Vicon CaraPost User Guide

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Vicon Motion Systems is an OMG plc company.
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About the Vicon CaraPost User Guide

Read this guide for basic information that enables you to start using Vicon CaraPost. The guide begins by explaining how to install and license CaraPost. It then explains a basic workflow, from importing capture files (*.pico*) and a calibration file (*.xcp*), through initialization and tracking to common clean-up tasks and export.

Videos that accompany this guide are available from *Vicon Support*. The videos include the following topics:

- *Introduction and basic overview*
- *Blob detection*
- *Creating and using sticks and labels*
- *Initialization*
- *Tracking*
- *Optimization*
- *Data export*

For more detailed and advanced information, see the *Vicon CaraPost Reference Guide*.

About Vicon Cara documentation

The following documentation (online help and PDFs) is included in the Vicon Cara release:

Document	Description
Vicon Cara User Guide	Provides system description, installation instructions (in PDF only) and licensing instructions, and a basic step-by-step workflow. PDF and online help installed with CaraLive.
Vicon Cara Reference	Contains details of advanced functionality, information about the configuration server, descriptions of settings and options, and supported file formats. Hardware details and a glossary are also included. PDF and online help installed with CaraLive.
Vicon CaraPost User Guide	Provides system description, installation instructions (in PDF only) and licensing instructions, and a basic step-by-step workflow. PDF and online help installed with CaraPost.
Vicon CaraPost Reference	Contains details of advanced functionality, descriptions of settings and options, and supported file formats. A glossary is also included. PDF and online help installed with CaraPost.

The PDFs (for Adobe Reader version 8.0 or later) are installed as part of your Vicon Cara software installation.

The documents available to you depend upon your Vicon software license options.

You can also obtain these, and other Vicon documents, from the Downloads page of the *Vicon Support website*.

Prepare to use Vicon CaraPost

Before using Vicon CaraPost for the first time, ensure that your equipment meets the minimum requirements and that you understand the file types with which you will work. For more information, see the following topics:

- *Vicon CaraPost requirements*
- *About Vicon CaraLive output files*

Vicon CaraPost requirements

The following specifications for a PC for use with Vicon CaraPost is given as an approximate guide only. Ensure that your system meets these requirements:

- Quad core 3+GHz processor
- 16 GB Memory
- 500 GB hard drive
- NVidia Quadro K4000 or equivalent graphics card
- Windows 7 Professional 64-bit

For information about requirements for using Vicon CaraLive, see *Using Vicon Cara*.

About Vicon CaraLive output files

To work with Vicon CaraPost, you need to import capture files (*.*pico*) and the related calibration files (*.*xcp*).

Takes (.*pico* files) are captured with Vicon CaraLive; calibration files (.*xcp*) are also created using CaraLive, but may be saved with CaraPost. For information on creating calibration files, see the *Vicon Cara User Guide*.

Tip

Example capture files and calibration files are available for download on the Vicon Support website: this document assumes that you are working with these files. If you prefer, you may substitute your own .*pico* and .*xcp* files, but you may then need to use different blob detection settings from those described, and perform additional manual processing.

Install and license Vicon CaraPost

This chapter covers the following topics:

- *Install Vicon software*
- *License Vicon CaraPost*:
  - *Request a license*
  - *Activate a license*
  - *Set the license server*
  - *Move and revoke licenses*
  - *View information about license servers*

Install Vicon software

To install Vicon CaraPost:

1. Log on to Vicon Online Support at *http://www.vicon.com/support/*, using the Vicon Online Support logon that was provided when you bought CaraPost.
2. Visit the **Animation** section of the **Downloads** page and download the CaraPost 1.1 software installer.
3. In Windows Explorer, go to the folder to which you downloaded the installer and double-click *Vicon_CaraPost_Setup.exe*.
4. On each wizard page, provide the requested details, and click **Next**.
5. On the **End-User License Agreement** wizard page, read and accept the terms.

   Tip

   If you choose to install the license server, if an older version of the license server is already installed, it is replaced. If the same version is already installed, the license server is not installed. If you are already using any other version of the SafeNet licensing tools, before replacing them with the version included with CaraPost, contact Vicon Support for advice.

   If you are setting up a network license server and you do not want CaraPost on that machine, you can choose to install only the license sever.

6. In the confirmation boxes, check that the selected components have been successfully installed and click **OK**.
7. On the final wizard page, click **Finish**.
8. Enter the required information into the subsequent dialog boxes until the installation is complete.

Note

Installing the Sentinel License Manager also installs the License Tools.

License Vicon CaraPost

To start using CaraPost, you must first request a license and activate it. You may also need to set the license server for your license. If you want to use CaraPost remotely, you will need to set up commuter licensing. For details of these procedures, see the following topics:

- *Request a license*
- *Activate a license*
- *Set the license server*
- *Move and revoke licenses*

The Vicon Licensing software also enables you to:

- *View information about license servers*

Request a license

To request a license, you start Vicon CaraPost and supply the relevant details.

To request a license from Vicon Support:

1. If you are using a SafeNet dongle to license your machine:
   a. Ensure you have installed the latest drivers for the dongle onto the PC on which you will run CaraPost. You can either choose the option for dongle drivers when you install CaraPost, or run the CaraPost installer at any time, or you can download the drivers from the *Vicon Support website*.
   b. Insert the dongle.
2. On the machine for which you want the license (either a networked license server or a standalone machine), start CaraPost and at the left of the dialog box, click **Request License**.

Tip

You can also manage licensing in the following ways:
– After you have licensed Vicon CaraPost, start CaraPost and on the **Help** menu, click **Licensing** ; or
– To run the Vicon Automated Unified Licensing Tool (VAULT) independently of CaraPost, click the **Start** button, then **All Programs** > **Vicon** > **Licensing** > **Product Licensing**.

3. At the top of the **Request a License** dialog box, from the **Product** and **Product Version** menus, ensure **CaraPost** and **1.x** are selected.
4. In the appropriate fields, type your name, email address and company name.
5. In the **Options** area, select whether to request:
   - **Standalone license locked to** *local PC name*: for use by the PC from which you are sending this request only
   - **Network license locked to** *license server name*: for use on the license server machine from which you are sending this request by one or more PCs on the same network
   - **Standalone license locked to a dongle**: for use with the specified dongle on a single PC. In the **Dongle ID** field, type the ID, which is found on the dongle.
   - **Network license locked to a dongle**: for use on a license server machine by one or more PCs via the specified dongle. In the **Dongle ID** field, type the ID, which is found on the dongle.
6. For network/server based licenses only: if necessary, change the value for the **Number of Seats**.
7. Leave the settings in the **Machine** area at their default values unless you are asked to change them by Vicon Support (for example, if you are using a dual-booting system or have had to reinstall Windows).
8. Do one of the following:
   - If you can currently email your license request, click the **Email Request** button; or
   - If email is currently unavailable, click **Save Request to a file**, so that you can send the request later. Type or browse to a suitable location and click **OK**. The file is saved as *ViconLicenseRequest*.xml*. When possible, email the file to Vicon Support.

Activate a license

After you have received a license file from Vicon Support, you must activate it before you can start using Vicon CaraPost.

To activate a license:

1. Check your email for a message from Vicon Support. The license file (named *CaraPost* Release Number License Type.*lic*) is attached to the email. If you are using a Safenet dongle, the email has the ID of your dongle (of the form UB*nnnnnn*) in the **Subject** line.

   If you have not received a license file, request one as described in *Request a license* on page 11.

2. Save the license file (**.lic*) to the Windows desktop of the machine for which you have a license (or any other suitable location).

3. Start CaraPost and in the **Vicon Automated Unified Licensing Tool** dialog box, click **Activate License**.

4. Depending on whether you are using the file as it was received from Vicon Support or as a text string copied from the file:

   - In the **License File Activation** field, type or browse to the location of the license file (**.lic*) and click **Activate from File**; or
   - Copy the text to the **License Activation string** field and click **Activate from String**.

5. Click **OK**.

Tip

You can only deactivate a network license from the relevant license server machine, not from any of the client machines.

Set the license server

If a server provides licenses to client PCs on your network, to enable a client PC to find its license quickly, on the client PC specify the license server for Vicon CaraPost to use.

If you use standalone licensing, CaraPost should automatically find its license, but if not, or if you need to change the license server, complete the following steps.

To enable CaraPost to find its license:

1. Ensure you have installed CaraPost as described in *Install Vicon software* on page 10. Depending on the type of license you have, ensure that your system is ready:
   - If your PC obtains its license from a license server, ensure that CaraPost is licensed on the relevant server.
   - If you are using a standalone license, ensure that you have requested, saved and activated your license on this machine.
2. Start CaraPost and depending on whether or not a license is found:
   - If the **Vicon Automated Unified Licensing Tool** dialog box opens, click **Set License Server**; or
   - If CaraPost opens and you want to view or change the license server:
     a. On the **Help** menu, click **Licensing**.
     b. In the **Vicon Automated Unified Licensing Tool** dialog box, go to the **Product License Location** list (in the lower half of the dialog box), and right-click on the line that shows the relevant CaraPost license and then click **Set License Type**.
3. In the **Change License Server** dialog box, do one of the following:
   - To use standalone licensing, click **Use Standalone/Commuter Licenses Only** and then click **OK**.
   - To obtain a license from any available license server (local or on a network), click **Use Standalone/Commuter Licenses Or Scan for a License Server** and then click **OK**.
   - To select a specific license server from a list of all available servers:
     a. Click **Discover**. Both local and network licenses are displayed.
     b. In the **Available Servers** list, double-click the required license server and then click **OK**.
   - To specify a license server on your network, click **Use a Specific Network License Server**, type the name in the **License Server** field, and click **OK**.

Tip

You can instead select the required license server by going to the **License Server** list (in the upper half of the dialog box), right-clicking on the line that shows the relevant CaraPost license and then clicking **Use This License for** Cara.

Move and revoke licenses

You can check out (borrow) a seat from a network license so that it can be used for the number of days that you specify, on a machine that is not connected to the license server network. You can check out a seat to either:

- A machine on your network (see *Check out to a network machine* below), so that Vicon CaraPost can subsequently be used when the machine is no longer connected to your network; or
- A machine that is not connected to your network (see *Check out to a remote machine* below)

When a commuter license is no longer needed, it is checked back in again, so that it can be used from the license server network as usual. Licenses are automatically checked in at the end of a specified check-out period, or can be manually checked in early (not applicable to remotely checked-out licenses), For more information, see *Check in a commuter license* on page 18.

Check out to a network machine

You can check out a seat from an existing license for use on a machine on your license server network, so that Vicon CaraPost can subsequently be used on the machine when it is no longer connected to your network.

To check out a seat to a machine on the license server network:

1. On a network machine that you later want to use remotely, open the advanced **Vicon Automated Unified Licensing Tool** dialog box by doing one of the following:
   - Start CaraPost and on the **Help** menu, click **Licensing**; or
   - Click the **Start** button, then **All Programs** > **Vicon** > **Licensing** > **Product Licensing**.
2. In the **License Server** list in the top part of the dialog box, right-click on the license that contains the seat that you want to check out and click **Check Out**.
3. In the **Check Out License** dialog box, specify the number of days for the license to be used remotely and then click **Check Out**.

   Checked out licenses are flagged with **Commuter** in the **Type** column in the **License Server** list in the top part of the **Vicon Automated Unified Licensing Tool** dialog box.

Check out to a remote machine

In addition to checking out a license to a network machine (see *Check out to a network machine* above), you can also check out a license to a machine that is running the Vicon Automated Unified Licensing Tool (VAULT), but is not connected to the network containing the license server. This involves the following procedures:

- *On the remote machine: Generate a locking code* and send it to a user of a machine on the license server network.
- *On a network machine: Check out a commuter license* and send it to the remote user.
- *On the remote machine: Save and activate the commuter license*

On the remote machine: Generate a locking code

1. To open the advanced **Vicon Automated Unified Licensing Tool** dialog box, do one of the following:
   - Start Vicon CaraPost and in the **Vicon Automated Unified Licensing Tool** dialog box click **Advanced Licensing**; or
   - Click the **Start** button, then **All Programs** > **Vicon** > **Licensing** > **Product Licensing**.
2. In the **Vicon Automated Unified Licensing Tool** dialog box, click **View Remote Locking Code**.
3. In the **Current Machine Locking Code** dialog box, type the email address of a person to whom the network license server is available, and click **Send**, or to save it to a string to send later, type or browse to the required location and filename, click **Save to File** and close the dialog box.

   The person with access to the license server can then check out a commuter license for use on the remote machine, as described in the following steps.

On a network machine: Check out a commuter license

1. To open the advanced **Vicon Automated Unified Licensing Tool** dialog box, do one of the following:
   - Start CaraPost and on the **Help** menu, click **Licensing**; or
   - Click the **Start** button, then **All Programs** > **Vicon** > **Licensing** > **Product Licensing**.
2. In the **License Server** list in the top part of the dialog box, right-click on a license that permits commuter licensing for CaraPost.

   If the selected license permits commuter licensing, the context menu displays a **Check Out** option and at the bottom of the dialog box, a **Check Out** button is displayed.
3. Click **Check Out** and in the **Check Out License** dialog box:
   a. Specify the number of days for which you want to use the license remotely.
   b. Expand the **Advanced Options** by clicking the downward pointing arrow on the right, and click **Remote Check Out**.

