- [Attach a Vicon IMU to a Vicon Active wand, page 330](#)
- [Align the IMU and Vicon worlds, page 333](#)
- [Align Vicon IMUs with segments, page 335](#)

Attach a Vicon IMU to a Vicon Active wand

The Vicon IMU alignment clip enables you to attach a Vicon IMU to an Active Wand.



Work with Vicon IMUs

To attach a Vicon IMU to a wand:

1. Locate the hole above the wand handle as indicated in the following image.



2. With the IMU figure facing up, attach the clip to the wand.



Work with Vicon IMUs

3. Slide the clip down, so that the clip attachment is inserted securely in the hole.



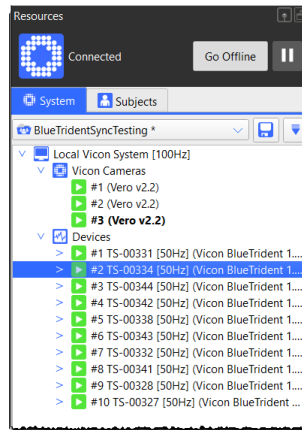
4. Insert a Vicon IMU into the IMU clip.



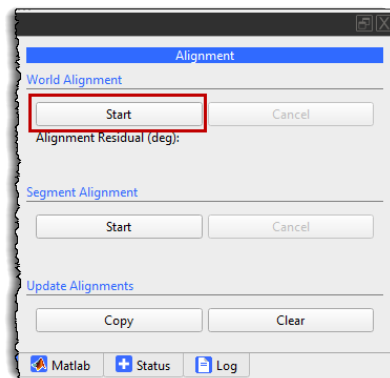
Work with Vicon IMUs

Align the IMU and Vicon worlds

1. In the Nexus System tree, under **Devices**, select the sensor you inserted into the clip (see [Attach a Vicon IMU to a Vicon Active wand, page 330](#)).



2. In the **Communications** pane, click the **IMeasureU** tab and in the **Alignment** pane, under **World Alignment**, click **Start**.

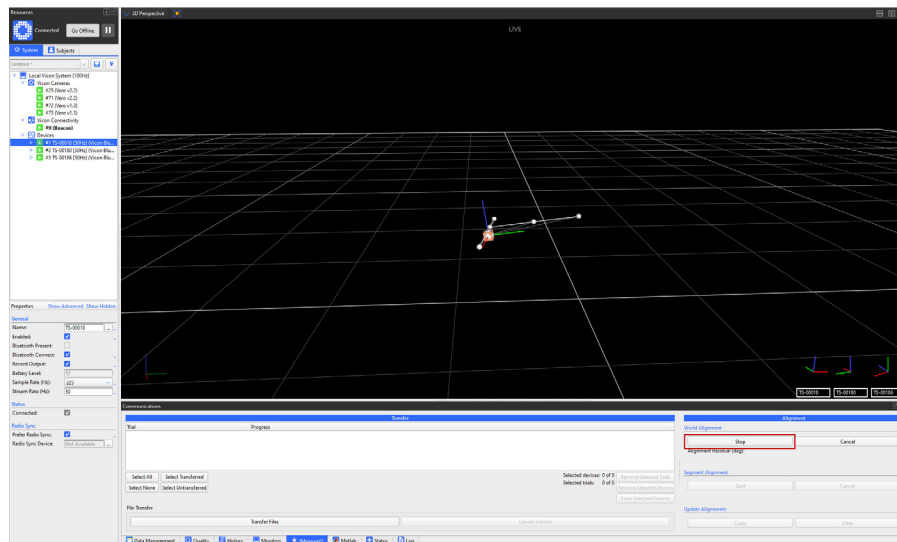


✓ **Tip:** If the **Start** button is not enabled, make sure:

- You've selected a sensor in the **System** tree (see Step 1).
 - The sensor has **Global Angle** output enabled (ie, **Global Angle** is selected – see [Select the required axes, page 311](#)).
 - Your Nexus system includes at least two calibrated cameras.
3. In your capture volume, wave the wand for several seconds. In the **Alignment** pane, **Alignment Residual** is displayed beneath the **Stop** button.

