# Vicon Nexus Reference Guide

## Contents

- About this guide .............................................. 4
- About Vicon Nexus documentation ..................... 5
  - Regulatory information ...................................... 6
- Data management with Nexus ............................... 7
  - Navigate in Data Management .......................... 9
  - Work with database hierarchy nodes ................. 12
  - Customize the Data Management display ............ 16
  - Advanced data searching ......................... 18
  - Load large trials ........................................ 20
  - Batch process trials .................................. 21
- Labeling skeleton calibration in detail .................. 24
  - Comparison of skeleton calibration operations ..... 25
  - Choose the appropriate subject calibration workflow 32
- Using monitors .............................................. 37
  - Create a monitor ....................................... 38
  - Configure a monitor .................................. 40
Configure an AND or OR Monitor ......................... 48
Activate and deactivate a monitor ...................... 50
Reload a monitor ........................................... 51
Monitor configuration examples ....................... 52
Use monitors for real-time event detection .......... 56

Modeling with Vicon Nexus .............................. 57
Modeling with MATLAB .................................. 59
Modeling with Python .................................... 70

Biomechanics workflow ................................. 73
Overview of the biomechanics workflow .......... 74
View real-time subject calibration feedback with monitors 76
About functional calibration in the biomechanics workflow 80
Create a biomechanics workflow ...................... 82
About SCoRE and SARA in Vicon Nexus .......... 88
Prepare data for use with SCoRE and SARA ....... 90
Capture and process a trial with SCoRE and SARA . 93
Process multiple joints with SCoRE and SARA .... 96

Improve manual labeling .............................. 102
Eliminate overlapping trajectories .................. 103
Prevent ghost markers .................................. 104

Eye tracking with Vicon Nexus ...................... 105
Set up eye tracking hardware ....................... 106
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Add a Dikablis Eye Tracker device in Vicon Nexus</td>
<td>108</td>
</tr>
<tr>
<td>Calibrate eye tracking in Vicon Nexus</td>
<td>110</td>
</tr>
<tr>
<td>Export eye vector data</td>
<td>117</td>
</tr>
<tr>
<td>Vicon Nexus user interface</td>
<td>120</td>
</tr>
<tr>
<td>About the Vicon Nexus user interface</td>
<td>121</td>
</tr>
<tr>
<td>Resources pane</td>
<td>122</td>
</tr>
<tr>
<td>System tab</td>
<td>126</td>
</tr>
<tr>
<td>System Resources nodes</td>
<td>132</td>
</tr>
<tr>
<td>Subjects tab</td>
<td>190</td>
</tr>
<tr>
<td>View pane</td>
<td>198</td>
</tr>
<tr>
<td>Tools pane</td>
<td>218</td>
</tr>
<tr>
<td>Communications pane</td>
<td>249</td>
</tr>
<tr>
<td>Menu bar</td>
<td>255</td>
</tr>
<tr>
<td>Toolbar</td>
<td>261</td>
</tr>
</tbody>
</table>
About this guide

This guide contains information about Nexus functionality that is likely to be of interest if you are already familiar with the basic procedures described in the Vicon Nexus User Guide.

For instructions on configuring your Vicon system within Nexus and on the basic tasks that are part of the everyday Nexus workflow, see the Vicon Nexus User Guide.
## About Vicon Nexus documentation

The following documentation is available with Nexus, both as help pages available online and as PDFs that you can download from docs.vicon.com:

<table>
<thead>
<tr>
<th>Document</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>What's New in Vicon Nexus</td>
<td>Information about the main features that are new in the current version of Nexus.</td>
</tr>
<tr>
<td>Installing and licensing Vicon Nexus</td>
<td>Step-by-step instructions installing and licensing Nexus.</td>
</tr>
<tr>
<td>Vicon Nexus User Guide</td>
<td>Information about how to use Nexus.</td>
</tr>
<tr>
<td>Vicon Nexus Reference Guide (this guide)</td>
<td>Descriptions of less frequently used or more complex procedures, background information, and further details about the Nexus user interface.</td>
</tr>
<tr>
<td>Creating labeling skeleton templates (VSTs)</td>
<td>Instructions on how to create your own custom labeling skeleton templates for use with Nexus.</td>
</tr>
<tr>
<td>Plug-in Gait Reference Guide</td>
<td>Detailed information on the Plug-in Gait model.</td>
</tr>
</tbody>
</table>

For additional documentation related to Nexus (for example PC Setup for Vicon Systems) and other Vicon documents, visit the Downloads page of the Vicon website.
Regulatory information

For Vicon Nexus regulatory information, see Vicon Nexus regulatory information in the Nexus documentation area of the Vicon documentation website (docs.vicon.com).
Data management with Nexus

The **Data Management** tab provides functionality for storing and managing all data associated with your motion capture files. Data is organized in a hierarchical structure, with data and information stored in relevant nodes.

The default location of **Data Management** is on a tab at the bottom of the **Communications** window. If you prefer, you can click the buttons at the top right of the **Communications** window to un-dock it and display it full-screen. To toggle the display of the Data Management tab, press F2.

![Tip]

You can also choose to hide the entire **Communications** pane, in which the **Data Management** tab appears, when you load a trial. To do this, on the **Window** menu, select the **Close Communications Pane on Trial Load** option. Alternatively, to temporarily hide/reveal the **Communications** pane, double-click any of its tabs.

By default, the last opened database is loaded when you restart Nexus.

The following topics provide an introduction to data management with Nexus:

- Navigate in Data Management on page 9
- Work with database hierarchy nodes on page 12
- Customize the Data Management display on page 16
- Advanced data searching on page 18
- Load large trials on page 20
- Batch process trials on page 21

For further details about data management, see the PDF *ProEclipse Quick Start Guide*, available from the Vicon website.
The **Data Management** tab also enables you to perform file transfers and transcribing of reference video files, as well as providing access to batch processing functionality. For information on these topics, see Work with digital video files in the *Vicon Nexus User Guide* and **Batch process trials on page 21.**
Navigate in Data Management

Navigation in Data Management is similar to that of the web or in Microsoft Windows. Forward, back and up controls are displayed and path navigation, similar to that in Windows Explorer is available.

For faster navigation within a database or across a hard drive, you can also hide the tree view to expand panes.

The Main Eclipse menu button gives you instant access to the most recently used databases.
It also gives you access to the **Manage Databases** dialog box, enabling you to create, browse and register databases, as well as access other options for managing them.

The Quick Search facility enables you to filter all the files that are visible in the current view by typing any letter into the Quick Find box.
For more detailed information, see Navigation in the PDF *ProEclipse Quick Start Guide*, available from the Vicon website.
Work with database hierarchy nodes

You view and manage the nodes created for the database hierarchy on the Navigate tab of the Data Management tab.

The data management function keeps all files associated with a Vicon motion capture trial together in a strict hierarchical order. The database hierarchy can contain up to four levels (Database, Patient Classification, Patient, and Session) to define the appropriate hierarchical structure for your motion capture trial as defined in the database template (.eni) file on which the database is based.

Each level (node) in the hierarchy has its own properties and can contain only certain types of data. The top-level node for the hierarchy has the same name as the database, with sub folders for each node. Sub-sessions and trials do not have their own folders but are sets of files within the session folder.

Caution

The hierarchy shown on the Data Management tab is mirrored in the folder system on your hard drive. Under no circumstances should you manually change these folders on your hard drive as this will prevent your database system from functioning correctly. Make any changes from within the Data Management tab in Nexus.

You can expand and contract the nodes in an database hierarchy as you would with standard file explorers. Additionally, you can identify a node for which you want to perform an action in the following ways:

- **Marked node** A marked node will be acted on by buttons selected from the Data Management toolbar.
  
  A marked node is highlighted with a red check mark across the node icon.

- **Selected node** A selected node will be acted on by commands selected from the context menu displayed when you right-click on the node.
  
  A selected node is highlighted with a blue background behind the text.

After you have selected or marked a node, you can carry out the operations described below.
Manage database nodes

After you have created one or more nodes in a trial database, on the **Data Management** tab you can create, delete, rename, and move folders and files to meet your requirements.

You can manage database nodes using the mouse and/or the following commands from the context (right-click) menu:

- Open Patient/Session/Trial/Subject
- Rename
- Delete
- Mark
- Clear Marks
- Save C3D Version > select file type(s), one of: Labeled, Gap filled, Filtered, Modeled
- Restore C3D Version
- Open File > select file type(s), one of: video file (.avi), processed data (.c3d), Raw camera data (.x2d)
- Delete File > select file type(s) as above
About Data type icons

View and open the different data types saved for a motion capture trial using the Data Type icons on the Data Management tab.

The icons for the standard data types that can be associated with Vicon motion capture trials are shown here in the default order in which they appear from left to right in the Files column:

<table>
<thead>
<tr>
<th>Icon</th>
<th>Data type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>🎥</td>
<td>Movie File</td>
<td>Multimedia sound and moving picture data in .mpg or .avi format files</td>
</tr>
<tr>
<td>🌟</td>
<td>Raw Analog Data</td>
<td>Unprocessed analog data (e.g., from force plates) in .x1d format files</td>
</tr>
<tr>
<td>🎨</td>
<td>Model Parameter File</td>
<td>The model’s parameters for Plug-in Gait or BodyLanguage models</td>
</tr>
<tr>
<td>⛓️</td>
<td>Centroid/Grayscale File</td>
<td>Unprocessed Vicon video data from Vicon cameras in .x2d format files</td>
</tr>
<tr>
<td>🍀</td>
<td>Processed Capture Data</td>
<td>Processed Vicon 3D motion data in .c3d format files</td>
</tr>
</tbody>
</table>

You may also see additional icons for file types of motion data created in earlier Vicon motion capture application software or exported for use in third-party applications (such as animation software or Excel spreadsheets).
Manage data files

View and manage the motion capture data saved to a trial database on the Data Management tab. The data files associated with a motion capture trial are indicated by data type icons in the Files column to the right of a node name in the database hierarchy.

To open a trial:
In the database hierarchy, double-click the node name.
Nexus opens the trial, and the reconstructed data (and the associated movie file if present) is displayed in the view pane.

To open a data file:
In the database hierarchy, double-click a node name.
or
Right-click the desired node name and on the displayed context menu point to Open File and then click on the required file type.
Nexus opens the specified data file, displays system and subject data in the appropriate Resources pane and displays the visual data in the current view pane.

To delete a data file:
In the database hierarchy, right-click the desired node name and on the context menu click Delete File.
The specified data file is deleted from the current database hierarchy, and the associated folders and files are deleted from your hard disk.
Customize the Data Management display

You can customize databases from within Vicon Nexus to display the required columns, to show specific, searchable metadata.

To customize the display of data on the Data Management tab:

1. On the Data Management tab, click the Main Eclipse menu button and then click Manage Databases.

2. In the Manage Databases dialog box, click the Edit button.

3. In the Edit Preference Scheme Default dialog box, specify how you want to display your data, for example, which columns to display, and how to display force plate data.
For more detailed information, see Customize in the PDF *ProEclipse Quick Start Guide*, available from the Vicon website.
Advanced data searching

The advanced search in Data Management enables you to create custom search fields that will return trials (or other data levels) based on your chosen set of search criteria that exist in either the metadata (columns) or within the C3D files (variables). This is particularly useful if you are trying to find an individual trial or sets of trials for comparison purposes. You can:

- Search a single database or across multiple databases
- Search databases that exist on the local PC or across a network drive
- Use the wizard-based search building system
- Build complex search criteria for metadata or C3D information

For example, searches you might set up could be:

- Find all trials where the subject BodyMass is greater than 75Kg, the Pathology is Osteoarthritis, the Affected Side is Left and the Maximum Knee Moment is greater than 715Nm; or
- Find all Subject Names where the Activity is Baseball Pitching, the Maximum Shoulder Angle Velocity is higher than 80 degrees per second and Trial Date is between Jan 1, 2013 and Today.

To use the search query wizard:

1. On the Data Management tab, click the Search tab at the bottom of the pane, and then click the Open search queries for editing button.

2. In the Eclipse Search Query Setup dialog box, click the Add New button (green plus sign) and specify your search.
3. When you have finished, click the **Exit Search Setup** button (top right).

4. Make sure you have selected the required location to search and then click the **Run currently selected search** button.

The results of your search are displayed.

You can now:
- Sort based on any of the returned data columns
- Open any level of data by double-clicking on it
- Export the data as ASCII to either Notepad or Excel
- Export the data as a list of paths to either Notepad or Excel (for external processing)

For further details, see **Data Search** in the PDF **ProEclipse Quick Start Guide**, available from the **Vicon website**.
Load large trials

To facilitate working with very large unprocessed data files, you can choose which files will be loaded (.x2d camera data and/or .x1d analog data), and how many frames of the trial are loaded.

To work with large trial data:

1. At the top of the Data Management tab, click Show Trial Loading Options.
2. To select only required frames, in the Raw Data Loading Options area, select Load Frames From and type the frame to start from in the first box and the end frame in the second box.
3. If required, choose whether to load both centroid/grayscale data (X2D) and raw analog data (X1D) files, or only one of these options.
4. Process the file(s) as normal.

Only the selected range and files are processed.
Batch process trials

If necessary, for example, if you are working with large numbers of files, you can set up and run automated operations as batch processes, using the controls in the Batch Processing interface on the Data Management tab.

Batch process multiple trials

You can automatically process any number of trials from the current motion capture database using the Show File Transfer/Batch Processing interface button on the Data Management toolbar at the top of the Data Management tab.

Batch processing is optional. It is useful for processing large numbers of files simultaneously or for automating frequently used processing operations.

⚠️ Important

Before batch processing trial data, ensure that you have already:

- Captured trial data
- Created any pipelines you intend to run
To batch process trial data:

1. On the Data Management tab, mark the nodes (select nodes, right-click and click Mark) containing the files you wish to batch process.

2. If the File Transfer/Batch Processing interface is not already displayed, on the Data Management toolbar, click the Show File Transfer/Batch Processing interface button, and then click the Batch Processing button. The marked nodes are displayed in the list on the Batch Processing tab.

   Tip

   To remove nodes from batch processing, on the Data Management tab, unmark the nodes (right-click marked nodes and click Clear Marks).

3. From the drop-down menu at the bottom right of the Batch Processing interface, select the pipeline to be run on the listed trial files and click the Start Processing button to start the batch process.

   When batch processing begins, an information window is displayed when a file is being imported for processing. It indicates the import status and contains buttons to Pause, Stop, or Cancel the import operation.
During the batch processing, the **Progress** column in the trials list indicates the overall status of the processing:

- Blank: Batch processing idle.
- Yellow moving bar: Batch processing in progress.
- Green static bar: Batch processing successfully completed.
- Red static bar: Batch processing failed or canceled.

**Tip**

Hover the mouse pointer over a progress bar to view details of the batch processing operations.
Labeling skeleton calibration in detail

The following topics will help you to choose the most appropriate type of labeling skeleton calibration for your particular trials.

- Comparison of skeleton calibration operations on page 25
- Choose the appropriate subject calibration workflow on page 32
Comparison of skeleton calibration operations

Subject-specific information is what enables a skeleton labeling template (VST) to be converted to a subject-specific labeling skeleton (VSK). All of the skeleton calibration operations make changes to the labeling skeleton, as can be seen inside the VSK file. For VST version 3 files, the attributes that are modified by at least one of the existing skeleton calibration operations are:

- **Parameters.** These control the pose of joints and the position of markers in the parent segment coordinate frame. A single parameter can be applied to both a segment and a marker or any combination of markers and segments. The calibration operations can change the value stored in the parameter.

- **Segments.** Bone lengths can be changed due to the parameters changing. The VST format doesn't have a concept of bone length. Bone lengths are inferred from the pose transformation between a pair of joints. This is made up of a pre- and a post-transformation. It is quite common for this transformation to have only one parameter that can be changed: this parameter is often named SomeBoneLength. The calibrated values are written to the VSK but are not reloaded on VSK import.

- **Joints.** Various attributes on the joint can be changed by the calibration operations. The mean, covariance, range-center and range can all be calculated from data.

- **Targets.** Target (marker) mean and covariance can be calculated from data.

Deciding which of the different skeleton calibration operations is best in your situation depends on a number of considerations including trial type, processing time, and desired labeling quality.

The following descriptions cover the various operations that use the same underlying skeleton calibration algorithm.

- Functional Skeleton Calibration operation on page 27
- Functional Skeleton Calibration - Markers Only operation on page 28
- Static Skeleton Calibration operation on page 29
- Static Skeleton Calibration - Markers Only operation on page 29
- Calculate Skeleton Joint & Marker Statistics operation on page 30

The operations change the following pieces of information in the skeleton
<table>
<thead>
<tr>
<th>Operation</th>
<th>Parameters</th>
<th>Segments</th>
<th>Joints statistics</th>
<th>Marker positions</th>
<th>Marker statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functional Skeleton Calibration operation on page 27</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Functional Skeleton Calibration - Markers Only operation on page 28</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Static Skeleton Calibration operation on page 29</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Static Skeleton Calibration - Markers Only operation on page 29</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Calculate Skeleton Joint &amp; Marker Statistics operation on page 30</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

For information on how to use the operations in common Nexus workflows, see Choose the appropriate subject calibration workflow on page 32.
Functional Skeleton Calibration operation

This operation is the most general of the skeleton calibration operations. It is used to fully calibrate a labeling skeleton from a trial in which the subject is moving. This is normally a ROM trial but can sometimes be a movement trial.

Functional Skeleton Calibration optimizes both joint and marker positions. It also calculates joint and marker statistics.

Ensure the trial covers the full range of motion that is expected in the movement trials.

Algorithm description

The Functional Skeleton Calibration operation runs two algorithms:

- The first optimizes the skeleton segment and marker parameters. This is done using a subset of the frames in the trial. These are chosen to get the subject in a variety of poses. The more frames that are considered, the better the skeleton will be, however using more frames makes the calibration take longer.

The calibration algorithm simultaneously tries to get the skeleton marker positions to be as close as possible to the corresponding labeled reconstructions. It does this by changing the joint angles, segment poses and, marker positions. It considers only the selected frames, so selecting more frames gives the algorithm more poses to try to match. The algorithm minimizes a statistical distance measuring how close the skeleton markers are to the reconstructions. This distance accounts for the fact that some skeleton markers (with a larger covariance) are expected to be found a larger physical distance away from their reconstructions. The default parameters reset this covariance to the template covariance (in the VST). The motion that is allowed between segments is constrained by the joint type. Any joint type mis-modeling will not be absorbed into the joint, but rather by either the segment or marker positions, where the effect will have less impact. In sparse marker sets this is sometimes a trade-off that has to be made.

- The second algorithm calculates the joint and marker statistics (see Calculate Skeleton Joint & Marker Statistics operation on page 30).

Examples of using Functional Skeleton Calibration

- Generating a skeleton with the best quality labeling results. This is because the method provides a large amount of data for markers and joint movement.

- Creating a custom labeling skeleton template defined using the Labeling Template Builder.
For information on how to use this operation in common Nexus workflows, see Calibrate a labeling skeleton using a ROM trial in the *Vicon Nexus User Guide*.

**Functional Skeleton Calibration - Markers Only operation**

This operation calculates the skeleton's marker positions from a ROM trial. This operation is useful if the skeleton has already been scaled appropriately for the subject and more accurate marker position information is required. Any parameters that are shared between bones and markers are not altered. The operation finishes by calculating joint and marker statistics (see **Calculate Skeleton Joint & Marker Statistics operation on page 30**).

**Algorithm description**

The **Functional Skeleton Calibration - Markers Only** operation is very similar to the full **Functional Skeleton Calibration** algorithm (see **Functional Skeleton Calibration operation on page 27**). The only difference is that the parameters that refer to segments positions are kept constant. For this algorithm to provide good labeling results, the skeleton must already be the correct size. You can achieve this in the following ways:

- Scale the template skeleton to a reconstruction point cloud.
- Recalibrate a subject after adjusting its markers.

Compared with the full **Functional Skeleton Calibration** operation, the **Markers Only** version has an extra step at the beginning. In this step, the parameters that influence segment properties (bone lengths) are identified. These parameters are held constant during the operation. If a parameter refers to both a segment and a marker, it is also held constant. This reduction in parameters to estimate means that a **Markers Only** calibration tends to be faster than a full calibration.

The algorithm uses the same criteria as the full skeleton calibration to decide how to move the marker parameters and joint angles for each selected frame. It also runs the algorithm to calculate the joint and marker statistics.

**Examples of using Functional Skeleton Calibration - Markers Only**

Recalibration of an existing skeleton when the markers have moved, for example, when an orthosis has been applied. If the orthosis is expected to move significantly with respect to the underlying segment, this operation is more suitable than **Static Skeleton Calibration - Markers Only** because this operation updates the marker covariances as well as the marker positions.
Static Skeleton Calibration operation

Static Skeleton Calibration attempts to calibrate a skeleton from a single frame. It tries to optimize both joint and marker positions. The subject is usually in a T-pose for the entire trial.

Algorithm description

This operation calibrates the joint and marker positions from a single frame. It also tries to fit the skeleton joint angles. To do this, it runs the same algorithm as Functional Skeleton Calibration with only one frame selected. It is not normally advisable to run this operation on a general skeleton template because it is not possible to determine the joint centers without any motion. For this operation to succeed, every joint center must be defined by a linear combination of marker positions. As it is not possible to estimate the joint and marker statistics from a single frame, the subject statistics are left unchanged.

Static Skeleton Calibration - Markers Only operation

This operation calculates the skeleton's marker positions from a single frame. This operation is only useful if the skeleton has already been scaled appropriately for the subject.

Algorithm description

The Static Skeleton Calibration - Markers Only operation provides a quick way to update a skeleton's marker positions. It usually operates on a static trial in which the subject is in the T-pose. Sometimes it is run on a single frame from a full ROM as part of the Auto Initialize Labeling pipeline. Static Skeleton Calibration - Markers Only estimates both the joint angles and the marker positions for the selected frame. Before running this operation, the subject skeleton must be correctly scaled. This is usually done by scaling the subject, as is done by the Auto Initialize Labeling pipeline. You could also use a previously calibrated skeleton for the same subject.

As happens in Functional Skeleton Calibration - Markers Only, the parameters that refer to segments are identified and held constant by the operation. The calibration then optimizes the joint angles and marker positions for the frame selected. Optimizing the joint angles allows the subject to be in a pose that is different from the T-pose. This protects against the calibration from introducing marker position errors due to the subject being in a slightly incorrect base pose.

As with Static Skeleton Calibration, the joint and marker statistics are left unchanged.
Examples of using Static Skeleton Calibration - Markers Only

This operation is used for recalibration of an existing correctly scaled skeleton. It is part of the Auto Initialize Labeling pipeline and runs after the Scale subject operation. It can also be used to recalibrate markers if they have fallen off and been replaced.

Calculate Skeleton Joint & Marker Statistics operation

This operation calculates joint and marker statistics from either a movement trial or a ROM trial. Both the Functional Skeleton Calibration and the Functional Skeleton Calibration - Markers Only operations run this operation after calculating the skeleton parameters.

Algorithm description

This operation calculates joint and marker statistics for the subject. Joint and particularly marker statistics are used in the labeling algorithms. Joint statistics tell the labelers how much a particular joint is expected to move. Marker statistics give information about how much soft tissue motion is expected for the markers. Good marker statistics can improve labeling significantly.

This operation assumes that the skeleton has already been calibrated. It does not change any joint or marker positions. If it is run on an uncalibrated skeleton, the covariances and ranges calculated will be large.

For joints, this operation calculates values for: mean, covariance, range center, and range matrix. For markers, it calculates mean and covariance. The statistics are calculated from all of the frames in the trial.

The values stored in the mean and covariance are not calculated directly from the data. During a ROM trial the subject has only a few joints moving at a time, the rest are not moving much. If you plot the joint position samples over a trial you tend to see a large peak of samples and a few spread across the joint range.

In some cases, such as the knee, a mean and covariance calculated from the samples does a very bad job of representing the distribution. In the case of the knee, the majority of the samples are collected with the knee straight. This leads to a mean that is nearly straight and a covariance that suggests the knee can bend forward and backward equally well.

Instead of calculating the mean and covariance directly, a range and range center is calculated. This applies to both joints and markers. It is then assumed that the samples that really represent the distribution are uniformly distributed across the range. If you look in the VSK, you can see that joint means and joint range centers are the same.
Examples of using Calculate Skeleton Joint & Marker Statistics

Calculate Skeleton Joint & Marker Statistics can be used when a skeleton has been calibrated using a single frame but doesn't label well. This operation can be used on a movement trial to calculate better joint and marker statistics which will improve the labeling performance.

For information on how to use this operation in common Nexus workflows, see Choose the appropriate subject calibration workflow on page 32.
Choose the appropriate subject calibration workflow

Your choice of workflow depends upon the raw data you are able to collect and your desired outcome.

To use any of the operations, observe the following preconditions:

- A fully labeled trial (ROM, static, or movement) must exist.
- The trial must contain only raw reconstructions; leave any gaps unfilled. (Unlabeled reconstructions have no influence on the operations.)

The following table summarizes the workflow to follow for common labeling skeleton calibration scenarios:

<table>
<thead>
<tr>
<th>In this scenario</th>
<th>Use this trial type</th>
<th>And this pipeline /operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simple movement (eg, basic gait).</td>
<td>Single static frame (base pose used when VST was created)</td>
<td>Reconstruct pipeline</td>
</tr>
<tr>
<td>Subject is unable to complete full ROM.</td>
<td></td>
<td>Auto Initialize Labeling pipeline</td>
</tr>
<tr>
<td>Speed of subject setup takes precedence over labeling accuracy.</td>
<td></td>
<td>For step-by-step instructions, see Calibrate a labeling skeleton using a static trial in the Vicon Nexus User Guide.</td>
</tr>
<tr>
<td>Automatic labeling (eg, Auto Initialize Labeling) or the Labeling operation alone does not produce satisfactory labeling.</td>
<td>Movement (ie, same motion as that being studied) that includes static motorbike/base pose as the first frame.</td>
<td>Reconstruct pipeline</td>
</tr>
<tr>
<td>The movement during capture is not sufficiently similar to the static/ROM trial.</td>
<td></td>
<td>Auto Initialize Labeling pipeline and manual labeling</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Calculate Skeleton Joint &amp; Marker Statistics operation on page 30</td>
</tr>
<tr>
<td>In this scenario</td>
<td>Use this trial type</td>
<td>And this pipeline /operation</td>
</tr>
<tr>
<td>------------------</td>
<td>---------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td>Complex movement (sports movements, or multi-segment, high velocity movement, where segments or markers interact).</td>
<td>ROM, beginning in static auto-label pose <strong>Note:</strong> Because of its labeling quality, Vicon recommends that this method is used whenever possible.</td>
<td>Reconstruct pipeline</td>
</tr>
<tr>
<td>Labeling accuracy is more important than speed of subject setup.</td>
<td></td>
<td>Auto Initialize Labeling pipeline on static frame, then use it to label whole trial.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Use manual labeling to correct any labeling errors for the whole trial.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Functional Skeleton Calibration operation on page 27</strong> on whole trial. For step-by-step instructions, see Calibrate a labeling skeleton using a ROM trial in the <em>Vicon Nexus User Guide</em>.</td>
</tr>
<tr>
<td>When a marker has fallen off and been re-applied.</td>
<td>Single static frame (base pose used when VST was created)</td>
<td>Reconstruct pipeline</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Label pipeline (or use previously calibrated skeleton) with</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Static Skeleton Calibration - Markers Only operation on page 29</strong> to recalibrate the marker that fell off.</td>
</tr>
</tbody>
</table>

For further details, see the recommended ways of working in the following workflow descriptions.
- Subject set up workflows on page 34
- Re-calibrate workflows on page 36
Subject set up workflows

The following workflows are the recommended ways of working when you are setting up a subject for labeling.

Auto Initialize Labeling pipeline

This is a recommended workflow for setting up a subject for labeling when you want to produce a labeling skeleton that can be used for trials that capture simple data, such as basic gait, non-ballistic/sports movements, or other movements that are not multi-segment, high velocity, or complex, where segments or markers tend to interact. This method uses less data (single static frame) than Functional Skeleton Calibration, and can be processed very quickly.

1. Put markers on the subject and get them to perform a static trial.
2. Reconstruct the trial and run the Auto Initialize Labeling pipeline.

The Auto Initialize Labeling pipeline consists of three operations:

1. A T-pose label operation (Autolabel Static). This operation labels the trial for the following two operations to use.

2. Subject scale (Scale Subject VSK). This operation takes the labeled reconstruction cloud and scales the template skeleton to be the same size. This enables you to use the same template skeleton for both children and adults.

3. Static Skeleton Calibration - Markers Only. This operation finishes off the set up by moving the skeleton markers to the correct locations in the segment coordinate frames. This is to allow for the variable placement of the markers.

This workflow calibrates both the bone lengths and marker positions from a single frame. However, the calibration is split over two operations. Scaling the subject changes all of the bone lengths by the same factor. The marker-only calibration can then use the scaled skeleton to optimize the marker positions.

Auto Initialize Labeling pipeline with Calculate Statistics

The standard Auto Initialize Labeling workflow is useful in cases where the subject’s ability to perform a full ROM trial might be limited or where total time of capture/calibration is paramount. In these types of capture scenarios, the Auto Initialize Labeling pipeline will often produce completely acceptable labeling. If less than ideal labeling performance is found, the addition of the Calculate Skeleton Joint & Marker Statistics operation can improve labeling.
To do this, you (semi-)manually label one of the movement trials and run a Calculate Skeleton Joint & Marker Statistics operation on it. This calculates the joint and marker statistics that represent the subject in that particular activity.

**Important**

Ensure that the trial contains no labeling errors, as any errors have the potential to significantly increase the estimated covariance of affected markers.

**ROM trial subject set up**

This workflow for setting up a subject provides more information (multi-frame, multi-joint range movements) to the Nexus subject calibrator and gives the best labeling performance in most scenarios. However, the increased amount of calibration data results in higher processing times than the simpler Static method (see Auto Initialize Labeling pipeline on page 34 above).

This workflow consists of the following steps:

1. The subject performs a range of motion trial in which they fully exercise all of their joints. It is recommended that the subject starts the ROM trial in the static autolabel pose, so that the Auto Initialize Labeling pipeline can be run on the first frame to generate a skeleton that can be used to help label the rest of the ROM trial.

2. After the trial has been captured you must reconstruct and label it. The recommended way of doing this is to run the Auto Initialize Labeling pipeline on a T-pose frame and use the skeleton generated by that operation to label the rest of the trial.

**Important**

If the trial is being labeled semi-automatically, scrub through the trial to make sure that all of the labels are correct. Incorrect labels degrade the quality of the calibration.

3. After you have labeled the trial, you run the Functional Skeleton Calibration operation. This calculates bone lengths, marker positions, and skeleton statistics.
Re-calibrate workflows

You may find yourself in a situation where a quick recalibration is preferable to performing a new full calibration. The following are two examples where a recalibration operation may be preferable to a full calibration.

Recalibrate for orthosis

Some capture sessions involve trials in which the subject is wearing an orthosis and others without. If the orthosis is large or moving significantly with respect to the segment(s), the trials with the orthosis might not label well. In this case you might want a quicker calibration procedure than a full Functional Skeleton Calibration.

One way of achieving this is to capture a second ROM trial with the orthosis. Instead of running a full Functional Skeleton Calibration, you could run a Functional Skeleton Calibration - Markers Only operation to update the marker positions and the subject statistics for the trials using the orthosis.

Recalibrate after replacing a marker

Markers sometimes get knocked off the subject and need to be re-applied. In this case you can use a frame in which the marker has been re-applied to run a Static Skeleton Calibration - Markers Only operation to recalibrate the marker that had fallen off.

In this situation it is highly likely that the marker covariance will not need to be updated so you do not need to run a Functional Skeleton Calibration - Markers Only operation.
Using monitors

Monitors enable you to evaluate subject and device outputs, so that when a specified condition or event happens (eg, a leg is raised to a specified height or a knee exceeds a specified angle), one or more actions is triggered (eg, a sound is played). If required, you can configure multiple actions and multiple monitors.

You can use monitors in both Live and Offline modes. In Live mode, you can compare the current value against the thresholds. In Offline mode, you can tune a series of monitors against captured data before applying them to live data.

For more information, see:
- Create a monitor on page 38
- Configure a monitor on page 40
- Configure an AND or OR Monitor on page 48
- Activate and deactivate a monitor on page 50
- Reload a monitor on page 51
- Monitor configuration examples on page 52
- Use monitors for real-time event detection on page 56

For an example of creating monitor, see Create a joint range overlay monitor on page 76 (part of a biomechanics workflow).
Create a monitor

Monitors enable you to specify conditions or events during motion capture sessions, and to interact with them. For example, you can create a monitor for a graphed model output (such as the subject raising an arm to a certain height, or the subject’s left knee angle exceeding 180 degrees), and then configure it on the Monitors tab of the Communications window to trigger one or more actions (such as an event on the time bar or a tone sounding) when the model output matches a condition you specify.

You create monitors in the Graph view. You can then configure the monitors in the Monitors tab of the Communications pane.

To create a monitor:

1. Decide on the elements you wish to monitor (trajectories, model outputs, devices, or joints).

2. In a Graph view, click the Differentiate the graph button and from the dropdown list, select either:
   - The current variable (x);
   - Its first derivative, that is, its velocity or angular velocity (x'), or
   - Its second derivative, that is, its acceleration or angular acceleration (x'').
   For example, a graph of a trajectory will have X, Y, and Z axes, but when differentiated to x' (velocity), the axes will change to X', Y', and Z' axes.

3. Click the Choose the components button and select the graph components that you want to plot in the Graph view (the options depend on your choice in the previous step).

4. On the Graph view toolbar, click the Create a Monitor button.
The monitor is added to the **Monitors** list in the **Monitors** communications pane.

The monitor takes the name of the component you selected. For example, if the Graph view you've selected shows X, Y, and Z for the LeftAnkleForce, three monitors are created: LAnkleForce:X, LAnkleForce:Y, and LAnkleForce:Z.

![Communications pane with selected monitors](image)

**Tip**

If you select multiple components for your Graph view, a monitor is created for each component (e.g., x, y, z). You can select and remove one or more monitors that you don't need from the **Monitors** list, or click **Clear** to remove all of them.

You can now configure the monitor, for example to specify a monitor threshold and trigger conditions that will trigger an action.
Configure a monitor

After you have created a monitor for a motion capture event in the Graph view pane, you can configure the monitor in the Monitors tab of the Communications pane. You can change the monitor’s default name, and configure it to be triggered upon a specified event or action.

To rename a monitor:

In the Monitors list on the Monitors tab, double-click the name of the required monitor and type a new name.

To configure a monitor:

1. In the Monitors list on the Monitors tab, click the name of the required monitor to select it.

2. In the Threshold section on the right, specify the value and condition that will trigger the action:

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Threshold</td>
<td>Select the type of threshold:</td>
</tr>
<tr>
<td>Mode</td>
<td></td>
</tr>
<tr>
<td>Above</td>
<td>Tracks a graph value above a specified range. You must also set the Upper Threshold value.</td>
</tr>
<tr>
<td>Upper</td>
<td></td>
</tr>
<tr>
<td>Below</td>
<td>Tracks a graph value below a specified range. You must also set the Lower Threshold value.</td>
</tr>
<tr>
<td>Lower</td>
<td></td>
</tr>
<tr>
<td>Between</td>
<td>Tracks a graph value within a specified range (default). You must also enter the Upper Threshold and Lower Threshold values.</td>
</tr>
<tr>
<td>Outside</td>
<td>Tracks a graph value outside a specified range. You must also enter the Upper Threshold and Lower Threshold values.</td>
</tr>
</tbody>
</table>
**Tip:** The threshold range you specify is displayed as a shaded area with a dashed line in the Graph view.