   Caution

   Do not overestimate the number of days for which the license will remain checked out. After a remote check out, you cannot check the license back in again until the number of days that you specified has expired.
4. In the **Remote Commuter License Check Out** dialog box, enter the locking code string for the remote machine that was emailed or sent by the user of the remote machine, as described in *On the remote machine: Generate a locking code* above, and click **Check Out**.
5. In the **Save Commuter License** dialog box, type or browse to a path and filename for the saved commuter license, click **Save to File** and then close the dialog box. The commuter license is saved as a license file (**.lic*).
6. Email the saved commuter license file to the remote user.

   The remote user can then save and activate the checked-out commuter license on the remote machine, as described in the following steps.

On the remote machine: Save and activate the commuter license

1. Save the file that was sent to you as described in *On a network machine: Check out a commuter license* above to the Windows desktop (or any other suitable location).
2. To open the advanced **Vicon Automated Unified Licensing Tool** dialog box, do one of the following:
   - Start Vicon CaraPost and in the **Vicon Automated Unified Licensing Tool** dialog box click **Activate License**; or
   - Click the **Start** button, then **All Programs** > **Vicon** > **Licensing** > **Product Licensing**, and then click **Activate License**.
3. Depending on whether you are using the file as it was received from the license network user or a text string copied from the file, do one of the following:
   - In the **License File Activation** field, type or browse to the location of the license file (*.*lic*) and click **Activate from File**; or
   - Copy the text to the **License Activation string** field and click **Activate from String**.
4. Close the **Activate a License** dialog box.

   In the **License Server** list in the top part of the **Vicon Automated Unified Licensing Tool** dialog box, checked out licenses are flagged with **Commuter** in the **Type** column.

Check in a commuter license

Licenses that have been checked out are checked back in and made available for use from the network in either of the following ways:

- If the specified check-out period has expired, the license is automatically checked back in.
- If the license is no longer needed for remote use, you can check it back in early.

Caution

This does not apply to licenses that were checked out using **Remote Check Out**, which remain checked out until their check-out period expires.

To check in a license manually:

1. To open the advanced **Vicon Automated Unified Licensing Tool** dialog box, do one of the following:
   - Start Vicon CaraPost and on the **Help** menu, click **Licensing.**; or
   - Click the **Start** button, then **All Programs** > **Vicon** > **Licensing** > **Product Licensing**.
2. In the top part of the **Vicon Automated Unified Licensing Tool** dialog box, click on the license you want to check in and then click **Check In License**.

Important

You cannot check in a license that was checked out using **Remote Check Out** before its check-out period has expired. You set the check-out period when you check out a license. To see how many days are left on a commuter license, in the **License Server** list in the top part of the **Vicon Automated Unified Licensing Tool** dialog box, find the relevant license and look at the date in the **Expiry** column.

Revoke a license

You may find that you need to move your Vicon CaraLive license to a license server machine that is different from the one for which you originally obtained the license. To do this, you must revoke the original license. (If you want to temporarily use a single license seat on a remote machine, see *Move and revoke licenses* on page 15.)

Important

To avoid delays when changing license servers, before clicking **Revoke License**, email Vicon Support and wait to receive a reply before proceeding.

Ensure that your email to Vicon Support includes the following details:

- The Vicon product name (ie Vicon CaraLive) and `license revocation` in the **Subject** line of the email.
- Information about the license that you want to revoke, including number of seats and locking code of the license server machine.
- The locking code of the machine to which you want to move the license.

View information about license servers

In the **Vicon Automated Unified Licensing Tool** dialog box, you can view information about all available license servers without affecting the license server that is currently in use. To do this:

1. Open the advanced **Vicon Automated Unified Licensing Tool** dialog box by doing one of the following:
   - Before licensing Vicon CaraPost, start CaraPost and in the **Vicon Automated Unified Licensing Tool** dialog box click **Advanced Licensing**; or
   - After CaraPost is licensed, start CaraPost and on the **Help** menu, click **Licensing** to open the **Vicon Automated Unified Licensing Tool** dialog box; or
   - Click the Windows **Start** button, then **All Programs** > **Vicon** > **Licensing** > **Product Licensing**.
2. In the **Vicon Automated Unified Licensing Tool** dialog box, if the required license server is not displayed in the **License Server** field at the top, click **Change** at the top right of the dialog box.
3. In the **Options** area of the **Select License Server** dialog box, do one of the following:
   - To view local standalone licenses and commuter licenses, select **View Licenses from the Locally Installed License Server**; or
   - To view licenses on a specified license server, type the name of the required server in the **License Server** field. If you do not know the name of the license server, click **Discover** and in the **Available Servers** list, double-click a license server.
4. Click **OK**.

   In **License Server** list in the top part of the **Vicon Automated Unified Licensing Tool** dialog box, licenses from the specified license server are displayed.

Tip

Changing the license server that is displayed in the **License Server** list does not affect the license server that is used for licensing, shown in the **Product License Location** list in the lower part of the dialog box. To change the license server that is used for licensing, see *Set the license server* on page 13.

Initialize and track a take

Vicon CaraPost enables you to process captures made using Vicon CaraLive.

The following topics describe the workflows for initializing and tracking a take using CaraPost. Two basic workflows are described:

- Initializing and tracking a take completely from scratch; and
- Using a frame from an existing processed take to provide an efficient way of initializing subsequent takes for the same actor and marker set (Initialize from ROM).

The first workflow is explained using a Range of Motion (ROM) take (called *ROM*) as an example, which is then used in the second workflow to initialize and track a subsequent take called *The Greatest*. All example data is available for download on the *Vicon Support website*, in the same location as the CaraPost installer.

To perform the Initialize from ROM workflow, you need to have processed (initialized) only a single frame in the ROM take; this gives the most efficient workflow. However, in some situations, processing the whole ROM take gives more flexibility for initializing subsequent takes, for example, if the actor cannot start from the ROM pose in each subsequent take. It is this slightly more general processing workflow that is described in this chapter, which includes the following topics.

- *Start Vicon CaraPost*
- *Import capture files*
- *Set blob parameters*
- *Detect blobs*
- *Initialize the calibration brim*

- *Initialize face marker positions*
- *Manually connect data*
- *Label face markers*
- *Create a mesh*
- *Track the rest of the take*
- *Save the completed take*

When you have completed these steps, you can perform any clean up required as described in *Optimize a take* on page 53.

You can then use a single frame from the resulting clean ROM file to initialize subsequent takes. For more information, see *Initialize from a ROM file* on page 49.

About the example files

To enable you to use to get accustomed to using Vicon CaraPost, the following sample files are supplied on the *Vicon Support website*, in the same location as the CaraPost installer.

- *ROM_0.pico, ROM_1.pico, ROM_2.pico, ROM_3.pico*
- *Calibration.xcp*
- *TheGreatest_0.pico, TheGreatest_1.pico, TheGreatest_2.pico, TheGreatest_3.pico* (short monologue from the film *The Greatest*)
- *MarkerList.txt* (sample list of marker names)

Start Vicon CaraPost

To start Vicon CaraPost:

1. On the Windows desktop, double-click the Vicon CaraPost shortcut:

   The Vicon CaraPost window is displayed.

Import capture files

After you have started Vicon CaraPost, the first step in processing a take is to import the capture files (*.*pico*), and the calibration file (*.*xcp*) that you want to work with.

Takes are captured with Vicon CaraLive; calibration files are created using CaraLive, but can also be saved from CaraPost. For information on creating takes and calibration files, see the *Vicon Cara User Guide*.

Important

You can download example capture files and calibration files from the *Vicon Support website*, in the same location as the CaraPost installer. The following instructions assume that you are working with these files. If you prefer, you may substitute your own *.pico* and *.xcp* files, but you may then need to use different blob detection settings.

The following example ROM file and accompanying calibration file is available on the *Vicon Support website*, in the same location as the CaraPost installer:

- *ROM-0.pico, ROM-01.pico, ROM-02.pico, ROM-3.pico*
- *Calibration.xcp*

To import and prepare a take for processing:

1. On the **File** menu, click **Import Pico Files**, browse to the folder containing the downloaded sample data, then in the dialog box, select the take named *ROM*.

   When the file has opened, click one of the buttons at the top left of the CaraPost window that enables you to view all four camera views:

2. To re-orientate the camera views (channels) that appear upside-down:

   a. To select a view, Shift+click on it.

      The **Channel** title at the top of the selected camera view turns green, to indicate you selected it.

   b. To select more than one view, keep the Shift key pressed down and click any other views that you need to rotate.

   c. To rotate a camera view, press CTRL+right arrow twice.

When you have finished, click in a view to deselect the selected views. The **Channel** titles turn yellow again. Ensure that you deselect all the views.

3. On the **File** menu, click **Import XCP** and from the folder containing the downloaded sample data, select *Calibration.xcp*.

   The **Log** displays a line item `Import XCP (`*file path and name*`) succeeded`. In the **Selection** window, a **Global** item appears at the bottom of the list.

   Tip

   If the **Selection** window or any other window that you want to display is not currently visible, right-click on the menu bar of one of the visible windows and click the required window name. To dock and undock windows, double-click them.

The *.xcp* file contains the Field of View (FOV) and radial distortion values for the cameras used during the Vicon CaraLive capture. Vicon CaraPost needs this information to reconstruct the 3D points correctly.

Set blob parameters

The blob detection settings are saved in the take that is captured with Vicon CaraLive. However, if the blob detection settings are not as required, you can change them, as described in *Preview and adjust blob parameters* below.

When setting the blob parameters, aim to adjust them so that the following markers are detected throughout the take.

Note

If you were just processing only a single frame in the ROM take, you would need to ensure that the blob parameters produce good results on the single frame only.

- Markers on the same side of the face as the camera
- Markers down the middle of the face
- ALL the calibration brim markers

If you have a few face markers in shadow or that have low contrast with the background because they're on or near the lips, etc, you can safely ignore them.

For detailed information on blob parameters, see *Blob Parameters section* in the *Vicon CaraPost Reference*.

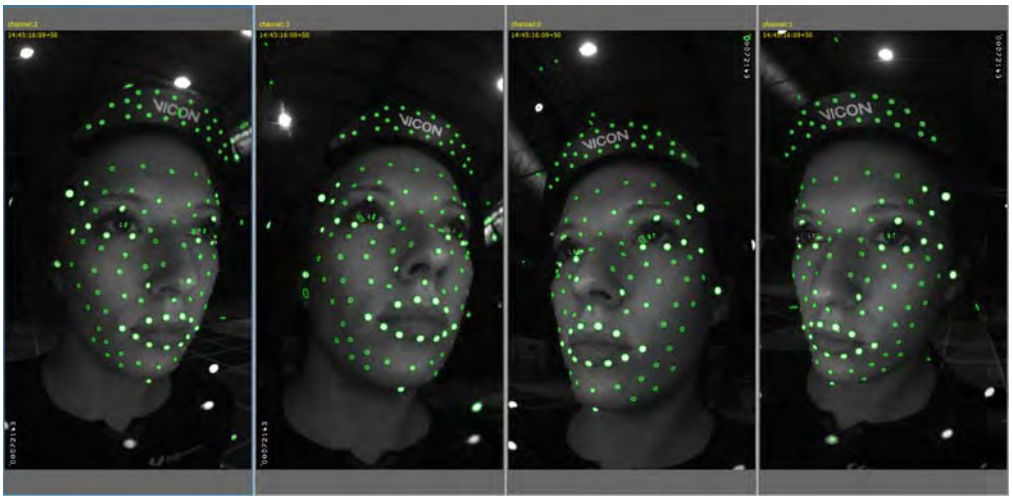
Preview and adjust blob parameters

After you have imported the capture files, you can preview and adjust the blob parameters. When you have set them to optimize blob detection throughout the whole take, you can run the Vicon CaraPost blob detection process.

To adjust blob detection settings:

1. To preview blob detection, right-click on a camera view and select **Blob Preview**.

   This displays the blobs that would be detected with the current **Blob Parameters** settings if you were to run the **Detect Blobs** process. With the default settings used on the *ROM* files, views similar to the following are displayed:



Tip

The blob detection results are likely to contain noise (additional, unwanted detections). Noise increases the chances of Vicon CaraPost making incorrect correspondences between the 2D and 3D data. If, to try to correct this, you make the blob parameters too strict, some markers may not be detected or may not be detected throughout the take. Although obtaining optimum detections is a balance between having too much noise or too few detections, it is better to detect as many of the brim blobs and face blobs as possible, even if this results in additional unwanted detections.

2. Go to the first frame that you want to track. This will normally be the first frame in the take, unless you are using a clapperboard, in which case, go to the first frame after the clapperboard is used. If you are processing a single ROM frame only, select a frame that contains a neutral face pose.

3. In the **Blob Parameters** section of the **Properties** pane, select the required blob type(s), ensuring that you select the color(s) required for both brim blobs and face blobs. If you are detecting blobs of one color only, clear the check boxes for the blobs of the unused color. This enables the system to work faster.

   For the *ROM* take, white markers are used on both the brim and the face, so select **Find White Blobs** and ensure **Find Black Blobs** is cleared.

   Tip

   Vicon Cara supports white and black blobs, so you can choose the type that suits your capture requirements. White markers normally offer the best level of contrast, especially when used in combination with on-board lighting. Both white and black versions of the brim and calibration grid are supplied in the Vicon Cara kit

4. For the *ROM* take from the sample data, adjust the remaining settings as follows:

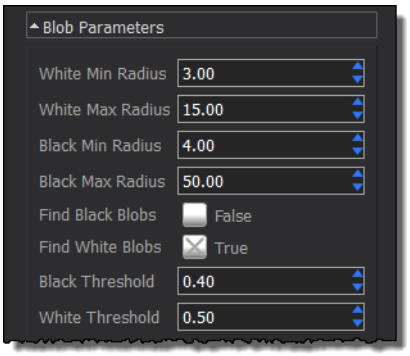
   - **White Min Radius** to 3
   - **White Max Radius** to 15
   - **White Threshold** to 0.5

   If you are not using the *ROM* take from the sample data and some blobs aren't visible:

   a. Decrease the **Threshold(s)** in decrements of 0.05 until all the blobs you need are detected. If additional, unwanted blobs are also detected, remember that you can easily delete these later if they cause a problem with the tracking.

   b. Adjust the **Min Radius** and **Max Radius** settings so they are as large and small respectively to fit all the blobs that you need.