Work with Vicon IMUs

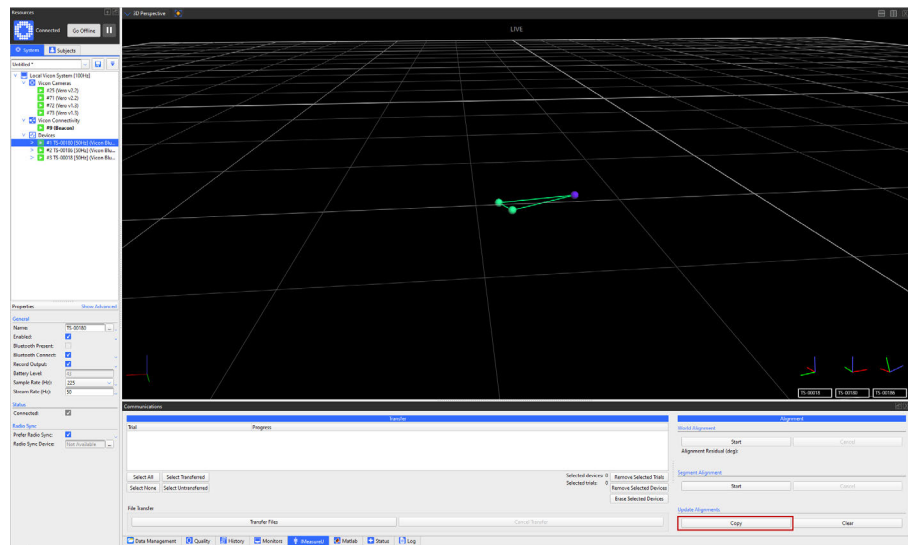
4. Under World Alignment, click Stop. The IMU world for the selected sensor is aligned to the Vicon world for the L-frame object.



Work with Vicon IMUs

Align Vicon IMUs with segments

1. In the **System tree**, select the sensor that is now aligned with the Vicon world, and on the **IMeasureU** tab, in the **Alignment** pane, under **Update Alignments**, click **Copy**.

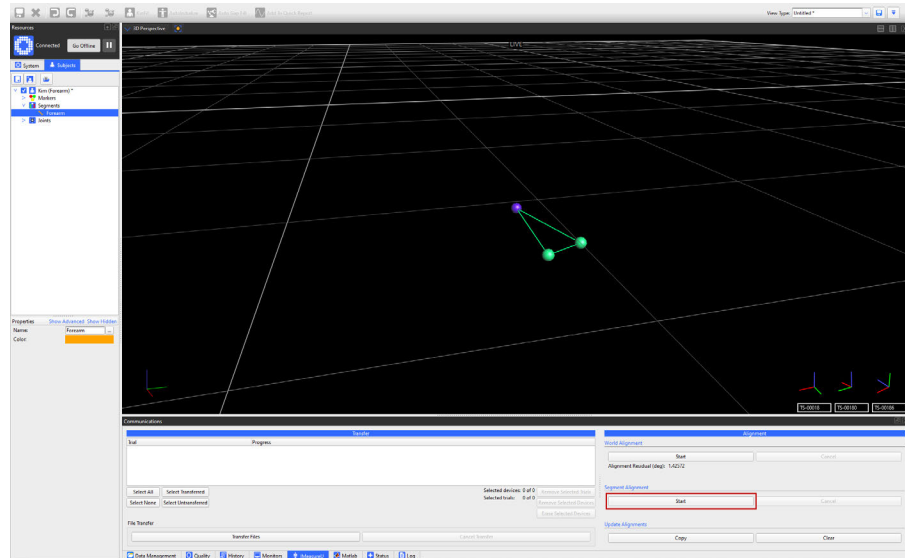


This copies the world alignment values from the aligned IMU to all the others. You can now attach the selected IMU to the required segment. In this example the IMU is associated with a Subject segment.