**Condition**

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>On Enter</td>
<td>Monitor triggers upon entering the threshold range.</td>
</tr>
<tr>
<td>On Exit</td>
<td>Monitor triggers upon exiting the threshold range.</td>
</tr>
<tr>
<td>Within</td>
<td>Monitor triggers on every frame within the threshold range.</td>
</tr>
<tr>
<td>Max Value on Exit</td>
<td>Monitor triggers upon exiting the threshold range, but the event is registered at the point of maximum value within the range. For example, if you set a Timebar Event with <strong>Max Value on Exit</strong>, the time bar event registers at the point of maximum value within the specified threshold range.</td>
</tr>
<tr>
<td>Min Value on Exit</td>
<td>Monitor triggers upon exiting the threshold range, but the event is registered at the point of minimum value within the specified range.</td>
</tr>
<tr>
<td>Always</td>
<td></td>
</tr>
</tbody>
</table>
3. To specify the action that will execute when the monitor threshold and trigger conditions are met, ensure the required monitor is selected and in the **Actions** area on the right of the **Monitors** tab, click **Add** and select the required action.

<table>
<thead>
<tr>
<th>Action</th>
<th>Description/Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capture</td>
<td></td>
</tr>
<tr>
<td>Start</td>
<td>Starts a capture.</td>
</tr>
<tr>
<td>Stop</td>
<td>Stops a capture.</td>
</tr>
<tr>
<td>Toggle</td>
<td>Switches to the opposite capture state, e.g., stops a capture that is in progress, or starts a capture if the previous state was stopped. Capture actions can only be performed in Live mode. If you want to create and test a capture action based on a representative trial, you can add a complementary <strong>Timebar Event</strong> to indicate that the condition was met. Then for the live test or real trial capture, turn off the monitor time bar action. <strong>Tip:</strong> In the Auto Capture settings of the Capture Tools pane, ensure the Arm button is enabled (pressed down) before triggering capture. You can also use other Auto Capture settings in conjunction with monitor events. For example, in addition to setting up a monitor event to trigger a capture, you can also set a pre-trigger capture time. To do this, set up the monitor to trigger the capture and also set a pre-trigger capture time so that the first frame captured is prior to the condition which triggers the capture.</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Action</th>
<th>Description/Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>External Trigger</td>
<td>Sends a trigger pulse to external equipment or software from the Sync Output ports on the back of the connectivity device.</td>
</tr>
<tr>
<td>Sync Port</td>
<td>Select which port you want to use to send the pulse (sends a trigger pulse from the Sync Output port of a Vicon Lock+ or Giganet to an external piece of equipment or software). Affects all connected devices.</td>
</tr>
<tr>
<td>Action</td>
<td>Choose from:</td>
</tr>
<tr>
<td></td>
<td>1. Toggle (between Low and High)</td>
</tr>
<tr>
<td></td>
<td>2. Go High (+4.3V)</td>
</tr>
<tr>
<td></td>
<td>3. Go Low (0V)</td>
</tr>
<tr>
<td>Timebar Event</td>
<td>Places an event on the time bar, which can be configured to include:</td>
</tr>
<tr>
<td>Subject Name</td>
<td>Enter the subject name.</td>
</tr>
<tr>
<td>Context</td>
<td>Select where to place a time bar event:</td>
</tr>
<tr>
<td></td>
<td>2. Left: Places a marker on the Left (e.g., left side of the body) rule of the time bar ruler.</td>
</tr>
<tr>
<td></td>
<td>3. Right: Places a marker on the Right (e.g., right side of the body) rule of the time bar ruler.</td>
</tr>
<tr>
<td>Event Type</td>
<td>Select the type of user-defined event that will be specified on the time bar:</td>
</tr>
<tr>
<td></td>
<td>1. General: Indicates the point on the time bar at which the trial subject performs a user-defined event.</td>
</tr>
<tr>
<td></td>
<td>2. Foot Strike: Indicates the point on the time bar at which the trial subject’s foot contacts the ground.</td>
</tr>
</tbody>
</table>
### Action	Description/Properties

- **Foot Off**: Indicates the point on the time bar at which the trial subject's foot leaves the ground.

### Clip

- **Active**: Sets the action to whichever state Nexus is in. *Tip*: Active has the same functionality as Offline if you are analyzing or processing an offline trial, and Live if you are currently in Live mode. This eliminates having to change this property when you switch between Live and Offline.
- **Live**: Sets the action to occur on a live clip.
- **Offline**: Sets the action to occur on a captured trial that has been loaded or a trial that is currently being captured.

### Frame

- **Current**: Sets the action for the currently selected frame in the clip.
- **First**: Sets the action to the first frame in the time interval. For an offline clip, this would be frame 1. For a live clip, this would be the first frame of a 100-frame moving time window.
- **Last**: Sets the action to the last frame in the current interval. For an offline clip, this would be the very last frame.

The Frame settings detect real time events that are written to the offline clip. During capture, the current Live frame is equivalent to the last Offline frame. If you set Clip to Offline and Frame to Last, you will have real time event detection during capture. If you configure this option, you will need to run a post-capture pipeline.

### Frame Offset

Type a number in the field to indicate the number of frames of offset before adding the event.
<table>
<thead>
<tr>
<th>Action</th>
<th>Description/Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Progress Bar</td>
<td>Displays a progress bar. The progress bar reflects a normalized value within the boundaries of the threshold; that is, Vicon Nexus computes the upper and lower threshold values so that a given value within the range is represented as a progress bar percentage. This action works best when the Monitor Threshold is set to Between, and is intended for a Trigger condition of Within. The Progress Bar will function when used On Enter, On Exit, etc., but will not provide meaningful results. For example, if you set the trigger condition to On Enter and the parameter enters the threshold region from below, then the progress bar value will remain near 0%. If the parameter enters the threshold region from above, the progress bar value will remain around 100%. <strong>Tip:</strong> The Progress Bar is divided into thirds, each designated by a color: Red for the lower third, yellow for the middle third, and green for the upper third.</td>
</tr>
<tr>
<td>Range Overlay</td>
<td>Displays an overlay in the 3D Perspective view that provides an easy, visual way to verify whether a ROM trial has captured enough of the required movement to be likely to provide a good calibration of the subject. For more information, see Create a joint range overlay monitor on page 76.</td>
</tr>
<tr>
<td>Name</td>
<td>The title of the overlay</td>
</tr>
<tr>
<td>Zero (deg)</td>
<td>Type a value or move the slider to specify where zero appears on the dial</td>
</tr>
<tr>
<td>Sound Tone</td>
<td>Sounds a system tone based on the threshold range and trigger condition. Sound Tone is recommended with the trigger conditions of Between and Within. The Sound Tone provides an audio alert in a similar fashion to the Progress Bar: If set to Between or Within, the sound pitch varies in proportion to the parameter’s value within the threshold range. Play Sound File (see below) is recommended with the trigger actions of On Enter or On Exit.</td>
</tr>
</tbody>
</table>
3. **Action Description/Properties**

<table>
<thead>
<tr>
<th>Action</th>
<th>Description/Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Toggle Monitor</strong></td>
<td>Changes the enabled state of the selected monitor to On, Off, or Toggle. Important: Vicon Nexus adjusts the Monitor Index field if changing the number of Monitors in a configuration affects the Monitor Index. That is, if you configure multiple monitors and set Toggle Monitor events, deleting a monitor can change the Monitor Index field number. Example (1): You configure Monitor 1, Monitor 2, and Monitor 3. You add a Toggle Monitor event to Monitor 2, with the Monitor Index set to 3 (meaning that Monitor 3 will toggle). If you remove Monitor 1, Monitor 2's Monitor Index will change from 3 to 2 (Monitor 3 is now Monitor 2). Example (2): You configure Monitor 1, Monitor 2, and Monitor 3. You add a Toggle Monitor to Monitor 2, with the Monitor Index set to 3. If you delete Monitor 3, Monitor 2's Monitor Index will be blank (there is no longer any Monitor 3 to toggle).</td>
</tr>
<tr>
<td><strong>Monitor Index</strong></td>
<td>Type the number corresponding to the monitor in the Monitors List.</td>
</tr>
<tr>
<td><strong>Action</strong></td>
<td>Sets the toggle state to On, Off, or Toggle.</td>
</tr>
<tr>
<td><strong>Play Sound File</strong></td>
<td>Plays the sound file you specify.</td>
</tr>
<tr>
<td><strong>Sound File</strong></td>
<td>Click the Browse button to navigate to the relevant directory on your computer, then select a .wav file from the drop-down list.</td>
</tr>
</tbody>
</table>

4. If you want to configure multiple actions for the monitor, repeat steps 2 and 3.
5. In the Configuration Management area of the **Communications** pane, click **Save** to save the configured monitor, enter a name for the monitor configuration and select **Shared** or **Private**.

6. In the Configuration Management area of the **View** pane, click **Save** to save the **Graph** view that corresponds to the monitor you have configured, type a name for the **Graph** view configuration, and select **Shared** or **Private**.

![Tip]

Whenever you want to view the graph related to the monitor, select it from the View pane list.

7. Test the monitor to ensure that the action occurs when the specified condition is met.

![Important]

Monitor actions function only in a forward time sequence. In other words, monitors will not activate when you manipulate the time bar ruler back and forth.

To configure multiple monitors, repeat steps 1–7 for each monitor.
Configure an AND or OR Monitor

In the **Communications** pane, on the **Monitors** tab, you can configure two special monitor types that execute actions based on the conditions of a group of monitors. They are called AND or OR monitors, or Boolean monitors.

The monitors that make up a Boolean monitor are called children. The Boolean monitor bases its action on the status of the child monitors; that is, based on whether the child's thresholds and triggers are present. You can trigger an action based upon a Boolean monitor's condition just like you can for an individual monitor, but Boolean monitors operate in specific ways:

- Boolean AND monitor on page 49
- Boolean OR monitor on page 49

To configure an AND or OR monitor:

**Important**

This procedure assumes that you have already configured multiple monitors. For information on creating and configuring monitors, see [Create a monitor on page 38](#) and [Configure a monitor on page 40](#).

1. On the **Monitors** tab, in the **Monitors** list, select two or more monitors that will make up the AND or OR monitor.

2. Click the AND or OR button below the **Monitors** list. A new Boolean monitor appears in the list (Boolean AND or Boolean OR).

3. Highlight the monitor name and a list of the child monitors within the monitor appears.

**Tip**

To change the child monitors included in the Boolean monitor, click in the **Children** field and type the monitor numbers, separated by commas.

4. Configure the monitor (see [Configure a monitor on page 40](#)).
Boolean AND monitor

If all the child monitors within a Boolean AND monitor meet the monitor configuration condition at the same time, then the Boolean AND monitor executes its configured action. In other words, if the condition of all the children is TRUE then the Boolean AND monitor condition is TRUE, and the Boolean AND monitor executes.

Example: If in Child monitor 1 the Left Knee Angle > 180 AND in Child monitor 2 the Right Knee Angle > 180, the Boolean AND monitor is true and the monitor action executes.

All the Boolean AND monitor children must meet the specified condition at the same time or the Boolean AND monitor condition is FALSE, and the Boolean AND monitor will not execute the action.

Boolean OR monitor

If at least one of the child monitors within a Boolean OR monitor meets the specified monitor configuration (threshold, trigger, and condition), then the Boolean OR monitor executes the specified action. In other words, the condition of at least one of children is TRUE, therefore the Boolean OR monitor condition is TRUE.

Example: If in Child monitor 1 the Left Knee Angle > 180 OR in Child monitor 2 the Right Knee Angle > 180, the Boolean OR monitor is true and the monitor action executes.

When none of the Children meets the specified condition, the Boolean OR monitor’s condition is FALSE and the Boolean OR monitor does not execute.
Activate and deactivate a monitor

After you configure a monitor (see Configure a monitor on page 40), you can activate or deactivate it.

To activate or deactivate a monitor:

1. On the Monitors tab in the Communications pane, select or clear the check box for the required monitor.
Reload a monitor

You will need to reload your monitor if you do any of the following:

- Make changes to the monitor configuration; or
- Configure or use other monitors; or
- Switch between Live and Offline mode.

**To reload a monitor:**

For a monitor to take effect in Live mode:
- Reload the trial file on the **Data Management** tab.

For a monitor to take effect in Offline mode:
- Select **Refresh List** from the Configuration menu on the **Monitors** tab.

**Tip**

Because monitors can be set to toggle on and off, you may need to reload the monitor before processing a new trial.
Monitor configuration examples

You can configure monitors in a variety of ways.

For examples of configuring monitors, see the following:
- Configure multiple actions on one monitor on page 52
- Configure multiple monitors on page 52
- Configure multiple actions on multiple monitors on page 53
- Configure Boolean monitors on page 54

Configure multiple actions on one monitor

A single monitor can perform multiple actions, such as to write a time bar event, display a progress bar, and sound a tone.

To configure a monitor with multiple actions that detects only the first occurrence of an event:

1. Configure a monitor to detect an event.
2. Add a Timebar Event action.
3. Add a Toggle Monitor action to toggle the monitor Off so that the Timebar Event is identified only the first time.

Configure multiple monitors

You can use multiple monitors to identify multiple events. Each event type, such as Foot Strike and Foot Off, would have its own monitor.

For example, you may want one monitor to look for the start of a particular body motion, which starts another monitor that evaluates whether the pelvic alignment is within the threshold range. If the pelvic alignment exceeds the threshold range, the second monitor could sound a tone to notify the operator, and activate a third monitor to evaluate the range of yet another element.
To configure multiple monitors:

1. Configure monitor 1 to detect the counter-motion of a jump (e.g., when the angular velocity of the knee exceeds a threshold).
2. Add a Capture action to the monitor to start a capture when this condition is met.
3. Add a Toggle Monitor action to toggle the monitor off so that the capture is initiated only once.
4. Configure monitor 2 to detect the maximum height of the sacrum for both the initial jump and the jump after landing on the force plate (Maximum Value on Exit).
   Add a Timebar Event action to the monitor.
5. Configure monitor 3 to detect landing on the force plate.
   Set the Threshold Mode to monitor the vertical force value (Fz) at the appropriate threshold (On Enter).

   **Tip**

   Force plate monitor properties will depend on which force plate device is being used. Some force plates used with Vicon Nexus register a positive vertical force on contact (such as the AMTI), while others register a negative force on contact (such as Kistler).

6. Add a Timebar Event action.
7. Configure monitor 4 to detect takeoff from the force plate.
   Set the Threshold Mode to detect when the vertical force value (Fz) drops below a threshold (you can use the same trigger value as for Monitor 3, but you would set the condition to On Exit).

Configure multiple actions on multiple monitors

To configure multiple monitors, each with multiple actions:

1. Configure a master monitor to trigger the detection of trial events (e.g., subject jumps onto a force plate and then jumps off).
2. Configure a series of monitors with Timebar Event actions (e.g., Foot Strike and Foot Off).
3. Clear each monitor’s check box so that its initial state is Off.
4. Add a Toggle Monitor action to the master monitor for each event monitor.

5. Set each Toggle Monitor to On. Once the master monitor is triggered, the event monitors will turn On. The events are detected and written to the time bar.

**Tip**

The trial conditions could be such that a master monitor isn’t necessary to control the event detection monitors in Step 2. The value of the master monitor is to make sure that the monitored parameters are in the proper state for appropriate event detections. This is a safeguard against identifying false events.

### Configure Boolean monitors

You should carefully consider how you configure Boolean monitor thresholds and triggers to execute event actions.

If you use an AND monitor, it will mark an event only if the conditions of the child monitors occur at the same frame (an AND monitor event requires all child monitor parameters to be true). This seems obvious, but let’s say you want to mark an event when parameter 1 is above one threshold and parameter 2 falls below another threshold. You’d be inclined to set:

- AND Child monitor 1:
  - Threshold Mode: Above Upper
  - Condition: On Enter

- AND Child monitor 2:
  - Threshold Mode: Below Lower
  - Condition: On Enter

However, configured this way, the AND monitor will mark the event only if the two parameters enter the respective threshold regions on the same frame, which is unlikely.
Unless you want this specific occurrence tracked, instead you would set:

- **AND Child monitor 1:**
  - Threshold Mode: Between
  - Condition: Within
- **AND Child monitor 2:**
  - Threshold Mode: Below Lower
  - Condition: On Enter

Configured in this way, when the parameter for Child monitor 1 is within its threshold, the action will execute the instant the parameter for Child monitor 2 falls below its threshold.

If you use an OR monitor, because the child monitor trigger conditions do not need to coincide (an OR monitor requires only one of the monitor parameters to be true), you can set:

- **OR Child Monitor 1**
  - Threshold: Above Upper
  - Trigger: On Enter
- **OR Child Monitor 2**
  - Threshold: Below Lower
  - Trigger: On Enter
Use monitors for real-time event detection

You can configure Vicon Nexus to record specified events during a capture, such as foot strike or foot off, which are written to the offline clip and can then be viewed on the time bar ruler.

Tip

You can also manually mark the time bar ruler (see Add events to trials in the Vicon Nexus User Guide).

To configure and use a real-time event detection monitor:

1. In the Monitors Communications pane, configure one or more monitors with the following Timebar Event settings:
   - Clip: Offline
   - Frame: Last
2. In the Capture Tools pane, configure your settings to either manually or automatically capture a trial.
3. In the Post-Capture Pipeline Setup section of the Capture Tools pane, select the check box to Run pipeline after capture and select a pipeline operation to run.
4. Capture a trial.
5. Play back the trial data to view the time bar events in the offline clip.
Modeling with Vicon Nexus

Nexus 2 offers the following options for modeling:

- **Plug-in Gait (and the Oxford Foot Model).** If you are new to modeling with Nexus, this provides a good introduction: the Plug-in Gait model is supplied with Nexus and all the operations necessary to run the model are easily accessible and ready to use. For more information, see Modeling with Plug-in Gait in the *Vicon Nexus User Guide*.

- **MATLAB.** If you are familiar with MATLAB, you can use the supplied examples to create your own custom model. See Modeling with MATLAB on page 59.

- **Python.** If you are familiar with Python, you can use the supplied examples to create your own custom models. See Modeling with Python on page 70.

**Note**

For research and experimental purposes, a version of Plug-in Gait in open MATLAB script is available. For further details, contact Vicon Support.

### About modeling terminology

For a clear understanding of the way modeling is represented in Nexus, bear in mind the following definitions:

- **Labeling** Any process, operation or algorithm that is used in Vicon Nexus to assign a label to a reconstruction.

- **Modeling** Takes labeled reconstructions and uses these to perform calculations whose results are new variables.

- **Models** Files or operations that produce new calculations after labeling. Plug-in Gait and the Oxford Foot Model are models, as are MOD files built in BodyBuilder.

- **Subject** The representation in Nexus of a physical entity (e.g., a patient).

- **Labeling skeleton template (VST):** Contains information and definitions related to labeling.
Labeling skeleton (VSK) A subject that has a labeling skeleton template attached to it and subject-specific properties that are required for modeling (after labeling)

The following examples show the distinction between labeling and modeling:

- **Labeling** VSTs/VSKs, labeling skeleton calibration (labeling calibration)
- **Modeling** PlugInGait.MOD, scripts in Bodybuilder, PECS, MATLAB calculations
Modeling with MATLAB

Important

Vicon Nexus 2 is compatible with, and has been tested with MATLAB R2013b. Nexus may function with other versions of MATLAB, but other versions have not been extensively tested by Vicon. To use MATLAB with Vicon Nexus 2, ensure that, in addition to installing MATLAB, you install .NET Framework version 4.5.

The MATLAB interface provides immediate feedback of scripting changes in the 3D Perspective view.

For more information, see:

- Example of modeling with MATLAB on page 59
- Advanced MATLAB modeling on page 63
- MATLAB commands for use with Nexus on page 64
- MATLAB troubleshooting on page 66

Example of modeling with MATLAB

The following example uses a supplied MATLAB script (SimpleMidpoint.m), which is installed with Nexus 2 in the following default folder:

C:\Program Files (x86)\Vicon\Nexus2.1\SDK\Win64\Matlab\Examples

This example script creates a marker mid way between two existing markers in a loaded trial, so you must specify the subject, the two markers between which to create the midpoint, and the name of the midpoint marker that is to be created.

To execute a MATLAB script from within Vicon Nexus:

1. In Nexus, open the trial on which the script is to run.
2. In the Communications window, click on the Matlab tab.
3. In the Matlab script field, enter or browse to the folder that contains the required MATLAB script (*.m).
4. In the Input arguments field, if your script requires arguments, provide a comma-separated list of arguments to be used by the script, surrounding each argument with single quotes. In this example:

'Colin','LWRA','LWRB','LWRM'

The supplied examples show the required input and its format.
If your script does not require any arguments, leave the Script arguments field blank.

5. If you want to launch MATLAB and display your script, click the Launch Matlab button.

6. Click Run Script.

Information, such as a time stamp and text describing the processing, together with any error messages, is displayed on the Matlab tab. Relevant information is also displayed in the Log pane.

The modeled marker (in this case, the midpoint marker, LWRM) is created, and can be seen in the 3D Perspective view.

On the Subjects Resources pane, additional outputs are displayed under a newly created Modeled Markers node of the resources tree. In the following example, the new marker is called MyMidpoint.
7. Display a Graph view of the new marker to see that a trajectory for the new marker has been created for the whole trial.

8. If necessary, you can change your script in MATLAB and, to check that it has the desired result, run it again from either MATLAB or by clicking Run Script again.

9. When you have finished refining your script, to include it in a pipeline, click Create Pipeline, which copies the information you have supplied to a Data Processing pipeline operation, Run Matlab Operation in the Pipeline tools pane. The required inputs are displayed in the Properties pane.
Advanced MATLAB modeling

From Nexus 2.2 and later releases, to simplify biomechanical modeling, additional MATLAB scripts are available in the Nexus SDK.

Classes that represent trajectories (read from Nexus or created as modeled markers), body segments, and angle outputs have been included to ease modeling of biomechanics based on Nexus data.

Sample functions include:

- Calculating the angles between two segments (as fixed, Euler or helical angles)

  ```matlab
  % Calculate the angle between two segments.
  % Can choose euler, fixed or helical angle.
  % Specify order of output angles for fixed and euler.
  
  LKneeAnglesEulerML = AngleBetween( LThigh, LShank, 'euler', 'yxz' );
  LKneeAnglesEulerML.Create( vicon );
  LKneeAnglesEulerML.Write( vicon );
  
  LKneeAnglesFixedML = AngleBetween( LThigh, LShank, 'fixed' );
  LKneeAnglesFixedML.Create( vicon );
  LKneeAnglesFixedML.Write( vicon );
  
  LKneeAnglesHelicalML = AngleBetween( LThigh, LShank, 'helical' );
  LKneeAnglesHelicalML.Create( vicon );
  LKneeAnglesHelicalML.Write( vicon );
  
  Creating modeled markers based on existing trajectory data

  ```matlab
  % Create a trajectory from the segment origin
  LThighPosML = NexusTrajectory('Colin');
  LThighPosML.SetPosition( LThigh.Position() );
  LThighPosML.Create( vicon );
  LThighPosML.Write( vicon );
  
  Translating points in the coordinate system of existing segments

  ```matlab
  % Create a global trajectory that is offset by (100,0,0) in the
  % segment coordinate system
  Offset = NexusTrajectory('Colin');
  Offset.SetPosition([100;0;0]);
  TestTranslateML = LKNE + Offset*LThigh - LThigh.Position();
  TestTranslateML = LThigh.TranslatePointInSegment( LKNE, [100; 0; 0 ] );
  TestTranslateML.Create( vicon );
  TestTranslateML.Write( vicon );
  ```
MATLAB commands for use with Nexus

Information on the following commands is provided to help you to get started using MATLAB for modeling with Vicon Nexus 2:

- DisplayCommandList on page 64
- DisplayCommandHelp on page 64

DisplayCommandList

This method has been defined in the MATLAB class provided to display a list of commands. The MATLAB standard MethodsView command can be used to query method signatures on not only the top-level ViconNexus class but the underlying .NET assembly as well.

To obtain a list of commands for use with Nexus:

1. At the command prompt, create an instance of the ViconNexus object (if you haven't already created one) to get access to its methods.

   ```matlab
   » vicon = ViconNexus()
   ```

2. You can then call any of its defined methods or use the 'client' property to access the .NET assembly directly.

   ```matlab
   » vicon.DisplayCommandList()
   ```

   A list of command names is displayed.

DisplayCommandHelp

You can display the help available for each command that can be used with Vicon Nexus.

To obtain help on each command that you can use with Nexus:

1. At the command prompt, create an instance of the ViconNexus object (if you haven't already created one) to get access to its methods.

   ```matlab
   » vicon = ViconNexus()
   ```

2. At the command prompt, enter:

   ```matlab
   » vicon.DisplayCommandHelp('commandName')
   ```

   Where `commandName` is the command for which you want to display help.
For example, the following command displays help on `GetTrajectory`:

```matlab
» vicon.DisplayCommandHelp('GetTrajectory')
```

The following information is displayed:

```plaintext
ans =
GetTrajectory Retrieve X, Y, Z values for the specified trajectory for all frames in the currently loaded trial.
Input Parameters
MarkerName = Name of a defined marker for the loaded subject
SubjectName = Name of the Subject that is loaded in to the Nexus workspace.
Output Parameters
E = Indication of whether or not the coordinate for a specific frame exists. A true value indicates that the data exists, a false value indicates that the data does not exist and the coordinate values do not contain valid data.
X = Array of X coordinates.
Y = Array of Y coordinates.
Z = Array of Z coordinates.
```
# MATLAB troubleshooting

The following table lists possible issues you may encounter when modeling with MATLAB, helps you to understand why the issue may have occurred, and suggests the remedial actions to take, in the order to try them.

<table>
<thead>
<tr>
<th>Issue</th>
<th>Reason</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nexus error: When you click the Run Script button, Nexus becomes unresponsive for some time, and finally, the Matlab tab displays the following error: Default Run Matlab Operation Host Application is not connected, unable to retrieve command list</td>
<td>MATLAB connects to Nexus over TCP/IP. If you disconnect your Ethernet cable and disable wifi (ie, if you are working entirely offline), MATLAB and Nexus cannot connect.</td>
<td>Install the Microsoft Loopback Adapter. For instructions on how to do this, see Adding the MS Loopback Adapter on Windows 7, on blogs.msdn.com</td>
</tr>
<tr>
<td>MATLAB error: Default Run Matlab Operation Host Application is not connected, unable to retrieve command list</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MATLAB error when constructing an instance of the ViconNexus object vicon = ViconNexus(); Undefined function or variable 'ViconNexus'</td>
<td>When you try to create an instance of the class object ViconNexus, MATLAB is unable to locate the definition for the class. This is generally an indication that the Search path in MATLAB has not</td>
<td>Ensure that the NexusSDK has been installed. The 32-bit version of the SDK should be installed for a 32bit installation of MATLAB; the 64-bit version of the SDK should be installed for a 64-bit installation of MATLAB. In MATLAB, ensure that the path to the NexusSDK has been added:</td>
</tr>
<tr>
<td>Issue</td>
<td>Reason</td>
<td>Action</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------</td>
</tr>
<tr>
<td>been set to include a path to the NexusSDK or that the NexusSDK has not been installed</td>
<td>64-bit MATLAB NexusSDK path is: NexusInstallFolder SDK\Win64\Matlab 32-bit Matlab NexusSDK path is NexusInstallFolder SDK\Win32\Matlab</td>
<td>Use the shortcut provided on the Start menu to set the MATLAB path.</td>
</tr>
<tr>
<td>MATLAB error when constructing an instance of the ViconNexus object vicon = ViconNexus();</td>
<td>This can happen if the VC++ 64-bit runtimes did not get installed from the Nexus bootstrap installer setup.exe</td>
<td>Install the runtimes manually. Navigate to the folder where the installation files were unzipped run vcredist_x64.exe</td>
</tr>
<tr>
<td>Could not load file or assembly 'NexusSDKClientDotNET.dll' or one of its dependencies. The specified module could not be found.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Generic type error message received in MATLAB after calling a function result = vicon.function(); Error using ViconNexus/function (line 123) Error: Invalid Parameter Value</td>
<td>Look at the log in the Nexus Matlab tab as it may contain more detailed information on the error that has been generated.</td>
<td></td>
</tr>
<tr>
<td>Issue</td>
<td>Reason</td>
<td>Action</td>
</tr>
<tr>
<td>-------</td>
<td>--------</td>
<td>--------</td>
</tr>
<tr>
<td>MATLAB error</td>
<td>After MATLAB sends a command to Nexus, it waits for a specific amount of time for the reply to be received. If the reply is not received in that timeframe, this error is generated. Delays in processing can occur when Nexus is waiting for input from the user to proceed or it has become unresponsive.</td>
<td>Look at the log in the Nexus Matlab tab to see if an error has been generated. Often, commands will return a reply, but some commands, such as <code>OpenTrial</code> and <code>RunPipeline</code>, require that Nexus generates a notification of task completion. An error in these commands can cause the reply to be delayed or not be generated. Look at the log in the Nexus Matlab tab to see if the command was received by Nexus. If the log does not have an entry showing that the command was received then it is possible that something has happened to the connection between the applications. Restart Nexus. Make sure that Nexus is not displaying a user prompt, if it is, answer the prompt and retry the command. Restart Nexus.</td>
</tr>
<tr>
<td>MATLAB error</td>
<td>The function called failed to execute because the connection to Nexus has either been dropped or never established.</td>
<td>Make sure that Nexus is running and is responsive.</td>
</tr>
<tr>
<td>Issue</td>
<td>Reason</td>
<td>Action</td>
</tr>
<tr>
<td>------------------------------</td>
<td>------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------</td>
</tr>
<tr>
<td>If running from within MATLAB, remove the ViconNexus object from the workspace using the MATLAB <code>clear</code> command and re-create the object.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Restart Nexus.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Restart MATLAB.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nexus error</td>
<td>This can happen if Nexus is able to determine that MATLAB is installed but it is unable to access the MATLAB automation server.</td>
<td>Run <code>matlab.exe</code> with the <code>/register</code> option to have MATLAB re-register its automation server components.</td>
</tr>
<tr>
<td>MATLAB version is shown in the Matlab tab but a message states that MATLAB is not accessible.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>When there are multiple versions of MATLAB installed, Nexus is running the wrong version of MATLAB</td>
<td>MATLAB registers COM components to provide access to its automation server. Nexus will use the currently registered components so the order of installation /uninstall/upgrade of different MATLAB versions can make a difference.</td>
<td>Run <code>matlab.exe</code> from the MATLAB version you wish to use with the <code>/register</code> option to have MATLAB re-register its automation server components.</td>
</tr>
</tbody>
</table>
Modeling with Python

Python is a powerful, widely used programming language that can be a useful tool for mathematical modeling with Vicon Nexus.

To ensure that custom modeling is available whether or not you have access to MATLAB, Python is automatically installed with Nexus.

For more information, see:

- Set up Python for use with Nexus on page 70
- Python commands for use with Nexus on page 71

In addition, the following Vicon Nexus 2 videos are available on YouTube:

- Python Plug-in Gait to Excel
- Python demonstration with custom Gait Kinematics script

**Note**

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

Set up Python for use with Nexus

To set up Python to work with Nexus:

1. Click Start, point to All Programs and then start to type Python.
2. Click the Python symbol.

3. To automatically configure Python for scripting with Nexus, at the command prompt, enter the following:
   ```python
   import ViconNexus
   vicon = ViconNexus.ViconNexus()
   ```
For information on how to access the help provided on the relevant Python commands, see Python commands for use with Nexus on page 71. For more information about how to use Python, see https://www.python.org/about/gettingstarted/.

**Tip**

If you disconnect your Ethernet cable and disable wifi, when you enter a Python command, the following error may be displayed:

`Host Application is not connected, unable to retrieve command list`

This is because Python connects to Nexus over TCP/IP and if you are working entirely offline, Python and Nexus cannot connect.

To solve this issue, install the Microsoft Loopback Adapter. For instructions on how to do this, see Adding the MS Loopback Adapter on Windows 7 on blogs.msdn.com.

### Python commands for use with Nexus

The following commands are provided to help you to get started using Python for modeling with Nexus.

**DisplayCommandList**

To obtain a list of commands for use with Nexus:

Ensure you have launched and configured Python as described in Modeling with Python on page 70, then at the Python command prompt, enter:

```
vicon.DisplayCommandList()
```

A list of relevant Python commands is displayed:
DisplayCommandHelp

To obtain help on each command that you can use with Nexus:

At the Python command prompt, enter:

vicon.DisplayCommandHelp ('commandName')

Where `commandName` is the command for which you want to display help.

For example, the following command displays help on GetTrajectory:

vicon.DisplayCommandHelp ('GetTrajectory')

Help on GetTrajectory is displayed:
Biomechanics workflow

Vicon Nexus 2 includes a Biomechanics Workflow area that enables you to associate specified data capture and processing steps with particular trial types, add joint range monitors for instant feedback, and quickly accept or reject the results of each step.

The following topics explain how to use the biomechanics workflow to simplify and speed up your work, and includes information on using functional calibration and SCoRE and SARA.

- Overview of the biomechanics workflow on page 74
- View real-time subject calibration feedback with monitors on page 76
- About functional calibration in the biomechanics workflow on page 80
- Create a biomechanics workflow on page 82
- About SCoRE and SARA in Vicon Nexus on page 88
- Prepare data for use with SCoRE and SARA on page 90
- Capture and process a trial with SCoRE and SARA on page 93
- Process multiple joints with SCoRE and SARA on page 96

For further information, see the PDF *Vicon Advanced Gait Workflow Guide*, available from the Vicon website.

In addition, a Vicon Nexus 2 video: SCoRE and SARA, 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.
Overview of the biomechanics workflow

The Biomechanics Workflow area is a powerful tool for simplifying and speeding up multi-step procedures, such as those involving SCoRE and SARA, the processing algorithms that can be used for hip and knee joint estimation.

The biomechanics workflow enables you to:

- Create a series of collection and processing steps for any set workflow.
- Specify capture settings for any step (a trial type, for example static, ROM, etc).
- Specify post-capture processing steps (post capture pipelines, for example, Reconstruct and Label).
- Associate real-time monitors (for example, joint range monitors) with a step.
- Accept or reject the results of each step with a single mouse click.

When you have set up all the steps in your biomechanics workflow, you can save it for future re-use. You can then apply the whole workflow or selected steps to your future work with Vicon Nexus, from capture right through to data export.

To use a biomechanics workflow that includes functional calibration, which is the recommended way of working, it is a good idea to begin by setting up joint range monitors to provide real-time subject calibration feedback. This is necessary, because, for functional calibration to work, you need to be sure that the ROM trial has included enough of the required movement to result in a successful subject calibration.
You can then include joint range monitors and define the steps required in your workflow, using the Biomechanics Workflow area on the Data Management tab in the Communications pane.
View real-time subject calibration feedback with monitors

Before you set up a biomechanics workflow that includes functional calibration, you can set up a joint range overlay monitor to provide instant visual feedback on how much joint movement the subject has performed during a ROM trial.

This is important because a minimum amount of angular movement (per joint) is needed to obtain the best possible calibration. Setting up a monitor enables you to decide immediately whether the ROM trial has captured enough range of joint movement to provide an accurate calibration.

Although collecting the recommended/desired amount of range does not guarantee a good calibration, obtaining positive feedback from a joint range monitor indicates that the ROM trial has the potential to provide a good calibration.

Create a joint range overlay monitor

To create a joint range overlay monitor, you use a Range Overlay monitor, which is available from the Actions menu in the Monitors area.

Because you will be monitoring joint movement, you need to first ensure a Kinematic Fit operation has been run on the subject. You can then create the monitor for a joint movement range.

To create a joint range overlay monitor:

1. Load a ROM trial.
2. Reconstruct and Label the ROM trial.
3. Run a Functional Skeleton Calibration pipeline operation.
4. Kinematic fit the subject using a Pipeline operation under the Core Processing category. Choose one of:
   - Kinematic Fit (if the subject is already labeled); or
   - Combined Processing with the Output level set to Kinematic Fit.

The following image shows a subject after kinematic fitting.
4. The subject now shows the internal labeling skeleton, displaying joints, as well as the labeled markers and segments.

5. In the Communications pane, click on the Monitors tab to give it focus and ensure a Graph pane is displayed.

6. In either the 3D Perspective view or in the Subjects Resources tree, click on a joint whose range you want to monitor.

7. In the Graph pane, click the Create a Monitor button.
The new monitor is added to the Monitors list on the Monitors tab in the Communications pane.

8. On the Monitors tab:

a. Click on the new monitor to select it, and in the Threshold area, set the desired Range of Motion for the selected joint by specifying the Threshold Mode, and the upper and/or lower limits of the range to be monitored.