   The **Blob Parameters** section should now look similar to this, although the values may vary if you are not using the *ROM* take:



Tip

To see the results of your changes, press Enter or click outside the text box.

5. Scrub through the take to make sure the blob detections are good for all frames, ideally with as little noise as possible.

   Although there may be a few unwanted detections and/or some blobs that are not detected in all frames, the take should now be ready for you to run the blob detection process.

Detect blobs

After you have previewed and adjusted the blob parameters, you can run the blob detection process on the required frame(s) in the take you have imported.

In the following steps, the blob detection process is run on the whole of the example ROM take. If you want to detect blobs in only a single frame, or a limited range of frames, use **Detect Blobs [Current Frame]**, or select a range of frames before running the **Detect Blobs [Active Range]** command. To select a range of frames, go to the first frame of the required range and press CTRL+1. Go to the last frame of the required range and press CTRL+2.

Tip

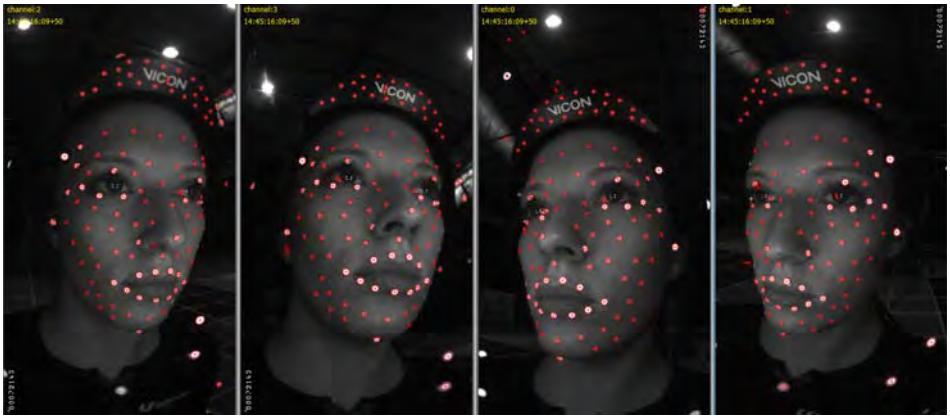
If you detect blobs for only a single frame or a limited range of frames, when you track the take, blob detection is automatically run on the whole take as well.

If you are likely to need to perform tracking more than once (for example, to try re-tracking with different parameters), you may find it quicker to ensure blob detection and tracking are run separately. To do this, ensure you blob detect the entire take before you track it.

To detect blobs for the whole take:

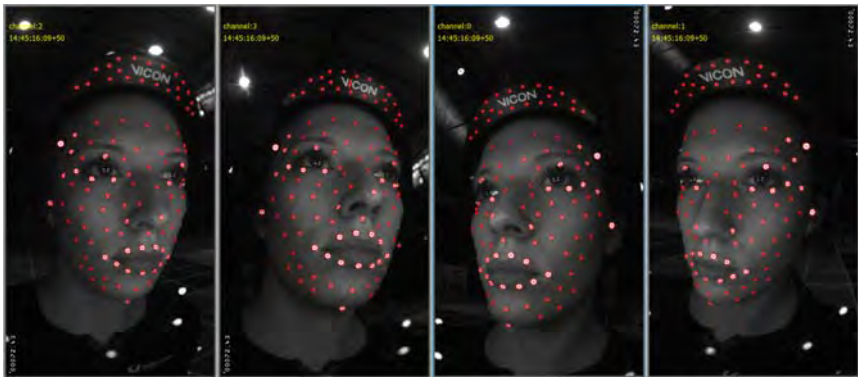
1. Scrub to the first frame (or press the Home key) of the *ROM* file.
2. To give a clear view of detections, turn off blob detection previews by right-clicking on a camera view and clearing **Blob Preview**.
3. On the **Process** menu, click **Detect Blobs [Active Range]**.

   The blob detection process runs on the whole take. The detected blobs are displayed in red. The first frame should look similar to the following example:



   Note that some unwanted blobs (red detections where there are no markers) will probably be detected. These may result in mismatched blobs during the **Initialize 3D** process.

4. To delete any unwanted detections, box-select (click+drag) or lasso-select (ALT+SHIFT+click+drag) them, then on the **Edit** menu, click **Delete Selected** or press CTRL+D. The result should look similar to the following example:



Initialize the calibration brim

After you have imported the relevant capture files and blob-detected the take, the next step is to enable CaraPost to initialize the calibration brim that was used on the first frame of the take. The calibration brim is a known pattern of markers that is used to calculate the positions of the cameras.

To initialize the calibration brim:

1. On the **Process** menu, click **Initialize Default Calibration Brim [V2.0]**.

   Note
   If you are using a custom brim, you may need to use a different option.

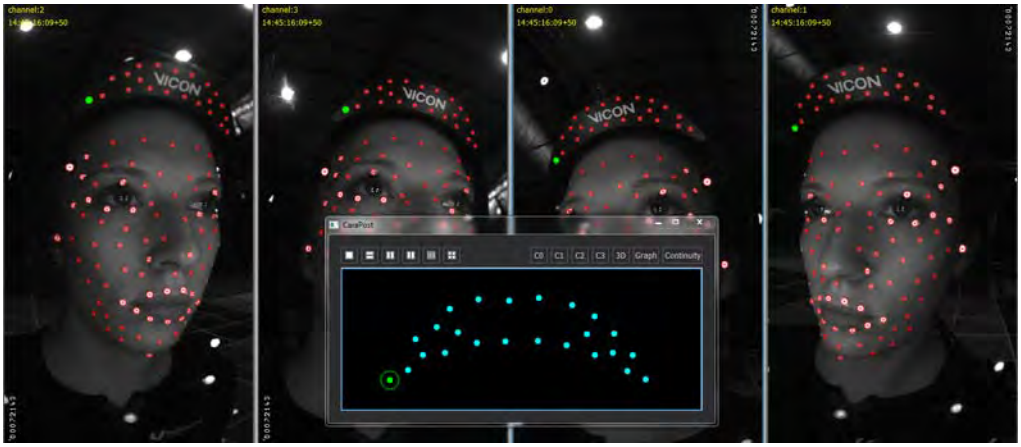
   In the History pane, **Initialize Default Calibration Brim** is displayed.

2. On the **View** menu, click **New Floating Workspace**.

   The calibration brim appears in a 3D view.

   Tip
   To zoom out so you can see the whole calibration brim, in the new workspace, press SHIFT+right-click+drag down.

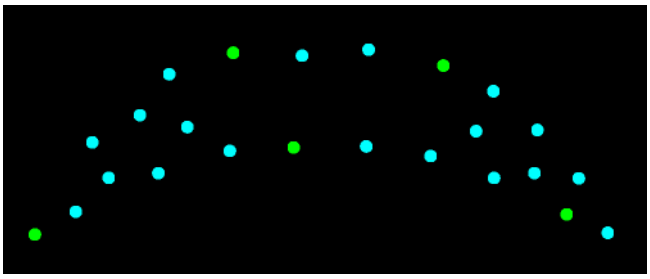
3. Click on the leftmost calibration brim marker in the first camera view so that it turns green. Then CTRL+click the same marker in the other three camera views and in the 3D view so they are all selected:



4. On the **Edit** menu, click **Merge** (or press M).

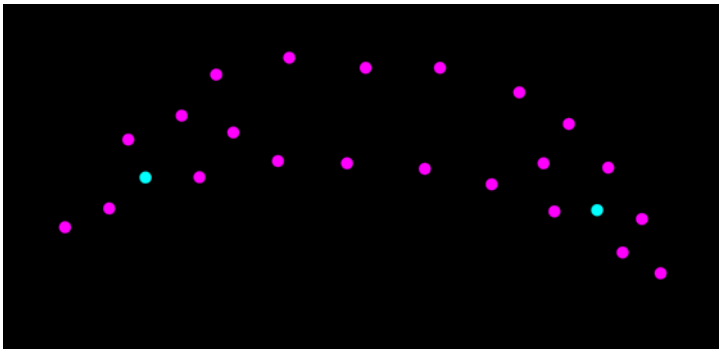
   A correspondence between the blob detections and the 3D model of the calibration brim is created.

5. Repeat the previous 2 steps to create correspondences for at least four points on the calibration brim in all camera views. The following example shows correspondences for five calibration brim points (displayed in green):



6. To enable Vicon CaraPost to calculate the approximate positions of the cameras, on the **Process** menu, click **Solve Calibration Brim [Manual]**.

   The 3D view should look similar to this:



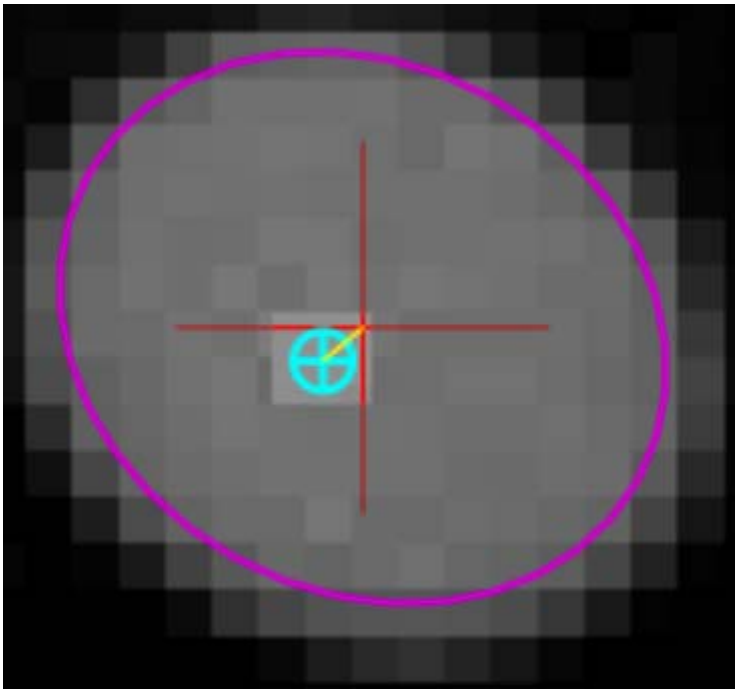
   The light blue points are not required, so select and delete them (press CTRL+D).

If necessary, use the following commands to adjust the view:

Action	Mouse and keyboard combination
Zoom	ALT+right-click+drag or SHIFT+right-click+drag
Pan	ALT+click+drag or SHIFT+click+drag
Dolly	ALT+left & right (or middle) button+drag or SHIFT+left & right (or middle) button+drag

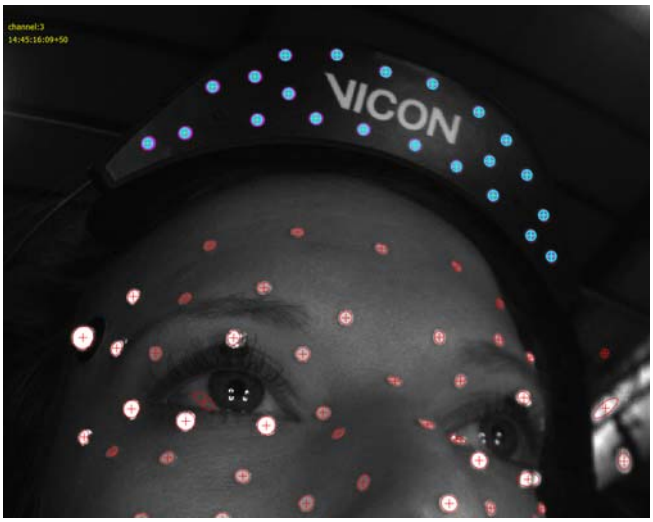
7. To examine the 2D re-projection errors, in a camera view, SHIFT+right-click+drag on a marker in the calibration brim (to keep the marker in the center of the view, you may also need to use SHIFT+left & right (or middle) button+drag).

   The view zooms in, so that you can clearly see the 2D and 3D data (slightly enlarged in the following example):



The red cross is the center point of the 2D detection, the blue cross is the center point of the 3D projection and the small yellow line connecting the two is the error.

In the above example the yellow line is short and when we look at the other detections in the same example, the blue crosses all appear over the detections, which indicates that the calibration brim is correctly aligned, as shown in the following image:



If the yellow lines representing the 2D re-projection errors are long (ie, more than a few pixels in length), this indicates that the calibration brim is not correctly aligned. The probable cause of this is that one or more brim points are mismatched in one or more of the camera views. Before continuing to the next processing step, correct any mismatches and obtain a good brim alignment.

Initialize face marker positions

When the calibration brim is correctly aligned and Vicon CaraPost has approximately calculated the camera positions, you must supply additional information to enable CaraPost to initialize the facial point data. This also enables CaraPost to calculate more accurate camera positions. You do this by matching additional seed points on the face, which are then used as a starting point to initialize the rest of the facial points.

The aim of this processing step is to correctly initialize the positions of all the face markers that you are interested in tracking through the take, and to ensure that there are matched detections in all the camera views in which they are visible.