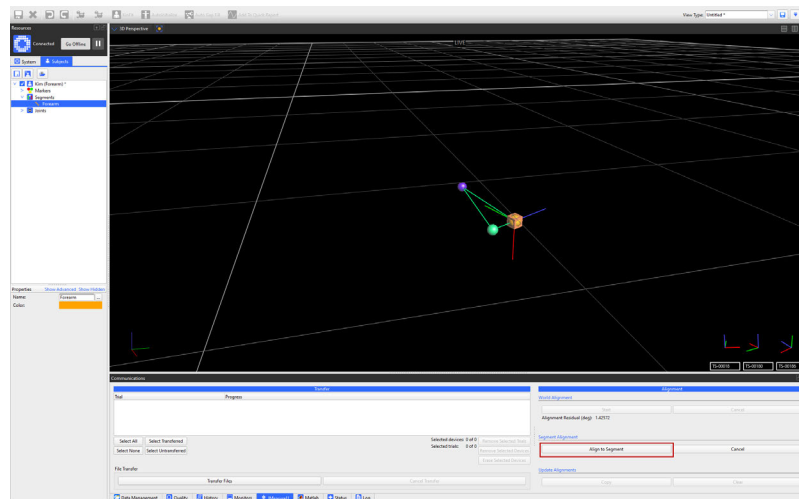
2. In the **Subjects Resources** pane, select the subject segment (in this case, Forearm) that you want to associate with the IMU.

Work with Vicon IMUs

- In the Alignment pane, under Segment Alignment, click Start. The Start button changes to display Align to Segment.



- Click Align to Segment. The selected IMU is now aligned with the selected Subject segment (in this case, Forearm).



- For each IMU that you want to align to a segment, select the IMU in the System tree and then repeat Steps 2–4 above.

Work with Vicon IMUs

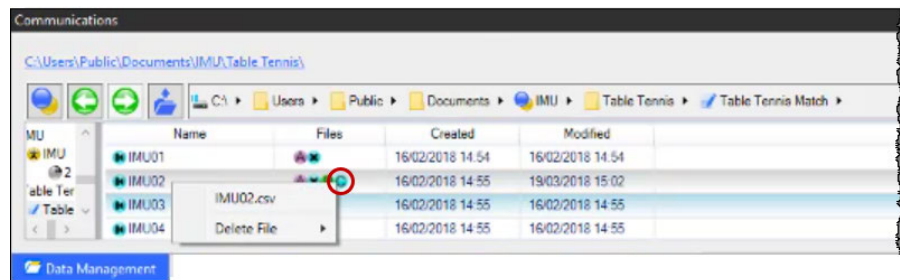
Export IMU data

You can export data captured using IMUs by running the appropriate pipeline.

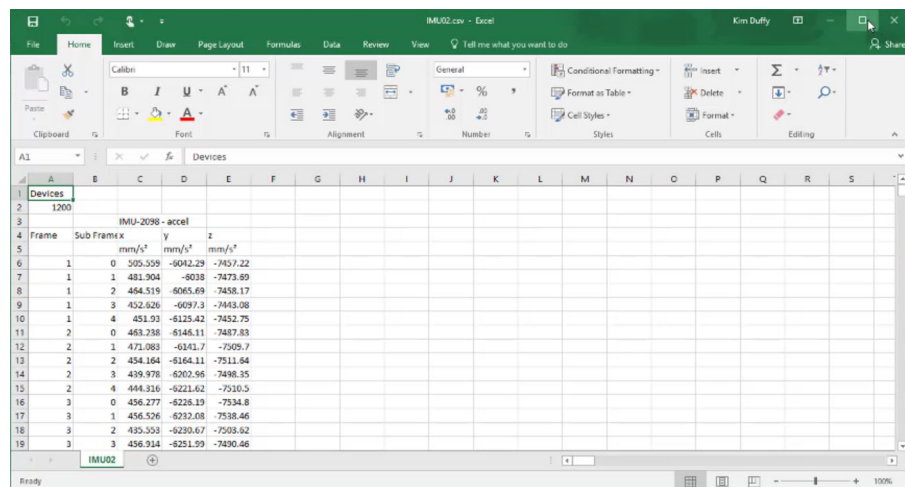
To export IMU data:

1. If you want to select data from only some devices, in the System Resources pane, ensure the required IMUs are selected.
2. In the Pipeline Tools pane, expand File Export and double-click Export ASCII to add it to the current pipeline.
3. In the Properties pane, ensure that the settings are as required. In the Devices section, if necessary, change the Devices for Export list to specify your selection.
4. Run the Export ASCII operation.

To open the exported file in Microsoft® Excel®, on the Data Management tab, click the relevant C icon and then click the filename.



The data is displayed in an Excel spreadsheet.



Export trial data

Export trial data

During your work with Vicon Nexus, you can export data for use in other software. Nexus offers a number of options for data export, accessible from the **Available Operations** list in the **Pipeline Tools** pane and from some view panes.

You can also export a video file (.mp4 or .avi) from a 3D or **Camera** view.

For more information, see:

- [Configure file export pipeline operations, page 339](#)
- [Export workspace to video, page 345](#)

Export trial data

Configure file export pipeline operations

You view and change the settings for the supplied export pipeline operations in the **Properties** pane at the bottom of the **Pipeline Tools** pane. For more information, see:

- [Configure the Export 3D Overlay Video operation, page 339](#)
- [Configure the Export ASCII operation, page 342](#)
- [Configure the Export C3D operation, page 344](#)

You can also export to a number of other file formats: to view the available formats, in the **Pipeline Tools** pane, go to the **Available Operations** list and expand **File Export**.

For general information about how to use pipelines, see [Work with pipelines, page 177](#).



Configure the Export 3D Overlay Video operation

You can export the 3D overlay of Vicon optical data over images from a supported calibrated video camera to an *.mp4* or *.avi* file for viewing in other applications using the **Export 3D Overlay Video** operation in the **Pipeline Tools** pane.

With the **Combined View** option in a **Camera** view, you can display Vicon optical data overlaid onto images from a calibrated digital video camera. For example, you can display 3D information, such as the floor grid, markers, and virtual force plates, overlaying the 2D video image. The **Export 3D Overlay Video** operation burns this 3D overlay information into an *.mp4* or *.avi* (digital video file) so that you can view it in other applications, such as Vicon Nexus Insight (*.mp4* only) or Vicon Polygon.

Export trial data

To export 3D overlay information to a video file:

1. In the **Camera** view toolbar, from the **View** drop-down list select **Combined** to view Vicon optical data overlaid onto images from a digital video camera.
2. In the **Options** dialog box (F7), select the desired options to configure the visualization of data to suit your needs (for example, you may want only the force vector to appear on the 3D overlay).
3. At the top of the **Options** dialog box, click the **Save** button to save the configuration you just created. The configuration is saved as an *.options* file in the appropriate Nexus **Options** folder.
4. In the **Pipeline Tools** pane, create a **File Export** pipeline that includes the **Export 3D Overlay Video** operation. (For a reminder of how to create a pipeline, see [Create a pipeline, page 180.](#))
5. In the **Current Pipeline** operations list, click on the operation, then in the **Properties** section at the bottom of the **Pipeline Tools** pane, view or change settings for the desired properties:
 - From the **View Options Set** list, which is displayed in alphabetical order, select the name of the *.options* file you created in step 3.
 - If you want to restrict the output to only one or more of the connected video cameras, ensure the required cameras are selected and in the **Cameras** list choose **Selected Video Cameras**.
 - Select an option from the **File Output** list. (The default is h.264 MP4).
 - Depending on whether quality or file size is the most important criterion for your requirements, select the most appropriate option from the **h.264 Compression** list.
 - If the trial is cropped, select the appropriate range of frames to export. If you do not do this, the exported video will be of the whole trial, but will be static in the cropped frames.
6. Run the pipeline either on an individual trial in the **Pipeline Tools** pane or on multiple files using the **Batch Processing Interface** (click **Show File Transfer/ Batch Processing interface**  and then the **Batch Processing** button  on the **Data Management** tab).