   ☑ Tip

   To select the required range, look at the values in the Graph view and choose the highest and lowest values shown over the whole trial.

b. In the Actions area, click Add and select Range Overlay from the list of monitor types

c. Ensure the new action is selected (blue) and in the Name field, provide a descriptive name for your new monitor.
The named monitor appears as an overlay in the Graph view.

9. Play through the trial to see the monitor working.  
   As the trial progresses, the monitor reflects the collected range of motion for the selected joint.
   
   ![Monitor overlay in Graph view](image)

   The nearer to 100% that is displayed by the monitor, the more of the required movement has been captured.

10. Save the configuration under a suitable name.  
    You can use your new monitor for both Live and Offline trials and include it in a biomechanics workflow.

Note that you can use a monitor that was based on a particular subject, such as monitors for labeled trajectories, model outputs, joints, or segments, for other subjects that contain the same marker/segment/joint name. However, note the following restrictions:

- If multiple subjects are present, the monitor will only work with the original subject.
- The new subject must have the same marker/segment/joint name as was used to configure the monitor.
- The new subject must be the only active subject (that is, selected in the System tree) that contains that marker/segment/joint name.
About functional calibration in the biomechanics workflow

For calibration, the subject variables of interest: Kinematics (Joint Angles) and Kinetic (Forces, Moments and Powers), must be calculated from a joint center point and have a joint axis line to be accurate.

Nexus 2 provides functional joint calibration, which estimates the center and axis of a joint using joint movement collected in a Range of Motion (ROM) trial.

Because functional calibration requires you to be able to decide whether, for a particular ROM trial, you have collected the minimum amount of angular movement (per joint) needed to obtain a good calibration, it is a good idea to set up a joint range monitor to give you the instant visual feedback that enables you to make this decision quickly (for information on setting up a joint range monitor, see View real-time subject calibration feedback with monitors on page 76).

The biomechanics workflow enables you to include functional calibration and joint range monitors in your workflow steps, so that you can set up the required procedures once and then reuse them as required. For information on setting up a biomechanics workflow, see Create a biomechanics workflow on page 82.

For more information about the distinction between static and functional joint calibration, see the following definitions:
- What is static joint calibration? on page 80
- What is functional joint calibration? on page 81
- What is local optimization? on page 81

What is static joint calibration?

Static calibration uses a single frame of data. The subject is captured in a single pose (body position). Regression equations are used to estimate / calibrate:
- The location of a Virtual Joint Center point (relative to a segment)
- A line defining the axis of rotation for the Joint

Vicon’s Plug-In Gait model uses static joint calibration.
What is functional joint calibration?

Functional joint calibration uses multiple frames of data where the joint of interest is moving (dynamic).
Using Range Of Motion (ROM) data from a joint enables functional joint calibration to better estimate the true center and axis of a joint.

What is local optimization?

The process of eliminating errors and finding the best solution for joint centers and axes is sometimes referred to as optimization.
Local optimization takes information from one joint at a time and tries to find the best solution only for that joint.
SCoRE and SARA are local optimization techniques. They are a set of algorithms produced by researchers at the University of Berlin – Julius Wolff Institute for Biomechanics and Musculoskeletal Regeneration.
Create a biomechanics workflow

To create a biomechanics workflow, you use the Biomechanics Workflow area of the Data Management tab in the Communications window to associate specified data capture and processing steps with particular trial types, and monitors.

Before you begin adding the steps that will comprise your new workflow, make sure you have set up any required range monitors (see View real-time subject calibration feedback with monitors on page 76).

The following example shows you how to set up a biomechanics workflow that includes steps for a static capture, followed by a ROM capture coupled with a joint range monitor.

To create a new workflow:

1. On the Data Management tab in the Communications pane, open the File Transfer/Batch Processing interface.

2. Click the Biomechanics Workflow button.

3. Click the Add Step button to add your first step.
4. Double-click on the new step and add a name for it, in this case, Static Calibration.

⚠️ **Important**

For each step, this name will be the name of the trial that is saved as a result of running the step.

5. From the list of trial types to the right of the step name, select the required trial type for the step.

If the trial type doesn't exist yet, switch to Live mode and on the Capture tools pane, specify the required settings for the trial type, for example, for a static trial:

- **Name**: Static
- **Duration of the capture**: 2 secs
- **Run pipeline after capture**: Reconstruct and Label
6. Save the new trial type and in the Trial Type list, select the new trial type (in this case Static).
Now, every time you go to Live mode and run the new workflow, the first step will automatically capture a 2-second, static trial, and run the Reconstruct and Label pipeline afterwards. It will then automatically go to Offline mode and display buttons to enable you to accept or reject the result of the first step (the reconstructed and labeled trial).

7. To set up step 2, in the Biomechanics Workflow area:

   a. Click Add Step again.

   b. In the Step column, type a name for the second step, in this case ROM.

   c. In the Trial Type list, select the required trial type, for example, ROM. If the ROM trial type doesn’t exist yet, you will need to create it, using the same procedure as you used for creating a static trial type in the previous step. For a ROM trial, you may want to specify a different duration, or clear the Auto Capture Setup options so that you can start and stop the capture manually, when sufficient data has been collected.

8. To add a range monitor to your ROM step so that you can quickly assess whether to accept it, click the Monitor button, and from the list of available monitors, select the required monitor, for example, the one you created previously (see View real-time subject calibration feedback with monitors on page 76).
9. Continue adding steps, creating appropriate trial types as necessary, and adding monitors to help you make the Accept or Reject decision for each step, until you have completed your workflow.

Tip
To reorder the steps, click on a step and drag it to the required position in the list.

10. To save the completed workflow, click the **Save current configuration** button at the top of the Biomechanics Workflow area, and enter a suitable name for your new workflow.

11. To run your new workflow, change to **Live** mode and in the **Biomechanics Workflow** area, click **Start**.
When the step has run, Nexus automatically goes to **Offline** mode and the **Biomechanics Workflow** area displays buttons to enable you to accept or reject the result of the step.

If you click **Accept**, the next step, is run. If you click **Reject**, Nexus returns to Live mode, so that you can perform another capture.
Tips for creating biomechanics workflow steps

- When you run through the biomechanics workflow, the Play icon is displayed next to the current step, so that you can instantly see where you are in the workflow.

- In a similar way to running pipeline operations in the Pipeline tools pane, you can select or clear the check boxes next to each step to run only the required steps.

- If necessary, you can reorder the steps by dragging steps up or down in the Biomechanics Workflow area.
About SCoRE and SARA in Vicon Nexus

The SCoRe and SARA operations are provided with Vicon Nexus 2 for research purposes and to enable clinical researchers to assess their use, compared with other methods. You can download the literature for these methods from the Vicon website or obtain it from the group at the University of Berlin. Before using these methods, you are strongly advised to review the published material to understand the methods and best practices for gaining meaningful results.

A review of this literature suggests that for the joints of the lower limbs, SCoRE can produce a meaningful estimation of hip joint center locations. The axes produced by the SARA optimization may not be useful. This is due to ball and socket nature of the joint.

The opposite is suggested for the hinge-link knee joint. The SARA-optimized axis (primary flex/ext axis) may be useful; however the joint center location may not be strictly defined along this axis.

To allow further development and validation of these methods, Nexus does not restrict where they can be run. The operations allow the calculation of SCoRE and SARA for any combination of parent and child segments.

⚠️ Important

You are responsible for reviewing the published articles before using these operations. Research is continuing the area of functional joint calibration and it is solely your responsibility as the user to determine whether the results from these methods are appropriate for your research outcomes or clinical use.

By combining SCoRE and SARA with an existing Plug-in Gait model, you can obtain full kinematic and kinetic outputs with reduced errors.

ℹ️ Note

To apply SCoRE and SARA to Plug-in Gait, you need to obtain the Plug-in Gait MATLAB script. For more information, contact Vicon Support.
About SCoRE

SCoRE is an acronym for Symmetrical Center of Rotation Estimation.

It is an optimization algorithm that uses functional calibration frames between a parent and child segment to estimate the center point of rotation. It is particularly valuable in providing repeatable and accurate hip joint center locations.

SCoRE locates the joint center only. Kinematics and kinetics must still be calculated by a full biomechanical model (such as Plug-in Gait).

About SARA

SARA is an acronym for Symmetrical Axis of Rotation Analysis.

It is an optimization algorithm that uses functional calibration frames between a parent and child segment to estimate the axis of rotation. It is particularly valuable in providing repeatable and accurate knee joint axes.

SARA locates the joint axis only. Kinematics and kinetics must still be calculated by a full biomechanical model (such as Plug-in Gait).
Prepare data for use with SCoRE and SARA

OCST is a mathematical approach that finds the average or common shape for selected sets of marker (3 or more). It enables a non rigid cluster (skin-based) to be described as if it were truly rigid.

Important

Although marker clusters that are attached to a truly rigid base do not necessarily require OCST processing to provide rigidity, if you want to include the supplied SCoRE and SARA pipeline operations as part of your workflow, use of the Calibrate OCST and Process OCST operations is recommended to provide the best possible results.

Related research can be found in the published papers:


To create a segment using OCST:

1. Load the trial containing the markers whose positions are to be calculated using OCST. These markers will form the segments that will be used in SCoRE and SARA pipeline operations.
2. In the Pipeline tools pane, from the Subject Calibration pipeline operations, double-click the Calibrate OCST operation to add it to the current pipeline.
3. Click on Calibrate OCST and in the Properties pane ensure the required start and end frames, together with the required markers (at least three) are specified. To select the required markers, in the 3D Perspective view, CTRL+click or ALT+drag the markers (at least three per segment).
If you have Markers set to Selected in the Properties pane, to check that you have selected the required markers:

a. In the Properties pane for Calibrate OCST, click the small arrow to the right of the Markers field and clear the Macro check box.

You can now see the selected marker names in the Markers field.

b. When you have made sure you have selected the required markers, re-select Macro again.

4. In the Name field, enter a name for the segment to be created by OCST.

5. To create the new segment, run the pipeline.
In the following example, OCST segments called Pelvis and LFemur are created.

The new OCST segment names (Pelvis and LFemur in the above example) can now be passed into SCoRE and SARA pipeline operations.
Capture and process a trial with SCoRE and SARA

You can use the biomechanics workflow to simplify and speed up the capturing and processing of data that requires a number of repeated steps, and can include trial types, range monitors and post-processing pipelines. This makes it a particularly useful tool if you want to use the new SCoRE and SARA pipeline operations that are included in Vicon Nexus 2, as you can save any required ROM trial types, including joint range monitors, OCST pipeline operations, and any other processing needed, in a single workflow.

Advice was sought from research labs in the biomechanics community who use the SCoRE and SARA methodologies in their clinical assessments. The recommended Vicon Nexus 2 workflow for using these functional joint calibrations is derived from this advice.

To apply SCoRE and SARA to Plug-in Gait, you need to obtain the Plug-in Gait MATLAB script. For more information, contact Vicon Support.

For more information, see:
- Collecting data for use with SCoRE and SARA on page 93
- Capturing hip and knee ROMs on page 94
- Using SCoRE and SARA on page 94

Collecting data for use with SCoRE and SARA

You can capture trials in the following ways:
- One joint per trial, that is separate trials for each hip and knee (Left Hip, Right Hip, Left Knee, Right Knee); or
- A single ROM trial that includes joint movement for all four joints

Collecting a single ROM trial can save time in both capture and processing. However, some pathological subjects may require assistance in completing a joint ROM, so this is not always an option and multiple ROMs may be needed. The biomechanics workflow provides a way of performing the ROMs in one or multiple trials and saving the workflow so that it can be easily repeated and results obtained with the minimum of effort.
Capturing hip and knee ROMs

The goal with either hip or knee joints is to move the joint through as much of its entire range as possible.

- **Knees** are basically hinge joints with flexion and extension. Flexing and extending the knee through its full range is all that is required to capture the required motion.

- **Hips** are ball joints. When capturing a ROM for hip joints, the recommended approach is to have the subject (on their own or with assistance) perform a 'star arc'. This involves swinging the leg directly forward, then back to the static position, then to the side at a forty-five degree angle to the first swing, and back, and so on, round in a circle.

Using SCoRE and SARA

Before you run a **Calibrate SCoRE/SARA** pipeline operation, specify and run a **Calibrate OCST** pipeline operation on the relevant data, as described in the following steps.

To use SCoRE and SARA:

1. Create a pipeline that includes all the necessary operations:
   - A Calibrate OCST operation that specifies the parent segment (for example, Pelvis), by selecting at least three markers (for example, LASI, RASI, LPSI, RPSI). For information on how to do this, see [Prepare data for use with SCoRE and SARA on page 90](#).

   ![Image of pipeline with Calibrate OCST operations]

   - A Calibrate OCST operation that specifies the child segment (for example, LFemur), by selecting at least three markers (for example, LASI, LTHI, LKNE).
A Calibrate SCoRE /SARA operation that creates a joint center between the specified parent (Pelvis) and child (LFemur).

2. Run the pipeline.
   In the 3D Perspective view, you can see an additional SCoRE (or SARA) marker.
1. Process multiple joints with SCoRE and SARA

The following steps show how to calculate SCoRe joint centers and SARA knee axes in the same workflow. Including both hips and knees in the same workflow saves time, but relies on having a subject who can perform the required ROMs reasonably easily and without much assistance.

Before you begin, make sure you have set up monitors to display all the required range of motion for both hips and knees. (For information on setting up joint range monitors, see View real-time subject calibration feedback with monitors on page 76.)

To calculate SCoRE joint centers and SARA knee axes:
1. Capture a subject ROM. Ensure that, for the first few frames and last few frames, the subject is in the motorbike pose, as shown in the following images.

2. Reconstruct the trial and then run the Auto Initialize Labeling pipeline on the first frame of data (motorbike pose) to initialize the labeling.

3. Run the Functional Skeleton Calibration pipeline operation (found in the Subject Calibration pipeline operations) to calibrate the labeling skeleton.
4. Capture ROM trials that move the hip joint and knee joints through a ROM, as described in Capture and process a trial with SCoRE and SARA on page 93. To enable you to quickly assess the ROMs for multiple SCoRE and SARA trials, you can set up a biomechanics workflow, including joint range monitors, similar to the following:

![Biomechanics workflow](image)

For information on setting up a biomechanics workflow, see Create a biomechanics workflow on page 82.

5. Run the Reconstruct and Label pipeline.

6. Create a new pipeline to contain the SCoRE/SARA calibrations you will need, plus any required OCST calibrations. For example, you could call the pipeline Calibrate SCoRE & SARA.

7. Add the required Calibrate OCST pipeline operations to the new pipeline (see Prepare data for use with SCoRE and SARA on page 90).

8. Specify OCST segments for all the required joints, for example:
   - Pelvis (LASI, RASI, LPSI, RPSI)
   - LFemur (LASI, LTHI, LKNE)
   - LTibia (LKNE, LTIB, LANK)
   - RFemur (RASI, RTHI, RKNE)
   - RTibia (RKNE, RTIB, RANK)

Your new pipeline will now look similar to this:
9. For each joint, add a **Calibrate SCoRE/SARA** operation (found in the **Subject Calibration** pipeline operations), and specify each parent and child segment, for example:

   - For left hip:
     - **Parent Name**: Pelvis
     - **Child Name**: LFemur

   - For right hip:
     - **Parent Name**: Pelvis
     - **Child Name**: RFemur

   For these two joints, leave the **SARA Axis** check box cleared, as it is normally more applicable to the knee joints.

10. Add two more Calibrate SCoRE/SARA operations for the knee joints:
For the left knee:
  - Parent Name: LFemur
  - Child Name: LTibia

For the right knee:
  - Parent Name: RFemur
  - Child Name: RTibia

For these two joints, select the **SARA Axis** check box, as it is applicable to the knee joints.

11. Save the pipeline and calibrate the joints by running the **Calibrate OCST** and **Calibrate SCoRE/SARA** pipeline operations.

   New hip and knee joint markers are displayed in the 3D Perspective view pane.

12. Collect dynamic trials with the subject performing the required movement (walking, etc).

13. Create a new **Process SCoRE & SARA** pipeline to contain the processing operations.

14. For each SCoRE/SARA joint that you created previously, add a **Process SCoRE/SARA** operation (found in the Data Processing pipeline operations).

   Specify the same Parent and Child segments as those you created in the **Calibrate SCoRE & SARA** pipeline.
15. Run the processing pipeline.
Improve manual labeling

In addition to the procedures described in Review trials and fill gaps in the Vicon Nexus User Guide, if your data contains overlapping trajectories and/or ghost markers, you may need to do some further work.

For more information, see:
- Eliminate overlapping trajectories on page 103
- Prevent ghost markers on page 104
Eliminate overlapping trajectories

Nexus recognizes a marker's trajectory continuously throughout a captured trial. There can be gaps in the data, but Nexus can still recognize the same marker trajectory on either side of a gap, as long as the gap is small enough or the marker's movement doesn't vary significantly within the gap.

Occasionally, instead of a gap or a continuous marker trajectory, Nexus creates two separate sub-trajectory sections that belong to the same marker. This is called an overlapping trajectory, because the two sections overlap; that is, they are both present in the same frame(s).

During the labeling process, because both trajectories are present in the same frame(s), Nexus assumes that they must belong to separate markers. Therefore, when Nexus auto-labels these trajectory sections, it labels one and leaves the other unlabeled.

Overlapping trajectories can cause difficulties during manual labeling. One common difficulty occurs when two markers are correctly labeled at the start of the trial but then become confused or “swapped” later in the trial.

If you attempt to correct this label swap with Whole selected in the Manual Labeling section of the Label/Edit Tools (the default setting), you may lose correct labels early in the trial. The easiest way around this issue is by clicking the Backward or Forward button before labeling, so that labeling is only continued in the frames before or after the current frame.

When this labeling method is used, Nexus “snips” the trajectory at the current frame and only labels in the direction chosen (forward in time or backward in time from the current frame). The process of snipping a trajectory causes a single continuous trajectory to be split into two separate unique trajectories at the current time frame.
Prevent ghost markers

The typical cause of overlapping trajectories is spurious, or ghost, markers that are present during marker reconstruction. A ghost marker is a false marker reconstruction that appears as an additional trajectory very close to a legitimate marker trajectory. Ghost markers can be reconstructed if:

- The Nexus Core Processor settings are not optimized for the type of capture you are performing. For example, if a Reconstruction Minimum Separation is set too low, Nexus may reconstruct all detected marker positions rather than selecting only the best candidates.

  Depending on whether you want to adjust the Core Processor settings for offline data or live capture:

  - If you do not want to recapture the trial you are processing, you can adjust the Offline processing parameters and reprocess the existing trial to see if Nexus can resolve the overlapping trajectory. You set offline processing parameters in the Core Processing operations in the Pipeline Tools pane.

  - However, you may also need to evaluate whether future captures will be similar enough to the current trial conditions (such as subject movements, marker placement and movement, number of cameras, etc.), that also adjusting the Live Core Processor settings will eliminate this situation in the future. You set live processing parameters by clicking on Local Vicon System in the System Resources pane and then in the Properties pane going to the General section and selecting the required Processing Output Level.

- One or more cameras need to be recalibrated. For example, if one or more cameras has been accidentally knocked since it was calibrated. For more information, see Understand camera calibration refinement on page 222.

- Camera masking is inadequate or has not been performed. For more information on masking, see Mask unwanted reflections in the Vicon Nexus User Guide.

After you have addressed the above issues, you will then need to reprocess the trial before proceeding.

If adjusting the reconstruction parameters and reprocessing do not produce a properly labeled trajectory, you may need to manipulate the trajectory sections manually.
Eye tracking with Vicon Nexus

The Dikablis Eye Tracking system, when combined with a Vicon motion capture system, enables you to calculate the head position and 3D gaze vector of a test subject. It is compatible with current Vicon cameras. A minimum of two cameras are required for use with the system.

The Dikablis Eye Tracking unit is available in either wired or wireless options. The wireless unit provides unlimited mobility and allows the test subject to move within a perimeter of up to 800 meters.

For more information, see:

- Set up eye tracking hardware on page 106
- Add a Dikablis Eye Tracker device in Vicon Nexus on page 108
- Calibrate eye tracking in Vicon Nexus on page 110
- Export eye vector data on page 117
Set up eye tracking hardware

Before setting up your Dikablis Eye Tracking system with Vicon Nexus, ensure the following system components are ready for use:

- Head unit
- Dikablis laptop
- Ethernet cable or crossover cable
- Battery pack and wireless transmitter (for wireless option), with battery fully charged
- Dikablis wireless receiver (for wireless option)

Although you can capture both Vicon data and Dikablis gaze data on a single PC, a dual-computer setup is recommended, where:

- The Dikablis laptop connects to the head unit and runs the Dikablis software.
- The desktop computer is connected to the Vicon system and runs Nexus.
- The Dikablis laptop is directly connected to the Nexus PC via a cable that runs between two Ethernet ports.

![Diagram of network connections]

**Note**

Before proceeding, ensure the battery is fully charged. When fitting the battery into its holder, make sure the battery is correctly oriented by first inserting the end with the contact points and then clicking the other end into place in the holder. For further instructions on setting up the hardware, see the *Dikablis Eye Tracker User Manual*. 
Ensure the Dikablis Eye Tracking system is calibrated

Before you add a Dikablis Eye Tracker device to Vicon Nexus, set up the Dikablis laptop and ensure that eye tracking is calibrated, so that the pupil is tracked accurately by Dikablis Recorder.

To ensure the Dikablis Eye Tracking system is calibrated:

1. Turn on the Dikablis laptop.
2. Double-click the Dikablis Recorder icon on the desktop to start the software.
3. Attach the head unit to the subject’s head (for instructions, see the Dikablis Eye Tracker User Manual).
4. In Dikablis Recorder, ensure that a cross hair appears on subject’s pupil and that the pupil is accurately tracked (for instructions, see the Dikablis Eye Tracker User Manual).
Add a Dikablis Eye Tracker device in Vicon Nexus

After you have verified that the Dikablis Eye Tracking system is calibrated, add the Dikablis Eye Tracker in Nexus as a device.

To add eye tracking in Nexus:

1. In the System resources pane, click the Go Live button.

2. Right-click Devices, point to Add Digital Device, and select Add Dikablis Eye Tracker. A Dikablis Eye Tracker node appears under Devices.

3. Click the Dikablis Eye Tracker node that you just added to select it and in the Properties pane, set the following communication parameters in the Connection section:
   - **IP Address**: Use the same IP address that has been set in the Dikablis eye tracking software.
   - **Port Number**: Leave as default (2002).

4. If the connection and IP address are correct, the Dikablis Eye Tracker icon in the System resources tree turns green. This indicates that Nexus is able to communicate with and receive the data stream from the Dikablis laptop.
5. With the head unit attached to the subject, display a Graph view in Nexus and ensure that a line is displayed charting the pupil coordinates.

Data will begin streaming from the Dikablis software when it is in Record mode.
Calibrate eye tracking in Vicon Nexus

Before capturing an eye tracking trial, you must calibrate eye tracking within Nexus. To do this, complete the following procedures in the order shown:

1. Set up a calibration trial for eye-tracking on page 110
2. Create objects for eye tracking in Vicon Nexus on page 111
3. Specify Dikablis Eye Tracker device properties on page 114
4. Calibrate eye tracking in Vicon Nexus on page 115

Set up a calibration trial for eye-tracking

To set up a Vicon Nexus calibration trial for eye-tracking:

1. Before you begin a calibration trial for eye-tracking, ensure you have calibrated your Vicon cameras, set the volume origin, and added the Dikablis device to Nexus.
2. Get your subject to enter the volume wearing the head unit with markers, and holding the calibration wand in front of them.
3. In the Capture tools pane, in the Next Trial Setup section, enter a Trial Name (for example, Calibration), and in the Capture section, click Start to capture a short trial (a couple of seconds).
4. Load the trial you just created (on the Data Management tab (F2), double-click on the trial) and on the Nexus toolbar, click the Reconstruct button.
5. In a 3D Perspective view, zoom in so you can see the two objects (subject and wand).
Create objects for eye tracking in Vicon Nexus

To set up a calibration trial for eye tracking, you need to create wand and head objects.

To create the objects in Nexus:

1. On the Subjects resources pane, click the Create a blank subject button.

2. In the Enter Subject Name dialog box, enter the subject name: Wand.

3. On the Subjects tab, click the Wand object you just created to select it and at the top of the Subject Preparation tools pane on the right of the screen, in the Subject dropdown menu, ensure Wand is selected.

4. In the Subject Preparation tools pane, in the Labeling Template Builder section, enter a segment name (Wand) in the Create Segments box and click Create.

5. In a 3D Perspective view, select the wand markers, beginning with the origin (middle) marker.

6. Ensure all the wand markers are selected.
7. In the Labeling Template Builder section, click Create again.

8. In the 3D Perspective view, check the axes and origin are shown for the wand.

9. To create a head object, in the Subjects Resources pane, click the Create a blank subject button and in the Enter Subject Name dialog box, enter Head.

10. On the Subjects resources pane, click the Head object you just created and at the top of the Subject Preparation tools pane, ensure Head is selected.

11. In the Labeling Template Builder section, in the Create Segments box, type Head and click Create.

12. In the 3D Perspective view, select the head markers, beginning with the origin marker. For the head’s origin marker, select the marker closest to the eyeball, then select the others.
13. In the Labeling Template Builder section, click Create again.

14. In the 3D Perspective view, check the axes and origin are shown for the new object.

15. Before proceeding, it is a good idea to save both subjects (Wand and Head). To do this, on the Subjects Resources pane, right-click on the node for each subject in turn and then click Save Subject.
Specify Dikablis Eye Tracker device properties

After you have created both the Wand and the Head in Nexus, specify their properties on the System Resources tab.

1. On the System resources tab, click on the Dikablis Eye Tracker node, and in the General section of the Properties pane, in the Head Segment field, enter Head.

2. In the Eye Offset section, enter the relevant values (that is, the distance between the origin marker and the eye).

```
Tip
To find the relevant eye offset values, if your Vicon system includes video cameras, you can use overlay video. If not, you can measure the distance from the origin marker.
```

3. In the Calibration Object field in the Calibration section, enter the name of the calibration object (Wand).

You have now set up the eye tracker properties.
Calibrate eye tracking in Vicon Nexus

After you have added eye tracking to Nexus, created Head and Wand objects, and set the eye tracking properties, you can complete the final steps.

To calibrate the eye tracker in Nexus:

1. On the **SystemResources** pane, under the expanded **Dikablis Eye Tracker** node, click the **Eye** node to select it.

2. Display a **Data Correction** view, to show both a **3D Perspective** and **Graph** view.

   ![Eye Tracking Calibration View](image)

   You should see the x and y values for the selected eye.

3. In the capture volume, place the wand 2–2.5 meters from the subject and get the subject to look at the origin marker (the middle marker at the top of the T).

4. On the **SystemResources** tab, click the **Dikablis Eye Tracker** node and in the **Properties** pane, go to the **Calibration** section and click **Add**.

5. Move the wand to another part of the volume and click **Add** again.
   In the **Samples** box, 2 is displayed.

6. Repeat the previous step.
   After you have collected three samples, an eye vector and an eyeball are displayed in the **3D Perspective** view.
7. Collect more samples (aim for at least five samples in total) to refine your results.

**Tip**

When collecting samples, place the wand in the bottom left of volume and have the subject look at the origin marker. Pause for about a second and then in the **Calibration** section, and click **Add**. Then place the wand in the top left of the volume, and have the subject look at the origin marker. Again, pause, and click **Add**. Repeat with the wand at the top right of the volume, and then at the bottom right of the volume. Continue to move the wand and click **Add** until the eye gaze vector accurately tracks the origin marker.

8. When the eye tracker system has been calibrated (and if the subject is looking at the origin marker), in **3D Perspective** view, the eye gaze vector will pass through (or point to) the origin marker of the calibration wand, depending on how far the subject's head is from the wand.

9. View the results in a **3D Perspective** view.

10. To check that the eye tracks the wand correctly, record a short trial.
Export eye vector data

To use eye vector data, you will normally want to export both the eye vector data itself and the Head and Tracker data (the segment data) that relates the eye vector to its position within the global coordinate system. To export all the information relating to the eye vector, you must reconstruct and label the trial and kinematically fit the data before exporting it.

To export eye vector data and segment data:

1. Load into Vicon Nexus the trial from which you want to export eye tracking data.
2. On the System tab of the Resources pane, click the Dikablis Eye Tracker node to select it.
3. To check that the eye vector data is included, open a Graph view pane and observe the eye vector x and y values.

Note

You can export the eye vector data at this point, but the exported file will not include the segment data, which is necessary to position the eye vector within the global coordinate system.
4. Run Reconstruct and Label, either by clicking the Reconstruct and Label button on the Nexus toolbar or by running the Reconstruct and Label pipeline in the Pipeline Tools pane.

   In the 3D Perspective view, as processing proceeds, you can see first the addition of the object markers and then the labeling.

5. After labeling is complete, to see and use the eye vector, you need to kinematically fit the data. To do this, run Kinematic Fit, either by clicking the KinFit button on the Nexus toolbar or by running the Kinematic Fit pipeline in the Pipeline Tools pane, making any changes necessary in the Properties pane.

   Tip

   To produce the required result, you may need to reduce the Prior Importance to zero.

6. Run the Kinematic Fit operation.

   The eye vector is displayed in the 3D Perspective view.

7. In the Pipeline Tools pane, expand File Export, then double-click Export ASCII.

8. In the Properties pane, in the Segments section, change the Global Angle setting to All.

9. Run the Export ASCII pipeline operation.

10. To see the exported data, on the Data Management tab, with the relevant trial selected, click on the hyperlink at the bottom and double-click the relevant .csv file to open it.

    The eye vector data is displayed as a unit vector in the columns headed RayX, RayY, and RayZ.
The units are between 1000 and -1000mm. Note that the eye vector data is local to the segment to which the eye tracker is connected (i.e., the Head). Both the eye vector data and the Head and Tracker (and Wand) data are exported.

11. To position the eye vector in global coordinate space, you need to use the Head and Tracker data. To ensure accuracy, you also need to apply the offset from the Head segment. To find the offset, in the System Resources pane, click on the Dikablis Eye Tracker node and in the Properties pane, go to the Eye Offset coordinates.

12. When you save, kinematic data is not saved, so to preserve kinematics, rerun Kinematic Fit.
Vicon Nexus user interface

This chapter provides detailed descriptions of the main components of the Vicon Nexus user interface:

- About the Vicon Nexus user interface on page 121
- Resources pane on page 122
- System tab on page 126
- System Resources nodes on page 132
- Subjects tab on page 190
- View pane on page 198
- Tools pane on page 218
- Communications pane on page 249
- Menu bar on page 255
- Toolbar on page 261

For basic instructions on how to use these components, see the Vicon Nexus User Guide.
About the Vicon Nexus user interface

The Vicon Nexus user interface includes the following components:

- **Resources pane on page 122**: Enables you to manage the components of your Vicon system and the subjects whose motion is to be captured.

- **View pane on page 198**: Enables you to set up the way you want to view the capture data from one or more cameras (or supported third-party devices), either live in real time or from file for post-processing.

- **Tools pane on page 218**: Enables you to manage each step of the motion capture workflow through preparation, acquisition, and review.

- **Communications pane on page 249**: Enables you to run customized workflows, check system status, view log information, and monitor trials.

- **Menu bar on page 255**: Enables you to access common commands from the current workflow stage.

- **Toolbar on page 261**: Enables you to access frequently used commands from the current workflow stage.

For introductory information about the Nexus user interface, see *Introducing Vicon Nexus* in the *Vicon Nexus User Guide*. 
Resources pane

The Resources pane contains the following elements:

- System connection buttons on page 122
- Resources tabs on page 123
- System and Subjects trees on page 124
- Properties pane on page 125

You can hide, pin, and unpin the Resources pane to ensure you use the available screen space as efficiently as possible (see Customize the Vicon Nexus user interface in the Vicon Nexus User Guide).

System connection buttons

Nexus has two operating modes: Live Mode and Offline Mode. The system status indicators at the top of the Resources pane make it easy for you to immediately identify the current operating mode and the hardware connection status.

- Live mode connects the system and starts real-time streaming.
- Offline mode disconnects the system and stops real-time data streaming. Previously captured and saved data can be played back offline.

<table>
<thead>
<tr>
<th>Appearance</th>
<th>System status</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="resources.png" alt="Image" /></td>
<td>System in Live Mode - No connection established with Vicon hardware</td>
</tr>
<tr>
<td><img src="connected.png" alt="Image" /></td>
<td>System in Live Mode - Connection established with Vicon hardware</td>
</tr>
<tr>
<td><img src="offline.png" alt="Image" /></td>
<td>System in Offline Mode - No trial loaded in memory</td>
</tr>
</tbody>
</table>
Appearance

System in Offline Mode - Trial is loaded in memory
The trial name is displayed to the left. The tooltip shows the file location.

Pause button

Pauses real-time data streaming. This button is available and is a brighter color when the system is in its Live mode.

Resources tabs

You select the type of resources to be displayed by clicking the appropriate Resources tab:

- **System** tab Lets you configure the components of your Vicon system. For more information, see System tab on page 126.
- **Subjects** tab Lets you load and manage files for the subjects whose motion data you want to capture and analyze in Vicon Nexus. For more information, see Subjects tab on page 190.
System and Subjects trees

You select the items and any sub items to be configured with the System tree or Subjects tree in the middle of the Resources pane. The nodes displayed in the tree depend on whether you are viewing the System tab or the Subjects tab in the Resources pane.

For more information, see System Resources nodes on page 132 and Subjects tab on page 190.
Properties pane

You view and change settings for the item selected in the resources tree in the Properties pane at the bottom of the Resources pane. The contents of this section depend on the node selected in the Resources tree.

For information about the available properties, see the Properties section for the required node in System Resources nodes on page 132.

To see additional settings for the selected node, click Show Advanced at the top right of the Properties pane. To show basic settings only, click Hide Advanced.
System tab

The **System** tab in the **Resources** pane enables you to manage the components of your Vicon system.

The System tab contains the following sections:

- System configuration management on page 126
- System Resources tree on page 127
- System Properties pane on page 131

System configuration management

![System configuration management section](image)

You create or manage configurations for the settings on the **System** tab using the configuration management section at the top of the pane. This section is displayed when Nexus is in Live or Pause mode (click the **Go Live** button or the **Pause** button).

This enables you to save any changes you make to the settings on the System tab to a configuration file, with the extension `.System`. You can then re-use your saved configuration file as required, for example, you could save different system settings for each type of motion capture application that you use.

In addition to creating customized **Systems** configurations, the Configuration menu button enables you to rename, import, reload and delete configurations and refresh the list.
System Resources tree

You select the node for the system component you want to configure in the **Resources** tree on the **System** tab (the nodes displayed depend on the current system connection mode and connected system components):
### Node Description

<table>
<thead>
<tr>
<th>Node</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local Vicon System</td>
<td>Displayed in Live mode only. Enables you to view and/or control the Vicon system capture rate and the Nexus memory buffer size; real-time processing settings; and the identification and connection settings for the Nexus host PC.</td>
</tr>
<tr>
<td></td>
<td>The <strong>Local Vicon System</strong> node contains sub nodes for each device connected to your Vicon system under the following nodes:</td>
</tr>
<tr>
<td></td>
<td>† Vicon Cameras</td>
</tr>
<tr>
<td></td>
<td>† Vicon Connectivity</td>
</tr>
<tr>
<td></td>
<td>† Video Cameras</td>
</tr>
<tr>
<td></td>
<td>† Devices (including force plates, accelerometers, EMG, Dikablis eye tracker, etc)</td>
</tr>
<tr>
<td></td>
<td>The node for the device designated as the Vicon system synchronization master is highlighted in bold in the <strong>System Resources</strong> tree. For more information, see <em>Change the synchronization master</em> in the <em>Vicon Nexus User Guide</em>.</td>
</tr>
<tr>
<td></td>
<td>For more information on this node, see <strong>Local Vicon System node on page 132</strong>.</td>
</tr>
<tr>
<td>Vicon Data</td>
<td>Displayed in Offline mode only. The details for cameras and capture devices in your Vicon system that were used for a previously saved motion capture trial. For more information, see <strong>Vicon Data node on page 144</strong>.</td>
</tr>
<tr>
<td>Vicon Cameras</td>
<td>The identification and configuration settings for each Vicon camera connected to your Vicon system. For more information, see <strong>Vicon Cameras node on page 145</strong>.</td>
</tr>
<tr>
<td>Vicon Connectivity</td>
<td>The identification and configuration settings for each Vicon connectivity device included in your Vicon system architecture. For more information, see <strong>Vicon Connectivity nodes on page 163</strong>.</td>
</tr>
<tr>
<td>Devices</td>
<td>The connection and configuration settings for Vicon and supported third-party devices included in your Vicon system architecture. For more information, see <strong>Devices node on page 170</strong>.</td>
</tr>
</tbody>
</table>
You can perform commands specific to a type of system component node or sub node by right-clicking on a node in the System Resources tree and selecting the desired command from the displayed context menu.