Selecting additional seed points is similar to merging the calibration brim points except that you don't need to click in the 3D view (because unlike the brim, the 3D structure of the facial points is not yet known).

For the seed points, choose four or five points that are both:

- Spread over the face
- Near other detections

Typically, choose the following points:

Position	Number of points	Minimum number of camera views in which points are visible
Forehead	1	4
Chin and/or lips	1 per position	4
Cheek	1 on each	2 or more
Nose	1	4

Tip

Four or five points are adequate for a simple take, but a more complex take with a more sophisticated marker set may require more seed points. For information on selecting and using seed points for a (dense) 156 marker set and other marker sets, see *3D initialization for alternative marker sets* in the *Vicon CaraPost Reference Guide*.

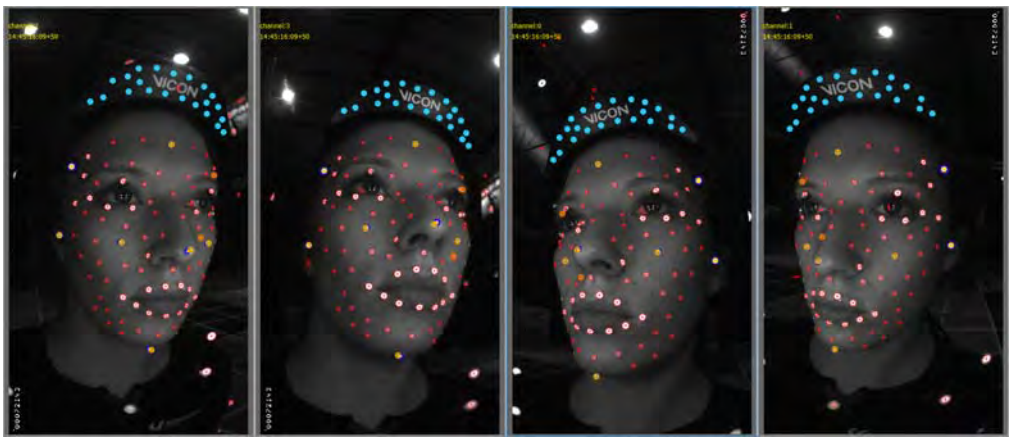
To add seed points:

1. CTRL+click on the chosen marker in each camera view in which it is visible.

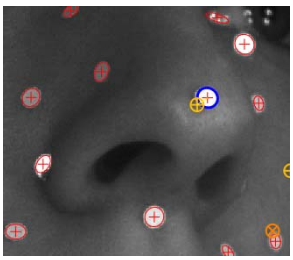
2. Press M to merge the detections.

   When you press M, a yellow point should appear in the 2D view and also in the 3D view.

   Repeat for all the points you want to use. For the ROM example provided, the result should look similar to the following image:



3. If you are working with the *ROM* take, zoom in to the nose marker in any camera view, and notice that it has a fairly large error line.



4. To use the additional seed points to further refine the camera positions and improve the accuracy of the points, on the **Process** menu, click **Bundle Current Frame [Unconstrained]**.

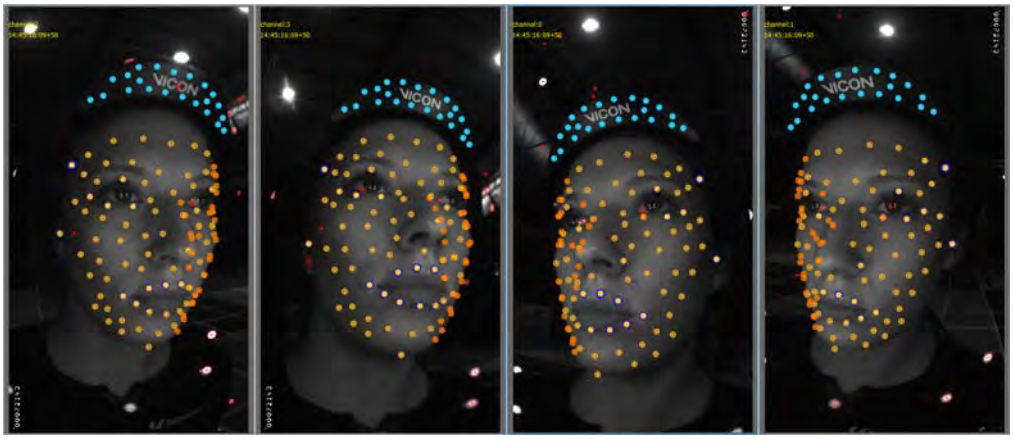
   The nose point now has almost no error line.

5. In the **Properties** pane, ensure that the **Initialize 3D Parameters** are set to the following (default) values:

   - **Max. Allowed Depth**: 35.0
   - **Max. 3D Distance To Merge**: 5.0
   - **Max. Allowed Symmetric Epipolar Distance**: 5.0

   For alternate marker sets, you may need to adjust these parameter values (see *3D initialization for alternative marker sets* in the *Vicon CaraPost Reference Guide*).

6. From the information you have supplied, you can now enable Vicon CaraPost to reconstruct all the other markers. To do this, on the **Process** menu, click **Initialize 3D**. The result should look similar to the following image:



Review the results of the initialization in detail across the four camera views, and also in a 3D view. Look out for:

- Mismatched detections. These appear as 3D points that are not aligned with the rest of the face points. See the examples in *Manually connect data* on page 36.
- Undetected face markers that you want to track. See the examples in *Manually connect data* on page 36.

If you find mismatched points or connections that were missed by the automatic process, you will need to manually correct them. For information on how to do this, see the next section.

Manually connect data

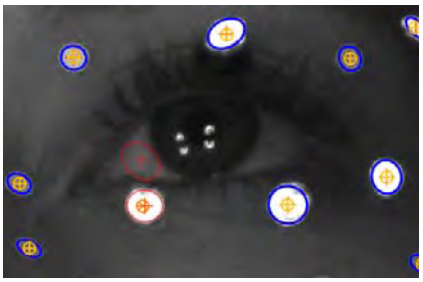
When you have reconstructed the markers, notice that there are both yellow and orange projections. The significance of these colors is:

- Yellow projections Have an associated detection in that camera view
- Orange points Do not have an associated detection in that camera view

You can merge some of these points to use all the available data. However, you should normally ignore partially obscured or very elliptical detections on the far side of the face as they may not track very well and can cause noisy 3D data.

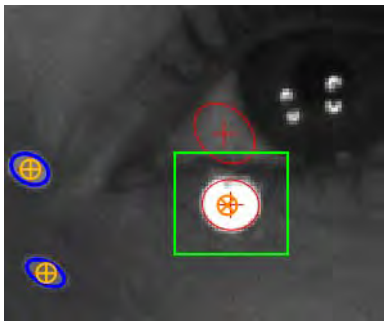
You may need to merge the points manually in the following situations:

- When Vicon CaraPost has not connected an orange projection to a red detection, as shown in the following example from channel 1, frame 0 of the *ROM* take:



To fix this:

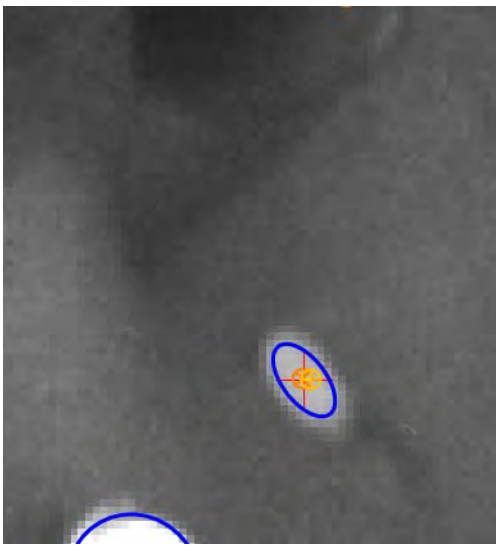
a. Drag-select both the red detection and the orange projection:



b. Press M.

The orange (disconnected) marker goes yellow, and the red detection becomes blue, indicating that the detection is now connected to a 3D marker point.

- When both an orange (unconnected) point and a yellow (connected) projection is displayed, as shown in the following example:



This happens when the same marker has been paired twice instead of in all available camera views or when an incorrect detection has been associated with a point on the face.

To fix an example of incorrect detection:

a. In channel 3, select the detection under the left nostril.

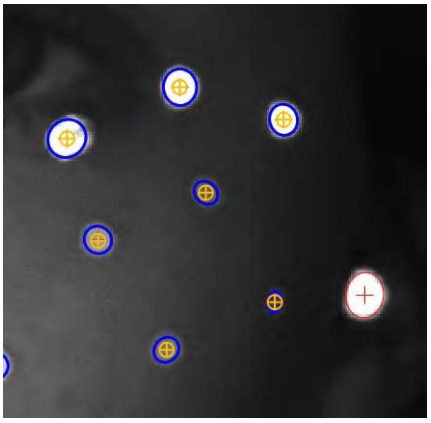
b. On the **Edit** menu, click **Detach Detections [Current Frame]** (or press CTRL+H).

   The detection is removed from channel 3.

c. In channel 3, drag+select the correct upper left lip marker and press *M* to merge the correct detection.

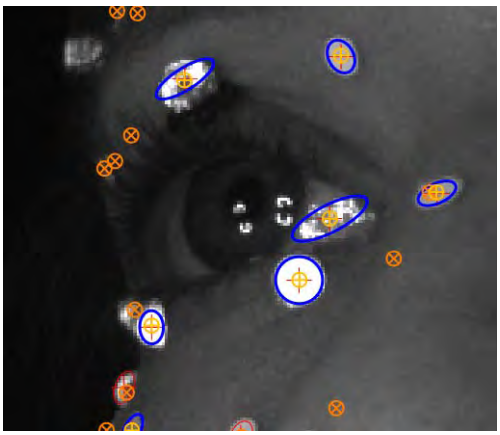
d. Repeat this process for the same marker in channels 3 and 2.

- When the marker detections in different camera views haven't been connected by the **Initialize 3D** process, as shown in the following example from channel 1 in the ROM example:



To fix this, select the relevant marker detections in channel 0 and 1 of the ROM take by CTRL+clicking the unmatched detections, and then press M.

- When unwanted detections are found on features on the face, as shown in the following example:



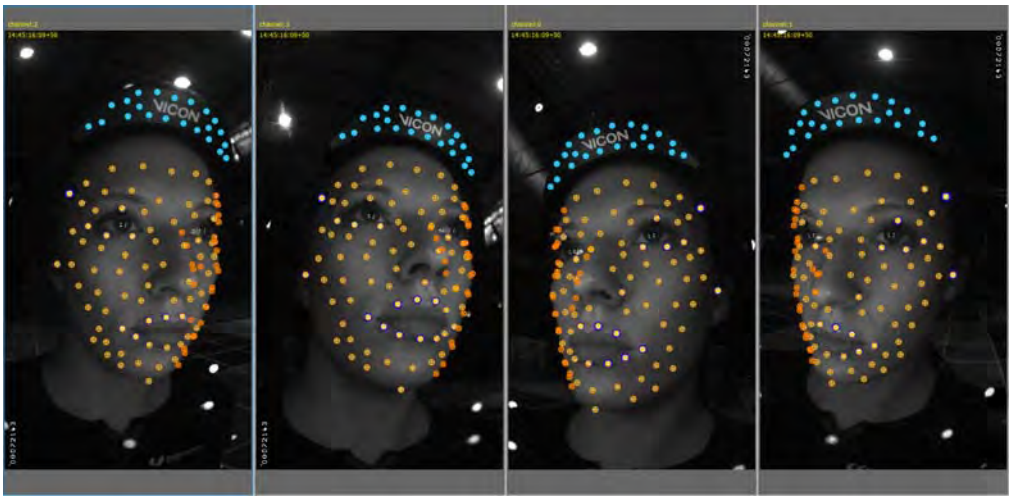
To delete the bad detection on the left eye, select the detection and on the **Edit** menu, click **Delete Selected** or press CTRL+D.

When you have finished adding extra information, you must refine the camera positions and reconstructions.

To refine the camera positions and reconstructions:

- On the **Process** menu click **Bundle Current Frame [Unconstrained]**.

  To check the quality of the reconstructions, look at the yellow error lines and also look again in the 3D view for erroneous reconstructions. If you are working with the *ROM* take, your final initialized file will look similar to this:



After you have finished initialization, you may find it helpful to label the markers, to enable you to identify them more easily and/or to create a mesh, to help you spot tracking errors. For information on these additional steps, see:

- *Label face markers*
- *Create a mesh*

Label face markers

To make it easier to identify points, you can give your face markers more recognizable labels than the default names. These marker labels will be carried throughout all your data and into your 3D package. You can label markers in either of the following ways, or use a combination of both methods:

- *Import marker labels*
- *Rename marker labels*

Import marker labels

An example list of marker names is supplied with Vicon CaraPost, but you can use your own list of marker names as required. The names can to be in a simple text file (*.txt*) separated with spaces and/or carriage returns, or in an existing *.cara* file.

For more information about the *.txt* file format for marker labels, see the *Vicon CaraPost Reference Guide*.