Export trial data

About 3D overlay files

The 3D overlay information from each reference video camera is stored in a separate file, in the format: `TrialName.DeviceID.overlay.*` where:

- `TrialName` is the base name of the trial file.
- `DeviceID` is the unique identification number Vicon assigns to a DV camera. You can find the `Device ID` in the **System Resources** pane, by expanding the **Video Cameras** node, selecting the desired video camera, and then in the **Properties** section expanding the **Settings** area.
- `overlay` identifies the file contents as the 3D overlay information associated with the video file.
- `*` is the file extension (*mp4* or *avi*).

For example, with a video camera with a Device ID of 52883644, if you run the **Export 3D Overlay Video** pipeline operation on a video file named `Walk1.52883644.avi`, the exported 3D overlay file will be called `Walk1.52883644.overlay.avi`.

**Note**

You cannot open an exported 3D overlay (`.overlay.avi`) file in Nexus.

Export trial data

Configure the Export ASCII operation

The **Export ASCII** pipeline operation enables you to export saved trial data to a plain text file, saved in CSV or TXT format.

To export processed Nexus data to an ASCII file:

1. Ensure you have loaded and processed the required data.
2. In the **Pipeline Tools** pane, create a **File Export** pipeline that includes the **Export ASCII** operation. (For a reminder of how to create a pipeline, see [Create a pipeline, page 180.](#))
3. In the **Current Pipeline** operations list, click on the operation, then in the **Properties** section at the bottom of the **Pipeline Tools** pane, view or change settings for the desired properties:
 - **Filename:** Do one of the following:
 - Accept the default **Current Trial** setting; or
 - To use a different path and/or filename, click the downward arrow to the right of the box, clear the **Macro** check box, and click the ellipsis (...). You can then enter the required file name, including its extension, for example `my_trial.csv`.
 - **File Extension:** Can be `.csv`, `.txt`, or if required, clear the **Macro** check box as described above and then specify the required extension.
 - **First Frame** and **Last Frame:** If required, change these to specify the range that you want to export.
 - **Delimiter:** Do one of the following:
 - Click to choose the delimiter of the exported data, selecting either commas, tabs, or line feeds/carriage returns; or
 - To use a different delimiter, click the downward arrow and clear the **Macro** check box. You can then edit the **Delimiter** field to specify a combination of ASCII characters (maximum of two characters).
 - **Local Numeric Format:** If you want the exported data to use the local language float number format, select this check box.
 - **Export Gait Cycle Parameters:** To export gait cycle analysis, select this option.
 - **Export Events:** To export events, select this option. If you choose to include events, they are sorted in the output file by type, subject and time of occurrence.

Export trial data

- **Digital Device Sampling:** Choose the digital devices frame rate and sampling rate options:
 - **MX Frames:** Exports at the same frame rate as the trajectory data. The exported data may be up-sampled to achieve an integer number of sub-samples per frame.
 - **Raw Frames** Exports at the original frame rate and sample rate. The exported frame and sub-frame numbers may not correspond to other devices or the trajectory data.
 - **Local Numeric Format:** To export using the local language's float number format, select this option.
 - For the rest of the outputs, you can do one of the following:
 - Click to choose to export either none, only the selected output type, or all of them; or
 - To supply a comma-separated list, click the downward arrow to the right of the drop-down list and clear the **Macro** check box.
- ✔ **Tip:** In most cases, as an alternative to selecting **All**, you can use the asterisk ***** wildcard.
4. Either run the pipeline or right-click the **Export ASCII** operation and click **Run selected op.**
 5. After you have run the pipeline operation and exported the file, you can examine the exported data as required.

Export trial data

Configure the Export C3D operation

The **Export C3D** pipeline operation exports the current state of the processed data to a .c3d file. You can then import the data into other software for further processing or report generation.