**Device status**

Some nodes have sub-nodes for individual components of that type:

- Green play button: Component OK (active or connected); if an analog device is connected to the Vicon component, the analog source is selected and all channels are configured.
- Yellow pause button: Component not fully set up
- Gray play button: Component connected but not contributing any data.
- Red stop button: Component down (unavailable or disconnected)
- Green arrow: Analog channel connected to source device.
- Yellow arrow: Analog channel not connected to source device, or device is disabled (Enabled check box is not selected in the Status section of the Properties pane.)

For more information on the status of system components, see Status tab on page 253.

**Reorder Devices dialog box**

You change the order in which devices are displayed in the System Resources tree in the Reorder Devices dialog box.
You access this dialog box by right-clicking **Vicon Cameras**, **Video Cameras**, **Vicon Connectivity** nodes, or **Devices** in the **System Resources** tree and selecting **Reorder** from the context menu. This menu is available only when the system is in Live mode (click the **Go Live** button); devices listed in an offline processing file cannot be reordered.

Each Vicon camera and connectivity device is assigned a unique ID at manufacture, which remains the same, regardless of its position in the list of other devices of the same type. Once integrated in a Vicon system, each device is assigned a sequential ID, which is used to identify it (for example, in user interface lists and camera calibration parameters (.xcp) files). This sequential ID is not dependent on which socket the device is plugged into (for example, a Vicon camera plugged into socket 2 in an MX Giganet is not necessarily assigned a device ID of 2). Reordering the device changes its sequential ID. You may find this useful if you want to order your device numbers to match their physical sequence in your capture volume.

**To change the order of devices in the Reorder Devices dialog box:**

1. In the **System Resources** tree, right-click **Vicon Cameras**, **Video Cameras**, **Vicon Connectivity** or **Devices** and from the displayed context menu select **Reorder**.

2. In the **Reorder Devices** dialog box, click on the device whose position you want to change.
   
   In the **Identifier** column, the color of the circle to the left of the ID number indicates the current status of that device:
   
   - **Blue (Present)** - Devices that are physically in use, or are part of the latest calibration
   - **Black (Remembered)** - Devices that are not present at this time, but were connected at least once in the past

   The **Original Identifier** column shows the sequence ID previously assigned to the device.

3. Change the order of the device using the buttons:
   
   - **Move Up** Move the selected entry up one position in the list.
   - **Move Down** Move the selected entry down one position in the list.
   - **Sort** Sorts the list of devices according to name and type. Remembered devices are at the bottom of the list.
   - **Clean** Removes the entries for devices that are not present in the current session.

4. Repeat steps 1–3 for each device whose position you wish to change.

5. Click **OK** to save the changes and close the **Reorder Devices** dialog box.
System Properties pane

You can view or modify system components in the Properties pane, which is at the bottom of the System tab.

The properties displayed depend upon the component node selected in the System tree. Properties can be presented in categories such as General, Settings, etc.

To see all the properties for a selected component node, ensure you have clicked Show Advanced at the top of the Properties pane.
System Resources nodes

The following topics describe nodes that are displayed in the tree on the System tab of the Resources pane:

- Local Vicon System node on page 132
- Vicon Data node on page 144
- Vicon Cameras node on page 145
- Video Cameras node on page 157
- Vicon Connectivity nodes on page 163
- Devices node on page 170
- Force plate nodes on page 171
- Analog accelerometer, EMG, and other analog device nodes on page 180
- Digital device nodes on page 182
- Dikablis Eye Tracker node on page 182
- Zerowire EMG node on page 185

Local Vicon System node

The Local Vicon System node is the top-level node that is displayed for the Nexus host PC when Nexus is in Live mode. It contains sub-nodes for each device connected to your Vicon system:

- Vicon Cameras
- Vicon Connectivity (Vicon Lock+, Vicon MX Giganet)
- Video Cameras
- Devices (including force plates, accelerometers, EMG, Dikablis eye tracker, etc)

The node for the device designated as the synchronization master is highlighted in bold in the System Resources tree. (For more information, see Change the synchronization master in the Vicon Nexus User Guide.)

For more information on the Local Vicon System node, see:

- Local Vicon System node context menu on page 133
- Local Vicon System properties on page 133
Local Vicon System node context menu

You can select from the following commands on the context menu displayed when you right-click on the Local Vicon System node:

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

Local Vicon System properties

You can configure the following settings in the Properties pane for the Local Vicon System node.

☑️ Tip

If you can't see some of the listed properties, click Show Advanced at the top of the Properties pane.

These settings affect the local Vicon system in Live mode. The equivalent settings for offline processing can be found under Core Processing operations on page 234 on the Pipeline tab.
Local Vicon System properties are divided into the following sections:

**System section**
Contains system-wide parameters that affect all the connected cameras and devices.

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Requested Frame Rate (Hz)</td>
<td>The rate (in Hertz) at which to synchronize the Vicon cameras. If using external video signal, select from displayed values (multiples of the base frame rate of the PAL, NTSC, or Film video standard specified in Standard) up to a maximum of 2,000. You can choose any number you want if you do not have any Genlock Standard set. The configured Vicon system capture rate is displayed in square brackets beside the node. For example, if the Vicon system frame rate is set to 100 Hz, the node title is displayed as Local Vicon System [100Hz]. If the Requested Frame Rate cannot be met due to the camera frame rate, Vicon Nexus displays the nearest adjusted frame rate in square brackets. To meet the Requested Frame Rate, you can change the Sub Sample Ratio of the relevant camera(s). Default: 100</td>
</tr>
<tr>
<td>Actual Frame Rate (Hz)</td>
<td>The frame rate used by the Vicon system, which is constrained by the camera frame rate limits.</td>
</tr>
<tr>
<td>Preferred Master</td>
<td>A list from which you can choose the synchronization master. If you are using multiple devices such as Vicon Lock+ or MX Giganets, to connect and control your cameras, a synchronization master is automatically chosen by Vicon Nexus. If the automatically selected synchronization master is not the required choice, you can select the appropriate device from the Preferred Master list. (For more information, see Change the synchronization master in the Vicon Nexus User Guide). Default: Automatic</td>
</tr>
<tr>
<td>Buffer Size (MB)</td>
<td>The size (in MB) of the memory buffer on the host PC when Nexus is receiving data from Vicon hardware. Specify a value between 0-1024 MB. This buffer is used if data comes in faster than Nexus can process it; therefore, the larger the buffer, the longer it takes before capture fails. Increasing this value enables a greater Capture Before Start</td>
</tr>
</tbody>
</table>
### Property Description

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>duration to be set. The optimum size of the Buffer Size parameter depends on the amount of memory on your PC. The proportion of the total memory buffer that is reserved for Vicon devices is determined by the Buffer Reserve (see below). Tip: If you experience failure of a combined video and optical camera calibration, particularly if you are capturing a long wand wave, close and restart Nexus. Reduce the Buffer Size to 0 MB before calibrating. Do not increase the buffer size to its usual level until you have completed a successful calibration. Default: 250</td>
<td></td>
</tr>
<tr>
<td>Buffer Reserve</td>
<td>The proportion of the total buffer size (see Buffer Size above) that is reserved for Vicon video devices. The default of 0.5 results in half of the total buffer size being reserved for Vicon video devices (Vicon Vue and Bonita Video cameras). The remaining buffer space is used by third-party video cameras. If you want to maximize the buffer space reserved for Vue or Bonita Video cameras, set this value to 1.0. If you are using only Basler cameras or third-party DV cameras, set this value to 0. Default: 0.5</td>
</tr>
<tr>
<td>Reboot All</td>
<td>Resets all of the Vicon hardware devices in the Vicon system. Use this button if a camera has failed to boot, or if you need to reset the whole system for other reasons. Alternatively, use the Reboot Vicon Hardware command from the context menu.</td>
</tr>
<tr>
<td>Minimize Latency</td>
<td>Minimizes the level of latency, or lag time, the RealTime Engine introduces during data streaming when data rates approach or exceed system processing capacity. If selected, the RealTime Engine introduces no lag time when processing data frames. This decreases data throughput, but increases the possibility of frames being dropped. If cleared, the RealTime Engine introduces 20 frames of lag time when processing data frames. As this increases data throughput, it can produce better labeling results. Default: Cleared</td>
</tr>
</tbody>
</table>
Genlock and Timecode section

Settings for genlock and timecode.

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Genlock Standard</td>
<td>The type of video standard supported by the connected video source: None, PAL, NTSC, Film (24 fps), Film (24/1.001 fps, 30Hz, VESA (100Hz) or VESA (120Hz). For information about the symbols in this list, see Icons in Genlock and Timecode lists on page 137. Default: None</td>
</tr>
<tr>
<td></td>
<td><strong>Important</strong>: To use the 30Hz option, the Vicon firmware must be Bundle 500 or above.</td>
</tr>
<tr>
<td>Enable Genlock</td>
<td>Enables genlock based on the signals that are currently detected.</td>
</tr>
<tr>
<td>Auto Genlock</td>
<td>Automatically selects a genlock standard and enables genlock based on the signals that are currently detected.</td>
</tr>
<tr>
<td>VESA Offset</td>
<td>Applies only if you have selected one of the VESA standards from the Genlock Standard list (see above). It enables a system offset relative to VESA signal (as a fraction of the VESA frame period). It changes when the Vicon cameras take a frame (and hence when the camera strobes are on) relative to the incoming VESA frames. The camera timing can be offset by up to one VESA frame. The main purpose of this feature is to prevent camera strobes from interfering with the IR-synchronized 3D glasses used in some virtual reality systems.</td>
</tr>
<tr>
<td>Timecode Source</td>
<td>The genlock timecode source. Can be VITC, LTC, Internal or Internal Drop (uses drop frame when applicable). Default is Internal. For information about the symbols in this list, see Icons in Genlock and Timecode lists on page 137. Note: VITC and LTC always display a flat line if the system is not genlocked. This is because these signal types can only be detected by a master device that is genlocked.</td>
</tr>
<tr>
<td>Enable Timecode</td>
<td>When selected, timecode is enabled.</td>
</tr>
</tbody>
</table>
Detected Timecode

Given as the number of timecode frames per second for example, 24 fps, 25 fps, 30 fps, 30 fps DropFrame

Icons in Genlock and Timecode lists

The icon to the left of each option provides additional information about the availability of that standard:

<table>
<thead>
<tr>
<th>Icon</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cross</td>
<td>The standard is not supported by the hardware (that is, no connected device supports locking to a signal of that type). If you select an unsupported standard, it restricts the available frame rates as it does in the previous version of Nexus.</td>
</tr>
<tr>
<td>Flat line</td>
<td>No device in the system is detecting that standard.</td>
</tr>
<tr>
<td>Blue square wave</td>
<td>The master device is detecting that signal and can genlock to it.</td>
</tr>
<tr>
<td>Green square wave</td>
<td>If you select a mode with the blue wave icon and then select the Enable Genlock check box, the icon turns green.</td>
</tr>
<tr>
<td>Red square wave</td>
<td>A device in the system is detecting the mode but a problem prevents it from being used, for example, if the signal is being detected by a device that is not the master device in the system.</td>
</tr>
</tbody>
</table>

In all cases, you can display a tooltip by holding the mouse over the Genlock Standard list.

General section

Settings for the Core Processor component, which receives data from the Vicon cameras and transforms the data to the trajectories or segments that your Vicon system is tracking.
**Property** | **Description**
--- | ---
Processing Output Level | The amount of real-time processing the Core Processor is to perform on source data:
  - **Circles**: Have the Nexus Core Processor attempt to circle fit grayscale blobs that the Vicon cameras could not resolve. Data will not be reconstructed to 3D trajectories, so you will only see data in the 2D Camera view pane.
  - **Reconstructions**: Create 3D reconstructions of marker images. 3D trajectories are created, but they are not labeled.
  - **Labels**: Assign labels to markers, based on the Vicon Skeleton (.vsk file). Labels are applied to the reconstructed trajectories if a .vsk file is present.
  - **Kinematic Fit**: Fit joint angles defining the relationship between segments. The segments defined in the .vsk file are fitted and displayed.

Default: **Labels**
**Important**: These settings are applied cumulatively. For example, selecting **Labels** applies that setting as well as the **Reconstructions** and **Circles** settings.

---

**Grayscale Circle Fitting section**

| Property | Description |
--- | --- |
Enable | Select this check box to enable circle fitting of grayscale blobs. If selected, processing speed may be slightly slowed, but more data may be collected. Default: Selected. |
Reconstruction section

Controlling the number of cameras that are required to start or continue a trajectory can be beneficial in producing higher quality data. The ability to define how trajectories are created can help you to produce higher quality data that requires less manual editing.

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental Drift Tolerance</td>
<td>Increase this parameter to reduce the sensitivity (in mm) of the camera calibration to environmental factors, particularly temperature change. Use this setting to compensate for environmental changes when you do not have time or other resources to recalibrate the whole system. For the most accurate results, recalibration remains the preferred solution. Default: 1.5</td>
</tr>
<tr>
<td>Minimum Cameras to Start Trajectory</td>
<td>This parameter controls how many cameras (rays) must see the same marker (centroid) in order to create a new reconstruction and potentially form a new trajectory. The minimum value that can possibly create a reconstruction is two cameras. The maximum value of this parameter is 30 cameras or the total number of cameras in your system. This value can be increased if there are a large number of unlikely reconstructions being created. Default: 3 cameras</td>
</tr>
<tr>
<td>Minimum Cameras to Continue Trajectory</td>
<td>This parameter controls how many cameras (rays) must see the same marker (centroid) in order to create a reconstruction to continue a recognized trajectory. The minimum value that can possibly create reconstructions is two cameras. The maximum value of this parameter is 30 cameras or the total number of cameras in your system. The value can be decreased if there are gaps in trajectories where reconstruction should be possible when viewed by fewer cameras. Default: 2 cameras</td>
</tr>
<tr>
<td>Reconstruction Minimum Separation</td>
<td>The minimum distance, specified as a value in the range 0–1000000 millimeters, allowed between 3D marker positions in order for them to be considered for reconstruction. If two</td>
</tr>
</tbody>
</table>
Candidate reconstructions are closer than this minimum separation, only the most likely reconstruction (in terms of the number of cameras contributing) will be reported. The other will be discarded. A higher value decreases the likelihood of creating spurious reconstructions, but increases the possibility that some genuine markers will not be reconstructed. Generally, this parameter should be slightly above the size of the markers you are using. For example, if you are using 14mm markers, try setting it to 16mm. Then, for example, if during reconstruction two markers (one a ghost marker) are found within 17mm, one would be discarded.

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Centroid Radius</td>
<td>The minimum radius (in pixels) of a 2D centroid that is allowed for a reconstruction. Any reconstruction with a radius less than this value is ignored.</td>
<td>0</td>
</tr>
<tr>
<td>Maximum Centroid Radius</td>
<td>The maximum radius (in pixels) of a 2D centroid that is allowed for a reconstruction. Any reconstruction with a radius greater than this value is ignored.</td>
<td>50</td>
</tr>
<tr>
<td>Minimum Reconstruction Radius</td>
<td>The minimum 3D radius (in mm) that is allowed for a reconstruction. Any reconstruction with a radius less than this value is discarded.</td>
<td>0</td>
</tr>
<tr>
<td>Maximum Reconstruction Radius</td>
<td>The maximum 3D radius (in mm) that is allowed for a reconstruction. Any reconstruction with a radius greater than this value is discarded.</td>
<td>1000</td>
</tr>
<tr>
<td>Volume min X</td>
<td>X value of lower corner of reconstruction volume.</td>
<td>-100000</td>
</tr>
<tr>
<td>Volume min Y</td>
<td>Y value of lower corner of reconstruction volume.</td>
<td>-100000</td>
</tr>
</tbody>
</table>
### Property Description

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume min Z</td>
<td>Z value of lower corner of reconstruction volume. Default -100000</td>
</tr>
<tr>
<td>Volume max X</td>
<td>X value of upper corner of reconstruction volume. Default 100000.</td>
</tr>
<tr>
<td>Volume max Y</td>
<td>Y value of upper corner of reconstruction volume. Default 100000.</td>
</tr>
<tr>
<td>Volume max Z</td>
<td>Z value of upper corner of reconstruction volume. Default 100000.</td>
</tr>
<tr>
<td>Use Target Volume</td>
<td>Sets the reconstruction volume to the dimensions of the target volume (Set the target volume dimensions in the Options dialog box (press F7))</td>
</tr>
</tbody>
</table>

**Trajectory Tracking section**

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trajectory Startup Error</td>
<td>The deviation allowed (in mm/sec) in a marker’s position at the start of a trajectory. This value is related to the radius within which the current trajectory is matched to a reconstruction in the following frame. To help start trajectories on faster moving markers, increase the value. To help with dense marker sets, decrease the value. Default: 150</td>
</tr>
<tr>
<td>Trajectory Prediction Error</td>
<td>The deviation allowed (in mm/sec) in a marker’s position on a trajectory. This value is related to the radius within which the current trajectory is matched to a reconstruction in the following frame. To help continue trajectories on faster moving markers, increase the value. To help with dense marker sets, decrease the value. Default: 150</td>
</tr>
</tbody>
</table>
## Labeling section

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Label Completeness</strong></td>
<td>Specifies the proportion of markers that have to be present when a subject enters the capture volume or when the trial starts. If it is less than this value, the subject is not labeled. Higher values help to prevent mis-labeling when the subject first enters the volume. For example, if labeling starts only a significant number of frames after the subject has entered the volume, then a reduction of this value may encourage labeling to start earlier, when a smaller percentage of total subject markers are first seen. Conversely, if when the subject enters the volume, the initial labeling result is poor, increasing the value encourages the labeler to wait until a larger proportion of subject markers are seen and should produce a more reliable labeling result. Default: 0.85</td>
</tr>
<tr>
<td><strong>Exit Threshold</strong></td>
<td>Specifies the proportion of a subject's markers below which the subject is considered by Nexus to have left the capture volume. Labeling will not recommence unless the proportion reaches the Entrance Threshold. Higher values help to prevent mis-labeling when the subject leaves the volume. For example, a value of 1 requires all markers to be recognized for labels to continue to be produced. <strong>Tip:</strong> Do not set this value higher than Label completeness entrance threshold. Default: 0.6</td>
</tr>
<tr>
<td><strong>Booting qualit</strong></td>
<td>Affects when the system will start labeling based on how well the labeling skeleton matches the reconstructed data. For greater tolerance, reduce this value; to reduce the risk of mis-labeling, increase this value. Lower values are more tolerant, but may result in more mis-labels, whereas higher values require a closer match between the labeling skeleton and the reconstructed data, and therefore reduce the risk of mis-labeling. If fewer than expected labels are achieved, reducing this value may decrease the number of labeled reconstructions.</td>
</tr>
<tr>
<td>Property</td>
<td>Description</td>
</tr>
<tr>
<td>------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Conversely, if the labeling results produce an unacceptably high number of mis-labels (due to poor skeleton-to-reconstruction matching), an increase in this number may result in fewer mis-labels. Default: 0</td>
<td></td>
</tr>
<tr>
<td>Booting versus tracking</td>
<td>Booting is a process in which Nexus attempts to work out the labeling for the active subjects with marker statistics calculated from the VSK. This is done without requiring any information from earlier frames, such as previous labels. Tracking is a process in which Nexus uses the pose of the labeling skeleton from the previous frame's labels. This is used to predict the labeling in the current frame. Values less than 0 favor rebooting; values greater than 0 favor tracking. Default: 0</td>
</tr>
<tr>
<td>Tracking quality</td>
<td>Compares the match between reconstructions and skeleton data with the previous frame to determine whether labeling continues. Adjusting this parameter affects how close this match must be. Higher values require a closer match between frames. This reduces the risk of incorrect labeling, but may leave more constructions unlabeled. Lower values do not require as close a match between frames. This can increase the total number of labeled reconstructions but may produce more mis-labels. For greater tolerance, reduce this value; to reduce the risk of incorrect labeling, increase this value. Default: 0</td>
</tr>
<tr>
<td>Smoothing factor</td>
<td>Specifies how much the subject markers can move between frames before labeling stops. This value can be increased for slow-moving subjects and decreased for faster motion (at the cost of a greater likelihood of mis-labels). Default is 200.</td>
</tr>
</tbody>
</table>
**Property**

**Joint Ranges Slack**

A calibrated skeleton contains joint range information. This informs the labeler about the expected Range of Motion for any joint and the markers associated with that joint, helping the labeler make decisions. If a subject’s joints move beyond the estimated range, the result may be unlabeled reconstructions. Increasing this value may increase the number of labels and is useful when the subject does not go through their entire Range of Motion during calibration. Values greater than 1 extend the joint ranges allowed in the subject calibration. Higher values can be set to reduce the chances of mis-labeled. Values less than 1 tighten the ranges.

Default: 1

**Enforce Joint Ranges**

If selected, Nexus considers only a marker labeling solution that adheres strictly to the joint range values defined in the labeling skeleton (VSK).

Default is cleared.

---

**Vicon Data node**

The **Vicon Data** node is the top-level node that is displayed on the **System** tab in the **Resources** pane when Nexus is in Offline mode. It represents the Nexus host PC. In this mode, you can view but not manage the device details displayed on the **System** tab.

It enables you to view details of the cameras and capture devices in your Vicon system that were used for a previously saved motion capture trial.

The **Vicon Data** node contains sub-nodes for each capture device that was connected to your Vicon system during the trial capture under the following nodes:

- **Vicon Cameras node**
- **Video Cameras node**
- **Devices node** (including force plates, accelerometers, etc)

The top-level **Vicon Data** node does not have any displayed properties. Not all properties that are configurable for a device in Live mode are visible in Offline mode. For further details, see **Local Vicon System node** on page 132.
**Vicon Cameras node**

The Vicon Cameras node on the **System** tab of the **Resources** pane enables you to manage the identification and configuration settings for each Vicon camera connected to your Vicon system.

For more information, see:
- Vicon Cameras node context menu on page 145
- Vicon Camera properties on page 146

**Vicon Cameras node context menu**

You can select the following commands from the context menu displayed when you right-click on the **Vicon Cameras** node:

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reorder</td>
<td>Display the <a href="#">Reorder Devices dialog box on page 129</a> in which you can change the order in which Vicon cameras are displayed in the <strong>System Resources</strong> tree.</td>
</tr>
<tr>
<td>Reboot Vicon Cameras</td>
<td>Stop and restart all of the Vicon optical cameras in the Vicon system.</td>
</tr>
<tr>
<td>Remove Vicon Cameras</td>
<td>Displays a choice of <strong>Disconnected</strong> or <strong>Missing</strong>:</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Enable Preview Mode</td>
<td>Enables Preview mode for Vicon cameras. In this mode Vicon Nexus displays a 'video' image from the optical sensor of a Vicon camera, which enables you to aim cameras more quickly and easily during setup. Note that this preview feature is for system setup purposes only. You cannot capture camera data in Preview mode.</td>
</tr>
</tbody>
</table>

You can select the following commands from the context menu displayed when you right-click on a node for a specific Vicon camera:
<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reset Calibration</td>
<td>Remove the selected camera from the current calibration.</td>
</tr>
<tr>
<td>Reboot</td>
<td>Start and restart the selected Vicon camera.</td>
</tr>
</tbody>
</table>

**Vicon Camera properties**

You can configure settings in the following sections of the Properties pane for Vicon cameras:

- Identification section on page 146
- Settings section on page 147
- Centroid Fitting section on page 151
- Centroid Tracking section on page 153
- Status section on page 154
- Hardware section on page 155
- Firmware section on page 156
- Calibration section on page 156
- Commands section on page 156

**Identification section**

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>A user-defined display name for the entire set of Vicon cameras or for each individual camera. For example, if a camera is placed over a door, you could name it “Over Door.” Default: Blank</td>
</tr>
<tr>
<td>Device ID</td>
<td>The unique identification number Vicon assigns to each camera during manufacture. The top-level entry for all Vicon cameras takes no value. Default: Identified on connection</td>
</tr>
</tbody>
</table>
## Settings section

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enabled</td>
<td>Whether or not the Vicon camera is currently enabled for use. Default: Selected</td>
<td></td>
</tr>
</tbody>
</table>
cameras), and if it is crucial to your work that the shutter periods for all cameras are precisely aligned, ensure that your firmware is upgraded to version 700 or later, and set the **Strobe Intensity** for the T-Series camera(s) to its maximum.

Default: 1

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gain</td>
<td>The digital amplification of the pixel value. Select a displayed value to determine the intensity of the grayscale from the Vicon cameras: x1, x2, x4, or x8.</td>
</tr>
<tr>
<td></td>
<td>This setting is applied to the camera to change the dynamic range of the recorded image. Increasing the gain means that the marker has less variation in grayscale intensity between its center and its edge, but in certain circumstances, using a higher gain yields markers that are easier for the camera to distinguish. Vicon does not recommend using a gain setting higher than x2.</td>
</tr>
<tr>
<td></td>
<td>Adjust this setting if the markers appear too faint or if the cameras have trouble distinguishing them; otherwise, leave the this property at the default x1 setting.</td>
</tr>
<tr>
<td></td>
<td>Default: x1</td>
</tr>
</tbody>
</table>

| Grayscale Mode    | The type of data for processed grayscale blobs that the Vicon cameras send to Vicon Nexus. The Vicon cameras perform data processing to create 2D data for Vicon markers. They generate grayscale blobs for reflections from objects in the capture volume and then use centroid-fitting algorithms to determine which of these are likely to be markers by comparing the shape of the grayscale blobs to the **Minimum Circularity Ratio** and **Max Blob Height** settings. During this processing, Vicon cameras can produce the following types of data for grayscale blobs: centroids data (x, y coordinates and the radius of the centroid calculated), grayscale data (pixel and line information), or coordinates data (line information, i.e. grayscale data without pixel values). You can specify which type of processed data Vicon cameras send to Nexus: |
|                   | **Auto**: Send grayscale data only of the grayscale blobs for which centroids were not generated, that is, those below the threshold specified for Minimum Circularity Ratio. Send coordinates data of grayscale blobs for which one or more line segments, or the total |
number of lines in the blob, exceeds the value set for **Max Blob Height**. If a marker can be centroid fitted by the Vicon camera, the centroid is passed to the capture PC. If it cannot, the full grayscale of the image is sent, allowing the data to be post-processed on the PC. This is the default and recommended mode.

- **None**: Send no grayscale or coordinates data; send only centroid data. Any grayscale image that cannot be centroid fitted by the camera will be discarded. Select this mode if you are capturing a large number of markers and have redundancy in your capture setup.

- **All**: Send grayscale data both of grayscale blobs for which centroids were generated and of those for which centroids were not generated, that is those below the threshold specified for **Minimum Circularity Ratio**. Send coordinates data of grayscale blobs for which one or more line segments, or the total number of lines in the blob, exceeds the value set for **Max blob height**. Select this setting if you need to see exactly where the camera calculates the centroid with respect to the grayscale marker image, for example when adjusting parameters. This setting results in much larger data rates and files; it may be useful for diagnostic purposes, but do not use it in normal capture situations.

- **Only**: Send all grayscale and coordinates data; send no centroid data. This setting is useful when focusing or making other adjustments to the cameras themselves as you see exactly the image recorded on the sensor.

- **Edges**: Send only edge coordinates data; send no centroid or grayscale data. If data rates are very high, for example when there are too many reflections, the camera automatically enters this mode. Use this setting to manually force the camera into this mode.

- **No Edges**: Send grayscale data both of grayscale blobs for which centroids were generated and of those for which centroids were not generated; send no coordinates data. Use this setting to prevent the Vicon camera from sending edge coordinates.
<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default: Auto</td>
<td><strong>Caution</strong> Even if you have not specified a Grayscale mode setting that would have coordinates data sent to Nexus, a Vicon camera automatically sends coordinates data— either temporarily or permanently— if it is overloaded with data (e.g., too many markers, too many reflections, hand or reflective objects immediately in front of the camera, too low a threshold or too high a gain). If a camera automatically starts to present coordinates data, you should identify the source of the overload and attempt to remedy it.</td>
</tr>
<tr>
<td>Allow Windowing</td>
<td>Windowing enables Vicon cameras that support windowing to run at a faster frame rate by using letterboxing to reduce the dimensions of the camera sensor area. The configured frame rate affects the field of view. When you select Allow Windowing, if you specify a frame rate greater than the maximum frame rate for the camera at full resolution, image size is automatically reduced in comparison with that for a lower camera frame rate by windowing. This keeps the pixel rate the same by transmitting a greater number of smaller images per second. Cannot be used in calibration mode. Default: Selected</td>
</tr>
<tr>
<td>Enable LEDs</td>
<td>Enables you to select whether or not to use the status lights on the Vicon camera strobe unit that provide feedback on the status of the camera (such as its enabled, connection, or selection state and any processing feedback). This is useful for motion capture applications in very dark environments (such as Virtual Reality) where the brightness of these LED status lights can cause problems. Default: Selected</td>
</tr>
<tr>
<td>Enable Display</td>
<td>Toggles on or off the OLED display on the front of the strobe (of supported Vicon cameras), which gives feedback about the current camera status, eg, when the camera has finished booting.</td>
</tr>
</tbody>
</table>
**Property**

- **Enable Tap to Select**
  - For supported Vicon cameras, enables you to lightly tap the camera in the volume to select it (and deselect the other cameras). This is useful, for example, when you are setting up cameras, before they are calibrated. Default: Selected

- **Enable Accelerometry**
  - Applies to supported Vicon cameras only. Accelerometers in the Vicon cameras enable bump detection to operate in calibrated cameras to alert you when they have moved from their calibrated positions. If a calibrated camera is knocked, the camera’s status LEDs flash red and in Nexus, the camera’s Bumped check box (in its Status properties) displays a check mark. See also Bumped and Bump Detection Sensitivity on page 154 in the Status section. Default: Selected

### Centroid Fitting section

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Threshold</strong></td>
<td>The threshold for the minimum brightness (intensity) for marker pixels (the setting does nothing to an overall marker, just the individual pixels); pixels of an intensity lower than this threshold are ignored. This value can be set between 0-1 to determine the pixels to be considered for centroid fitting onboard the Vicon cameras. Lower settings enable the camera to detect lower light levels, thus making the markers appear larger, but introduce more noise from unwanted reflections and other light sources. Higher settings reduce the noise, but make the markers themselves less visible. This setting differentiates between markers and ambient light. Vicon cameras record 10-bit grayscale data, which for each sensor pixel is a measure of how much light fell on that pixel during a given amount of time. However, the cameras will almost always pick up some ambient</td>
</tr>
</tbody>
</table>
To enable the cameras to distinguish between light that comes from markers and light that does not, a threshold is applied. Anything above this threshold is deemed to be a marker, anything below is deemed to be ambient light. A value in the region of 0.2 to 0.5 is usually appropriate, but Vicon strongly recommends that you use static markers in the volume in order to establish an appropriate setting. If cameras are evenly spaced around the volume, the same Threshold value is usually sufficient for all cameras.

**Threshold**

Adjust this setting, the **Strobe Intensity**, and the camera's aperture until reflections are minimized or gone.

Default: 0.2

---

**Minimum Circularity Ratio**

The circularity threshold used by the centroid-fitting algorithms in a Vicon camera. This value can be set between 0-1 to determine how similar a grayscale blob must be to the internal model of a marker— that is a radially symmetric object that has smooth, sharp edges and whose pixel intensity is brightest at the center and gradually fades towards the edges. The Vicon cameras consider grayscale blobs with circularity equal to or greater than this threshold to be well-formed, circular marker images. The higher the value, the more stringent the centroid fitter is; the lower the value, the less stringent the centroid fitter is. You may wish to apply higher settings for camera calibration to ensure that the Vicon system selects the best markers and thus provides the best possible calibration. A lower value may be appropriate for data capture.

Default: 0.5

---

**Maximum Blob Height**

The maximum height in pixels of a grayscale blob for a camera to attempt to circle fit it. If the number of pixels exceeds this value, the Vicon camera determines that the grayscale blob is not a marker, stops processing it, and discards the pixel values (it preserves just the coordinates data, which can be sent to Vicon Nexus, depending on the Grayscale mode setting).

Set this value between 0-500 to determine how large a grayscale blob can be for a Vicon camera to consider it a candidate marker. The Vicon cameras consider grayscale blobs with horizontal lines containing this...
number or fewer pixels to be good-sized, circular marker images. The higher the value, the larger a grayscale blob can be; the lower the value, the smaller a grayscale blob must be. Default: 50

Centroid Tracking section

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enable Centroid Tracking</td>
<td>When Nexus recognizes the presence of Vicon cameras, the Enable Centroid Tracking parameter becomes available. Tracking and identifying 2D centroids on an individual camera allows the production of 2D tracks. Tracking and identifying 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 the cameras' onboard sensors. When disabled, the 2D track calculation is performed by the PC (in Nexus). Click on a Vicon camera to turn on 2D switchable tracks. Disable this option to turn off. <strong>Note:</strong> Applies only to Vicon cameras that have the ability to process this information on board the camera. Default: Off</td>
</tr>
<tr>
<td>Marker Velocity</td>
<td>Maximum velocity at which a marker will be tracked, expressed as the percentage of image width per second. Default: 5</td>
</tr>
</tbody>
</table>
### Status section

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Connected</strong></td>
<td>Whether or not the Vicon camera is currently connected to the Vicon system. Default: Identified on connection</td>
</tr>
<tr>
<td><strong>Sync Master</strong></td>
<td>Whether or not the Vicon camera is designated as the synchronization master for the Vicon system. (Not relevant for MX T-Series cameras.) For more information, see Change the synchronization master in the Vicon Nexus User Guide. Default: Identified on connection</td>
</tr>
<tr>
<td><strong>Contributing Centroids</strong></td>
<td>Whether or not the Vicon camera is contributing centroid data during the current motion capture. Default: Identified during capture</td>
</tr>
<tr>
<td><strong>Contributing Grayscale</strong></td>
<td>Whether or not there is a socket open to the Vicon camera that is capable of receiving grayscale. This socket may be dropped when the system is under heavy load, therefore this property is useful as a system status monitor. It is not related to Grayscale property under Settings. Default: Selected</td>
</tr>
<tr>
<td><strong>Contributing Tracks</strong></td>
<td>Whether or not the camera is contributing tracks. Default: Cleared</td>
</tr>
<tr>
<td><strong>Bumped</strong></td>
<td>If selected, indicates that a calibrated camera has moved (usually because it has been accidentally knocked) since it was calibrated. To remove selected camera's bumped status, clear this check box. To clear all cameras' Bumped status, press CTRL+SHIFT+B. Applies only to Vicon cameras that support indicating Bumped status. Default: Cleared</td>
</tr>
<tr>
<td><strong>Bump Detection Sensitivity</strong></td>
<td>Enables you to change the sensitivity of the camera to knocks and bumps. Applies only to Vicon cameras that support bump detection. Default: Medium</td>
</tr>
</tbody>
</table>
## Hardware section

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>The type of Vicon camera. The top-level entry for all Vicon optical cameras takes no value. Default: Identified on connection</td>
</tr>
<tr>
<td>Strobe Type</td>
<td>The type of strobe unit (if any) attached to the front of the Vicon camera: Visible Red (VR), Near Infrared (NIR), or Infrared (IR). Default: Identified on connection</td>
</tr>
<tr>
<td>Camera Body Temp 1</td>
<td>Current operating temperature given in degrees Celsius. A colored temperature indicator on the right changes to reflect a change in temperature: yellow (warming up to the temperature specified by the lower bounds), green (between the specified upper and lower bounds) or red (overheated above the upper bounds). To change the upper and lower bounds, click Camera Temperature Range in list on the left of the Options dialog box (F7). Applies only to Vicon cameras that support temperature sensor display. Default: Identified during connection</td>
</tr>
<tr>
<td>Camera Body Temp 2 or Strobe Temperature (Vicon Vantage only)</td>
<td></td>
</tr>
<tr>
<td>Sensor Width</td>
<td>The width (in pixels) of the Vicon camera sensor. Default: Identified on connection</td>
</tr>
<tr>
<td>Sensor Height</td>
<td>The height (in pixels) of the Vicon camera sensor. Default: Identified on connection</td>
</tr>
<tr>
<td>Revision</td>
<td>Camera revision number.</td>
</tr>
<tr>
<td>MAC Address</td>
<td>The Media Access Control (MAC) address assigned to the Vicon camera during manufacture. This is a hexadecimal value in the format ##.##.##.##.##.##.##.##.##.##.##. The top-level entry for all Vicon cameras takes no value. Default: Identified on connection</td>
</tr>
<tr>
<td>IP Address</td>
<td>The Internet Protocol (IP) address assigned to the Vicon camera on the Vicon MX Ethernet network. The top-level entry for all Vicon cameras takes no value. Default: Identified on connection</td>
</tr>
</tbody>
</table>
### Property Description

**Destination IP Address**
The IP address of the network adapter to which data from this camera will be sent. 
Default: Default

#### Firmware section

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Firmware Version</td>
<td>The version number of the firmware currently installed on the Vicon camera.</td>
</tr>
<tr>
<td>Firmware Complete</td>
<td>Whether or not the currently installed firmware is complete. If not, you can reprogram the firmware.</td>
</tr>
<tr>
<td></td>
<td>Default: Identified on connection</td>
</tr>
</tbody>
</table>

#### Calibration section

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reset Calibration</td>
<td>Removes the selected camera from the current calibration.</td>
</tr>
<tr>
<td>Focal Length (mm)</td>
<td>The focal length (in millimeters) of the Vicon camera lens. The focal length of the lens is automatically calculated by the calibration algorithm. You only need to enter this value manually if you use the <strong>Aim Cameras</strong> function. Can be set to a value between 2-100.</td>
</tr>
<tr>
<td></td>
<td>Default: 8</td>
</tr>
</tbody>
</table>

#### Commands section

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reboot</td>
<td>Stop and restart the selected Vicon camera.</td>
</tr>
</tbody>
</table>
Video Cameras node

The Video Cameras node on the System tab of the Resources pane enables you to manage the identification and configuration settings for each digital video camera connected to your Vicon system. You can also remove or reorder video cameras.