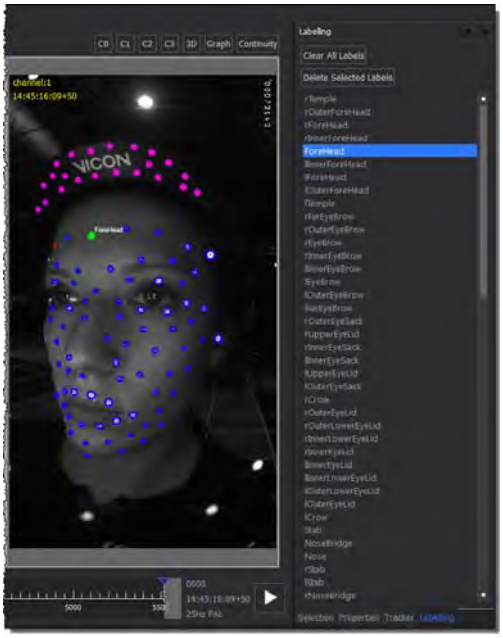
Example file supplied:

- *MarkerList.txt*

To import marker names and label the markers:

1. On the **File** menu, click **Import Labels From Cara File** or **Import Labels From Text File** and import the required file.

   The list of marker names appears in the **Labelling** pane.



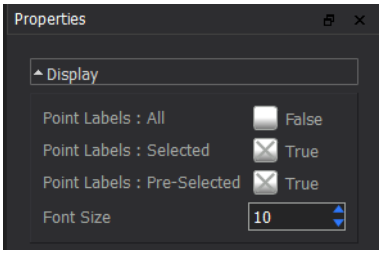
Tip

If you can't see the **Labelling pane**, right-click on the menu bar of one of the visible panes and click **Labelling**.

2. To label a marker, select a point in a camera view or 3D view then click on the marker name in the **Labelling** pane and press *M*.

   The name is now associated with that point. When you come to the **Initialize from ROM** processing step, the marker names are maintained across subsequent takes.

3. If you want to change the way the marker names are displayed, edit their properties in the **Display** section of the **Properties** pane:



Rename marker labels

In addition to importing a file containing marker names and assigning them to the markers, you can also rename marker labels.

To rename marker labels:

1. In a camera view, 3D view (**View** > **New Floating Workspace**), or in a Continuity graph, click on the point to rename and then press Ctrl+R (or **Edit** > **Rename Point**).

2. In the **Rename Point** dialog box, enter a new name.

   The new label name appears in the view.

Tip

To view all custom labels, right-click in the view and then click **Point Labels: All**.

Create a mesh

You can make it easier to detect tracking errors by creating sticks between selected points, or creating sticks between all the points to form a mesh.

Errors are easy to spot as irregularities or holes in the mesh.

Creating a mesh enables you to more easily see:

- If any points are missing in a particular frame, and
- If any points have been incorrectly tracked or have swapped across the take.

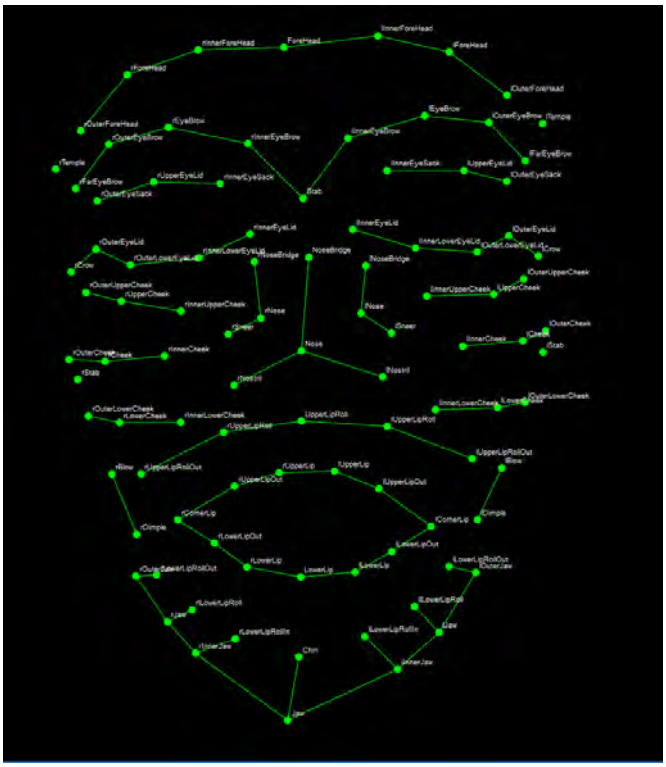
Meshes can also be exported for use in other applications, eg, Vicon Blade.

To create and customize sticks:

1. In a 3D view (**View** > **New Floating Workspace**) or camera view, Ctrl+click two adjacent points between which you want to create a stick, and then press S (or on the Edit menu, click **Create Stick from Selected Points**). You can continue doing this until you have constructed a whole mesh.

2. To change the color of the sticks, in a 3D view Ctrl+click or drag to select the required sticks and then click **Edit** > **Change Stick Color**.

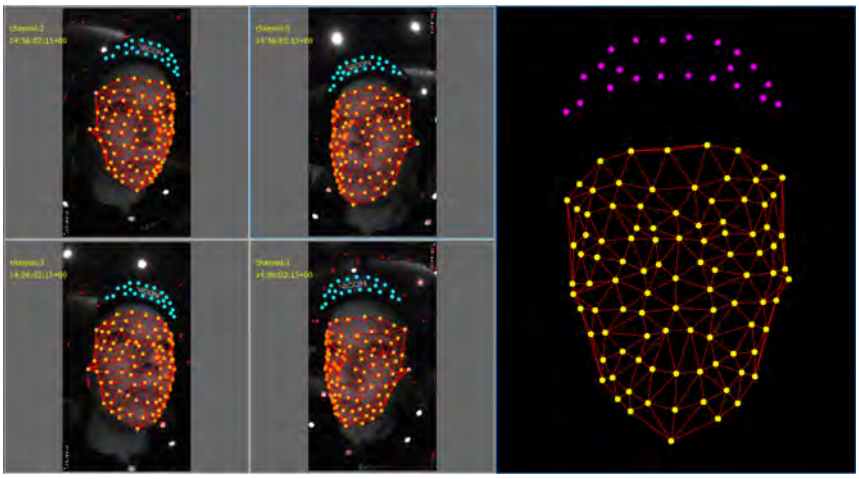
If you have customized the marker labels, the labels can be displayed on the mesh, as shown in the following example. (For information on creating custom marker labels, see *Label face markers* on page 40).



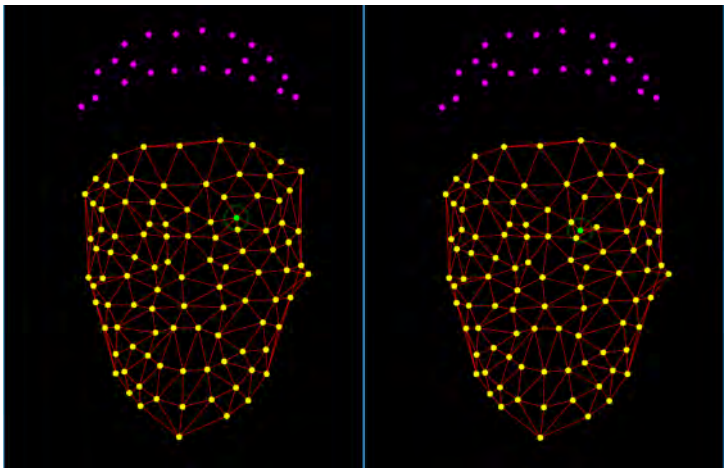
To create a mesh of all points:

- If you want to automatically create a mesh of all the points, on the **Edit** menu, click **Create Stick Mesh**.

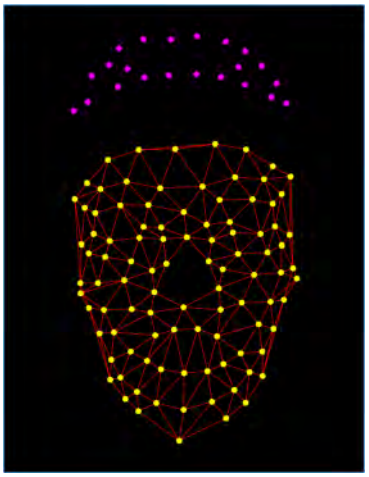
  The following example shows a mesh in the 2D views and the corresponding 3D view.



Errors are easy to spot as irregularities or holes in the mesh. The following example shows that the selected point (displayed in green) has failed to track correctly between the first frame and the next, resulting in an obvious cross-over of the sticks between the two frames.



The following example shows a point missing from the nose:

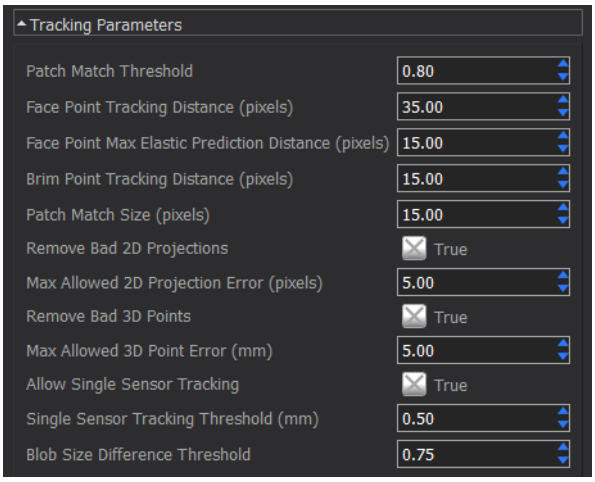


Note

If you had decided to process only one frame of the ROM take, you could stop at this point, and save the take so that it could be used to initialize subsequent takes (see *Initialize from a ROM file* on page 49).

Track the rest of the take

When you have set up your camera positions and 3D reconstructions for the first frame, you can track the rest of the take. The default parameters, shown in the following example, should work well for most situations.



Tip

For information about each parameter, see *Vicon CaraPost User Interface* and *Tracking parameters for alternative marker sets* in the *Vicon CaraPost Reference Guide*.

To track the rest of the take:

1. To ensure you have not accidentally selected any points, click in the camera view in an area that contains no points. If you have one or more points selected before starting tracking, only the selected points will be tracked.

2. On the **Process** menu, click **Track Forwards [Sequence]**.

   Depending on the specification of your computer and the length of the take, processing may take some time. For example, the *ROM* files may take over a minute to track.

   ### Tip

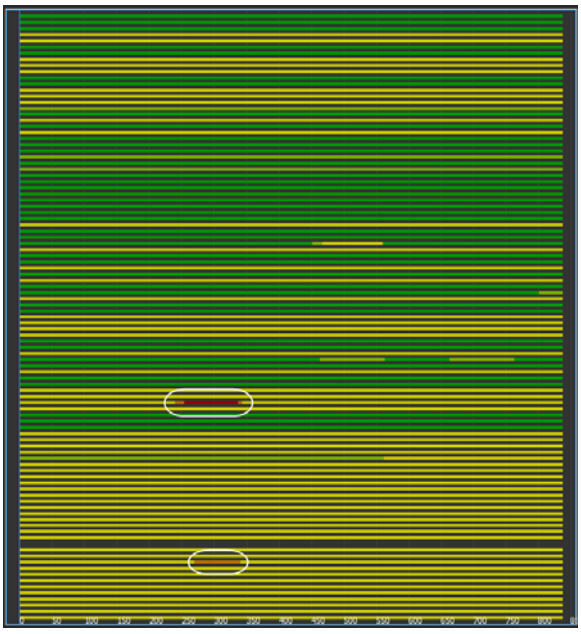
   If you detected blobs for only a single frame or a limited range of frames, when you track the take, blob detection is automatically run on the whole take as well.

3. To check the data quality:

   a. Play the take, looking at the video and 3D views. Make sure the points are tracked across the whole take and check for noise in the 3D view, and in particular, any marker points which become mismatched or swapped during the tracking.

   b. To help you find noisy data or gaps, right-click on a camera view (channel), point to **View** and then click a different view, such as **Graph** or **Continuity**. If you click on a point in a view, you can also use the **Selected Points** view to quickly spot any gaps in the data. To zoom in any of the views, SHIFT+right-click+drag.

   The following Continuity chart shows two problem areas in the ROM take, shown by the orange and red sections. Orange represents where a single camera has tracked a point and red indicates that no cameras have tracked a point, thus creating a gap.



If you find that the take still contains mismatched points, noisy data, or points that drop in and out, you may want to perform some further manual clean up (see *Optimize a take* on page 53).

Before you proceed, it's worth saving and exporting your cleaned take, if you haven't done so already.

Save the completed take

After you have initialized and labeled a take, it is worth saving and exporting the cleaned up data.

To save a take:

- On the **File** menu, click **Save**. If you are working with the supplied examples, the saved file will be referenced in *Initialize from a ROM file* below.

For information on exporting a take, see *Export a take* on page 73.

Initialize from a ROM file

When you have finished cleaning up a ROM file (see *Optimize a take* on page 53), to avoid having to repeat the manual 3D initialization and labeling process with subsequent takes, you can save the ROM take and then use one of its frames to initialize other takes. Marker labels and sticks are carried into the new take.

This section uses as examples the following supplied sample files:

- *The Greatest*. The performer was Leigh-Anne Gilbert and the monologue was taken from the film The Greatest.
- *ROM_LabelledClean.cara*

Depending on how similar the subsequent takes are to the ROM take, you may be able to completely initialize the takes from the ROM take, or at least to initialize the calibration brim so that you can re-use the camera and brim data.