In the **Properties** section you can view or change the following properties:

- **Filename** Name of the file to be exported. By default, this is the name of the current trial, for example **Trial01**. To change the name, click the downward arrow to the right of the field and clear the **Macro** check box. You can then enter a new name.
- **First Frame** First frame of the range to be exported
- **Last Frame** Last frame of the range to be exported
- **Trial Name Postfix** Adds the string you specify to the end of the filename. For example, if you entered **export** in this field, the name of the output file would be **Trial01.export.c3d**.
- **Integer Format** Measures the maximum range between real data points, and determines a scale factor. The data is then scaled to that range when saved to the c3d file, and all values are written with the Integer format. When the data is read into another program (eg, Polygon), the scale factor is applied to the data, converting it into Real data. The Real data format saves the data as it is, without any multiplication by a scale factor, and writes it to the c3d file. Certain types of data are best suited for the Real format option because no resolution is given up in the storage of the data. However, bear in mind that not all programs can read both Integer- and Real-formatted c3d files. For more details on the .c3d format, see [c3d.org](https://www.c3d.org)³⁰.
- **Subject Prefixes** Prefixes the exported marker labels with the subject's name. (To specify that marker labels are prefixed only when more than one subject's data is exported, choose the Auto option.)
- **X Axis Direction, Y Axis Direction, Z Axis Direction** Enables you to choose the direction of the axis in the exported 3D world.

³⁰ <https://www.c3d.org/HTML/default.htm>

Export trial data

Export workspace to video

The **Export Workspace to Video** button in the Camera view, 3D Perspective and 3D Orthogonal views lets you easily create visually rich content for presentations or for use in other third-party applications.

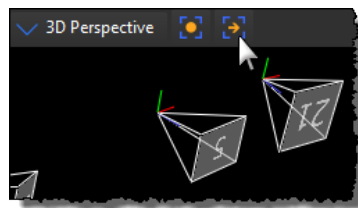
Nexus enables you to create video files of a selected 3D workspace.

Before you export a workspace, ensure you have:

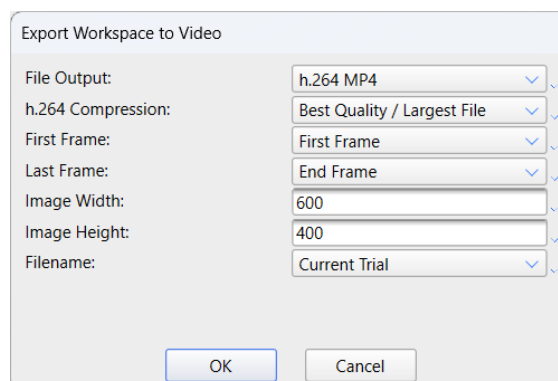
- Loaded a trial.
- Installed the desired video compression codec.

To export a workspace as a video:

1. Ensure Nexus is not in Live mode.
2. In the workspace, click the **Export Workspace to Video** button.



3. In the **Export Workspace to Video** dialog box, enter the required information and then click **OK**. Note that **Image Width** and **Image Height** refer to the resolution (in pixels) of the exported image.



A progress bar indicates the status of the export process and by default, a video file (*.mp4) with the same name as the current trial is created in the trial session folder. (You can change the name and location if required.)

Further resources

Further resources

If you need more information than that supplied in the documentation or on the [Vicon Support web pages](#)³¹, please contact Vicon:

Denver, CO
Vicon Denver
12650 E Arapahoe Rd
Suite 200, Centennial
CO 80112, USA
T: 303.799.8686
F: 303.799.8690
E:support@vicon.com³²

Los Angeles, CA
Vicon LA
3750 S. Robertson Boulevard
Suite 100, Culver City, Los Angeles
CA 90232, USA
T: 310.437.4499
E:support@vicon.com³³

Oxford, UK
Vicon Oxford
6 Oxford Pioneer Park
Yarnton, Oxfordshire
OX5 1QU, United Kingdom
T: +44.1865.261800
E:support@vicon.com³⁴

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