See also:
- Video Cameras node context menu on page 157
- Video Camera properties on page 157
- PC setup for Vicon systems (PDF available from Vicon website)

Video Cameras node context menu

You can select the following commands from the context menu displayed when you right-click on the Video Cameras node:

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reorder</td>
<td>Display the Reorder Devices dialog box on page 129 in which you can change the order in which digital video cameras are displayed in the System resources tree.</td>
</tr>
<tr>
<td>Reboot Video Cameras</td>
<td>Stop and restart all of the Vicon Video cameras in the Vicon system.</td>
</tr>
<tr>
<td>Remove Video Cameras</td>
<td>Removes disconnected video cameras</td>
</tr>
<tr>
<td>(Disconnected or Missing)</td>
<td></td>
</tr>
<tr>
<td>Align Shutters (Basler)</td>
<td>Aligns the shutters with the rest of the Vicon system. Use after any change to the camera settings that affects shutter alignment.</td>
</tr>
</tbody>
</table>

Video Camera properties

You can configure settings in the following sections of the Properties pane for video cameras. The available properties depend on the type of video camera included in your Vicon system, so you may not see all of the properties described.
The settings for some properties may differ depending on whether you are using video calibration setup mode or live capture mode. For these properties, changes you make in video calibration setup mode do not affect the settings in live capture mode and vice versa. In the following lists, these properties are indicated by an asterisk (*).

### Identification section

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>A name that you supply, which enables you to identify the camera in Vicon Nexus. Default: Blank</td>
</tr>
<tr>
<td>Device ID</td>
<td>The unique identification number Vicon assigns to the digital video camera. The top-level entry for all cameras takes no value. Default: Identified on connection</td>
</tr>
</tbody>
</table>

### Settings section

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enabled</td>
<td>Whether or not the digital video camera is currently enabled for use. Default: Selected</td>
</tr>
<tr>
<td>Color*</td>
<td>Whether the video camera captures in color. Default: Selected</td>
</tr>
<tr>
<td>Shutter Duration*</td>
<td>The length of time that the camera shutter is open during an image capture. The maximum shutter speed cannot exceed the value specified in Requested Frame Rate. For example, if the frame rate is set to 50 fps, an image is taken every 20 milliseconds, the shutter speed cannot exceed 19 ms. Default: 9</td>
</tr>
<tr>
<td>Video Saturation</td>
<td>This value controls the amount of color in the image. Decreasing the value towards 0 results in a grayscale image with no color; increasing the value over 1 results in supersaturated colors. Default: 1</td>
</tr>
<tr>
<td>Property</td>
<td>Description</td>
</tr>
<tr>
<td>---------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Video Gain*</td>
<td>The digital amplification of the pixel value. Select a displayed value to determine the intensity of the grayscale from the video cameras: x1, x2, x4 or x8. This setting is applied to the camera to change the dynamic range of the recorded image. Increasing the gain means that the marker has less variation in grayscale intensity between its center and its edge, but in certain circumstances, using a higher gain yields markers that are easier for the camera to distinguish. Vicon does not recommend using a gain setting higher than x2. Adjust this setting if the markers appear too faint or if the cameras have trouble distinguishing them; otherwise, leave the this property at the default setting. Default: x1</td>
</tr>
<tr>
<td>Camera Gain*</td>
<td>The digital amplification of the pixel value. The value can be set between 0-100. Gain on a video camera is similar to the contrast control on a television. Higher values mean a greater camera response to a change in light level and, therefore, a greater visible difference between pixels of different intensity. Adjust this setting until you are satisfied with the image quality— the optimum settings depends on factors such as the ambient light conditions and the Camera Brightness setting. Default: 10</td>
</tr>
<tr>
<td>Camera Brightness*</td>
<td>The brightness of pixels. The value can be set between 0-100. Brightness on a video camera is similar to the brightness control on a television; it represents an offset of the entire image signal. Higher values mean a greater apparent brightness of the image. Adjust this setting until you are satisfied with the image quality— the optimum settings depends on factors such as the ambient light conditions and the Camera Gain setting. Default: 50</td>
</tr>
<tr>
<td>Camera Gamma*</td>
<td>The gamma setting of the camera. The value can be set between 0.1-10. A setting of 1 is linear. Default: 1</td>
</tr>
</tbody>
</table>
### Property Description

**Brightness Offset** *(all)*

A linear intensity offset that is applied to each component of the video image. Where Video Gain is a multiplication,Brightness Offset adds a value to the component. Default: 0

**Capture Path**

The drive letter (e.g., C:\ or H:) of the computer from which video data from the digital video camera is to be captured. Because the data rates can be very high, you are advised to capture digital video data to a different drive than the Vicon optical data. For optimum performance, specify a different capture drive for each camera. Do not use a mapped drive. Default: Blank

**Pixel Aspect Ratio**

The height vs. width ratio of pixels. The default varies according to camera type: Vicon Nexus detects whether the camera is likely to produce non-square pixels and adjusts the ratio accordingly. Default: Depends on camera type

---

**Frame Rate section**

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Trigger Source</strong></td>
<td>The source of the synchronization signal. Select the Vicon connectivity unit to which the video camera is connected from this drop-down list. If None is selected, no synchronization occurs. When specifying a requested frame rate for Basler cameras, set the Requested Frame Rate and ensure the Incoming Frame Rate and the rate reported in the System tree are as required, before selecting the trigger source. Default: Blank</td>
</tr>
<tr>
<td><strong>Trigger Offset (ms)</strong></td>
<td>The sync pulse delay, in millisecond (ms). Default: 0</td>
</tr>
<tr>
<td>Property</td>
<td>Description</td>
</tr>
<tr>
<td>-----------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Requested Frame Rate*</td>
<td>The rate, in frames per second (fps), for the video camera to control the camera shutter speed, data rate, and area of interest to achieve the desired frequency. Default: Depends on the connected camera</td>
</tr>
<tr>
<td>Incoming Frame Rate</td>
<td>The actual system frame rate at which the camera is sending video frames to Nexus. The Incoming Frame Rate may differ from the Requested Frame Rate and the rate reported next to the camera node in the System tree due to system limits and fluctuations.</td>
</tr>
</tbody>
</table>

**Centroid Fitting section**

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Threshold</td>
<td>This setting differentiates between markers and ambient light. To enable the cameras to distinguish between light that comes from markers and light that does not, a threshold is applied. Anything above this threshold is deemed to be a marker, anything below is deemed to be ambient light. A value in the region of 0.2 to 0.5 is usually appropriate. Default: 0.5</td>
</tr>
</tbody>
</table>

**Hardware section**

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Destination IP Address</td>
<td>The IP address of the network adapter to which data is to be sent. For video cameras, the Destination IP address must not be shared with another camera. Always choose the shortest possible path between the camera and the computer and ensure that the network adapter with the destination IP address is plugged into the same Vicon connectivity device or switch as the camera. Default: Default For more information, see the <em>PC Setup for Vicon Systems</em> PDF.</td>
</tr>
</tbody>
</table>
### Property Description

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sub Sample Ratio*</td>
<td>Ratio of sub-sampled frames to requested frame rate, for example, for a Requested Frame Rate of 240Hz, a sub sample ratio of 2:1 gives a sub-sampled frame rate of 120Hz. Default: 1:1</td>
</tr>
</tbody>
</table>

#### Calibration section

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reset Calibration</td>
<td>Removes the selected camera from the current calibration.</td>
</tr>
<tr>
<td>Focal Length (mm)</td>
<td>The focal length (in millimeters) of the camera lens. Set this to a value between 2-100. Set this value if you use the Aim Cameras function or Static Video Calibration. On some cameras with variable zoom, the focal length may be difficult to determine; to obtain the lens properties, see the documentation supplied with the camera. Default: Basler 20, Bonita: 8</td>
</tr>
</tbody>
</table>

#### Commands section

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reboot button</td>
<td>When clicked, reboots the selected video camera</td>
</tr>
</tbody>
</table>

You can also remove or reorder video cameras (see Video Cameras node context menu on page 157).
Vicon Connectivity nodes

You use the Vicon Connectivity node on the System tab of the Resources pane to configure Vicon connectivity units (e.g., Vicon Lock+ units or MX Giganets), which are smart boxes that can be combined to create a distributed architecture.

See also:
- Vicon Connectivity node context menu on page 163
- Vicon Lock+ node and MX Giganet node on page

Vicon Connectivity node context menu

You can select the following commands from the context menu displayed when you right-click on the Vicon Connectivity node:

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reorder</td>
<td>Display the Reorder Devices dialog box on page 129 in which you can change the order in which Vicon connectivity units are displayed in the System Resources tree.</td>
</tr>
<tr>
<td>Reboot All Vicon Connectivity Units</td>
<td>Stop and restart all of the Vicon connectivity units in the Vicon system.</td>
</tr>
</tbody>
</table>

Vicon Lock+ node and MX Giganet node

The Vicon Lock+ and MX Giganet nodes are displayed under the Vicon Connectivity node on the System tab of the Resources pane when Vicon Nexus is connected to a Vicon system with at least one Lock+ or MX Giganet unit and is in Live mode.

These connectivity unit nodes enable you to manage the identification and configuration settings for each Vicon Lock+ and MX Giganet unit included in your Vicon system architecture.

For each connectivity unit the node name includes:
- The device position number
- Any display name specified in the Identification property
The device type listed in parentheses
For example, #1 Name (Lock+).

If either or both analog option cards are installed in the MX Giganet and in all cases for Vicon Lock+, the sample rates are displayed in brackets, for example, #1 Name [1000Hz/1000Hz] (MX Giganet), 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.

See also:
- Vicon Lock+ and MX Giganet node context menu on page
- Vicon Lock+ and MX Giganet node properties on page
- Analog card properties on page 170

Vicon Lock+ and MX Giganet node context menu
You can select the following commands from the context menu displayed when you right-click on a node for a specific Lock+ or MX Giganet:

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reboot</td>
<td>Stop and restart the selected device.</td>
</tr>
<tr>
<td>Reset Timecode</td>
<td>Reset the Timecode to 00:00:00:00.</td>
</tr>
</tbody>
</table>

Vicon Lock+ and MX Giganet node properties
You can configure settings in the following sections of the Properties pane for the Vicon Connectivity node and nodes for any current Vicon connectivity units:

- Identification section on page 165
- Status section on page 165
- Genlock section on page 166
- Timecode section on page 166
- Sync Out section on page 167
- Hardware section on page 169
- Firmware section on page 169
- Commands section on page 169
If you are using an analog card (this applies to all Lock+ units and MX Giganet units that are fitted with analog cards), see also:

- Analog card properties on page 170

**Identification section**

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>A user-defined display name for the entire set of Vicon connectivity units or for each individual connectivity unit. Default: Blank</td>
</tr>
<tr>
<td>Type</td>
<td>The device type. Default: Identified on connection.</td>
</tr>
<tr>
<td>Device ID</td>
<td>The unique identification number Vicon assigns to each connectivity unit during manufacture. The Vicon Connectivity node takes no value. Default: Identified on connection</td>
</tr>
</tbody>
</table>

**Status section**

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connected</td>
<td>Whether or not the connectivity unit is currently connected to the Vicon system. Default: Identified on connection</td>
</tr>
<tr>
<td>Enabled</td>
<td>Whether or not the connectivity unit is currently enabled for use. Default: Selected</td>
</tr>
<tr>
<td>Sync Locked</td>
<td>Whether or not the connectivity unit is receiving and locked to the master synchronization signal for the Vicon system. Default: Identified on connection</td>
</tr>
<tr>
<td>Sync Master</td>
<td>Whether or not the connectivity unit is designated as the synchronization master for the Vicon system. For more information, see <em>Change the synchronization master</em> in the <em>Vicon Nexus User Guide</em>. Default: Identified on connection</td>
</tr>
</tbody>
</table>
### Genlock section

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enabled</td>
<td>Whether or not Genlock functionality supported by the connectivity unit is currently enabled. If so, the scan rate of the incoming video signal from a PAL or NTSC video source is synchronized with Vicon cameras. Default: Identified on connection</td>
</tr>
<tr>
<td>Source</td>
<td>The genlock device source. Default: Internal</td>
</tr>
<tr>
<td>Standard</td>
<td>The video standard of the external video source with whose incoming video signal scan rate the connectivity device is to synchronize the Vicon cameras. If one is not identified, None is displayed. Default: Identified on connection</td>
</tr>
<tr>
<td>Status</td>
<td>The status of the Genlock functionality: None, In Use, Ready To Use, Requires Other Frame Rate, Requires Device To Be Master, or Requires Genlock. Default: Identified on connection</td>
</tr>
</tbody>
</table>

### Timecode section

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enabled</td>
<td>Whether or not Timecode functionality supported by an connectivity unit is currently enabled. If so, the connectivity unit can be configured to trigger from or be time-stamped from a connected VITC (video) or LTC (audio) Timecode source. Default: Identified on connection</td>
</tr>
<tr>
<td>Source</td>
<td>The source designated as the master Timecode signal generator: VITC (external video device), LTC (external audio device), or Internal (Vicon connectivity unit). Default: Internal</td>
</tr>
<tr>
<td>Property</td>
<td>Description</td>
</tr>
<tr>
<td>-----------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Dropped Frames</td>
<td>Whether or not the connectivity unit is to adjust its internal counter to drop frames for the NTSC video standard. This option is available only if Internal is specified in Source. If selected, the separator character in the Timecode display in the Capture tools pane changes between a colon (:) for non-drop frames and semicolon (;) for drop frames. Default: Cleared</td>
</tr>
<tr>
<td>Standard</td>
<td>The video standard of the Timecode source from which the connectivity unit will trigger data capture or be time-stamped. If one is not identified, None is displayed. Default: Identified on connection</td>
</tr>
<tr>
<td>Status</td>
<td>The status of the Timecode functionality: None, In Use, Ready To Use, Requires Other Frame Rate, Requires Device To Be Master, or Requires Genlock. Default: Identified on connection</td>
</tr>
</tbody>
</table>

**Sync Out section**

The characteristics of a synchronization pulse that the connectivity unit is to generate to synchronize third-party hardware with the Vicon system (for technical details, see the *Vicon Vantage Reference Guide* or *Go Further with Vicon T-Series*). 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 each sync output, use the Browse for a folder button to navigate to the folder containing the *.gpo files (by default, C:\Program Files(x86)\Vicon\Nexus2.|6\GPO) and then used the drop-down list button to select the desired file (None, Duration, DV_Double, DV_Half, DV_Normal, or DV_Quarter):
<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Socket 1</td>
<td>The .gpo configuration file to use to specify the synchronization signal for Powered Sync Output 1 in the rear panel of the connectivity unit. Default: Blank</td>
</tr>
<tr>
<td>Socket 2</td>
<td>The .gpo configuration file to use to specify the synchronization signal for Powered Sync Output 2 in the rear panel of the connectivity unit. Default: Blank</td>
</tr>
<tr>
<td>Socket 3</td>
<td>The .gpo configuration file to use to specify the synchronization signal for Powered Sync Output 3 in the rear panel of the connectivity unit. Default: Blank</td>
</tr>
<tr>
<td>Socket 4</td>
<td>The .gpo configuration file to use to specify the synchronization signal for Powered Sync Output 4 in the rear panel of the connectivity unit. Default: Blank</td>
</tr>
<tr>
<td>Socket 5</td>
<td>The .gpo configuration file to use to specify the synchronization signal for Sync Output 5 in the rear panel of the connectivity unit. Default: Blank</td>
</tr>
<tr>
<td>Socket 6</td>
<td>The .gpo configuration file to use to specify the synchronization signal for Sync Output 6 in the rear panel of the connectivity unit. Default: Blank</td>
</tr>
<tr>
<td>Socket 7</td>
<td>The .gpo configuration file to use to specify the synchronization signal for Sync Output 7 in the rear panel of the connectivity unit. Default: Blank</td>
</tr>
<tr>
<td>Socket 8</td>
<td>The .gpo configuration file to use to specify the synchronization signal for Sync Output 8 in the rear panel of the connectivity unit. Default: Blank</td>
</tr>
</tbody>
</table>
### Hardware section

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAC Address</td>
<td>The Media Access Control (MAC) address assigned to the connectivity unit during manufacture. This is a hexadecimal value in the format <code>##.##.##.##.##</code>. The top-level entry for all connectivity units takes no value. Default: Identified on connection</td>
</tr>
<tr>
<td>IP Address</td>
<td>The Internet Protocol (IP) address assigned to the connectivity unit on the Vicon system Ethernet network. The top-level entry for all connectivity units takes no value. Default: Identified on connection</td>
</tr>
</tbody>
</table>

### Firmware section

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Firmware Version</td>
<td>The version number of the firmware currently installed on the connectivity unit. Default: Identified on connection</td>
</tr>
<tr>
<td>Firmware Complete</td>
<td>Whether or not the currently installed firmware is complete. If not, you can reprogram the firmware. Default: Identified on connection</td>
</tr>
</tbody>
</table>

### Commands section

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reboot</td>
<td>Stop and restart the connectivity unit.</td>
</tr>
</tbody>
</table>
Analog card properties

Configuration section
You can configure the following settings in the Properties pane for an analog card connected to a connectivity unit:

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sampling Frequency (HZ)</td>
<td>The sample rate for the analog card. The default analog sampling frequency is 1000 Hz and the corresponding default Vicon system frame rate is 100 Hz. The analog frequency must be an integer multiple of the frame rate and both must divide evenly into 135 MHz (the master clock frequency). If you change the frame rate, the analog frequency may change automatically to meet these criteria. Similarly, if you enter an invalid analog sampling rate, its value is automatically adjusted to meet the criteria. Default: Identified on connection</td>
</tr>
<tr>
<td>Channel Count</td>
<td>The number of channels provided by the analog card Default: 64</td>
</tr>
</tbody>
</table>

Devices node
Use the Devices node to manage the connection and configuration settings for supported analog and digital devices of all types, including force plates, accelerometers, EMG devices, and the Dikablis eye tracker.

See also:
- Devices node context menu on page 170
- Force plate nodes on page 171
- Analog accelerometer, EMG, and other analog device nodes on page 180
- Dikablis Eye Tracker node on page 182

Devices node context menu
You can select the following commands from the context menu displayed when you right-click on the Devices node:
<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reorder</td>
<td>Selecting this command displays the Reorder Devices dialog box on page 129. Reordering the force plates changes their position in the Devices tree.</td>
</tr>
<tr>
<td>Add Analog Device</td>
<td>Enables you to select from the following options to add supported analog devices:</td>
</tr>
<tr>
<td></td>
<td>- Add AMTI AccuGait Force Plate</td>
</tr>
<tr>
<td></td>
<td>- Add AMTI OR6 Series Force Plate</td>
</tr>
<tr>
<td></td>
<td>- Add analog accelerometer</td>
</tr>
<tr>
<td></td>
<td>- Add analog EMG</td>
</tr>
<tr>
<td></td>
<td>- Add Bertec Force Plate</td>
</tr>
<tr>
<td></td>
<td>- Add generic analog</td>
</tr>
<tr>
<td></td>
<td>- Add Kistler Force Plate (External Amplifier)</td>
</tr>
<tr>
<td></td>
<td>- Add Kistler Force Plate (Internal Amplifier)</td>
</tr>
<tr>
<td></td>
<td>- Add Motekforce Link treadmill</td>
</tr>
<tr>
<td>Add Digital Device</td>
<td>Enables you to select from the following options to add supported digital devices:</td>
</tr>
<tr>
<td></td>
<td>- Add Dikablis Eye Tracker</td>
</tr>
<tr>
<td></td>
<td>- Add ZeroWire/Wave EMG</td>
</tr>
<tr>
<td>Disconnected Devices</td>
<td>Enables you to select whether to show or hide devices that are not currently connected to the system.</td>
</tr>
</tbody>
</table>

**Force plate nodes**

You manage the connection and configuration settings for supported force plates included in your Vicon system architecture with the appropriate force plate node. You select the required force plate node under the Devices node in the System Resources tree. If no analog source is selected, [No Source] is displayed after the device type. Force plate data can be acquired through the analog capture functionality of a Vicon Lock+ or an MX Giganet with an analog card.
See also:
- Force plate node context menu on page 172
- Force plate properties on page 173

For information about configuring force plate display options, which affect the way force plates are displayed in the 3D Perspective view, see Configure force plates in the Vicon Nexus User Guide.

For information on how to handle cross-plate foot strikes when modeling with Plug-in Gait, see Cross-plate foot strikes in the Vicon Nexus User Guide.

**Force plate node context menu**

You can select the following commands from the context menu displayed when you right-click on a force plate node:

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foot Contact</td>
<td>Attributes the force plate to:</td>
</tr>
<tr>
<td></td>
<td>- Auto-detect, in which Nexus attributes the force plate contact based upon foot segment kinematics</td>
</tr>
<tr>
<td></td>
<td>- Left foot contact</td>
</tr>
<tr>
<td></td>
<td>- Right foot contact</td>
</tr>
<tr>
<td></td>
<td>- Invalid if no valid left or right foot contact can be associated with the force plate. You can also adjust these settings by right-clicking a displayed force plate in the 3D Perspective view pane.</td>
</tr>
</tbody>
</table>
| Show Raw           | Adds each raw voltage signal for the device. For example, Kistler force plates contain 8 input channels that are processed to yield a resultant force and moment (3 components each, 6 total). Using the Show Raw command, you can select one or more inputs and graph their raw data in a Graph view pane, allowing you to view, troubleshoot, or configure a monitor for the raw signals. If you use Show Raw and collect a trial, the raw voltages will be stored in the .x1d file, so you can view them in the offline trial as well as the force channels. If you save the trial, or export a .c3d file, when you load the...
<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>the trial the raw channels will be grouped together and designated within an Imported Analog Device.</td>
</tr>
<tr>
<td></td>
<td>To remove the raw inputs from the System Resources tree, right-click on the force plate node and click Hide Raw.</td>
</tr>
<tr>
<td>Zero Level</td>
<td>Calibrates the force plate. This process eliminates any significant offset between the force plate’s nominal output levels at rest and its theoretical zero level. Select this option if, after setting the force plates to the electrical zero level, small differences remain between the theoretical zero level and the observed output level. This option is also available in the General section of the Properties pane.</td>
</tr>
<tr>
<td>Remove Device</td>
<td>Removes the force plate entry from the System Resources tree.</td>
</tr>
</tbody>
</table>
General section

For all force plates:

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>A user-defined display name for the force plate. Default: Blank</td>
</tr>
<tr>
<td>Delay Compensation</td>
<td>The delay compensation value (in seconds). All devices have a delay compensation value which adjusts the synchronization offset between the device and the Vicon data. Analog data collected with a Vicon connectivity device should already be synchronized, so this value should be set at 0. Values can be set between -10 and 10. Default: 0</td>
</tr>
</tbody>
</table>

For all but Kistler force plates:

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calibration File</td>
<td>The force plate calibration file Nexus is to use. This file describes the force plate's properties, such as its physical dimensions, output voltages, and crosstalk coefficients between each analog output. Nexus automatically displays some of these values as the default settings in the relevant properties for the force plates (for example, X Length, Y Length and Calibration Matrix). Use the Browse for a folder button to navigate to the folder containing the calibration file supplied by the force plates manufacturer. Then use the drop-down list button to select the desired file. Default: Blank</td>
</tr>
<tr>
<td>Calibration Matrix</td>
<td>Displays the size of the calibration matrix (e.g., 6x6 Matrix). Click the Edit Text button to display the Calibration Matrix dialog box, which shows the values supplied by the force plate manufacturer. If you do not have a calibration file for your force plate, contact the manufacturer for a replacement file or refer to the calibration information supplied in your force plate documentation. You can manually edit the values for each channel scale. If you manually enter the values, ensure that you use the correct input values to transform the voltages captured by the MX Giganet or MX Ultranet analog card.</td>
</tr>
<tr>
<td>Property</td>
<td>Description</td>
</tr>
<tr>
<td>------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td>to forces and moments. The sensitivity values you must specify depend upon the type of force plate as shown in Calibration matrix values on page 176. Default: Identified from calibration file specified in the Calibration File property</td>
</tr>
<tr>
<td>Zero Level</td>
<td>Resets the force plate voltage zero level. This process eliminates any significant offset between the force plate’s nominal output levels at rest and its theoretical zero level. Use this function if after setting the force plates to the electrical zero level, small differences remain between the theoretical zero level and the observed output level. Click the Edit Text button to display the Zero Level matrix in which you can enter the required value to calibrate the force plate. Then click Apply, then click Close.</td>
</tr>
</tbody>
</table>
| Correction Factor| The factor by which Nexus is to convert the values supplied from a force plate into the values it requires. Correction factor corresponds to a force plate’s amplifier setting and is used along with the calibration matrix to convert raw Volts to Newtons. For an AMTI OR6 Series force plate:  
  - Forces: from Newtons per microvolt (N/V) to Newtons (N).  
  - Moments: from Newton meters per microvolt (Nm/V) to Newton millimeters (Nmm).  

  The formula for calculating the coefficient (K) is:  
  \[ K = \frac{1000000}{(\text{Gain} \times \text{Excitation Voltage})} \]  
  where both Gain and Excitation Voltage are established in the AMTI amplifier. Check the settings for your AMTI amplifier. Default: 25 (for an AMTI amplifier with a default setting of 4,000 Gain and 10V Excitation Voltage). |
| Force Threshold  | The threshold (in Newtons) identifying the noise floor value for calculated forces. Forces that do not exceed this magnitude are assumed to be too noisy and are clamped to zero. Values can be set between 0-50. Default: 25 |
For Kistler (Internal amplifier) force plates only:

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivities (mV/N)</td>
<td>Force plate sensitivity vector. Click the Edit Text button to display the Sensitivities (mV/N) matrix in which you can enter the required values in millivolts per Newton. Default: Identified on connection</td>
</tr>
</tbody>
</table>

**Calibration matrix values**

<table>
<thead>
<tr>
<th>Supported Force Plate</th>
<th>Manufacturer Supplied Units</th>
<th>Nexus Required Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMTI Hall Effect Plate (AccuGait Series)</td>
<td>United States Customary (USC) units Supplied in manufacturer's .acl file.</td>
<td>lb/V</td>
</tr>
<tr>
<td>AMTI Strain Gage Plate (BP Series and OR6 Series) (See Caution below)</td>
<td>United States Customary (USC) unit matrix Supplied in manufacturer's .plt file and Sensitivity Matrix.</td>
<td>uV/Vex /lb/uV/Vex /in lb</td>
</tr>
<tr>
<td>Bertec</td>
<td>International System (SI) units Supplied in manufacturer's documentation.</td>
<td>N/V</td>
</tr>
<tr>
<td>Kistler (External Amplifier)</td>
<td>International System (SI) units Supplied in manufacturer's documentation.</td>
<td>pC/N</td>
</tr>
<tr>
<td>Kistler (Internal Amplifier)</td>
<td>International System (SI) units Supplied in manufacturer's documentation.</td>
<td>mV/N</td>
</tr>
</tbody>
</table>
If you are connecting to AMTI OR6 Series force plates, Nexus expects the force plate calibration values from the USC matrix in pounds (lb) and Inch-Pounds (in-lb) as supplied by AMTI with recent plates. Some older AMTI OR6 Series plates, however, have their USC calibration matrix presented in units of Pounds and Foot-Pounds (ft-lb). If the calibration matrix for your force plate is presented with units of ft-lb, you must convert the values to the required in-lb units. To do this, create a copy of the calibration .plt file and in this copy divide the values of the last three columns of the matrix by 12. Save this modified calibration file and apply it to your force plate by specifying it in the **Calibration File** field. If you enter the matrix values manually, first divide the terms in the **Sensitivity Matrix** by 12. The force plate moments will then scale correctly.

### Source section

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Source</strong></td>
<td>The Vicon connectivity device to which the physical force plates device is connected. From the drop-down list, select the correct one from the available analog option cards detected in your Vicon system architecture. Default: None</td>
</tr>
<tr>
<td><strong>Gain (V)</strong></td>
<td>The programmable gain (+/- volts) for the channel: 1.25 Volts, 2.5 Volts, 5 Volts, or 10 Volts. The gain voltages correspond to 8, 4, 2 and 1 gain values, respectively (e.g., a gain of 2.5 Volts means that the input signal will be multiplied by 4. Default: 10.00</td>
</tr>
<tr>
<td><strong>Fill</strong></td>
<td>Fills all input connections in the expected sequence, starting with the lowest unassigned pin, for the device selected in Source.</td>
</tr>
<tr>
<td><strong>Clear</strong></td>
<td>Clears the input connection setting from all pins.</td>
</tr>
<tr>
<td><strong>Channel</strong></td>
<td>The input connections from the device. After selecting the Source, select the source input from the drop-down list, or use the Fill button to automatically fill all the positions.</td>
</tr>
<tr>
<td>- AMTI AccuGait: FzA, FzB, FzC, FzD, FyAC, FxDC, FxAB, FyBD</td>
<td></td>
</tr>
<tr>
<td>- AMTI OR6 and Bertec: Fx, Fy, Fz, Mx, My, Mz</td>
<td></td>
</tr>
<tr>
<td>- Kistler: Fx (1+2), Fx (3+4), Fy (1+4), Fy (2+3), Fz1, Fz2, Fz3, Fz4</td>
<td></td>
</tr>
<tr>
<td>Default: None</td>
<td></td>
</tr>
</tbody>
</table>
### Dimensions section

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>X Length (mm)</td>
<td>The length (in millimeters) of the x axis of the force plate. Default: Identified from calibration file specified in the Calibration property, if one.</td>
</tr>
<tr>
<td>Y Length (mm)</td>
<td>The length (in millimeters) of the y axis of the force plate. Default: Identified from calibration file specified in the Calibration property, if one.</td>
</tr>
</tbody>
</table>

### Position section

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>X Position (mm)</td>
<td>The origin coordinate (in millimeters) for the X axis of the force plate in relation to the origin of the capture volume, as specified by the L-Frame when you perform the System calibration. Default: 0</td>
</tr>
<tr>
<td>Y Position (mm)</td>
<td>The origin coordinate (in millimeters) for the Y axis of the force plate in relation to the origin of the capture volume, as specified by the L-Frame when you perform the System calibration. Default: 0</td>
</tr>
<tr>
<td>Z Position (mm)</td>
<td>The origin coordinate (in millimeters) for the Z axis of the force plate in relation to the origin of the capture volume, as specified by the L-Frame when you perform the System calibration. Default: 0</td>
</tr>
</tbody>
</table>

Normally, the force plate origin is chosen by placing the calibration device on the desired corner of the force plate. In this case, the position offset is half the width and half the length of the plate. However, for other plates that did not have the calibration device placed on them during calibration, you must fully specify the coordinates of the center of the plate in relation to the capture volume origin.
### Orientation section

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>X Angle Axis (deg)</td>
<td>Maps the x axis (in degrees) of the local force plate coordinate system to the global coordinate system specified for Nexus in the System Preparation tools pane. Default: 0</td>
</tr>
<tr>
<td>Y Angle Axis (deg)</td>
<td>Maps the y axis (in degrees) of the local force plate coordinate system to the global coordinate system specified for Nexus in the System Preparation tools pane. Default: 0</td>
</tr>
<tr>
<td>Z Angle Axis (deg)</td>
<td>Maps the z axis (in degrees) of the local force plate coordinate system to the global coordinate system specified for Nexus in the System Preparation tools pane. Default: 0</td>
</tr>
</tbody>
</table>

### Origin section

For all but Kistler force plates:

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>X Origin (mm)</td>
<td>The displacement (in millimeters) from the sensor X origin to the force plate X origin. Default: 0</td>
</tr>
<tr>
<td>Y Origin (mm)</td>
<td>The displacement (in millimeters) from the sensor Y origin to the force plate Y origin. Default: 0</td>
</tr>
<tr>
<td>Z Origin (mm)</td>
<td>The displacement (in millimeters) from the sensor Z origin to the force plate Z origin. Default: 0</td>
</tr>
</tbody>
</table>

For Kistler force plates:
### Property Description

- **a (mm)**: The displacement (in millimeters) from the sensor X origin to the force plate X origin. Default: 120
- **b (mm)**: The displacement (in millimeters) from the sensor Y origin to the force plate Y origin. Default: 200
- **az0 (mm)**: The negative displacement (in millimeters) from the sensor Z origin to the force plate surface. Default: 48

### Analog accelerometer, EMG, and other analog device nodes

You manage the connection and configuration settings for supported analog devices included in your Vicon system architecture with the appropriate Devices sub-node on the System tab of the Resources pane.

See also:

- Analog device node context menu on page 180
- Analog EMG device node properties on page 181

For information on force plates, see Force plate nodes on page 171.

### Analog device node context menu

You can select the following options from the context menu displayed when you right-click on a sub-node for an analog accelerometer or EMG:

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zero Level</td>
<td>Calibrates the force plate. This process eliminates any significant offset between the force plate's nominal output levels at rest and its theoretical zero level. Select this option if, after setting the force plates to the electrical zero level, small differences remain between the theoretical zero level and the observed output level. This option is also available in the General Properties pane.</td>
</tr>
</tbody>
</table>
Option | Description
---|---
Remove Device | Remove the device entry from the System resource tree.

You can select from a list of available outputs from the context menu that is displayed when you right-click on a **Generic Analog** sub-node. Nodes representing the outputs you select are added below the **Generic Analog** sub-node in the **System Resources** tree.