To initialize takes from a previously processed ROM take:

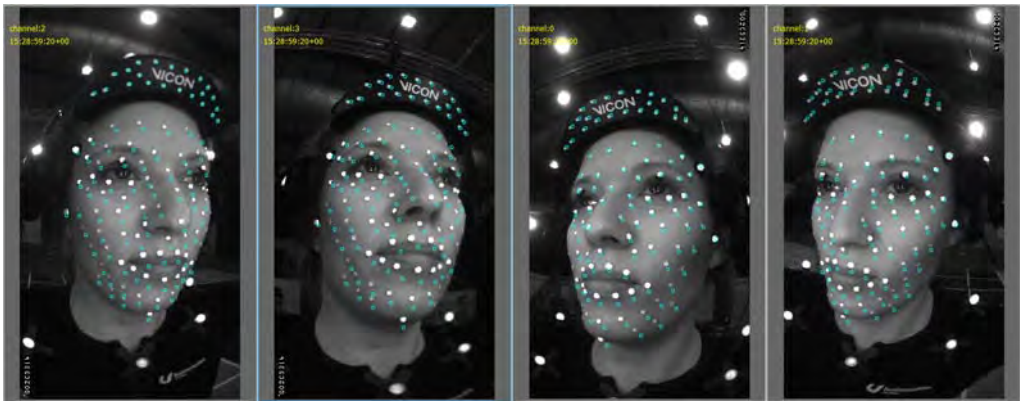
1. Save the cleaned ROM take as a *.cara* file (**File** > **Save As**).
2. Open or import the file(s) to which you want to apply the ROM take. You are likely to obtain the best results from files that share as many details as possible with the ROM file, for example:
   - The position of the cameras in relation to the brim
   - The position of the actor's head in relation to the brim
   - The marker set
   - The actor

To work with the supplied example files, on the **File** menu, click **Import** and from the sample data folder, select *The Greatest*.

3. Ensure the take is open at the frame at which you want to apply the ROM. For the sample data, leave the take open at frame 0.

4. On the **Process** menu, click **Load ROM** and select the *.cara* file that contains the labeled and cleaned up ROM take. In the supplied sample data, this is a file called *ROM_LabelledClean.cara*.

5. To see the loaded ROM information, right-click on a camera view and ensure **ROM** is selected. The ROM information is shown in blue. In the following example, you can see the ROM markers in light blue. The positions are fairly close between the ROM take and the take to be initialized.



6. Do one of the following:

   - To use the data from the whole ROM (the face as well as the brim), on the **Process** menu, click **Initialize from ROM**.

     Select this option if the position of both the cameras and the actor's head in relation to the calibration brim, and other elements (for example, the marker set, face poses, etc), are the same in the ROM file as they are in the take you are now processing.

   - To use the data from the calibration brim only, on the **Process** menu, click **Initialize from ROM [Brim Only]**.

Select this option if the position of the cameras in relation to the calibration brim is the same in the ROM file as it is in the take you are now processing, but other elements have changed.

The data from the first frame of the ROM file is applied to the take from the current frame onward.

If **Initialize From ROM** fails or doesn't label the majority of the points, see *Troubleshooting* in the *Vicon CaraPost Reference Guide*.

Optimize a take

The following topics describe common cleanup tasks involved in optimizing the results of automatic tracking.

The aim of the cleanup and optimization step is to take the initial tracking results, use a mixture of manual and automatic tools to correct any errors in the data, and to fill any gaps. This will result in clean 3D marker data for the whole take.

- *Tracking errors or swaps*
- *Dropped or missing tracks*
- *Gaps due to lack of blobs*
- *Bad camera contributions*
- *Merged blobs*
- *Single camera tracking*
- *Interpolated gap filling*

In addition to cleanup procedures described in the above topics, you may occasionally also need to use target tracking. For more information, see *Target tracking* in the *Vicon CaraPost Reference Guide*.

If required, after you have corrected any errors and filled gaps, you can stabilize the results to obtain the best output and/or align the face data in the 3D world. For information, see *Stabilize a take* on page 64 and *Align face data in 3D space* on page 71.

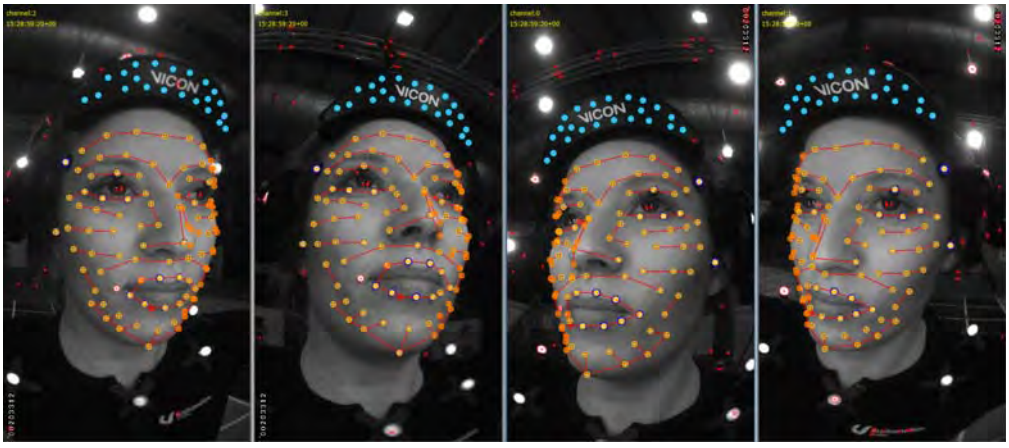
Tracking errors or swaps

Always begin optimization by correcting any tracking errors or swapped points, where the automatic tracking algorithm has mislabeled point(s) on the face or brim during the take. The easiest way to detect swapped or mismatched points is to create a mesh for the 3D points (for information, see *Create a mesh* on page 43). You can then recognize point tracking errors by playing through the tracking results in the 3D view with the mesh overlaid.

Tracking errors and swaps are very time-consuming to fix manually, so if you have tracking errors or swaps on more than a few points, it makes sense to undo the existing tracking results, and redo the automatic tracking with a more appropriate set of automatic tracking parameters (for information, see *Tracking troubleshooting* in the *Vicon CaraPost* Reference Guide).

However, if you have tracking errors on only a few points, you can delete the bad tracking results by hand as described in the following example.

In this example, the tracker has mislabeled the right corner of the mouth. (Note that this error is not present in the supplied ROM take.)



Sometimes the tracking process can track the incorrect points. This is more common with very dense marker sets. To fix it, you need to locate the range of the swap and remove the data, as described in the following steps.

To fix tracking errors:

1. To select the frames affected by the swap, go to the first frame of the swap and press CTRL+1 (or on the **View** menu, click **Set Active Range Start)**, then go to the last frame or the frame where it swaps back and press CTRL+2 (or on the **View** menu, click **Set Active Range End**).

2. To remove the bad data across this range, on the **Edit** menu, click **Detach Detections [Active Range]**. Do this for each camera that has the bad data. You can you either select the cameras in the **Selection** pane or select the marker in a single camera view.

3. Re-track the parts of the take where you have made manual corrections, using different tracking parameters if appropriate.

   Tip

   To speed up the tracking, select only the markers that you want to re-track before tracking. It's also often worth running **Process menu** > **Track Forwards [Single Frame]** on the selected markers, to make sure they don't swap again.

4. If the points swap again, you can manually correct them by adding the correct points. To do this:

   a. Go to the frame of the swap and remove the bad data as described above.

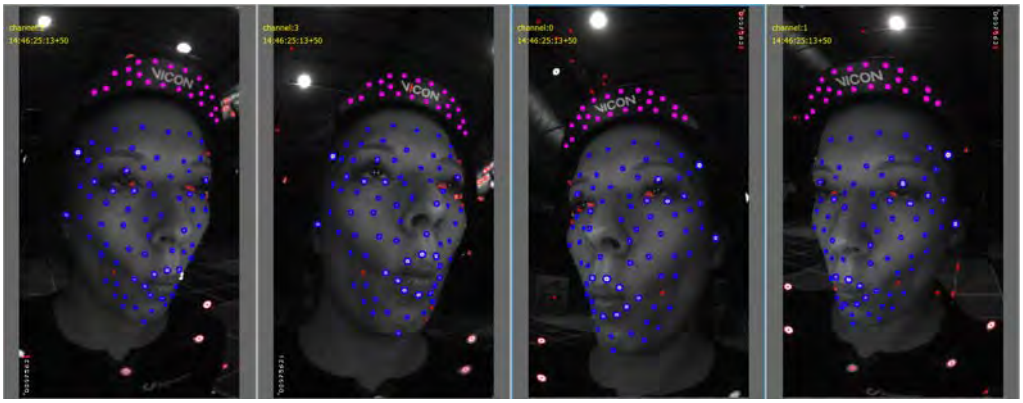
   b. Either select the correct blob and merge the point (press M), or add a point by clicking **Edit** menu > **Edit Target Track**. For more information, see *Target tracking* in the *Vicon CaraPost Reference Guide*.

5. Re-track using the correct point or the target track that you added. Make sure there is no existing data within the range that you are re-tracking.

Dropped or missing tracks

A common issue you will come across is that the tracking misses a blob. This can happen when a marker gets occluded and then appears again, or for fast moving markers on the face, like the eyelids. It's very easy to fix this though.

In the following example, the tracker has missed the lDimple and rDimple markers (note that this error is not present in the supplied ROM take).



To fix a missing blob:

1. Go to the frame before the tracking drops and select the point, or select it in another camera view.

2. Go forwards a frame to where it drops and select the undetected blob in any missing camera views.

3. Press *M* to merge the points.

4. Select the merged point and on the **Process** menu, click either **Track Forwards [Sequence]** or **Track Forwards [single frame]**.

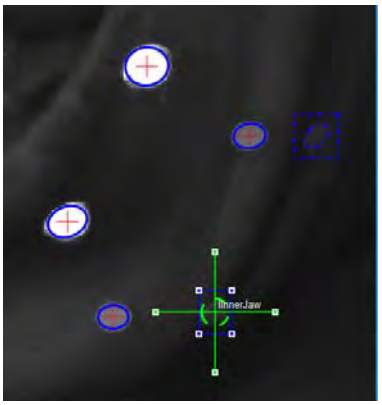
   Tip

   To speed up tracking, select only the required marker before tracking.

Gaps due to lack of blobs

Sometimes, tracking fails due to a marker not having enough contrast and thus no blob being present. You can improve this by using on-board lights or changing the Auto Exposure settings, but you can also manually add Target Tracks to help fill any gaps.

In the supplied sample *ROM* take, the InnerJaw Marker drops out on frame 0254 in channels 0 and 1.



To fill a gap using target tracks:

1. Select the required point on the frame before it drops out.
2. To manually add a point, press SHIFT+ E (or on the **Edit** menu, click **Edit Target Track**).

   Tip

   You can also add a completely new point using this method. For more information, see *Target tracking* in the *Vicon CaraPost Reference Guide*.

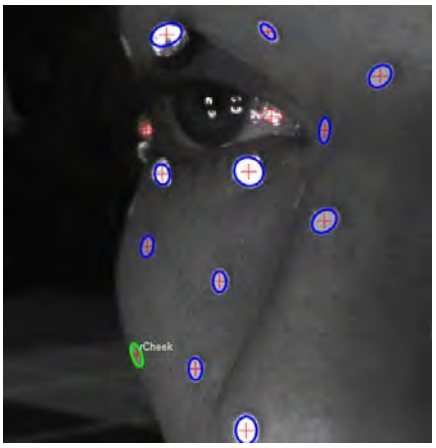
3. Set the blue inner square to match the size of the marker you are tracking.
4. You can now either track forwards or backwards to try to re-track the gap, or fill the gap by clicking **Interpolate Gaps** on the **Process** menu.

   For more information, see *Interpolated gap filling* on page 62.

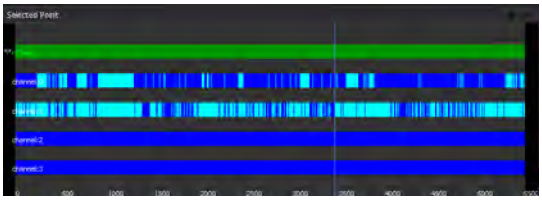
Bad camera contributions

In some situations, a camera tracks a point that gives bad contributions, for example, when a point is on the edge of the face, is too small, or disappears. In other cases, points get too close together and the size of the blob jumps, which can add noise to the data.

The following example from the supplied *ROM* take shows the rCheek marker in Channel 1 on the edge of the face.



Points on the edge of the face can cause bad or noisy data, which is visible in the 3D Graph View and in the **Selected Point** view, as shown in the following example.



The light blue data represents where a blob has disappeared and the tracker has dropped to patch tracking. For more information on patch tracking, see *Target tracking* in the *Vicon CaraPost Reference Guide*.

You can fix these issues in different ways, depending on how much of the take is affected, as described in the following steps.

To fix camera contributions that are bad across the whole take:

1. To remove the camera from contributing across the whole take, select the marker in the required camera view. In the above example from the supplied *ROM* take, select the rCheek marker in Channel 1.

   Tip
   You are recommended only to remove camera contributions on points that are seen in three or more camera views.

2. On the Edit menu, click Detach Detections [Active Range].

   The camera contributions are removed and the point is updated in the 3D view.

If the bad contribution is only across you a certain range, you can select the range of the swap and delete the detections, as described in the following steps.