### Analog EMG device node properties

You can configure settings in the following sections in the **Properties** pane for analog EMG devices:

- General section on page 181
- Source section on page 182

#### General section

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>A user-defined display name for the device. Default: Blank</td>
</tr>
<tr>
<td>Delay Compensation (s)</td>
<td>The delay compensation value (in seconds).</td>
</tr>
<tr>
<td></td>
<td>Many EMG systems, particularly new wireless systems, may introduce a small</td>
</tr>
<tr>
<td></td>
<td>delay in transmission of data. This delay may cause a misalignment between</td>
</tr>
<tr>
<td></td>
<td>Vicon frames of data and EMG frames of data. The Delayed Compensation</td>
</tr>
<tr>
<td></td>
<td>slider bar enables you to correct this difference and properly align Vicon</td>
</tr>
<tr>
<td></td>
<td>data with EMG data. To find the amount of delay for an EMG system, refer to</td>
</tr>
<tr>
<td></td>
<td>the operating manual of the EMG system. If you can’t find the value in the</td>
</tr>
<tr>
<td></td>
<td>EMG manual, contact the EMG manufacturer.</td>
</tr>
<tr>
<td></td>
<td>All devices have a delay compensation value which adjusts the synchronization</td>
</tr>
<tr>
<td></td>
<td>offset between the device and the Vicon data. Analog data collected with the</td>
</tr>
<tr>
<td></td>
<td>MX Giganet should already be synchronized, so this value should be set at</td>
</tr>
<tr>
<td></td>
<td>0. Values can be set between -10 and 10. Default: 0</td>
</tr>
</tbody>
</table>
### Property Description

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amplifier Gain</td>
<td>The voltage gain scale factor. Can be set between 1 - 1000. Default: Depends on device</td>
</tr>
<tr>
<td>Source</td>
<td>The Vicon connectivity device to which the physical force plates device is connected. From the drop-down list, select the correct one from the available analog option cards detected in your Vicon system architecture. Default: None</td>
</tr>
</tbody>
</table>

### Digital device nodes

You manage the connection and configuration settings for supported digital devices included in your Vicon system architecture with the appropriate Devices sub-node in the System Resources tree.

A sub-node is displayed under the Devices node of the Local Vicon System node when Vicon Nexus is connected to a Vicon system with at least one analog or digital device and is in Live mode. The sub-node is displayed under the Devices node of the Vicon Data node when Nexus is in Offline mode.

Currently supported digital devices include:
- Dikablis Eye Tracker node on page 182
- ZeroWire EMG node on page 185

#### Dikablis Eye Tracker node

The Dikablis Eye Tracker enables you to track movement of the eye’s pupil to calculate the gaze vector. Its node is displayed under the Devices node when Vicon Nexus is connected to a Vicon system that includes at least one Dikablis Eye Tracker.

The Dikablis Eye Tracking system is compatible with current Vicon cameras. A minimum of two cameras are required for use with the system.

For information on setting up a Vicon system that includes Dikablis Eye Tracker, see Eye tracking with Vicon Nexus on page 105.
Dikablis Eye Tracker node context menu

The following command is available from the context menu that is displayed when you right-click on a Dikablis Eye Tracker node in the resources tree on the System tab:

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remove Device</td>
<td>Removes the Dikablis Eye Tracker node from the System resource tree.</td>
</tr>
</tbody>
</table>

Dikablis Eye Tracker node properties

You can configure the following settings in the Properties pane for a Dikablis Eye Tracker. For instructions on setting up the hardware, see the Dikablis Eye Tracker User Manual.

- General section on page 183
- Connection section on page 184
- Eye Offset section on page 184
- Calibration section on page 185

General section

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>A user-defined display name for the device. Default: Blank</td>
</tr>
<tr>
<td>Delay Compensation (s)</td>
<td>The delay compensation value (in seconds).</td>
</tr>
<tr>
<td></td>
<td>Many eye tracking systems, particularly new wireless systems, may introduce a small delay in transmission of data. This delay may cause a misalignment between Vicon frames of data and eye tracking frames of data. The Delayed Compensation slider bar enables you to correct this difference and properly align Vicon data with eye tracking data. To find the amount of delay for an eye tracking system, refer to the operating manual of the eye tracking system. All devices have a delay compensation value which adjusts the</td>
</tr>
</tbody>
</table>
### Property Description

synchronization offset between the device and the Vicon data. Analog data collected with the Vicon connectivity devices should already be synchronized, so this value should be set at 0. Values can be set between -10 and 10. Default: 0

| Head Segment | Enter or navigate to the name of the segment that contains the eye. |

**Connection section**

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IP Address</td>
<td>Enter the same IP address that has been set in the Dikablis Recorder software.</td>
</tr>
<tr>
<td>Port Number</td>
<td>The port number for connecting the Dikablis Recorder on the Dikablis laptop. Normally, leave this number at its default value (2002).</td>
</tr>
</tbody>
</table>

**Eye Offset section**

To find the relevant eye offset values, if your Vicon system includes video cameras, you can use overlay video. If not, you can measure the distance from the origin marker.

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>x</td>
<td>Enter the X-coordinate of the eye in the head segment coordinate frame (the distance between the origin marker and the eye (in mm)</td>
</tr>
<tr>
<td>y</td>
<td>Enter the Y-coordinate of the eye in the head segment coordinate frame (the distance between the origin marker and the eye (in mm)</td>
</tr>
<tr>
<td>z</td>
<td>Enter the Z-coordinate of the eye in the head segment coordinate frame (the distance between the origin marker and the eye (in mm)</td>
</tr>
</tbody>
</table>

Vicon Motion Systems Ltd. 27-Sep-2016 Page 184 of 265
Calibration section

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calibration Object</td>
<td>Enter the name of the calibration device (normally Wand)</td>
</tr>
<tr>
<td>Reset</td>
<td>Clears the current calibration</td>
</tr>
<tr>
<td>Add</td>
<td>Add a point to the current calibration.</td>
</tr>
<tr>
<td>Remove</td>
<td>Undoes the last Add operation</td>
</tr>
<tr>
<td>Samples</td>
<td>The number of points used in the current calibration</td>
</tr>
<tr>
<td>Residual</td>
<td>Estimated residual accuracy value. Calculated as the average reprojection error in eye tracker pixels.</td>
</tr>
</tbody>
</table>

Zerowire EMG node

You can configure the following settings in the Properties pane for a digital ZeroWire EMG device:

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auto Populate</td>
<td>Enables or disables automatic detection of ZeroWire EMG modules that are in use. Enabling this feature causes Nexus to automatically add and remove EMG components when they are connected. When Auto Populate mode is enabled, the add and remove EMG menu items are unavailable. Default: Selected</td>
</tr>
<tr>
<td>Sync Rate</td>
<td>Sets the device frame rate, and affects the number of samples per frame. In free-running mode this parameter may be left at its default. In hardware sync mode this parameter should be set to the appropriate</td>
</tr>
<tr>
<td>Property</td>
<td>Description</td>
</tr>
<tr>
<td>--------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Sync Pulse</td>
<td>Enables or disables the use of a TTL compatible hardware sync pulse to control drift between the ZeroWire device and a Vicon system. If you wish to use this feature, connect the ZeroWire unit to a GPO pin via the included ZeroWire sync cable. Advanced users wishing to synchronize ZeroWire to a Vicon system running at a frame rate which does not divide into 2000Hz (for example, 120Hz) should construct a GPO program which provides a sync pulse at a rate which does divide. The GPO program entitled <em>ZeroWire 100Hz Sync.gpo</em> is provided as an example (see <a href="#">Example ZeroWire100Hz Sync.gpo program on page 188</a>). Default: Unchecked</td>
</tr>
<tr>
<td>Trigger Pulse</td>
<td>Enables or disables the use of a TTL compatible hardware trigger pulse to synchronize the start and stop of ZeroWire data acquisition with a Vicon system. Users wishing to synchronize ZeroWire to a Vicon system should connect the ZeroWire unit to a GPO pin via the included ZeroWire sync cable, and run the included GPO program entitled <em>ZeroWire Trigger.gpo</em> (see below). For best results, use this feature with the Sync Pulse feature. Consult the ZeroWire technical manual for a description of the ZeroWire sync cable. Default: Unchecked</td>
</tr>
</tbody>
</table>

sync frame rate, which would usually be the same as the MX frame rate. Values which do not divide into 2000 can not be used. See the Sync Pulse parameter. Default: 50
General section

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>A user-defined display name for the device. Default: Blank</td>
</tr>
<tr>
<td>Delay Compensation (s)</td>
<td>The delay compensation value (in seconds). All devices have a delay compensation value which adjusts the synchronization offset between the device and the Vicon data. Analog data collected with the Vicon connectivity devices should already be synchronized, so this value should be set at 0. Values can be set between -10 and 10. Default: 0</td>
</tr>
<tr>
<td>Errors</td>
<td>An advanced parameter which stores any diagnostic errors received from the ZeroWire device. Use this parameter for troubleshooting. For further information, see the documentation supplied by the manufacturer. Default: Determined by device state</td>
</tr>
</tbody>
</table>

Sync section

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sync Rate</td>
<td>Sets the device frame rate, and affects the number of samples per frame. In free-running mode this parameter may be left at its default. In hardware sync mode this parameter should be set to the appropriate sync frame rate, which would usually be the same as the MX frame rate. Values which do not divide into 2000 can not be used. See the Sync Pulse parameter. Default: 50</td>
</tr>
<tr>
<td>Sync Pulse</td>
<td>Enables or disables the use of a TTL compatible hardware sync pulse to control drift between the ZeroWire device and a Vicon system. If you wish to use this feature, connect the ZeroWire unit to a GPO pin via the included ZeroWire sync cable. Advanced users wishing to synchronize ZeroWire to a Vicon system</td>
</tr>
</tbody>
</table>
Property Description

Running at a frame rate which does not divide into 2000Hz (for example, 120Hz) should construct a GPO program which provides a sync pulse at a rate which does divide. The GPO program entitled ZeroWire 100Hz Sync.gpo is provided as an example (see Example ZeroWire100Hz Sync.gpo program on page 188).
Default: Unchecked

Trigger Pulse Enables or disables the use of a TTL compatible hardware trigger pulse to synchronize the start and stop of ZeroWire data acquisition with a Vicon system. Users wishing to synchronize ZeroWire to a Vicon system should connect the ZeroWire unit to a GPO pin via the included ZeroWire sync cable, and run the included GPO program entitled ZeroWire Trigger.gpo (see Example ZeroWire Trigger.gpo program). For best results, use this feature with the Sync Pulse feature. Consult the ZeroWire technical manual for a description of the ZeroWire sync cable.
Default: Unchecked

Example ZeroWire100Hz Sync.gpo program

The ZeroWire 100Hz Sync.gpo file is defined as follows:

```xml
<?xml version="1.0" standalone="yes"?>
<AllPrograms>
  <Program Name="ZeroWire 100Hz Sync">
    <Type>Repeating</Type>
    <Polarity>High</Polarity>
    <StartEvent>MXDVStart</StartEvent>
    <StopEvent>MXDVStop</StopEvent>
    <StartOffset MicroSeconds="0"/>
    <StopOffset MicroSeconds="0"/>
    <PulseWidth MicroSeconds="5000"/>
    <PulsePeriod MicroSeconds="10000"/>
  </Program>
</AllPrograms>
```
Example ZeroWire Trigger.gpo program

The ZeroWire Trigger.gpo file is defined as follows:

```xml
<?xml version="1.0" standalone="yes"?>
<AllPrograms>
  <Program Name="Duration">
    <Type>Duration</Type>
    <Polarity>High</Polarity>
    <StartEvent>MXDVStart</StartEvent>
    <StopEvent>MXDVStop</StopEvent>
    <StartOffset Frames="0"/>
    <StopOffset Frames="0"/>
    <PulseWidth Frames="0"/>
    <PulsePeriod Frames="0"/>
  </Program>
</AllPrograms>
```
Subjects tab

The Subjects tab of the Resources pane enables you to prepare and manage the subjects whose motion data you want to capture and analyze in Vicon Nexus.

The Subjects tab contains the following sections:

- Subjects toolbar on page 190
- Subjects Resources tree on page 190
- Subjects properties on page 191

Subjects toolbar

Create or manage subject nodes for Vicon labeling skeleton templates (.vst files) or Vicon labeling skeletons (.vsk files) using the following buttons in the toolbar at the top of the Subjects Resources pane:

- Create a blank subject: Create a new subject node in the Resources tree. You can subsequently create, attach, or import .vst or .vsk files for the blank node. The node automatically includes the minimum sub nodes for the elements required for a .vst file.

- Create a new subject from a labeling skeleton: Create a new subject node in the Resources tree based on an existing .vst file. The node automatically includes any sub nodes and data for the elements defined in the selected .vst file.

- Load an existing subject: Load an existing labeling skeleton (.vsk file) into a subject node in the Resources tree. The node automatically contains sub nodes and data for all elements defined in the selected .vsk file.

Subjects Resources tree

Enable a subject for motion capture and data recording in the tree in the Subjects Resources pane.

Expand (>) or collapse (V) the following sub-nodes to display or hide a list of subject elements that you can use for selecting, editing, or showing in graph traces:
Markers Model markers defined in the .vst or .vsk file as well as trajectories for markers visible in the capture volume or from a loaded .c3d file. The marker text is gray if the marker is not physically present in the capture volume.

Segments Segments defined in the .vst or .vsk file.

Joints Joints defined in the .vst or .vsk file. The names of the segments that the joint connects are shown in parentheses after the joint name.

Model Outputs Components of variables calculated for a kinematic model (such as Angles, Forces, Moments, Powers, or Bones) created by Vicon Plug-in Gait and available in Nexus from a loaded .c3d file.

You can perform commands to manage specific nodes by right-clicking on the node in the Subjects Resources tree and selecting the desired command from the displayed menu.

The color-coded symbols displayed for entries in the Markers and Segments lists correspond to the colors defined for each model marker and joint in the .vst or .vsk file. This provides a helpful visual aid when you are manually labeling a subject. The symbols for entries in the Joints list and the Traces list are not color coded: the same joint symbol is displayed for all joints, and the same model outputs symbol is displayed for all model outputs.

If no markers, segments, or joints have yet been defined for a new subject, the lists may not contain any entries.

Subjects properties

The Properties section at the bottom of the Subjects Resources pane enables you to view or edit properties of the node selected in the Subjects tree. The properties displayed depend upon the subject node, sub node, or element selected in the System Resources tree (marker, segment, joint, or trace). For details on how to specify settings for properties, see Set properties in Vicon Nexus in the Vicon Nexus User Guide.

For more information, see:

- Subject node context menu on page 192
- Subject node Properties pane on page 192
- Markers context menus on page 194
- Markers properties on page 194
- Segments context menu on page 195
- Segments properties on page 195
- Joints context menu on page 195
Subject node context menu

You can select the following commands from the context menu displayed when you right-click on a subject node:

- **Attach Labeling Skeleton Template** In the Choose a Subject file dialog box, navigate to and select the .vst or .vsk file to be attached to this subject node and then click Open. Nexus attaches the specified .vst or .vsk file, closes the dialog box, and updates the subject node with sub nodes and data contained in the specified file.

- **Save Subject** Nexus saves the contents of the subject node in a .vsk file in the currently active session of the motion capture database.

- **Save Labeling Skeleton as Template** In the Choose a Subject file dialog box, navigate to the folder in which you want to save the Vicon labeling skeleton template, enter the name for the .vst file, and then click Save.

Nexus saves the contents of the subject node in the specified .vst file. It also generates a corresponding marker file with the same base name and a .mkr extension in the same folder. If you subsequently run a BodyBuilder model that requires a marker file, this .mkr file is automatically copied to the relevant session folder.

Save your .vst file in the default Nexus model templates folder (C:\Program Files(x86)\Vicon\Nexus2.#\ModelTemplates) to make it available from the list of available .vst files displayed when you create a new subject node from a template.

- **Revert to Uncalibrated** Nexus discards any calibration data in the .vsk file and reverts to the generic information from the Vicon labeling skeleton template on which the .vsk file was based.

- **Delete Subject and VSK** In the Warning confirmation message, click Yes to proceed.

Nexus deletes the subject node from the Subjects Resources pane, unloads the .vsk file from the current session, and unlabels the trajectories associated with that subject

Subject node Properties pane

The Properties section of the Subjects Resources pane enables you to edit the properties of a Vicon labeling skeleton template (.vst file).
You can configure the following settings for a Subject node:

- **Name** The name of the selected subject node. This name is used when the Vicon labeling skeleton template is saved in a .vst file or the Vicon labeling skeleton is saved in a .vsk file. You can change this either by overtyping the current name or by clicking the ellipsis (…) to display the **Name** dialog box in which you can overtype the existing node name with a text string.

- **Color** Not currently applicable.

- **Add Parameter** Enables you to add a custom parameter (measurement) to the model. In the **Add Subject Parameter** dialog box, supply a name, specify whether the measurement is required to run the model, specify the units, value and default for your new measurement.

- **Set All to Default** Sets all the selected subject's parameters to their default values.

In the remaining sections, properties vary depending on the labeling skeleton used for the subject selected in the **Subjects** tree (the following example properties are from a subject based on Plug-in Gait):

**General section**

- **Bodymass** The subject's body mass (in kg).
  Default: As defined in the .vsk or .vst file, or user-specified.

- **Height** The subject's height (in mm).
  Default: As defined in the .vsk or .vst file or user-specified

- **InterAsisDistance** The distance (in mm) between the subject's left and right anterior superior iliac spine (ASIS).
  Default: As defined in the .vsk or .vst file or user-specified

- **KneeWidth** The width (in mm) of the subject's knee.
  Default: As defined in the .vsk or .vst file or user-specified

- **AnkleWidth** The width (in mm) of the subject's ankle.
  Default: As defined in the .vsk or .vst file or user-specified

**Left section and Right section**

- **LegLength** The length (in mm) of the subject's leg.
  Default: As defined in the .vsk or .vst file or user-specified

- **AsisTrocanterDistance** The distance (in mm) between the subject's ASIS and greater trochanter.
  Default: As defined in the .vsk or .vst file or user-specified

- **KneeWidth** The width (in mm) of the subject's knee.
  Default: As defined in the .vsk or .vst file or user-specified

- **AnkleWidth** The width (in mm) of the subject's ankle.
  Default: As defined in the .vsk or .vst file or user-specified
- **TibialTorsion**: The torsion (in deg) of the subject's tibia. Default: As defined in the .vsk or .vst file or user-specified

- **SoleDelta**: The distance in millimeters between the thickness of the sole at the toe and at the heel.

- **ShoulderOffset**: The vertical distance (in millimeters) from the base of the acromion marker to the shoulder joint center.

- **ElbowWidth**: The width (in millimeters) of the elbow along flexion axis.

- **WristWidth**: The anterior/posterior width (in millimeters) of the wrist.

- **HandThickness**: The anterior/posterior width (in millimeters) of the hand.

For more details on these measurements, see *Take subject measurements for Plug-in Gait* in the *Vicon Nexus User Guide*.

### Markers context menus

You can select the following command from the context menu displayed when you right-click on the **Markers** node:

- **Reorder**: Displays the **Reorder Markers** dialog box, where you can change the order in which the markers are displayed.

You can select the following command from the context menu displayed when you right-click on a sub node for a specific marker:

- **Detach Marker**: The marker is detached from the subject and is no longer displayed in the list of markers on the **Subjects** tab (and is removed from the VSK) or the **Manual Labeling** list in the **Label/Edit Tools** pane.

### Markers properties

You can configure the following settings in the **Properties** section for the markers:

- **Name**: The name of the Vicon marker. You can rename a marker by overtyping it. Default: As defined in .vsk or .vst file or as specified in the **Labeling Template Builder**.

- **Color**: The color in which to display the Vicon marker in a 3D Perspective view pane. You can assign either a specific color or the associated context color. Default: As defined in .vsk or .vst file or as specified in the **Labeling Template Builder**.

- **Radius**: The size of the Vicon marker attached to subject during trial capture. This setting also dictates the size of the marker displayed in the 3D Perspective view pane. You can change the radius by either overtyping the current value or dragging the slider bar left to decrease the value or right to increase it. Default: As defined in .vsk or .vst file or as specified in the **Labeling Template Builder**.
- **Status** The requirement for the marker's inclusion in a .vst file for static trials (used for calibration) and/or the .vsk file calibrated from the .vst file for dynamic trials (used for analysis):
  - **Required**: Marker must be present for both static and dynamic trials.
  - **Optional**: Marker can optionally be left off. If the marker is not present for the calibration, the autolabeler will not look for it in the dynamic trials. If the marker is present in the static trial, it will also form part of the dynamic marker set and will be used to aid tracking and to provide redundancy.
  - **Calibration Only**: Marker must be present for static trials to align coordinate systems, but it must be removed for dynamic trials.
    Default: Required

**Segments context menu**

You can select the following commands from the context menu displayed when you right-click on a sub node for a specific segment:

- **Pick as Kinematic Fill Source** Enables you to copy the kinematics from the selected segment to fill a gap.
  The suggested fill is displayed in purple in the 3D Perspective window. You can also view the suggested fill options as colored dotted lines in the Graph view.

- **Delete Segment** Deletes the selected segment.

**Segments properties**

You can configure the following settings in the Properties section for the segments:

- **Name** The name of the skeleton segment.
  Default: As defined in .vsk or .vst file or as specified in the Labeling Template Builder

- **Color** The color in which to display the skeleton segment in a 3D Perspective view pane. You can assign either a specific color or the associated context color.
  Default: As defined in .vsk or .vst file or as specified in the Labeling Template Builder

**Joints context menu**

You can select the following command from the context menu displayed when you right-click on a sub node for a specific Joint:

- **Unlink Joint** Unlinks the selected segments.
**Joints properties**

- **Name** The names of the segments connected by the joint. Default: As defined in .vsk or .vst file or as specified in the Labeling Template Builder.
- **Output Format** The joint angle output format (if appropriate):
  - XYZ Euler Angles
  - ZYX Euler Angles
  - XZY Euler Angles
  - ZX Euler Angles
  - YXZ Euler Angles
  - ZXY Euler Angles
  - Helical Axis
  Default: Helical Axis

**Model Output properties**

- **Name** The names of the model outputs in a loaded .c3d file.
  Default: As defined in the .c3d file

**Model Outputs context menu**

Model outputs depend upon the modeling that is performed, but can include some or all of the following:

- Angles
- Forces
- Moments
- Powers
- Scalars
- Bones

You can delete a single model output, groups of model outputs or all the outputs under a single output sub-node by right-clicking on the relevant node(s) in the Subjects Resources tree and then clicking **Delete**. (You can also delete model outputs using the Delete Model Outputs pipeline operation, available in the Data Processing operations on the Pipeline Tools pane.)
Element color properties

In the Color property for Markers and Segments, you can specify the default color for these subject elements using one of the following methods:

- Assign a specific color using the color map.
- Click the current color in the entry field to display the Select Color dialog box.
- In the Basic colors area, click the square for the desired color, or in the Custom colors areas define a new color.
- Specify the default color of its associated context (if any) using the Context Color macro.
- Click the Color property context menu button and select Macro. Context Color is displayed in the entry field. A marker inherits its context from the segment to which it is attached. A segment’s context is derived from its name, for example “LeftFemur” has a left context. To turn off the context color macro, clear Macro in the Color property context menu.

<table>
<thead>
<tr>
<th>Context</th>
<th>Default Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>General</td>
<td>Orange</td>
</tr>
<tr>
<td>Left</td>
<td>Red</td>
</tr>
<tr>
<td>Right</td>
<td>Green</td>
</tr>
</tbody>
</table>
View pane

The View pane enables you to visualize data from one or more cameras in real time or from a saved file.

You can visualize the system components or subjects selected in the Resources pane, or the results of processing performed in the Tools pane during any stage of the Nexus motion capture workflow.

Tip

By default, the View pane is in the center of the Nexus window. You cannot detach or change the position of this pane, but you can open a separate floating view workspace.

You view and manipulate the type of data you specified for display in the view pane below the toolbar. By default, a single view pane is displayed. You can display multiple view panes, and specify the same or different view in each. You can manually resize each view pane.

You can control the way data is visualized in the view panes, for example, by changing the display options for force plate, in the Options dialog box (press F7).

View panes contain the following controls:

- **View pane toolbar** Select the view to use, manage any display options for the selected view, and specify the number and arrangement of views displayed in the toolbar at the top of the view pane. The lists and buttons on the View pane toolbar that are available from all types of view panes are described below.

- **View list**
Select the views to be displayed from the View list:

- **3D Perspective view on page 199** Reconstructed motion capture data from all active Vicon cameras in 3D (three-dimensional) perspective, that is length, width, and depth.

- **3D Orthogonal view on page 201** Motion capture data in 3D perspective viewed from a specified point of sight, or direction, of the capture volume.

- **Camera view on page 202** Raw 2D motion capture data from an individual Vicon camera or a supported digital video camera.

- **Graph view on page 205** Various values of one or more selected items (such as the x, y, and z components of a marker trajectory) plotted against each other or against time.

- **Subject viewer on page 213** The base pose for the labeling skeleton template (VST) of the currently selected subject. Also facilitates manual labeling.

**Standard buttons**

Specify the number and arrangement of view panes displayed in the workspace using the following buttons:

- **Horizontal** Split the current view horizontally into two view panes.

- **Vertical** Split the current view vertically into two view panes.

- **Close** Close the current view pane. (You cannot close the default View pane in the center of the Nexus window.)

Depending upon the view selected, there may be additional lists and buttons available.

- **Time bar on page 214** You manipulate offline trial data using the time bar.

**3D Perspective view**

The **3D Perspective** view enables you to visualize reconstructed motion capture data from all active Vicon cameras, or Vicon Skeleton Templates (.vst), or Vicon Skeleton (.vsk) files, in 3D (three dimensional) perspective, that is length, width, and depth.

You can view 3D data live in real time or from a previously saved trial.

In addition to the standard buttons (see **View pane on page 198**), the **3D Perspective** view contains the following sections:
3D Perspective view pane toolbar You manage the display of 3D data in the active workspace by selecting the following buttons at the top of the view pane:

- **Center camera on selection** Position the currently selected data in the center of the view pane. This option does not automatically zoom in on the selected data.
- **Export Workspace to AVI** Enables you to create video files of a selected 3D workspace (including any labeled subject). For more information, see Export 3D Workspace as AVI in the Vicon Nexus User Guide.
- **3D Perspective view** You view and manipulate 3D data in the view pane below the view pane toolbar. For example, you can dolly, orbit, pan, tilt, truck, and zoom to control the portion of the capture volume that is displayed.

### 3D Perspective view usage tips

When you display a 3D Perspective view pane:

- If you have additional 3D Perspective or other view panes (3D Orthogonal, Camera, Graph view or Subject Viewer panes) open, you can change the number and arrangement of view panes displayed in the workspace to suit your preferences using the view pane toolbar buttons at the top right of the view pane.
- You can highlight the representations of specific cameras in the 3D Perspective view pane workspace by selecting one or more cameras under the Vicon Cameras node in the System Resources pane.
- You can configure display options in the Options dialog box (F7), such as force plate display options.

**To visualize data in the view pane:**

1. Either stream live camera data (click Go Live), or double-click the name of a processed data file on the Data Management tab.

2. From the View pane toolbar, select 3D Perspective. The reconstructed 3D data from all cameras is displayed in a single 3D Perspective view pane. Information about the current trial appears at the top of the view pane:
   - NO TRIAL if no trial is loaded
   - LIVE if Nexus is in Live mode
   - The trial file name if you are viewing a trial in Offline mode.

3. If you want to change the way this text is displayed, open the Options dialog box (F7), and configure the Workspace Title option.
3D Orthogonal views

The 3D Orthogonal view pane enables you to visualize motion capture data in 3D perspective viewed from a specified point of sight, or direction, of the capture volume.

You can view 3D data from an orthogonal perspective live in real time or from a previously saved trial.

In addition to the standard buttons (see View pane on page 198), the 3D Orthogonal view pane contains the following sections:

- **3D Orthogonal view pane toolbar** Manage the display of data in the active workspace with the following list and button at the top of the view pane:

- **Orthogonal view list** Set the point of sight by selecting one of the following orthogonal projections (also called orthographic projections): -Z (default), +Z, +X, -X, +Y, -Y

- **Center camera on selection** Position the currently selected data in the center of the view pane. This option does not automatically zoom in on the selected data.

- **3D Orthogonal view** View and manipulate 3D data in the view pane below the view pane toolbar. For example, you can dolly, tilt, truck, and zoom (but not pan or orbit) to control the portion of the capture volume that is displayed.

3D Orthogonal view usage tips

When you display a 3D Orthogonal view pane:

- To visualize data in the view pane, either stream live camera data (click Go Live), or double-click a processed data file on the Data Management tab.

- Reconstructed 3D data from all cameras is displayed in a single 3D Orthogonal view pane, initially from the -Z (top) view.

- The current trial name appears at the top of the view pane:
  - NO TRIAL if no trial is loaded
  - LIVE if Nexus is in Live mode
  - The trial file name if you are viewing a trial in Offline mode.

- If you want to change the way this text is displayed, open the Options dialog box (F7), and configure the Workspace Title option.
Camera view

The Camera view pane enables you to view raw 2D motion capture data from an individual Vicon camera or a supported digital video camera either live in real time or from a previously saved raw capture file (.x2d).

In addition to the standard buttons (see View pane on page 198), the Camera view pane contains the following sections:

- **Camera view pane toolbar** Manage the display of camera data in the workspace with the following controls and buttons in the Camera view pane toolbar at the top of the view pane:
  - **View list** Manage the way camera data is visualized in the active Camera view pane by selecting the following options from the View drop-down list:
  - **3D Overlay** Overlay multiple Camera view panes on top of each other, so all camera views are displayed in a single view pane. Each camera is rendered in a unique color.
    - Default: Off
  - **Rotated** Rotate the Camera view, so it is corrected to the vertical axis defined in the system calibration (which corresponds to the earth’s vertical axis). It also enables you to manually rotate the view by dragging the view left or right.
    - Information from the camera calibration is required to present the rotated view.
    - Default: Off
  - **Combined** Correctly model lens distortions and display a corrected camera view with the 3D view rendered underneath the 2D camera view. This is particularly useful for viewing Vicon optical data overlaid onto images from video cameras. You can burn this overlay information onto the .avi file to view in other applications using the Export 3D Overlay Video pipeline operation.
    - Default: Off
  - **Zoom to Fit** Zoom the selected Camera view pane to fit the full workspace.
    - Default: On
  - **Zoom to Window** See Display camera sensor window, below.
  - **Export Workspace to AVI button** Enables you to create video files, including labeled subject, of a selected 3D workspace. For more information, see Export workspace as AVI in the Vicon Nexus User Guide.
- **Paint a mask onto the camera button** Paint over any cells in the camera grid (displayed when the button is clicked) that contain unwanted reflections. When a cell is painted, its background color changes from black to blue. The camera mask consists of blue cells obscuring unwanted reflections. For more information, see *Mask unwanted reflections* in the *Vicon Nexus User Guide*.

- **Erase a mask from the camera button** Erase a previously painted cell from a mask. When an individual cell is erased, its background color changes from blue to black, and any reflection that had previously been obscured is visible again.

- **Clear the mask from the camera button** Automatically remove a previously painted mask. When the mask is cleared, the background color of any previously painted cells changes from blue to black, and any reflections that had previously been obscured are visible again.

- **Display grayscale blobs button** When selected, grayscale blobs are displayed in the Camera view.

- **Display centroid circles button** When selected, centroids are displayed in the Camera view.

- **Display camera sensor window button** Displays a visual representation of the windowing that occurs at higher frame rates. The windowed area is indicated by a rectangle within the Camera view, showing the size and position of the active window on the camera sensor. (Windowing is also displayed in the 3D Overlay view and in Rotated view). For instant feedback on the area that is captured and to save room on the screen, you can zoom in to the sensor window. To do this, in a Camera view, from the View menu, select **Zoom to window**, or to turn on **Zoom to window** for all windows, press the hot keys: Ctrl+Shift+Z.

  To toggle the display of windowing, in the Options dialog box (F7), click the Camera Limits option and in the Properties pane, select the Sensor Window property.

- **Lock / Unlock button** (displayed with standard buttons on the right) Lock the current Camera view pane, so that it is effectively detached from the selection set and is not affected by any subsequent selections in other open view panes. This is useful for displaying views from different cameras in multiple Camera views.

  When the active clip changes, or when you switch from Live to Offline mode, the selection is automatically unlocked.

- **Camera view pane** View and manipulate 2D data in the view below the view pane toolbar. For example, you can orbit, truck, dolly, and zoom the displayed data.
Camera view usage tips

To visualize optical data in a Camera view:

1. Either stream live camera data (click Go Live), or double-click a raw data file (.x2d file) on the Data Management tab.

2. In the System Resources tree, select one or more cameras whose data you want to visualize. To do this, expand the Vicon Cameras node and then click on the sub node for one or more cameras. The 2D data from each selected camera is displayed in a separate Camera view pane.

To visualize video data in a Camera view:

Note that a video camera is listed under the Video Cameras node for each .avi file you have loaded.

1. Do one of the following:
   - Double-click on the desired movie file on the Data Management tab; or
   - From Windows Explorer, drag the required .avi file onto a Camera view pane. (If you drag an .avi file onto a Camera view pane, the current trial closes, and no file name is displayed in the View pane, because the .avi file is not associated with any particular trial.); or
   - Import an .avi file into the current trial by running the Import AVI pipeline operation. This operation is located in the File Import operations list in the Pipeline Tools pane.

2. If you make a change to the video file camera settings, an asterisk (*) appears next to the configuration name at the top of the System Resources tree, reminding you that there are unsaved changes to your system configuration.

3. In the System Resources pane, expand the Video Cameras node and select one or more digital video cameras.

4. To play offline video, click Play in the tool bar. The video from each camera selected is displayed in a separate Camera view pane.
Graph view

The Graph view enables you to view various values of one or more selected items (such as the x, y, and z components of a marker trajectory) against each other or against time, or analog data from any supported force plates or EMG devices.

You can view graphs of motion data live in real time or from a previously saved reconstructed and labeled trial.

In addition to the standard buttons (see View pane on page 198), the Graph view contains the following controls.

Graph view pane toolbar

Manage the display of graph data in the view pane with the following controls at the top of the view pane. The Graph view pane toolbar leads you left to right through the normal flow of operations required to plot a graph for the selected elements.

- **Graph type drop-down list**
  Select the type of graph to be displayed from the categories in this drop-down list. (Graph types that are not available for the data currently selected in the System Resources pane are dimmed.) See Graph type options on page 208.)
Differentiate the graph button

Specify, for the currently displayed graph, the current variable, its first derivative (velocity or angular velocity), or its second derivative (acceleration or angular acceleration) by selecting the desired options from this drop-down list:

- x (none)
- x’ (velocity)
- x” (acceleration)

A graph of a trajectory will have X, Y, and Z axes, but when differentiated to x’ (velocity), the axes will change to X’, Y’, and Z’ axes.

Tip

You can then use the Add Monitor button to provide real-time bio-feedback on differentiated as well as positional data. For more information, see Using monitors on page 37.

Choose the components of the graph button

Specify the components of the selected graph type to be plotted in the active Graph view by selecting the desired options from this drop-down list (only components that you have selected for Graph view are available).

This option enables you to focus on a component of particular interest, which occupies more of the workspace. When multiple components are plotted, each is always shown on a separate axis, and the components shown are applied to all channels visible in the workspace. The number of vertically stacked graphs displayed in the workspace depends on the number of options selected for graph view, and from those, the number selected from this list.

Legend button

Display a legend for the current graph listing the color for each trace plotted, the subject (if multiple subjects are loaded), and the name of each element being plotted in that trace. To display a temporary tooltip with this information, hovering the mouse pointer over the button. To open a separate splitter pane to permanently display the legend to the right of the graph view, click the button.
Choose the rotation order button If you select a segment in the Subjects Resources pane, you can select Global Angle from the Graph type drop-down list. This enables the Choose the rotation order button. Clicking on the Rotation Order button lists the angle convention choices of Helical (default), XYZ, XZY, etc. This enables you to choose either a Helical or an Euler angle convention. The Euler angle convention has multiple rotation order conventions represented by XYZ, XZY, etc.

Create a monitor button Add the selected graph component as a monitor entry in the Monitors communications pane.

Scale the graph to fit (horizontal) button Zoom out the x-axis to show the complete range of the trace for the selected time period. This is useful if you have zoomed in a long way and now want to quickly see the entire graph again.

Lock the horizontal graph axis button Lock the horizontal axis to prevent further rescaling of the axis once it is at a desired length of frames. This is useful if you want the horizontal axis range to stay the same.

Scale the graph to fit (vertical) button Scale the y-axis so that all the data in selected traces for the currently visible x-axis is visible. If there are multiple components in the selected traces, they are all set to the same range, that is, the range required to show all the data in the component with the largest range. If Nexus is in Live mode, this button acts as a toggle, enabling you to leave this mode switched on or off. If on, when plotting live data, the y-axis is automatically scaled as the data changes so all traces are visible. Manually zooming switches the automatic mode off.

Lock the vertical graph axis button Lock the vertical axis to prevent further rescaling of the axis once it is at a desired range. This is useful if you want the vertical axis range to stay the same.

Scale the graph to fit (horizontal and vertical) button Scale the x and y axes simultaneously to fit the horizontal and vertical ranges of data.

Lock / Unlock button (displayed with standard buttons on the right) Lock the current Graph view pane, so that it is effectively detached from the selection set and is not affected by any subsequent selections in other open view panes. This is useful for displaying elements in multiple Graph views. When the active clip changes, or when you switch from Live to Offline mode, the selection is automatically unlocked.
Graph view pane

View and manipulate graph data in the view pane below the view pane toolbar. For example, you can slide the displayed data along the axes or zoom in and out.

Graph type options

Devices
Displays graphs for the components of the analog signals from force plates or EMG devices. This is useful for examining analog device activity such as force plate strikes or EMG voltage output. You can also display graphs displaying units of mm/s² of analog signals from an accelerometer device, which allows you to examine voltage output from an accelerometer device.

Components: View force plate data such as Forces, Moments, and Center of Pressure, or to view Other Devices, such as EMG and Accelerometer data.

Subjects

Labeling View labeling data for the current subject

Trajectories
Displays graphs for one or more marker trajectories selected, such as the global XYZ components of a marker, a marker’s distance from the global origin, distance between two markers, angle between three markers, or a count of how many reconstructed markers are in any current frame of data.

Components: View the X, Y, and Z coordinates of a marker selected in either the Subjects Resources pane or the 3D Perspective view.

Distance From Origin: View the straight-line distance between the chosen point and the global origin. Plots the distance from the capture volume origin to each selected marker. This is useful for plotting velocity or acceleration of markers.

Distance Between: View the straight-line distance between two markers selected in either the Subjects Resources pane or the 3D Perspective view.

Distance Between (XYZ): View the global X, Y, and Z components of the distance between two markers selected in either the Subjects Resources pane or the 3D Perspective view. Plots the absolute distance (as a vector) between two selected markers. This is useful, for example, to see how the distance between two markers that are assumed to have a rigid relationship changes over time. This graph type calculates a separate component (X,Y,Z) distance between the two markers. It is only available when two markers are selected in the 3D Perspective view.
- **Angle Between**: Plots the angle between the two vectors formed by any three markers selected in either the **Subjects Resources** pane or from the **3D Perspective** view pane. This is useful for seeing how the group of markers moves over time.

- **Trajectory Count**: View the number of markers (both labeled and unlabeled) currently reconstructed in the **3D Perspective** view. Plots the total number of trajectories over time visible to the Vicon cameras (if streaming Live data in real time) or processed in trial (if viewing previously captured data in a file).

**Model Outputs**
Displays three graphs of the components of any output variables (such as Angles, Forces, Moments, Powers, or Bones) that have been calculated by Vicon Plug-in Gait for your model. This is useful for visually validating data produced by post-capture processing models without having to load the data into Polygon for full biomechanical analysis or reporting.

- **Model Outputs**: Select to view outputs from calculations run in post-capture pipeline.

- **Difference Between**: The difference between first and second selected model output in X, Y and Z (example: New Patient 1:LAnkleAngles - New Patient 1:RAnkleAngles)

**Joints**
Displays graphs of the components of selected joint kinematics, either three graphs for Euler angles or six graphs for a helical vector (as appropriate for the joint type). This is useful for displaying approximate joint angles between linked segments of the labeling template worn by your subject in real time. This type of graph can only be plotted for a subject that has been kinematically fitted (for example, one that has had the **Kinematic Fit** operation, found under **Core Processing** on the **Pipeline Tools** pane, run on it).

- **Kinematics**: Select to view kinematic angles between linked segments of the subject. (To see these angles, you must have performed kinematic fitting on labeled trajectories.)

**Segments**

- **Global Angle**: The angle between the selected segment and the global origin in rotation (RX, RY, RZ) and translation (TX, TY, TZ).
Graph view usage tips

- When zooming into or out of graph data, the display of grid lines 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, in the Options dialog box (F7), select Graph and then ensure the Show Minor Grid Lines property is selected.

- The Graph view contains rulers and axes along the left and bottom edges and graph traces for the item being plotted. The contents of the axes of the Graph view depend on whether the system is in Live or Offline mode:

  - **Live** The y-axis vertical ruler is on the right side of the graph and the x-axis horizontal ruler is below the graph. The y-axis represents the live frame, so is constantly updated in real time. The x-axis represents the time (in frames). It starts on the right side, which is labeled 0 (zero) and is labeled from right to left with decreasing negative values to reflect the number of frames away from the live frame. Because the current time is always zero, the Time Bar is not displayed at the bottom of the workspace.

  - **Offline** The y-axis vertical ruler is on the left side of the graph and the x-axis horizontal ruler is below the graph. The rulers indicate the scale and the variable names that are being plotted and the horizontal and vertical axes are labeled to indicate the units of measurement used. The graph traces represent the actual data and are scaled to the current rulers. You can select elements to graph in the Resources pane or the 3D Perspective view.

    If the elements selected have more than one component, these components are shown on separate, vertically stacked axes sharing a common x-axis. You can select the components to be displayed from the Component Options list in the Graph view pane toolbar.

- You navigate in Graph view in the usual way, using the mouse. For example, to pan and zoom, click and hold the right mouse button and then drag the mouse up/down to zoom along the Y axis or drag left/right to zoom along the X axis. To pan the graph in any direction, hold the left and right mouse buttons down at the same time as you drag the mouse.

- When you select a data type in the System Resources pane (Trajectories, Model Outputs, Devices, or Joints), Nexus will attempt to intelligently update the Graph view type to match the data type you’ve selected.
To visualize data in a graph:

1. Either click the Go Live button or on the Data Management tab, double-click a processed data file (.c3d) file.

2. Select the elements to be graphed (eg markers, model outputs, force plates, etc) in any of the following ways:
   - In the Subjects Resources pane, expand the desired Subject node, expand the relevant sub-node (eg Markers, Model Outputs, etc), and then select (CTRL+click to select multiple elements) one or more elements; or
   - In a 3D Perspective view pane, select one or more elements displayed in the view pane.

   The number of elements you select depends on the type of graph you wish to view.

3. From the view pane toolbar select Graph.
   - If required, you can select additional elements to add to the Graph view pane. If you are viewing trajectories, each one is displayed in a different color trace. You can use the Legend button in the Graph view pane toolbar to identify the color trace used for each trajectory. If the trace for any additional elements is not visible, use the Fit Horizontally, Fit Vertically, or Fit Both Horizontally and Vertically buttons.

4. If you want to save a particular graph view (for example, specific trajectories that you have selected), save your configuration using the Configuration menu button next to the View Type list on the Nexus toolbar.

You can visualize raw analog signals in a Graph view by selecting Show Raw from the device node context menu in the System Resources pane.
Graphing joint kinematics

1. Select the joints that are of interest.

2. From the Graph Type list in the Graph view pane toolbar, select the Kinematics option under the Joints section to plot the joint angles for the selected joints. Kinematic components for root segments include Tx, Ty, and Tz, accompanied by Rx, Ry, and Rz. These components can be further differentiated to also include Rx’, Ry’, Rz’, Rx”, Ry”, Rz”, Tx’, Ty’, Tz’, Tx”, Ty”, and Tz”. Designate the T’s as translations and the R’s as rotations between the two segments that the joint connects.

Tip

You can plot the Mean and Standard Deviation values for a component in a Graph view pane. To do this, in the Options dialog box, select Graph from the list on the left. Click Show Advanced and then select the Show Mean and SD check box.

Note: The ‘ and “ designations are used to indicate velocity and acceleration, respectively.
Subject viewer

The Subject Viewer pane enables you to display the base pose for the labeling skeleton template (VST) of the currently selected subject. This helps you ensure that your subjects adopt the correct base (neutral) pose.

You can also use the Subject Viewer to assist with manual labeling by making it easy to correlate reconstructions with the appropriate marker. To do this:

1. Ensure the Label/Edit Tools pane is displayed and that the view pane displays both a 3D view of the subject whose markers you are labeling and the Subject Viewer.

2. Select a marker in the Subject Viewer.
   Nexus switches to labeling mode. The mouse pointer changes to display the name of the currently selected marker and the marker is highlighted in the Manual Labeling list.
   This works both ways: selecting a marker in the Manual Labeling list highlights the marker in the Subject Viewer.

3. In the 3D view, click on the marker that is the equivalent of that highlighted in the Subject Viewer and the Manual Labeling list.
   The next marker is automatically highlighted, ready for you to continue labeling.
Time bar

You manipulate offline trial data with time and synchronization characteristics in the time bar.

The time bar is available at the bottom of all types of view pane when you play back data from a saved trial. It is displayed only when the system is in Offline mode (click the Go Offline button), and contains the following controls:

- **Play/Stop button**
  - [Play] Play forward continuously through trial. When clicked, the button switches to its Stop setting.

- **Jump to Previous Event button**
  - [Previous] Play backward one event (when in Event Identification Mode).

- **Enter Event identification mode button**
  - [Event] Switch between modes in which you can manipulate data based on time (button off) or events (button on). For details on manipulating data, see Add events to trials in the Vicon Nexus User Guide.

- **Jump to the next event button**
  - [Next] Play forward one event (when in Event Identification Mode).

- **Ellipsis**
  - Display a context menu from which you can select the following options to manipulate trial data (you also can display the context menu by right-clicking anywhere on the time bar):
    - **Zoom to Trial** Reset the ruler to the full trial timescale after zooming in or out.
    - **Zoom to Region-of-Interest** Reset the ruler to the range of frames identified by the Start Range Frame indicator and the End Range Frame indicator (for details on these indicators, see below).
    - **Set Current Frame**
    - **Play Every Frame**
Replay Speed Specify the playback speed relative to real time by selecting one of the following sub options: 1/10, 1/4, 1/2, 1, 2, or Other. The Other option displays a dialog box in which you can set a specific value. Default: 1

Trajectory Tails Specify the length of tails for selected trajectories, as a value in frames before and after every gap by selecting one of the following from the displayed context menu: 0 frames, 25 frames, 50 frames, 100 frames, 200 frames, or Other. The Other option displays the Trajectory Tails dialog box in which you can set a specific value. Default: 100 frames

Clear All Events Clear all marked events from the ruler. Note that you can also use the Delete Timebar Events pipeline operation to delete events from a specified range of frames.

You can also manage data playback using the keyboard. For example, you can use keys and mouse actions to manage the timescale displayed in the timeline, the time bar data displayed in the workspace, and event identification mode. For more information see Hot keys and shortcuts in the Vicon Nexus User Guide.

You identify or manipulate trial data based either on time or event, depending on the whether the Enter Event Identification Mode button is on or off with the following areas of the time bar.

Timeline

The overall time span and the range of frames currently viewable in the workspace. The timeline is split into default contexts:

- **Left** The top rule on the timeline contains markers for any events specified for the left context.
- **Right** The middle rule on the timeline contains markers for any events specified for the right context.
- **General** The bottom rule on the timeline contains markers for any events specified for the general context.
- **Selected frame** The number of the currently selected frame is displayed at the bottom of the timeline.
Timescale
Displays the overall span of time for the range of frames that can currently be selected. The current frame of trial data is displayed in the label on the left side of the scale at the bottom of the timeline. You can move the visible portion of the timescale or zoom in or out of it (for details, see Shortcuts for working with the time bar in the Vicon Nexus User Guide).

Indicators
Indicate a selected characteristic of the trial data for playback. You can move the indicators along the timeline to manually move the data playback forward or backward and display the desired frame in the view pane. Indicators are displayed when appropriate for the playback operation:

- **Current time indicator**
  Indicates the current time of the data playback along the timeline. This vertical bar spans the entire height of the timeline. In Event Identification Mode, the current time indicator follows the mouse cursor. You can click and drag the mouse for slow-motion playback. When you release the mouse button, the event context menu is displayed.

- **Start of range indicator**
  Indicates the frame specified as the start of the range of trial data to play back or process. This blue triangle is initially positioned on the first frame at the bottom of the timeline.

- **End of range indicator**
  Indicates the frame specified as the end of the range of trial data to play back. This blue triangle is initially positioned on the last frame at the bottom of the timeline.

- **Event markers**
  Indicate a specific event to be applied or displayed in the currently selected frame of the trial data:
Foot Strike The point at which the trial subject’s foot contacts the ground.

Foot Off The point at which the trial subject’s foot leaves the ground.

General A point at which the trial subject performs a user-defined event.

Custom A point at which the trial subject performs a user-defined event that can be named.

Delete Event <$Type$> Deletes the selected event.

Delete All Events at Frame $x$ Deletes all events previously set for the current frame.

Clear All Events Deletes all events previously set for the entire trial.

To work with an event, you must be in Event Identification Mode (see Enter Event identification mode button on page 214).
Tools pane

Configure settings, run tools, and view data processing results in the sections below the toolbar in the Tools pane. The contents of this section depend on the button you select in the Tools pane toolbar.

The Tools pane contains the following tabs:

- System Preparation tools on page 218
- Subject Preparation tools on page 224
- Capture tools on page 225
- Label/Edit tools on page 229
- Pipeline tools on page 230

System Preparation tools

System calibration is a process by which Vicon Nexus calibrates the system based on specialized calibration objects (whose dimensions and relative marker positions are known). It consists of several procedures:

- **Camera calibration** The camera calibration process calculates the physical position and orientation of each Vicon camera in the capture volume based on the movement of the calibration object. Nexus uses this information to determine each camera's physical position and orientation in the capture volume, to correct for any lens distortion, and to set internal camera parameters.

- **Set volume origin** During this process, Nexus measures the position of the calibration object and uses this information to identify the origin of the world (center of the capture volume) and its horizontal and vertical axes. These volume origin and axes are referred to as the global coordinate system. The global origin coordinates are always (0,0,0). The global axes coordinates are given in the form (x, y, z), where x is a horizontal axis, y is the horizontal axis perpendicular to x, and z is the vertical axis. If the floor of your volume is uneven, you can also use the Set Floor Plane option as part of this process.

For basic step-by-step instructions on how to complete these procedures, see *Calibrate a Vicon system* in the *Vicon Nexus User Guide*.

To enable you to perform these procedures, the System Preparation Tools pane contains the following sections (to show additional options, click Show Advanced in the relevant section):
- **Video Calibration Setup** Enables you to activate video calibration mode by clicking the Activate button. Note that if you haven’t saved the current configuration, you will be prompted to do so before you can proceed.
  
  You automatically activate calibration mode when you click Start in the Mask Cameras section, the Aim Cameras section or the Calibrate Cameras section.
  
  To exit calibration mode, click the Deactivate button in the Video Calibration Setup section.

- **Mask Cameras** Enables you to automatically create cameras masks to obscure all reflections visible to the Vicon cameras. By enabling the Advanced properties, you can choose to mask all cameras or just selected cameras. For more information on how to mask cameras, see *Mask unwanted reflections* in the *Vicon Nexus User Guide*.

- **Aim Cameras** Enables you to check the positioning of Vicon cameras around the capture volume with real-time feedback. You normally perform this step before you begin calibration check. For more information on how to aim cameras, see *Aim Vicon cameras* in the *Vicon Nexus User Guide*.

- **Calibrate Cameras** Enables you to calibrate the Vicon cameras to determine their positions, orientations, and lens properties, which enables Nexus to produce accurate 3D and 2D (video) data from motion data captured throughout the capture volume. The **Advanced** properties contain the following options:
  
  - **Wand** The calibration object to be used during the dynamic stage of the camera calibration process.
    Default: Active Wand v2 (both optical cameras and digital video cameras are calibrated with an Active Wand)
  
  - **Calibration Type** Specify whether to use a **Full Calibration** or a quicker **Calibration Refinement**. (If you have not already calibrated or aimed all cameras, you cannot perform a calibration with the **Calibration Refinement** option.) For more information on calibration options, see *Understand camera calibration refinement* on page 222.
  
  - **Cameras to Calibrate** Can be **All Cameras** or **Selected Cameras** (that is, the cameras selected in the **System Resources** tree). The selection is applied when the **Stop** button in the **Calibrate Cameras** section is clicked.
    Default: All Cameras
  
  - **Refinement frames** The minimum coverage (in number of frames) required per camera in the final phase of the refine camera calibration process.
    Default: 1000. For more information, see *Understand camera calibration refinement* on page 222.
  
  - **Wand Ratio Tolerance** (Advanced setting) Tolerance of the distance between the markers on the wand (expressed as a ratio), to enable it to be labeled in 2D.
    Default 0.2.
- **Wand Straightness Tolerance** Tolerance in alignment of wand markers (relating to the maximum angle allowable between the markers), to enable it to be labeled in 2D.

- **DV Calibration frames** The minimum coverage (in number of frames) required per DV camera for the calibration to autostop (if Auto Stop is selected). Default: 500

- **Auto Stop** Whether or not Nexus is to automatically stop the camera calibration process when sufficient data has been collected.

For more information on how to calibrate cameras (both optical and video), see *Calibrate Vicon cameras* in the *Vicon Nexus User Guide*.

- **Set Volume Origin** Enables you to define the global origin and the axes of the world (in the context of the capture volume). The Advanced options are:
  - **L-Frame** The calibration object to be used for setting the volume origin. Default: 5 Marker Wand & L-Frame
  - **Start/Set Origin** and **Cancel** buttons Enable you to start, set the origin and cancel setting the origin.
  - **One Marker** Enables you to set the origin to the selected marker.
  - **Three Markers** Enables you to set the origin to the selected three markers.
  - **Set Floor Plane** Enables you to set the position of the floor plane in Nexus by using markers in the volume to automatically define it. For more information, see *Calibrate the floor plane* in the *Vicon Nexus User Guide*.

- **Static Video Calibration** If you are not using an Active Wand, you use this section to calibrate digital video cameras included in your Nexus system. This enables 3D overlay from Vicon cameras to be displayed with the 2D video from the digital video cameras.

- **Manage Camera Calibration** Contains the following controls:
  - **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** Navigate to and select a previously saved camera calibration (.xcp file) defining settings for the Vicon cameras and any supported digital video cameras in your Nexus system.
  - **Camera Calibration Feedback** Enables you to view system calibration processing progress and status information.
  - **Progress bar** This bar displays a percentage indicating the progress of the overall camera calibration process.
- **Camera** This column contains the device ID for each Vicon camera being calibrated.

- **Wand Count** For each Vicon camera, this value identifies the number of frames it has captured containing the calibration object. Initially, the entry for the number of wand frames is displayed in red; the entry turns green when Nexus has acquired enough wand data to calibrate that camera, typically 1000 frames. By default, the calibration process stops when the camera with the lowest frame count reaches the number of frames specified in the **Refinement frames** parameter in the Calibrate Cameras section.

- **World Error** Displays the calibration error in millimeters. World error is calculated per camera from the **Image Error** in pixels and the distance of the camera to the center of the volume. Cameras further away, with the same image error, display a larger world error.

- **Image Error** This value (RMS distance in camera pixels) indicates the accuracy of the 3D reconstruction of the markers. This value represents the difference between the 2D image of each marker on the camera sensor and the 3D reconstructions of those markers projected back to the camera's sensor. Acceptable values depend on factors such as the size of the capture volume and the camera lens type.
Understand camera calibration refinement

Calibration refinement provides a fast, reliable way to fine-tune an existing camera calibration, for example, as part of your daily calibration workflow before beginning the day’s captures.

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

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

⚠️ Important

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

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

Under most circumstances, the default value for Refinement frames produces good results. If you need to improve the results, particularly if you are using larger numbers of cameras, try increasing this value.
Note that the value specified for **Refinement frames** applies to the number of frames used:

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

**When to use a refinement calibration**

The following table gives guidance on when to use each type of calibration:

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

You must create a Vicon labeling skeleton template (.vst file), or import an existing one, for each type of subject whose motion is to be captured and analyzed in Nexus. You only need to do this once for each type of subject. Sample .vst file are provided under the Nexus model templates folder (by default, C:\Program Files (x86)\Vicon\Nexus2. #\ModelTemplates).

You must then calibrate the .vst file to create a Vicon labeling skeleton (.vsk file) that is scaled for each specific subject of that type. You must do this the first time you intend to capture a new subject and each time you want to use a different marker arrangement on the same subject.

For detailed information about creating and using custom Vicon labeling skeleton templates, see Creating Labeling Skeleton Templates (VSTs).

To enable you to produce .vst and .vsk files, the Subject Preparation Tools pane contains the following sections:

- **Subject** Select a specific Vicon labeling skeleton template (.vst file) or Vicon labeling skeleton (.vsk file). The contents of this list depends on the subject nodes enabled for capture (ie displayed with a check mark next to them) in the Subjects pane.

- **Subject Capture** Enables you to capture a brief trial to obtain subject data. You can use the subject data to build or calibrate a Vicon labeling skeleton template and to manually label a subject.

- **Subject Calibration** Enables you to manage the subject calibration process to create a Vicon labeling skeleton (.vsk file) for a specific subject.

- **Labeling Template Builder** Enables you to build a generic Vicon labeling skeleton template (.vst file) for a type of subject (for example, humans, wearing a particular marker set). You subsequently use this .vst file to calibrate a Vicon labeling skeleton (.vsk file) for a specific subject of that type (for example, Jane, wearing the same particular marker set).
Capture tools

The Capture Tools pane enables you to collect motion data.

Collecting motion data involves identifying where in a motion capture trial database to store the data, specifying the type of source data that is to be captured, optionally configuring any remote triggering, optionally determining any automated processing to be performed, and managing the capture process. You can capture trials manually or configure Nexus to capture trials automatically.

For basic instructions on collecting data, see Capture movement trials in the Vicon Nexus User Guide.

The Capture Tools pane contains the following sections:

- **Trial Type list** Create or manage configurations for the motion capture trial types specified in the Capture Tools using the configuration management section at the top of the pane. (For information on managing configurations, see Manage configurations in the Vicon Nexus User Guide.)

- **Next Trial Setup** Specify identification and information details for the way Nexus is to store data for this trial in a motion capture database:

  - **Session** A link to the active subject\session node in the currently loaded trial database. Click the link to open the Communications window, displaying the Data Management tab, or bring it to the front if it is already open, with the active node highlighted. If you make a different session the active node, the Session link is updated.
    Default: Identified by system

  - **Trial Name** The name under which to save the trial data in the motion capture database.
    Default: Blank if you are creating a new trial in a new session, or if the trial is the latest of several in a session and Auto increment is selected (see below), the system automatically names it after the preceding trial and increments numbering by 1.

    Do not use the following special characters in a trial name:
    \ backslash
    . period
    / slash
    , comma
    < left angle bracket
    ? question mark
    > right angle bracket
Description Enter any description you want to specify for the trial. This description is displayed on the Data Management tab in the row associated with the captured trial.
Default: Blank

Notes Enter any notes you want to specify for the trial. These notes are displayed on the Data Management tab in the row associated with the captured trial.
Default: Blank

Auto increment trial number Choose whether or not to have Nexus automatically add a numerical suffix to the trial name for each subsequent trial, for example, Trial001, Trial002, Trial003, etc.
Default: Selected

Permit overwrite of existing files Choose whether or not to have Nexus overwrite an existing data file without prompting you with a warning that it has the same name as that specified in the Trial Name field with this trial data.
Note that if Auto increment trial number is selected and the file name that would be created using the next sequential numerical suffix is the same as that for an existing file, that previous file is overwritten.
Default: Cleared

Data Source Setup Specify the type of motion data to be captured by your Nexus system in the Data Source Setup section of the Capture Tools pane:

Device Data Analog signals captured by any third-party devices such as force plates or EMG devices.
Default: Selected

Optical Camera Data Marker images visible to the Vicon optical cameras
Default: Selected

Video Camera Data Digital video captured by any connected digital video cameras.
Default: Selected

Auto Capture Setup You can configure Vicon Nexus to automatically capture trials using the following controls:

Range Use an external remote control device to trigger data capture in your Vicon system. The remote control device must be connected to an MX Giganet or Vicon Lock+ unit in your Vicon system (for details, see Go Further with Vicon MX T-Series
Capture before Start 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).

Stop after duration Specify the number of seconds of data to record after which capturing will automatically stop.

Triggers Use a labeling percentage value that you specify or an external timecode source to trigger data capture in your Vicon system. The timecode source must be connected to an MX Giganet or Vicon Lock+ unit (for details, see Go Further with Vicon MX T-Series or Vicon Vantage Reference PDF), and the corresponding timecode options must be configured under the relevant Vicon Connectivity node in the System Resources pane.

Start on Labeling (%) Captures automatically start when a subject first fully enters the volume. 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 and therefore to trigger capture start.

Stop on Labeling (%) Captures automatically stop when the subject leaves the volume. 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 to have left the volume and therefore to trigger capture stop.

Start/Stop on remote trigger Start and/or stop capture on the activation of a remote trigger. This option is disabled if no remote trigger devices are recognized. Trigger the start of the capture from your remote control device. After you have acquired the data you need, trigger the stop of the capture from your remote control device.

Start on Timecode Select this check box and specify the timecode at which capture should automatically start.

Stop on Timecode Select this check box and specify the timecode at which capture should automatically stop.

For further details on the use of timecode functionality in Vicon systems, see the Vicon Vantage Reference or Go Further with Vicon.
Start/Stop over network

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.

Address

Enables you to select the network interface (first field) and UDP port (second field) on which to broadcast.

Arm button

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.

Lock 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.

Post-Capture Pipeline Setup

Enables you to specify any automatic post-processing that you want Nexus to perform on the captured data:

Run pipeline after capture

Whether or not to run a previously defined pipeline immediately after the trial is captured. Select the pipeline that you want from the drop-down list. Default: Cleared

Capture section

Enables you to manage the motion capture process and view the number of frames captured and the current duration in seconds during processing:

Start/Stop

Click this button to start a capture. When clicked, the button switches to the Stop setting. If you have set the Stop after Duration or Stop on Timecode settings in the Auto Capture Setup section, or if there is data in the buffer that has still to be written to disk, the button switches to Stopping until the capture has completed. If you click the button while it displays Stopping, the capture stops, and you will lose any data that was due to be captured, or that is currently in the buffer but not yet written to disk.

Cancel

Click this button to cancel an active capture.

Frames Captured

Displays the number of frames captured in the current trial. This number increments until the motion capture process is stopped.

Trial time

The amount of time elapsed during the current capture is displayed in hh:mm:ss(ff) format, where hh is hours, mm is minutes, ss is seconds and ff is frames. For example, a 2.5 second capture at 50 Hz (125 frames) is displayed as 00:00:02 (125).
Label/Edit tools

The Label/Edit Tools pane enables you to manually label trial data and fill any gaps in trial data. It contains the following sections:

- **Subject** You select the subject whose motion capture data is to be manually labeled or edited in the Subject list at the top of the Label/Edit Tools pane. To appear in this list, the subject's node must be selected (that is, its check box must be selected in the Subjects tree in the Resources pane).

- **Manual Labeling** You manually label reconstructed trial data for the selected subject using the controls in this section.

- **Forward, Whole, and Backward** buttons Label the currently selected trajectory either for the whole trial, or backward or forward from the current frame. Use Whole if you are confident that the trial data contains very few mislabels or swaps. Use Backward or Forward if you want to label the trial data either backwards or forwards from the current frame, without affecting the work you have done on other frames.

**Tip**

When you are manually labeling a subject, to help you place the selected label onto the correct 3D reconstruction in the 3D Perspective view pane, the pointer changes to include a tooltip that identifies the label. You can also use the Subject Viewer to help you identify the markers (see Subject Viewer on page 213).

- **Auto advance selection** When selected, Nexus automatically advances to the next marker in the Manual Labeling list.
  Default: Selected

- **Find Next Unlabeled Trajectory** When you click this button, Nexus advances to the next frame that contains an unlabeled marker trajectory.

- **Swap Marker Labels** To correct swapped marker labels, select the relevant two marker trajectories and then click this button.

- **Gap Filling** Enables you to identify and fill any gaps in reconstructed marker trajectories.
  For detailed information about each of the gap-filling algorithms, search for the FAQ *What gap-filling algorithms are used in Nexus 2?* on the Vicon website.

For instructions on how to manually label trials, see *Manually label a trial* in the Vicon Nexus User Guide.
Pipeline tools

The Pipeline Tools pane enables you to create and manage a customized sequence of operations to automate the processing of a trial.

Pipeline processing is optional, but is useful for automating the data processing operations that you use frequently or on a large number of trials.

The Pipeline Tools pane contains the following sections:

- **Available Operations** section
  - The Available Operations section enables you to select the type of pipeline you want to create and the operations to run. Operations are grouped under the following types:
    - File Import operations on page 233 For automating the import of trial files into Vicon Nexus from third-party software packages.
    - Core Processing operations on page 234 For automating reconstruction, labeling, and kinematic fitting to produce 3D trajectories from raw marker data.
    - Subject Calibration operations on page 235 For automating the processing of system and subject calibration.
    - Events & Timebar operations on page 238 For automating operations involving events and/or normally performed using the time bar.
    - Fill Gap & Filter Data operations on page 239 For automating the post-processing of data, such as gap-filling.
    - Data Processing operations on page 243 For automating the production of model outputs (forces and moments, joint angles, etc).
    - File Export operations on page 245 For automating the export of trial files from Nexus to third-party software packages.
    - System operations on page 247 For automating offline camera calibration and applying a codec to video.
    - Legacy operations on page 248 For automating the processing of legacy trial data.
Current Pipeline section

At the top of the Current Pipeline section, the configuration management controls enable you to create or manage configurations for the settings specified in the Pipeline Tools pane.

The middle of the Current Pipeline section enables you to manage the pipeline operations and view their status with the playback controls and progress bar.
In the list at the bottom of the **Current Pipeline** section, you can view the operations included in the currently loaded pipeline.

For information on using pipelines, see *Work with pipelines* in the *Vicon Nexus User Guide*.

**Tip**

Pipeline operations are run in the order they appear in this list. You can drag operations into the desired position in the list. Alternatively, you can run an individual operation by right-clicking on it and clicking **Run selected Op**.
Properties pane

You can view or change settings for the selected pipeline operation in the Properties pane at the bottom of the Pipeline Tools pane.

Pipeline operations

Pipeline operations are found in the Pipeline Tools pane, in the Available Operations section.

File Import operations

Use File Import operations to automate the import of trial files to Vicon Nexus from third-party software packages.

<table>
<thead>
<tr>
<th>Operation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Import AVI</td>
<td>Import a video .avi file to be saved and associated with the current trial.</td>
</tr>
<tr>
<td>Import MP</td>
<td>Import subject parameters specified in a .mp file into the active subject.</td>
</tr>
</tbody>
</table>
### Operation Description

<table>
<thead>
<tr>
<th>Operation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Import VSK</td>
<td>Import a labeling skeleton (.vsk) file.</td>
</tr>
<tr>
<td>Import XCP</td>
<td>Import a calibration file (.xcp) into the current trial to replace the current calibration.</td>
</tr>
</tbody>
</table>

### Core Processing operations

Use **Core Processing** operations to automate the processing of offline reconstruction, labeling, and kinematic fitting to produce 3D trajectories from raw marker data.

<table>
<thead>
<tr>
<th>Operation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combined Processing</td>
<td>Performs one or more of: reconstruction, labeling, and subject motions. Running this operation is faster than running each process individually.</td>
</tr>
<tr>
<td>Reconstruct</td>
<td>3D trajectories are reconstructed from the raw 2D marker data.</td>
</tr>
<tr>
<td>Label</td>
<td>Controls how 3D trajectories are labeled with subject data</td>
</tr>
<tr>
<td>Kinematic Fit</td>
<td>Controls how the labeling skeleton contained in the .vsk is kinematic-fitted to the marker data. In addition to specifying the frames on which to operate, you can adjust settings for:</td>
</tr>
<tr>
<td></td>
<td><strong>Prior importance</strong>: Weighting given to the uncalibrated values from the VST. Range is 0-100, default is 25.</td>
</tr>
<tr>
<td></td>
<td><strong>Mean pose ratio</strong>: Ratio of tracking pose as prior (where 0 = mean pose only; 1 (default) = external (or tracking) prior only.)</td>
</tr>
</tbody>
</table>

The equivalent settings for Live processing can be found in the **Local Vicon System properties** on page 133, found in the **System Resources** pane.
Subject Calibration operations

Use Subject Calibration operations to automate the processing of labeling skeleton calibration.

<table>
<thead>
<tr>
<th>Operation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set Autolabel Pose</td>
<td>Sets the pose for Autolabel Static to be the pose at the selected frame.</td>
</tr>
<tr>
<td>Autolabel Static</td>
<td>Run on a reconstructed static trial to automatically label the labeling skeleton in a single frame, using information from the .vst file. It matches the shape of the reconstruction to the shape of the subject template for that pose. The labels are applied to the whole trajectory, not just the chosen frame. It works best when all the markers have been reconstructed and there are no additional markers or clutter in the scene. This operation does not require a .vsk file.</td>
</tr>
<tr>
<td>Scale Subject VSK</td>
<td>Scales the labeling skeleton to be the same size as a labeled set of reconstructions on a particular frame. The scale factor is calculated assuming that the subject is in the same pose as was used for Autolabel Static (see above). (Note that this scaling respects any constraints that you may have specified in the template. For example if your template specifies (ie a StaticParameter) that a segment is 100mm long, the segment will not be scaled. Only parameters are considered for scaling.)</td>
</tr>
<tr>
<td>Functional Skeleton Calibration</td>
<td>Calibrate the subject’s bone lengths, joint locations, and marker locations from a whole trial. Use to calibrate a whole ROM trial.</td>
</tr>
<tr>
<td>Functional Skeleton Calibration - Markers-only</td>
<td>Calibrate the subject’s marker locations from a whole trial. This is useful, for example if a marker becomes detached from the subject and you need to re-run the calibration with the replaced marker.</td>
</tr>
</tbody>
</table>
### Operation Description

<table>
<thead>
<tr>
<th>Operation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Static Skeleton Calibration</strong></td>
<td>Calibrate the subject’s bone lengths, joint locations, and marker locations from a single frame. Use to calibration a static calibration, as in versions of Vicon Nexus earlier than 2.0.</td>
</tr>
<tr>
<td><strong>Static Skeleton Calibration - Markers-only</strong></td>
<td>Uses a single frame to update the marker locations for the labeling skeleton. This operation both fits the subject pose (that is, the pose that was defined when the labeling skeleton was created) to the labeled reconstructions and calibrates the marker locations. Fitting the subject pose allows for the likely situation of your subject standing close to the template pose. Again, this operation respects any constraints specified in the labeling skeleton template and changes only parameters. This operation is useful, for example if a marker becomes detached from the subject and you need to re-run the calibration with the replaced marker.</td>
</tr>
</tbody>
</table>
| **Update Skeleton Parameters** | Initial label booting can be improved by providing more representative data from a movement or ROM trial. This operation enables you to do this by updating the default values of a selected skeleton with movement or ROM trial data contained in the current calibrated labeling skeleton (VSK). The options for this operation are:  
  - **Update Marker Covariances**  
    Marker covariance is used by the labeler to account for skin motion, so the default for this option is Selected.  
  - **Update Parameters**  
    If you have calibrated a skeleton from the Labeling Template Builder, select this check box.  
  - **Update Joint Mean & Covariance**  
    Joint covariance is used in booting the labeling. If you have a very flexible subject, a larger covariance will help, so select this check box.  
  - **Update Joint Ranges**  
    Joint ranges can be enforced to detect infeasible joint angles. If you have a very flexible subject, larger joint ranges are needed, so select this check box. |
<table>
<thead>
<tr>
<th>Operation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calculate Skeleton Joint &amp; Marker Statistics</td>
<td>Measure the subject’s labeling statistics from a whole trial.</td>
</tr>
<tr>
<td>Calibrate OCST</td>
<td>Finds the Optimum Common Shape</td>
</tr>
<tr>
<td>Calibrate SCoRE/SARA</td>
<td>Calibrate joint positions using the Symmetrical Center of Rotation Estimation and Symmetrical Axis of Rotation Analysis.</td>
</tr>
</tbody>
</table>

For more information on the labeling skeleton calibration operations, see [Labeling skeleton calibration in detail on page 24](#).
**Events & Timebar operations**

Use **Events & Timebar** operations to automate processes relating to events and the timebar.