To fix camera contributions that are bad across a limited range:

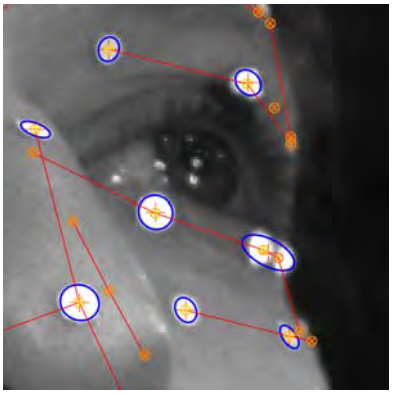
1. Go to the first frame of the swap and on the **View** menu click **Set Active Range Start** (or press CTRL+1), then go to the last frame or the frame where it swaps back and on the **View** menu, click **Set Active Range End** (or press CTRL+2).

2. To remove the contributions across the range, select the point in the camera view and on the **Edit** menu, click **Detach Detections [Active Range]** (or press CTRL+SHIFT+H).

Merged blobs

Points that get too close together and merge can often be seen as jumps in the data in the 3D view. This is because the centers of the two markers suddenly jump as they become one marker.

In the following example, two blobs have merged into one below the eye. (This is not present in the supplied ROM take and is shown as an example only.)



To fix this issue, you can manually add points in and re-track, as described in the following steps.

To fix points that merge:

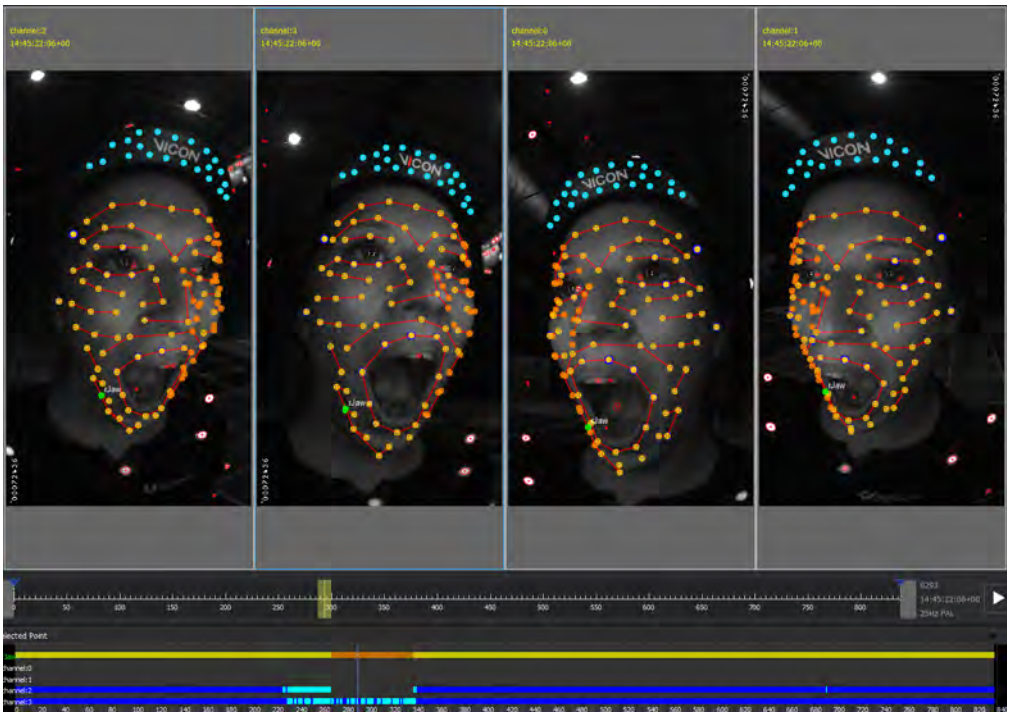
1. Remove the bad data as described in *Bad camera contributions* on page 58.
2. Go to the frame before the newly created gap.
3. In the **Tracking Parameters** section of the **Properties** pane, lower the **Blob Size Difference Threshold** to **0.01**.
4. Select the two points and on the **Process** menu, click **Track Forwards [Single Frame]**.

   You should now be able to track the markers as they get close together.
5. Before continuing, set the **Blob Size Difference Threshold** back to its default value of 0.75.

Single camera tracking

When possible, you should ensure points can be seen in two or more cameras., However, in some situations a marker gets occluded and can only be seen in one camera. To handle these situations, Vicon CaraPost has the ability to track points using only a single camera.

In the following example from the supplied *ROM* take, you can see a single camera track on the marker rJaw. It is displayed in orange in the **Selected Point** view.



Single camera tracking is used by the automatic tracker when a point is seen by only one camera. It is also used when you click **Track Forwards [Single Frame]**. If a point becomes visible again in two cameras, the tracking reverts to multi-camera tracking.

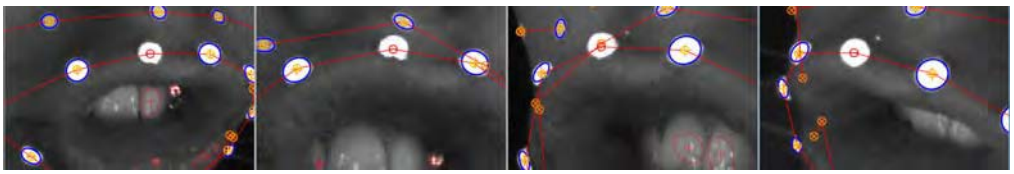
Single camera tracking works automatically when only one camera can see a point. You may notice that a 3D trajectory jumps when a second camera picks up a point. If this happens, it may be worth using **Interpolated Fill** as described in *Interpolated gap filling* on page 62.

Interpolated gap filling

In some situations, a point is missing from all four cameras. For example, markers can get hidden under folds of the skin, or lip markers may get hidden during an extreme facial pose. Vicon CaraPost can fill these gaps in the data using an intelligent interpolated fill. This fill looks at the movement of neighboring points and uses an average of their positions.

For a detailed description of how this function works, see *Gap interpolation algorithm* and *Interpolate gaps* (*Process menu* option) in the *Vicon CaraPost Reference Guide*.

The following example shows the interpolated fill (small red circle) in the four camera views. (Note this is not present in the ROM take and is shown as an example only.)



To fill gaps:

1. Ensure you have processed your take so that all the available 2D blobs have been used. In general it's best to make use of any existing data before filling gaps.

   Tip

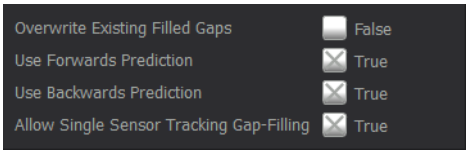
   The exception to this rule is if your data is very noisy. In this case, using **Interpolate Fill** might give better results.

2. **To fill** all gaps across all points in the data, on the **Process** menu, click **Interpolate gaps.** (If you want to fill only a selected point, select the required point first.)

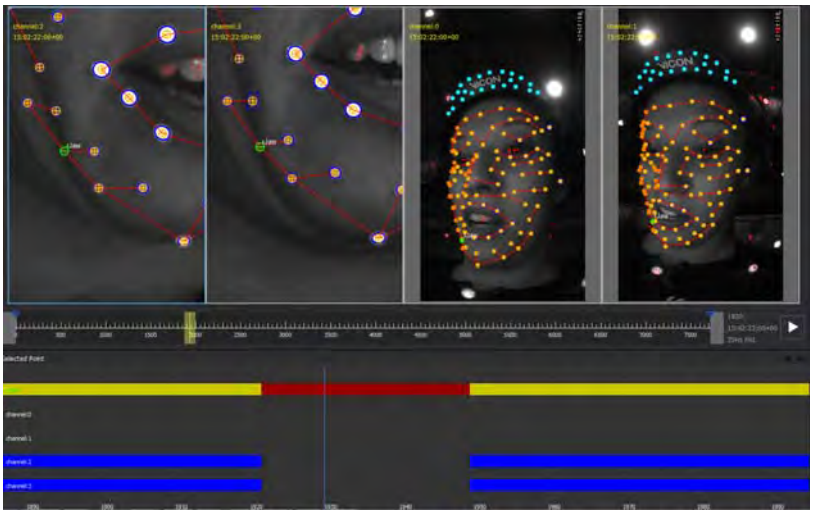
   You can see the results of the fill in both the 3D view, 2D camera views, and the **Selected Point** view. In a camera view the fill is represented by a small red circle with a line through it. Check the results of the fill in each camera view.

3. If you want to change the type of interpolated fill that is performed, edit the settings in the in the **Gap-Filling Parameters** section of the **Properties** pane.

   You can choose whether to look forwards or backwards, which will smooth out the interpolated fill. You can also specify whether to use single camera detections in the interpolated fill.



   In the **Selected Point** pane, an interpolated fill is displayed in red.



   Using a mixture of multi camera, single camera, and interpolated fills, along with the ability to add manual target tracks to your points you can deal with most capture situations. For information on using target tracks, see *Target tracking* in the *Vicon CaraPost Reference Guide*.

Before you use the cleaned and gap free ROM take to initialize other files, it's worth saving your scene and exporting your cleaned take. For more information, see *Export a take* on page 73.

To avoid having to repeat all these steps again, you can use the ROM file to initialize the other takes, as described in *Initialize from a ROM file* on page 49.

Stabilize a take

The stabilization offered by Vicon CaraPost is the process of removing unwanted motion from the face points. This unwanted motion can be caused by the head rig moving relative to the skull during violent head motions, or by the cameras moving relative to the rest of the head rig.

To stabilize a take, you must first have tracked and (if necessary) cleaned the relevant data.

CaraPost offers both manual and assisted options for stabilization:

- Manual Stabilization, where stabilization relies purely on stabilization points that you select, is faster to set up and use, but does not include any additional stabilization from CaraPost. The stabilization error (see *About the stabilization error* on page 70) is simply reported by CaraPost at the end of the process.
- Assisted Stabilization, where CaraPost automatically improves on the information that you provide, usually produces the best stabilization. The stabilization error is minimized by CaraPost throughout the whole Active Range. However, it requires slightly more setup than the manual process and can take longer to run, depending on the properties you specify.

For both options, the first step is to select the stabilization points. For more information, see:

- *Select stabilization points*
- *Manual stabilization*
- *Assisted stabilization*
- *About the stabilization error*
- *Stabilize multiple takes*

Tip

To display the results of stabilization, ensure that on the **View** menu, **Toggle Show Stabilized** is selected.

When this option is selected, stabilized results are displayed in 3D view.

Select stabilization points

The first step for both assisted stabilization and manual stabilization is to select stabilization points in a frame where the actor's face is in a neutral pose. CaraPost uses this frame (the base frame) as the 3D reference frame to transform the point data from other frames. To stabilize all frames in the Active Range (or the whole take if no Active Range is selected), CaraPost uses the frame-to-frame correspondence of the stabilization points to define the 3D transform that is applied to the point data for each frame.

To select stabilization points:

1. If necessary, on the timebar, set an Active Range, ensuring that the range includes only fully tracked and cleaned data.

2. Scrub through the take and note at least three points that you can use for stabilization. To ensure the points provide good stabilization, look for points that:

   - Move as little as possible throughout the Active Range (that is, they are unaffected by changes in the actor's expression).
   - Are present in every frame throughout the Active Range (that is, that any gaps have been filled).

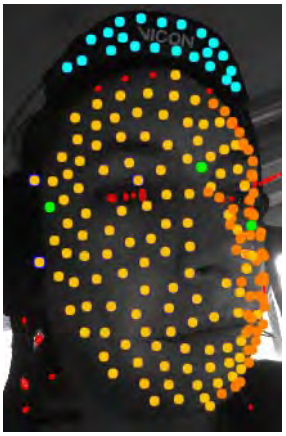
   For example, you may find that the inner corners of the eyes or on the upper cheeks near the ears are relatively stable, compared with other more mobile points.

   Tip

   Points on the brim can also contribute to stabilization, but only include them if they are fixed relative to the skull coordinate frame. If the brim moves relative to the face points during the take (eg slips slightly down the actor's forehead), do not include them. If you want to include brim points, ensure **Use Brim Points** is selected in the **Properties** pane (for information, see *Use Brim Points* in the *Stabilization Parameters section* in the *Vicon CaraPost Reference Guide*.

3. Within the specified active range, scrub to a frame in which the face is in a neutral pose and all the stabilization points are clearly visible. This will be the base frame, on which stabilization is based. Ensure that the chosen base frame is the current frame.

4. In the View pane, CTRL+click on the three or more points that you noted previously.



Selected points turn green.

5. Depending on the type of stabilization you want to perform, for the next steps, see *Manual stabilization* on page 67 or *Assisted stabilization* on page 68.

Manual stabilization

Manual stabilization takes a minimum of three points that you have selected as being relatively unaffected by changes in expression, and then for each frame maps those points on the current frame to the same points on the base frame.

Although a minimum of three points is required, if you can find more stable points in the Active Range, select these too, as they will improve the results of the stabilization process.

Important

Ensure that any points you select are both as stable (ie static) as possible throughout the Active Range and are present in every frame in the Active Range. If you select points that do not meet these criteria, stabilization will be impaired.

To perform manual stabilization:

1. Ensure that you have selected at least three gap-free points in the base frame, as explained in *Select stabilization points* on page 65.