<table>
<thead>
<tr>
<th>Operation</th>
<th>Description</th>
</tr>
</thead>
</table>
| **Auto Crop Trial**               | For trials where the subject starts outside the volume, moves into the volume and then exits, Nexus can automatically determine the first and last frame where the subject is fully in the volume.  
  **First Frame** and **Last Frame** Set these options to the frames during which the subject enters and leaves the volume.  
  **Start %** and **End %** Set these options to the required minimum percentage of markers (i.e., the percentage expected from the total number of markers in your subject's labeling skeleton) that must be labeled in each case.  
  **Frames Required** If necessary, adjust this option 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 percentage, but the point at which the trial is intended to start (i.e., the point at which the percentage is maintained over a number of frames) is later in the trial. |
| **Autocorrelate Events**          | Based on user-defined parameters, this 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. Normally used after the **Detect Events from Forceplate** operation. |
| **Detect Events from ForcePlate** | Automatically detects gait cycle events and adds them to the timebar throughout the trial using vertical GRFs measured by a force plate connected to the Vicon system. 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. |
| **Delete Timebar Events**         | Delete events from the specified range for the subject(s). An advanced option lets you choose whether to delete events that are inside or outside the specified range of frames. |
**Fill Gap & Filter Data operations**

Use Fill Gap & Filter Data operations to automate gap-filling and other post-processing.

<table>
<thead>
<tr>
<th>Operation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fill Gaps - Cyclic</td>
<td>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), fills gaps using patterns from earlier or later gait cycles. You can specify the Gap Length, Units, First and Last Frame, and select the trajectories to fill.</td>
</tr>
<tr>
<td>Fill Gaps - Kinematic</td>
<td>Fills all gaps in trajectories that pass through a selected segment, based on calculated kinematics. To run this operation, you must have already obtained the kinematic data on which to base gap-filling, for example, by running the Nexus Legacy Fit Motion pipeline.</td>
</tr>
<tr>
<td>Fill Gaps - Pattern</td>
<td>Fills the selected gap using the shape of another trajectory without a gap. Use this tool only if there is a suitable marker with a trajectory similar to the one whose gap you wish to fill.</td>
</tr>
<tr>
<td>Fill Gaps - Rigid Body</td>
<td>Fills gaps in a trajectory based on other trajectories in a rigid body. 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.</td>
</tr>
</tbody>
</table>
| Fill Gaps - Woltring | Run on labeled dynamic trials to fill in gaps using Woltring quintic spline interpolation. Includes the option to choose maximum gap frame length to fill. You can configure the following settings in the Properties section:  
  - **Max Gap Length** The maximum length of any gap in a marker trajectory that will be filled with this operation. Default: 5  
  - **First Frame** The first of the range of frames in the region of interest of the trial that you wish to analyze. For example, if the capture includes the subject entering the capture volume, you are strongly advised to set the range of frames to exclude this portion of the capture. That will simplify the job of cleaning up your data. You can specify the following settings: |
<table>
<thead>
<tr>
<th>Operation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>First Frame</strong></td>
<td>The first frame of the trial.</td>
</tr>
<tr>
<td><strong>Selected Start</strong></td>
<td>The frame indicated by the Start Range Frame indicator on the time bar ruler.</td>
</tr>
<tr>
<td><strong>Current Frame</strong></td>
<td>The frame indicated by the Current Time indicator on the time bar ruler.</td>
</tr>
<tr>
<td><strong>First Full Frame</strong></td>
<td>First full frame of range to process</td>
</tr>
<tr>
<td></td>
<td>Default: Selected Start</td>
</tr>
<tr>
<td><strong>Last Frame</strong></td>
<td>The last of the range of frames in the region of interest of the trial that you wish to analyze. For example, if the capture includes the subject leaving the capture volume, you are strongly advised to set the range of frames to exclude this portion of the capture. That will simplify the job of cleaning up your data. You can specify the following settings:</td>
</tr>
<tr>
<td><strong>End Frame</strong></td>
<td>The last frame of the trial.</td>
</tr>
<tr>
<td><strong>Selected End</strong></td>
<td>The frame indicated by the End Range Frame indicator on the time bar ruler.</td>
</tr>
<tr>
<td><strong>Current Frame</strong></td>
<td>The frame indicated by the Current Time indicator on the time bar ruler.</td>
</tr>
<tr>
<td><strong>Last Full Frame</strong></td>
<td>Last full frame of range</td>
</tr>
<tr>
<td></td>
<td>Default: Selected End</td>
</tr>
</tbody>
</table>

**Filter Analog Data - Butterworth**

Filter analog device data using a low-pass digital Butterworth filter. The filter is by default setup as recommended in Winter, D.A. Biomechanics of Motor Control and Human Movement to filter out signal noise above 300 Hz using a fourth order filter with zero lag (see descriptions below for an explanation of these parameters).

**Note:** For force plates, only the calculated Force and Moment signals can be filtered. Raw and Center of Pressure signals cannot be filtered. You can configure the following settings in the Properties section:

- **Cut-Off Frequency** The filter cut-off frequency, separating the low-frequency signal from high frequency noise. Data at frequencies above the cut-off frequency are attenuated increasingly as the frequency increases. The attenuation exactly at the cut-off...
Frequency is designed to be "half power," or -3 dB. Note cut-off frequencies greater than half of the analog device sampling frequency (often called the Nyquist frequency) cannot be used and will result in an error message and no filtering of the data.

- **Filter Order** The Second Order filter performs a single pass of the filter in the forwards (increasing time) direction, resulting in a "lag," or "phase shift" in the analog data. The Fourth Order filter performs two passes of the filter, in first the forward, then the reverse direction, resulting in any lag being cancelled out (hence "zero lag"). The parameters of the Fourth Order filter are adjusted, such that the attenuation exactly at the cut-off frequency is maintained at "half power," or -3 dB.

- **Devices** A comma-separated list of Devices, Outputs and Components can be typed, or the Macros All or Selected can be used. All will always filter the data from every device currently connected and Selected will filter the data from the devices, device outputs, and output components with names matching those currently selected in the System resource pane and in the 3D Perspective view.

**Filter Model Outputs - Butterworth**

Filter subject model outputs using a low-pass digital Butterworth filter. The filter is by default set up as recommended in Winter, D.A. Biomechanics of Motor Control and Human Movement to filter out signal noise above 6 Hz using a Fourth Order filter with zero lag. You can configure the following settings in the Properties section:

- **Cut-Off Frequency** Same as Analog Data above.
- **Filter Order** Same as Analog Data above.
- **Model Outputs** A comma-separated list of Model Outputs can be typed, or the Macros All or Selected can be used. All will always filter all Model Outputs calculated for a subject and Selected will filter Model Outputs with names matching those currently selected on the Subjects tab of the Resources pane and in the 3D Perspective view. You can use the * wildcard for all model outputs.
<table>
<thead>
<tr>
<th>Operation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filter Trajectories -</td>
<td>Filters trajectories using a low-pass digital Butterworth filter. The filter is by default set up as recommended in Winter, D.A. Biomechanics of Motor Control and Human Movement to filter out signal noise above 6 Hz using a Fourth Order filter with zero lag. You can configure the following settings in the Properties section:</td>
</tr>
<tr>
<td>Butterworth</td>
<td>- <strong>Cut-Off Frequency</strong> Same as Analog Data above.</td>
</tr>
<tr>
<td></td>
<td>- <strong>Filter Order</strong> Same as Analog Data above.</td>
</tr>
<tr>
<td></td>
<td>- <strong>Trajectories</strong> A comma separated list of trajectories can be typed, or the Macros All, All Labeled, or Selected can be used. All will always filter every trajectory, including unlabeled ones, All Selected will filter every currently labelled trajectory, and Selected will filter trajectories with names matching those labelled trajectories currently selected on the Subjects tab of the Resources pane and in the 3D Perspective view.</td>
</tr>
<tr>
<td>Filter Trajectories -</td>
<td>Vicon Gait Model event VCM Spline Filter</td>
</tr>
<tr>
<td>VCM Spline</td>
<td></td>
</tr>
<tr>
<td>Filter Trajectories -</td>
<td>Filters the data using the Woltring filter to ensure smooth trajectories for calculating kinetics.</td>
</tr>
<tr>
<td>Woltring</td>
<td></td>
</tr>
<tr>
<td>Delete Optional Subject</td>
<td>Run on any trial to delete a specified group of subject markers from the marker list that will not be used during the dynamic captures.</td>
</tr>
<tr>
<td>Marker</td>
<td></td>
</tr>
<tr>
<td>Delete Unlabeled Trajectories</td>
<td>Run on a fully labeled trial to delete any remaining unlabeled trajectories. Includes the option to choose maximum length of unlabeled trajectory to delete.</td>
</tr>
</tbody>
</table>
## Data Processing operations

Use **Processing** operations to automate real-time and offline motion capture data processing.

<table>
<thead>
<tr>
<th>Operation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process Static Plug-in Gait Model</td>
<td>Runs the static Plug-In Gait model on the active subject of the current trial. For more information, see <em>Modeling with Plug-in Gait</em> in the <em>Vicon Nexus User Guide</em> and the <em>Plug-in Gait Reference Guide</em>.</td>
</tr>
<tr>
<td>Calculate Gait Cycle Parameters</td>
<td>Calculate Vicon Gait Model temporal parameters. Includes the option to set the output units.</td>
</tr>
<tr>
<td>Process Dynamic Plug-in Gait Model</td>
<td>Runs the dynamic Plug-In Gait model on the active subject of the current trial. For more information, see <em>Modeling with Plug-in Gait</em> in the <em>Vicon Nexus User Guide</em> and the <em>Plug-in Gait Reference Guide</em>.</td>
</tr>
<tr>
<td>Run Static BodyLanguage Model</td>
<td>Runs the static BodyLanguage model.</td>
</tr>
<tr>
<td>Run Static Oxford Foot Model</td>
<td>Runs the static Oxford Foot Model pipeline operation (installed as part of Nexus) that was previously available as a separate legacy VPI.</td>
</tr>
<tr>
<td>Run Dynamic BodyLanguage Model</td>
<td>Runs the dynamic BodyLanguage model.</td>
</tr>
<tr>
<td>Run Dynamic Oxford Foot Model</td>
<td>Runs the dynamic Oxford Foot Model pipeline operation (installed as part of Nexus) that was previously available as a separate legacy VPI.</td>
</tr>
<tr>
<td>Run MatLab Operation</td>
<td>Execute MATLAB script.</td>
</tr>
<tr>
<td>Operation</td>
<td>Description</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>For information on using MATLAB with Nexus, see Modeling with MATLAB on page 59.</td>
<td></td>
</tr>
<tr>
<td>Process OCST</td>
<td>Finds the coordinate system trace using the Optimum Common Shape Technique. For more information, see Biomechanics workflow on page 73.</td>
</tr>
<tr>
<td>Process SCoRE - SARA Joints</td>
<td>Generates joint position model outputs using Symmetrical Center of Rotation Estimation and Symmetrical Axis of Rotation Analysis. For more information, see Biomechanics workflow on page 73.</td>
</tr>
<tr>
<td>Calculate Gait Deviation Index</td>
<td>Generates a GDI (Gait Deviation Index) score for the subject of the current trial.(^1) When you run this operation on a trial, two GDI values (left and right), are output to the log and saved as subject parameters. You can output these values when you run the Export ASCII pipeline operation by selecting the Export Gait Cycle Parameters option.</td>
</tr>
<tr>
<td>Delete Model Outputs</td>
<td>Enables you to delete from the current trial the selected model output(s), all model outputs, or to specify a comma-separated list of model output names. Tip: You can also access the same options by right-clicking the relevant node in the Subjects Resources tree.</td>
</tr>
</tbody>
</table>

1. The following research publication provides supporting information on the scientific basis and validation of Vicon's implementation of the calculation of the GDI score:

## File Export operations

Use **File Export** operations to export of data from Vicon Nexus for use with third-party software packages.

<table>
<thead>
<tr>
<th>Operation</th>
<th>Description</th>
</tr>
</thead>
</table>
| Export 3D Overlay Video | Export a copy of the reference video .avi file(s) with the 3D Perspective data overlaid onto the video image. You can choose which 3D view option to display and select the codec used to compress the new .avi file. You can configure the following settings in the Properties section:  
- **View Options Set**: The .options configuration files that have been saved in the Options dialog box (F7). You can select settings for the 3D data to be exported with the .avi file. Select a configuration file from the drop-down list. If you do not specify a file, the current view options are used. Default: blank  
- **Video Codec**: The video compression method to use when exporting the .avi file. Select a codec appropriate for the digital camera used to capture the .avi file. Default: (None)  
  **Tip**: If you want to export labeled subjects in the Nexus 3D workspace, use instead the Export Workspace to AVI button (available on the View pane toolbar). For more information, see *Export 3D Workspace as AVI* in the *Vicon Nexus User Guide*. |
| Export ASCII | Export delimited ASCII format to a .csv or .txt file, or another format that you specify by clearing the Macro check box (click the downward arrow at the right of the extension list) and entering the required extension. You can select commas, tabs, or line feeds as the delimiter. |
| Export C3D | Export 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. |
## Operation Description

<table>
<thead>
<tr>
<th>Operation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Export MKR</td>
<td>Export an <code>.mkr</code> file. You can choose whether the exported file name is based on the active subject name(s) or active labeling skeleton template name(s). If you choose <strong>Active Labeling Skeleton Names</strong>, the name of any labeling skeleton template attached to the subject (for example, PlugInGait FullBody Ai) is used as the name of the MKR file. If more than one subject is present with the same model attached, a log message indicates that only one MKR file will be exported.</td>
</tr>
<tr>
<td>Export MOX</td>
<td>Export Nexus data files in <code>.mox</code> format for MoXie (<a href="http://moxie.small.eu/">http://moxie.small.eu/</a>).</td>
</tr>
<tr>
<td>Export MP</td>
<td>Export the current subject parameters to an <code>.mp</code> file (subject parameter file compatible with legacy software).</td>
</tr>
<tr>
<td>Export TRC</td>
<td>Export a <code>.trc</code> file.</td>
</tr>
<tr>
<td>Export VSK</td>
<td>Export a labeling skeleton (.vsk) file</td>
</tr>
<tr>
<td>Export XCP</td>
<td>Export the current calibration file to an <code>.xcp</code> file in a specified location.</td>
</tr>
<tr>
<td>Export MOT</td>
<td>Export files in <code>.mot</code> format for use in OpenSim.</td>
</tr>
</tbody>
</table>

For more information on how to use the export operations, see *Export trial data* in the *Vicon Nexus User Guide*. 

---

Vicon Motion Systems Ltd.  27-Sep-2016  Page 246 of 265
**System operations**

Use **System** operations to automate offline camera calibration and applying codecs to video files.

<table>
<thead>
<tr>
<th>Operation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Process Offline Camera Calibration</strong></td>
<td>Run on a captured trial of a calibration wand wave to calibrate a system (instead of calibrating the system live).</td>
</tr>
<tr>
<td><strong>Transcode Video for Trial</strong></td>
<td>Automates transcoding the raw video files associated with the current trial. Enables you to choose the required codec.</td>
</tr>
<tr>
<td><strong>Apply Codec to Video</strong></td>
<td>Applies a codec to all AVIs associated with the current trial. You can select which codec to use, whether to keep the original movie file, and whether to remove interlacing.</td>
</tr>
<tr>
<td><strong>Important:</strong> Reverting to the backup file to re-do the de-interlacing is not supported in Nexus. For more information, see De-interlace AVI files in the Vicon Nexus User Guide.</td>
<td></td>
</tr>
<tr>
<td><strong>Reset force plate offsets</strong></td>
<td>Resets the force plate offsets. Enables you to specify the range of frames on which to operate, the affected device(s), and the range of frames to use for zeroing the force plate.</td>
</tr>
<tr>
<td><strong>Set Camera Calibration Origin</strong></td>
<td>Sets the camera calibration origin using a calibration object.</td>
</tr>
</tbody>
</table>
Legacy operations

Use Legacy operations to automate the processing of legacy trial data:

<table>
<thead>
<tr>
<th>Operation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nexus Legacy Labeler</td>
<td>Run on fully reconstructed trials to label the subject as a whole instead of frame-by-frame as in the Core Processor. This operation requires a .vsk file.</td>
</tr>
<tr>
<td>Nexus Legacy Fit Motion</td>
<td>Run on fully labeled trials to Kinematic Fit the trial as a whole instead of frame-by-frame as in the Core Processor.</td>
</tr>
</tbody>
</table>
Communications pane

The Communications pane enables you to view and manage the state of your Vicon system, and streamline your motion capture workflow.

The tabs at the bottom of the Communications pane enable you to switch between the available monitoring tools.

Tip

To avoid the pane taking up too much onscreen space, you can choose to hide the Communications pane when you load a trial. To do this, on the Window menu, select the Close Communications Pane on Trial Load option. Alternatively, to temporarily hide/reveal the Communications pane, so that the tabs are minimized to the bottom of the screen without completely closing, double-click any of its tabs.

For information, see:
- Data Management tab on page 249
- Quality tab on page 251
- History tab on page 251
- Monitors tab on page 251
- MATLAB tab on page 253
- Status tab on page 253
- Log tab on page 254

Data Management tab

The Data Management tab contains the following controls:

- Database location You can view the full path of the active node in the trial database at the top left of the Data Management tab. To access the files in Windows Explorer, click the hyperlink.

- Navigation buttons You open the Manage Databases dialog box, go forward a node, go back a node and move up a level using the navigation buttons at the top left of the Data Management tab.
**Search button** Displays or hides the **Search** window. For more information, see Advanced data searching on page 18.

**Show Trial Loading Options button** Displays or hides the **Raw Data Loading Options** area, in which you can specify your requirements for loading large trials. For more information, see Load large trials on page 20.

**Show File Transfer/Batch Processing Interface button** Displays or hides the Remote File Transfer/Batch Processing pane on the right side of the **Data Management** tab. For more information, see Work with digital video files in the Vicon Nexus User Guide and Batch process trials on page 21.

**Data Management toolbar** You create and manage nodes in the database hierarchy using the buttons in the toolbar at the top right of the **Data Management** tab. From left to right, the buttons are:

- New Patient Classification button
- New Patient button
- New Session
- New Polygon Report

**Database hierarchy nodes** You view a visual representation of the structure and contents of a trial database, and select individual data types for loading in Nexus, in the nodes on the **Data Management** tab.

**Data type icons** You can view and select individual motion capture files using the icons that represent the data saved for the trial.

**Data fields** You can view or enter descriptive text or numerical data associated with a specific node in the trial database in the fields in the columns to the right of a node name.

For information on using Data Management in Vicon Nexus, see Data management with Nexus on page 7.
Quality tab

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

For information on using the Quality tab, see Assess trial health with the data Quality pane in the Vicon Nexus User Guide.

History tab

The History tab in the Communications pane enables you to review all processing that has been performed on a loaded trial file.

This ensures that, even if you have not worked with the data before, you can continue to work on the trial without missing or duplicating processing steps performed by another Nexus user.

To display information about a particular event, click on the event on the History tab. 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.

Note

A processing history is available only for files processed in Nexus 2.3 and above.

Monitors tab

The Monitors tab enables you to configure monitors that you create in the Graph view pane to detect motion capture events.

For information on creating and using monitors and detailed descriptions of the options, see Using monitors on page 37.

The Monitors tab contains the following areas:
Monitors configuration management area

You manage monitor configurations in the Monitors tab using the configuration management section at the top of the pane.

Monitors area

The Monitors area enables you to define the monitor behavior. It contains the following components:

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monitors list</td>
<td>Lists the currently defined monitors. Select the check box next to a monitor name to enable the monitor, or clear the check box to disable the monitor. Select a monitor in the list to view or configure its properties.</td>
</tr>
<tr>
<td>AND button</td>
<td>When multiple monitors are selected from the list, this button adds a Boolean AND monitor that triggers an action when all of the monitor trigger conditions are present.</td>
</tr>
<tr>
<td>OR button</td>
<td>When multiple monitors are selected from the list, this button adds a Boolean OR monitor that triggers an action when at least one of the monitor conditions is present.</td>
</tr>
<tr>
<td>Remove button</td>
<td>Removes the selected monitor from the list.</td>
</tr>
<tr>
<td>Clear button</td>
<td>Removes all monitors from the list.</td>
</tr>
</tbody>
</table>


**Actions area**

The **Actions** section of the **Monitors** tab enables you to view or modify monitor action settings. It contains the following components:

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actions list</td>
<td>Actions that you add will execute when the monitor threshold and trigger conditions are met.</td>
</tr>
<tr>
<td>Add button</td>
<td>Click to add the selected action to the Actions list. You can select from: Capture, External trigger, Timebar Event, Progress Bar, Range Overlay, Sound Tone, Toggle Monitor and Play Sound File.</td>
</tr>
<tr>
<td>Remove button</td>
<td>Click to remove the selected action from the Actions list.</td>
</tr>
<tr>
<td>Clear button</td>
<td>Clears all actions from the Actions list.</td>
</tr>
</tbody>
</table>

**MATLAB tab**

Enables you to execute a MATLAB script from within Vicon Nexus. For more information, see [Modeling with MATLAB on page 59](#).

**Status tab**

Enables you to monitor the state of your Vicon system during any stage of the Nexus motion capture workflow. This is useful for identifying problems and determining the Nexus system component that needs to be examined.

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

- **Status Summary**
  - View a visual summary of the status of system components in the **Status Summary** section of the Status communications pane:
  - **Vicon Cameras**
    - View the status of Vicon cameras.
Video Cameras
View the status of digital video cameras.

Connectivity
View the status of Vicon connectivity units.

Capture
View the status of capture sessions in Nexus.

- The background in each summary corresponds to the icon displayed for the devices in the System Resources pane.
- The color of a summary border reflects the status for the set of components:
  - Green: All components OK
  - Yellow: One or more components are on standby
  - Red: One or more components are down

Status Details
View details of the status of a system component in the Status Details section of the Status tab. The contents of this section depend on the component you click on in the Status Summary section.

Log tab
Enables you to monitor Nexus system activity and troubleshoot any errors. For example, if a pipeline operation fails (indicated by a red X next to the operation in the Pipeline Tools pane), you can find information as to why the failure occurred on the Log tab.

The icon on the Log tab automatically appears to scroll to indicate that a warning is displayed (for example, a new log entry indicating that an operation has failed).
Menu bar

The Nexus menu bar contains the following controls:

- File menu on page 255
- Edit menu on page 256
- Window menu on page 257
- Help menu on page 260

File menu

The File menu contains the following options:

- **Save** (shortcut CTRL+S) Saves the current data for subjects enabled in the Subjects Resources pane to the .c3d file for the current trial.
- **Copy As** Displays the Choose a c3d file dialog box in which you can enter or select the name of the file to copy to. Makes a copy of the current trial .c3d, .vsk, and .mp files. Using this feature, you can archive copies of a .c3d file to document its processing progression.

  **Tip**

  You are prompted to save the copy in the same location in the Data Management hierarchy as the original file, and after saving it will be available in the Data Management pane.

- **Import XCP** Displays the Choose an XCP file dialog box in which you can select the desired Vicon camera calibration parameters (.xcp) file to load in Nexus. Use this command to import .xcp files created in Vicon Nexus.
- **Export XCP** Displays the Choose an XCP file dialog box in which you can specify a calibration parameters (.xcp) file into which to export the current Vicon camera settings. Use this command to export .xcp files created in Vicon Nexus.
- **Exit** Closes the Vicon Nexus application window. If you have not saved any changes made to trial data, Nexus displays a prompt to enable you to save changes to trial data, subjects, or both, before it closes.
Edit menu

The Edit menu contains the following options, which take effect only when the system is in Pause or Offline mode:

- **Undo** (shortcut CTRL+Z) Undoes the last action. This command is available only after a relevant action has been performed. The name of the Undo command changes to reflect the latest action, for example, *Undo Import XCP*. You also can hover the mouse pointer over the Undo button to display a tooltip that identifies the action to be undone. Some actions, such as reconstructing data, cannot be undone.

- **Redo** (shortcut CTRL+Y) Reinstates the previously undone action. This command is available only after an Undo command has been performed. The name of the Redo command changes to reflect the latest action, for example, Redo Import XCP. Hover the mouse pointer over the Redo button to display a tooltip that identifies the action to be redone. Any action that was undone can be redone.
Window menu

The Window menu contains the following options:

- **New floating workspace.** Opens a separate floating view pane. For information, see View pane on page 198.
- **Reset to default layout** Resets the Nexus panes to their layout when Nexus was installed.
- **Toolbar** Opens the Customize Toolbar dialog box, in which you can add, remove, and customize buttons on the Nexus toolbar. For more information, see Customize Toolbar dialog box on page 262.
- **Sounds** (shortcut F6) Opens the Sounds dialog box, in which you can view or change the sounds that are used to alert you to Nexus events. You can also disable the sounds individually or disable all sounds. For more information, see Sounds dialog box on page 258.
- **Options** (shortcut F7) Opens the Options dialog box, in which you control the way data is displayed. For more information, see Options dialog box on page 259.
- **Plug-ins** Displays the Plugins dialog box in which you can view and manage plug-in modules that have been loaded in Vicon Nexus.
- **Manage Control Authorizations** Opens the Vicon Control dialog box, where you can authorize or revoke authorizations for instances of Vicon Control that are connected to the Vicon system. For more information, see Vicon Control dialog box on page 260.
- **Close Communications Pane on Trial Load** Enables you to choose whether to show or hide the Communications pane when you load a trial. If selected, the Communications pane is minimized at the bottom of the Nexus window the next time you load a trial. The Communications pane remains hidden until you choose to reveal it by double-clicking one of the tabs at the bottom of the Communications pane. Your chosen setting for this option is retained when you exit and restart Nexus. It can be set as required by each Nexus user.
Sounds dialog box

Nexus can play sounds through your PC's speakers to alert you when a Nexus event has taken place (for example, operation completion, system status, and issues). This keeps you informed of system status while you're still in the volume, so that you don't have to spend time returning to the PC to look at the screen.

You can access this dialog box from the Window menu or by pressing F6.

By default, Nexus uses speech sounds to alert you to the following events:

- Calibration start
- Wand Wave complete
- Calibration complete
- Calibration failed
- Origin set
- Capture started
- Capture ended
- Capture failed
- Camera bumped
- Pipeline ended
- Pipeline failed

Nexus is supplied with a set of default sound files (.wavs). You can modify the sounds that are used for each event and you can disable sounds individually or disable all sounds.

To disable all sounds, in the Sounds section, clear the Enabled check box.

To disable one or more sounds, click the relevant drop-down arrow and select (None) from the list.

To choose one of the other sounds supplied with Nexus, click the drop-down arrow and select the required sound from the list.

To substitute your own sounds for those supplied with Nexus, click the relevant ellipsis (...) and enter or browse to the location of the required .wav files.
Options dialog box

The Options dialog box enables you to control the way data is visualized in the view panes. You can access this dialog box from the Window menu or by pressing F7.

The Options dialog box includes a configuration area:

![Options dialog box]

This enables you to save any changes you make in the Options dialog box to a configuration file, with the extension .Options. You can then re-use your saved configuration file as required, for example, you could save a different set of options for each type of motion capture application that you use.

In addition to creating customized Options configurations, the Configuration menu button enables you to rename, import, reload and delete configurations, and refresh the list.

To configure settings in the Options dialog box:

1. Open the Options dialog box in either of these ways:
   - Click the Window menu and then click Options; or
   - Press F7.
2. In the list of options on the left side of the dialog box, click an option whose properties you wish to view or change. You can now:
   - Select the check box to switch on the functionality or clear the check box to switch off the functionality for the option.
   - In the Properties section on the right side of the dialog box, view or change settings as desired for any available properties. (To see additional settings that may be available for an option, click Show Advanced.)
3. Repeat step 2 for each property whose settings you wish to configure.
4. To save your settings, do one of the following:
   - To save your settings as the current configuration and close the Options dialog box, click Close; or
   - To give your configuration a name, so that you can easily find it for re-use later, click the Configuration menu button, then click Save As, enter a name in the dialog box, click OK, and then choose whether to save your configuration as Shared or Private.
Vicon Control dialog box

The Vicon Control dialog box enables you to carry out the following operations:

- To grant unprompted access in future, ensure the relevant device’s check box is selected in the Known Devices list.
  In future, the device will be able to connect without having to be re-authorized.

- To permanently revoke access, clear the device’s check box in the Known Devices list.
  The device is disconnected and in future, it will not be able to connect. This is useful if you accidentally authorized a device, or if you need to remove an authorized device from the system, for example, if it is lost or sold.

- To remove a connected device from the Known Devices list and force re-authorization on the next attempt to connect, select the device and then click Forget Device.
  To reconnect, the device will have to send an authorization request and be re-authorized.

- To remove all connected devices from the Known Devices list and force re-authorization on the next attempt to connect by any of the listed devices, click Forget All.

Help menu

The Help menu contains the following commands:

- View latest help from vicon.com Displays the most recent version of the live online help.

- View installed help Displays the help file (PDF) that was installed with Vicon Nexus.

- Check for updates Detects whether any Nexus updates are available.

- About Vicon Nexus Displays the Vicon Nexus startup screen, in which you can view version and license server information about the installed release of Nexus.

- Hotkeys Displays a list of Nexus shortcuts and hot keys.

- Vicon Product Licensing Displays the Vicon Automated Unified Licensing Tool (VAULT), which enables you to manage your Vicon product licensing.
Toolbar

The Nexus toolbar contains the following controls. For information on how to change the standard toolbar, see Customize Toolbar dialog box on page 262:

- **Save** Saves the current data for subjects enabled in the Subjects Resources pane to the .c3d file for the current trial.

- **Close** Closes the current trial and clears data. You are prompted to save any unsaved changes before closing the current trial.

- **Undo** Undoes the last action. This command is available only after a relevant action has been performed. Hover the mouse pointer over the Undo button to display a tooltip identifying the action to be undone. Some actions, such as reconstructing data, cannot be undone.

- **Redo** Reinstates the previously undone action. This command is available only after an Undo command has been performed. Hover the mouse pointer over the Redo button to display a tooltip identifying the action to be redone. Any action that was undone can be redone.

- **Reconstruct** Runs the Reconstruct pipeline defined in the Pipeline Tools pane. For information on Reconstruct settings, see the equivalent Local Vicon System settings (Reconstruction section on page 139), which control the same functionality for realtime.

- **Reconstruct and Label** Runs the Reconstruct and Label pipeline defined in the Pipeline Tools pane. For information on Reconstruct settings, see the equivalent Local Vicon System settings (Reconstruction section on page 139). For information on Label settings, see the equivalent Local Vicon System settings (Labeling section on page 142), which control the same functionality for realtime.

- **KinFit** Runs the Kinematic Fit pipeline defined in the Pipeline Tools pane.
AutoInitialize

Runs the Auto Initialize Labeling pipeline, which consists of the AutoLabel Static, Scale Subject VSK, and Static Skeleton Calibration - Markers-only pipeline operations. For more information, see Subject calibration operations on page 235.

Auto Gap Fill

Runs the Auto Intelligent Gap Fill pipeline, which consists of Nexus gap-filling operations (see Fill Gap & Filter Data operations on page 239). This enables you to quickly fill all gaps in your trial, without having to choose which fill method is best for each gap.

View Type list

Create or manage the layouts specified in the View pane using the View Type list at the top of the pane. The view type includes the layout of view panes as well as any cameras, hardware devices, and subject elements that were selected in the System Resources pane or the Subjects Resources pane when the view type was saved. For example, if you save a view type with all cameras selected and a Camera view specified for each, the next time you select that view type, all of the cameras are automatically selected and displayed in separate Camera views. If you save a view type with a Graph view showing the EMG channels, when you next select this view type, the correct EMG device is selected. If you save a view type with a Graph view showing the distance between two specific markers, when you next select this view type, these two markers are selected.

Customize Toolbar dialog box

You can add, remove, and customize buttons on the Nexus toolbar using the Customize Toolbar dialog box.

To access this dialog box:

On the Window menu, click Toolbar.

The toolbar settings are saved in the appropriate configuration file: the default Nexus toolbar is stored in the Shared configuration folder; if customized, the toolbar is saved in a Private configuration folder and loaded the next time you start Vicon Nexus.

The Save, Undo, and Redo buttons always appear on the Nexus toolbar in their default positions on the left of the toolbar; you cannot customize these buttons.
You can add new buttons to run a specified pipeline, load a previously created View Option configuration, or display a View Type configuration. For each button, you can define a tooltip, associate an icon, and associate a text string. You can group related buttons together on the toolbar with separators or reposition buttons along the toolbar.

You can customize your toolbar in the following ways:

- Add or change toolbar buttons on page 263
- Change a button's position on the toolbar on page 264
- Group related buttons with separators on page 265
- Remove a button or separator from the toolbar on page 265

Add or change toolbar buttons

To add or change a toolbar button in the Customize Toolbar dialog box:

1. Click Add Button. A new button entry is added to the bottom of the Toolbar Buttons list and is highlighted and selected. Alternatively, select an existing toolbar button.

2. In the Button Properties area, configure the following information for the selected button:
   - **Caption**: The label to be displayed on the button.
   - **Icon**: The icon to be displayed for the button. Select an available icon from the drop-down list.
   - **Tooltip**: The text to be displayed to indicate the operation to be executed when the button is pressed.

3. Select the check box for one of the following actions to be taken when the button is pressed:
   - **Load View Options**: Apply the specified view options settings. Select a previously created View Option configuration from the drop-down list. If you have not created any configurations, this check box is not selectable and this list is empty.
   - **Load View Type**: Apply the specified view type. Select a previously created View Type configuration from the drop-down list. If you have not created any configurations, this check box is not selectable and this list is empty.
   - **Run Pipeline**: Run the specified pipeline. Select a pipeline file supplied with Nexus or a previously created custom pipeline from the drop-down list.
4. Click Apply to preview the button on the Nexus toolbar. If you are not happy with the result, change the button details in the Customize Toolbar dialog box and preview the changes again.

5. Repeat steps 1-4 for each button you want to add to the Nexus toolbar.

6. Click OK to save the customized toolbar and close the dialog box.

Change a button's position on the toolbar

To change the position of a toolbar button in the Customize Toolbar dialog box:

1. In the Toolbar Buttons list, select the entry for the button whose position you want to change.
   Button entries in this list from top to bottom correspond to the button positions on the toolbar from left to right.

   **Important**

   Nexus executes any customized buttons in the following order:
   1) View Option
   2) View Type
   3) Pipeline
   Vicon recommends that you lay out your custom toolbar buttons in this order to avoid the potential for losing unsaved changes if you press multiple buttons before saving a configuration.

2. Change the button's position on the toolbar using the buttons:
   - **Move Up**: Move the selected button up one position in the list, that is, left one position on the toolbar.
   - **Move Down**: Move the selected button down one position in the list, that is, right one position on the toolbar.

3. Click Apply to preview the changed button location on the Nexus toolbar. If you are not happy with the result, change the position again in the Customize Toolbar dialog box and preview the position again.

4. Click OK to save the customized toolbar and close the dialog box.
Group related buttons with separators

To group related buttons together on the toolbar in the Customize Toolbar dialog box:

1. Click Add Separator. A new separator entry is added to the bottom of the Toolbar Buttons list and is highlighted and selected.
2. Change the separator’s position on the toolbar using the buttons:
   - Move Up: Move the selected separator up one position in the list, that is, left one position on the toolbar.
   - Move Down: Move the selected separator down one position in the list, that is, right one position on the toolbar.
3. Repeat steps 1–2 for each separator you want to add between buttons on the Nexus toolbar.
4. Click OK to save the customized toolbar and close the dialog box.

Remove a button or separator from the toolbar

To remove a toolbar button or separator in the Customize Toolbar dialog box:

1. In the Toolbar Buttons list, select the entry for the button or separator you want to remove from the toolbar.
2. Click Remove.
3. In the displayed confirmation dialog box, click Remove Item. The entry is removed from the list and button or separator is removed from the toolbar.
4. Click OK to save the customized toolbar and close the dialog box.

If you want to discard any changes you have made in the Customize Toolbar dialog box, click Cancel.
Nexus displays a warning message for you to confirm that you want to lose any changes you have made.

If you want to reload the default Nexus toolbar, click Reset.
Nexus displays a warning message asking you to confirm that you want to discard any customizations you have previously saved.