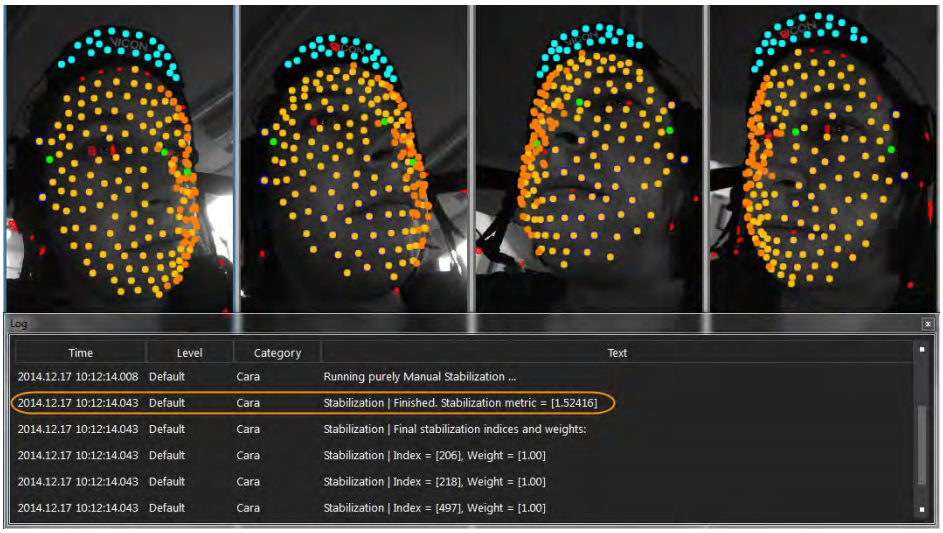
2. If you want to select any points on the brim, ensure **Use Brim Points** is selected in the **Stabilization Parameters** section of the **Properties** pane.

   Important

   Only select brim points if the brim is completely stable. Also note that selecting any **Stabilization Parameters** other than **Use Brim Points** has no effect on manual stabilization.

3. On the **Process** menu, click **Stabilize Data [Manual]**.

   The Log pane displays the progress of the stabilization and the stabilization error. The lower the error, the better the stabilization.



Assisted stabilization

Normally, assisted stabilization produces better results than manual stabilization, as the assisted process examines all the face points, and where they are consistent with the original selection, enables them to contribute to the final stabilization result and to minimize the stabilization error across the whole of the Active Range.

Tip

Assisted stabilization is normally not as fast as manual stabilization, depending on the number of **Processing Iterations** specified, the **Stable Points Percent** and whether Use Brim Points is selected, which may all require more intensive processing.

To perform assisted stabilization:

1. Select at least three gap-free points from the current frame, as explained in *Select stabilization points* on page 65.

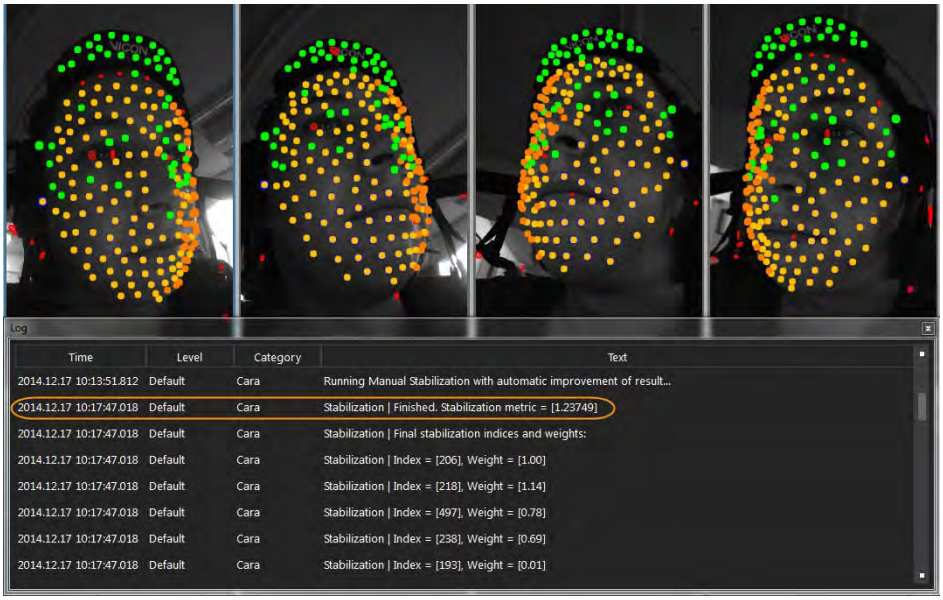
2. In the **Properties** pane, expand the **Stabilization Parameters** section and make any required changes. For information on the stabilization parameters, see the *Stabilization Parameters section* in the *Vicon CaraPost Reference Guide*. .

3. On the **Process** menu, click **Stabilize Data [Assisted]**.

More points are selected and given the weighting specified in the **Base Frame Weighting** and **Inter Frame Weighting** fields in the **Stabilization Parameters** section of the **Properties** pane. The stabilization generated using these points minimizes the stabilization error across the whole of the Active Range.

In the 3D view, green stabilization points are displayed and in the Log pane, the stabilization error is displayed, along with a list of the stabilization points used, and the weighting used for each stabilization point.

The following illustration shows a take in which the brim was static throughout, so the **Use Brim Points** property was selected, enabling the automatic selection of the brim points as well as the original three selected points and other stabilization points added by CaraPost.



About the stabilization error

The stabilization error is a weighted sum of the following errors:

- Base Frame Stabilization Error The root-mean-square of the differences between the percentage specified by the Stable Points Percent most stable points in each frame and the corresponding points in the base frame (calculated across the whole of the Active Range).

- Inter Frame Stabilization Error The root-mean-square of the differences between the percentage specified by the Stable Points Percent most stable points in each frame and the previous frame (calculated across the whole of the Active Range).

Stabilize multiple takes

To minimize the chance of 'jumps' between takes that are to be used together, ensure that for all the takes:

- The base frame shows a face with a neutral expression.
- The same points are selected for stabilization.
- The same points are used for alignment (see *Align face data in 3D space* on page 71),

Note

If you are using the **Stabilize Data [Assisted** option], different sets of points may be automatically selected for use in stabilization in multiple takes.

Align face data in 3D space

After you have tracked and (if necessary) cleaned and stabilized the relevant take in CaraPost, if required you can align the face data into a coordinate frame that you define by selecting 3D face points.

Tip

If you are stabilizing a take that you also want to align, it is preferable to perform stabilization before you align the take. This is because if you stabilize after aligning data, the markers are returned to their original positions, as stabilization operates on the original, raw data, so you will need to repeat the **Align Data** operation.

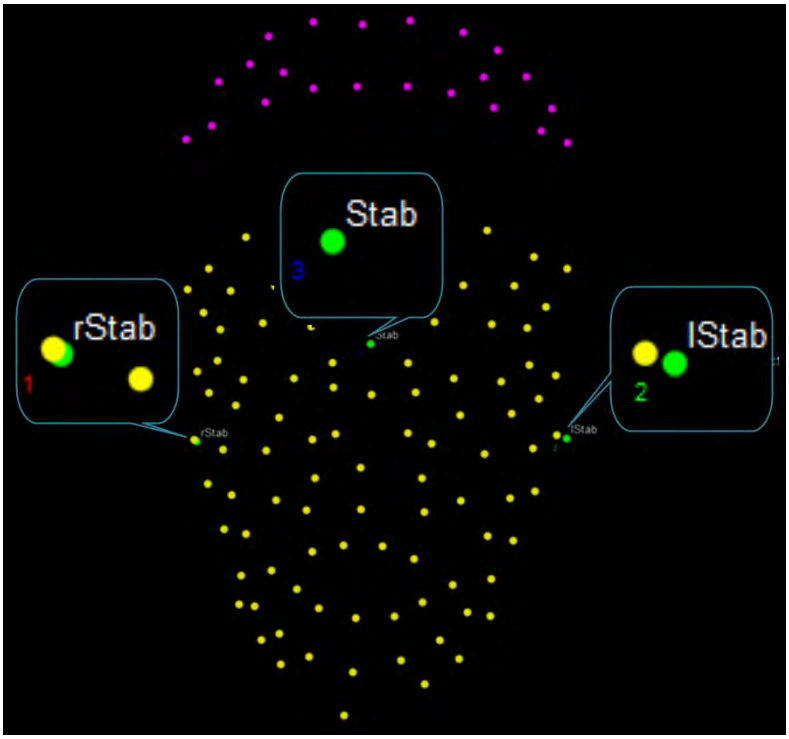
To align the face data in 3D space:

1. Ensure no points are currently selected and display a 3D view (on the **View** menu, click **New Floating Workspace**).

2. As described in *Select stabilization points* on page 65, select three points to define the x, y, and z axes, ensuring you select them in the required order. The order in which you select the points affects the alignment:

   - The first and second points define the x-axis
   - The z-axis is defined as the cross product of the x-axis together with the normal of the plane of the three points.
   - The origin of the coordinate system is the centroid of the three points.

In the 3D view, the order of selection is indicated by a small colored 1, 2, or 3 to the lower-left of the selected points.



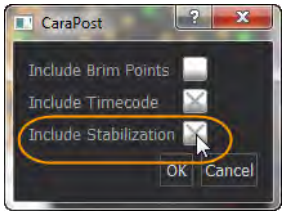
3. On the **Process** menu, click **Align Data**.

Export a take

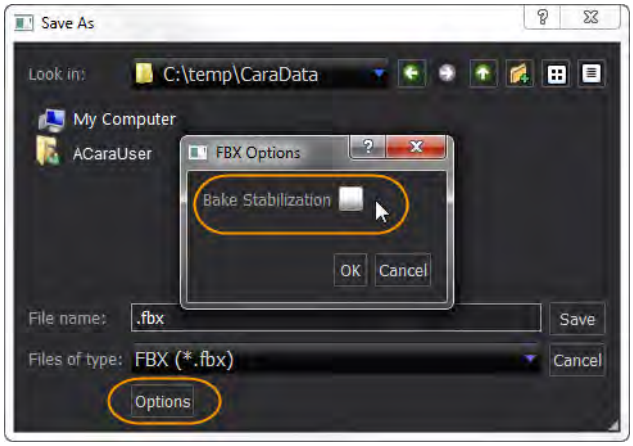
After you have finished processing a take (see *Initialize and track a take* on page 21 and *Optimize a take* on page 53), you can export the resulting files as *.c3d* or *.fbx*, ready to use in your animation package.

To export a processed take:

1. On the **File** menu, click **Export C3D** or **Export FBX**, depending on the format required by your 3D animation package.
2. Depending on the format you selected, if you have created stabilization and alignment data, you can control its export by selecting the relevant option:
   - If you select **Export C3D**, you can clear or select the option **Include stabilization**:



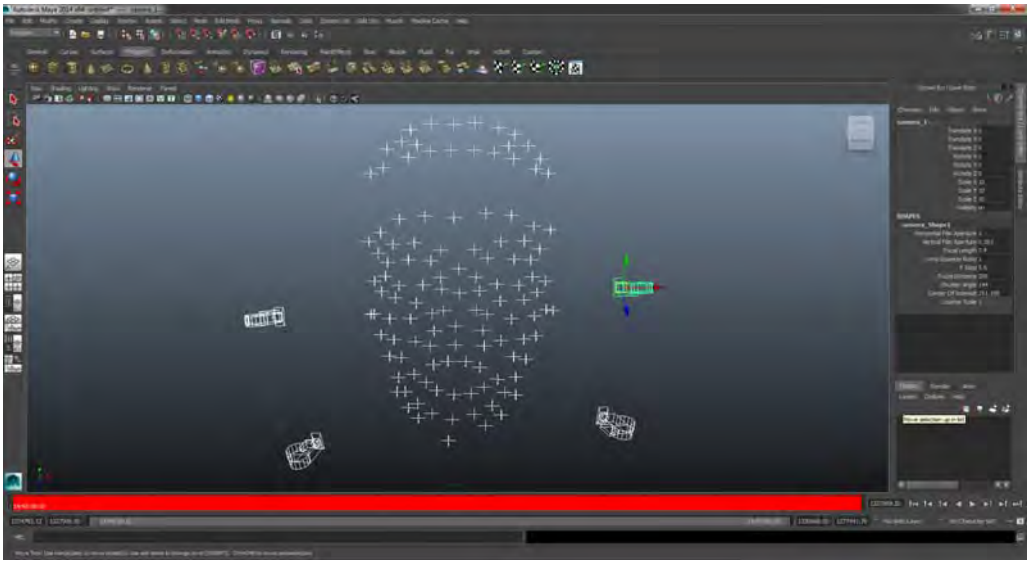
- If you select **Export FBX** and then in the **Save As** dialog box, click the **Options** button, you can select or clear the **Bake Stabilization** option to determine how the stabilization data is handled:



  - If the **Bake Stabilization** option is cleared (the default), stabilization and alignment is output as an animated root node, and if stabilization is not required, you can remove it.
  - If the **Bake Stabilization** option is true, the stabilization and alignment are pre-baked into the face point data, while the camera and the brim point are parented to an animated transform node called **Stabilization**.

The resulting file is ready for import to your animation package.

As shown in the following example, you can use Export FBX to transfer your Vicon Cara data into 3D packages like Autodesk® Maya®.



Autodesk screenshot reprinted with the permission of Autodesk, Inc.

Further resources

You can access further help on using Vicon CaraPostfrom the following resources:

- *Vicon CaraPost videos*
- *Vicon CaraPost sample data*
- *Contact Vicon*

Vicon CaraPost videos

Videos that accompany this guide are available from *Vicon Support*. The videos include the following topics:

- *Introduction and basic overview*
- *Blob detection*
- *Creating and using sticks and labels*
- *Initialization*
- *Tracking*
- *Optimization*
- *Data export*

Vicon CaraPost sample data

You can download the sample *.pico*, *.xcp*, and *.cara* files that accompany the *CaraPost User Guide* from the *Vicon Support website*, in the same location as the Vicon CaraPost installer.

Contact Vicon

If you need more information than that supplied in the documentation or on the *Vicon Support website*, use the following resources to contact Vicon:

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